

[54] DOOR SYSTEM FOR A RAILWAY CAR

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[52] U.S. Cl. **105/450, 105/443**

[51] Int. Cl. **B61d 19/00**

[58] Field of Search ... 105/343, 348, 378, 341, 329,
105/425, 426, 430, 432, 447-450, 443

[56] **References Cited**

UNITED STATES PATENTS

3,724,396	4/1973	Roth	105/450
679,080	7/1901	King, Sr.	105/432

977,310	11/1910	Howson	105/450
2,085,443	6/1937	Nichols et al.	105/450

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Assistant Examiner—Richard A. Bertsch
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[57] ABSTRACT

A door system for a railway passenger car which accommodates both high and low level boarding platforms includes a sliding upper door for both high and low level boarding, a segmented lower door immediately below the upper door for low level boarding, and a staircase connecting the floor of the car to the lower door opening. The staircase is covered by a segmented sliding floor panel during high level boarding, and the sliding floor panel and lower door are retracted to fully enclosed positions under the staircase during low level boarding.

13 Claims, 10 Drawing Figures

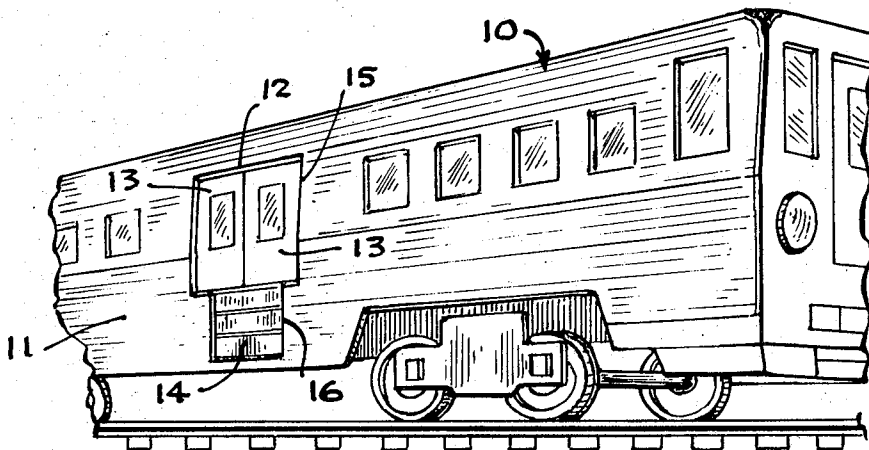


FIG. 1

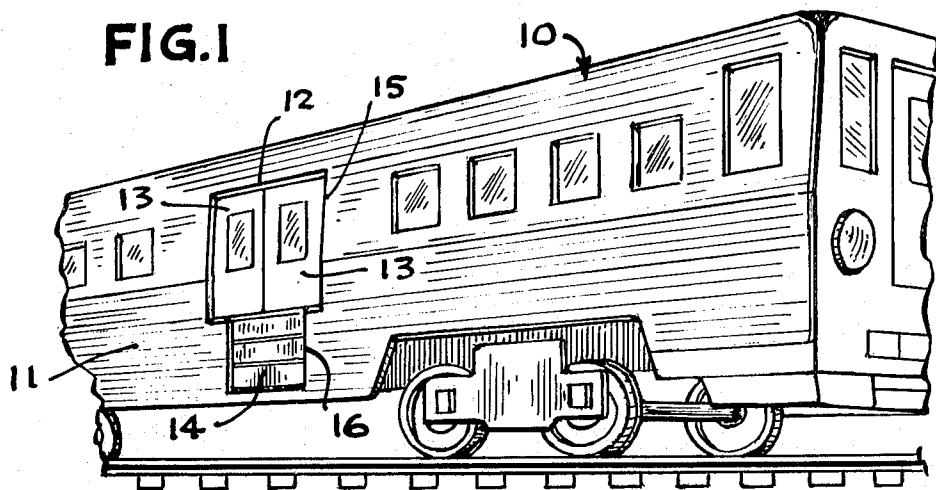


FIG. 4

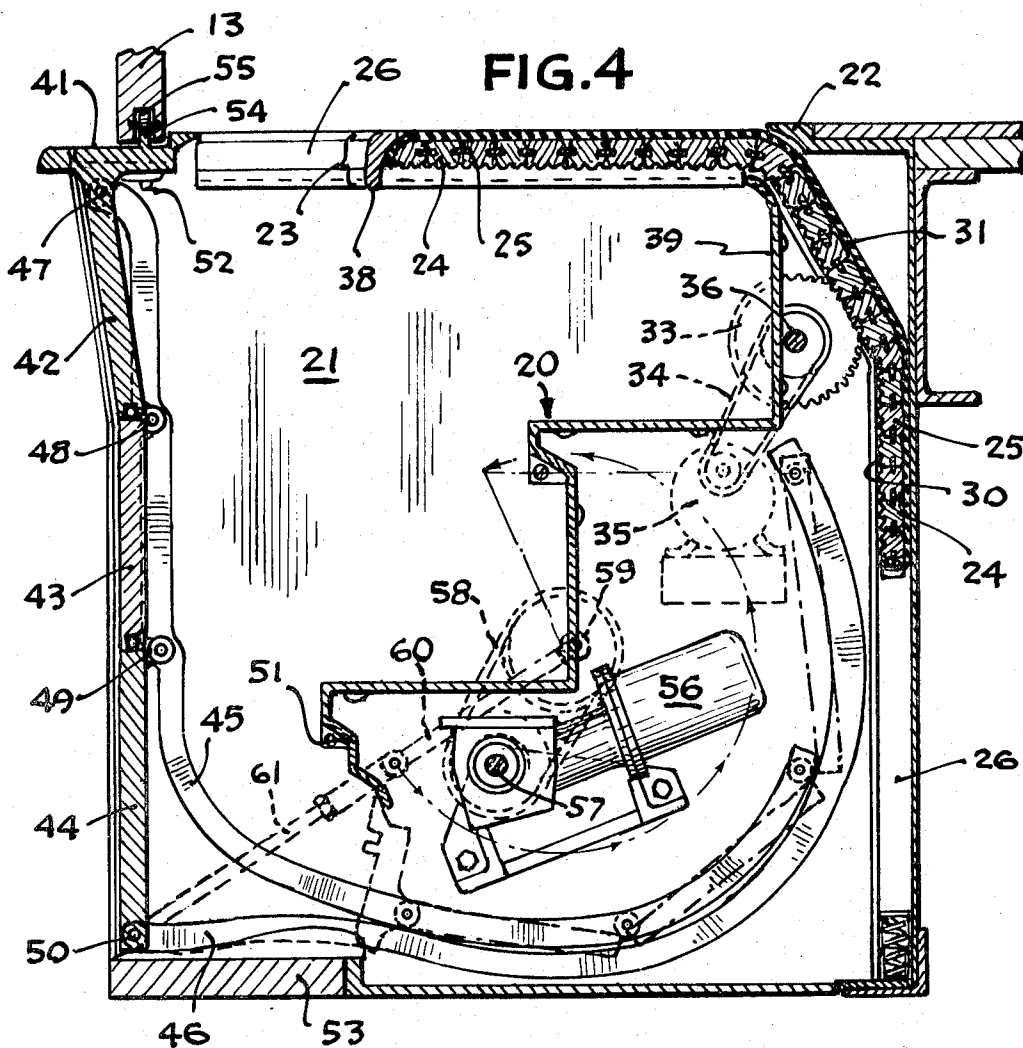


FIG. 2

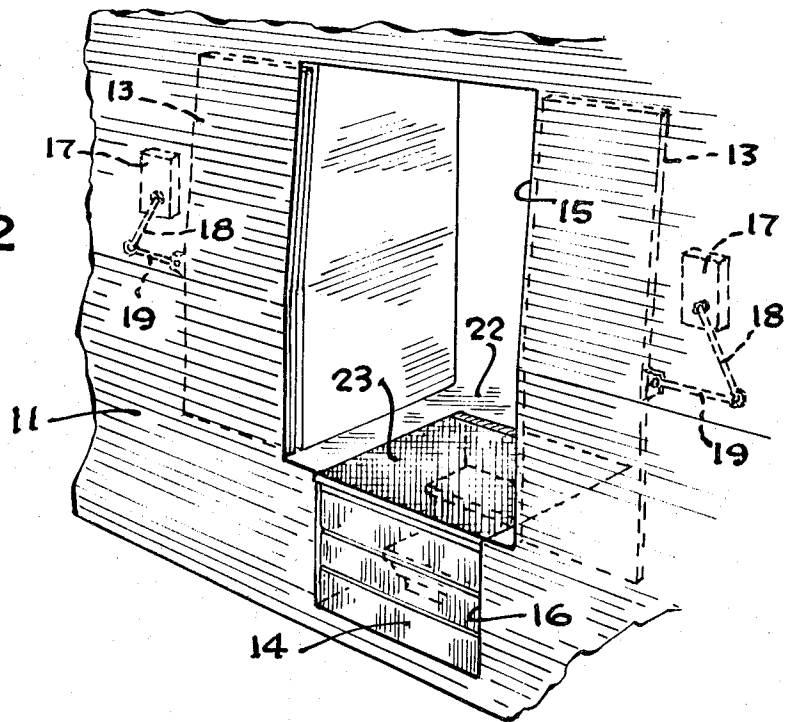


FIG. 3

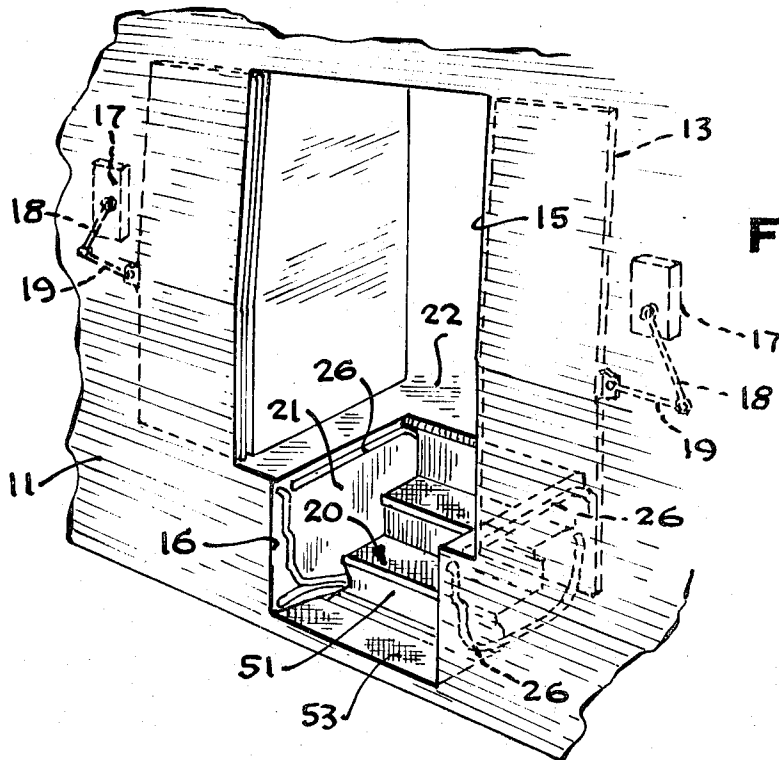


FIG. 5

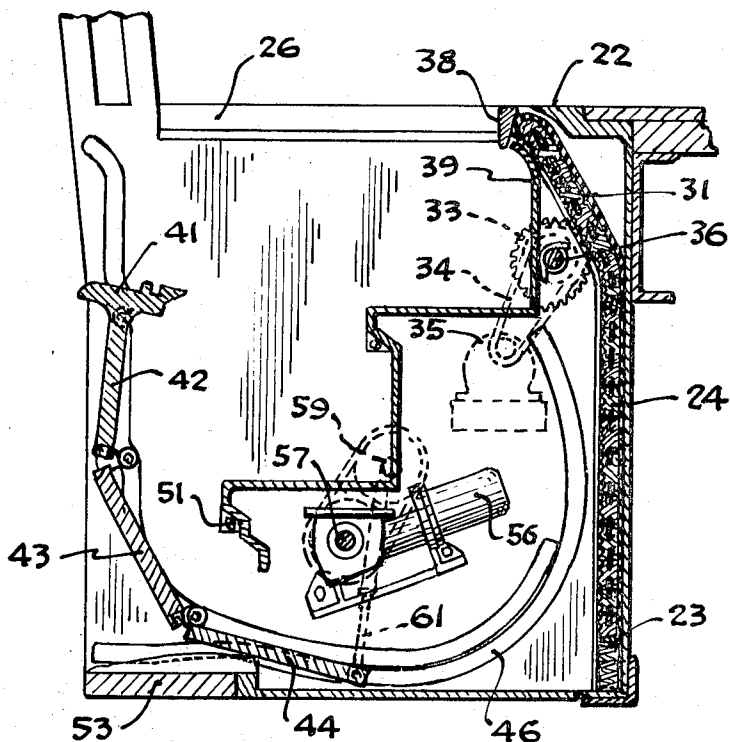


