

[54] **STAIRWAY FOR RAIL-MOUNTED CONVEYANCES**[72] Inventors: **Franz Tonne**, Dusseldorf; **Werner Brand**, Bergisch Neukirchen; **Benno Wolowitz**, Dusseldorf-Gerresheim, all of Germany;[73] Assignee: **Waggonfabrik Verdingen A.G.**, Dusseldorf, Germany[22] Filed: **Dec. 11, 1969**[21] Appl. No.: **884,179**

[52] U.S. Cl. 105/447, 244/129 D, 280/166

[51] Int. Cl. B61d 23/02

[58] Field of Search 280/166; 105/443, 447; 244/129 D

[56] **References Cited****UNITED STATES PATENTS**3,572,754 3/1971 Fowler.....105/447
2,220,035 10/1940 Brack 105/447

1,156,752 10/1915 Campbell.....105/447

Primary Examiner—Drayton E. Hoffman*Assistant Examiner*—Richard A. Bertsch*Attorney*—Michael S. Striker[57] **ABSTRACT**

A stairway for use in streetcars or subway cars wherein a portion of the floor constitutes the uppermost step and is spaced inwardly from a lowermost step which is fixedly secured to the chassis. An auxiliary step which has two hingedly connected panels is movable between a first position in which the two panels constitute an extension of the uppermost step and overlie the lowermost step so that the floor can be reached from a relatively high subway platform, and a second position in which one of the panels extends downwardly from the uppermost step and the other panel extends horizontally between the levels of the uppermost and lowermost steps to constitute an intermediate step whereby the stairway is ready to be used on streetcars to permit boarding from a low street curb.

