The present invention relates to sliding door arrangements. More particularly, the present invention relates to sliding door arrangements of the type which are used, for example, on railroad cars. Sliding door arrangements of this type include a pair of doors which are located in a common plane when they are closed. Either one of the doors may be swung outwardly from this common plane for movement to an interim position overlapping the other door, and when a rear end of such a door is turned during the swinging thereof, this end of the door is not supported by a rail or the like so that upon failure of the opening mechanism serious accidents can occur.

One of the objects of the present invention is to provide a sliding door arrangement of the above type which is composed of simple rugged elements which will withstand the rough handling necessitated by railroad cars. Another object of the present invention is to provide a sliding door arrangement of the above type which includes only a single rail which is used by both of the doors.

Another object of the present invention is to provide a structure which will safely and reliably guide a heavy door of the above type at all times irrespective of whether the door is in its closed position or in its open position or is being moved between its open and closed positions.

It is also an object of the present invention to provide a sliding door arrangement of the above type with a releasable locking structure capable of locking the doors in such a way that it is impossible for either of the doors to become accidentally unlocked while at the same time providing for easily and conveniently locking and unlocking of the doors.

The objects of the present invention also include the provision of a sliding door arrangement which makes it impossible for either of the doors to become derailed from the rail which supports the doors for movement between their open and closed positions.

With the above objects in view, the present invention includes a sliding door arrangement a substantially vertical frame means and an elongated substantially horizontal rail carried by the frame means.

An elongated door has an inner closed position where the door engages the frame means and is located inwardly of the rail. A moving means is carried by the frame means and cooperates with the door for moving the same outwardly from its closed position to an outer position nearer to the rail, and a rail engaging means is carried by the door for cooperation with the rail to support the door on the rail for movement therealong to an open position wherein the door uncovers a space which it occupied when it was in its closed position.

The novel features which are considered as characteristic for the invention are set forth in particular in the appended claims. The invention itself, however, both as to its construction and its method of operation, together with additional objects and advantages thereof, will be best understood from the following description of specific embodiments when read in connection with the accompanying drawings, in which:

FIG. 1 is a partly schematic and partly broken away perspective view of a railroad car provided with the sliding door arrangement of the present invention;

FIG. 2 is a schematic, partly sectional, side elevational view illustrating the structure which cooperates with a door during the initial movement thereof from its closed to its open position;

FIG. 3 is a fragmented partly sectional transverse elevational view showing the manner in which part of one door cooperates with the other door to participate in the guiding thereof during its movement between its open and closed positions, the structure shown at the upper right of FIGURE 3 being located in a plane which is substantially in advance of the plane in which the structure at the lower portion of FIG. 3 is located;

FIG. 4 is a fragmented partly sectional schematic plan view illustrating the operation of the structure of the invention during the initial movement of a door from its closed toward its open position;

FIG. 5 is a sectional view of a plate which forms part of the structure of the invention, FIG. 5 being taken along lines V—V of FIG. 4 in the direction of the arrows; FIG. 6 is another sectional view of the plate of FIG. 5, FIG. 6 being taken along line VI—VI of FIG. 4 in the direction of the arrows;

FIG. 7 is still another sectional view of the plate of FIG. 5, FIG. 7 being taken along line VII—VII of FIG. 4 in the direction of the arrows;

FIG. 8 is a fragmented sectional elevational view of part of the guide structure of the invention, FIG. 8 being taken along line VIII—VIII of FIG. 4 in the direction of the arrows;

FIG. 9 is a fragmented elevational view showing the lock structure of the present invention as well as the turning means for participating in the turning of the door from its closed toward its open position;

FIG. 10 is an end view of the structure of FIG. 9 as seen from the left side of FIG. 9, part of the door of FIG. 9 being shown in section in FIG. 10;

FIG. 11 is a fragmented sectional plan view of the lock and turning structure of FIGS. 9 and 10, FIG. 11 being taken along line XI—XI of FIG. 10 in the direction of the arrows;

FIG. 12 is a side elevational view of the sliding door arrangement of the present invention, FIG. 12 being partly schematic;

FIG. 13 is a partly sectional plan view illustrating the structure which cooperates with the upper part of a door of the invention during movement of the door initially from its closed toward its open position;

FIG. 14 is a sectional plan view of an outer end portion of a door of the invention showing how this door cooperates with a stationary frame member;

FIG. 15 is a fragmented sectional elevational view showing the rail engaging means at one end of the door of the invention and how this rail engaging means cooperates with a rail, FIG. 15 showing in solid and dot-dash lines the different positions which the structure takes during different positions of the doors;

FIG. 16 is a fragmented sectional elevational view taken along line XVI—XVI of FIG. 12 in the direction of the arrows and showing the rail engaging means at the end of the door opposite from that shown in FIG. 15;

FIG. 17 is a longitudinal sectional elevational view of a part of the rail of the invention which is formed with a recess at its upper edge;

FIG. 18 schematically illustrates the doors in their closed positions;

FIG. 19 schematically illustrates the position which
the parts of FIG. 18 take when the left door of FIG. 18 has been initially moved toward its open position; and FIG. 20 shows the position which the doors take when the left door of FIGS. 18 and 19 has been moved to its open position.

FIG. 1 of the drawings shows a railroad car provided with the sliding door arrangement of the present invention, and this railroad car includes a vertical frame means made up of an elongated lower horizontal frame member 3, the pair of end vertical frame members 4, the central vertical intermediate frame member 5, an upper horizontal frame member 7, an upper transverse frame member 8, and the end walls 9 of the railroad car. The frame members 3, 4, 5, 7, and 8 are all interconnected with each other, as by being welded together, and these members cooperate together to form a vertical frame means of the structure of the invention. This structure includes the doors 19 and 19a shown in FIG. 1, and when these doors are in their closed position illustrated in FIG. 1, they are in a common vertical plane with the vertical frame member 5 located between and engaging the inner ends of the doors which are located next to the vertical frame member 5, while the outer ends of the doors 19 and 19a cooperate with the end frame members 4 when the doors 19 and 19a are in their closed position illustrated in FIG. 1. The railroad car illustrated in FIG. 1 includes a plurality of roof members 20 which may be longitudinally slidably, if desired, so that one-half of the car may be completely opened. The structure which supports the roof members 20 for movement between their open and closed positions does not form part of the present invention.

