The present invention relates in general to folding doors and, more particularly, to hardware for a folding door assembly which includes either a single set of doors foldable to one side of a doorway, or two sets respectively foldable to opposite sides of a doorway.

A general object of the invention is to provide hardware components for such a folding door assembly which are fabricated in such a manner that vertical drilling of the doors to attach such components is unnecessary and a related general object being to provide large areas of engagement between the door-mounted hardware components and the door surfaces against which they are seated. With this construction thin particulate board doors may be used, which is an important feature.

The door-mounted hardware components engage the rear surfaces of the doors so that they are substantially completely concealed from view.

The invention contemplates, and more specific objects thereof are to provide, a folding door assembly which includes: an overhead track spanning the doorway and carried by the supporting structure in which the doorway is formed; a pair of doors adapted to at least partially span the doorway and adapted to be folded to one side thereof; upper and lower mounting plates mounted on the rear surface of one of the doors adjacent one vertical edge thereof and respectively adjacent the upper and lower ends thereof; upper and lower pivot members respectively carried by the upper and lower mounting plates; means for varying the positions of the upper and lower pivot members vertically relative to the upper and lower mounting plates; upper and lower pivot members respectively engageable by the upper and lower pivot members on the upper and lower mounting plates and respectively carried by the track at the upper end of the corresponding door and by the supporting structure at the lower end of the corresponding door; horizontal adjusting means for horizontally adjusting the upper and lower pivot members mentioned; a guide member mounted on the rear surface of the other door adjacent the upper end thereof and adjacent one vertical edge thereof and engaging the track; and hinge means mounted on the rear surfaces of the doors adjacent the other vertical edges thereof and pivotally interconnecting the two doors.

Another object of the invention is to provide a mounting plate having a front side seattable against the rear surface of the corresponding door and provided therein with a vertical, forwardly facing first channel in which the corresponding pivot member is vertically moveable. A related object is to provide tabs on the front side of the mounting plate which project inwardly from the edges of the first channel therein and which engage the front side face of the corresponding pivot member to retain it within the first channel.

A further object is to provide each mounting plate with a vertical, forwardly facing, second channel formed in the rear wall of the first channel, such second channel being located rearwardly of the corresponding pivot member and receiving therein vertically extendable and contractible positioning means for varying the position of the pivot member vertically relative to the mounting plate.

Still another object is to provide a folding door hardware assembly of the foregoing nature wherein the rear wall of the second channel is in each mounting plate is provided thereina with a horizontal slot intermediate its upper and lower ends, such slot having an element of the corresponding vertically extensible and contractible positioning means seated therein.

An object in connection with another embodiment of the invention is to provide a vertically extensible and contractible positioning means comprising a coil spring having a portion seated in the corresponding slot, the coil spring also being seated against an element on the corresponding pivot member which is in alignment with and disposed within the second channel of the corresponding mounting plate.

An object in connection with another embodiment of the invention is to provide a vertically extensible and contractible positioning means including a nut seated in the corresponding slot and including a screw threaded through such nut and extending through an element on the corresponding pivot member which is in alignment with the second channel in the corresponding mounting plate.

A further object of the invention is to provide a horizontally adjustable pivot member, mounted on the supporting structure at the lower end of the pivoted door of the folding door assembly, which is channel-shaped and telescoped over a horizontal leg of an angle-shaped bracket secured to the supporting structure, this pivot member having depending flanges provided with inwardly-struck portions under latters extending flanges of the horizontal leg of the bracket to retain the bracket and the pivot member in assembled relation while permitting horizontal sliding movement of the pivot member along the horizontal leg of the bracket. A related object is to provide a set screw threaded through the channel-shaped pivot member and engaging the leg of the bracket to secure the channel-shaped pivot member in any desired horizontal position on the horizontal leg of the bracket.

Another object is to provide an improved means for horizontally adjusting the position of the pivot member which is horizontally slidable relative to the overhead track.

A further object is to provide pivot members and a guide member on the doors of the folding door assembly respectively having laterally offset pivot and guide elements located substantially in the mid-planes of the doors.