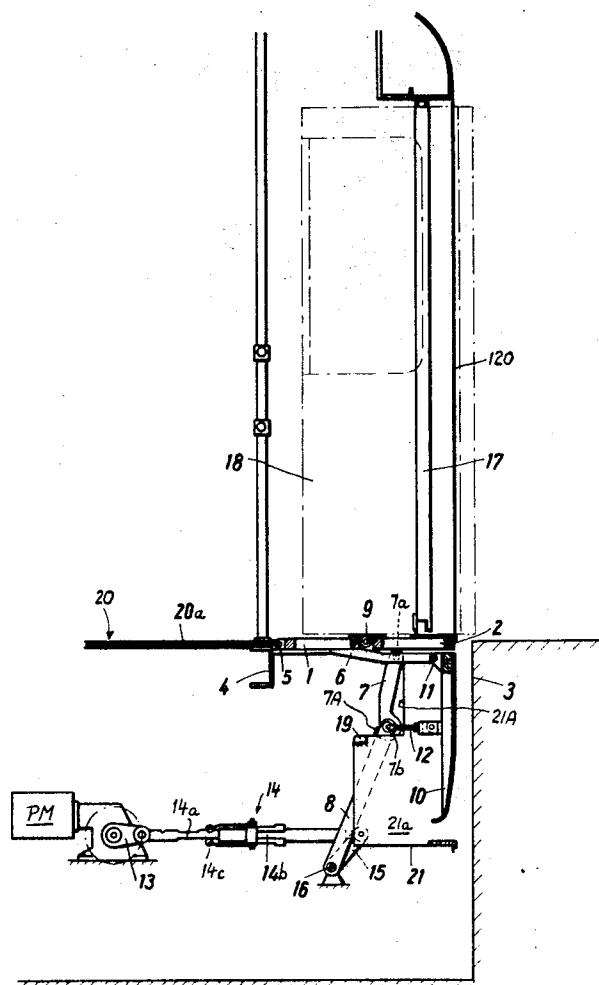
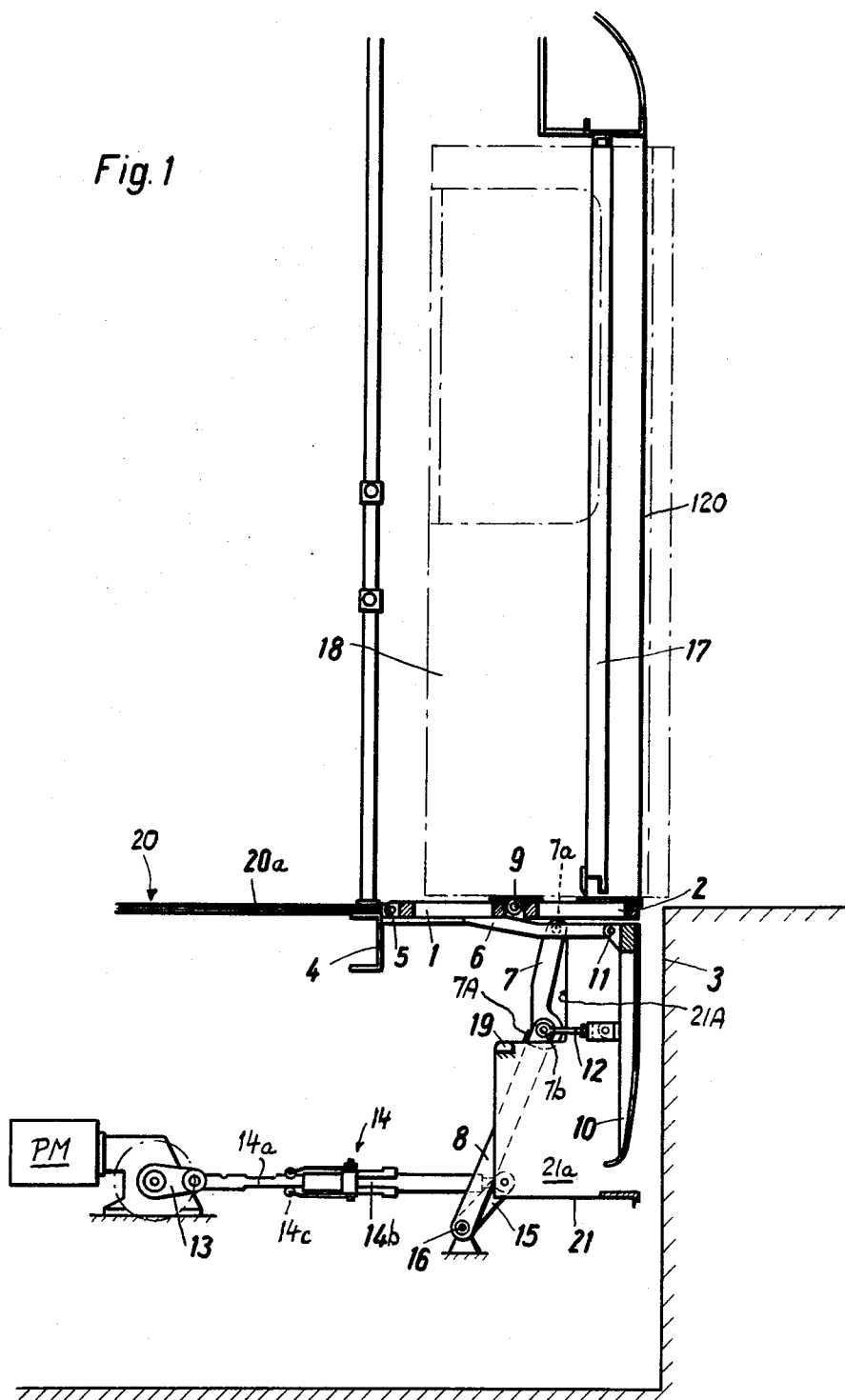
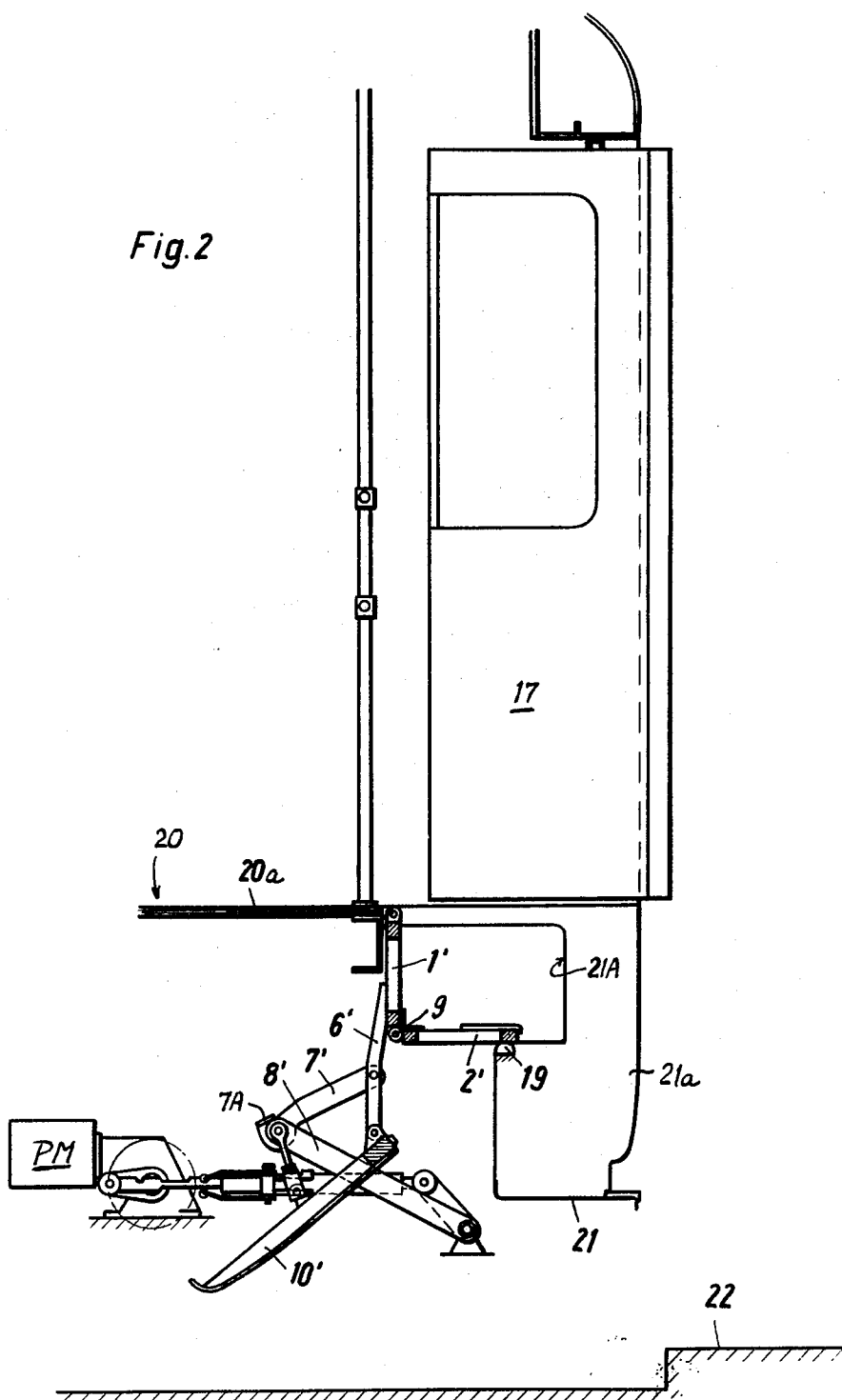
14 Claims, 4 Drawing Figures

