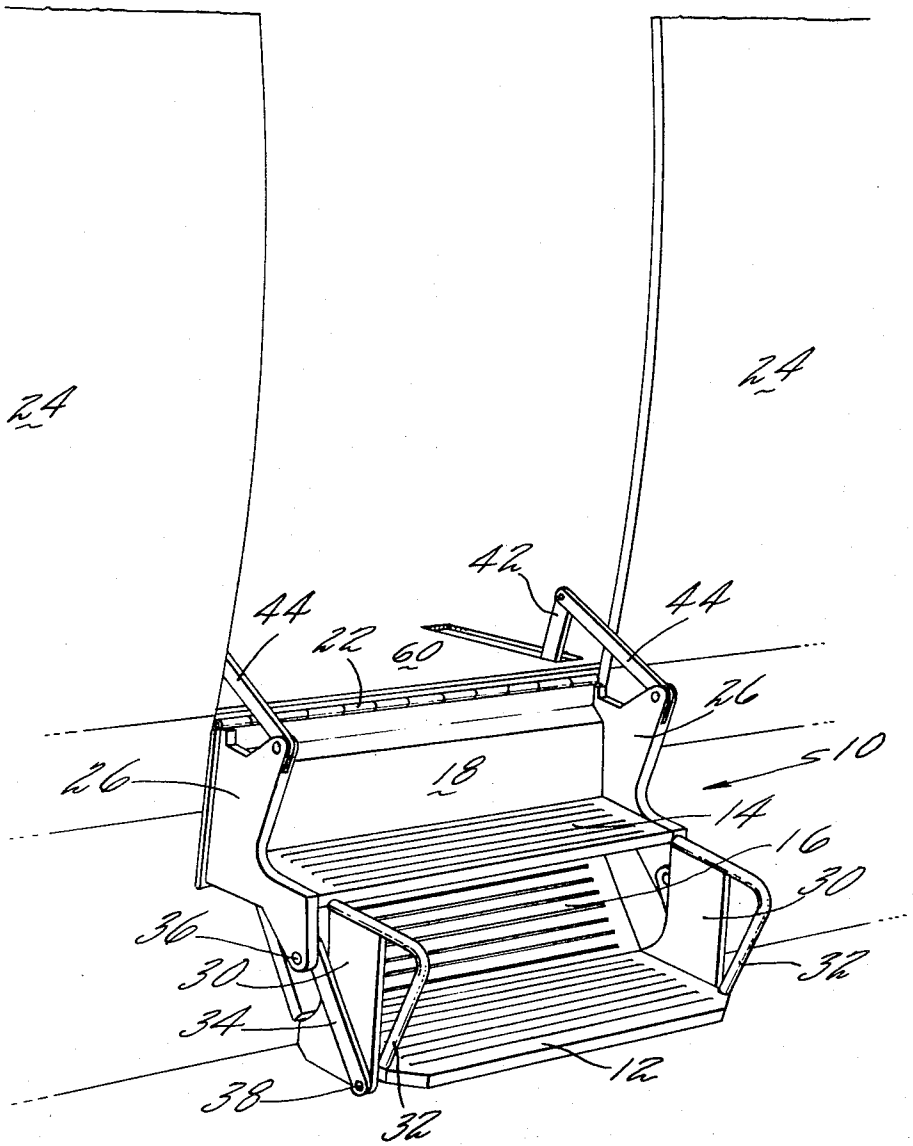
Nov. 5, 1968 A. R. CRIPE ET AL 3,408,959

