

July 5, 1960

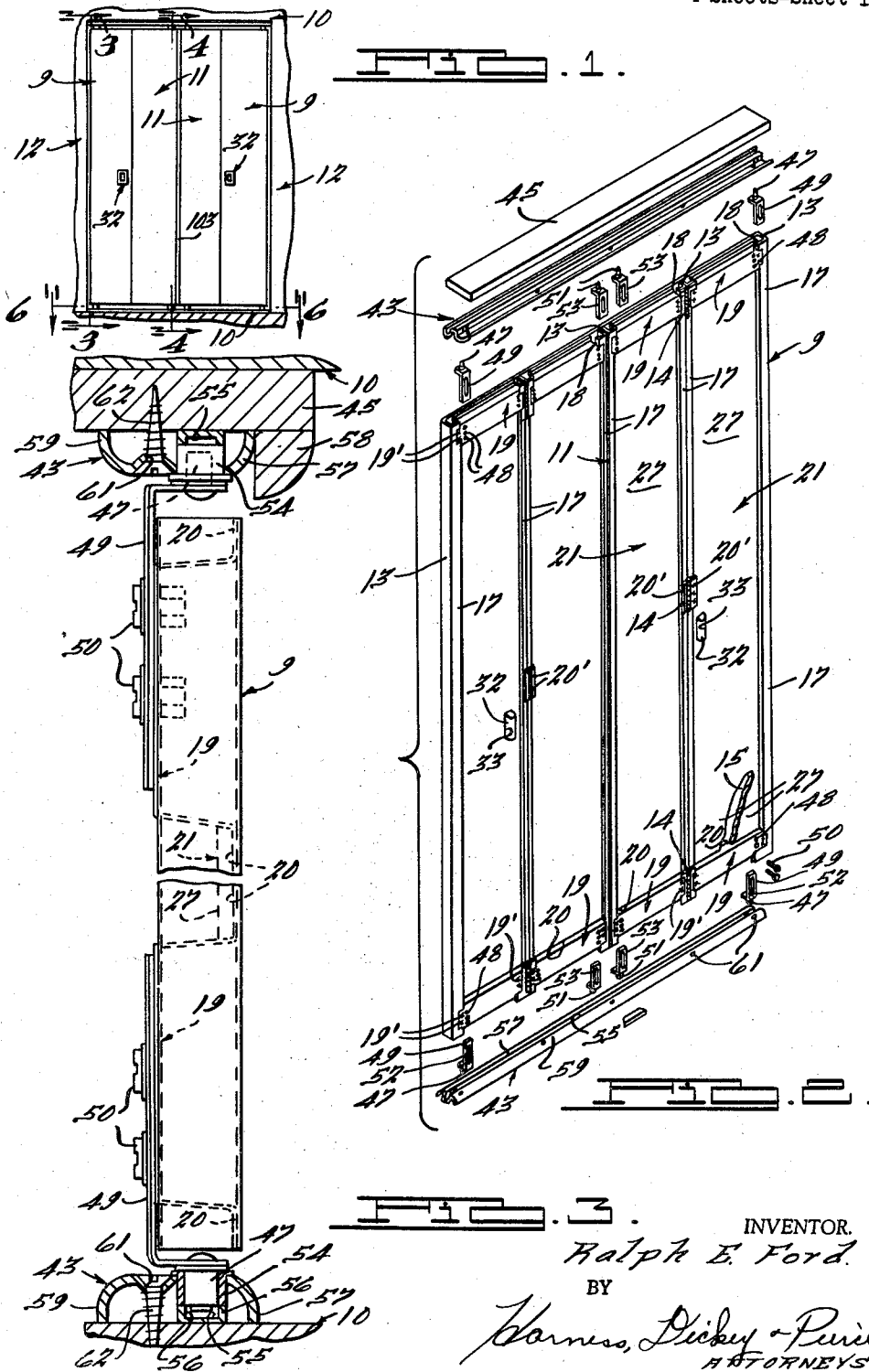
R. E. FORD

2,943,675

DOOR

Filed Aug. 5, 1957

4 Sheets-Sheet 1



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4 Sheets-Sheet 2

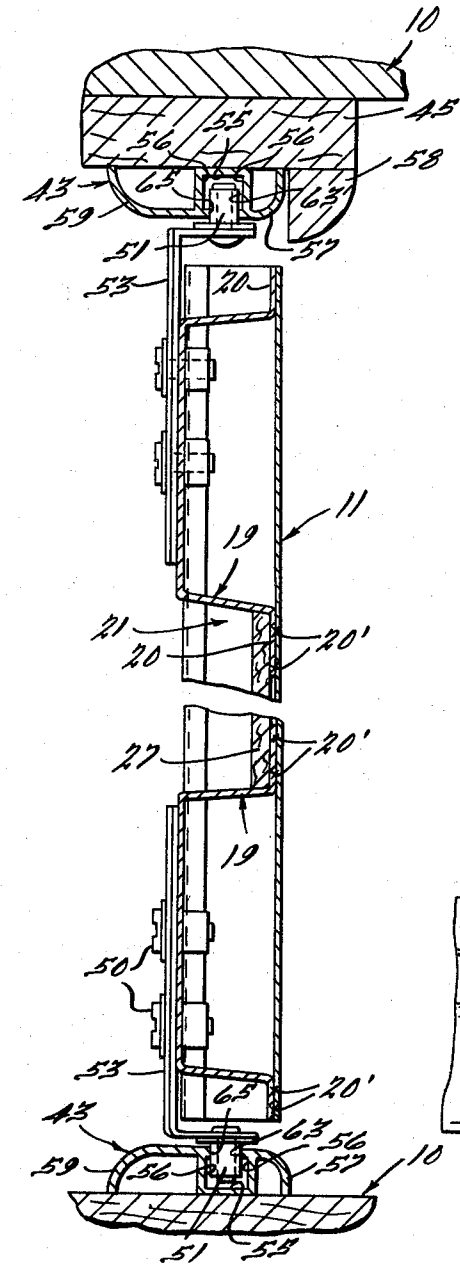


FIG. 4.

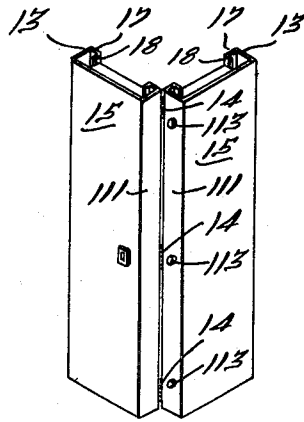


FIG. 5.