Fig. 1



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Fig. 3

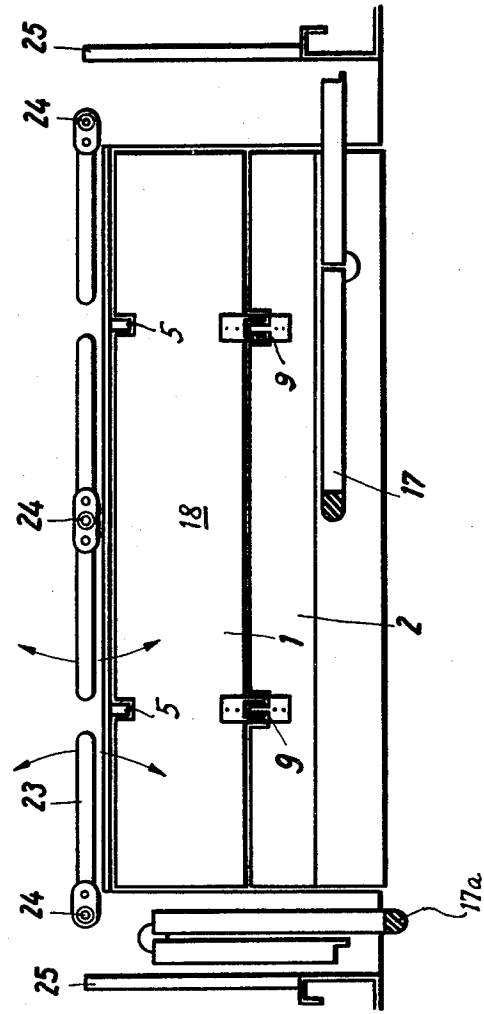
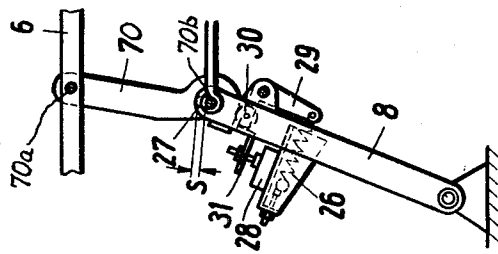


Fig. 4



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STAIRWAY FOR RAIL-MOUNTED CONVEYANCES

BACKGROUND OF THE INVENTION

The present invention relates to conveyances or vehicles in general, and more particularly to improvements in stairways for conveyances which travel on rails. Still more particularly, the invention relates to improvements in stairways for railroad cars, streetcars or subway cars.

