Aug. 11, 1970 J. McAULAY, JR 3,523,390

ELEVATOR DOOR GUIDE

Filed May 10, 1968

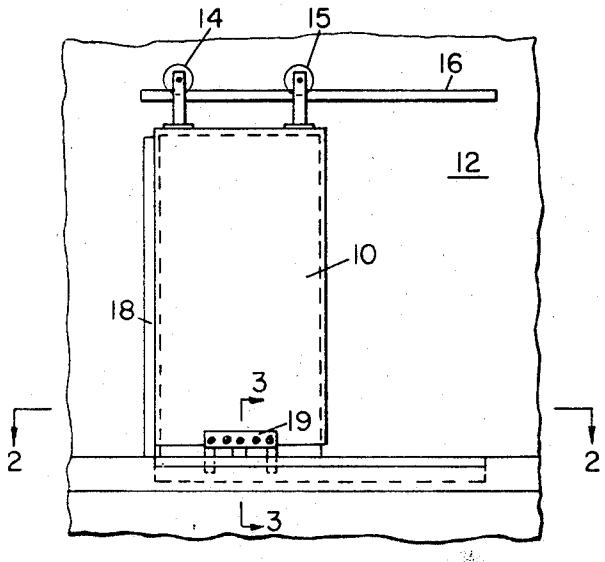
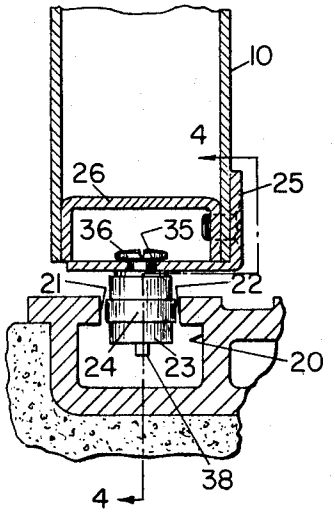


FIG. 1

FIG. 3



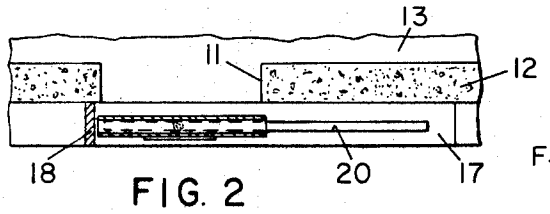


FIG. 2

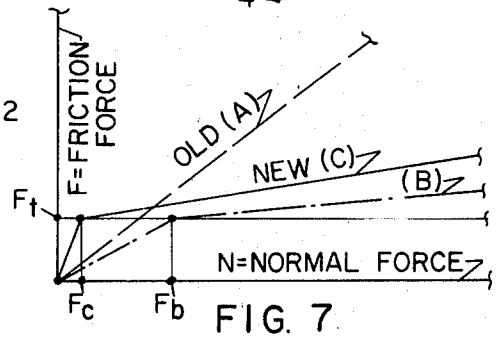
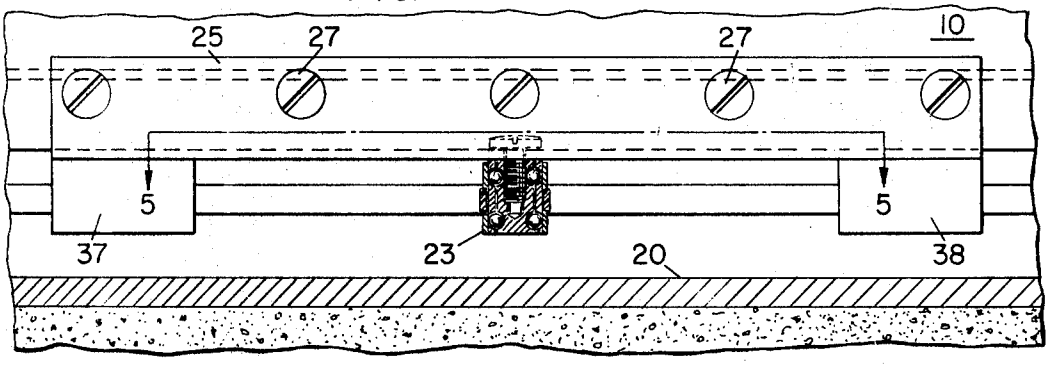