FOLDING STAIRCASE

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FIG. 1



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FOLDING STAIRCASE

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FIG. 2

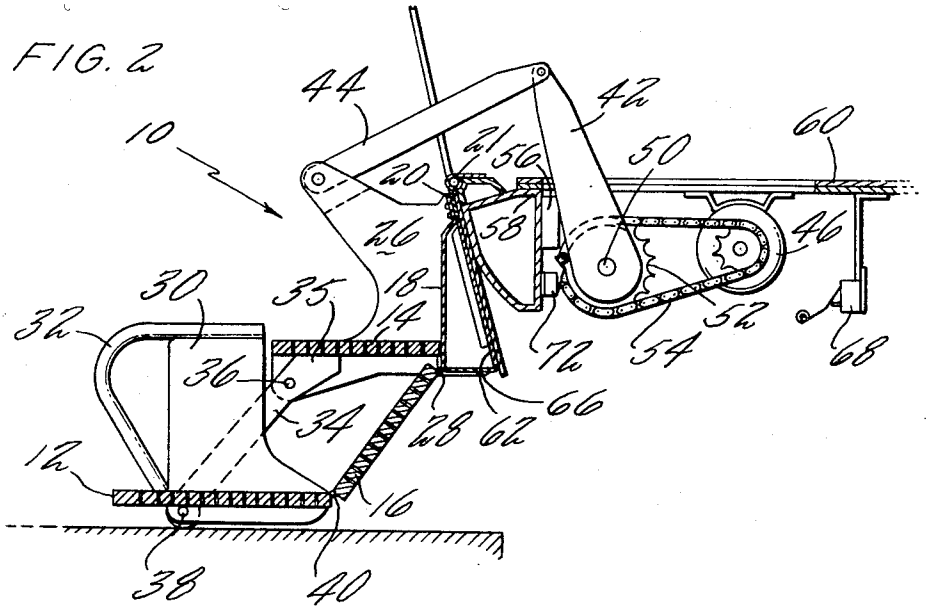
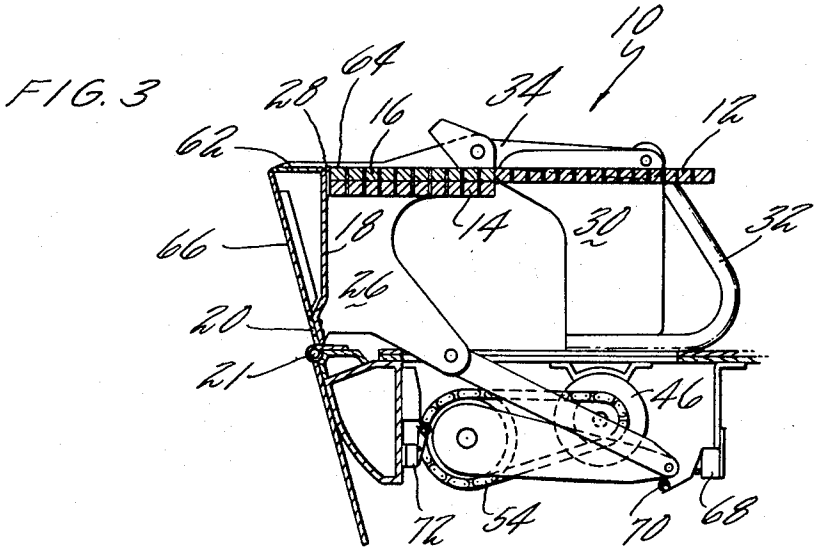


FIG. 3



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FOLDING STAIRCASE

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ABSTRACT OF THE DISCLOSURE

A folding staircase for a passenger vehicle that converts from a platform in the vestibule of the vehicle to a pair of steps extending outwardly from the door of the vestibule and down to a station platform. The convertible staircase pivots 180° around the vehicle's doorsill by means of an arm and link mechanism to fold from the exterior stair position into the interior platform position.

Background of the invention

Field of invention.—This invention relates to a staircase for entering and leaving a passenger vehicle and more particularly to a convertible staircase that folds from a staircase position external of the vehicle into a platform in the vestibule of the vehicle.

Description of the prior art.—In the construction of staircases for railway vehicles, it has been the general practice to provide a pair of rigid steps that are covered by a separate platform located thereabove. The outer portion of the staircase is open to the elements and, therefore, subject to the formation of snow, ice and sleet on the treads. The stairs project downwardly from the car body increasing the air resistance under the car frame, and are usually covered by a trap door that must be raised manually before a passenger can enter or leave the car by way of the staircase.

One of the railway passenger-vehicle staircases of the prior art comprises a series of individually hinged steps that can be successively folded so that one or more of them can be extended for use. This particular type of construction does not permit the staircase to be converted into a platform inside the vestibule when the staircase is not in use. A construction of this type is shown in United States Patent No. 976,195.

Another of the railroad passenger cars of the prior art utilizes a secondary staircase that slides down over a fixed staircase, thereby covering any ice or snow thereon (United States Patent No. 1,397,294). When the secondary stairs are raised, they form a platform that becomes an integral part of the vestibule floor inside the car.

Another staircase device, as shown in the patent to A. F. Paul, United States Patent No. 1,802,926, employs a trap door in the floor of the car vestibule that can be lowered into stair-forming position to enable passengers to pass in and out of the car from low-level platforms. The stair treads move at the same time, but at different rates of speed so that they are simultaneously brought into the trap door forming position or into the stair-forming position.