It is well known to provide streetcars with stairways which include two or more steps enabling the passengers to board the car from a relatively low curb. It is also known to provide subway cars with floors which extend to the level of the subway platform so that the passengers can step directly from the platform onto the floor of a subway car or vice versa. Problems arise when a subway train is used on a route which is located partly underground and partly above the ground so that its cars must be provided with stairways to insure that passengers can board or leave the cars comfortably and safely, not only when the train stops along a relatively high platform at a subway station but also when the train stops on a street along a relatively low curb. The same problems arise when the curbs at all of the streetcar stops are not of identical height; it happens frequently that a streetcar must stop at a street curb which is as high as the platform in a subway station because such high curbs are safer on busy streets, at intersections, as well as when the streetcar stops are intentionally established in tunnels to protect the passengers from street traffic. High platforms are desirable because it takes less time to board or leave the car if a passenger can simply step from the platform onto the floor of a waiting car or vice versa. Also, the likelihood of accidents is reduced considerably if the passengers need not climb or descend steps during boarding or leaving of a rail-mounted conveyance. Nevertheless, it happens again and again that the car must stop along a curb whose height is only 6 inches or less as well as along platforms whose height is a multiple of the height of a street curb. As a rule, a conveyance which travels on rails must have one or more stairways with three steps if it is to pick up or discharge passengers onto a street curb. This is due to the fact that the floor of the passenger compartment or compartments is so high above the ground that a single step or two steps would be insufficient to permit safe and rapid boarding or evacuation of cars by elderly persons, children or invalids.

German Pat. No. 1,163,886 discloses a stairway for streetcars or subway cars which is provided with three steps when the floor of the car is distant from the ground (FIGS. 1-3) and with two steps when the floor is close to the ground (FIGS. 4 and 5), and is respectively convertible into a two-step or a single-step stairway. This is achieved by utilizing a substantially L-shaped auxiliary step which can be pivoted about a horizontal axis between a first position in which one of its portions constitutes an outward extension of the second or intermediate step and a second position in which it affords access to a normally concealed lowermost step (FIGS. 1-3) or between a first position in which one of its portions constitutes an outward extension of the upper step and a second position in which it affords access to a normally concealed lower step (FIGS. 4-5). A drawback of the stairway shown in FIGS. 1-3 is that it can only be converted from a three-step stairway into a two-step stairway so that the passengers must climb steps when the stairway is used in a subway car.

It is also known to provide a streetcar or a subway car with a set of steps which are movable transversely of the longitudinal axis of the vehicle. The steps are moved from the one to the other side in dependency on the angular position of the sub-frame or truck which carries the wheels. Such stairways are normally employed in relatively long cars and serve to insure safe boarding or evacuation of cars which are brought to a stop along an arcuate curb or platform. Their drawback is that the cost involved in the construction and mounting of mechanisms which move the steps transversely of the cars is very high and that such stairways cannot be readily installed in existing conveyances.

SUMMARY OF THE INVENTION

An object of our invention is to provide a novel and improved stairway for use in various types of conveyances, particularly for use in cars which are designed for travel on rails, such as railroad cars, rail omnibuses, streetcars and/or subway cars as well as those cars which are used above and also below the ground.

Another object of the invention is to provide a conveyance which embodies the improved stairway.

A further object of the invention is to provide a convertible stairway which can be installed in new as well as in existing streetcars or subway cars, and which can be converted from a single-step stairway into a stairway with two, three or more steps, or vice versa.

An additional object of the invention is to provide novel operating means which can be employed in the improved stairway to convert it from use in streetcars to use in subway cars or vice versa and which can effect such conversion safely, with little loss in time, and either automatically or in response to manipulation of controls by the conductor, engineer or another authorized person.

The invention is embodied in a conveyance, particularly in a streetcar or subway car, which comprises a chassis or frame having an upright wall and a floor located at a first level above the ground, preferably at the level of a subway platform, a portion of the floor being spaced inwardly from the aforementioned wall and constituting the upper step of a stairway, an auxiliary step having a first section or panel hingedly secured to the upper step and/or to the frame and a second section or panel hingedly secured to the first panel so that the first panel is located between the upper step and the second panel, and operating means for moving the auxiliary step between a first position in which its panels are substantially coplanar with and outwardly adjacent to the upper step to constitute an extension of the upper step and to preferably extend to the vertical plane of the aforementioned wall, and a second position in which the first panel extends downwardly from the upper step and the second panel extends substantially horizontally at a level below and outwardly adjacent to the upper step to constitute a lower step. In the first position of the auxiliary step, the stairway is particularly suited for use in a subway car because the passengers can reach or leave the floor by walking directly over the extension and onto a subway platform or vice versa. In the second position of the auxiliary step, the stairway is particularly suited for use in streetcars because the passengers can board the streetcar by stepping first onto the lower step and thereupon onto the upper step which is located at the floor level. It is normally preferred to provide the stairway with a lowermost step which is fixedly mounted in the chassis and is outwardly adjacent to and located at a level below the lower step in the second position of the auxiliary step but is overlapped by the extension in the first position of the auxiliary step.

