United States Patent

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Continuation of application Ser. No. 475,685, July 29, 1965, now abandoned.

[54] **FOLDING DOOR HARDWARE**
7 Claims, 12 Drawing Figs.

[52] **U.S. Cl.** **16/151**
[51] **Int. Cl.** **E05d 7/08**
[50] **Field of Search** 16/151; 160/206; 151/69

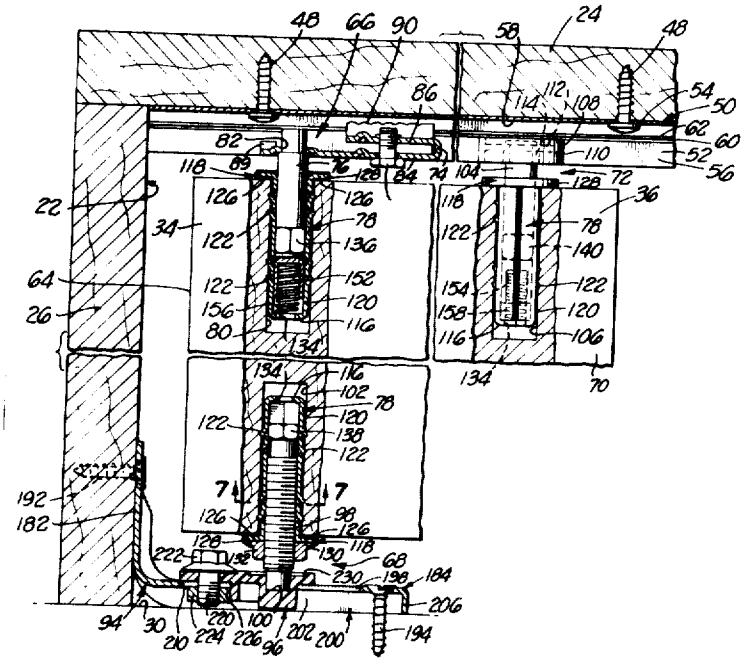
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ABSTRACT: A pivot or guide assembly for folding doors comprising a sleeve secured in its door-edge opening by driving it thereinto inner-end-first. The sleeve is hexagonal to receive a hexagonal portion of a pivot or guide pin to prevent rotation of the pin while permitting vertical adjustment of the position thereof. Springs bias certain of the pins in such a way that the corresponding sleeves can be driven through the pins without damaging the springs. In one form, an annular retainer secures a rotatable nut to the outer end of the sleeve and the pin threadedly engages the nut so that rotation of the nut displaces the pin longitudinally of the sleeve without rotation of the pin. The sleeve is a split sleeve and the annular retainer limits spreading of the segments thereof. The disclosure also includes a folding-door bottom pivot assembly which includes a pivot bracket and a pivot socket adjustable relative thereto to adjust the horizontal position of the pivot axis of the door.



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2 Sheets-Sheet 1

FIG. 1.

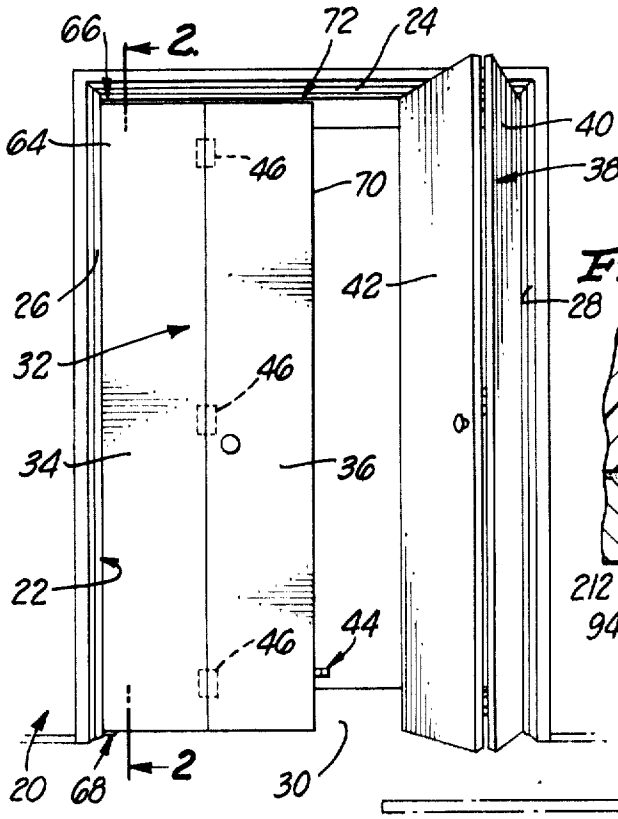


FIG. 2.

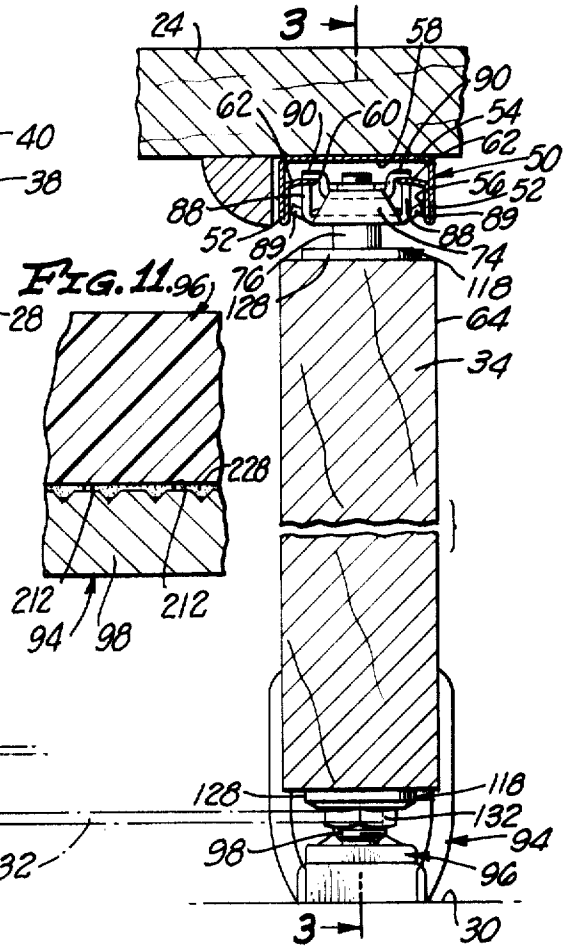


FIG. 11.