The foregoing objects, advantages, features and results of the present invention, together with various other objects, advantages, features and results thereof which will be evident to those skilled in the art in the light of this disclosure, may be attained with the exemplary embodiments of the invention disclosed in detail hereinafter and illustrated in the accompanying drawings, in which:

FIG. 1 is a rear elevational view of a folding door assembly utilizing the surface mounted folding door hardware of the invention;
FIG. 2 is an enlarged elevational view, partially in section, duplicating the circled portion 2 of FIG. 1;
FIG. 3 is a sectional view taken along the arrow line 3—3 of FIG. 2;
FIG. 4 is an enlarged elevational view, partially in section, duplicating the circled portion 4 of FIG. 1;
FIGS. 5 and 6 are sectional views respectively taken along the arrowed lines 5—5 and 6—6 of FIG. 4;
FIG. 7 is an enlarged elevational view, partially in section, duplicating the circled portion 7 of FIG. 1; and
FIG. 8 is a sectional view taken along the arrowed line 8—8 of FIG. 7.

Referring initially to FIG. 1 of the drawings, illustrated therein is a wall structure 10 provided with a doorway 12...
The doorway 12 is adapted to be closed by a pair 22 of doors 24 and 26 and a pair 28 of doors 30 and 32. The door pairs 22 and 28 are identical, except that one is a mirror image of the other, both door pairs being identically hung. Consequently, the description which follows will be restricted to the door pair 28 as a matter of convenience.

It will be understood that the door pairs 22 and 28, when closed, may be aligned by any suitable folding door aligners. No such door aligners are shown in the drawings as a matter of convenience.

Considering the door pair 28, the doors 30 and 32 thereof are hinged together along their adjacent vertical edge by ordinary flat back hinges 34 which are mounted on the rear surfaces of the doors in vertical alignment. With this construction, the hinges 34 are readily attached to the doors 30 and 32 by simple screws and the interdoor hinge axis is rearwardly offset from the central vertical planes of the doors. As will become apparent, this rearward offset of the interdoor hinge axis provided by the hinges 34 produces a toggle joint which moves over center as the doors are closed, thereby holding them in their closed positions.

As shown in FIGS. 1 to 5 of the drawings, spanning the door 12 and secured to the header 14 thereof, as by screws 36, is an overhead track 38. This track includes two laterally spaced, parallel, depending flanges 40 connected by a transverse web means 42 and cooperating therewith to form below the web means a downwardly facing primary track 44 which is generally channel-shaped. The web means 42 is formed to provide a downwardly facing C-shaped, secondary track 46 which is located above the primary track and which openly communicates therewith through a mouth 48 of reduced width formed in the web means. The heads of the screws 36 for mounting the track 38 are contained within the secondary track 46.

The lead door 32 of the door pair 28 is provided at its upper end, and adjacent the vertical edge thereof opposite the edge to which the interdoor hinges 34 are connected, with a guide means 50 engageable with the primary track 44.

The guide means 50 comprises a mounting plate 52 having a front side seated against the rear surface of the lead door 32. The mounting plate 52 is provided at its upper end with a horizontal flange 54 overlying the upper end of the lead door. Extending upwardly from the horizontal flange 54 is a journal 56 for a guide roller 58 engageable with the track flanges 40 defining the primary track 44.

The axis of rotation of the guide roller 58 lies substantially in the midplane of the lead door 32. The mounting plate 52 is provided therein with vertical slots 60 through which extend screws 62 for attaching the mounting plate to the rear surface of the lead door 32. As will be apparent, this construction permits adjusting the position of the guide roller 58 vertically to locate it at the proper level within the primary track 44.

The anchor door 30 of the pair 28 is pivotally connected to the wall structure 10 adjacent the vertical edge of this door opposite the vertical edge thereof which is connected to the lead door 32 by the hinges 34. Upper and lower pivot means 64 and 66 pivotally connect the anchor door 30 to the wall structure 10.

Referring to FIGS. 4 to 6 of the drawings, the upper pivot member 64 includes a pivot member 72 having thereon a pivot element in the form of a socket 70. The pivot member 64 also includes a pivot member 72 having thereon a pivot element in the form of a pin 74 disposed in the socket 70. The pivot member 68 is mounted on and is horizontally adjustable relative to the track 38, while the pivot member 72 is mounted on and is vertically adjustable relative to the anchor door 30. The common axis of the socket 70 and the pin 74 lies substantially in the midplane of the anchor door 30.