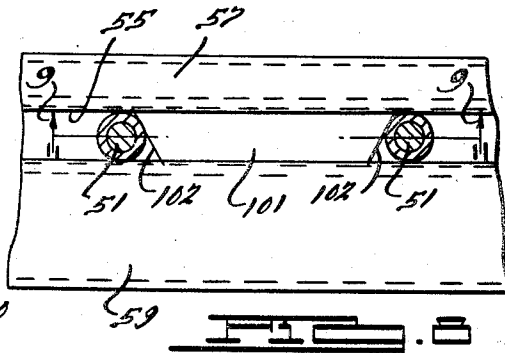


FIG. 6.

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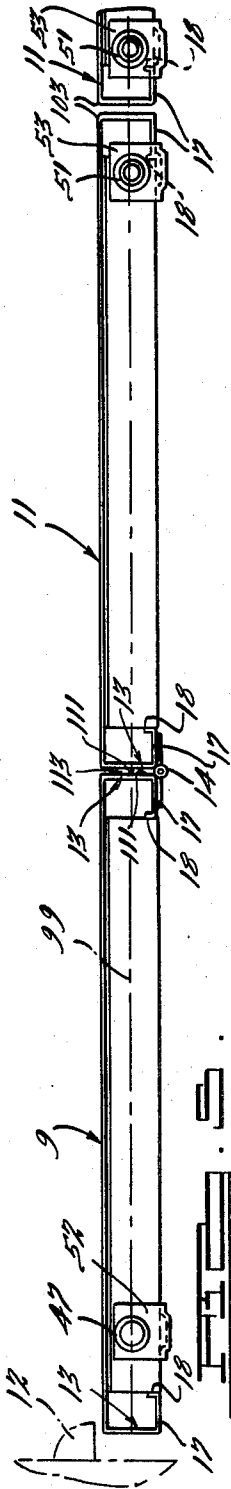
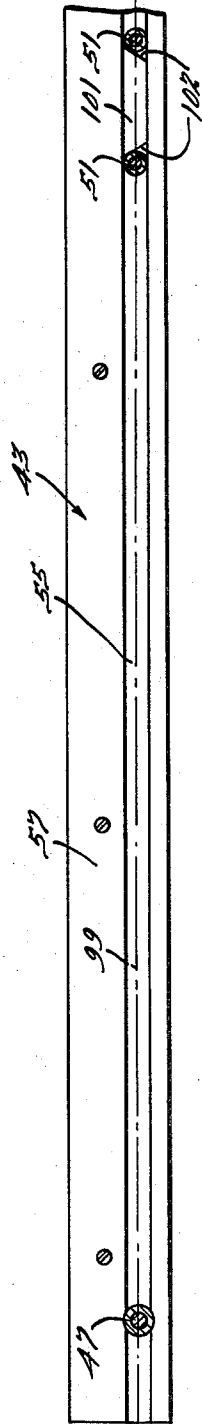
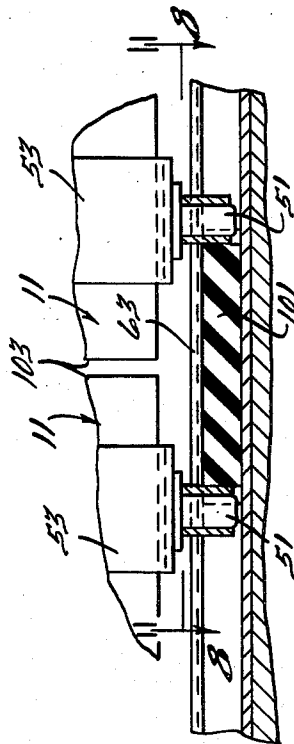
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4 Sheets-Sheet 3