The vertical frame members 4 and 5 are preferably in the form of elongated hollow bars of rugged constructions. The cross sectional configurations of one of the end frame members 4 is apparent from FIG. 14. As may be seen from FIG. 14 each vertical frame member 4 has a wall 10 located in a vertical plane parallel to the door 19 or 19a in order to engage the same as to provide the necessary sealing as well as to receive the force of the load which may act against the door to urge the same outwardly. The left end of the door 19, as described in FIG. 14, fixedly carries a vertical hollow tubular member 100 of substantially triangular cross section, and this member 100 extends into a labyrinth formed by the vertical frame member 4 in the manner illustrated in FIG. 14. The doors 19 and 19a are of identical construction and are symmetrically arranged with respect to the vertical frame member 5, and in the description which follows only the door 19 and the structure cooperating therewith will be described. It is to be understood, however, that the identical structure cooperates with the door 19a, and as may be seen from FIGS. 1 and 12, the structure is arranged symmetrically with respect to the vertical frame member 5 so that the structure on one side of the frame member 5 is a mirror image of the structure on the other side of the frame member 5.

As will be apparent from the description which follows, the door 19 when it is in its closed position is in the solid line position indicated in FIG. 14. During movement from its closed to its open position and just before the door 19 reaches its closed position it will first be located to the left of the solid line position indicated in FIG. 14 so that the member 100 will assume the dotted line position indicated in FIG. 14. As may be seen most clearly in FIG. 11, the central vertical frame member 5 is made up of a base plate 12 to which a front strengthening plate 13 is fixed as by being welded thereto, this front plate 13 extending vertically along the entire length of the frame member 5.

Referring now to FIGS. 14, 15, and 16, it will be seen that the front frame member 7 includes an elongated plate 16 which extends along the entire length of the car and which is provided with a stiffening corrugation 101. At its inner edge plate 16 is fixed to plate 17, and a plate 18 is fixed to the plates 16 and 17 as indicated in FIGS. 15 and 16. Along substantially its entire length the plate 18 has the width indicated in FIG. 18. However, to wards its ends, the width of the plate 18 diminishes, and at its ends the plate 18 has the width shown in FIG. 16. Thus, next to the vertical frame members 4 and 5 the plate 18 has the width indicated in FIG. 16, and this plate gradually widens to the width shown in FIG. 15, the plate 18 having the largest part of its length extending between each post 4 and the center post or frame member 5.

Along its outer edge the plate 16 has a downwardly directed flange shown at the left of FIGS. 15 and 16, and the rail 26 is fixedly carried by this flange of the plate 16, this rail 26 extending along the entire length of the vertical frame means. If desired the rail 26 may be formed integrally with the plate 16. The plate 17 fixedly carries at its top end a rail 102 which cooperates with the shelfable roof members 20' in a manner which does not form part of the present invention.

As may be seen from FIG. 1, each of the doors 19 and 19a is strengthened along its upper edge by a hollow tubular member 20 and along its lower edge by a hollow tubular member 21. The upper member 20 of each door carries the rollers 47 illustrated in FIG. 1 which means respectively located adjacent the opposite ends of each door at the upper part thereof. Each of these rollers is turnably supported by a bearing block 103 which forms part of the rail engaging means. As may be seen from FIG. 15, the bearing block 103 includes a front downwardly extending portion 104 and a rear downwardly extending portion 105 between which the roller 48 in the case of FIG. 15 is located. It will be noted from FIG. 16 that the roller 47 is carried by a similar bearing means. The inner or rear downwardly extending portion 105 of the bearing block 103 is directed downwardly beyond the rail 26, and is provided at its bottom end with an outwardly directed flange 106 which is fixedly connected with a vertically extending pin 107 which extends turnably through a tube carried by the member 20 in the manner shown in FIG. 15. The nut 108 prevents axial movement of the pin 107 with respect to the door 19, while at the same time this pin 107 is turnable about its axis with respect to the door 19, so that the rail engaging means including the block 103 and the roller 47 or 48 carried thereby is capable of turning with respect to the door for a purpose described below. As will be apparent from the description which follows, the bearing block 103 which carries the roller 48, the flange 106 fixedly carries at its top surface a spacer member 109 which is spaced at a predetermined distance below the bottom face 118 of the rail 26 for a purpose described below.

As is indicated in FIGS. 1 and 12, the rail 26 extends parallel to the doors 19 and 19a, when the latter are in their closed position shown in FIG. 18, throughout most of the length of the rail 26. However, adjacent to its ends, the rail 26 has portions 52 which are inclined inwardly toward the doors 19 and 19a when they have the position indicated in FIG. 18, and beyond these portions 52 the rail 26 is located substantially in the same plane as the doors 19 and 19a. Therefore, when the door 19 moves from the position of FIG. 18 to that of FIG. 20, the bearing means 48, 103 is enabled to move along the inclined portion 52 of the rail 26 as a result of the turning movement of the pin 107 provided by the cooperation of the pin 107 with the member 20.

As may be seen from FIGS. 1, 12 and 9, an elongated rod 28, one such rod being provided for each door, extends vertically adjacent and parallel to the vertical frame member 5. This rod 28 is supported by member 5 of the vertical frame member for turning movement about its axis. For example, the bottom frame member 3 may fixedly carry a thrust bearing which supports the rod 28 at its bottom end in such a way that this rod 28 can turn about its axis but cannot move axially. Also, as is shown
in FIG. 9, the frame member 5 fixedly carries bearings 61 which guide the rod 28 for turning movement about its axis, and a suitable collar may be fixed to the rod 28, as by a pin passing transversely through the collar and the rod 28, and this collar may rest on the top face of the upper bearing 61 shown in FIG. 9 so as to participate in the support of the rod 28 while freeing the same for turning movement about its axis.