As shown in FIGS. 7 and 8, the lower pivot means 66 includes a pivot member 76 having thereon a pivot element in the form of a socket 78, the pivot member 76 being horizontally adjustable relative to a journal 78 disposed in the socket 78. The pivot member 80 having thereon a pivot element in the form of a pivot pin 82 disposed in the socket 78. The common axis of the socket 78 and the pin 82 is substantially in the midplane of the anchor door 30 and is substantially vertically aligned with the common axis of the upper socket 70 and pin 74.

Since the pivot axis of the anchor door 30 and the guide axis of the lead door 32 lie substantially in the central planes of the doors, and since the interdoor hinge axis provided by the hinges 34 is rearwardly offset from the central planes of the doors, the interdoor hinge axis must move over center relative to the plane containing the pivot axis of the anchor door 30 and the guide axis of the lead door 32 as these doors are moved into their closed positions. This provides the hereinbefore-discussed toggle joint for assisting in maintaining the doors 30 and 32 in their closed positions.

Considering the upper pivot means 64 in more detail with reference to FIGS. 4 to 6 of the drawings, the pivot member 68 is an upwardly facing, channel-shaped member having the socket 70 formed in its bottom wall. The pivot member 68 is slidably disposed within the primary track 44 and is provided with transversely spaced, upwardly flanged 84 the upper edges of which are seated against the under side of the web means 42. The pivot member 68 is provided at the end thereof opposite the socket 70 with an upstanding portion 86 which includes a doubled-back portion 88 spaced upwardly from the bottom wall of this pivot member. The upstanding portion 86 terminates in a tab 90 which extends upwardly into and is guided by the mouth 48 interconnecting the primary and secondary tracks 44 and 46.

Within the secondary track 46 is a nut 92 which extends downwardly through the mouth 48 and is seated on the doubled-back portion 88 spaced upwardly from the bottom wall of this pivot member. The described structure of the pivot member 68 provides a stable anchor for the pivot pin 74 which may be locked in any desirable horizontal position readily by means of the single screw 94.

The pivot member 72 on the door 30 includes a depending portion 96 adjacent the rear surface of the door 30 and a forwardly extending flange 98 overlying the upper end of the door 30 and carrying the pivot pin 74.

The pivot member 72 is connected to the door 30 by a mounting plate 100 having a front side seated against the rear surface of the door 30. At its upper edge, the mounting plate 100 is provided with forwardly extending tabs 102 which overlie the upper end of the door 30 and which serve to position the mounting plate 100 relative to the door. The mounting plate 100 is secured to the rear surface of the door 30 by a fastener 108.

The mounting plate 100 is provided in its front side with a vertical, forwardly facing, first channel 106 which extends substantially from the upper end of the mounting plate to the lower end thereof, and in which the depending portion 96 of the pivot member 72 is vertically slidably and horizontally adjustable. The front side of the mounting plate 100 is provided with tabs 108 thereon which project inwardly from the edges
of the first channel 106 and which engage the front sides of vertical flanges 110 along the edges of the depending portion 96 of the pivot member 72 to retain this pivot member within the first channel 106 in the mounting plate 100. The mounting plate 100 is provided in the rear wall of the first channel 106 therein with a vertical, forwardly facing, second channel 112 having a horizontal slot 114 therein intermediate its upper and lower ends. Within the second channel 112 is a vertically extensible and contractible positioning means for varying the vertical position of the pivot member 72 relative to the mounting plate 100, which comprises a vertical, coiled compression spring 116 having at its lower end an enlarged portion 118 disposed in and seated in the slot 114. As will be apparent, the enlarged portion 118 of the spring 116 may be snapped into the slot 114, which acts to key the spring in place. The upper end of the spring 116 is seated against a tab 120 on the pivot member 72, the tab 120 projecting rearwardly into the second channel 112. As will be apparent, the spring 116 biases the pivot member 72 upwardly, upward movement of this pivot member relative to the mounting plate 100 being limited by engagement of a rearwardly extending, hook-like projection 122 on the pivot member 72 with the enlarged portion 118 of the spring 116. Spring biasing the pivot member 72 upwardly in the foregoing manner means that the pivot pin 74 thereon may be readily engaged with, or disengaged from, the pivot socket 70 to facilitate installation of and/or removal of the doors 30 and 32.

