June 17, 1930. E. J. G. PHILLIPS 1,764,976

FOLDING DOOR

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Fig. 1.

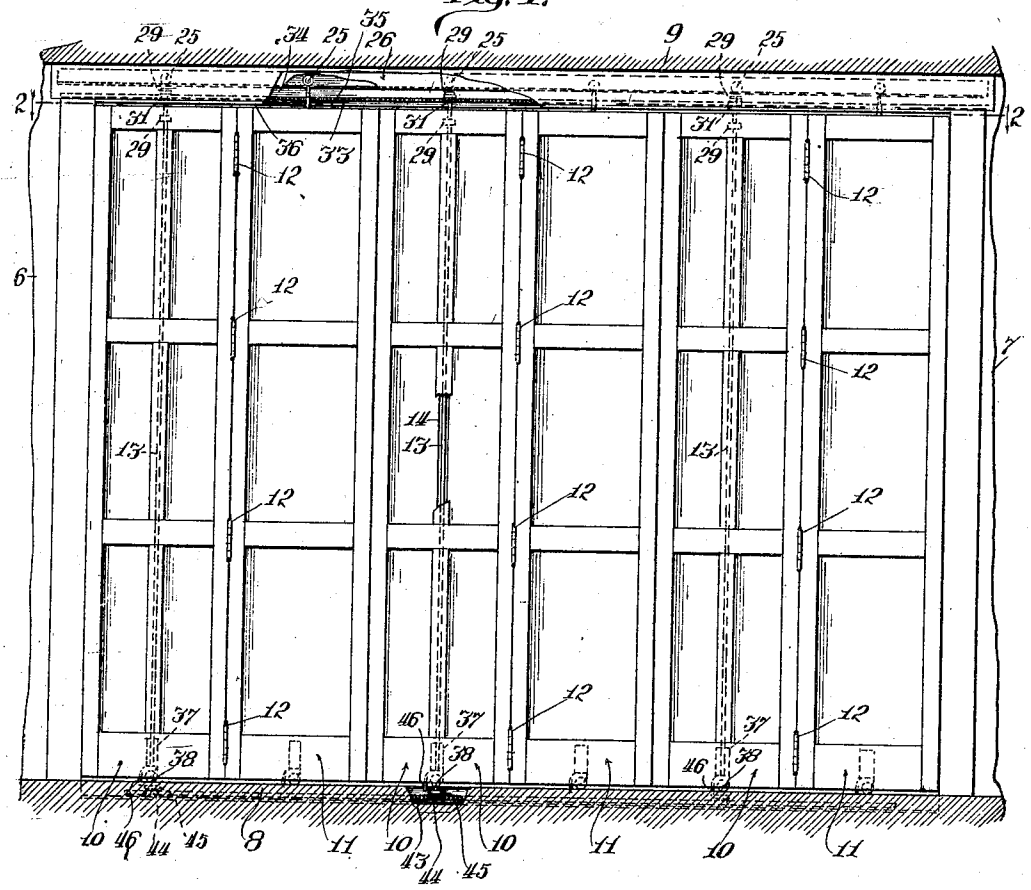
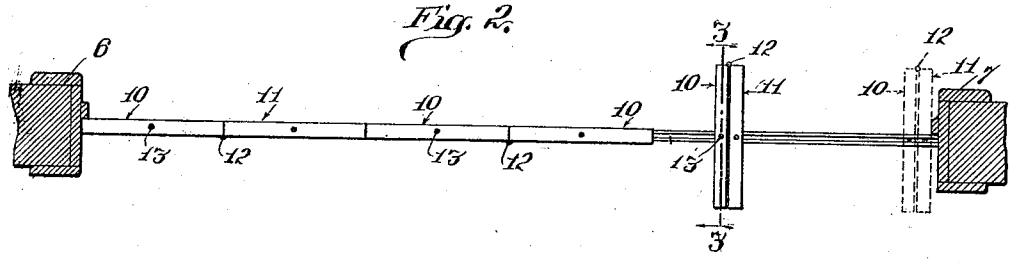


Fig. 2.