The novel features which are considered as characteristic of the invention are set forth in particular in the appended claims. The improved conveyance itself, however, both as to its construction and its mode of operation, together with additional features and advantages thereof, will be best understood upon perusal of the following detailed description of certain specific embodiments with reference to the accompanying drawing.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a fragmentary transverse vertical sectional view of a conveyance which embodies one form of the improved stairway and wherein the auxiliary step is shown in a position it assumes while constituting an outward extension of the upper step;

FIG. 2 is a similar fragmentary sectional view but showing the auxiliary step in a position it assumes when its second or outer panel constitutes an intermediate step;

FIG. 3 is a plan view of the stairway shown in FIG. 1; and

FIG. 4 is a fragmentary elevational view of a portion of modified operating means for the auxiliary step.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring first to FIG. 1, there is shown a portion of a streetcar or subway car which comprises a chassis or frame including a vertical side wall 120 and a horizontal floor 20 having a portion 20a which is inwardly spaced from the lower edge of the side wall 120 and constitutes the upper step of a three-step stairway. This stairway further includes a lowermost step 21 which is fixedly secured to the chassis and whose outer horizontal edge extends substantially to the plane of the side wall 120. In accordance with a feature of the present invention, the stairway further includes an auxiliary step which comprises a first or inner section or panel 1 hingedly connected to the outer edge of the upper stair 20a, as at 5, and a second or outer panel or section 2 which is hingedly connected to the outer edge of the first panel 1, as at 9. An operating unit is provided to move the auxiliary step between a first position which is shown in FIG. 1 and in which the panels 1, 2 are outwardly adjacent to and coplanar with the floor 20 to constitute an extension of the upper step 20a (whereby the outer edge of the second panel 2 extends substantially to the plane of the side wall 120), and a second position which is shown in FIG. 2 and in which the first panel extends substantially vertically downwardly from the hinge 5 (position 1') and the second panel extends substantially horizontally and outwardly of the hinge 9 (position 2') so as to constitute an intermediate step which is located between the planes or levels of the upper step 20a and lowermost step 21. The outer portion of the panel 2 then preferably rests on a deformable elastic cushion or stop 19 which is provided in the chassis of the conveyance. The upper step 20a rests on and is secured to a horizontal beam 4 which forms part of the chassis. The hinge 5 can connect the first panel 1 directly to the upper step 20a or to the beam 4. The numeral 17 denotes one door of the conveyance which is shown in open and closed positions (see FIGS. 2 and 1, respectively). The stairwell is shown at 18.

FIG. 1 illustrates a relatively high platform 3 which is customarily employed in subway stations and whose top surface is located at the level of the floor 20. Thus, if the panels 1, 2 are moved to the positions shown in FIG. 1, and if the door 17 is moved to open position (indicated in FIG. 1 by phantom lines), the passengers can walk from the platform 3, over the extension including the panels 1, 2 and onto the portion 20a of the floor 20, or vice versa. FIG. 2 shows a relatively low curb 22 which is located at a level below the lowermost step 21 and is customary at streetcar stops. A passenger who is about to board the streetcar can step off the top surface of the curb 22 onto the lowermost step 21, thereupon onto the intermediate step (i.e., onto the panel 2 which then assumes the position 2' shown in FIG. 2 while the panel 1 assumes the position 1'), and finally onto the upper step 20a. Inversely, a passenger leaving the streetcar will descend from the step 20a onto the step 2 (in the position 2' of FIG. 2), thereupon onto the lowermost step 21, and finally onto the top surface of the curb 22.