FIG. 6

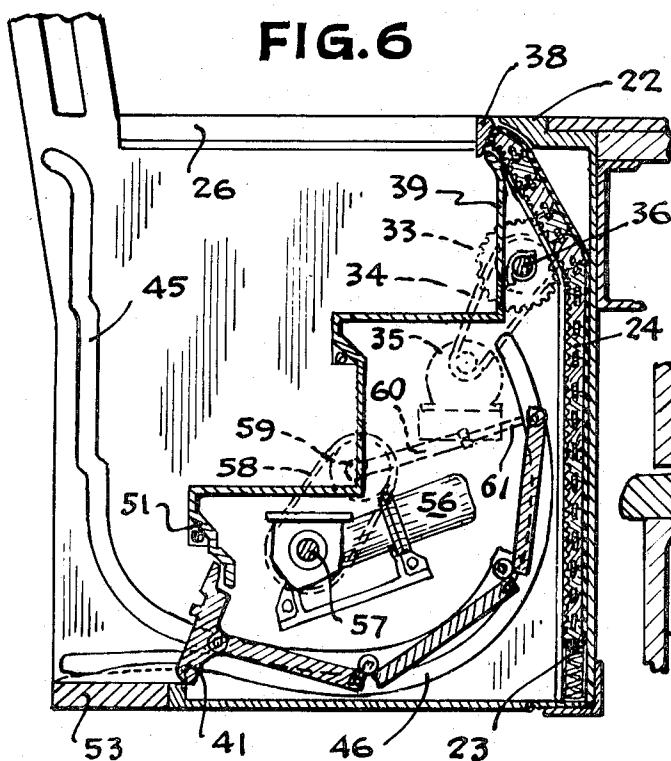


FIG. 10

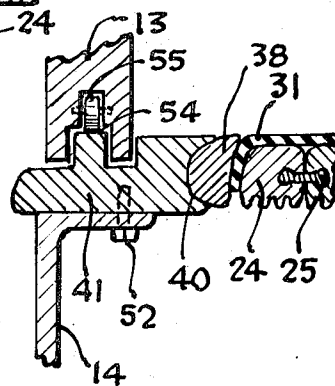


FIG. 7

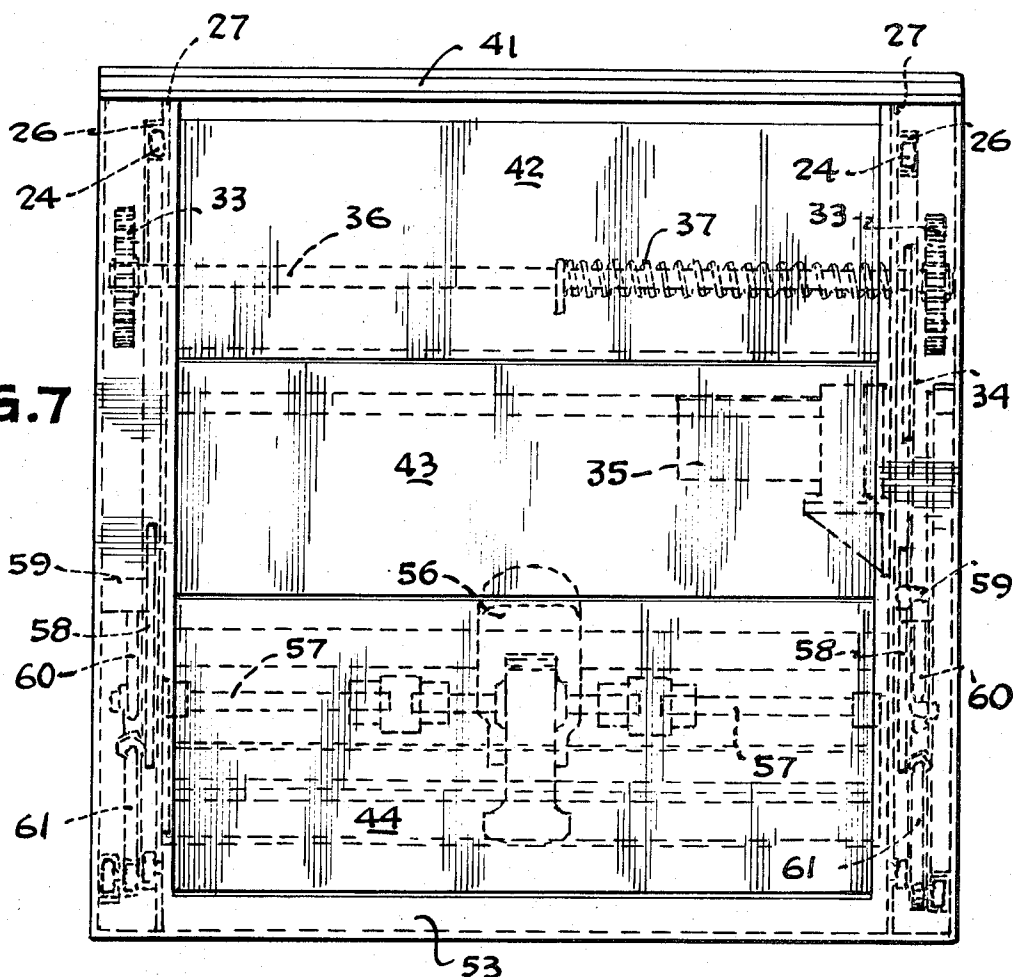


FIG. 8

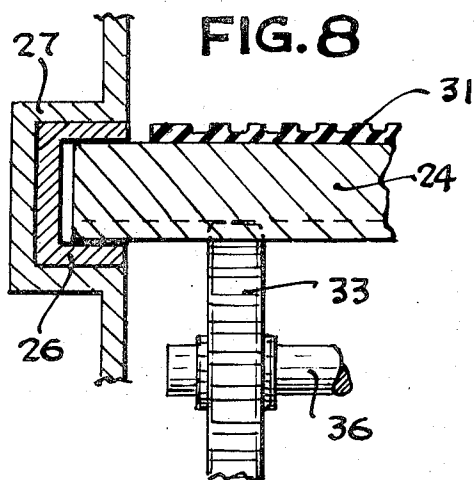
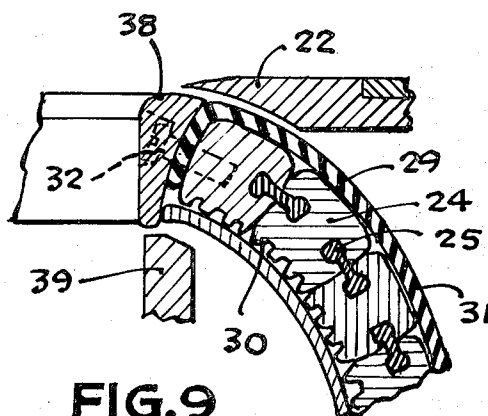


FIG. 9



DOOR SYSTEM FOR A RAILWAY CAR

BACKGROUND OF THE INVENTION

This invention relates to door systems, and more particularly to a door system for a railway passenger car which accommodates both high and low level boarding platforms.

