

[54] **PIVOTAL SUPPORT AND GUIDE  
 HARDWARE FOR FOLDING DOORS**

[76] Inventor: **Lester L. Smith**, 230 W. Monroe  
 St., Suite 2040, Tucson, Ariz. 60606

[22] Filed: **Jan. 28, 1974**

[21] Appl. No.: **436,961**

[52] U.S. Cl. .... **160/206**, 160/118, 16/151,  
 16/87 R, 16/93 R, 16/95 R, 16/130, 16/132,  
 16/169 R, 85/33

[51] Int. Cl. .... **E05d 15/26**

[58] Field of Search ..... 16/87 R, 87.2, 87.4 R,  
 16/91, 93 R, 95 R, 102, 105, 106, 129, 130,  
 131, 132, 151, 169, 185; 160/206, 118; 85/33

[56] **References Cited**

**UNITED STATES PATENTS**

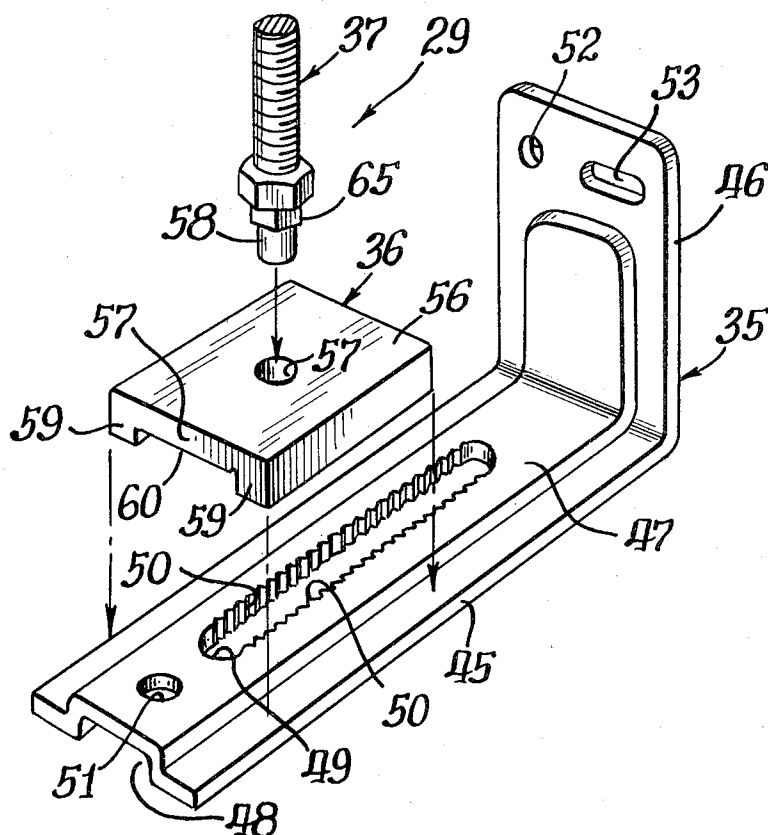
|           |         |                     |         |
|-----------|---------|---------------------|---------|
| 3,187,800 | 6/1965  | Kirby .....         | 160/206 |
| 3,233,657 | 2/1966  | Kirby .....         | 160/206 |
| 3,328,832 | 7/1967  | Gimpson et al. .... | 16/151  |
| 3,400,627 | 9/1968  | Raynovich .....     | 85/33   |
| 3,410,330 | 11/1968 | Matyas .....        | 160/206 |
| 3,597,790 | 8/1971  | Kellems .....       | 16/151  |