The operating means for moving the auxiliary step including the panels 1, 2 between first and second positions comprises at least one connecting member or lever 6 which is secured to the underside of the panel 1 and extends outwardly below the panel 2 in the first position of the auxiliary step, and a link train which connects the member 6 with a prime mover PM. The outer end of the member 6 is connected to the upper edge portion of a skirt or shield 10 by a horizontal hinge 11 which is parallel to the hinges 5, 9 and to the pivot 7a between the connecting member 6 and the first link 7 of the aforementioned link train. A second link 12 is articulately connected to a median portion of the skirt 10 and to a pivot 7b at the lower end of the link 7. A third link 8 is pivotable back and forth about a horizontal shaft 16 which is mounted in the chassis of the conveyance, and to the aforementioned pivot 7b. The link train further includes a short link 15 which is rigid with the link 8 and is turnable about the axis of the shaft 16, a crank arm 13 which is rotatable by the prime mover PM, and a rod 14 which connects the crank arm 13 with the free end of the link 15. In the first position of the auxiliary step 1,2, the con-

necting member 6 cooperates with the link 12 to maintain the skirt 10 in a substantially vertical plane in which the skirt extends downwardly from the outer edge of the second panel 2. In the second position of the auxiliary step, the parts 6, 7, 12 maintain the skirt 10 in the position 10' shown in FIG. 2 in which the skirt is located inwardly of and below the level of the intermediate step 2 (in the position 2'). In FIG. 1, the pivot 7b is located to the right of a line connecting the axis of the shaft 16 with the axis of the pivot 7a between the link 7 and member 6 so that the panels 1, 2 cannot move from the positions shown in FIG. 2 unless the crank arm 13 is caused to turn through 180°. The end wall 21a in the stairwell 18 then serves as a stop for a small platform 7A of the link 7 to prevent jackknifing of the panels 1, 2. As shown in FIG. 1, the link 8 is outwardly adjacent to the end wall 21a and the pivots 7a, 7b extend into the space between the illustrated end wall 21a and the other end wall (not shown). Each end wall 21a has a cutout 21A. In FIG. 2, the panel 2 (in the position 2') rests on the cushion 19 and the panel 1 (in the position 1') cooperates with the link train to hold the panel 2 in horizontal position. The effective length of the link 12 is preferably adjustable to insure that the outer side of the skirt (in the position shown in FIG. 1) can be moved rather close to the vertical surface of the platform 3. If the lowermost step 21 is omitted, the passengers will not be inconvenienced when the conveyance is brought to a halt adjacent to a relatively high platform 3. When the conveyance is brought to a halt adjacent to a curb 22, the passengers must step from the top surface of the curb 22 directly onto the intermediate step or panel 2 (in the position 2') or vice versa. The end walls 21a extend upwardly from the longitudinal ends of the step 21 and the elastic cushion 19 extends between the cutouts 21A in such end walls. The material of the cushion 19 is preferably selected with a view to be capable of yielding by 1 or more millimeters; such yieldability of the cushion 19 enables the panel 2 to actuate one or more electric safety switches which insure that the operating means cannot displace the panels 1, 2 and/or that the door actuating mechanism is held at a standstill when the weight of one or more persons standing on the panel 2 in the position 2' of FIG. 2 causes the cushion 19 to yield. This is a desirable safety feature of the conveyance. The cushion 19 can also serve as a means for pressurizing a hydraulic or pneumatic fluid to thereby insure immobilization of the operating means for panels 1, 2 and the door actuating mechanism when the weight of one or more persons is added to the weight of the panel 2 in the position 2' of FIG. 2.

The prime mover PM is preferably an electric motor which can be energized to turn the crank arm 13 through 180°. In accordance with a further feature of the invention, the rod 14 is a composite structure having a first portion 14a provided with recesses or notches for springbiased rolls 14c provided on a second portion 14b. If the panel 2 (in the position 2' of FIG. 2) carries the weight of one or more persons or the auxiliary step 1,2 is otherwise prevented from moving to the position of FIG. 1 or 2, the rolls 14c leave their grooves when the prime mover PM rotates the crank arm 13 to thereby prevent accidents and/or damage to the auxiliary step and the link train. Also, when the rolls 14c leave their grooves, they can actuate an electric switch which thereby disconnects the prime mover PM from the energy source. It is clear that the electric prime mover PM can be replaced by a hydraulic or pneumatic motor. The primed numerals denote in FIG. 2 such positions of parts of the operating means which these parts (6, 7, 8, 10) assume in the second position of the auxiliary step.