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Fig. 3.

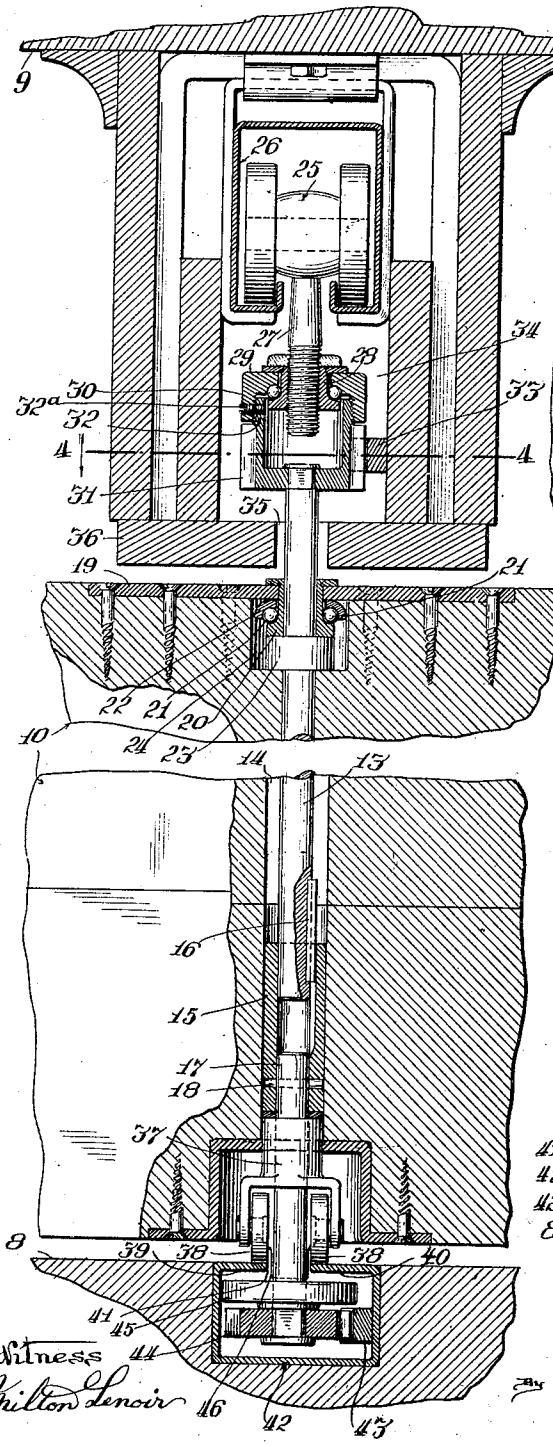


Fig. 4.

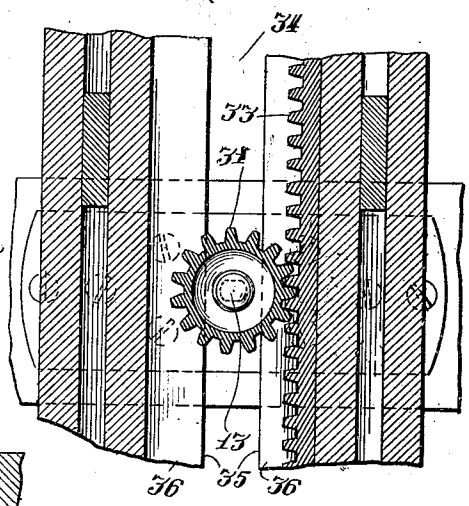
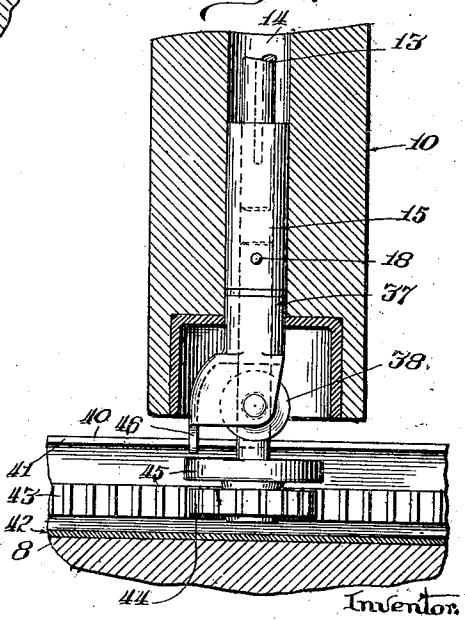