It is frequently necessary that the entranceway of railway cars, particularly those intended for interurban service, be able to accommodate high level boarding platforms, such as those at the height of the car floor typically found in urban areas, and low level platforms, such as those at or slightly above track level typically found in rural areas. Early efforts at providing a suitable entranceway were directed to the provision of a stairwell leading from the floor of the car downwardly for lower level platform boarding, and a trap door covering the stairwell and providing a continuation of the floor for upper level platform boarding. This system was not satisfactory because the exit end of the staircase was always open and therefore susceptible to accumulating snow, ice and water, making its use in inclement weather hazardous.

One generally successful solution to this problem is described in U.S. Pat. No. 3,724,396 which is, assigned to the present assignee. Basically, this system comprises a pair of upper sliding doors to be opened for high level boarding, and a single lower door immediately below the sliding doors to be opened with the upper doors for low level boarding. A staircase extends from the lower door opening in the side of the car to an opening at floor level in the entranceway of the car, the latter opening being covered by a hinged trap door during high level boarding.

One problem with this system has been the hinged trap door, which requires that an extraordinarily large area in the entranceway be kept clear to permit changing from low to high level boarding. Furthermore, the trap door is at best clumsy and difficult for one man to operate, and is not readily adaptable to automated operation. Another problem with this system is that the lower door requires a complex retraction mechanism which retracts through an open riser in the staircase to a storage location beneath the staircase. In its retracted position, this mechanism is exposed to weather and possible damage by boarding passengers because no provision is made for closing the open riser.

Accordingly, it is a general object of the present invention to provide a new and improved door system for railway passenger cars which permits boarding at both high and low platform levels.

It is a more specific object of the present invention to provide a door system for railway passenger cars wherein the selection of high or low boarding platform heights can be accomplished automatically.

It is a still more specific object of the present invention to provide a door system for railway passenger cars wherein the mechanism is fully enclosed and does not interfere with adjacent space within the railway car.

BRIEF DESCRIPTION OF THE DRAWINGS

The features of the present invention which are believed to be novel are set forth with particularity in the appended claims. The invention, together with further objects and advantages thereof, may best be understood by reference to the following description taken in connection with the accompanying drawings, in the

several figures of which like reference numerals identify like elements, and in which:

FIG. 1 is a fragmentary perspective view of a railway passenger car incorporating a door system constructed in accordance with the invention;

FIG. 2 is a perspective view of the door system and its associated boarding area in a position to accommodate high level boarding platforms;

FIG. 3 is a perspective view of the door system and its associated boarding area in a position to accommodate low level boarding platforms;

FIG. 4 is a fragmentary sectional view taken through the door and adjacent boarding area of the railway car showing the doors of the door system in a fully closed position;

FIG. 5 is a fragmentary sectional view taken through the doors and adjacent boarding area of the railway car showing the lower door in a partially open position;

FIG. 6 is a fragmentary sectional view taken through the doors and adjacent boarding area of the railway car showing the lower door fully retracted and the door system in position to accommodate a low level boarding platform;

FIG. 7 is a side view, partly in section, of the stairwell of the door system and the underlying mechanism for retracting the lower door;

FIG. 8 is a cross-sectional view of a portion of the sectionalized retractable floor panel of the door system showing its engagement with a guide channel;

FIG. 9 is a cross-sectional view of a portion of the segmented sliding floor panel of the door system showing its engagement with the floor of the car; and

FIG. 10 is a cross-sectional view of the sectionalized retractable door panel of the door system showing its engagement with the threshold plate carried by the lower door.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to FIG. 1, a railway passenger car 10 is illustrated as having a sidewall 11 in which the door system 12 of the present invention is mounted to permit ingress and egress of passengers from an adjacent boarding platform. More particularly, the door system 12 includes a pair of sliding upper doors 13 and a multi-section lower door 14. The upper sliding doors 13 are so aligned as to tightly close an upper door opening 15 while in their extended positions, and the lower door is so aligned as to close a lower door opening 16 while in its extended position. In both cases the upper and lower door openings are closed substantially flush with the sidewall 11 of the railway car.

Referring now to FIG. 2, the door system of the invention is shown in a position for accommodating a high level platform, the two sliding upper doors 13 being in their open position wherein they are stored in respective ones of two slot-shaped pockets on either side of the entranceway to the railway car. Suitable door operators 17 are provided for sliding the upper doors between their open and closed positions, these operators normally operating simultaneously and being controlled by the same control circuit. Door operators 17 are operatively connected to the upper door sections by means of an appropriate linkage, such as the oscillating drive arms 18 and connecting rods 19 shown in FIG. 2. While a two section sliding door has been illustrated, it will be appreciated that a single-section

sliding door could also be employed. Furthermore, while sliding doors are preferred because of the obvious ease with which they can be incorporated into a railway car, other types of doors such as a multi-sectioned accordion-type door could be employed.