FIG. 9.

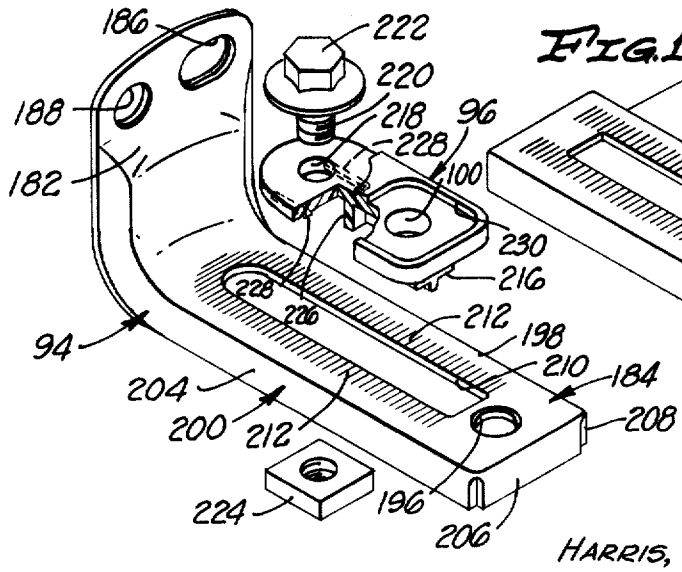


FIG. 10.

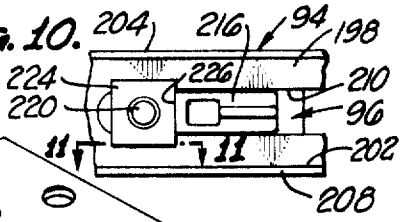
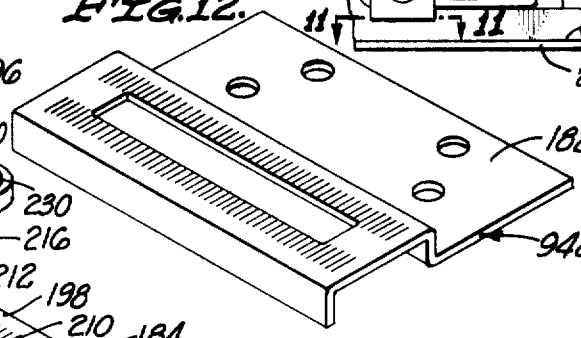


FIG. 12.



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FIG. 3.

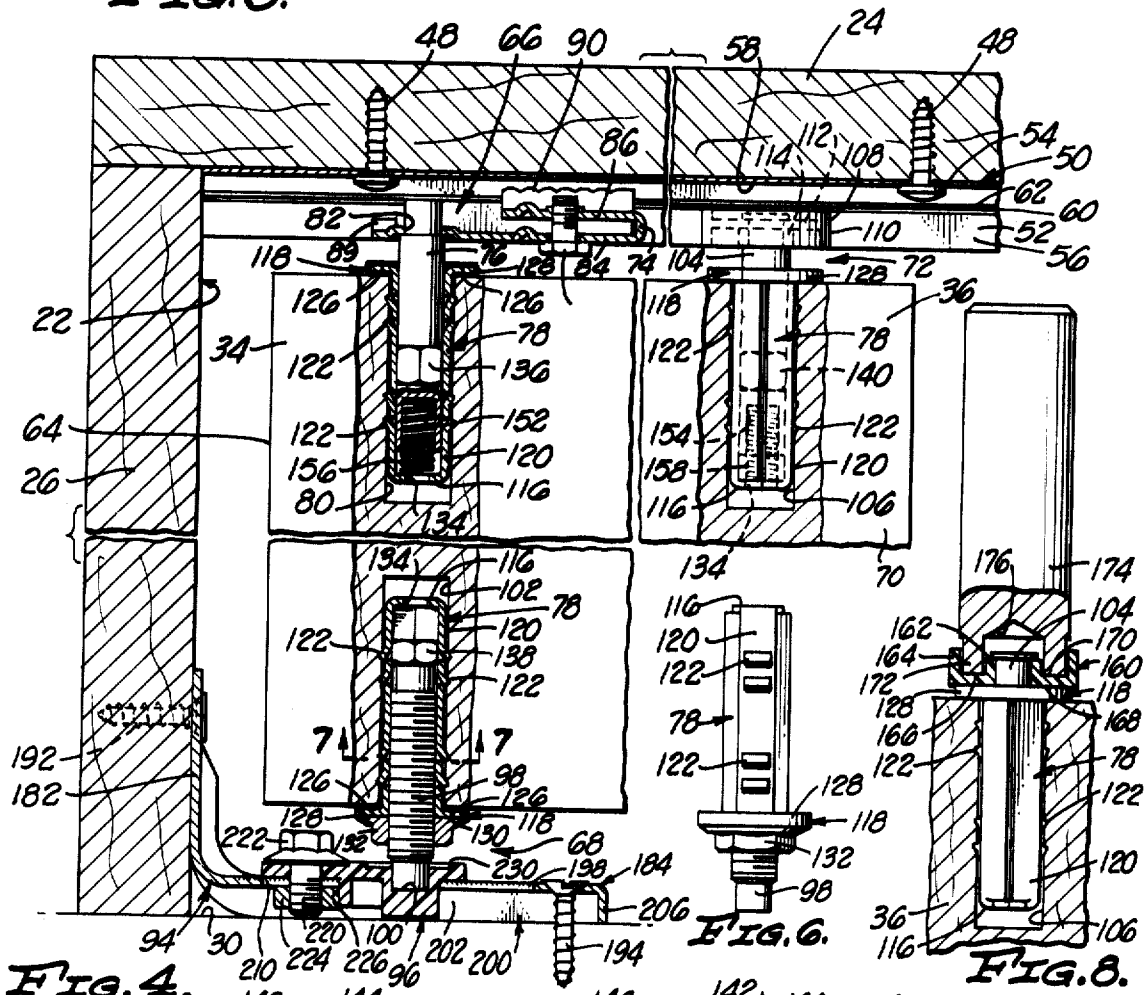


FIG. 6.