FIG. 3 is a plan view of the panels 1, 2 in the position of FIG. 1. The stairwell 18 accommodates two doors 17, 17a the latter of which is shown in open position. Each of these doors is a folding door. The hinge means 9 between the panels 1, 2 comprises two axially spaced discrete hinges, and the hinge means 5 also comprises two discrete hinges. Two protective lateral walls 25 flank the stairwell 18 and are outwardly adjacent to the doors 17, 17a in open positions of such doors. The chassis further supports stiles 23 which are swingable about the axes

of vertical posts 24 and normally assume the idle positions shown in FIG. 3 in which they are located in a vertical plane parallel to the side wall 120, i.e., these stiles are normally aligned with each other as considered in the direction of movement of the car. The posts 24 are mounted on the floor 20 closely adjacent to the inner edge of the panel 1. When the doors 17, 17a are closed, the stairwell 18 is surrounded by the protective walls 25, by the stiles 23, and by the doors 17, 17a. The stiles 23 can be locked in the illustrated positions to thereby prevent passengers from occupying the panel 1 and/or 2 when the car is in motion and when the conductor desires to move the panels to the positions 1', 2' of FIG. 2 or back to the positions shown in FIGS. 1 and 3. The arrangement is preferably such that the locking means for the stiles 23 is operatively connected with the aforementioned control switches which are actuated in response to deformation of the cushion 19. For example, the stiles 23 can be locked in the positions shown in FIG. 3 by electrically actuated locking means when the pressure on the cushion 19 is reduced, i.e., when the intermediate step 2' of FIG. 2 is not occupied by one or more passengers. This indicates that no passenger is in the process of boarding or leaving the car and that the stiles 23 can be safely locked in illustrated positions. Locking of stiles 23 is followed by closing of the doors 17, 17a.

FIG. 4 illustrates a portion of a modified conveyance which again comprises a connecting member 6 secured to the inner panel 1 (not shown) and a first link 70 which is articulately connected to the member 6 by pivot 70a. The lower end of the link 70 has an elongated slot 27 for a pivot 70b which passes through the prongs of the bifurcated upper end of the link 8. A helical spring 26 biases a bell crank lever 29 whose upper arm carries a roller 30 which is biased against the lower edge face of the link 70. The spring 26 is strong enough to cause the roller 30 and link 70 to actually support the platforms 1, 2 if these platforms are not occupied by one or more passengers. The panels 1, 2 are assumed to be held in the positions shown in FIG. 1 in which they constitute an extension of the upper step 20a. When the extension is occupied by one or more persons, the spring 26 yields and allows the lever 29 to turn in a counterclockwise direction whereby an actuating member or trip 31 on the upper arm of the lever 29 actuates an electric safety switch 28 which opens the circuit of the prime mover to prevent jackknifing of the extension. The character s indicates the extent of downward movement of the link 70 when the extension 1, 2 carries the weight of one or more passengers, of one or more parcels or even the weight of a single animal, such as a dog. This distance is selected in such a way that it suffices to insure that the switch 28 is actuated when the pivot pin 70b abuts against the surface at the upper end of the slot 27.

It is further clear that the safety system of the conveyance may include photoelectric devices which scan the space above the step 21 and/or step 2' to prevent starting of the prime mover and/or operation of the door actuating mechanism when at least one person occupies one of the two lower steps or the extension of the upper step. However, even if the conveyance is equipped with photoelectric safety devices, the stiles 23 are desirable nevertheless because they insure that no passenger can step onto the platform 1 and/or 2 and/or onto the step 21 when the train is in motion. It is further clear that the conveyance can be provided with a simpler door assembly, for example, with a single folding or one-piece door.

The safety device for the lowermost step 21 can be designed in the customary way. For example, the major part of this step 21 can be designed to descend slightly when it carries the weight of one or more passengers, animals and/or packages and to thereby actuate a system of safety switches or the like which prevent closing of doors and/or movements of the auxiliary step until the pressure on the movable portion of the lowermost step decreases to a predetermined value.

The safety locking device for the stiles 23 is inactivated in response to opening of the doors. As stated before, the doors are closed subsequent to locking of stiles 23 in the positions shown in FIG. 3.

When the stairway is incorporated in a streetcar, the doors are closed first and the auxiliary step is thereupon moved to the position shown in FIG. 1 whereby the skirt 10 moves to operative position to conceal the lowermost step 21 and to enhance the appearance of the conveyance.

An important advantage of our stairway is that it can be employed in subway cars which are also designed for use as streetcars whereby the passengers need not climb or descend steps when they move from the subway platform onto the floor 20 or vice versa. On the other hand, the stairway can be provided with three discrete steps to facilitate boarding or leaving of cars which are used in street traffic, i.e., when the passengers must climb from the street level or from a very low curb to the level of a floor which is located at a substantial distance above the ground. The stairway can be incorporated in new subway and streetcars or in existing cars, especially in existing cars whose floors are located well above the rails so that it is necessary to employ a stairway with more than two steps when the car is used in street traffic. The skirt 10 enhances the internal and external appearance of the car when the platforms 1, 2 constitute an extension of the upper step 20a and it does not interfere with the use of stairway when the platforms 1, 2 are moved to the positions shown in FIG. 2.