Turning now to a more detailed consideration of the lower pivot means 66, and referring to FIGS. 7 and 8 of the drawings, the pivot member 76 has the general form of an inverted channel telescoped over and horizontally slidable relative to a horizontal leg 124 of an angle-shaped bracket 126 provided with a vertical leg 128 screwed, or otherwise secured, to the jamb 18. The horizontal leg 124 of the bracket 126 has a central portion 130 seated on the floor 20 and has on opposite sides of the central portion thereof laterally spaced, laterally outwardly projecting, longitudinally extending edge flanges 132 disposed above the floor. The channel-shaped pivot member 76 has depending flanges 134 which receive the horizontal leg 124 of the bracket 126 therebetween, and which have inwardly struck portions 136 projecting laterally inwardly under the longitudinally extending flanges 132 to retain the horizontal leg of the bracket within the channel-shaped pivot member 76. A set screw 138 is threaded through the upper wall of the channel-shaped pivot member 76 and engages the central portion 130 of the horizontal leg 124 of the bracket 126 to secure the pivot member in question in any desired horizontal position so as to properly locate the common vertical pivot axis of the socket 78 and the pin 82.

Considering the pivot member 80, it includes a forwardly extending flange 140 which underlies the door 30 and which carries the pivot pin 82, the latter being located substantially in the mid-plane of the door 30, as hereinbefore discussed. The pivot member 80 also includes an upstanding portion 142 which is vertically movable in a vertical, forwardly facing, first channel 144 in a mounting plate 146. This mounting plate is identical to the mounting plate 100, except that it is inverted, and is provided with forwardly extending tabs 148 underlying and engaging the inner surface of the lower end of the door 30 for positioning purposes. The mounting plate 146 has a front side seated against the rear surface of the door 30 and is secured to the rear surface of the door by screws 150. The front side of the mounting plate 146 is provided thereon with tabs 152 which project inwardly from the edges of the first channel 144 therein and which engage the front sides of vertical flanges 154 along opposite edges of the upstanding portion 142 of the pivot member 80 to retain such pivot member within the first channel 144 in the mounting plate 146. As will be apparent, the first channel 144 extends substantially from the lower end of the mounting plate 146 to the upper end thereof to form a stable vertical track for the upstanding portion 142 of the pivot member 80.

Rearwardly of the first channel 144, and formed in the rear wall thereof, is a vertical, forwardly facing, second channel 156 having a horizontal slot 158 therein intermediate its upper and lower ends. Disposed in and seated in the slot 158 is a nut 160 which is also seated against the rear side of the upstanding portion 142 of the pivot member 80 to prevent rotation of the nut. Threaded through the nut 160 is a screw 162 which extends upwardly through a tab 164 on the upstanding portion 142 of the pivot member 80 and which is provided with a head 166 at its upper end. The tab 164 extends rearwardly from the pivot member 80 and is in vertical alignment with the second channel 156.

The foregoing nut and screw combination, comprising the nut 160 and the screw 162, constitutes a vertically extensible and contractible positioning means for varying the relative vertical positions of the mounting plate 146 and the pivot member 80 to raise or lower the doors 30 and 32 as required to properly position them in the doorway 12. As this is done, the resilient vertically extensible and contractible positioning means of the upper pivot means 64, which is provided by the spring 116, automatically maintains the pivot pin 74 within the pivot socket 70. Thus, the invention permits adjusting the door positions from the bottom, which is an important feature.

It will be noted that the invention does not require a lower guide track in or on the floor, which is an important feature.

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 as defined by the claims which follow.