FIG. 8.

FIG. 4.

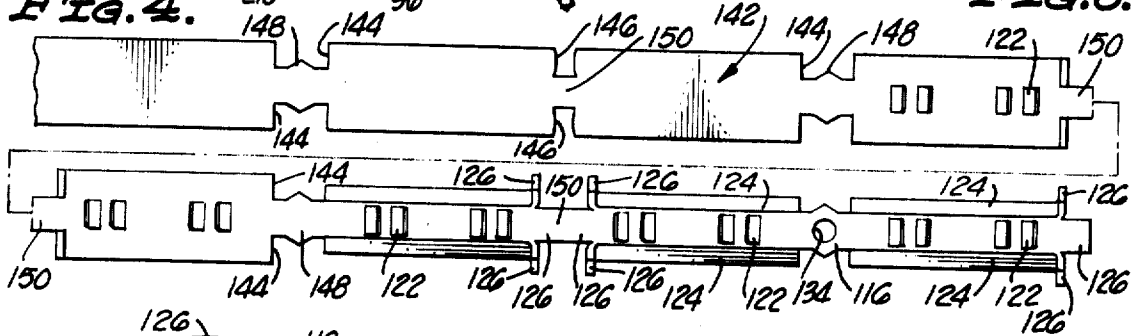


FIG. 5.

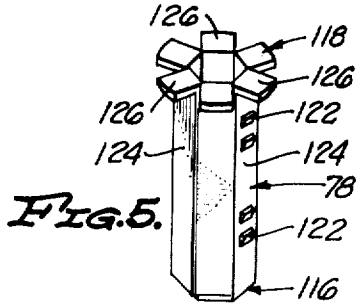
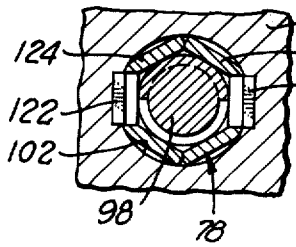


FIG. 7.



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FOLDING DOOR HARDWARE

This application is a continuation of Ser. No. 475,685 filed July 29, 1965 and now abandoned.

BACKGROUND OF INVENTION

The present invention relates in general to door hardware and, more particularly, to hardware assemblies for pivotally mounting and/or guiding folding doors.

As background, folding doors are commonly used in pairs. One door of each pair, hereinafter referred to as the inner or jamb door, is pivotally mounted adjacent one jamb of the doorway by upper and lower pivot assemblies. The other door of each pair, hereinafter referred to as the outer or lead door, is hinged to the jamb door and is provided with a guide assembly movable along a track, usually an overhead track, spanning the doorway. When such a folding door assembly is closed, the leading edge of the lead door is disposed adjacent the opposite jamb of the doorway in the case of a two-door installation, or in the case of a four-door installation, the leading edge of the lead door of one pair is disposed adjacent the leading edge of the lead door of the second pair.

As further background, the upper and lower pivot assemblies for the jamb door and the upper guide assembly for the lead door, which assemblies are sometimes referred to herein generically as folding-door hardware assemblies, commonly include upper and lower pivot subassemblies and an upper guide subassembly respectively set in openings in the upper and lower edges of the jamb door and an opening in the upper edge of the lead door. Each such subassembly includes a sleeve or socket secured in the corresponding door-edge opening and includes a pin disposed in and projecting longitudinally outwardly from the outer end of the sleeve. In the cases of the upper and lower pivot assemblies, such pins are upper and lower pivot pins respectively engageable with upper and lower pivot sockets. In the case of the guide assembly, the pin in question is a guide pin carrying a rotatable guide wheel engageable with the track for guiding the leading edge of the lead door.

SUMMARY AND OBJECTS OF INVENTION

A general object of the invention is to provide a pivot pin or guide pin sleeve for pivot or guide assemblies of the foregoing nature which is secured in its door-edge opening simply by driving it thereinto inner-end-first, the sleeve having a flanged outer end which seats against the door edge to limit insertion, and the sleeve having external projections engageable with the wall of the door-edge opening to prevent rotation of the sleeve in the opening and withdrawal thereof from the opening.

An important object of the invention is to provide such a drive sleeve having longitudinally spaced groups of circumferentially spaced external louvres facing the outer end of the sleeve and engageable with the wall of the opening to resist rotation and pullout. A related object is to provide the sleeve with an externally smooth pilot portion adjacent its inner end for the purpose of guiding the sleeve into the door-edge opening.

Another important object is to provide a drive sleeve of the foregoing nature which is longitudinally split into segments from its outer end toward its inner end, and to provide such segments, at the outer end of the sleeve, with laterally outwardly extending flanges encompassed by an annular retainer, preferably channel shaped in cross section, to prevent laterally outward movement of the segments relative to each other.