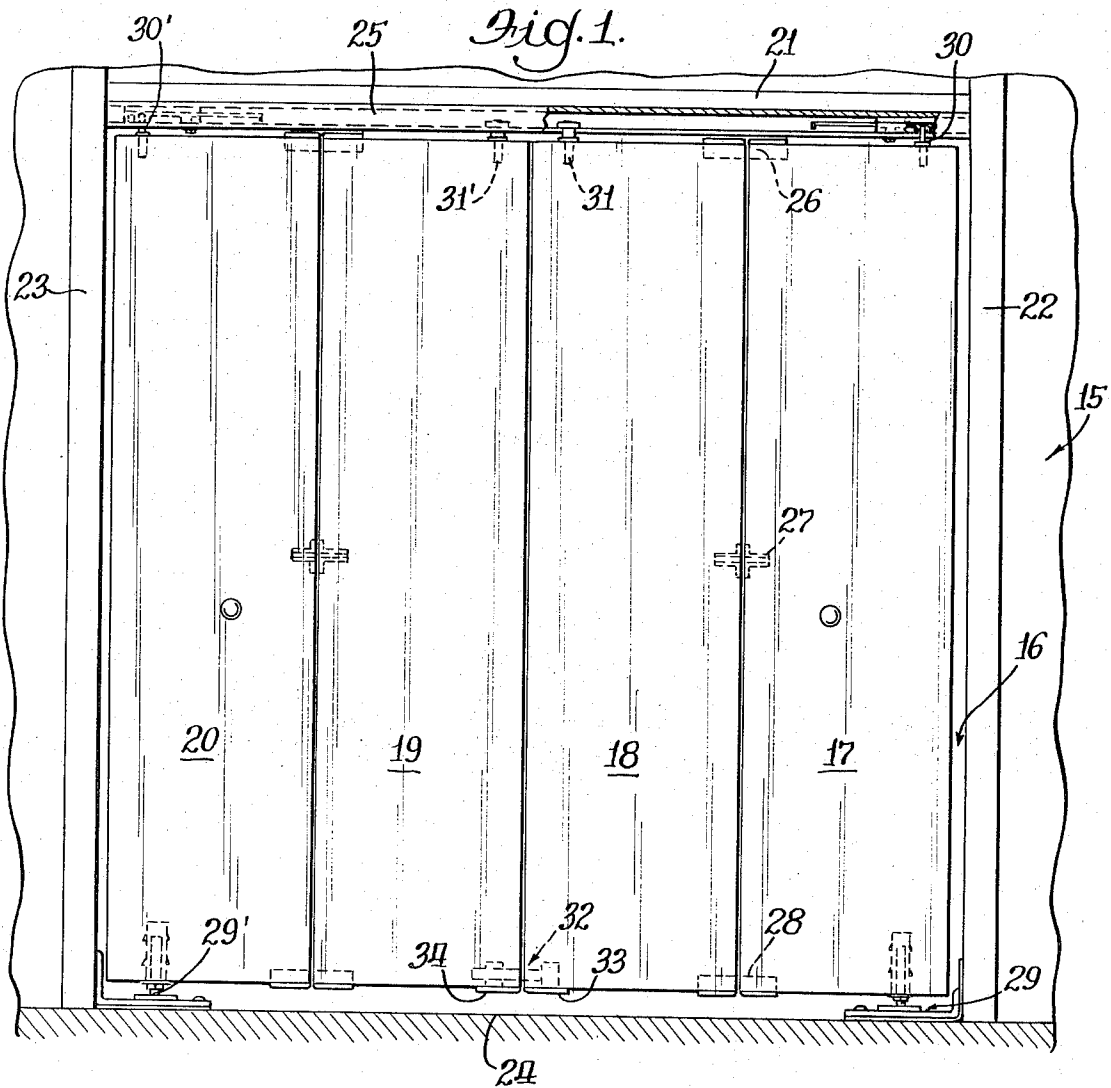
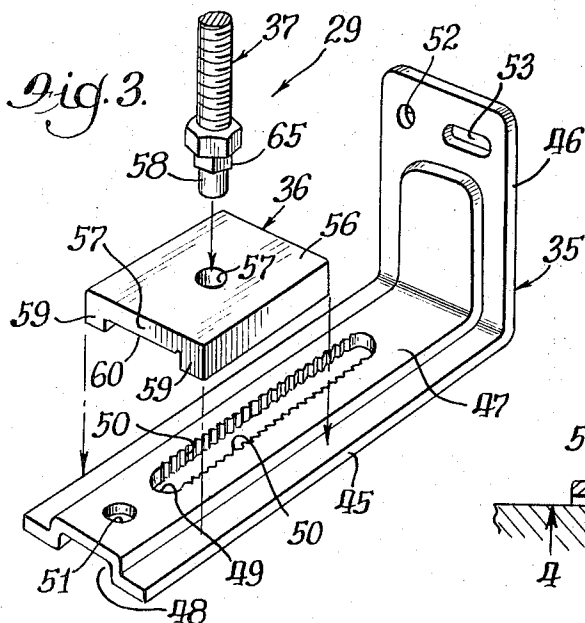
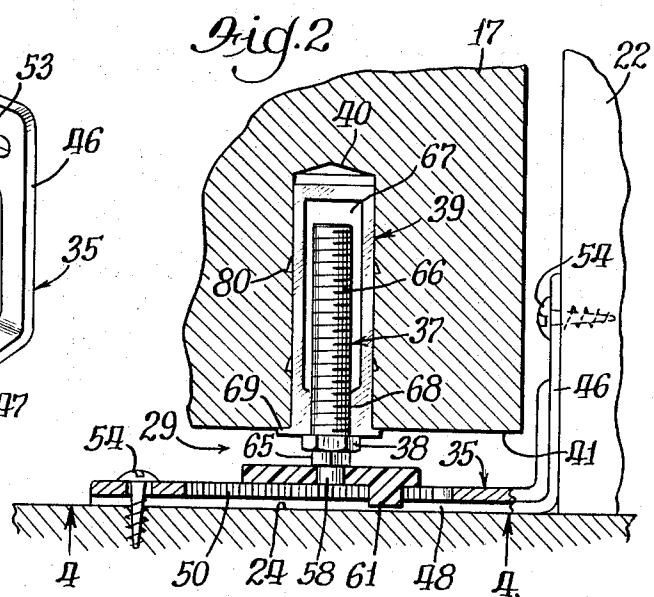
Primary Examiner—Richard J. Scanlan, Jr.  
 Attorney, Agent, or Firm—Davis, McCaleb & Lucas

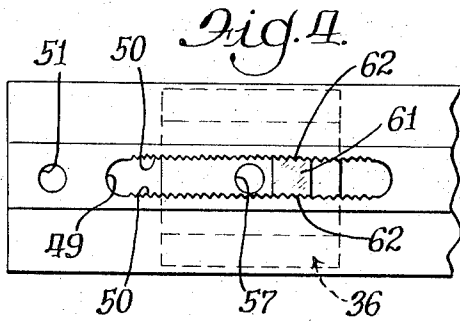
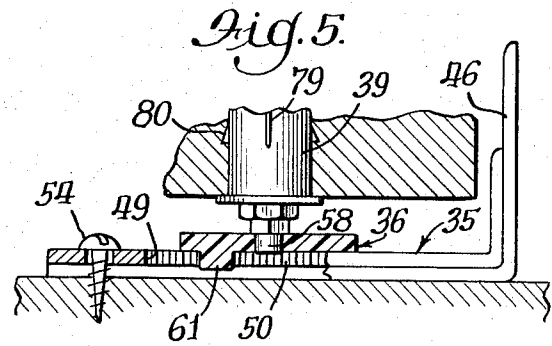
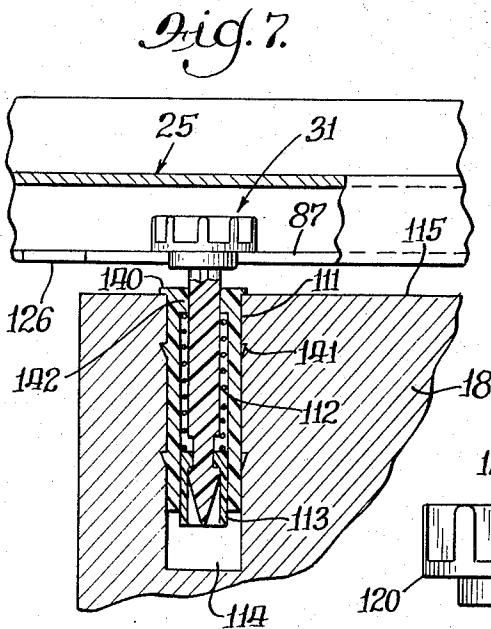
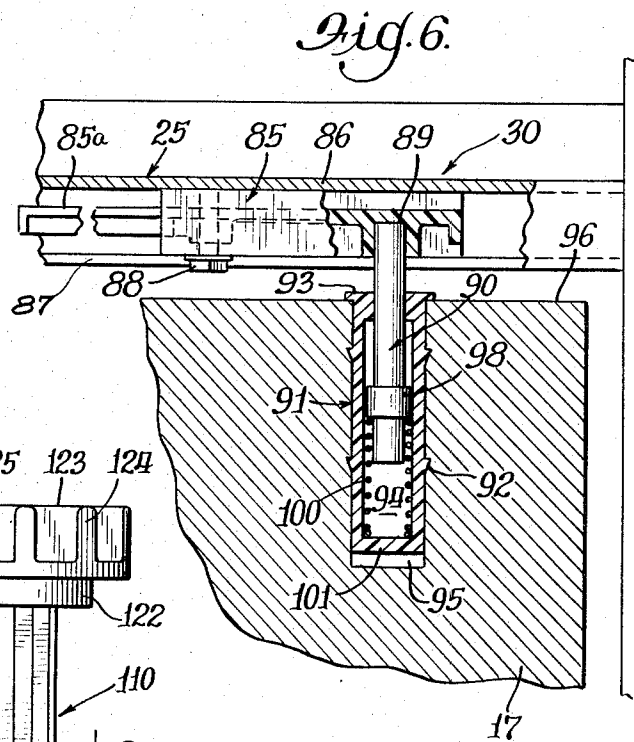
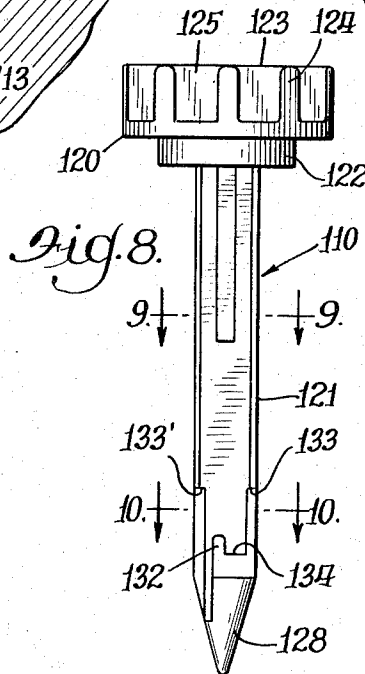
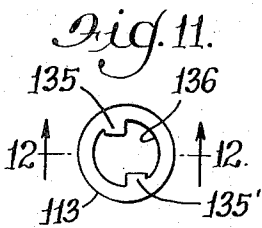
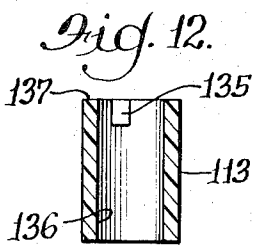
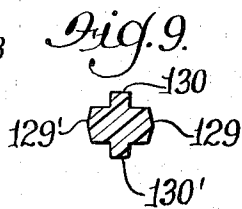
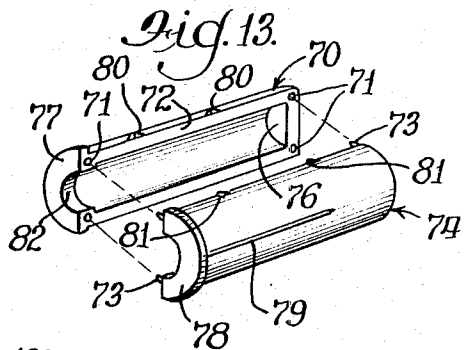
[57] **ABSTRACT**