This rod 28 fixedly carries adjacent its lower end a plate 63 shown in FIGS. 4-7. This plate 63 is of substantially triangular configuration, as is apparent from FIG. 4, and actually this plate 63 has the configuration of an equilateral triangle except for the right-hand corners of the plate 63 shown in FIG. 4. The rod 28 passes through an opening of the plate 63 and is keyed to the latter by a key 64 so that the plate 63 is compelled to turn with the rod 28. The plate 63 is fixed to the rod 28 so as to be immovable with respect thereto in any suitable way as by fixing to the rod 28 the collar 62 (FIG. 3) which is located directly beneath the plate 63 in engagement with the latter.

This plate 63 is formed adjacent its left end, as viewed in FIGS. 4 and 7, with a first upwardly directed recess 66 which forms part of a sphere. Also, the plate 63 is formed with a second upwardly directed elongated recess 65 which extends from the recess 66 to the right, as viewed in FIGS. 4 and 7, up to the periphery of the plate 63. The surface of the recess 65 forms part of a cylinder, so that the recess 65 extends radially from the recess 66 which forms part of a sphere. For a purpose which is described below the recess 66 has a depth which is slightly greater than the recess 65. For example, the recess 66 may be 3-5 millimeters deeper than the recess 65. As is apparent from FIG. 2, the surface of the recess 65 is inclined downwardly to the right, as viewed in FIG. 2, for a purpose described below, and the right end of the recess 65, as viewed in FIG. 2, may be, for example, 8 mm. lower than the left end of the recess 65. The recess 66 is 3-5 mm. deeper than this left end of the recess 65, as is apparent from FIG. 2.

The plate 63 includes a straight rib 67 which extends along the recess 65 for a purpose described below, and this rib 67 terminates short of the recess 66. The plate 63 is formed at the center of the recess 66 with a vertical bore 68 so that rain water, for example, cannot accumulate in the recess 66. The rod 28 together with the plate 63 forms part of the turning means for moving the door 19 as its right end, as viewed in FIGS. 18 and 19, from the position of FIG. 18 to that of FIG. 19 as well as back from the position of FIG. 19 to that of FIG. 18. As may be seen from FIGS. 2 and 3, a rigid member 69 is fixed to and extends angularly from a lower portion of the door 19, and at its bottom end the member 69 has an inwardly directed portion 70 which turnably supports a roller 71 whose outer surface forms part of a sphere. The roller 71 is a sphere except for its opposite flat side faces, and also this roller 71 is formed with an annular groove 72 for a purpose described below. The radius of curvature of the exterior surface of the roller 71 is substantially the same as the radius of curvature of the surface of the recess 66 but slightly smaller than the radius of curvature of the elongated recess 65. It will be noted from FIG. 3 that the roller 71 can turn only about the axis of the portion 70 of the member 69. This roller 71 rests on the plate 63 in the recess 66 thereof when the door 19 is in its closed position as well as during initial movement of the door 19 toward its open position, so that the rod 28 and the plate 63 serve to support the door 19 at its right end, as viewed in FIGS. 18 and 19, when the door 19 is in the position of FIGS. 18 and 19.

The door 19 is shown to the right of the door 19 in FIG. 3, and both of these doors are provided with a downwardly extending free edge portion 73 at their lower portions, this edge portion 73 cooperating with the roller 71 in a manner described below. As may be seen from FIG. 8, a plate 74 is fixed to the exterior surface of the vertical frame member 5, and this plate 74 fixedly carries a guide strip 75 which has a bottom edge which also cooperates with the roller 71 as described below. The bottom guiding edge of the strip 75 is aligned with the bottom edges 73 of the doors 19 and 19a when these doors are in their closed position illustrated in FIG. 18.

Referring now to FIG. 11, it will be seen that the right edge of the door 19 is formed by an elongated, vertically extending profiled member 89 having an inner flange 88 and an outer vertical flange 90 which is curved inwardly at 91. The base plate 12 of the frame member 5 is profiled at its left edge so as to have the vertical flange 92 directed toward the web of the member 89, and at its left edge the plate 12 is formed with a groove 93 which receives the flange 88 when the door 19 is in the closed position shown in FIG. 11. Moreover, the flange 90 engages the free edge of the flange 92 with the edge 91 extending slightly to the rear of the free edge of the flange 92, so that a sealed enclosure is provided in the manner shown in FIG. 11.

The turning means for turning the right end of the door 19, as viewed in FIGS. 18 and 19, from the position of FIG. 18 to that of FIG. 19 includes in addition to the rod 28 and the plate 63, the plate 76 shown in FIGS. 9 and 11 fixed to the rod 28 between the bearings 61. This plate 76 is, for example, 8 mm. lower than the recess 65. A handle 79 has a bifurcated portion 80 pivotally connected to the plate 76 by the pivot pin 77 so that the handle 79 is vertically turnable, and the operator may engage the handle 79 to turn the latter together with the plate 76 and the rod 28.

A locking structure is provided for retaining each door in its closed position, and this locking structure includes a downwardly projecting portion 80 of the handle 79. When the handle 79 is in the position shown in FIG. 9, the projection 88 extends downwardly through an opening of a plate 83, the parts 83 and 84 forming an eye which is fixed as by welding, for example, to the exterior surface of the door 19. The door 19, further, fixedly carries on top of the portion 21 thereof a vertical bar 82 fixed in the manner shown in FIG. 10 to the upper portion of member 21 and to the lower surface of the plate 83 so as to form a handle by which the operator may longitudinally shift the door. Also, the door 19 fixedly carries just above the plate 83 a plate 85 located in a vertical plane perpendicular to the plate 83, and at its top end the plate 85 carries a pivot pin 86 extending through bores of a bifurcated portion of a latch member 87 which by gravity will turn down to the position indicated in FIGS. 9, 10 and 10 where the latch member 87 is located directly over the handle 79 to prevent upward turning thereof until the operator first has turned the latch member 87 upwardly to the dot-dash line position indicated in FIG. 10. Thereafter, the operator may turn the handle member 79 in a clockwise direction about the pivot pin 77, as viewed in FIG. 9, so as to move the projection 88 upwardly out of the eye 83, 84, and then the handle member 79 together with the plate 76 may be turned outwardly away from the door 19 so as to turn the rod 28 in a clockwise direction, as viewed in FIG. 4.