The lower door 14, enclosing the lower door opening 16, also encloses the lower end of a staircase 20 located in a stairwell 21 adjacent the lower door opening 16. The upper end of the staircase 20 commences at the floor 22 of the car and is selectively closable by a segmented sliding floor section 23. This floor section, in its closed position as shown in FIG. 2, forms a continuation of the floor 22 to permit high level platform boarding. Floor section 23 terminates at its outer edge slightly inside of the sliding doors 13, thereby enabling it to be opened enroute while the sliding doors and the lower door are in their closed positions.

In accordance with the invention, and with reference to FIG. 4, the retractable floor section 23 is seen to comprise a plurality of transversely extending slat-like segments 24 which extend across the top of the stairwell 21. These slat sections are joined together by means of elongated coupling members 25 disposed between the slat members and extending along their entire length. Referring to FIG. 9, these coupling members are of generally bone-shaped cross section being formed of generally flat strip-like members having cylinder-like enlargements at either end. These enlargements are received by complementarily shaped recesses extending the entire length of the adjacent slat members 24, thereby effectively coupling the slat members together in side-by-side relationship while retaining a large degree of freedom in relative movement. The slat members 24 are preferably formed of extruded aluminum or similar light-weight high strength material and the coupling members 25 of extruded neoprene or similar flexible material.

The slat sections 24 are constrained to reciprocate along an operating path overlying stairwell 21 by means of a guide channel 26 disposed in opposed relationship on either side of the stairwell. Referring to FIG. 8, these guide channels are preferably constructed of a high strength material such as steel and are set into the side-walls 27 of the stairwell with sufficient depth to accommodate the slat members 24 and the weight of passengers standing thereon without undue flexing or distortion. Furthermore, these guide channels are preferably designed to provide minimum friction to the slat sections as they are extended or retracted, as by incorporating a teflon coating 28 or similar friction reducing means either at the ends of the slat sections or in the guide channel itself.

Referring again to FIG. 9, the slat-like door sections 24 are seen to have a substantially flat top surface 29 and a toothed bottom surface 30. The top surface may be covered by a floor mat 31, which preferably is manufactured of rubber or other flexible water-proof material and has a slip-resistant top surface similar to that of the car floor 22. This mat preferably extends the entire length of the retractable floor section 23, and may be removably fastened to the slat sections thereof by means of one or more machine screws 32.

As shown in FIG. 4, retractable floor section 23 is preferably extended and retracted by actuating means in the form of one or more toothed drive wheels 33 which engage the toothed bottom surfaces 30 of slat segments 24. In this respect, the teeth on the bottom

surfaces may extend as grooves along the entire length of the slat members, or alternately only along those portions of the slats intended to engage the drive wheels 33. While it is contemplated that the retractable floor section be driven by means of drive wheels at both edges to prevent undesirable torsional forces, it would also be possible to utilize a longitudinally grooved drive roller engaged to the slats along their entire length.

Drive wheel 33 is rotationally coupled by means of a conventional V belt and pulley arrangement or a sprocket and chain drive 34 to a bidirectional motor 35. Suitable control circuitry is provided to control the direction of rotation of motor 35 so that the floor section can be extended and retracted at will by means of a single drive mechanism. While not shown in FIG. 4, it is contemplated that limit switches would be positioned adjacent the floor section so as to be actuated at the extended and retracted extremes of its travel. These switches would serve, in conjunction with appropriate control circuitry, to terminate the operating cycle of the floor section by removing power to motor 35.

In the present embodiment two drive wheels 33 mounted on a common axle 36 are utilized to drive the floor portion between its closed and open positions. Referring to FIG. 7, the drive wheels are disposed at opposite edges of the retractable floor section and the inter-connecting axle 36 is located beneath staircase 20 so as to present no exposed mechanism which could effect reliability or present a hazard to passengers. Axle 36 preferably carries a coil spring 37 which has one end attached to the axle and its other end attached to the framework of the passenger car. The spring rotationally biases axle 36 in a counter-clockwise direction to offset the weight of the movable floor portion and thereby reduce the effort necessary in moving the floor section from its retracted to its extended position.

As can be seen in FIG. 9, the forward edge of retractable floor section 23 contains an end cap 38. This end cap is affixed to the front slat-member by machine screw 32, and cooperates with that machine screw in retaining mat 31 securely in position. End cap 38 is shaped to obtain a smooth transition between the floor 22 of the car and the first riser 39 of staircase 20 when floor section 23 is retracted. When the floor section is extended, as in FIG. 10, the same end cap is received by a complementarily-shaped recess 40 on a threshold plate 41 carried by the upper edge of the lower door 14. In this way the slidable floor portion, unlike previously used trap door type floor panels, can be made to provide a tight weather-proof passageway in both its retracted and extended positions.