FIG. 7

FIG. 4



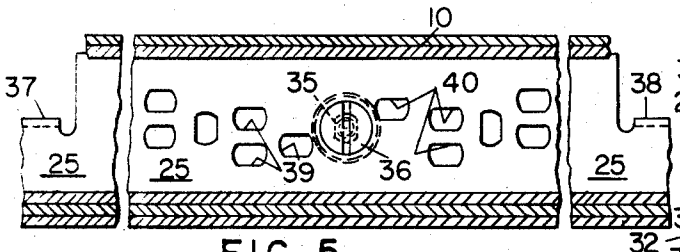


FIG. 5

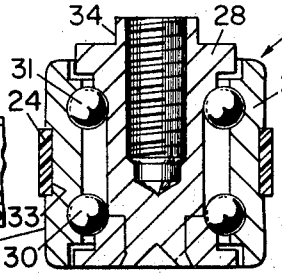


FIG. 6

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ELEVATOR DOOR GUIDE

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ABSTRACT OF THE DISCLOSURE

A door guide arrangement for an elevator door including a door supported by a wall and slidable to open and closed positions relative to an opening in the wall, door support means slidably supporting the door from the wall, door sill means disposed below the door having an elongate groove with oppositely facing groove sidewalls, and a door guide fixedly connected to the door at the bottom edge thereof by a support bracket, comprising rotatable bearing means having an inner shaft portion mounted on said support bracket and an outer race portion with an outer surface facing said groove sidewalls and supported by said inner shaft portion for rotation relative thereto, and an annular friction member mounted on and fixedly connected to said outer race surface having a surface with a substantially greater coefficient of sliding friction than said outer race surface.

The present invention relates to door guides, and particularly to a door guide for guiding the bottom edge of a horizontal sliding elevator door.

In a conventional elevator installation, a horizontal sliding door is used at each hoistway floor landing and on the elevator car. A conventional door is supported by door hanger rollers, which roll on a door hanger track that is fixedly connected to a wall portion disposed above the door opening, and the door slides horizontally to open and closed positions relative to the door opening. The door is guided by a guide member, which projects from the bottom edge of the door and is received in an elongate groove in the door sill.

The conventional guide member for the bottom edge of an elevator door is an elongate guide block fixedly connected to the door. The guide block is composed of a material, which has a relatively low coefficient of sliding friction, and it has a pair of elongate faces on opposite sides thereof which engage the groove sidewalls.

One problem with the conventional type of door guide is that a relatively high transverse force acting on the door and a corresponding normal force acting on the door guide can increase the friction force acting on the door guide and the corresponding force of resistance to movement of the door to a level which would require a more powerful automatic door operator.

Such a relatively high transverse force acting on the door may be caused by a wind load, such as a relatively high wind load acting on an exterior building hoistway door or by a relatively high wind load caused by air pressure acting on one side of an interior building hoistway door in an air conditioned building.

In accordance with one embodiment of the present invention, the friction force on the door guide caused by a relatively high transverse force acting on the door is minimized by using a rotatable door guide having an inner shaft fixedly connected to the door at the bottom edge thereof and an outer anti-friction race supported by the shaft for rotation relative thereto and having an annular friction member fixedly mounted on the outer race for engaging the groove sidewall and to assure rotation of the outer race with a variation in the transverse force.

Accordingly, it is one object of the invention to provide a door guide for guiding the bottom edges of a horizontal sliding elevator door.

It is another object of the invention according to the aforementioned object to minimize the friction force on the door guide caused by a relatively high transverse force acting on the door.

It is a further object of the invention according to the aforementioned object to assure the reliability of operation of the door guide when there is a variation in the transverse force acting on the door.