When the handle member 79 is in the position indicated in FIG. 9, a bore 81 of the projection 80 is aligned with another bore of the handle member 82 so that a padlock may be passed through these aligned bores in a simple and convenient manner to reliably lock the door so as to prevent upward movement of the handle 79 until the padlock is removed, or, if desired, a lead sealing wire may be passed through the aligned openings 81.

At approximately the elevation of the lower bearing 61 of FIG. 9, the vertical frame member 5 fixedly carries a plate 94 shown in FIG. 11, and when the plate 76 has been turned to the dot-dash line position indicated in FIG. 11, the handle 79 may be allowed to turn down so that it hangs vertically from the plate 76 in the space.
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95 defined between the strengthening plate 13 and the stop member 94, as is apparent from FIG. 11. When the handle member 79 hangs down in this space 95, it is clear that the path of movement of the door 19 and will not in any way interfere with the movement of the door 19 between the positions thereof indicated in FIGS. 19 and 20.

As may be seen from FIGS. 12 and 13, the rod 28 is fixedly carries adjacent its top end a rigid projection 110 which is fixed to the rod 28 as by being welded thereto, and the outer free end 111 of the member 110 engages either directly with the inner surface of the door 19 at the edge portion 88 thereof, or, as shown in FIG. 13, the edge portion 88 may fixedly carry a small plate 112 which is in direct engagement with the edge 111. When the rod 28 is turned the projection 110 turns between the solid and dot-dash line positions indicated in FIG. 13, and the vertical frame member 5 is provided at the elevation of the member 110 with a suitable cutout into and out of which the member 110 may freely move. This member 110 cooperates with an upper portion of the door 19 at its edge next to the vertical member 5, so as to guide this upper portion of the door 19 and so as to maintain it in alignment with the lower portion of the door 19 at its right end, as viewed in FIG. 13. During the movement of the door between its positions shown in FIGS. 19 and 20, the inner face of the door 19 is in continuous engagement with the member 110, so that the latter prevents inward movement of the upper portion of the door 19, except when the rod 28 is turned in a clockwise direction, as viewed in FIG. 13, to return the member 110 to the solid line position thereof indicated in FIG. 13.

As may be seen from FIG. 12, the rail 26 is formed in the region of the vertical member 5 with a pair of recesses 114 and 115 formed in the upper surface of the rail 26. These recesses 114 and 115 may have a depth a indicated in FIGS. 15-17 which is on the order of 5 mm., for example. When the doors 19 and 19a are in their closed position, these recesses 114 and 115 are aligned with the pair of rail engaging means which are carried by the doors 19 and 19a respectively at their inner ends which are next to the vertical member 5, as is apparent from FIG. 12. Thus, as may be seen from FIG. 16, the rail engaging means at the end of each door next to the vertical member 5 can move through the recess 114 in the case of door 19 or the recess 115 in the case of door 19a from a position 119 where the rail engaging means is located over the rail 26 in the manner shown in FIG. 16. FIG. 16 shows the dot-dash lines the position which this part of the door takes when the door is closed. Thus, the plate 63 cooperates with this member 110 to support the door 19 (or the door 19a) at such an elevation that the lower portion 116 of the outer part 104 (FIG. 15) of the block 103 will be able to move through the recess 114 (or the recess 115 in the case of door 19a) without engaging the rail 26.

The above-described structure of the invention operates as follows:

When both of the doors 19 and 19a are in their closed position they will engage the vertical frame means in the manner shown diagrammatically in FIG. 18. At this time the plate 63 has the dot-dash line position indicated in FIG. 4. It will be noted that at this time while the groove 74 of the rail 71 is in a plane which is parallel to the door 19, the rib 67 of the plate 63 extends angularly from the roller 71 and is out of alignment with the groove 72. Moreover, at this time the bottom edges 73 of both of the doors as well as the bottom edge of the guide strip 75 (FIG. 8) are all in alignment.

Assuing that the operator now decides to open the door 19, he will first remove from the openings 81 any padlock or similar device. Then the latch member 87 up to the dot-dash line position indicated in FIG. 10, so that the operator will thereafter be able to turn the handle 79 upwardly to remove the projection 89 from the opening 84 of the eye 83, and with the handle 79 thus engaged in FIG. 11, the operator can turn the handle 79 together with the plate 76 so as to turn the rod 28 and the plate 63 therewith in a counterclockwise direction, as viewed in FIG. 4. This turning will continue until the plate 76 has reached the dot-dash line position indicated in FIG. 11, and it will be noted at this time that the plate 76 has engaged the base plate 12 of the frame member 5, so that the rod 28 cannot be turned further. Then the handle 79 is dropped into the space 95 referred to above. This angular turning of the rod 28 so as to move the plate 63 from the dot-dash line position shown in FIG. 4 along the circle 96 to the solid line position shown in FIG. 4 has resulted in the turning of the right end of the door 19 from the position of FIG. 18 to that of FIG. 19. During this turning of the door 19, the plate 63 has turned with respect to the roller 71 so that when the plate 63 has reached the outer angular position thereof shown in solid lines in FIG. 4, the rib 67 is aligned with the groove 72. The door 19 has been advanced outwards so that the plate 89 at its right end has moved from the dot-dash line position of FIG. 4 to the solid line position indicated in FIG. 4. It will thus be seen that while the edge 73 of the door 19 which is still in a plane parallel to the guide strip 75, the edge 73 of the door 19 has been advanced to a plane in front of the strip 75. The groove 72 will at this time be aligned with the strip 75 as well as with the strip 73 of the door 19a, as indicated in FIG. 3. Thus, during movement of the door 19 to the right from the position of FIG. 19 to that of FIG. 12 during the initial part of this movement be received in the groove 72 to cooperate with the roller 71 for guiding the door 19, and simultaneously a part of the strip 75 will be received in an upper part of the groove 72 to participate in the guidance of the door 19. The operator, during the subsequent movement of the door toward the position shown in FIG. 20, first the strip 75 and then the lower edge of the door 19a will cooperate with the groove 72 of the roller 71 to guide the door 19 at its lower portion.