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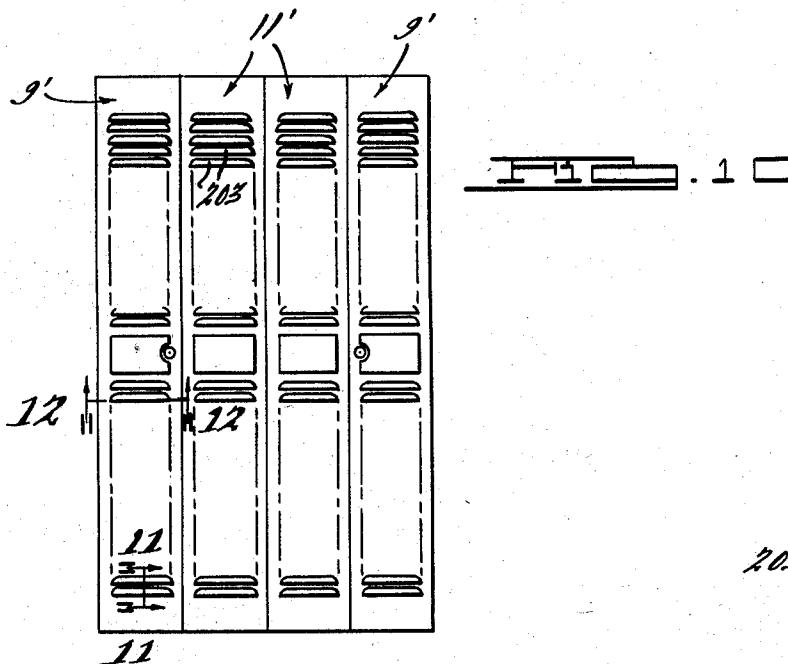
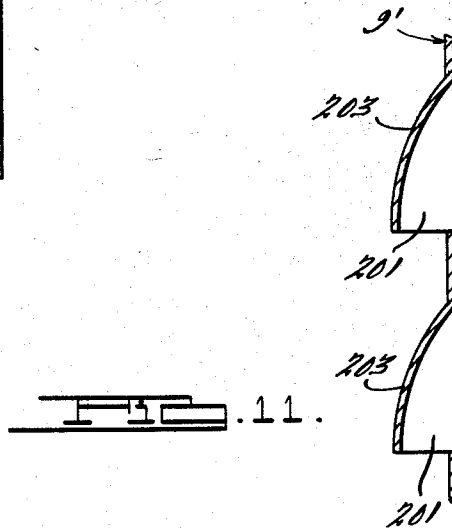
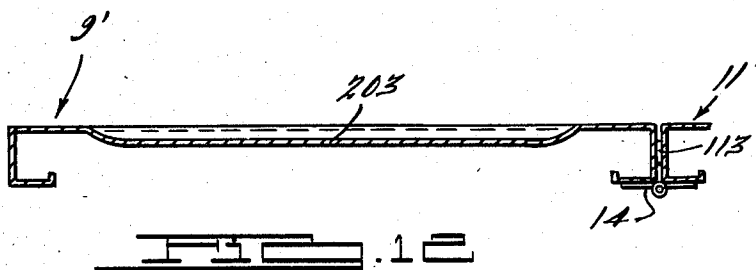
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4 Sheets-Sheet 4



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2,943,675

DOOR

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Filed Aug. 5, 1957, Ser. No. 676,075

4 Claims. (Cl. 160—206)

My invention relates to folding door constructions having sliding and pivoting sheet metal panels. In particular, this application concerns an improvement in the door construction shown in my parent application S.N. 510,655, filed May 24, 1955, now Patent No. 2,898,987, issued August 11, 1959, and is also related to my joint application with William A. Ternes, S.N. 603,481, filed August 13, 1956, now Patent No. 2,804,136, issued August 27, 1957.

It is an important object of this invention to provide a means for removing noise and rattle from metal doors of the type referred to in the above applications, particularly during the closing action of the door construction.