Still another important object is to provide the drive sleeve of the invention with at least a portion of noncircular internal cross section, and to provide the sleeve with a pin having a complementary portion of noncircular external cross section in and engaging and held against rotation by the noncircular internal portion of the sleeve. With this construction, if the pin is an externally threaded pivot pin having an adjusting nut threaded thereon, the pin is automatically held against rotation as the adjusting nut is rotated for adjustment purposes. Also, if the pin is either a pivot pin or a guide pin, it is held against rotation relative to the sleeve to prevent relative movement which might produce squeaks, or other noises, upon opening or closing of the doors. In other words, in the case of a pivot pin, relative movement is restricted by this construction to relative pivoting between the pivot pin and a pivot socket therefore. Similarly, in the case of a guide pin, this construction restricts relative movement to relative rotation of the guide pin and a guide wheel mounted thereon. Since such relatively moving parts as pivot pins and pivot sockets, or guide pins and guide wheels, can readily be designed for completely noiseless operation, the aforementioned rotation-preventing connection between each pin and its sleeve insures completely noise-free operation, which is an important feature. Also, in the case of an externally threaded pivot pin having an adjusting nut threaded thereon, the desired adjustment will not be affected by friction between the pivot pin and its pivot socket, which is another important feature.

Still another object of the invention is to provide a sleeve and externally threaded pin combination of the foregoing nature having an adjusting nut, threaded on the pin and seated against the sleeve-segment flanges at the outer end of the sleeve, which is encompassed by the same annular retainer used to prevent laterally outward movement of the sleeve segments relative to each other, such annular retainer preventing longitudinally outward movement of the nut relative to the sleeve while permitting rotation of the nut relative to the sleeve, and the pin, for adjustment purposes.

A further object of the invention is to provide the inner end of the sleeve with a hole for insertion of a tool into engagement with the inner end of the pin, which tool may, for example, serve as an anvil in riveting a guide wheel on the outer end of the pin.

Another object of the invention is to provide the inner end of the pin with a longitudinal hole and to provide a spring having an end in such longitudinal hole and seated against the pin and having its other end seated against the inner end of the sleeve, such construction providing a spring-biased pivot pin, for example. With this arrangement, the inner end of the pin can bottom on the inner end of the sleeve without completely closing the coils of the spring, whereby the sleeve can be driven into its opening, by a driving force applied to the outer end of the pin, without damaging the spring, which is an important feature.

Yet another object of the invention is to provide a sleeve, guide pin and guide wheel assembly wherein the guide wheel has a web having opposed flat sides one seatable against the flanged outer end of the sleeve and the other engageable by a tool for driving the sleeve through the web of the guide wheel.

Another important object of the invention is to provide a bottom pivot assembly, for the lower edge of the jamb door, which includes: a pivot bracket having a slotted wall and having on one side of such wall means for spacing same from an adjacent surface, such as a floor; a pivot element having a guide in and movable longitudinally of the slot in the pivot-brakcet wall and having therein a pivot socket and a hole in register with the slot; and a bolt assembly extending through the hole and the slot and including as elements thereof a bolt head and a threaded nut one of which engages the pivot element and the other of which engages the recited side of the pivot-bracket wall.

Another object is to provide a bottom pivot assembly of the foregoing nature wherein the pivot element is provided with means for preventing rotation of the element of the bolt assembly which is engagement with the recited side of the pivot-bracket wall.

Yet another object is to roughen the pivot-bracket wall adjacent the slot therein, and to provide the pivot element with deformable ribs engageable with such roughening, so that the ribs on the pivot element are deformed to assist in locking the pivot element in place relative to the pivot bracket upon tightening of the bolt assembly mentioned.

Still another object is to provide a bottom pivot assembly wherein the pivot element is provided with a recess surrounding the pivot socket to assist in guiding a pivot pin into the pivot socket.

The foregoing objects, advantages, features and results of the present invention, together with various other objects, advantages, features and results of the invention which will be evident to those skilled in the folding door hardware art in the light of this disclosure, may be achieved with the exemplary embodiments of the invention described in detail hereinafter and illustrated in the accompanying drawings.

DESCRIPTION OF DRAWINGS

In the drawings:

FIGS. 1 is a perspective view of a folding door installation, shown as comprising two pairs of folding doors, which embodies the invention;

FIG. 2 is an enlarged, fragmentary sectional view taken as indicated by the arrowed line 2–2 of FIG. 1;

FIG. 3 is a fragmentary sectional view taken as indicated by the arrowed line 3–3 of FIG. 2;

FIG. 4 is a view illustrating successive steps in the preferred method of making a drive sleeve of the invention;

FIG. 5 is an isometric view of a nearly completed drive sleeve of the invention;

FIG. 6 is an elevational view showing a drive sleeve and pin combination of the invention;

FIG. 7 is an enlarged sectional view taken along the arrowed line 7–7 of FIG. 3;

FIG. 8 is a view, partially in elevation and partially in section, showing a drive sleeve, guide pin and guide wheel combination of the invention and showing one way in which the drive sleeve of this combination may be driven into a door-edge opening;

FIG. 9 is an exploded isometric view of a bottom pivot assembly of the invention for the jamb door of one of the pairs shown in FIG. 1;

FIG. 10 is a fragmentary bottom plan view of the lower pivot assembly shown in FIG. 9;

FIG. 11 is an enlarged, fragmentary sectional view taken as indicated by the arrowed line 11–11 of FIG. 10; and

FIG. 12 is an isometric view of an alternative bottom pivot bracket of the invention.

DESCRIPTION OF PREFERRED EMBODIMENTS OF INVENTION

Referring initially to FIG. 1 of the drawings, illustrated therein is a wall 20 provided with a doorway 22 therethrough which is bounded by a header 24, jambs 26 and 28, and a floor 30. Within the doorway 22 are a pair 32 of folding doors 34 and 36 and a pair 38 of folding doors 40 and 42. The two pairs 32 and 38 of doors are identical, except that one is a mirror image of the other, both door pairs being identically installed. Consequently, the description which follows will be restricted to the door pair 32 as a matter of convenience. It will be understood that the door pairs 32 and 38, when closed, may be aligned by any suitable folding door aligning means 44. Consequently, the aligning means 44 is not shown in detail.