Fig. 5.



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UNITED STATES PATENT OFFICE

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FOLDING DOOR

Application filed June 23, 1924. Serial No. 721,882.

My invention relates to folding doors of the accordion type, or doors composed of a plurality of leaves, hinged together so that the several leaves may be folded together in an accordion-like manner, and when so folded will occupy a transverse position relative to the door opening, and be bunched either at one end thereof, or part at one end and part at the other. Sometimes such doors are suspended from hangers connected with alternate leaves and arranged to run on a track extending longitudinally of the door-way immediately above its upper or head jamb, the lower portion of the door being guided by some form of guiding means attached to the lower margins of alternate leaves and running in a slot in the floor, or on a slotted rail set into the floor, and extending longitudinally of the door-way. Doors of this kind are, however, apt to stick or bind when it is attempted to move them longitudinally of the door-way, unless uniform pushing force be applied to their upper and lower ends, and as such uniform application of power is not apt to occur in practice, such doors as heretofore constructed have not operated satisfactorily.

My present invention has to do with the mounting of such doors, and has for its principal object to provide devices for that purpose, by the use of which the leaves will slide more easily and without cramping or binding should the pushing power be applied unevenly so that it would tend to move one end of the folded leaves faster than the other. Another object is to provide an improved mounting for folding doors of the accordion type, by the use of which the leaves may all be made of the same width and the use of leaves of half width at the ends of the door opening will be avoided, and a further object is to improve door mountings of this character in various other respects that will be hereinafter pointed out. I accomplish these objects as illustrated in the drawings and as hereinafter described. What I believe to be new is set forth in the claims.

In the accompanying drawings,—

Fig. 1 is a front elevation of a door opening showing my improvements in a general way, applied to a door composed of three pairs of leaves, some parts being broken away;

Fig. 2 is a horizontal section on line 2—2 of Fig. 1, except that one of the pairs of leaves is shown folded;

Fig. 3 is an enlarged detail, being a vertical section on line 3—3 of Fig. 2, some parts being broken away;

Fig. 4 is a cross-section on line 4—4 of Fig. 3; and

Fig. 5 is a partial vertical section similar to the lower part of Fig. 3, but taken at right angles to the section there shown.

Referring to the drawings,—6, 7 indicate the end jambs of a door-way, 8 the floor, and 9 the upper jamb. Mounted in the door-way is a folding door which, in the illustrated construction, comprises three pairs of leaves, the leaves of each pair being indicated by the reference numerals 10, 11, and being connected together along their abutting margins by hinges 12 so that they may be swung relatively to each other either to a position of alinement or to a position of parallelism. When the leaves of the several pairs are in alinement they are designed to completely close the door-way, as illustrated in Fig. 1, and if desired the margins of the several leaves may be arranged to interlock in any well known way to make a tighter closure. It will be noted that all the leaves may be, and preferably are, of the same width, and that the end leaves are not connected with the end jambs of the door-way, so that all the folded leaves may be assembled at either end of the door opening when they are moved as hereinafter described, or some of them may be moved to one end thereof and the rest to the other end, or some may be left unfolded while others are folded, as shown, for example, in Fig. 2.

Coming now to the manner in which the pairs of leaves are mounted for movement relatively to the door opening, by reference particularly to Figs. 1 and 3 it will be seen that one leaf of each pair, as for example the leaf 10, is provided with a vertically disposed rod or shaft 13 which extends longitudinally of the leaf midway between its side margins, the door having a suitable bore 14 to receive said rod. In the illustrated construc-

tion said rod is made in three parts, so that it is extensible to adapt it to fit doors of different heights, and also to accommodate variations in the distance between the door hanger track and the floor track hereinafter referred to, this being accomplished in the illustrated construction by providing a sleeve 15, which fits telescopically on the lower end of the upper member 13 of said rod and is keyed thereto by a spline 16 so that said parts rotate together. The sleeve 15 is rotatably mounted in the bore 14, and at its lower end it is connected with a rod 17 similar to the rod 13 and forming a downward extension thereof. The rod 17 is non-rotatably connected with the sleeve 15 preferably by a pin 18. It will be noted that the rod 13 extends up above the upper margin of the leaf in which it is fitted, and the rod 17 extends down below the lower margin of such leaf, the object of which will be hereinafter set forth. By the construction described I provide an extensible pivot rod or shaft for the leaf, located centrally with respect to the side margins thereof, so that the leaf is balanced and swings easily about such pivot as an axis. Preferably only one leaf of each pair is equipped with the pivoting devices described.

The leaf is suspended on the upper portion of the rod 13 by providing the upper margin of the leaf with a plate 19, preferably screwed thereto and having a central opening through which the rod 13 passes, and which fits loosely upon the upper end of a tubular member 20 having a ball race adapted to receive anti-friction balls 21. Resting upon said balls is a cup 22 which lies directly under the plate 19 and receives the downward thrust thereof. The member 20 rests upon a collar 23, preferably formed integral with the upper portion of the rod 13. The collar 23 and the anti-friction bearing members described are all contained in a recess 24 provided in the upper part of the door leaf. By this construction the weight of the leaf is supported by the rod 13 through said anti-friction devices, so that it turns easily about said rod as an axis.

The rod 13 is itself suspended from a door hanger of any approved type mounted to run on an overhead track extending along the door-way and mounted in the upper jamb in the usual way. Preferably I employ for this purpose a two-wheeled hanger 25 running in an inverted U-shaped sheet metal track 26 of well known design. As shown in Fig. 3, said hanger is provided with a depending shank or rod 27, the lower end portion of which is screw-threaded to engage a threaded sleeve 28 which forms the lower part of an anti-friction bearing, preferably a ball bearing, the upper member of which is composed of a cup 29 having a depending marginal flange 30 which is internally screw-threaded, as shown in Fig. 3. Attached to said cup by such screw threads is a pinion 31 disposed horizontally and having at its upper margin an externally screw-threaded annular flange 32 which engages the threaded flange 30, said parts being locked together by a set screw 32^a. The upper end of the rod 13 is non-rotatably connected to, and coaxially with, the pinion 31 in any suitable way, preferably by squaring the upper end of said rod and fitting it in a correspondingly shaped hole in said pinion, the upper end of said rod being then upset to prevent its withdrawal. The teeth of the pinion 31 mesh with the teeth of a rack 33 which extends longitudinally of the door-way and is firmly secured in position at one side of the path of said pinion as it is moved along by the travel of the door hanger along its track. All these parts are mounted in a suitable recess 34 in the upper jamb, such as are usually provided for the reception of door hanger tracks, the rod 13 extending through a longitudinal slot 35 in a plate 36 which forms a partial closure for the recess 34 at its under side.

The lower portion of the rod 13, or rather the downward extension 17 thereof, carries a bracket 37 in which are mounted anti-friction rollers 38 which project a short distance below the lower margin of the door leaf, the axis of said rollers being parallel with the axis of the door hanger rollers. The rollers 38 run on tracks 39, 40 level with the floor and disposed at opposite sides of a slot 41 that extends longitudinally of the door opening vertically under the slot 35 in the upper door jamb, said tracks being preferably composed of the upper horizontally disposed members of a metallic box-like member 42 which is sunk in the floor and extends longitudinally of the door-way from end to end thereof. As shown in Fig. 3, said box-like member is rectangular in cross-section, and to one of the side walls thereof is secured a rack 43 similar to the rack 33 and meshing with a pinion 44 carried by and non-rotatably secured to the lower end of the extension rod 17, and connected through it and the sleeve 15 with the rod 13. The pinions 31 and 44 are of the same diameter, and consequently they cooperate with their respective racks 33 and 43 to cause the upper and lower ends of the pivot rod, comprising the members 13, 15 and 17, to move at the same speed, so that it cannot be tipped or rocked in the plane of the door-way by the application of unbalanced pressure to the leaf in moving it transversely of the door opening. There is therefore no danger of binding or cramping on that account. The upper pinion 31 is held properly in engagement with the rack 33 by the door hanger, and the lower pinion 44 is held in engagement with its rack 43 by a roller 45 mounted on the rod 17 and bearing against the vertical wall of the member 42 opposite that at which the rack 43 is connected.

As shown in Fig. 3, the teeth of the pinion 31 are somewhat wider than those of the rack 33 to permit vertical adjustment of said pinion, which may be accomplished by reason of the screw-threaded connection thereof with the door hanger 25. By this means the parts may be adjusted so that the weight of the door is sustained by the hanger 25, which functions as a guide for the upper end of the rod 13 to hold the pinion 31 properly in mesh with the rack 33.

For the purpose of holding the bracket 37 against rotation, so as to hold the rollers 38 in proper relation to the tracks 39, 40, the bracket 37 is provided with a downwardly extending finger 46 which projects into the slot 41, as shown in Fig. 5, and is held by the margins of said slot against lateral swinging.

As has been explained, I prefer to provide only one of the leaves of each pair with the rods 13, 17 and sleeve 15, the other leaf being merely suspended from an ordinary door hanger, while its lower margin is provided with a rolling support such as a bracket similar to the bracket 37 and provided with the rollers 38 and the depending finger 46. Obviously, the fact that the latter leaf is hinged to the leaf having the rod 13 and the parts connected thereto, compels the tops and bottoms of both leaves to move at the same rate of speed, and therefore there is no need of duplicating such parts on both leaves, although that could be done if desired.

From the foregoing description it will be understood that a door may be composed of two or more pairs of leaves, and that the leaves of the several pairs may either be turned to a position where they aline with each other and with the other pairs of leaves, or any pair of leaves may be folded independently of the other pairs. When completely folded each pair of leaves assume the position shown at the right in Fig. 2, so that the two leaves are parallel and are at right angles to the vertical plane of the door opening. When in such position they are held against joint oscillation by the fact that the vertical pivots at the upper ends of said leaves engage the side margins of the slot 35 at separated points, and in like manner the fingers 46 at the lower ends of said leaves are spaced apart from each other in the slot 41, so that neither leaf can swing about the vertical axis of the other, nor can they both swing about a common vertical axis. The use of the anti-friction bearings between the upper end of the rod 13 and the door hanger is advantageous, because it permits said rod to rotate freely under the action of the pinions 31 and 44, and the anti-friction connection between the door leaf and said rod enables the leaf to turn easily when being folded or turned to its operative position. As the sleeve 15 is connected with the upper section of the rod 13 by the spline 16, it rotates therewith, but may slide longitudinally thereof, so that the rollers 38 automatically adjust themselves to any variations in the distance between the door hanger track and the floor tracks 39, 40 due to sagging or other causes.

What I claim as my invention and desire to secure by Letters Patent, is—

1. A folding door comprising a leaf, a door hanger mounted over the doorway to travel longitudinally thereof, an extensible rod on which said leaf is pivoted to turn about a vertical axis, said rod being connected to travel with said door hanger and to rotate relatively thereto about its own axis, means for holding said rod against tipping in the plane of the doorway when said leaf is moved longitudinally of the doorway, and a floor engaging support for the lower portion of said rod.