In all of the above mentioned staircase devices, the mechanism for raising, lowering or folding the stairs and converting them from platform to stairway position is unduly complicated and comprises a series of chain or pulley drives with associated linkages. All of these staircases are contained inside the passenger vehicle when converted from a platform to a stair-forming position, and none of them can be extended outwardly from the side of the train to rest upon a station platform. None of the staircases of the prior art suggest the formation of an interior platform step that will aid a passenger in reaching a station platform at a higher level than the floor of the passenger vehicle vestibule.

Summary of invention

An object of the invention is to provide a passenger-vehicle staircase that extends outwardly from the vehicle vestibule at passenger stations having low level platforms and which converts into a platform inside the car in the vestibule for use at stations having high-level platforms.

In accordance with one aspect of the present invention, a staircase is provided which quickly converts from a platform step inside the vehicle and above the vestibule floor, into a set of stairs extending from the vestibule floor outwardly from the vehicle to rest on a low level station platform.

When in the platform-step position, the convertible staircase of this invention forms a step above the vestibule floor of the vehicle so that passengers can ascend from the floor by way of the platform step, up and onto a high level station platform.

At stations having a passenger platform lower than the vehicle's vestibule floor, the convertible staircase is extended from the side of the car to permit exit to the low level passenger platform. Passengers descend directly from the vestibule floor, down the stair treads to the station passenger platform. The botom tread of the stair is hingedly attached to its upper tread, and, therefore, the bottom tread is free floating and self adjusting, enabling it to rest firmly on low level passenger platforms that vary in height or with very low platforms to assume a position thereabove but normal height beneath the next higher step.

The invention accordingly provides a passenger vehicle staircase operated by a simple mechanism and one that can be utilized with great ease at passenger platforms above and below the level of the vehicle vestibule floor.

The foregoing and other objects, features and advantages of the present invention will become more apparent in the light of the following detailed description of a preferred embodiment thereof as ilustrated in the accompanying drawings.

Brief description of the drawings

FIGURE 1 is a perspective view of a preferred embodiment of the invention showing the staircase in the extended position.

FIGURE 2 is a side view of the preferred embodiment of the invention and shows the convertible staircase in the stair-forming position.

FIGURE 3 is a side view of the invention showing the staircase converted into a platform step above the vestibule floor.

Description of the preferred embodiment

Referring generally to the preferred embodiment of FIGURES 1, 2 and 3, a staircase **10**, comprises a lower tread **12**, an upper tread **14**, a lower riser **16**, and an upper riser **18**. The top edge of riser **18** is riveted to a hinged member **20** (FIGURES 2 and 3) and is pivotally connected to the frame **21** of the vehicle door at points **22** (FIGURE 1) in the side **24** of a passenger vehicle. By pivoting around hinge **20**, the staircase **10** can be converted from the stair-forming position, shown in FIGURES 1 and 2, to the platform-step position illustrated in FIGURE 3. Two upper side frames **26** serve as supports for upper tread **14** and upper riser **18**. Each of these side frames **26** is firmly attached to tread **14** and riser **18** to form a single assembly that is riveted or welded to hinge **20**. The lower riser **16** is hingedly connected to the bottom of the upper riser **18** at point **28** (see FIGURE 2).

A lower side frame **30** is welded to each end of lower tread **12**, as shown in FIGURES 1 and 2. A supporting stop member **32** is welded to each of the side frames **30**, as well as to the lower tread **12**. In this way, side frames **30**, support stops **32**, and lower tread **12** form a single structure.

The upper side frames **26** and the lower side frames **30** are operatively connected by connecting arms **34** using pins **36** and **38**. Additionally, the rear portion of tread **12** is pivotally connected to the bottom portion of the riser **16** at point **40**, more clearly seen in FIGURE 2. Because of the pivoting action just described about points **28**, **36**, **38** and **40**, tread **12** is free to swing up and down in the horizontal plane. This type of construction gives the lower tread **12** considerable freedom in movement and also maintains the lower tread in parallel relationship to the upper tread **14** at all times. Therefore, staircase **10** is self adjusting to varying platform heights at different passenger stations.