If an existing car whose stairway includes three fixedly mounted steps is to be converted to embody the present invention, the lowermost step can remain to constitute the step 21 and the two upper steps are then replaced by panels 1 and 2. The door or doors of such existing cars merely require some shortening at their lower ends. Thus, the conversion of existing cars can be carried out economically and the converted cars are useful for street traffic as well as in the subway system.

Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can, by applying current knowledge, readily adapt it for various applications without omitting features which, from the standpoint of prior art, fairly constitute essential characteristics of the generic and specific aspects of our contribution and, therefore, such adaptations should and are intended to be comprehended within the meaning and range of equivalence of the claims.

What is claimed as new and desired to be protected by Letters Patent is set forth in the appended

1. In a conveyance, particularly in a street car or subway car, a combination comprising a chassis including an upright wall and a floor located at a first level above the ground and having a portion spaced inwardly from said wall and constituting the upper step of a stairway; an auxiliary step having a first panel articulately secured to said upper step and a second panel articulately secured to said first panel; and operating means for moving said auxiliary step between a first position in which said panels are substantially coplanar with and outwardly adjacent to said upper step to constitute an extension thereof and a second position in which said first panel extends downwardly from said upper step and said second panel extends substantially horizontally at a second level below said first level and constitutes a lower step, said panels being located in said first and said second positions thereof within a plane defined by the outer surface of said upright wall.

2. A combination as defined in claim 1, wherein said second panel extends substantially to the plane of said wall in the first position of said auxiliary step.

3. A combination as defined in claim 1, further comprising a lowermost step fixed to said chassis at a third level below said second level and outwardly adjacent to said second panel in the second position of said auxiliary step.

4. A combination as defined in claim 3, wherein said lowermost step extends substantially to the plane of said wall.

5. A combination as defined in claim 1, further comprising a shield secured to said auxiliary step and movable therewith between a first position in which it extends downwardly from the outermost portion of said second panel in the first position of said auxiliary step and a second position in which it is located inwardly of said lower step in the second position of said auxiliary step.

6. A combination as defined in claim 5, further comprising connecting means securing said shield to the underside of said first panel.

7. A combination as defined in claim 6, wherein said operating means comprises prime mover means and a link train coupling said prime mover means with said connecting means.

8. A combination as defined in claim 7, wherein said connecting means is articulately connected with said shield and wherein said link train comprises a first link articulately connected to said connecting means, a second link articulately connected to said shield, and a third link turnable in said chassis about a fixed axis and articulately connected with said first and second links.

9. A combination as defined in claim 1, further comprising at least one partition movably mounted on said floor inwardly adjacent to said auxiliary step.

10. A combination as defined in claim 9, wherein said partition is a stile which is swingable about a vertical axis to and from an idle position in which it separates said upper step from said auxiliary step, and further comprising means for locking said stile in said idle position.

11. In a conveyance, particularly in a street car or subway car, a combination comprising a chassis including an upright wall and a floor located at a first level above the ground and having a portion spaced inwardly from said wall and constituting the upper step of a stairway; an auxiliary step having a first panel articulately secured to said upper step and a second panel articulately secured to said first panel; operating means for moving said auxiliary step between a first position in which said panels are substantially coplanar with and outwardly adjacent to said upper step to constitute an extension thereof and a second position in which said first panel extends downwardly from said upper step and said second panel extends substantially horizontally at a second level below said first level and constitutes a lower step; and a safety device for

preventing movement of said auxiliary step in at least one position thereof when a predetermined load rests on said auxiliary step, said safety device including electric switch means and means for actuating said switch means in response to placing of a predetermined weight onto said auxiliary step.

12. A combination as defined in claim 11, wherein the means for actuating said switch means forms part of said operating means.

13. A combination as defined in claim 12, wherein the means for actuating said switch means comprises a link operatively connected with and being arranged to carry the weight of said auxiliary step and to change its position in response to placing of a weight onto said auxiliary step to thereby effect actuation of said switch means.

14. In a conveyance, particularly in a street car or subway car, a combination comprising a chassis including an upright wall and a floor located at a first level above the ground and having a portion spaced inwardly from said wall and constituting the upper step of a stairway; an auxiliary step having a first panel articulately secured to said upper step and a second panel articulately secured to said first panel; operating means for moving said auxiliary step between a first position in which said panels are substantially coplanar with and outwardly adjacent to said upper step to constitute an extension thereof and a second position in which said first panel extends downwardly from said upper step and said second panel extends substantially horizontally at a second level below said first level and constitutes a lower step; deformable stop means supporting said lower step in the second position of said auxiliary step and arranged to yield in response to placing of a predetermined weight on said auxiliary step; and a safety device operative in response to deformation of said stop means.

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