2. A folding door comprising a leaf, a door hanger mounted over the doorway to travel longitudinally thereof, a rod on which said leaf is pivoted to turn about a vertical axis, means pivotally connecting the upper end portion of said rod with said door hanger to cause said rod to travel with said door hanger and to permit rotation of said rod about its own axis, said means being adjustable to adjust said rod vertically, means for holding said rod against tipping in the plane of the doorway when said leaf is moved longitudinally of the doorway and a floor engaging support for the lower end of said rod.

3. A folding door comprising a leaf, a door hanger mounted over the doorway to travel longitudinally thereof, an extensible rod on which said leaf is pivoted to turn about a vertical axis, said rod being connected to travel with said door hanger and to rotate relatively thereto about its own axis, means for holding said rod against tipping in the plane of the doorway when said leaf is moved longitudinally of the doorway, and an anti-friction support for the lower end portion of said rod.

4. A folding door comprising a leaf, a door hanger mounted over the doorway to travel longitudinally thereof, an extensible rod on which said leaf is pivoted to turn about a vertical axis, means pivotally connecting the upper end portion of said rod with said door hanger to cause said rod to travel with said door hanger and to permit rotation of said rod about its own axis, said means being adjustable to adjust said rod vertically, means for holding said rod against tipping in the plane of the doorway when said leaf is moved longitudinally of the doorway, and an anti-friction support for the lower end portion of said rod.

5. A folding door comprising a leaf, a door hanger mounted over the doorway to travel longitudinally thereof, an extensible rod on which said leaf is pivoted to turn about a vertical axis, an anti-friction bearing connection

between said rod and said door hanger arranged to permit said rod to rotate about its own axis, said connection being adjustable toward and from the door hanger, means for holding said rod against tipping in the plane of the doorway when said leaf is moved longitudinally of the doorway, and an anti-friction support for the lower end of said rod.

6. A folding door comprising a leaf, a door hanger mounted over the doorway to travel longitudinally thereof, said hanger having a depending member, a pinion mounted on the lower end portion of said member, a rack extending longitudinally of the doorway and engaging said pinion, an extensible rod depending from said pinion and rotating therewith, a pinion at the lower end of said rod and rotating therewith, a rack extending longitudinally of the doorway and engaging the latter pinion, means pivotally supporting said leaf on said rod to permit said leaf to turn about a vertical axis, and an anti-friction support for the lower end of said rod.

7. A folding door comprising a leaf, a door hanger mounted over the doorway to travel longitudinally thereof, a rod on which said leaf is pivoted to turn about a vertical axis, said rod being connected to travel with said door hanger and to rotate relatively thereto about its own axis, means for holding said rod against tipping in the plane of the doorway when said leaf is moved longitudinally of the doorway, a bracket loosely mounted on the lower portion of said rod, anti-friction rollers carried by said bracket to run on the floor, and means for preventing said bracket from rotating.

8. A folding door comprising a vertically-disposed rod, a door hanger connected with the upper end portion thereof, a leaf pivoted centrally between its side margins upon said rod to turn about said rod as an axis, into angular relation with the door-way, means operating to hold said rod against tipping in the plane of the doorway when said leaf is moved longitudinally of the doorway, and a floor engaging support for the lower portion of said rod.

9. A folding door comprising a vertically-disposed extensible rod, a door hanger connected with the upper end portion thereof, a leaf pivoted centrally between its side margins upon said rod to turn about said rod as an axis, into angular relation with the doorway, means associated with the end portions of said rod operating to hold the same against tipping in the plane of the doorway when said leaf is moved longitudinally of the doorway, and a floor engaging support for the lower portion of said rod.

10. A folding door comprising a vertically-disposed extensible rod, a door hanger connected with the upper end portion thereof, a leaf pivoted centrally between its side margins upon said rod to turn about said rod as an axis, into angular relation with the doorway, racks and pinions associated with the end portions of said rod for holding the same against tipping in the plane of the doorway when said leaf is moved longitudinally of the doorway, and a floor engaging support for the lower portion of said rod.