Also, during this turning movement of the right edge of the door 19, the bearing block 103 which carries the roller 47 has been turned with the door 19 from the dot-dash line position of FIG. 16 to the solid line position of FIG. 16 so that the roller 47 of the door 19 is now located directly over the rail of the door 19. This will be noted that the member 102 is in engagement with the inner surface of the door 19 at its upper portion to maintain the upper part of the door vertically in alignment with the lower portion thereof supported by the cooperation between the roller 71 and the plate 63, so that the member 110 cooperates the proper alignment of the roller 47 over the rail 26, as shown in the solid lines in FIG. 16. The bearing block 103 has moved during this part of the operation to the position 113 indicated in FIG. 13.

As may be seen from the circle 96 of FIG. 4, the swinging of the right edge of the door 19 from the position of FIG. 18 to that of FIG. 19 has resulted first in a slight movement of the door 19 to the left, as viewed in FIGS. 18 and 19, and then in a slight movement of the door 19 back to the right until the plate 63 has the solid line position indicated in FIG. 4. As was pointed out above, the solid and dot-dash line positions of the member 100 shown in FIG. 14 indicate this slight movement of the door 19 to the right and left during the turning of the right edge thereof between the positions of FIGS. 18 and 19.

With the door 19 thus located in the position indicated in FIG. 19, the operator may grasp the handle 82 and pull the door 19 to the right, as viewed in FIG. 19. It will be noted that the door 19 cannot be moved to the left, as viewed in FIG. 19. During this rightward move-
ment of the door 19, because of the inclination of the elongated recess 65 of the plate 63, the roller 47 will move downwardly slightly as indicated in FIG. 2 so that it comes into engagement with the rail 26, and when the roller 48 engages the inclined portion 52 at the left end of the rail 26, as viewed in FIGS. 18 and 19, the bearing block 103 which carries the same will be able to turn so that the roller 48 can follow along the track or rail 26 as a result of the cooperation of the pin 107 with the member 20, as pointed out above.

The roller 48 is always on the track. The roller 47, however, is not on the track when the doors are in their closed positions. This is clearly shown in FIG. 16. It is only when the inner ends of the doors are swinging forwardly during the opening of the doors that the rollers 47 become aligned over the tracks, and then through sliding of the doors to their open positions, respectively, the rollers 47 will engage the tracks. With respect to FIG. 20, the roller 71 is completely off plate 63. After the door 19 is swung forwardly at its right end from the position of FIG. 18 to that of FIG. 19, the roller 47 of the door 19 becomes aligned over the track 26, as illustrated in FIG. 16. At this time the roller 71 is of course off the plate 63. Now the operator shifts the door 19 from left to right, as viewed in FIGS. 19 and 20, from the position of FIG. 19 to that of FIG. 20 and during the initial part of this movement the roller 71 will move along the plate 63 while the roller 47 will move from the left position thereof shown in FIG. 2 toward the dot-dash position shown in FIG. 2. In this latter dot-dash position shown in FIG. 2 the roller 47 has just engaged the track. Just before the roller 71 has moved down the inclined groove portion 65 of plate 63 so that the roller 47 gradually approaches and finally engages the track. As may be seen from FIG. 2, the roller 71 is displaced toward the right with respect to the roller 47, and as is apparent from FIG. 2 at the moment when the roller 71 leaves the plate 63 at the right end of the roller 47 will engage the track and the door 19 will now be supported at its right end by engagement of the roller 47 with the track.

It will be noted that during the movement of the door 19 from the position of FIG. 19 to that of FIG. 20 the entire weight of the door 19 is carried by the rail 26. None of the weight of the door 19 is carried by the door 19a, and only the bottom edge 73 of the latter cooperates with the groove 72 of the roller 71 in the guiding of the lower portion of the door. Because the door 19 is carried in this way by the rail 26, it is impossible for the roller 47 to become derailed from the rail 26. For the same reason the roller 48 cannot become derailed from the rail 26. The recess 115 for the roller 47 of the door 19a is identical with the recess 114, and when the roller 47 of the door 19 reaches the recess 115 it will simply move slightly down and then again up slightly so that the recess 115 presents no difficulty. It will be noted from FIGS. 2 and 17 that the ends of the recess 114 are very gradually inclined, and the same is true of the recess 115, so that there is no difficulty encountered upon movement of the roller 47 through the recess 115 when the door 19 is moved from the position of FIG. 19 to that of FIG. 20. It should also be noted that deraiment is further prevented by the member 110 which is in continuous sliding engagement with the inner face of the door 19 as it moves from the position shown in FIG. 20.

The roller cannot become derailed in a direction inwardly toward the interior of the railroad car. Because the member 105 of the bearing block 103 extends downwardly beyond the rail 26, it is impossible for the door to become derailed in a direction toward the railroad car.

It will be noted from FIG. 20 that when the door 19 has reached its fully open position it has not yet arrived at the inclined portion 52 at the right end of the rail 26, so that there is no tendency for the door 19 to move toward the door 19a, and in fact during almost its entire movement the door 19 is located in a plane parallel to and located forwardly of the door 19a. It may be, however, that the door 19 will be moved to the right beyond the member 118, so that the latter cannot at this time prevent inward movement of the door 19 adjacent to its left end, as viewed in FIG. 20. Therefore, the spacer 109 shown in FIG. 15 is provided. The extent to which the lower portion 116 of the part 104 of the bearing block 103 extends downwardly from the top edge of the rail 26 is such that deraiment cannot occur in an inner direction toward the interior of the car. The distance between the bottom face 118 of the rail 26 and the top face of the spacer 109 is less than the difference between the distance from the top of the rail 26 to the bottom of the portion 116 and the depth of the recess 114, so that if the door should happen to be raised, the spacer 109 will first engage the bottom surface 118 of the rail 26 before the lower portion 116 of the bearing block 103 can become located at an elevation higher than the top surface of the rail 26 at any part thereof including the recess 114, and thus deraiment in a direction inwardly toward the interior of the car cannot occur even if the door 19 has been moved to the right so that it is no longer engaged by the member 110.