It is a still further object of the invention according to the aforementioned objects to minimize the noise and wear of the door guide during door operation.

To the fulfillment of these and other objects, the invention provides a door guide arrangement for an elevator door including a door supported by a wall and slidable to open and closed positions relative to an opening in the wall, door support means slidably supporting the door from the wall, door sill means disposed below the door having an elongate groove with oppositely facing sidewalls, and door guide means fixedly connected by a guide support to the door at the bottom edge thereof comprising rotatable bearing means having an inner portion mounted on said guide support and an outer portion with an outer surface facing said groove sidewalls and supported by said inner portion for rotation relative thereto, and an annular friction member mounted on and fixedly connected to said outer portion surface having a surface with a substantially higher coefficient of sliding friction than said outer portion surface.

Other objects of the invention will become apparent upon reading the following description and accompanying drawing, wherein like parts are designated by like numerals throughout the several views, and wherein:

FIG. 1 is a partly schematic elevation view of an elevator hoistway door with a door guide embodying the invention;

FIG. 2 is a sectional view taken along the line 2—2 of FIG. 1;

FIG. 3 is a sectional view taken along the line 3—3 of FIG. 1;

FIG. 4 is a sectional view taken along the line 4—4 of FIG. 3;

FIG. 5 is a sectional view taken along the line 5—5 of FIG. 4;

FIG. 6 is an enlarged view of a portion of FIG. 4; and

FIG. 7 is a graph showing curves of friction force relative to normal force.

Referring to the drawing, there is shown one embodiment of the invention, which is an elevator hoistway door **10** having a door guide **19**. Door **10** is located adjacent an opening **11** in a hoistway wall **12** of a floor landing **13**. Door **10**, which is slidable horizontally to an open or a closed position, is suspended by a pair of door hanger rollers **14**, **15**, which roll on a door hanger track **16**, that is fixedly connected to wall **12**. There is a door sill **17** at the bottom of opening **11** and a door jamb **18** at the side of opening **11**. Door guide **19** is received in an elongate groove **20** in sill **17** and normally engages one or the other of the oppositely facing sidewalls **21**, **22** of groove **20**.

Door guide **19** includes a bearing member **23**, which rotates relative to door **10**, an annular tire member **24** which is mounted on bearing **23**, and a bracket **25**, which connects bearing **23** to door **10**. Bracket **25** is connected near the center of door **10** to a bottom member **26** of door **10** by means such as machine screws **27**.

Bearing **23** includes an inner race shaft portion **28**, an outer race wheel portion **29**, and a pair of lower and upper groups of anti-friction bearing ball members **30**,

31, which are disposed between inner race 28 and outer race 29. Outer race 29 has an outer surface 32 with an annular slot 33, which receives tire 24. Slot 33 is disposed the groups of bearing ball members 30, 31 so as to minimize the thickness of race 29. Tire 24 is bonded to slot 33 by a method of bonding such as by using an appropriate adhesive, or like method. Inner race 28 has a reduced end portion 34 of oblong-shaped cross-section, which extends through a slotted hole 35 in bracket 25. Inner race 28 receives a machine screw 36, which connects end portion 34 to bracket 25. Tire 24 is normally in engagement with one or the other of the groove sidewalls 21, 22. The clear distance between groove sidewalls 21, 22 is greater than the outer diameter of tire 24 to assure that tire 24 engages only one of the sidewalls 21, 22 at a time. The operation of door guide 19 and the effect of the variable normal force on door guide 19 is explained hereafter.