Pivot and guide hardware assemblies adapted to low cost production and suited for use in supporting planar panels, particularly in folding door installations and the like, for pivotal swinging movements relative to one another and to and from coplanar relationship in a door opening; the hardware assemblies having housing means constituting plug-type mounting portions insertable into and quickly securable within precisely located bored openings formed in the panel edges to minimize production and installation costs and to effect proper operating positioning and alignment of the hardware. The pivot hardware assemblies are coaxially aligned adjacent the top and bottom edge portion of one of each pair of hingedly interconnected panels and include means for vertical and lateral alignment adjustment of the panels within the door opening while the edge region of the unpivotally supported panel of a pair thereof, remote from the hinge axis therebetween, is movably joined to a guide track or rail by a guide assembly movable linearly along the track and capable of resiliently supporting the panel assembly from the guide track.

**13 Claims, 13 Drawing Figures**







# PIVOTAL SUPPORT AND GUIDE HARDWARE FOR FOLDING DOORS

## BACKGROUND OF THE INVENTION

Folding door installations, whether comprising two, four or more panels have been used to provide easily openable and closable enclosures providing maximum access to and through a door opening in which the installation is mounted without requiring excessive room for swinging door movements, as in a conventionally hinge mounted door. Conventional guide and pivot hardware for supporting such panels and providing for their respective movements have been known and used. While wood panels are relatively rugged and durable, their mass and expense, cost of installation, particularly for use on household closets and cupboards, have become important factors in the building industry militating against their widespread use. While lighter wooden panels and reinforced plastic doors or panels have been used, the supporting hardware and costs of installation and maintenance thereof have been too expensive, both from a manufacturing and an installation standpoint. Additionally, previously known hardware for this purpose has been difficult to maintain in dependable operational alignment.

The present invention has within its purview the provision of improved and simplified hardware assemblies for pivotally supporting and guiding folding door panels distinguished by structure by which operational dependability may be achieved with relatively lightweight panels of wood or reinforced molded plastic and whereby the door panels may be fabricated at the time of production to include accurately aligned mounting apertures cooperative with the hardware of this invention for supporting operational pivoting and guiding assemblies in a manner to readily minimize installation time and costs and which include operationally positive means for readily adjusting and aligning the door assemblies upon installation in the field.

Among the features distinguishing the present invention from prior known hardware for this purpose is the provision of improved guide means for resiliently supporting a portion of the door weight from an overhead rail or track so as to alleviate binding and turning movement forces on the pivotal support system. By so resiliently supporting the door panels from the guide track, movements thereof along the track readily accommodate off level discrepancies between the track and the normal path or movement of doors laterally across the door opening thereby avoiding binding or jamming of the doors and permitting smooth opening and closing movements thereof. At the same time the weight supporting function of the guide means substantially alleviates turning movement forces on the coaxially aligned pivots associated with the door panels to promote dependability of operation.

In addition to the novel supporting function above alluded to, improved and simplified means are provided for vertically and laterally adjusting the doors within the door opening on their pivotal axis of the movement so as to effectuate a simplified and positive system of door alignment to avoid and minimize the necessity for realignment adjustment after repeated operational movements of the panels.

## OBJECTS OF THE INVENTION

The principal object of this invention is to provide

improved pivot and guide support hardware assemblies for folding doors in which fabricated door panels may be accurately made and bored at the time of fabrication to receive readily insertable mounting portions of parts of the hardware assemblies.

Another object of this invention is to provide improved pivotal support and guide hardware assemblies for folding doors and the like adapted for low cost production and installation and inclusive of simplified means for adjustably positioning and aligning folding door panels within and for movement across door openings.

Still another object of this invention is to provide an improved bottom pivot assembly for folding doors having novel means for vertically adjusting the positioning of the doors within a door opening supported thereby and for laterally aligning the pivotal axis of the doors.

Still a further object of this invention is to provide an improved guide assembly for folding door installations which is capable of resiliently supporting and guiding hingedly interconnected folding panels from and for movement along an overhead guide track.