Considering the door pair 32 more specifically, the doors 34 and 36 thereof are, respectively, jamb and lead doors hinged together along their adjacent vertical edges by suitable hinges 46. These may be ordinary flat back hinges which are mounted on the rear surfaces of the doors 34 and 36 in vertical alignment. With this construction, the hinges 46 are readily attached to the doors 34 and 36 by simple screws and the interdoor hinge axis is rearwardly offset from the central vertical planes of the doors. As explained in detail in U.S. Pat. No. 3,162,890, issued Dec. 29, 1964 to Robert Brydolf, one of the present inventors, and Council A. Tucker, this rearward offset of the interdoor hinge axis produces a toggle joint which moves over center as the doors 34 and 36 are closed, thereby holding them in their closed positions.

As shown in FIGS. 2 and 3 of the drawings, spanning the doorway 22, and secured to the header 24, as by screws 48, is an overhead track member 50. As disclosed in detail in U.S. Pat. No. 3,054,447, granted to Robert Brydolf, one of the present inventors, on Sept. 18, 1962, the track member 50 includes two laterally spaced parallel, depending flanges 52 connected by a transverse web means 54 and cooperating therewith to form below the web means a downwardly facing primary track 56 which is generally channel shaped. The web 54 is formed to provide a downwardly facing, C-shaped secondary track 58 which is located above the primary track and which openly communicates therewith through a mouth 60 of reduced width formed in the web means 54. More particularly, the mouth 60 is formed by two inwardly extending flanges 62 constituting part of the web means 54. The head of the screws 48 for mounting the track member 50 are contained within the secondary track 58.

Referring particularly to FIG. 3 of the drawings, the jamb door 34 is mounted adjacent its inner or jamb edge 64 for pivotal movement about a vertical axis by upper and lower pivot assemblies 66 and 68. The leading edge 70 of the lead door 36 is guided along the primary track 56 by an upper guide assembly 72 engageable with such track.

Considering the pivot and guide assemblies 66, 68 and 72 in somewhat more detail, the upper pivot assembly 66 includes an upper pivot bracket 74 secured to the overhead track member 50. The upper pivot assembly 66 also includes an upper pivot pin 76 which is housed in a sleeve 78 driven into an opening 80 in the upper edge of the jamb door 34, and which projects upwardly into an upper pivot socket 82 in the upper pivot bracket 74. As best shown in FIG. 3, the pivot socket 82 is formed in a lower arm 84 of the upper pivot bracket 74, the latter being generally U-shaped, as viewed in cross section in FIG. 3, and having an integral upper arm 86 paralleling the lower arm 84. The lower and upper arms 84 and 86 of the upper pivot bracket 74 are both disposed within the primary track 56, the lower arm 84 having tabs 88, FIG. 2, seated against the lower sides of the flanges 62 of the track member 50, and having integral centering tabs 89 seated against the inner sides of the depending flanges 52. The upper arm 86 of the upper pivot socket 74 is provided with corrugated flanges 90, FIGS. 2 and 3, adapted to grippingly engage the upper sides of the flanges 62 of the track member 50. The two arms 84 and 86 of the upper pivot bracket 74 are urged together by a screw 92 extending through the lower arm 84 and threaded into the upper arm 86, as shown in FIG. 3. As will be apparent, the position of the upper pivot bracket 74 longitudinally of the track member 50 may be adjusted as required to locate the jamb door 34 relative to the jamb 26 properly, whereupon the adjusted position of the upper pivot bracket 74 may be fixed positively by tightening the screw 92.

The lower pivot assembly 68 includes a lower pivot bracket 94 carrying a lower pivot element 96 adjustable in the same direction as the upper pivot bracket 74 so as to position the jamb edge 64 of the jamb door 34 properly. The manner in which the lower pivot bracket 94 is mounted, and the manner in which the lower pivot element 96 is adjusted relative to the lower pivot bracket, will be considered in more detail hereinafter in conjunction with FIGS. 9 to 11 of the drawings. Considering the lower pivot assembly 68 further, it includes a lower pivot pin 98 which projects downwardly into a lower pivot socket 100 in the lower pivot element 96, the lower pivot pin being housed in another sleeve 78 driven into an opening 102 in the lower edge of the jamb door 34.

The guide assembly 72 includes a guide pin 104 which is housed in another of the guide sleeves 78 driven into an opening 106 in the upper edge of the lead door 36 adjacent the leading edge 70 thereof. The guide pin 104 projects upwardly from its sleeve 78 into the primary track 56. Rotatably mounted on the upper end of the guide pin 104 is a guide wheel 108 having an annular rim 110 engageable with the depending flanges 52 of the track member 50 to guide the leading edge of the door along the track member 50. The annular

rim 110 of the guide wheel 108 is connected by an annular web 112 to an annular hub 114 rotatably mounted on the upper end of the guide pin 104.

It will be noted from the foregoing description that each of the pivot and guide assemblies 66, 68 and 72 utilizes one of the drive sleeves 78 as a component thereof. The drive sleeves 78 constitute an important part of the present invention and one of them will now be considered in detail.

Referring particularly to FIG. 5, each drive sleeve 78 has inner and outer ends 116 and 118 and is capable of being driven, inner end first, into one of the door-edge openings 80, 102 and 106. To facilitate driving thereof, each drive sleeve 78 is provided adjacent its inner end 116 with an externally smooth pilot portion 120. To secure each drive sleeve 78 in its opening against rotation and against axial withdrawal, it is provided with longitudinally spaced groups of circumferentially spaced external louvers 122 facing and diverging toward the outer end 118 thereof. As shown in FIG. 3, these louvers 122 bite into the material of the doors 34 and 36 to resist axial withdrawal in a very positive manner. At the same time, they resist rotation of the drive sleeve within its opening.

As best shown in FIGS. 5 and 7, each drive sleeve 78 is longitudinally split into two segments 124 from its outer end 118 toward its inner end 116. The segments 124 are provided at the outer end 118 of the drive sleeve 78 with laterally outwardly extending flanges 126. An annular retainer 128 of channel shaped cross section circumferentially encompasses and axially embraces the flanges 126 on the segments 124 to prevent laterally outward movement of such segments relative to each other. The annular retainer 128 may, for example, be applied by a spinning operation.