We claim:

1. In a hardware assembly to be mounted on a rear surface of a door of a folding door assembly, the combination of: a mounting plate having a front side seatable against said rear surface of said door, said front side of said mounting plate having a vertical, forwardly facing, first channel therein which extends substantially the entire distance between the upper and lower ends thereof, said first channel having a rear wall provided therein with a vertical, forwardly facing, second channel which is vertically substantially coextensive with said first channel, said second channel having at least one wall; a pivot member disposed in and movable vertically in said first channel, said pivot member having a vertical pivot element thereon at one end thereof; and vertically extensible and contractible positioning means in said second channel rearwardly of said pivot member and engaging said mounting plate and said pivot member for varying the position of said pivot member vertically relative to said mounting plate, said positioning means having a lower end seatable against a portion of said wall of said second channel and having an upper end seatable against an element on said pivot member in alignment with said second channel.

2. In a hardware assembly to be mounted on a rear surface of a door of a folding door assembly, the combination of: a mounting plate having a front side seatable against said rear surface of said door, said front side of said mounting plate having a vertical, forwardly facing, first channel therein which extends substantially the entire distance between the upper and lower ends thereof, said first channel having a rear wall provided therein with a vertical, forwardly facing, second channel which is vertically substantially coextensive with said first channel, said second channel having a rear wall provided with a
horizontal slot therein intermediate the upper and lower ends of said second channel; a pivot member disposed in and movable vertically in said first channel, said pivot member having a vertical, forwardly facing, first channel therein which extends substantially the entire distance between the upper and lower ends thereof, and vertically extensible and contractible positioning means in said second channel rearwardly of said pivot member and engaging said mounting plate and said pivot member for varying the position of said pivot member vertically relative to said mounting plate, said front side of said mounting plate having a vertical, forwardly facing, first channel therein which extends substantially the entire distance between the upper and lower ends thereof, and vertically extensible and contractible positioning means in said second channel rearwardly of said pivot member and engaging said mounting plate and said pivot member for varying the position of said pivot member vertically relative to said mounting plate, said positioning means including an element seated in said pivot plate, and said positioning means engaging an element on said pivot member in alignment with said second channel.

3. In a hardware assembly to be mounted on a rear surface of a door of a folding door assembly, the combination of: a mounting plate having a front side sealable against said rear surface of said door, said front side of said mounting plate having a vertical, forwardly facing, first channel therein which extends substantially the entire distance between the upper and lower ends thereof, and vertically extensible and contractible positioning means in said second channel rearwardly of said pivot member and engaging said mounting plate and said pivot member for varying the position of said pivot member vertically relative to said mounting plate, and said positioning means including a nut seated in said slot and including a screw threaded through said nut and extending through and having a head seated on an element on said pivot member in alignment with said second channel.

4. In a hardware assembly to be mounted on a rear surface of a door of a folding door assembly, the combination of: a mounting plate having a front side sealable against said rear surface of said door, said mounting plate being of the style having a vertical, forwardly facing, first channel therein which extends substantially the entire distance between the upper and lower ends thereof, and vertically extensible and contractible positioning means in said second channel rearwardly of said pivot member and engaging said mounting plate and said pivot member for varying the position of said pivot member vertically relative to said mounting plate, and said positioning means including a nut seated in said slot and including a screw threaded through said nut and extending through and having a head seated on an element on said pivot member in alignment with said second channel.

5. In a hardware assembly to be mounted on a rear surface of a door of a folding door assembly, the combination of: a mounting plate having a front side sealable against said rear surface of said door, said mounting plate being of the style having a vertical, forwardly facing, first channel therein which extends substantially the entire distance between the upper and lower ends thereof, and vertically extensible and contractible positioning means in said second channel rearwardly of said pivot member and engaging said mounting plate and said pivot member for varying the position of said pivot member vertically relative to said mounting plate, and said positioning means including a nut seated in said slot and including a screw threaded through said nut and extending through and having a head seated on an element on said pivot member in alignment with said second channel. A pivot member disposed in and movable vertically in said first channel, said pivot member having a vertical, forwardly facing, first channel therein which extends substantially the entire distance between the upper and lower ends thereof, and vertically extensible and contractible positioning means in said second channel rearwardly of said pivot member and engaging said mounting plate and said pivot member for varying the position of said pivot member vertically relative to said mounting plate, said positioning means including an element seated in said slot, and said positioning means engaging an element on said pivot member in alignment with said second channel.