Having thus described the invention, the above and further objects, features and advantages thereof will be recognized by those familiar with the art from the following detailed description of a preferred embodiment thereof illustrated in the accompanying drawings.

## DRAWING DESCRIPTION

In the drawings:

FIG. 1 is an elevational view of a wall portion having a door opening in which to accommodate double bifold door installation, comprising pivot and guide assemblies according to this invention;

FIG. 2 is a large fragmentary view in elevation, with parts thereof in section, illustrating the features of the improved bottom pivot assembly of this invention;

FIG. 3 is an exploded perspective view of the bottom pivot assembly illustrated in FIG. 2;

FIG. 4 is a top plan view thereof;

FIG. 5 is a front elevational view, similar to FIG. 2, showing alternate or modified positioning of parts for the bottom pivot assembly;

FIG. 6 is a partial fragmentary view in front elevation with parts in section setting forth the features of the improved top pivot assembly according to this invention;

FIG. 7 is a partial fragmentary view in front elevation, with parts thereof in section, illustrating the features of the improved guide assembly of this invention;

FIG. 8 is an enlarged elevational view of the improved guide roller means utilized in the assembly illustrated in FIG. 7;

FIG. 9 is a cross-sectional view taken substantially along vantage line 9—9 of FIG. 8 and looking in the direction of the arrows thereon;

FIG. 10 is another cross-sectional view taken substantially along vantage line 10—10 of FIG. 8 and looking in the direction of the arrows thereon;

FIG. 11 is a top plan view of the retainer member employed with the guide means of FIG. 8;

FIG. 12 is a cross-sectional view taken substantially along the vantage line 12—12 of FIG. 11 and looking in the direction of the arrows thereon; and

FIG. 13 is an exploded perspective view of a housing assembly employed with the hardware assemblies of this invention.

### DESCRIPTION OF THE PREFERRED EMBODIMENT

In the embodiment of this invention illustrated in the accompanying drawings for exemplifying the features thereof, a wall is formed with a door opening 16, which, as shown in FIG. 1, may constitute the entrance to a closet or the like. For enclosing the closet opening 16, either one or two pairs of planar interhinged folding panels 17, 18, 19 and 20 may be employed. Structurally, the opening 16 is bordered by a horizontal lintal 21 along its top margin, parallel vertical jamb members 22 and 23 at its opposite vertical or side margins and a floor or sill 24 along the bottom margin thereof. Extending across the top of the door opening 16 is a guide rail or track 25, usually made of extruded metal such as aluminum and having a track section providing support for guiding movements of one of the interior panels 18 or 19 of a door pair, linearly back and forth across the door opening. Top, intermediate and bottom hinge assemblies 26, 27 and 28, respectively, face or edge mounted and of known construction or of the order set forth in my application Ser. No. 422,321 filed Dec. 6, 1973, for example, serve to interconnect each pair of bifold panels 17, 18 and 19, 20 along adjacent opposing edges for hinging movement about a vertical axis defined by such hinge assemblies.

Spaced inwardly from the margins of the two outboard panels 17 and 20 which respectively lie adjacent the jamb members 22 and 23 in the illustrated installation, are pivot assemblies for supporting the panels 17 and 20 for pivotal movement about a vertical axis. Specifically, panel 17 is supported by a bottom pivot assembly 29 and a top pivot assembly 30 according to this invention while panel 20 is similarly supported by corresponding pivot assemblies 29' and 30'. The interior or inboard panels 18 and 19, or, that is, the panels unsupported by the pivot assemblies, are resiliently supported and guided from the overhead track 25 by means of guide roller assemblies 31 and 31', respectively.

Typically and preferably, bifold door installations of the type employing four panels as shown in FIG. 1 are provided at opposing edges of the interior panels 18 and 19 with aligning means 32 comprising co-acting guide parts 33 and 34 individually attached at the free or exposed bottom corner regions of the two panels for co-acting aligning such opposing edges in coplanar relation when the panels are moved to closed coplanar positions. For this purpose, alignment means of the order set out and described in my copending application, Ser. No. 422,321 above referred to or in U.S. Pat. No. 3,351,973 issued Nov. 14, 1967, may be employed.

Inasmuch as the present invention is mainly concerned with the provision of improved pivot and guide hardware assemblies, particularly adapted for bifold door installations, attention will now be directed to the improved combination and arrangement of elements of the bottom pivot assembly 29, as best illustrated in FIGS. 2 and 3 of the drawings.

As best shown in FIG. 2, assembly 29 comprises bottom angle bracket 35, which is generally L-shaped in elevational profile, a pivot block 36 mounted over bracket 35, a bottom pivot member 37 having a lock nut 38 mounted thereon and a housing means 39 insertable in a bored opening 40 formed inwardly of the lower edge 41 of a door panel 17, for instance. It will

be understood, of course, that the bottom pivot assembly 29' is identical to assembly 29, and so a description of one will suffice for both herein.

With particular reference to FIG. 3, it will be recognized that the bracket member 35 has a major floor engaging arm portion 45 formed integrally with a shorter arm portion 46 located at one end thereof and at right angular relation to portion 45. The two arm portions are stamped with a raised platform portion 47 which extends along the length of portion 45 and partly along the length of the shorter arm portion 46. This platform portion acts as a reinforcing structure and provides a clearance space 48, in particular, beneath the arm portion 45 thereof. Platform portion 47 is particularly distinguished by a central elongated opening 49 formed generally intermediately of the length of platform portion 47 and which opening 49 is formed with a pair of opposing lengthwise serrated margins or edges 50, the serrations of which resemble gear teeth. Additional openings 51, 52 and 53 are formed in the arm portions 45 and 46, respectively, opening 53 being elongated and adjacent opening 52 in the shorter arm portion 46 for receiving mounting screws 54 whereby the bracket 35 is attachable to jamb 22 and the floor or sill 24, as best illustrated in FIG. 2.

The pivot block 36, as best shown in FIG. 3, comprises a generally rectangular shaped body 56 having a central socket opening 57 receptive of a lower cylindrical pivot portion 58 of the pivot member 37. The body 56 of block 36 is further formed with a pair of depending legs 59, 59 separated by a cutaway portion 60, in the lower face thereof whereby such legs 59 are adapted to straddle the central raised platform portion 47 of the bracket arm portion 45 in operation. This relation is best illustrated in FIGS. 2-5. Also depending beneath the lower face of the cutaway portion 60 thereof is an anchor portion 61 (see FIG. 2) formed as a rectangular block (see FIG. 4) and which has serrated side margins 62, 62 for intermating engagement with the serrated or toothed margins 50 of the central opening in platform portion 47. It will be understood that with this arrangement, the pivot block 36 may be placed at various desired positions along the length of the opening 49 by locking the anchor block 61 with the serrated margins 50 of the elongated opening. It also will be understood that the anchor portion 61 may be disposed adjacent the short arm portion 46 of the anchor bracket, as best illustrated in FIG. 4, or reversibly therefrom, as illustrated in FIG. 5, to present a wide range of longitudinal position adjustments for the block 36 in operation. This adjustable positioning ability determines the displacement of the opening 57 in block 36 at selected distances laterally of bracket arm portion 46 and thus of the jamb member 22 or 23, as the case may be. Consequently, a ready and convenient system is embodied in the present invention for quickly adjusting the lateral positioning of the door pairs within the frame of the opening 16 and for adjusting the axis of pivotal movement thereof for vertical alignment regardless of the vertical or off vertical attitude of the jamb members 22 and 23, as will be understood more fully from description which follows presently.