In FIGURES 2 and 3, the mechanism for converting the staircase **10** from the step-forming position to the platform step position is more clearly shown. The staircase **10** pivots about points **22** (FIGURE 1) by the action of an arm **42** and a link **44** driven by a drive motor **46**. The arm **42** is fixedly attached to a rotatable gear **52** that is operatively connected to a drive motor **46** by a conventional chain or belt **54**. When the staircase is in the stair-forming position shown in FIGURE 2, arm **42** comes to rest against a stop **56**, which is fixedly attached to a brace **58** inside the framework of the passenger vehicle.

The vehicle has a vestibule floor **60** that extends to the edge of the car door, as illustrated in FIGURE 3. When the staircase **10** is converted into the platform step position, shown in FIGURE 3, support stops **32** rest against the top of the floor **60** to firmly support the treads **12**, **14** and riser **16**. The horizontal platform step in FIGURE 3 comprises riser **16** and tread **12**.

The frame member **62** forms an extension of the upper stair tread **16** and is attached thereto to form a continuation of the step platform between the outer surface **24** of the car and the forward end **64** of the platform step (see FIGURE 3). Outside member **66** is attached to the end of frame member **62** and riveted onto hinge **20** thereby forming the outside surface of the vehicle when the staircase is converted from the step position to the platform position.

The following two situations wherein a passenger can utilize the convertible staircase to enter and leave the passenger vehicle, emphasize the advantages of this invention.

In railway stations where the passenger platform is at a higher level than the floor of the vehicle, a passenger entering or leaving the vehicle steps upon the platform step, illustrated in FIGURE 3, thereby eliminating the discomfort and danger of a large step up or down.

At most stations the passenger platform is at a lower level than the floor of the vehicle. As the passenger vehicle comes to a stop at these stations, the conductor opens the door of the car and energizes motor **46** which, in turn, drives chain **54** and gear **52**, thereby rotating arm **42** and connecting link **44** (FIGURE 3) counterclockwise. The arm **42** and the link **44** extend outwardly through the open doorway carrying the convertible staircase **10** along therewith and down to the station platform level. As the staircase **10** passes through the doorway, it unfolds and the bottom tread **12** folds down along with the bottom riser **16**. The unfolding action stops when the upper ends **35** of connecting arms **34** come to rest against the bottom side of upper tread **14**, thereby preventing the lower tread **12** from dropping further. As mentioned hereinbefore, the free-floating action of tread **12** about pivot points **38** and **40**, enables the staircase to adjust itself vertically to compensate for variations in station platform height.

Adjustable stops **56** are provided to regulate and stop the extension of arms **42** so that when the arms and staircase **10** are extended, as shown in FIGURE 2, rotation of the arms **42** and the staircase **10** will stop at a preselected position.

With the staircase **10** in this stair position, shown in FIGURE 2, passengers enter and leave the car by means of treads **12** and **14**, stepping to or from the vestibule floor **60**.

Before the vehicle leaves the station, the conductor energizes drive motor **46** and the staircase **10** begins its clockwise rotation about hinge **20**, folding into a platform step with the support stops **32** coming to rest on the vestibule floor **60**.

The microlimit switch **68**, illustrated in FIGURE 3, is utilized to deenergize the motor **46**, automatically, when the staircase **10** has been converted into the platform-step condition. As arms **42** pivot clockwise, the forward edge of one of the arms comes into contact with the switch **68** at point **70**, thereby deactuating the motor **46**. Similarly, microlimit switch **72** deenergizes motor **46**, automatically, when staircase **10** has been converted into the stair position.

Although the invention has been shown and described with respect to a preferred embodiment thereof, it should be understood by those skilled in the art that the foregoing and other changes and omissions in the form and detail thereof may be made therein without departing from the spirit and scope of the invention, which is to be limited and defined only as set forth in the following claims.

We claim:

1. A staircase for a railway vehicle that converts from a platform position in the vestibule inside the vehicle doorsill to stair-forming position leading to a station platform which comprises:

a pair of stair treads separated by a lower riser and pivotally connected thereto, said treads comprising a lower tread and upper tread;

an upper riser pivotally connected to said upper tread and pivotally connected to the frame of the vehicle doorsill;

a first side frame fixedly attached to said upper tread and said upper riser at each end thereof;

a connecting arm member pivotally connecting said lower and said upper treads at each end thereof and parallel to said lower riser and spaced therefrom, said connecting arm member and said lower riser being free to pivot to orient said lower tread from a position coplanar with said upper tread to a position parallel to but beneath said upper tread and carrying said lower tread attached thereto;

an arm and link mechanism pivotally connected to each of said first side frames;

and power means for actuating said arm and link mechanisms, so that when said power means is energized said arm and link mechanisms are actuated, causing the staircase to pivot about the vehicle doorsill and into the vehicle vestibule to form a platform.

2. A staircase for a railway vehicle that converts from a platform-step position above the vestibule floor inside the vehicle doorsill to stair-forming position leading to a station platform which comprises:

a pair of stair treads separated by a lower riser and pivotally connected thereto, said treads comprising a lower tread and upper tread;

an upper riser pivotally connected to said upper tread and pivotally connected to the frame of the vehicle doorsill;

a first side frame fixedly attached to said upper tread and said upper riser at each end thereof;

a connecting arm member pivotally connecting said lower and said upper treads at each end thereof and parallel to said lower riser and spaced therefrom, said connecting arm member and said lower riser being free to pivot under said upper tread from a

position coplanar therewith to a position parallel to but beneath in open position and carrying said lower tread attached thereto;

an arm and link mechanism pivotally connected to each of said first side frames;

and power means for actuating said arm and link mechanisms, so that when said power means is energized said arm and link mechanisms are actuated, causing the staircase to pivot about the vehicle doorsill and into the vehicle vestibule to rest upon the top of the vestibule floor to form a platform step.

3. A staircase for a railway vehicle that converts from a platform-step position above the vestibule floor inside the vehicle doorsill to stair-forming position leading to a station platform which comprises:

a pair of stair treads separated by a lower riser and operatively connected thereto, said treads comprising a lower tread and an upper tread;

a connecting arm member pivotally connecting said lower and said upper treads at each end thereof and parallel to said lower riser and spaced therefrom, said connecting arm member and said lower riser being free to pivot under said upper tread from a position coplanar therewith to a position parallel to but beneath in open position and carrying said lower tread attached thereto;

an upper riser pivotally connected to said upper tread and pivotally connected to the frame of the vehicle doorsill;

a first side frame fixedly attached to said upper tread and said upper riser at each end thereof;

a second side frame fixedly attached to said lower tread at each end thereof;

an arm and link mechanism pivotally connected to each of said first side frames;

and power means for actuating said arm and link mechanisms, so that when said power means is energized said arm and link mechanisms are actuated, causing the staircase to pivot about the vehicle doorsill and into the vehicle vestibule to fold into a platform step coming to rest above the vestibule floor.

4. The apparatus of claim 3 wherein:

said second side frame has a supporting stop member fixedly attached thereto, said stop member acting as a support for the platform step and coming to rest on the vestibule floor when the staircase is converted and folded into the platform-step position.

5. A convertible staircase for a railway vehicle that pivots about the vehicle's doorsill to fold from a stair-forming position external to the vehicle into a platform-step position inside the vehicle's vestibule and above the vestibule floor which comprises:

a bottom tread pivotally attached to the bottom side of a lower riser thereabove;

an upper tread;

a first side frame fixedly attached to said upper tread at each end thereof and having an ear extending slightly below said upper tread;

an upper riser fixedly attached to the rear of said upper tread and positioned between said first side frames and extending slightly below said upper tread, said lower riser having its upper side pivotally connected to the lower edge of said upper riser;

a second side frame fixedly attached to said lower tread at each end thereof;

a connecting arm member pivotally connected to said ear of said first side frame and having its other end pivotally connected to the lower front edge of said second side frame, said connecting arm member and said lower riser being free to pivot under said upper tread from a position coplanar therewith to a position parallel to but beneath in open position and carrying said lower tread attached thereto;

a pivoting linkage assembly operatively connected to said first side frame at each end thereof;

and power means for actuating said linkage assembly so that when said power means is energized said linkage assembly is actuated, causing the staircase to pivot about the vehicle doorsill and into the vehicle vestibule to rest upon the top of the vestibule floor to form a platform step.

6. The apparatus of claim 5 wherein said pivoting linkage assembly comprises:

a link pivotally connected to said first side frame;

an arm pivotally connected to the opposite end of said link;

a rotatable gear operatively connected to the opposite end of said arm;

and connecting means to connect said power means to said rotatable gear, so that when said power means is energized, said rotatable gear rotates carrying said arm and said link therewith, causing said staircase to pivot about the doorsill and into the vehicle vestibule to fold into a platform step coming to rest above the vestibule floor.

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