Members 30, 31 and the engaged surfaces of races 28, 29, have a relatively low coefficient of rolling friction so that the starting torque required to rotate outer race 29 is minimized. Members 30, 31 and races 28, 29 are preferably composed of a suitable metal of relatively high hardness and strength to minimize rolling friction and to resist bending and bearing stresses. Tire 24 has a relatively high coefficient of sliding friction so that sliding of tire 24 on sidewall 21 or 22 is substantially avoided, such as sliding of tire 24 is avoided when tire 24 exerts a relatively low normal force on a smooth groove sidewall of a metal door sill. Tire 24 is preferably composed of an elastomeric material, such as a polyurethane elastomer or like material, which has a relatively high coefficient of sliding friction to minimize sliding, which is abrasion resistant for long life, and which is sound deadening for quiet operation. The coefficient of sliding friction of the surface of tire 24 on sidewall 21 or 22 is substantially higher than that of outer surface 32 relative to sidewall 21 or 22. The modulus of elasticity and the hardness of members 30, 31 and races 28, 29 are substantially higher than that of tire 24.

Bracket 25 also has a pair of safety-stop flange portions 37, 38 which are also received in groove 20 near the center thereof and which are disposed on opposite sides of bearing 23. Flanges 37, 38 clear away from the path of bearing 23 any waste particles, which may fall into groove 20; and flanges 37, 38 also limit the movement of door 10 relative to groove 20 in a direction transverse thereto for safety when bearing 23 is disconnected from door 10, such as when bearing 23 is disconnected and removed temporarily for repair. Bracket 25 also has alternate slotted holes 39, 40 which are disposed on opposite sides of hole 35 to receive end portion 34, and which provide alternate positions for adjusting the location of the connection of bearing 23 to door 10. In this way, after door 10 is installed and aligned to minimize tilting and after its suspension is adjusted, bearing 23 can be adjustably positioned and fixedly connected to door 10 so that bearing 23 can be located reasonably close to the center of groove 20.

In operation, door guide 19 is normally subject to a variable normal force, which may be a relatively large force due to a relatively large wind load on door 10 or which may be a relatively slight force. If there is no wind load on door 10, the slight imbalance in the suspension of door 10 is usually sufficient to cause a slight normal force on door guide 19. Thus, the normal force on door guide 19 varies from a very low force to a very high force.

FIG. 7 is a graph of friction force versus normal force on a moving door guide. Curve A of FIG. 7 represents the old prior art door guide, such as a solid steel block; and curve C of FIG. 7 represents the new door guide 19 according to the invention for comparison. FIG. 7 also has a curve B, which is included for comparison with curves A and C, as explained hereafter. Each point on curves A, B and C is equal to the ratio of the friction force to the normal force on its respective door guide, which ratio is equal to the coefficient of friction.

Curve A of FIG. 7 has a substantially constant slope, which is approximately equal to its coefficient of sliding friction. Curve C of FIG. 7 changes in slope at the starting torque friction force F_t. Curve C has a steep slope below the starting torque friction force F_t, which slope is approximately equal to its coefficient of sliding friction; and has a substantially flat slope above the starting torque friction force F_t, which slope is approximately equal to its coefficient of rolling friction. A comparison of curves A and C indicates that the new door guide 19 substantially minimizes the friction force when the door is subject to a relatively high normal load.

Tests on bearing 23 verify that it is necessary to combine tire 24 with bearing 23. Tests on bearing 23 without tire 24 indicate that flat portions are worn on outer surface 32 by sliding on sidewall 21 or 22 when the normal load is insufficient to rotate bearing 23. This occurs when there is little or no wind load on door 10, which is the condition that usually exists.

Curve B of FIG. 7 shows that it is necessary to use tire 24 on bearing 23. Curve B represents bearing 23 itself without tire 24 for comparison with new curve C of FIG. 7. As explained before, bearing 23 is composed of a metal of relatively high hardness and strength to minimize rolling friction and starting torque and to resist bending and bearing stresses due to the normal load thereon. Curve B of bearing 23 changes in slope at the level of the starting torque friction force F_t. Curve B has a step slope below starting torque friction force F_t. which slope is approximately equaly to its coefficient of sliding friction; and it has a flatter slope above starting torque friction force F_t, which slope is approximately equal to its coefficient of rolling friction.