Turning now to the features of pivot member 37, it will be seen from FIGS. 2 and 3 in particular, that the same constitutes a cylindrical machined metal member having the cylindrical pivot portion 58 at its lower end and immediately below a radially enlarged shoulder

portion 65 illustrated as having hexagonal contour to provide wrench engaging surfaces for purposes which will appear directly. Mounted immediately above portion 65 there is the adjustment nut 38 which is adapted to threadingly move along the threaded main body portion 66 of the pivot member and relative to the fixed shoulder portion 65 thereon. Shown best in FIG. 2 of the drawings, the threaded body portion 66 of the pivot member 37 extends coaxially within the hollow interior 67 of the housing member 39 and particularly threadingly engages the latter at internal shoulder portions 68 thereof.

With reference now to FIG. 13, the housing member 39 of the lower pivot assembly is substantially in accordance with the illustration there set forth with minor exceptions as will be pointed out. Basically housing member 39 is formed as two semi-cylindrical half shells adapted to closely intermate along a plane of severance coincident with the longitudinal axis thereof as shown in FIG. 13. More specifically, it will be noted that one of the half shells is constructed as a female member 70 having four socket openings 71 in its intermating face 72 for reception of male prongs 73 projecting from the opposing intermating face of a male half shell member 74 (see FIG. 13). Inasmuch as the two half shell members 70 and 74 are preferably made of molded plastic material, the location and interfitting relationship of the sockets 71 and prongs 73 are extremely accurate so that when the two half shells are fitted together, they form, for all intents and purposes, a hollow cylindrical housing closed at one end thereof by a wall made up of two half wall portions 76. At its opposite end, the housing has an enlarged collar formulated from two semi-cylindrical collar portions 77 and 78 of the intermating shell portions 70 and 74, respectively.

The external surfaces of the two shell portions are formed with one or more longitudinal extending and outwardly projecting anti-rotational ribs 79 and a plurality of mating tang portions 80 and 81. When organized in opposing registration with one another upon assembly of the two half shells, portions 80, 81 constitute barbs or tangs along the plane of severance or separation between the two half shells, which barbs or tangs effectively prevent withdrawal of the housing 39, for instance, from the mounting socket 40 therefor formed inwardly of the door edge 41. Further, it will be noted that internal surfaces of the collar portions 77 and 78 of the housing shell members illustrated in FIG. 13 provide or form a cylindrical bearing wall 82 in the construction set out in that FIGURE. The only particular difference between the housing member 39 associated with the bottom pivot assembly 29 of FIG. 2 and the housing illustrated in FIG. 13 resides in the axial extent of the bearing wall 68 of housing 39 as opposed to the bearing wall 82 in FIG. 13. Principally, it will be noted that the bearing wall 68 of housing 39 is somewhat elongated or extended thereover and is formulated with a threaded wall for engaging the threaded body portion 66 of the pivot member 37. Thus the latter may be rotatably advanced axially along the threads of portion 68 by wrench means engaged with the wrench-engaging surfaces of the shoulder portion 65 adjacent the pivot projection 58 thereon. In this fashion door panel 17, or more particularly the pair of door panels 17 and 18 may be adjustably moved vertically in response to rotational activity of the pivot member 37 to achieve the desired vertical adjustment of the doors

in the opening 16. Once the desired vertical positioning of the doors is achieved, the lock nut 38 is secured against the shoulder 69 of housing 39 to secure the pivot member 37 against further axial movement into housing 39.

From the above it will be understood that mounting of the bottom pivot assembly with the door panel 17 is accomplished quite simply by merely inserting the housing 39, previously assembled about the threaded body portion 66 of the pivot member 37 into the machine bored opening or socket 40. Once in place, the external tang projections composed of the mating portions 80 and 81 thereon positively prevent axial withdrawal of the housing from the bore 40 while the projecting ribs 79 assist the tangs to prevent rotation of such housing within bore 40. Once the housing 39 and pivot member 37 are so assembled in the bottom edge of the door panel 17, the latter is merely set on the pivot block 36 with the pivot portion 58 of member 37 entering pivot socket 57 of the pivot block to complete the assembly. In this latter regard, if it is desired to relocate the block 36 along the serrated opening 49, one has merely to raise the door and pivot member 37, relocate the block 36 to the desired position relative to the door jamb 22 and then remount the pivot member in the pivot bearing block. This assembly therefore presents a much simpler and more accurate and positive operating assembly than has been known heretofore in the art. In general prior bottom pivot assemblies of this character have employed slidably adjustable means for holding the lower pivot end of the pivot member 37 and which are operable by loosening and tightening screws or bolts holding the pivot block onto the bracket member in the manner set out in U.S. Pat. No. 3,597,790 of Aug. 10, 1971, for example.

Having described the features and structure of the bottom pivot assembly 29, attention now is directed to FIGS. 1 and 6 of the drawings wherein the upper pivot assembly 30 is illustrated. As shown best in FIG. 6, the pivot assembly 30 comprises an upper bearing block 85 adapted to be mounted in the rail member 25 between the upper wall 86 thereof and inwardly projecting guide rail or track flanges 87; the block 85 being held in desired adjustable position along the rail 25 by means of a locking screw 88, which is rotatably actuated by a screw driver or like instrument and tightened against the upper wall 86 of the rail member. Block 85 preferably is formed of plastic, such as nylon, and has a pivot receptive socket or bore 89 for rotatably receiving the upper or outer end of a cylindrical pivot member 90 of assembly 30. It will be noted that the left hand end of block 85 is formed with an extended stop arm 85a, the outer end of which is positioned along the track 25 away from the jamb member 25 to act as a stop means, engageable with the roller assembly 31 at full opening movement of the door panels 17 and 18. Thus the fully opened position of such doors is determined by the stop arm 85a.