In accordance with another aspect of the invention, lower door 14 is laterally segmented for retraction to a storage position beneath staircase 20. Referring again to FIG. 4, the lower door 14 is seen to comprise three sections or panel members 42, 43 and 44. It could comprise a greater or lesser number of panels, depending on the contour of the car and other design considerations. These panels are joined by means of hinges at their adjacent edges and are sized so that they together seal off the entire lower door opening 16 of the railway car. The three door panels are guided along a defined operating path and into a stored position beneath staircase 20 by means of guide channels 45 and 46 disposed in opposed relationship on either side of stairwell 21, in a manner similar to guide channel 26. Movement of

the door sections is guided by a trio of roller-followers 47, 48 and 49 which engage guide track 45, and a single roller 50 which engages guide track 46. The guide tracks 45 and 46 extend through an aperture provided in the lowermost riser 51 of staircase 20 and into an upwardly arcuate storage position beneath the staircase.

The path of movement of the door during the retraction process is best illustrated by reference to FIGS. 5 and 6, which show the door in intermediate and retracted positions, respectively. Initially, lowermost panel 44 of the door swings inwardly and slightly upwardly, while its upper end remains essentially stationary and pivots about roller 49. From that point, panel 44 takes an essentially arcuate path downwardly and rearwardly until it is wholly within the compartment formed beneath staircase 20. By reason of the pivotal connection between panel 44 and panels 43 and 42, the upper two panels are forced to follow behind panel 44 and thus are also drawn into the compartment formed beneath the staircase.

Threshold plate 41 is attached to the top edge of door panel 42 by means of a plurality of bolts 52 or other appropriate means. As we have seen, during high level boarding this threshold plate coacts with retractable floor section 23 in forming a solid weather-tight floor surface. In so doing, it effectively extends floor 22 beyond retractable floor section 23, thus serving as a filler for the dangerous gap which would otherwise exist between the end of the extended floor section and a high level station platform. Threshold plate 41 also serves as a support for sliding doors 13. To this end it is provided with a guide track 54 which slidably receives rollers or slide bars 55 carried on the bottom edges of sliding doors 13. When lower door 14 is in its closed position, the guide track 54 forms a continuation of a similar track contained in the door pockets on either side of the upper door opening 15 providing additional lateral support for the bottoms of the doors to resist displacement in transit.

During low level boarding threshold plate 41 further functions as a riser panel to seal the aperture provided in the bottom riser 51 of staircase 20 for retracting the lower door 14. This can be best seen by reference to FIG. 6, wherein the three panels of the door have been fully retracted and stored beneath staircase 20. While not shown, suitable weather seals would be provided about the aperture in riser 51 to form a weather-tight seal with threshold plate 41. Suitable weather seals would also be provided on the door panels 42, 43 and 44 and around the lower door opening 16. The profiles of the guide tracks 45 and 46 are such as to cause the lower door 14 to retract away from the seals when opening and to progressively apply sealing force from top to bottom when closing, as the top sections 42 and 43 move vertically to almost full height and the lower section 44 pivots about the lower edge of section 43 outward into a fully closed position.

In their closed position the three panels of the lower door essentially rest against the lowermost stairstep 53 so that the weight of a passenger stepping on threshold plate 41 is effectively translated to the car structure through the vertically aligned door sections 42, 43 and 44 as they bear against the stairstep 53. At this point the upper roller-followers 47, 48 and 49 are arranged in a nearly vertical portion of guide channel 45 and therefore tend to resist any outward displacement of

the door panels caused by the weight of a passenger on the threshold plate. Furthermore, the essentially vertical alignment of guide track 45 prevents the lower door from extending beyond the car outline during opening and closing operations, thereby permitting operation with the car closely adjacent to a boarding platform or similar structure. The inside surface of the lower door section 44 may be curved at its bottom end to prevent a passenger waiting to exit from stepping onto the bottom stairstep 53 prior to retraction of door 14.

The actuating means for operating the lower door 14 between open and closed positions includes a reversible electric motor 56 and appropriate gearing for imparting power to an output shaft 57. This shaft may be rotationally coupled at either end by belt and pulley arrangements 58 to shafts 59 to which a pair of crank arms 60 are mounted. The outer ends of crank arms 60 may be pivotally connected to the bottom edge of door panel 44 by connecting arms 61 which may be adjustable in length to accommodate variations in the mechanism and door 14.

As mentioned previously, retractable floor section 23 is provided with electrical interlock switches for limiting its travel between extended and retracted positions. The same switches can be utilized to interlock the operation of lower door 14 such that it can be retracted only when the retractable floor section is fully retracted. An intermediate position of the movable door section would preclude operation of either the upper doors 13 or the lower door 14.

While the stairwell is shown to be wide enough only for a single column of passengers, it will be appreciated that it could be made wider, if desired. Furthermore, while a conventional electric door operating mechanism is shown for operating the doors, a fluid motor of the pneumatic or hydraulic type could be utilized instead.

While a particular embodiment of the invention has been shown and described, it will be obvious to those skilled in the art that changes and modifications may be made without departing from the invention in its broader aspects, and, therefore, the aim in the appended claims is to cover all such changes and modifications as fall within the true spirit and scope of the invention.