6. In a folding door hardware assembly, the combination of: an angle-shaped bracket having a vertical leg and a horizontal leg, the latter being an upwardly-facing channel having transversely spaced, longitudinally extending edges; a channel-shaped pivot member having a pivot element thereon at one end thereof, said channel-shaped pivot member having transversely spaced, depending flanges which receive said horizontal leg of said bracket to secure said channel-shaped pivot member in a pivot position on said horizontal leg of said bracket.

7. In a folding door hardware assembly, the combination of: a horizontal track member including two spaced, parallel, depending flanges and transverse web means connecting said flanges and cooperating therewith to form a substantially C-shaped web which is generally channel shaped, said web means being generally C-shaped in cross section and forming a generally C-shaped secondary track located above and facing in the same direction as said primary track, said secondary track having a mouth of reduced width formed in said web means between the web walls provided for said primary tracks; an upwardly-facing, channel-shaped pivot member providing a pivot element and slidably disposed in said primary track, said pivot member having transversely spaced, upstanding flanges seated against the under side of said web means on opposite sides of said pivot member and interconnecting the interiors of said primary tracks, said pivot member being slidably horizontally relative to said horizontal leg of said bracket; and a vertical set screw threaded downwardly through said channel-shaped pivot member and engaging said horizontal leg of said bracket to secure said channel-shaped pivot member in a pivot position on said horizontal leg of said bracket.

8. In a folding door hardware assembly, the combination of: an angle-shaped bracket having a vertical leg and a horizontal leg, the latter being an upwardly-facing channel having transversely spaced, longitudinally extending flanges; a pivot member having a pivot element, said pivot member being a downwardly-facing channel and being telescopically connected to said horizontal leg of said bracket, said pivot member having transversely spaced, longitudinally extending flanges; said flanges of said pivot member having portions underlying portions of said flanges of said horizontal leg of said bracket to prevent upward movement of said pivot member, said pivot member being slidably horizontally relative to said horizontal leg of said bracket; and a vertical set screw threaded downwardly through said pivot member and engaging said horizontal leg of said bracket to secure said pivot member.
in any desired horizontal position relative to said horizontal leg of said bracket.

References Cited by the Examiner

UNITED STATES PATENTS

<table>
<thead>
<tr>
<th>Patent Number</th>
<th>Date</th>
<th>Inventor(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>790,524</td>
<td>5/05</td>
<td>Plice</td>
</tr>
<tr>
<td>949,076</td>
<td>2/10</td>
<td>Jacobs</td>
</tr>
<tr>
<td>2,804,136</td>
<td>8/37</td>
<td>Ternes et al.</td>
</tr>
<tr>
<td>2,835,359</td>
<td>5/58</td>
<td>Boldt et al.</td>
</tr>
<tr>
<td>2,842,795</td>
<td>7/58</td>
<td>Majeske</td>
</tr>
<tr>
<td>2,901,036</td>
<td>8/59</td>
<td>Greig</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Patent Number</th>
<th>Date</th>
<th>Inventor(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2,915,118</td>
<td>12/59</td>
<td>Capitani</td>
</tr>
<tr>
<td>2,927,762</td>
<td>3/60</td>
<td>Owinski</td>
</tr>
<tr>
<td>2,943,675</td>
<td>7/60</td>
<td>Ford</td>
</tr>
<tr>
<td>2,987,756</td>
<td>6/61</td>
<td>Hollansworth</td>
</tr>
<tr>
<td>2,999,267</td>
<td>9/61</td>
<td>Sterling et al.</td>
</tr>
<tr>
<td>3,006,025</td>
<td>10/61</td>
<td>Duban</td>
</tr>
<tr>
<td>3,011,209</td>
<td>12/61</td>
<td>Majeske</td>
</tr>
<tr>
<td>3,030,654</td>
<td>4/62</td>
<td>Migneault et al.</td>
</tr>
<tr>
<td>3,041,657</td>
<td>7/62</td>
<td>McNinch</td>
</tr>
</tbody>
</table>

DONLEY J. STOCKING, Primary Examiner.

JOSEPH D. SEERS, Examiner.