11. A folding door comprising a leaf, a door hanger mounted over the doorway to travel longitudinally thereof, an extensible rod on which said leaf is pivoted to turn about a vertical axis, said rod being connected to travel with said door hanger and to rotate relatively thereto about its own axis, means for holding said rod against tipping in the plane of the doorway when said leaf is moved longitudinally of the doorway, a floor engaging support for the lower portion of said rod, a second leaf hinged to said first-mentioned leaf, and an overhead door hanger pivotally connected with said second leaf to permit the latter to turn about a vertical axis

12. A folding door comprising a leaf, a door hanger mounted over the doorway to travel longitudinally thereof, an extensible rod on which said leaf is pivoted to turn about a vertical axis, said rod being connected to travel with said door hanger and to rotate relatively thereto about its own axis, means for holding said rod against tipping in the plane of the doorway when said leaf is moved longitudinally of the doorway, a floor engaging support for the lower portion of said rod, a second leaf hinged to said first-mentioned leaf, an overhead door hanger pivotally connected with said second leaf to permit the latter to turn about a vertical axis, and an anti-friction support for the lower end portion of said second leaf.

13. A folding door comprising a leaf, a door hanger mounted over the door-way to travel longitudinally thereof, an extensible rod on the upper portion of which said leaf is suspended, said rod being connected to travel with said door hanger, and an anti-friction support bearing on the floor below the leaf, said support being connected with the lower portion of said rod.

14. A folding door comprising a leaf, a door hanger mounted over the door-way to travel longitudinally thereof, a rod on which said leaf is pivoted to turn about a vertical axis, said rod being connected to travel with said door hanger and to rotate relatively thereto about its own axis, and an anti-friction support bearing on the floor below the leaf, said support being connected with said rod and adjustable longitudinally thereof.

15. A folding door comprising a leaf, a door hanger mounted over the door-way to travel longitudinally thereof, a rod on which said leaf is pivoted to turn about a vertical axis, said rod being connected to travel with said door hanger and to rotate relatively

thereto about its own axis, said rod having upper and lower end portions non-rotatably connected together, and automatically adjustable longitudinally relatively to each other, means supporting the weight of said leaf on the upper end portion of said rod and means for holding the leaf against tipping in the plane of the doorway when it is moved longitudinally thereof.

16. A folding door comprising a leaf, a door hanger mounted over the doorway to travel longitudinally thereof, a rod on which said leaf is pivoted to turn about a vertical axis, said rod being connected to travel with said door hanger and to rotate relatively thereto about its own axis, a pinion carried at the upper end of said rod and rotating therewith, a stationary rack extending longitudinally of the doorway and engaging said pinion, a pinion mounted on the lower end portion of said rod and rotating therewith, a stationary rack extending longitudinally of the doorway and engaging the latter pinion, and adjusting means operative to raise or lower said leaf independently of vertical movement of said lower pinion.

17. A folding door comprising a leaf, a door hanger mounted over the doorway to travel longitudinally thereof, a rod on which said leaf is pivoted to turn about a vertical axis, said rod being connected to travel with said door hanger and to rotate relatively thereto about its own axis, a pinion carried at the upper end of said rod and rotating therewith, a stationary rack extending longitudinally of the doorway and engaging the latter pinion, an anti-friction roller support for the lower end portion of said rod, and adjusting means operative to raise or lower said leaf independently of vertical movement of said anti-friction roller support.

18. A folding door comprising a leaf, a door hanger mounted over the doorway to travel longitudinally thereof, a rod on which said leaf is pivoted to turn about a vertical axis, said rod being connected to travel with said door hanger and to rotate relatively thereto about its own axis, a pinion carried on the upper end portion of said rod and rotating therewith, a stationary rack extending longitudinally of the doorway and engaging said pinion, a pinion mounted on the lower end portion of said rod and rotating therewith, a stationary rack extending longitudinally of the doorway and engaging the latter pinion, and adjusting means interposed between the upper end portion of said rod and said door hanger for raising or lowering said leaf.

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