The closing of the door 19 takes place through the reverse of the above operations. As was pointed out above, the door 19a operates in the same way as the door 19 and the structure shown at the left of the member 5 to cooperate with the door 19 is repeated at the right of the vertical member 5 to cooperate with the door 19a, all of this structure being identical and the parts being symmetrical with respect to the vertical member 5 and actually being mirror images of each other. Thus, when the door 19a is moved to its open position it will be located in front of the door 19 in overlapping relation with respect to the same, and in this case the bottom edge 73 of the door 19 will cooperate with the groove 72 of the roller 71 carried by the door 19a to guide the latter at its lower portion.

It will be noted that as soon as the roller 48 of the door 19 has been moved beyond the left inclined portion 52 of the rail 26, the door 19 is in a position parallel to the door 19a. During the movement of the door 19 from the position of FIG. 19 to that of FIG. 20, the handle 79 is located in the space 95 between the doors 19a and 19 and completely out of engagement with the door 19 so that the handle cannot become damaged and cannot interfere with the movement of the door.

When the plate 63 has the solid line position indicated in FIG. 4, the rib 67 is in the same vertical plane as the strip 75 and the edge 73 of the door 19a which is still in its closed position. This plate 63 remains in this position until the door 19 has been moved back from the position of FIG. 20 to that of FIG. 19. When the door reaches again the position of FIG. 19, the roller 71 will move downwardly slightly into the recess 66 so that the operator will know when the door has reached the position indicated in FIG. 19. If the door 19 has not yet reached this position, then the rib 67 will still be in the groove 72 of the roller 71, and should the operator try to turn the rod 28 at this time, the cooperation of the rib 67 with the groove 72 of the roller 71 will prevent turning of the rod 28, and the operator then knows that he must push the door 19 further until it reaches the end position indicated in FIG. 19. Thus, the cooperation of the rod 28 and all of the parts carried thereby will not be turned until the roller 71 has become fully located in the recess 66 beyond the rib 67.

If desired the end frame members 4 may be provided with suitable springs which engage the outer ends of the doors 19 and 19a when the latter are in their closed position for urging these doors toward the central vertical plane member 5 so as to guarantee the desired sealed engagement between the doors and the vertical member 5.
It will be understood that each of the elements described above, or two or more together, may also find a useful application in other types of sliding door arrangements different from the types described above.

While the invention has been illustrated and described as embodied in sliding arrangements for railroad cars, it is not intended to be limited to the details shown, since various modifications and structural changes may be made without departing in any way from the spirit of the present invention.

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 that, from the standpoint of prior art, fairly constitute essential characteristics of the generic or specific aspects of this invention and, therefore, such adaptations should and are intended to be comprehended within the meaning and range of equivalence of the following claims.

What is claimed as new and desired to be secured by Letters Patent is:

1. A sliding door arrangement comprising, in combination, substantially vertical frame means; a pair of substantially vertical doors located in a common inner plane in engagement with said frame means when both of said doors are in a closing position; a single elongated rail supported by said frame means, being substantially coextensive with said pair of doors and located outwardly thereof in a plane substantially parallel to said common plane; and means carried by said frame means and cooperating with said doors for optionally moving either one of said doors outwardly away from said inner plane toward said rail; rail engaging means carried by said doors to cooperate with said rail when either one of said doors is moved outwardly toward said rail by said moving means for supporting the doors on said rail and for guiding said doors for movement therealong, whereby the door which is moved toward said rail by said moving means can cooperate with said rail to move therealong to a position overlapping the other door for uncovering the space which is occupied by the moved door when the latter is in said common plane.

2. A sliding door arrangement comprising, in combination, substantially vertical frame means; a pair of substantially vertical doors located in a common inner plane in engagement with said frame means when both of said doors are in a closing position; a single elongated rail supported by said frame means, being substantially coextensive with said pair of doors and located outwardly thereof in a plane substantially parallel to said common plane; and means carried by said frame means and cooperating with said doors for optionally moving either one of said doors outwardly away from said inner plane toward said rail; rail engaging means carried by said doors to cooperate with said rail when either one of said doors is moved outwardly toward said rail by said moving means for supporting the doors on said rail and for guiding said doors for movement therealong, whereby the door which is moved toward said rail by said moving means can cooperate with said rail to move therealong to a position overlapping the other door for uncovering the space which is occupied by the moved door when the latter is in said common plane.

3. In a sliding door arrangement, in combination, a substantially vertical frame member; an elongated substantially vertical rod extending parallel to and located adjacent said frame member and supported thereby for turning movement about its axis; a substantially horizontal rail located adjacent an upper portion of and carried by said frame member; a plate fixedly carried by said rod adjacent a lower part thereof and formed with an upwardly directed recess; an elongated door having one end located next to said frame member inwardly of said rail when said door is in an inner closed position; means fixedly carried by said door, extending into said recess, and resting on said plate so that the latter supports said door at least when said door is in said inner closed position; and rail engaging means carried by an upper portion of said door adjacent said roller being movable thereof and spaced inwardly from said rail when said door is in said inner closed position thereof, whereby when said rod is turned about its axis in one direction said plate will turn therewith to swing said one end of said door outwardly toward said rail, said rod and plate moving said one end of said door to an outer position where said rail engaging means cooperates with said rail to support said door thereon and to guide said door for movement along said rail to an open position.

4. In a sliding door arrangement, in combination, substantially vertical frame means having a substantially vertical frame member; an elongated door located in an inner substantially vertical plane in engagement with said frame means when said door is in a closed position thereof, said door when it is in said closed position having one end extending along said vertical frame member; an elongated substantially horizontal rail carried by said vertically adjacent said door and extending substantially parallel thereto when said door is in said closed position thereof; an elongated rod turnably supported for movement about its axis by said frame means and located adjacent and extending substantially parallel to said vertical frame member; a roller carried by a lower portion of said door adjacent to said vertical frame member when said door is in its closed position; a plate fixedly carried by a lower portion of said rod, formed with a first upwardly directed recess in which said roller is located when said door is in its closed position, said plate being supported said end of said door when the latter is in its closed position, and said plate being formed with a second elongated upwardly directed recess extending from said first recess to an outer edge of said plate, said rod being turnable together with said plate from a first angular position when said door is in its closed position thereof in a given direction outwardly to a second angular position where said second recess extends parallel to said rail, said plate during its turning movement to said outer angular position swinging said one end of said door outwardly away from said vertical frame member, and means carried by said plate from said first to said second recess and then from said second recess beyond said plate during movement of said door away from the position it takes when it has been moved outwardly away from its closed position by turning of said rod and plate; and rail engaging means carried by an upper portion of said door, spaced inwardly from said rail when said door is in its closed position, and cooperating with said rail when said end of said door has been swung outwardly by turning of said rod and plate for supporting said end of said door on said rail for movement therealong.

5. In a sliding door arrangement, in combination, substantially vertical frame means having a substantially vertical frame member; an elongated door located in an inner substantially vertical plane in engagement with said frame means when said door is in a closed position thereof, said door when it is in said closed position having one end extending along said vertical frame member; an elongated substantially horizontal rail carried by said frame means and located outwardly of said door and extending substantially parallel thereto when said door is in said closed position thereof; an elongated rod turnably supported for movement about its axis by said frame means and located adjacent said door; a roller carried by a lower portion of said door adjacent to said vertical frame member when said door is in its closed position.
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13 position; a plate fixedly carried by a lower portion of said rod, formed with a first upwardly directed recess from said first recess to an outer edge of said plate, said rod being turnable together with said plate from a first angular position when said door is in its closed position thereof, said door being in said closed position thereof in a given direction outwardly to a second angular position where said second recess extends parallel to said plate, and said plate being in its turning movement to said outer angular position swinging said end of said door outwardly away from said vertical frame member, and said roller being movable from said first to said second recess and then from said second recess beyond said plate during movement of said door away from the position it takes when it has been moved outwardly away from its closed position by turning of said rod and plate; and rail engaging means carried by an upper portion of said door, spaced inwardly from said rail when said door is in its closed position, having a first upwardly directed recess and a second upwardly directed recess extending from said first recess to the periphery of said plate, said plate having an elongated rib extending along said second recess thereof; a door having one end extending along said vertical frame member when said door is in a closed position thereof, said door carrying at a lower portion thereof a roller which is located in said first recess when said door is in its closed position, said plate supporting said door when the latter is in its closed position, and said roller being formed with an annular groove at its exterior surface; turning means connected to said rod for angularly turning the same and said plate therewith from an inner angular position when said door is in its closed position and where said rib extends angularly from said roller in a plane different from that in which said groove thereof is located outwardly to an outer angular position for swinging said end of said door outwardly away from said vertical frame member and in which said rib is located in the same plane as said groove to be received into the same during movement of said door in a direction away from said vertical frame member and said roller rolling along said second recess, so that said roller cooperates with said groove during movement of said roller along said second recess and so that said roller must be located in said first recess before said plate and rod can be turned back to their inner angular position to again locate said door in its closed position.

7. In a sliding door arrangement, in combination, frame means having a substantially vertical frame member; an elongated rod located adjacent and extending substantially parallel to said vertical frame member and supported for turning movement about its axis by said frame means; a plate fixedly carried by said rod adjacent a lower portion thereof and formed with a first upwardly directed recess and a second upwardly directed recess extending from said first recess to the periphery of said plate, said plate having an elongated rib extending along said second recess thereof; a door having one end extending along said vertical frame member when said door is in a closed position thereof, said door carrying at a lower portion thereof a roller which is located in said first recess when said door is in its closed position, said plate supporting said door when the latter is in its closed position, and said roller being formed with an annular groove at its exterior surface; turning means connected to said rod for angularly turning the same and said plate therewith from an inner angular position when said door is in its closed position and where said rib extends angularly from said roller in a plane different from that in which said groove thereof is located outwardly to an outer angular position for swinging said end of said door outwardly away from said vertical frame member and in which said rib is located in the same plane as said groove to be received into the same during movement of said door in a direction away from said vertical frame member and said roller rolling along said second recess, so that said roller cooperates with said groove during movement of said roller along said second recess and so that said roller must be located in said first recess before said plate and rod can be turned back to their inner angular position to again locate said door in its closed position; and a second door having an elongated downwardly directed edge portion extending into said groove of said roller for guiding said first-mentioned door at the lower portion thereof during its movement away from said vertical frame member.

8. In a sliding door arrangement, in combination, substantially vertical frame means having a pair of opposite ends and having intermediate said ends a substantially vertical frame member; a pair of elongated doors having closed positions where said doors are located in a common plane and cooperate with said frame means to close a given space, said doors being respectively located on opposite sides of said vertical frame member when said doors are in their closed position and extending from said frame member respectively to the opposite ends of said
frame means; an elongated rail located outwardly of said doors when the latter are in their closed position and carried by said frame means in a position extending substantially parallel to said doors along upper portions thereof, said doors respectively having adjacent to said vertical frame member a pair of rail engaging means to cooperate with said rail for guiding said doors for movement therewith; a pair of vertical rods located adjacent said vertical frame member and respectively supported by said frame means for turning movement about their axes, respectively; a pair of plates respectively carried by said rods adjacent their lower ends, said plates each being formed with an upwardly directed first recess and with an upwardly directed elongated second recess extending from said first recess to the outer periphery of said plate, said second recess of each plate having an elongated rib extending therealong; a pair of rollers respectively carried by said doors adjacent to said vertical frame member when said doors are in their closed position, said rollers being respectively located in said first recesses of said plates when said doors are in their closed positions and said plates supporting said doors at the ends thereof adjacent to said vertical frame member when said doors are in their closed position, so that when one of said rods is turned about its axis the plate fixed thereto will turn therewith to swing the end of one of said doors which is adjacent to said vertical frame member outwardly away from the same to move said door toward said rail for placing the rail engaging means carried by the latter door in a position to cooperate with said rail for supporting the latter door from movement along said rail to a position overlapping the other door, said rib extending parallel to said rail when the plate carrying the same has been turned outwardly for swinging one of said doors to its outer position adjacent to said rail, said rollers each being formed with an annular groove which receives said rib to participate in the guiding of said doors for movement along said rail, and each door having a lower edge portion which extends into said groove of the roller of the other door during movement of the latter along said rail for participating in the guiding of the door along said rail.

10. In a sliding door arrangement, in combination, substantially vertical frame means having a vertical frame member; an elongated vertical rod located adjacent said frame member and supported by said frame means for turning movement about its axis; a door cooperating with said frame means to close a given space, said door having a closed position where said door is located in a predetermined plane and where an end of said door extends along said vertical frame member; means carried by said rod and cooperating with said door for moving the same away from its closed position when said rod is turned; a plate fixedly carried by said rod and extending therefrom; a handle member pivotally connected to said plate for turning the latter and said rod therewith in order to move said door to and from its closed position, said handle member having an elongated projection extending downwardly therefrom; an eye fixedly carried by said rod and receiving said projection of said handle member when said door is in its closed position for retaining said door in its closed position; and a swingable latch member turnable carried by said door over said handle member and being movable by gravity downwardly to a position located directly over said handle member to prevent upward movement thereof until said latch member is manually turned away from said handle member, so that said latch member retains said handle member in a position where said projection thereof is located in said eye.

12. In a sliding door arrangement, in combination, substantially vertical frame means having a vertical frame member; an elongated vertical rod located adjacent said frame member and supported by said frame means for turning movement about its axis; a door cooperating with said frame means to close a given space, said door having a closed position where said door is located in a predetermined plane and where an end of said door extends along said vertical frame member; means carried by said rod and cooperating with said door for moving the same away from its closed position when said rod is turned; a plate fixedly carried by said rod and extending therefrom; a handle member pivotally connected to said plate for turning the latter and said rod therewith in order to move said door to and from its closed position, said handle member having an elongated projection extending downwardly therefrom; an eye fixedly carried by said rod and receiving said projection of said handle member when said door is in its closed position for retaining said door in its closed position; and a stop member carried by said vertical frame member for engaging said plate when said rod has been turned to a position which moves said door outwardly away from its closed position, said stop member defining with said vertical frame member a space into which said handle member is downwardly swingable so as to be located out of the path of movement of the door after the latter has been turned outwardly away from its closed position.

13. In a sliding door arrangement, in combination, elongated substantially vertical frame means having a pair of opposite ends and having a vertical frame member intermediately disposed therebetween; a pair of elongated doors having closed positions located in a common plane engaging said frame means, said doors respectively having inner ends located next to and engaging said vertical frame member when said doors are in their closed position and outer ends located respectively adjacent to the opposite ends of said frame means; an elongated rail carried by said frame means substantially at the elevation of upper portions of said doors, said rail extending for substantially its entire length in a plane parallel to and spaced outwardly from said doors when the latter are in their closed position, and said rail respectively having opposite ends inclined inwardly toward said doors at said outer ends thereof, respectively; a pair of rail engaging means carried by each door at an upper portion thereof adjacent its opposite ends, the pair of rail engaging means which are respectively located at said outer ends of said doors cooperating permanently with said elongated rail and the pair of rail engaging means which are respectively located at the inner ends of said doors being spaced inwardly from said rail when said doors are in their closed position; and means carried by said frame means adjacent said vertical frame member thereof and cooperating with said doors for optionally swinging either elongated rail outwardly adjacent to said vertical frame member outwardly toward said rail to place the rail engaging means at the inner end of the thus swung door in engagement with said rail so that the latter door can be moved along said rail into a position overlapping the other door.
14. In a sliding door arrangement, in combination, elongated substantially vertical frame means having a pair of opposite ends and having a vertical frame member intermediate said opposite ends thereof; a pair of elongated doors having closed positions located in a common plane engaging said frame means, said doors respectively having inner ends located next to and engaging said vertical frame member when said doors are in their closed position and outer ends located respectively adjacent to the opposite ends of said frame means; an elongated rail carried by said frame means substantially at the elevation of upper portions of said doors, said rail extending for substantially its entire length in a plane parallel to and spaced outwardly from said doors when the latter are in their closed position, and said rail respectively having opposite ends inclined inwardly toward said doors at said outer ends thereof, respectively; a pair of rail engaging means carried by each door at an upper portion thereof adjacent its opposite ends, the pair of rail engaging means which are respectively located at the outer ends of said doors cooperating permanently with said elongated rail and the pair of rail engaging means which are respectively located at the inner ends of said doors being spaced inwardly from said rail when said doors are in their closed position; and means carried by said frame means adjacent said vertical frame member thereof and cooperating with said doors for optionally swinging either one of said doors at its inner end adjacent to said vertical frame member outwardly toward said rail to place the rail engaging means at the inner end of the thus swung door in engagement with said rail so that the latter door can be moved and outer ends located respectively adjacent to the other door, said rail being formed adjacent to the inner ends of said doors when the latter are in their closed position with a pair of upwardly directed recesses into which the pair of rail engaging means adjacent to said vertical frame member when said doors are in their closed position are movable for placing said latter rail engaging means optionally in a position for cooperating with said rail.

15. In a sliding door arrangement, in combination, substantially vertical frame means having a vertical frame member; an elongated rod supported for turning movement about its axis by said frame means and located adjacent and extending substantially parallel to said vertical frame member; a plate fixedly carried by said rod adjacent a bottom end thereof and being formed with an upwardly directed first recess and an upwardly directed elongated second recess extending from said first recess; and a roller carried by said door and located in said first recess when said plate is swung outwardly to a position located over said rail when said plate is swung outwardly to a position which moves said end of said door away from said vertical frame member, whereby when said door moves in a direction which causes said roller to move along said second recess outwardly beyond said plate, said rail engaging means will move downwardly into engagement with said rail.

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