In the cases of the drive sleeves 78 for the upper pivot and guide assemblies 66 and 72, the annular retainers 128 engage the flanges 126 only. However, in the case of the drive sleeve 78 for the lower pivot assembly 68, the corresponding annular retainer 128 also circumferentially encompasses and axially embraces an annular flange 130 on a nut 132 threaded on the lower pivot pin 98. With this construction, the corresponding annular retainer 128 prevents axial separation of the nut 132 from the corresponding drive sleeve 78, while at the same time permitting rotation of the nut relative to the lower pivot pin 98 in adjusting the vertical position of the door pair 32.

Each drive sleeve 78 is provided in its inner end 116 with an axial hole 134. As an example, the hole 134 may receive a pin, not shown, acting as an anvil to support the inner end of the guide pin 104 while the outer end of such guide pin is being riveted over the outer end of the annular hub 114 of the guide wheel 108. Thus, the hole 134 in the inner end 116 of each drive sleeve 78 represents an important manufacturing feature.

Each drive sleeve 78 is noncircular, and preferably hexagonal, in internal cross section, as best shown in FIG. 7 of the drawings. The upper and lower pivot pins 76 and 98 and the guide pin 104 are respectively provided with portions 136, 138 and 140 of complementary noncircular, preferably hexagonal, external cross section so as to prevent rotation of such pins in their respective drive sleeves. Preventing rotation of the lower pivot pin 98 in this fashion is important because it facilitates adjustment of the vertical position of the door pair 32 by means of the nut 132, it being noted that the nut supports the weight of the door pair. Also, since the lower pivot pin 98 cannot rotate relative to its drive sleeve 78 as the result of friction between such drive pin and the lower pivot socket 100 in opening and closing the doors 34 and 36, the adjusted position of the nut 132 cannot change accidentally, which is another important feature.

Locking the upper pivot pin 76 and the guide pin 104 against rotation relative to their drive sleeves 78 prevents squeaks, or other noises, which might result from such rotation. It will be noted that, in the upper pivot assembly 66, relative movement is restricted to relative pivotal movement between the upper pivot pin 76 and the upper pivot bracket 74. Proper lubrication will prevent any noise from such relative pivotal movement. Similarly, in the guide assembly 72, relative movement is restricted to relative rotational movement between the annular hub 114 and the guide pin 104. Noise from this source can also be eliminated by proper lubrication, as by selecting a self-lubricating material for the guide wheel 108. Also, in the lower pivot assembly 68, relative movement is restricted to relative pivotal movement between the lower pivot pin 98 and the lower pivot socket 100. Noise due to this relative movement can be prevented by proper lubrication, as by utilizing a self-lubricating material for the lower pivot socket 100. Thus, keying the pins 76, 98 and 104 to their respective sleeves 78, combined with proper lubrication of the relatively moving parts of the pivot and guide assemblies 66, 68 and 72, insures noiseless operation, which is an important feature.

In order to obtain the desired internal hexagonal cross section for each drive sleeve 78, it is preferably made with an overall cross section which is hexagonal. In other words, each drive sleeve is preferably hexagonal both internally and externally.

FIG. 4 of the drawings illustrates a preferred method of making the drive sleeves 78 utilizing a progressive stamping operation performed on a strip 142 having a width equal to one-half the perimeter of the finished drive sleeve. Initially, the strip 142 is provided with notches 144 and 146 respectively corresponding to the inner and outer ends 116 and 118 of the finished drive sleeves 78. The notches 144 are so formed as to interconnect the unfinished drive sleeves by means of tabs 148 having configurations corresponding to the inner ends 116 of the drive sleeves, the holes 134 being formed in the tabs 148 subsequently. The notches 146 are so formed as to leave interconnecting tabs 150 which ultimately form some of the flanges 126 at the outer ends 118 of the finished drive sleeves. As the progressive stamping operation continues, the louvers 122, flanges 126 and holes 134 are formed, and each half of each unfinished drive sleeve 78 is given its desired semihexagonal cross section. Finally, each unfinished drive sleeve 78 is separated from the preceding one, and the two halves are bent toward each other, along lines at the ends of the interconnecting tabs 148, to achieve the configuration of FIG. 5. Also, the tabs 150 are bent laterally outwardly to form the corresponding flanges 126.

The upper pivot pin 76 and the guide pin 104 are provided in their inner or lower ends with longitudinal or axial holes 152 and 154, respectively, receiving compression coil springs 156 and 158, respectively. The springs are seated at their upper ends against the corresponding pins, and are seated at their lower ends against the inner ends 116 of the corresponding drive sleeves 78. The relative lengths of the holes and the springs are such that when the pins engage the inner ends of the drive sleeves, the coils of the springs are not quite completely closed.

The foregoing construction is important because it permits driving the sleeves 78 through the pine 76 and 104, by bottoming the pins in the drive sleeves, without damaging the springs 156 and 158. In other words, the drive sleeves 78 of the upper pivot and guide assemblies 66 and 72 may be driven by driving forces applied directly to the pins 76 and 104, and without damaging the springs 156 and 158. Alternatively, of course, the drive sleeves 78 of the upper pivot and guide assemblies 66 and 72 may be driven by suitable tools, not shown, engaging the outer ends 118 of such drive sleeves.

The drive sleeve 78 of the lower pivot assembly 68 may be driven through the nut 132 by driving forces applied to the outer or lower end of the lower pivot pin 98. Alternatively, a suitable tool for applying the driving forces directly to the nut 132 may be utilized.

FIG. 8 of the drawings illustrates an alternative way of driving the sleeve 78 of the guide assembly 72. Referring to FIG. 8, the guide pin 104 is provided in this instance with a rotatable guide wheel 160 of somewhat different construction than the guide wheel 108. More particularly, the guide wheel 160 includes an annular hub 162 rotatably mounted on the outer

end of the guide pin **104** and includes an annular rim **164**, the hub and the rim being integrally interconnected by an annular web **166** offset axially toward the drive sleeve **78** and having a flat side **168** seatable against the flanged outer end **118** of the drive sleeve. The other side **170** of the annular webb **166** is engageable by an annular rim **172** of a driving tool **174** having an axial cavity **176** to receive the annular hub **162** and the outer end of the guide pin **104**. With this construction for the guide wheel **160**, the driving tool **174** may be utilized to drive the corresponding sleeve **78** through the annular web **166** of the wheel. The driving forces are distributed over sufficiently large areas of the annular web **166** to eliminate any possibility of damage thereto during the driving operation.

Turning now to FIGS. **9** to **11** of the drawings for a more detailed consideration of the lower pivot bracket and pivot element **94** and **96**, the bracket **94** is shown as generally L-shaped and as including an upstanding arm **182** adapted to be positioned against the jamb **26** and a generally horizontal arm **184** adapted to be positioned directly below and to parallel the overhead track member **50**. The upstanding arm **182** is provided with a horizontal screw slot **186** and a screw hole **188**. In installing the bracket **94**, a screw, not shown, is first driven into the jamb **26** through the slot **186**. Prior to tightening such screw, the lateral position of the bracket **94** may be adjusted as required. Subsequently, screws **192** and **194**, FIG. **3**, are driven into the jamb **26** and the floor **30**, respectively, through the hole **188** in the upstanding arm **182** and through a hole **196** in the horizontal arm **184**. When the screws **192** and **194** are driven, and the screw in the slot **186** is tightened, the lower pivot bracket **94** is firmly secured in the correct position.

The horizontal arm **184** of the lower pivot bracket **94** provides a horizontal wall **198** carrying depending spacing means **200** for spacing same upwardly from the floor **30** so as to provide a clearance space **202** between the horizontal wall **198** and the floor. In the particular construction illustrated, the spacing means **200** comprises flanges **204**, **206** and **208** depending from corresponding edges of the wall **198** and enclosing the clearance space **202**.

Formed in the horizontal wall **198** and extending longitudinally thereof, i.e., parallel to the overhead track member **50**, is a slot **210**, the upper surface of the wall **198** being roughened adjacent the longitudinal edges of slot **210**, preferably by providing it with transverse serrations **212**.

The lower pivot element **96** is seated on the upper surface of the wall **198** and is provided thereon with a depending, elongated, guide lug **216** which is disposed in the slot **210**. As will be apparent, the lug **216** is movable longitudinally of the slot **210** to guide the pivot element **96** longitudinally of the wall **198** in adjusting the position of the lower pivot socket **100** relative to the jamb **26**.

The pivot socket **100** registers with the slot **210** and the lower pivot element **96** is provided therein with a hole **218** spaced from the pivot socket **100** and also registering with the slot **210**. The pivot element **96** is secured to the wall **198** of the lower pivot bracket **94** by a bolt assembly which includes a bolt **220** extending downwardly through the hole **218** and the slot **210** and having a head **222** seated on the pivot element. The bolt assembly also includes a nut **224** threaded on the bolt **220** and seated against the lower side of the wall **198**. As best shown in FIG. **10**, the nut **224** is preferably a square nut having flat sides one of which is engageable with a flat end surface **226** of the depending lug **216** to prevent rotation of the nut as the bolt **220** is rotated in tightening or loosening the nut.

The lower pivot element **96** is provided on its lower side with laterally spaced, longitudinally extending ribs **228** respectively engageable with the serrations **212** on opposite sides of the slot **210**. Upon tightening of the bolt and nut assembly **220** and **224**, the serrations **212** deform and bite into the ribs **228**, as shown in FIG. **11**, to assist in locking the lower pivot element in place relative to the horizontal wall **198**. In order to achieve the desired cooperation between the ribs **228** and the serrations **212**, the pivot element **96** is preferably made of a nonmetallic, somewhat deformable material such as nylon. Such material also provides the pivot socket **100** with the desired self-lubricating qualities relative to the lower pivot pin **98**.

The lower pivot element **96** is provided in its upper surface with a homing recess **230** encompassing the upper end of the pivot socket **100**. As will be apparent, this homing recess assists in guiding the lower end of the pivot pin **98** into the pivot socket **100** when hanging the jamb door. This is accomplished by initially inserting the upper pivot pin **76** into the upper pivot socket **82** and then lifting the jamb door **34** sufficiently to compress the spring **156** enough to permit the lower end of the lower pivot pin **98** to be placed in the homing recess **230**. The lower end of the the jamb door **34** is then moved back and forth until the lower end of the lower pivot pin **98** drops into the lower pivot socket **100**. The nut **132** may then be rotated, utilizing a suitable wrench **232**, FIG. **2**, until the desired vertical position of the jamb door **34** is achieved.

In FIG. **12** of the drawings is shown an alternative lower pivot bracket **94*a*** which is to be secured solely to the floor, instead of to a jamb and the floor. Instead of the upstanding arm **182**, the lower pivot bracket **94*a*** is provided with a floor-engaging flange **182*a*** adapted to be secured to the floor by screws, or the like. The flange **182*a*** is preferably located inside a closet, or the like, with which the folding door installation is used. In all other respects, the lower pivot bracket **94*a*** is similar to the lower pivot bracket **94** so that a further description is not necessary.

Although exemplary embodiments of the invention have been disclosed herein for purposes of illustration, it will be understood that various changes, modifications and substitutions may be incorporated in such embodiments without departing from the spirit of the invention.

We claim:

1. In a hardware assembly for use with a member having an opening therein, the combination of:

a. a sleeve having inner and outer ends and capable of being driven, inner end first, into the opening in the member, said inner end being substantially flat and said outer end having a flange seatable against said member;

b. a pin having a planar inner end within said sleeve and seatable against said flat inner end of said sleeve;

c the length of said pin being greater than that of said sleeve;

d. said pin having an outer end projecting from said outer end of said sleeve when said inner end of said pin is seated against said inner end of said sleeve;

e. said outer end of said pin being exposed and defining a cylindrical pivot member having an exposed end so that a driving force applied thereto is transmitted to said inner end of said sleeve through said pin when said inner end of said pin is seated against said inner end of said sleeve; and

f. interengaging means on said sleeve and pin preventing relative rotation therebetween.