Aside from the block 85 just described, assembly 30 also includes a cylindrical housing 91, in accordance with the described structure set forth in FIG. 13 and including external anti-rotational ribs (not shown), anchor tangs 92, a flange portion 93 at one end and an internal cylindrical chamber 94 formed by two intermating half shell portions and adapted to be insertably received and mounted within a socket 95 bored inwardly of the upper edge 96 of the door panel 17, for example.

Pivot member 90, as shown best in FIG. 6, is formed as a cylindrical metal rod of uniform diameter throughout its length except for an intermediate enlarged radially extending or projecting shoulder portion 98 of a size or diameter substantially meeting the internal diameter of chamber 94 with sufficient clearance to permit free movement of the shoulder and pivot member relative to the housing 91. A compression coil spring 100 is mounted between the lower face of the shoulder portion 98 and the bottom wall 101 of the housing 91 to normally force the pivot member 90 axially outwardly of the housing and toward the block 85 with resilient thrusting action.

With this arrangement, mounting the door panels between the upper and lower pivot assemblies is a simple matter. First the pivot member 90 is inserted into the socket 89 of block 85, and the door is raised upwardly toward the rail member 25 compressing spring member 100. In this process sufficient clearance is obtained to set the bottom pivot projection or portion 58 of the lower pivot assembly in the pivot block 36 as previously described. Thereafter vertical adjustment of the door panels is accomplished by threadingly adjusting the pivot member 37 of the lower pivot assembly relative to its housing 39 with which it is threadingly interengaged as described. In similar fashion, vertical orientation of the door panels relative to the jamb member 22 or 23, as the case may be, is carried out by positioning of the block 36 along serrated opening 49 of the lower assembly bracket 35 as previously described, and by adjustably positioning the block 85 of the upper pivot assembly along the guide rail 25 so as to achieve vertical alignment of the pivot axis defined by and between the pivot assemblies 29 and 30.

It is to be further noted that the two pivot members 37 and 90 are preferably metal while the block 85 and 36 of such pivot assemblies are preferably of a plastic material such as nylon to provide a smooth operating engagement for the outer ends of the pivot members. In this fashion the necessity for lubrication of the pivot centers is avoided while smooth and quiet sustained operation of the pivot centers is achieved.

Having described the features of the lower and upper pivot assemblies, attention is now directed to FIGS. 7 through 12 of the drawings whereat the features of the guide roller assembly 31 are set forth, it being understood that assembly 31' is identical thereto.

As best seen in FIG. 7, assembly 31 comprises combined roller and spindle means 110, housing 111 therefor, spring means 112 within the housing about the spindle portion of means 110 and a locking collar or retainer mounted within the lower end of the housing 111 on the spindle of means 110 to maintain spring 112 in operating position. The entire assembly, and more particularly the housing 111 thereof, is inserted into a mounting socket 114 bored inwardly of the upper edge 115 of an associated door panel, such as panel 18.

With specific reference now to FIG. 8 of the drawings, the roller and spindle means 110 will be described. As therein shown, such comprises a molded plastic assembly having a roller member 120 at the upper or outer end thereof and formed coaxially with a depending spindle member 121. In the particular embodiment illustrated, the roller and spindle members are integrally formed although it is fully contemplated within the purview of this invention that they may be separately constructed and interconnected for rota-

tional movement of the roller member 120 about the upper end of the spindle member 121. In the embodiment illustrated, the roller member 120 is formed with a lower cylindrical shoulder 122 and an enlarged cylindrical head portion 123, having plural extending rib portions 124 to constitute a wheel formation of generally cylindrical exterior configuration. The periphery thereof is interrupted by gaps 125 between the adjacent rib portions 124. In operation the cylindrical shoulder portion 122 fits between parallel lower flange portions 87 of the guide rail 25 and is of a diameter substantially equal to the spacing therebetween, but with sufficient clearance for free operating movement therealong. The enlarged head portion 123, on the other hand, fits over the flange portions 87 of the guide rail to ride either rotationally if so desired or with sliding movement therealong. Insertion of the enlarged head portion 123 between the flange portions 87 of the guide rail is accomplished in a conventional fashion by means of a cutout opening 126 in the metal flange portions 87 and of a diameter or size sufficient for the passage of the head portion 123 therethrough. This cutout is located beyond the normal travel of the head portion 123 along the guide rail 25 as produced by movements of the door panels 17 and 18.

As will be recognized best from an examination of FIGS. 8 and 9, the spindle portion 121 of means 110 is formed as an elongated member having a pointed lower end 128 and a body portion which is formulated by diametrically opposed rib portions 129, 129', 130 and 130' (see FIG. 9). The ribs thus provided act as a centering guide for spring means 112 in assembly. Adjacent its pointed outer end 128, the longer extending rib portions 129, 129' of spindle member 121 are cut away substantially in accordance with the cross sectional showing set out in FIG. 10, to provide a pair of upstanding locking ears 132, 132' on opposite sides thereof and clearance spaces between the upper ends of such locking ears and the lower reaches of the ribs 129, 129'. The upper limits of the clearance spaces are determined by the shouldered areas 133, 133' (see FIG. 8). Adjacent each of the upright ear portions 132, 132' is a detent shoulder or recess 134, 134' (see FIG. 10) adapted to cooperate with one of two locking tabs 135, 135', respectively, formed inwardly of the generally cylindrical interior walls 136 of the locking collar member 113, as best shown in FIGS. 7 and 12.

As shown in FIGS. 11 and 12, collar member 113 comprises a cylindrical member, preferably molded of plastic and having an internal cylindrical surface 136 of a diameter slightly greater than the external dimensions of the spindle portion 121 so as to slidably fit thereover. As noted before, the locking tabs 135, 135' project inwardly of the surface 136 to cooperate with the inset detent shoulders 134 adjacent the lower end of the spindle.

In assembly, the spring member 112 is mounted over the body of the spindle 121 and internally guided by the rib portions 129, 129' and 130, 130', as previously noted. Thereafter the locking collar 113 is mounted over the pointed outer end 128 of the spindle member, compressing spring 112 until the locking tabs 135 are above the locking ears 132. Thereupon slight rotational movement of the locking collar relative to the spindle permits the tabs 135 to move over ears 132, 132' and seat in the detent recesses 134, 134'. Thus the spring member 112 is retained in compression between the

upper end 137 of the locking collar and the upper end of housing 111, as will now be described.