This invention is hereby claimed as follows:

1. In a railway passenger car having a floor, sidewalls and a ceiling, a bilevel boarding door system comprising:

- an upper door opening in one of said sidewalls terminating at the level of said floor;
- an upper door having open and closed positions for selectively closing said upper door opening;
- a lower door opening extending downwardly from said floor level to a predetermined low level platform boarding height;
- a lower door having open and closed positions for selectively closing said lower door opening;
- a stairwell having a staircase extending downwardly from a floor level opening inside said car to said lower door opening;
- a slidably mounted floor panel comprising a plurality of pivotally-coupled slat-like elements transversely suspended between said guide channels;
- means comprising a pair of complementary guide channels disposed on opposite walls of said stairwell, for defining an operating path for said floor

panel between an extended position overlying said floor level opening and a retracted position clear of said opening; and

actuating means for extending said panel along said operating path and into said extended position to enable high platform boarding when said upper door is open, and for alternately retracting said floor panel along said operating path and into said retracted position to enable low platform boarding when said upper and lower doors are open.

2. A door system as defined in claim 1 wherein at least a portion of the bottom surface of said slat-like members is longitudinally grooved, and wherein said actuating means comprise at least one toothed drive wheel disposed to coact with said grooves.

3. A door system as defined in claim 2 wherein said actuating means comprise two drive wheels disposed perpendicular to said floor and adjacent respective ones of said guide channels.

4. A door system as defined in claim 3 wherein said slat-like elements include a guide roller at either end in operative engagement with respective ones of said guide channels.

5. A door system as defined in claim 1 wherein said slat-like members have longitudinally extending slots along either edge and are coupled together by longitudinally extending coupling members engaging adjacent ones of said slots.

6. In a railway passenger car having a floor, sidewalls and a ceiling, a bi-level boarding door system comprising:

an upper door opening in one of said sidewalls terminating at the level of said floor;

an upper door having open and closed positions for selectively closing said upper door opening;

a lower door opening extending downwardly from said floor level to a predetermined low level platform boarding height;

a stairwell including a staircase therein extending downwardly from an upper opening inside said car at said floor level to a lower opening in said sidewall at said predetermined low level platform boarding height, said stairwell being substantially aligned with said lower door opening;

a lower door comprising a plurality of pivotally-connected panels extending transversely across said lower door opening;

means defining an operating path for said door panels between a closed position flush with the exterior surface of said sidewall, and an open position underlying said staircase; and

actuating means for extending said door panels along said operating path into said closed position to enable high platform boarding, and for alternately retracting said panels along said operating path into said open position to enable low platform boarding.

7. A door system as defined in claim 6 wherein said means for defining an operating path for said lower door panels comprise complementary guide channels disposed on opposite walls of said stairwell, and wherein said door panels are suspended between said guide channels.

8. A door system as defined in claim 7 wherein said means for defining an operating path for said lower door panels comprise first and second pairs of guide

channels disposed on either side of said stairwell, and wherein said lower door comprises first, second and third panel members, the top edge of said first panel member and the pivotal connections between said first, second and third panel members being operatively engaged with said first pair of guide channels, and the bottom edge of said third panel member being operatively engaged with said second pair of guide channels.

9. A door system as defined in claim 8 wherein said actuating means comprise a rotary actuator, and a linkage assembly connected between said actuator and said third door panel.

10. A door system as defined in claim 7 wherein said upper door comprises a sliding door, said lower door comprises first, second and third panel members, said first panel member includes a threshold plate along its top edge, and said threshold plate includes a guide track for guiding and supporting said sliding door along its bottom edge.

11. A door system as defined in claim 6 wherein said staircase includes an aperture through which said lower door retracts when moving along said operating path to said open position, and wherein said threshold plate effectively closes said aperture when said lower door is in said open position.

12. A door system as defined in claim 11 wherein said aperture is disposed in the bottom riser of said staircase.

13. In a railway passenger car having a floor, sidewalls and a ceiling, a bi-level boarding door system comprising:

an upper door opening in one of said sidewalls terminating at the level of said floor;

an upper door having open and closed positions for selectively closing said upper door opening;

a lower door opening extending downwardly from said floor level to a predetermined low level platform boarding height;

a lower door comprising a plurality of elongated pivotally-connected panels extending transversely across said lower door opening;

a stairwell having a staircase extending downwardly from a floor level opening inside said cars to said lower door opening;

means defining an operating path for said door panels between a closed position flush with the exterior surface of said sidewalls, and an open position underlying said staircase;

actuating means for extending said door panels along said operating path into said closed position for high platform boarding and for alternately retracting said panels along said operating path into said open position for low platform boarding;

a slidably mounted floor panel;

means defining an operating path for said floor panel between an extended position overlying said floor level stairwell opening and a retracted position clear of said opening; and

actuating means for extending said panel along said operating path and into said extended position for high platform boarding, and for alternately retracting said floor panel along said operating path and into said retracted position for low platform boarding.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,795,205 Dated March 5, 1974

Inventor(s) Ralph A. Gritchen et al

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

In column 6, line 28, "door" should be --floor--.

Signed and sealed this 17th day of September 1974.

(SEAL)
Attest:

McCOY M. GIBSON JR.
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents