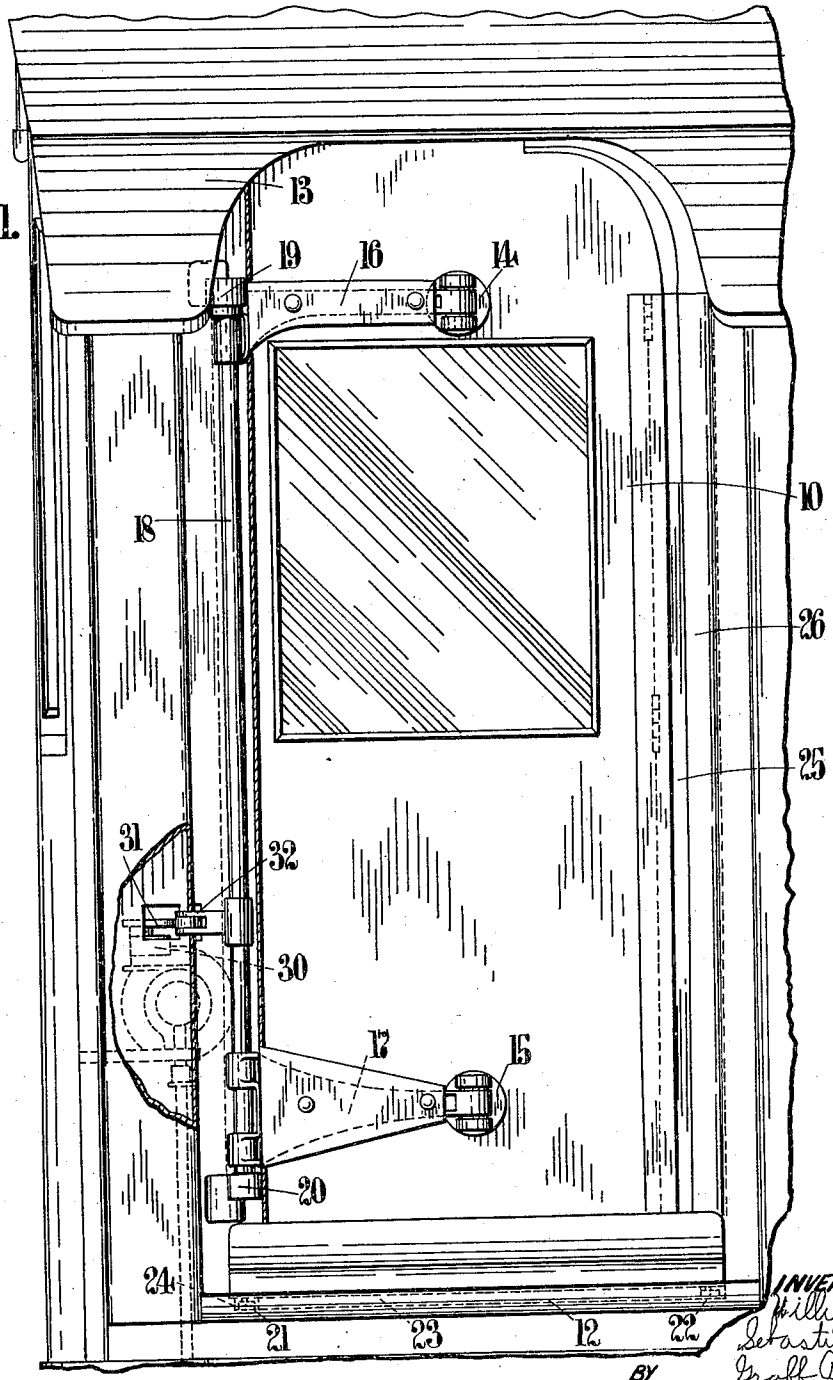
July 10, 1928. 1,676,375

W. S. GRAFF-BAKER

SWINGING DOOR

Filed Feb. 12, 1926 4 Sheets-Sheet 1

Fig. 1.



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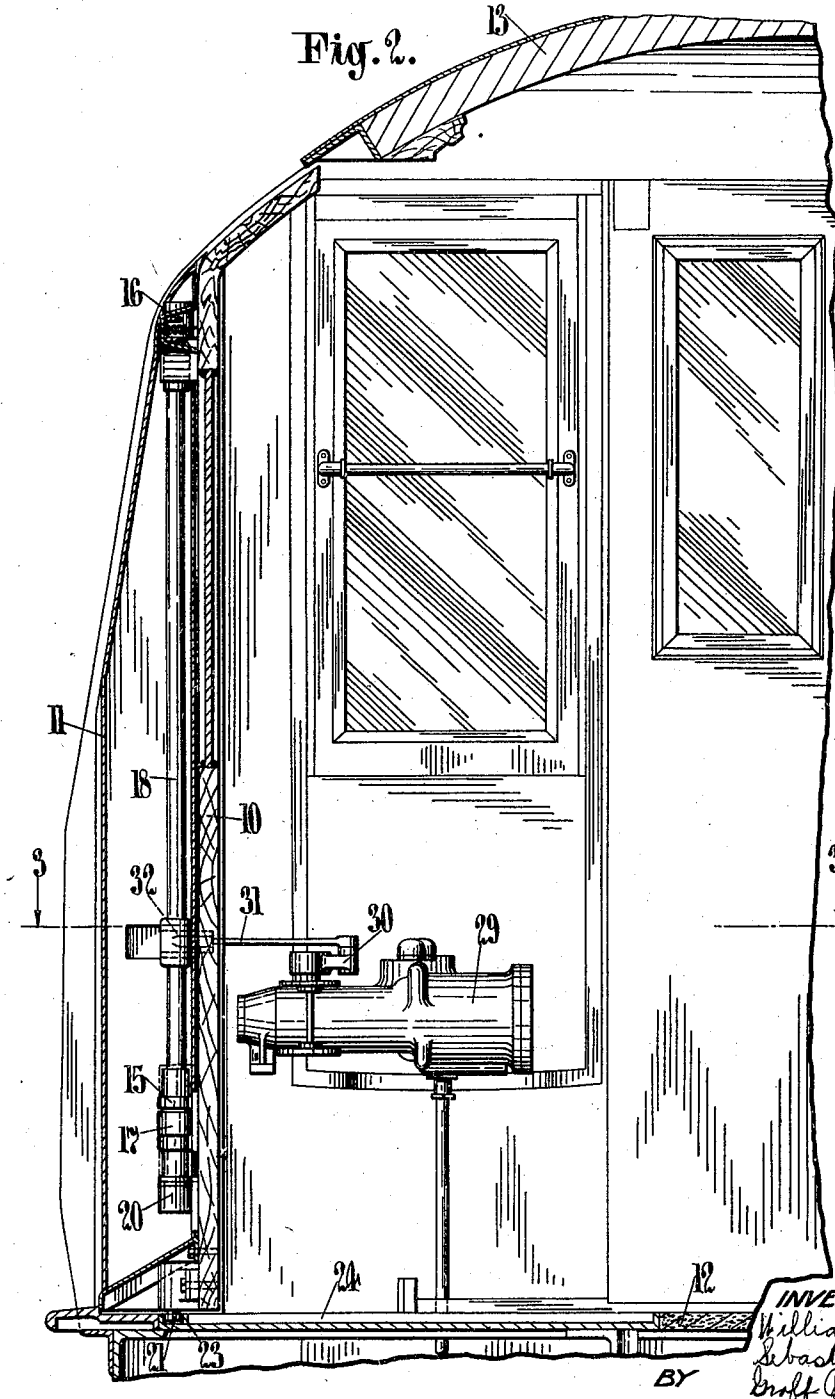
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SWINGING DOOR

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Fig. 2.



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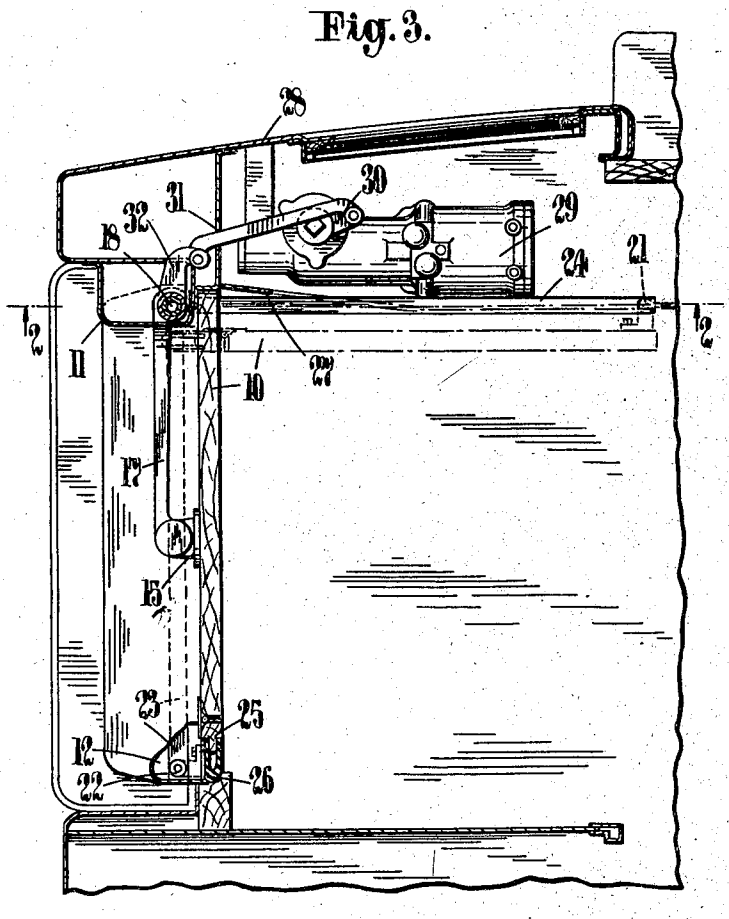
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Fig. 3.



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SWINGING DOOR

Filed Feb. 12, 1926 4 Sheets-Sheet 4

Fig. 4.

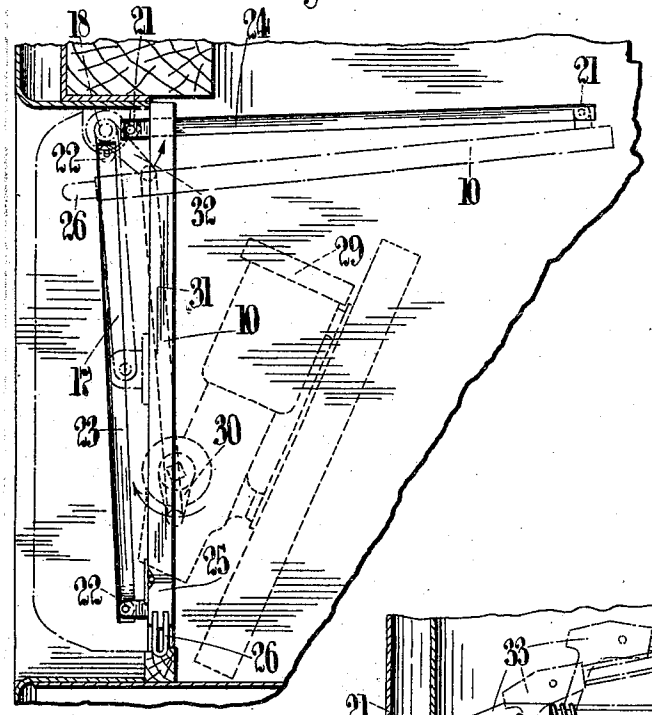
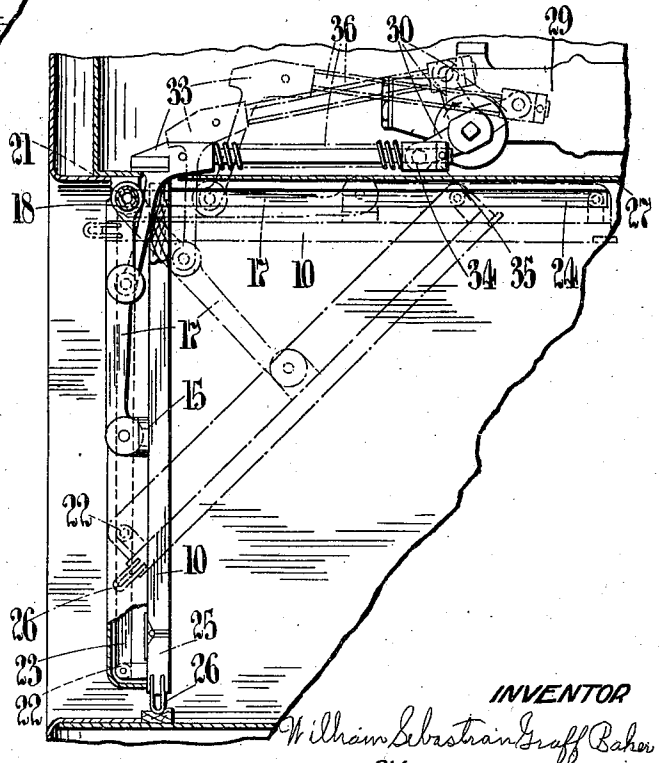


Fig. 5.



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UNITED STATES PATENT OFFICE.

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SWINGING DOOR.

Application filed February 12, 1926, Serial No. 87,745, and in Great Britain February 14, 1925.

This invention is for improvements in or relating to swinging doors, and has reference to the type of door which is arranged to be displaced bodily, in swinging from its open to its closed positions and vice versa, and at the same time to be rotated about an axis lying in or near to the general plane of the door and parallel to the lateral edges thereof, in such manner that said lateral edges, or points located near them, travel in paths whereof the centre lines, produced if necessary intersect one another, one lateral edge travelling towards the point of intersection of the said centre lines while the other lateral edge travels away therefrom. In this type of door, straight guide-tracks are provided, lying respectively along the aforesaid paths of movement of the lateral edges of the door, and co-operating guiding elements (usually rollers) are provided on the door, at or near the lateral edges thereof, to engage respectively with the two guide-tracks.

One object of the present invention is to support the door in an improved manner and render it capable of swinging more smoothly than heretofore. Another object of the invention is so to construct and arrange the door that an operative connection may, with convenience or advantage, be effected between the door and an operating mechanism therefor.

According to the primary feature of the present invention there is provided a door of the type above described, which door is characterized in that the guide-tracks are so disposed that their centre lines intersect one another at right angles, and is further characterized by the combination with the door of one or more operating-arms which are each hinged at one end to a relatively stationary support (for example a door post or an equivalent part of the structure to which the door is applied) to swing about an axis intersecting, and perpendicular to, the two centre lines aforesaid, and which each have pivotal connection at the other end with the door, the axes of pivoting at the two ends of the arm being parallel and so disposed that a plane containing them bisects or approximately bisects a line joining the centres of the guiding-elements on the door which co-operate with the guide-tracks. It will be found that with the above construction the door is displaced bodily by means of the operating-arms and not as heretofore by the constraint of the guide-tracks. The path of bodily displacement of the door is geometrically related to the path of the co-operating guiding-elements which run in the guide-tracks, in such manner that the guide-tracks function merely to rotate the door about its central vertical axis. Consequently, much of the strain previously occurring at the guide-tracks is eliminated.

Preferably, the operating-arm or arms constitute the sole support for the weight of the door so that the guide tracks are relieved entirely of such weight and can, therefore, function more easily to turn the door about its central axis. Where a plurality of operating-arms are provided these are preferably fixed to a hinge-rod common to said arms and mounted in bearings carried by the aforesaid relatively stationary support. This feature of construction eliminates the tendency of the door to rack and consequently to jam in the guide-tracks, by maintaining in alignment the axes of pivotal connection between the arms and the door. With a door supported as indicated above it is unnecessary to provide guide-tracks both at the top and bottom of the door as has been necessary in the constructions known heretofore. This is very distinctly an advantage in cases where there is no head-room or not sufficient head-room above the door to accommodate a set of guide-tracks, for example in the case of a vestibule door in the side of a railway vehicle where the door extends practically to the roof of the vehicle and, sometimes, for a short distance inwardly along the contour of the roof, the latter being cut away above the door.

The invention further comprises the provision of a door constructed as above set forth and having combined with it means (for example a compressed-air motor operatively connected to one of the operating-arms) for rotating the operating-arms about the axis of their hinge-connection with the door-post. This arrangement is advantageous in that whilst the door cannot be opened by hand by pushing it sideways, the door may readily be opened with but little effort

by the operating mechanism acting through the operating-arms.

In a mechanically operated door as just mentioned, it is a feature of the invention to arrange the operating motor beneath the floor over which the door swings, and to have the member about the axis of which the operating-arms swing extended down through the said floor to make operative connection with the motor, and furthermore to arrange the guide-tracks which are at right angles to each other to terminate short of the said axis and be angularly set (for example at a small angle) relatively to the planes in which the door lies in its fully closed and fully opened positions respectively. This arrangement will increase the available space within the vestibule wherein the door is situated.

According to a further feature of the invention the operating-arms in a mechanically operated door are coupled by a connecting rod to a motor crank arm to be manipulated thereby, and the said crank arm and connecting rod are so constructed and arranged that a line joining the pivots at the ends of the connecting rod passes through the axis of rotation of the crank arm when the door is in its closed position. In this way a condition of dead centres is provided both against movement to open the door by pushing it sideways and by pushing it inwardly.

For a more complete understanding of the invention there will now be described, by way of example only and with reference to the accompanying drawings, certain constructions of door according to the invention. It is to be understood, however, that the invention is not restricted to the precise constructional details set forth.

In the drawings,

Figure 1 is an elevation showing a door according to the present invention in closed position in a doorway at the side of a railway vehicle.

Figure 2 is another elevation taken in section on the line 2—2 of Fig. 3. It will be appreciated that Figs. 1 and 2 are elevations looking in directions at right angles to each other.

Fig. 3 is a plan view taken in section on the line 3—3 of Fig. 2.

Fig. 4 is a view corresponding to Fig. 3 of a modified construction of door, and

Fig. 5 is a similar view of another modified construction.

Like reference numerals indicate like parts throughout the drawings.

Referring firstly to Figs. 1–3, the door 10 therein shown is wholly supported upon a vertical door-post 11 which extends from the floor 12 to the roof 13 of the vehicle. The door 10 carries brackets 14 and 15 which pivotally receive the extremities of operating-arms 16 and 17 respectively, these operating-arms at their other ends being fixed one above the other upon a vertical hinge-rod 18. This rod 18 is carried in bearings 19 and 20 mounted upon the door-post 11. Under its lower edge the door 10 carries rollers 21 and 22 which are intended to be received in guide-tracks 23 and 24 formed in the floor 12. These tracks 23 and 24 are each straight and they are so disposed that their centre lines are perpendicular to one another and intersect in the axis of the rod 18. In Figs. 1–3, the track 23 is shown as being parallel to the centre line of the vehicle. The rollers 21 and 22 are preferably mounted in ball bearings, each to rotate about a vertical axis, and they are disposed towards the two upright edges of the door and are intended to run one in the track 23 and the other in the track 24.

The axis of the pivotal connection between the arms 16 and 17 and the door 10 is parallel to the axis of the rod 18 and this first-named axis is so disposed midway between the rollers 21 and 22 aforesaid as to bisect a straight line joining the centres thereof. With this construction, as the roller 22 travels towards the rod 18 the roller 21 travels away therefrom, and vice versa. The closed position of the door is shown in full lines in Figure 3 and the fully opened position is shown in chain lines in this figure.

The upright edge of the door which is remote from the rod 18 in the closed position is formed with a hinged strip 25 having a rubber edging piece 26, these parts being provided in order to avoid injury to a passenger who may inadvertently leave say his arm across the path of movement of the door as it is closing.

When the door is fully opened it lies closely against the wall 27 of an enclosed space behind the end wall 28 of the vehicle, and within this enclosed space there is accommodated a compressed-air motor 29 for operating the door. This motor and its operative connections with the door may take various forms according to circumstances. In the arrangement illustrated the motor 29 has an external crank arm 30 which is arranged to rotate or oscillate in a horizontal plane. This crank arm is connected by a rod 31 to an arm 32 fast upon the rod 18. Consequently, when the crank arm 30 is turned the rod 18 will be correspondingly turned to cause the arms 16 and 17 to move the door, the guide tracks 23 and 24 serving to cause the door to follow the requisite path. The arm 32 on the rod 18 is located in this construction at a level intermediate of the level of the arms 16 and 17.

The construction just described will be found to cause the requisite movement of the door in a simple and efficient manner and will permit the door to occupy convenient

positions in its closed and opened states and also to sweep over a comparatively small area in moving from the one position to the other.

In some circumstances it is possible to mount the motor 29 below the floor of the vehicle and thus increase the available space adjacent to the doorway. Such a construction is illustrated in Fig. 4 in which the rod 18 is extended right down to and through the floor to carry therebelow the arm 32. Since the guide-tracks 23 and 24 are at right angles to each other with their centre lines intersecting the axis of the rod 18, it follows that these tracks must terminate short of this rod. A result of this is that the door cannot be brought into a position precisely parallel with the track 23 in its closed position nor with the track 24 in its fully opened position. In these circumstances it is preferred that the door in its fully closed position shall lie parallel with the longitudinal centre line of the vehicle, so consequently the tracks 23 and 24 are set at a small angle to the planes in which the door lies in its closed and fully opened positions.

In the construction shown in Fig. 5, the crank arm 30 is connected by an angular rod 33 to one of the operating-arms 16 and 17 at a point intermediate of the ends of the latter. The major portion of the length of the rod 33 can always lie behind the wall 27 so as to be hidden, while only the extremity of the rod need protrude through this wall towards the door. The crank arm 30 and rod 33 are so constructed and arranged that a line joining the pivots at the ends of the rod 33 passes through the axis of rotation of the crank arm 30 when the door is in the closed position as shown in Fig. 5 in full lines. Consequently a condition of dead centres is provided both against movement to open the door by pushing it sideways or pushing it inwards. The rod 33 is attached to the crank arm 30 by means of a sliding block 34 which is held between a fixed collar 35 and a spring 36. The purpose of this yielding connection between the door and its operating motor is to ensure that any pressure excited by the door when closing on an obstacle shall not be of an unyielding nature.

It is to be understood that the invention is not restricted to the precise constructional details set forth.

I claim:—

1. In a door of the type described the combination with the door of guide tracks disposed so that their centre lines intersect one another at right angles, guiding elements on the door, one or more operating arms hinged at one end to a relatively stationary support to swing about an axis intersecting and perpendicular to the said two centre lines, said arms each having pivotal connection at the other end with the door, the axes of pivoting at the two ends of the arms being parallel and so disposed that a plane containing them substantially bisects a line joining the centres of the guiding elements on the door which co-operate with the guide tracks.

2. In a door of the type described the combination with the door of guide tracks disposed so that their centre lines intersect one another at right angles, guiding elements on the door, one or more operating arms hinged at one end to a relatively stationary support to swing about an axis intersecting and perpendicular to the said two centre lines, said arms each having pivotal connection at the other end with the door, the axes of pivoting at the two ends of the arms being parallel and so disposed that a plane containing them substantially bisects a line joining the centres of the guiding elements on the door which co-operate with the guide tracks, said guide tracks, which are at right angles to each other, terminating short of said axis and being angularly set relatively to the planes in which the door lies in its fully closed and fully opened positions respectively.

In witness whereof I affix my signature.

WILLIAM SEBASTIAN GRAFF-BAKER.