As best set out in FIG. 7 of the drawings, the housing 111 comprises a cylindrical member adapted to be inserted into the mounting socket 114 as previously noted. For all intents and purposes, the housing 111 is identical with that shown in FIG. 13 except that the same does not have an outer end wall at its lower end, of the order provided by the two semi-end wall portions 76 of the structure set out in FIG. 13. However, housing 111 may be made 252 cylindrical molded shell or of two half shell portions and has an enlarged collar or flange 140 at its outer or upper end to engage against the end surface 115 of the door panel 18 when inserted fully into the socket 114. Locking tangs 141 and anti-rotational ribs (not shown) are provided on the exterior of the housing body, as in the FIG. 13 structure, to lock the housing 111 firmly in the socket 114 and prevent its rotation with respect thereto.

In the normal assembly of the elements and portions of the guide roller assembly 31, the spindle member 121 of means 110 is normally inserted through the cylindrical opening formed by the shoulder portions of housing 111 designating at 142 in FIG. 7. It will be recognized that such shoulder portions are semi-cylindrical in formation and correspond to the shoulder portions 82 in the structure set out in FIG. 13. Spring member 112 is thereafter inserted over the spindle 121 through the open bottom end of the housing 111 and the locking collar 113 is thrust upwardly beneath the lower end of the spring and locked in position in the dent recesses 134 at the lower end of such spindle to complete the assembly in the manner illustrated in FIG. 7. The entire assembly is then mounted in the socket 114 by thrusting the housing 111 thereinto so that the tangs 141 lock the same against axial withdrawal.

It will be noted that with a guide and roller assembly 31 according to this invention, spring means 112 opposes movement of the spindle member 121 outwardly of the housing 111 and resiliently urges the head portion 120 of means 110 toward the upper edge of the door 18. Thus with the roller member mounted over flanges 87 of the guide rail, as previously noted, the spring means 112 resiliently opposes movement of the door away from track 25. In this fashion assembly 31 resiliently supports a portion of the door weight from the track 25. Further, due to the resilient movement of the spindle and roller means 110 as regulated by the spring means 112, vertical variations in the door's movement along the rail 25 are readily accommodated while maintaining the same resiliently and snugly supported from the rail means.

From the foregoing description of the illustrated embodiment, it will be recognized by those of skill in this art that the objectives of this invention, particularly of providing improved pivot and guide support means for folding doors, adapted to low cost production by virtue of the ability to employ plastic molded materials for most elements thereof, accompanied by advantages permitting minimum installation time in accurately located mounting openings, have been accomplished. Also the unique structural combination of the pivot and guide assemblies present novel features of quick and positive location adjustment for folding door assemblies equipped with hardware of this invention, whereby positive alignment of the door's pivot axis is obtainable along with determination of the fully

opened position thereof through operation of the stop arm extension on the adjustable upper pivot block. Other features, such as the resilient support at the outer end of the inboard movable door panels, materially assists in the ability to maintain the pivot axis in adjusted position while assuring quiet, smooth, long life operation of door installation.

Thus, while it is believed the present invention and the attendant features and advantages thereof will be understood from the description presented herein, it will be apparent that various changes may be made in the particular form, construction and arrangement of parts and specific materials, without departing from the spirit and scope of the present invention or sacrificing its many advantages; the described embodiment being only that presently preferred to enable those of skill in the art to understand and practice the same.

I claim:

1. A hardware assembly for pivotally supporting hingedly interconnected folding door panels mounted in a door opening defined by an overhead horizontal lintel, a pair of vertical side jamb members and a floor, comprising: an elongated track mountable on and beneath the lintel and having a lengthwise extending guide slot opening inwardly of the lower face thereof; an upper pivot block mountable within said track and having a pivot socket therein communicating with said guide slot and means for anchoring said upper pivot block at selected locations along said track laterally inward of one of said jamb members, a lower pivot block having a second pivot socket formed inwardly of its upper face, a lower pivot bracket having an elongated floor engaging arm provided with means for attaching said bracket to the floor and having an elongated central opening, plural serrated teeth formed along and extending inwardly of the lengthwise opposing edges of said opening, said lower pivot block having an anchor portion depending from and beneath a bottom face thereof for insertion into said elongated opening, said anchor portion having serrated teeth matingly engageable with the serrated teeth of said elongated opening whereby said lower pivot block is positively connected to said floor engaging arm at selected locations along the length thereof, said anchor portion being positioned adjacent one end of said lower pivot block and off center with respect to said second pivot socket therein whereby the same is reversibly positionable in said elongated opening to provide a dual range of positions for interconnecting said lower pivot block with said floor engaging arm.

2. The combination of claim 1 and a pair of coaxially aligned elongated pivot pins extending outwardly of the upper and lower end edges of a door panel and having outer end pivot portions rotatably mounted in the said pivot sockets of said upper and lower pivot blocks, respectively, bi-part cylindrical housing means mounted about and encasing the inner end portion of each of said pivot pins and rotatably supporting the same, each said housing being coaxially insertable into one of a pair of coaxially aligned mounting openings therefor bored inwardly of the said upper and lower end edges of the door panel, and each said housing having tang portions projecting from the exterior thereof to prevent axial withdrawal thereof from a said mounting opening into which it is inserted.

3. The combination of claim 2 wherein said housing means is molded from plastic material and comprises a

pair of semi-cylindrical portions having intermating projections and sockets on opposing mating surfaces thereof, each of said semi-cylindrical portions having a semi-cylindrical wall portion at one end thereof, a semi-cylindrical opening comprising a bearing wall portion at the opposite end thereof, and a hollow interior whereby the assembly of the semi-cylindrical portions formulates a cylindrical housing closed at one end for encasing and supporting a major portion of a said pivot member.

4. The combination of claim 3 wherein the said bearing wall portions of the housing associated with the lower pivot member are threaded and said lower pivot member is formed with a threaded body portion engageable therewith whereby said lower pivot member is threadingly movable axially of the said housing therefor, and lock nut means on said body portion externally of said housing for locking said lower pivot member against threading movement into its housing.

5. Supporting hardware assemblies for supporting planar folding door panels in a door opening having a horizontal lintel across its upper margin, a pair of parallel spaced vertical jamb members along the lateral margins thereof and a floor or sill across its lower margin, the lintel supporting an elongated guide track having a downwardly facing guide slot opening inwardly of the lower side thereof and bordered by a pair of parallel spaced flanges comprising: an upper pivot assembly comprising an upper pivot block mountable in said guide track over said flanges thereof and laterally adjacent a said jamb member, means on said upper pivot block for releasably locking the same to and within said track at selected positions relative to said jamb member, said upper pivot block having a cylindrical pivot socket opening inwardly of its lower face, opposite said guide slot; a pivot pin mounted to extend outwardly of the upper end edge of a door panel and having an outer end portion insertable in said pivot socket, a bi-part housing surrounding and rotatably supporting said pivot pin and mountable within a cylindrical mounting socket therefor bored inwardly of the said upper end edge of said door panel, said pivot pin having an enlarged shoulder intermediate its ends, located within said housing, and spring means mounted between said shoulder and a closed bottom wall of said housing for resiliently biasing said pivot pin to maintain the outer end portion thereof in said pivot socket; and a lower pivot assembly comprising an L-shaped mounting bracket having an elongated floor engaging arm portion and a jamb engaging arm portion formed at right angles thereto, said floor engaging arm portion having a central raised platform portion provided with an elongated central opening with spaced serrated lateral margins, said arm portions being receptive of means for attaching the same to the floor and said jamb member, respectively; a lower pivot block mounted in straddling relation over said platform portion and having a depending portion formed with serrated edges lockingly engageable with the serrated margins of said elongated opening whereby to provide selective positioning of said lower pivot block on said floor engaging arm and in relative spaced relation to said jamb member, said lower pivot block having an upper planar surface formed with a second pivot socket extending inwardly thereof; a lower pivot pin having a cylindrical threaded body, a pivot portion at its outer lower end receptive in the socket of said lower pivot block, and wrench-

engaging surfaces formed intermediate said threaded body and pivot portion, a bi-part housing surrounding said threaded portion and having means threadingly engaged with the latter, and a lock nut mounted on said threaded body portion beneath said housing for selectively locking said pivot pin against threading movement into said housing, said housing being insertable into a mounting socket formed inwardly of the lower end edge of the said panel in coaxial alignment with the said socket formed in the upper end edge thereof and having tang and rib means operable to prevent rotational and axial movement of said housing in said mounting socket, whereby said panel mountable between said upper and lower pivot blocks, is pivotal on the axis of said pivot pins, is adjustable laterally relative to said jamb member by selective positioning of said pivot blocks and is adjustable vertically by threaded movement of said lower pivot pin.

6. The combination of claim 5, and a guide roller assembly resiliently supporting a second non-pivotally supported panel of a hingedly joined pair of panels comprising: a guide wheel over-engageable with the spaced flanges of said track, an elongated spindle member extending coaxially from said guide wheel and depending therebeneath, housing means coaxially receptive of said spindle member and insertably mountable in a mounting socket therefor bored inwardly of the upper end edge of said second panel, said housing having tang projections on its exterior for preventing its withdrawal from said mounting socket, spring means surrounding said spindle member within said housing with one end of said spring means engaging an upper interior wall of said housing; and a locking collar removably mounted over the lower end of said spindle member and having an end surface engaging the lower end of said spring whereby said spring resiliently opposes movement of said spindle out of said housing to provide a resilient suspending support for said panel from said track.

7. The combination of claim 6 and surface portions on said wheel for slidably engaging said flanges.

8. The combination of claim 6 wherein said wheel is rotatable about the upper end of said spindle member.

9. The combination of claim 6 wherein said housing is formed as a bi-part molding of plastic material consisting of two semi-cylindrical shell portions having intermating surfaces and interlocking projections and recesses therein whereby such shell portions assemble to form an open ended cylinder, and tang portions extending from the exterior of said cylindrical shell portions in directions opposing axial withdrawal of said housing from its said mounting socket.

10. The combination of claim 6 wherein said spindle member is formed integrally with said guide wheel, and is formed with detent recesses adjacent the lower end thereof, said locking collar being coaxially insertable over the lower end of said spindle member and formed with opposing internal projections receptive in said detent recesses whereby to interlock said spindle and collar.

11. In a bifold door assembly comprising a pair of planar door panels hingedly interconnected along adjacent opposing marginal edges within a rectangular door opening and mounted for pivotal movement of one panel thereof about an axis adjacent one side jamb margin of said door opening, the combination comprising: overhead track means mounted along the upper

13

margin of said door opening and having a lengthwise extending guide slot opening inwardly of the lower face thereof, a guide roller assembly suspending the second non-pivotally supported panel of said pair adjacent the unhinged margin thereof comprising roller means mounted in and engaged with said track and having a portion extending through said guide slot thereof, spindle means depending coaxially from said guide roller, housing means coaxially surrounding said spindle means and adapted for insertion into a socket therefor bored inwardly of the upper end edge of said second panel, means for locking said housing in said socket, spring means mounted about said spindle means within said housing and having an upper end thereof engaged with an internal upper wall of said housing, and means locked over the lower end of said spindle means within said housing and engageable with the lower end of said spring means whereby the latter opposes movement of said spindle means axially out of said housing thereby to provide a resilient supporting force urging said second panel upwardly toward said track.

12. The combination of claim 11, and upper and lower pivot assemblies supporting said one panel adjacent said jamb margin, each said pivot assembly having a pivot pin extending inwardly of an end edge of said one panel and defining a pivotal axis therefor, and each said pivot assembly having means for laterally adjusting said pivot axis relative to said jamb margin; said guide roller assembly in vertically supporting said second panel from said track counteracting turning moment

14

forces on said means for adjusting said axis thereby to maintain the same in adjusted position.

13. In a hardware assembly for pivotally supporting a door for movement about a vertical pivotal axis, a bottom pivot assembly comprising: a floor engaging bracket having an elongated arm portion associated with means for mounting the same over a horizontal undersupport, said arm portion having an elongated platform portion operationally disposed in parallel spaced relation to the undersupport and formed with an elongated opening therein, and plural serrated teeth formed along and projecting inwardly of opposing lengthwise edges of said opening; pivot means comprising a rigid pivot member carried in a generally cylindrical housing means adapted to be mounted in a socket therefor formed inwardly of the bottom edge of the door, said pivot member having a lower portion extending outwardly of said door edge and contiguous to a threaded shank portion threadingly engageable with said housing for thread-regulated movement of said pivot member relative to said door; and support means insertable through said opening in said platform portion and having teeth thereon lockingly interengageable with the serrated teeth in said elongated opening whereby to detachably interconnect said pivot member with said bracket at selected positions along the length of said elongated opening for the purpose of vertically aligning the pivotal axis of the door.

\* \* \* \* \*

35

40

45

50

55

60

65

UNITED STATES PATENT OFFICE  
CERTIFICATE OF CORRECTION

PATENT NO. : 3,866,658  
DATED : February 18, 1975  
INVENTOR(S) : Lester L. Smith

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

Title page of patent [76] shows: "Inventor: Lester L. Smith, 230 W. Monroe St., Suite 2040, Tucson, Ariz. 60606" should be --Inventor: Lester L. Smith, 5151 Mission Hills Drive, Tucson, Arizona 85718--.

Signed and sealed this 20th day of May 1975.

(SEAL)

Attest:

RUTH C. MASON  
Attesting Officer

C. MARSHALL DANN  
Commissioner of Patents  
and Trademarks