2. A hardware assembly as set forth in claim **1** wherein said inner end of said pin is provided with a longitudinal hole therein, said hardware assembly further including:

a. a coil spring having an end in said longitudinal hole and seated against said pin and having its other end seated against said inner end of said sleeve;

b. said spring acting in compression to bias said pin away from said inner end of said sleeve;

c. the length of said longitudinal hole exceeding the minimum length of said spring; and

d. whereby said inner end of said pin, when displaced toward said inner end of said sleeve, seats against said inner end of said sleeve before all of the coils of said spring contact each other.

3. In a hardware assembly for use with a member having an opening therein, the combination of:

a. a sleeve having inner and outer ends and capable of being driven, inner end first, into the opening in the member;

b. a pin in said sleeve and projecting longitudinally from said outer end thereof;

c. said pin having an inner end within said sleeve and seatable against said inner end of said sleeve and provided with a longitudinal hole therein;

d. a coil spring having an end in said longitudinal hole and seated against said pin and having its other end seated against said inner end of said sleeve;

e. said spring acting in compression to bias said pin away from said inner end of said sleeve;

f. the length of said longitudinal hole exceeding the minimum length of said spring; and

g. whereby said inner end of said pin, when displaced toward said inner end of said sleeve, seats against said inner end of said sleeve before all of the coils of said spring contact each other.

4. In a hardware assembly for use with a member having an opening therein, the combination of:

a. a sleeve having inner and outer ends and capable of being driven, inner end first, into the opening in the member;

b. said sleeve being of noncircular internal cross section the full length thereof;

c. a pin in said sleeve and projecting longitudinally from said outer end thereof;

d. said pin having a portion of noncircular external cross section in and complementary to and engaging and held against rotation by said sleeve;

e. the length of said portion of said pin being small as compared to the length of said sleeve;

f. whereby said portion of said pin is movable longitudinally of said sleeve a substantial distance as it is held against rotation thereby; and

g. a compression spring seated against said inner end of said sleeve and said pin and biasing said pin away from said inner end of said sleeve.

5. In a hardware assembly for use with a member having an opening therein, the combination of:

a. a sleeve having inner and outer ends and capable of being driven, inner end first, into the opening in the member;

b. means on said outer end of said sleeve providing a flat driving surface;

c. a pin in and movable longitudinally of said sleeve and having an outer end projecting longitudinally from said outer end of said sleeve;

d. a wheel having a hub mounted on said outer end of said pin and having an annular rim and an annular web connecting said rim to said hub;

e. said wheel having a flat side adjacent said flat driving surface on said sleeve which is larger than said flat driving surface and which is movable into engagement with said flat driving surface upon longitudinal movement of said pin relative to said sleeve; and

f. whereby said sleeve may be driven by means of a tool seated against the opposite side of said wheel.

6. In a hardware assembly for use with a member having an opening therein, the combination of:

a. a sleeve having inner and outer ends and capable of being driven, inner end first, into the opening in the member, said outer end having a flange seatable against said member;

b. a pin having an inner end within said sleeve and seatable against said inner end of said sleeve;

c. the length of said pin being greater than that of said sleeve;

d. said pin having an outer end projecting from said outer end of said sleeve when said inner end of said pin is seated against said inner end of said sleeve;

e. said outer end of said pin being exposed and defining a cylindrical pivot member having an exposed end so that a driving force applied thereto is transmitted to said inner end of said sleeve through said pin when said inner end of said pin is seated against said inner end of said sleeve; and

f. interengaging means on said sleeve and pin preventing relative rotation therebetween.

7. In a hardware assembly for use with a member having an opening therein, the combination of:

a. a sleeve having inner and outer ends and capable of being driven, inner end first, into the opening in the member;

b. said sleeve having a flange at its outer end;

c. a pin in said sleeve and projecting longitudinally from said outer end thereof;

d. a nut threaded on said pin and seated against said flange on said sleeve;

e. retainer means connecting said nut and said flange on said sleeve to prevent longitudinally outward movement of said nut relative to said sleeve while permitting rotation of said nut relative to said sleeve;

f. interengageable means on said pin and said sleeve for preventing relative rotation thereof and for permitting longitudinal movement of said pin relative to said sleeve in response to rotation of said nut relative to said pin and sleeve; and

g. means on the inner end of said pin and engageable with said nut for limiting longitudinally outward movement of said pin, such means having a sliding fit with the interior of said sleeve.

UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,597,790 Dated August 10, 1971

Inventor(s) KENNETH K. KELLEMS and ROBERT BRYDOLF

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

Under "References Cited, United States Patents":
Patent No. "2,465,242" should be --2,465,742--, and
Patent No. "3,015,128" should be --3,015,124--;
and to the list should be added:

--461,070	10/1891	Clark	16-38
3,151,665	10/1964	Stack	160-206
3,173,168	3/1965	Nordmark et al	16-38
3,187,800	6/1965	Kirby	160-206
3,221,804	2/1965	Rudnick	160-206
3,230,575	1/1966	Schultz, Jr.	16-38--;

Attorney: "Geisell" should be --Russell--;

Column 2, line 8: "therefore" should be --therefor-- (page 4, line 13);
Column 2, line 59: "brakcet" should be --bracket-- (page 6, line 16);
Column 3, line 16: "Figs." should be --Fig.-- (page 7, line 20);
Column 4, line 16: "head" should be --heads-- (page 10, line 22); and
Column 6, line 56: "pine" should be --pins-- (page 18, line 25).

Signed and sealed this 16th day of May 1972.

(SEAL)
Attest:

EDWARD M.FLETCHER,JR.
Attesting Officer

ROBERT GOTTSCHALK
Commissioner of Patents

FORM PO-1050 (10-69)

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