A comparison of curves B and C of FIG. 7 verifies that it is necessary to combine tire 24 with bearing 23. A comparison of curves B and C of FIG. 7 illustrates that the normal force F_c of new curve C, which can generate the starting friction force F_t, is much lower than the corresponding normal force F_b of curve B. This shows that the new door guide 19 with tire 24 does not slide on the groove sidewall 21 or 22 in the range of normal force between F_c and F_b in FIG. 7, while the bearing 23 by itself without a tire 24 does slide in this range. Thus, when there is substantially no wind load on door 10, the use of tire 24 assures that bearing 23 will rotate and avoid wearing of flat portions on the surface of bearing 23. In addition, tire 24 also reduces guide noise, door shaking, transfer of vibration from the door to the sill, and door maintenance.

While the present invention has been described in a preferred embodiment, it will be obvious to those skilled in the art that various modifications can be made therein within the scope of the invention. For example, two door guides can be attached to the bottom edge of door 10 instead of one door guide 19. In addition, two bearings can be mounted on bracket 25, instead of one bearing 23. It is intended that the appended claims cover all such modifications.

What is claimed is:

1. A door guide arrangement for guiding the bottom edge of an elevator door which is supported by a wall and which is slidable to open and closed positions relative to an opening in the wall and which is suspended by door support means slidably supporting the door from the wall, and for following a door sill means which is disposed below the door and which has an elongate groove with oppositely facing sidewalls, comprising:

an elongate guide support connected to the door and having stop means disposed between said groove sidewalls,

adjustable fastening means arranged to connect said guide support to said door bottom edge and to ad-

justably position said stop means relative to said groove sidewalls,

rotatable bearing means having an inner portion fixedly mounted on said guide support and having a longitudinal axis and having an outer portion with an outer surface facing said groove sidewalls and rotatably supported by said inner portion for rotation relative thereto,

said bearing outer portion being a one-piece member of cylindrical shape,

two axially-spaced annular groups of anti-friction members disposed between said inner portion and said outer portion,

an annular friction member mounted on and fixedly connected to said outer portion surface having a surface with a substantially higher coefficient of sliding friction than said outer portion surface, and

adjustable connector means arranged to fixedly connect said bearing inner portion to said guide support and to adjustably position said annular friction member relative to said groove sidewalls.

2. The door guide arrangement in calim 1, wherein said outer portion surface has an annular slot receiving said annular friction member, and wherein said bearing outer portion has a radially inner surface, said radially inner surface having two axially-spaced annular inner grooves respectively receiving said two groups of anti-friction members, said inner grooves being disposed on axially opposite sides of said annular slot and spaced substantially equidistant therefrom.

3. The door guide arrangement in claim 2, wherein said bearing inner portion has two axially-spaced parts having an assembly joint therebetween near one end thereof, said assembly joint being disposed radially inwardly of one group of said anti-friction members.

4. The door guide arrangement in claim 3, wherein said guide support is an elongate angle bracket having a plurality of spaced slotted hole portions, and wherein said bearing inner portion has an end portion near the other end thereof shaped to fit said slotted hole portions and to receive said connector means for adjustably positioning the bearing in a longitudinal direction and in a transverse direction relative to the door and the groove sidewalls.

5. The door guide arrangement in claim 4, in which said stop means includes, a pair of flanges received in said groove and disposed on opposite sides of said bearing, and in which said bracket has a central slotted hole portion disposed between said flanges equidistant therefrom.

6. The door guide arrangement in claim 5, wherein the coefficient of rolling friction between said bearing portions and said groups of anti-friction members is substantially less than that between said annular friction member and said groove sidewalls, and wherein said annular friction member has a substantially lower modulus of elasticity and lower hardness than said bearing portions and said groove sidewalls, and wherein said annular friction member has an axial height which is substantially smaller than the axial spacing between said two groups of anti-friction members and which is substantially smaller than the axial height of said groove sidewalls engaged therewith.

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U.S. Cl. X.R.

16—90; 187—56; 308—6