It is also another important object of this invention to provide means for yieldably holding the doors in a closed position.

A further object of the invention is to provide a means which functions both to silence the doors and lock them in a closed position.

My preferred structure for accomplishing the above and other objects of the invention comprises a compressible snubber that is placed in the guide track to be engaged by the projecting guide elements of the inside door panels. Such engagement yieldably resists closing movement of the door and causes the folding panels to be held in an over-center closed position. Furthermore, it eliminates rattle of the guide elements and door panels in the track. In addition to this compressible snubber I preferably use compressible bumper pads between adjacent panels of each folding door section. These compressible bumper pads hold the door panels in a closed position that is flush with the wall surface and will also absorb vibrations and avoid metal to metal contact of the hinged door panels.

The invention is illustrated in a preferred embodiment in the accompanying drawings in which:

Figure 1 is a front view of the folding door construction in its closed position;

Fig. 2 is an exploded view of the folding door assembly including hardware;

Figs. 3 and 4 are enlarged vertical sections taken along the lines 3—3 and 4—4 respectively of Fig. 1, with the door panel sections in each view being broken away to reduce their over-all lengths for the purpose of illustration;

Fig. 5 is a top plan view of one door section consisting of a pair of panels hinged together and a portion of the adjacent door section;

Fig. 6 is a section taken along the line 6—6 of Fig. 1 showing the arrangement of the guide elements at the bottom of the door sections in Fig. 5, a similar section at the top of the door being substantially identical to this section;

Fig. 7 is a simplified view with parts removed showing the resilient bumpers attached to one of the adjacent sides of a pair of hinged panels of a door section;

Fig. 8 is an enlarged view of a portion of Fig. 6 show-

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ing the resilient pad in the track engaged by guide elements of the inside door panels;

Fig. 9 is a sectional view with parts in elevation of the structure of Fig. 8 taken along the line 9—9 thereof;

Fig. 10 is a front elevation of a hinged pair of louvered door panels; and

Figs. 11 and 12 are sections along the lines 11—11 and 12—12 respectively of Fig. 10 showing the cross sectional shape of the louvers.

The door construction generally comprises a pair of door sections which are pivotally secured at the left- and the right-hand sides of a closet opening or doorway. Each door section comprises a pair of panels, an outside panel which is vertically pivoted adjacent one side of the closet opening, and an inside panel which is pivotally hinged to the outside panel. Each door section functions to open and close one half of the closet opening in the manner disclosed in the copending applications referred to. Guide means, including an upper or lower track, or both, serves as a pivot support for the outside panels and as a guide for the inside panels of the door units in their opening and closing movements. Suitable hardware is provided for securing the assembly and a door pull is included to manipulate the door units.

Referring to the structure in more detail, the two door sections are identical except for being disposed on opposite hands of the closet or door opening. The closet or door opening comprises top and bottom horizontal surfaces generally designated 10, and vertical side surfaces generally designated 12. A left- and a right-hand door section operate at opposite vertical side surfaces to completely close and fully open the door or closet opening. Each door section as viewed in Fig. 1 comprises an outside panel 9 and an inside panel 11. In the exploded view of Fig. 2 which depicts the door assembly from the inside of the doorway, the same panels 9 and 11 are shown. The outside panel 9 is adapted to be pivoted between the top and bottom horizontal surfaces 10 about a vertical axis adjacent one of the vertical side surfaces 12 of the door opening. The inside panel 11 is pivotally connected to and supported by the outside panel 9 as by hinges 13 so as to have a free end which slides across the door opening. In the closed position the panels 9 and 11 assume a coplanar position with the free end of the inside panel 11 extended to the center of the door opening and in the open position panels 9 and 11 fold against one another outside of the door opening, the free end of the inside panel 11 having moved axially in the plane of the door opening toward the said vertical side surface to assume a position adjacent the pivot axis for the outside panel 9.

The panels are preferably formed from sheet steel although it will be understood that they may be formed from other material. The vertical sides 13 of each panel extend outwardly from the central body portion 15 and have intumed back flanges 17 which terminate in re-entrant lips 18. The vertical sides 13 together with the back flanges 17 stiffen the individual panels since they run the length thereof. Further stiffening is provided by transverse hat sections 19 disposed at the top and bottom of each of the individual panels, the side flanges 20 of which are preferably spot welded along the lengths thereof to the body portion 15 as seen at 20'. The ends of each of the hat sections 19 are cut out but the webs thereof overlap and are spot welded at 19' to opposite back flanges 17 on its associated panel, it being noted that the door is constructed so that it can be readily fabricated by spot welding using production techniques. A substantially rectangular open cavity 21 is thus formed in each of the individual panels between the sections 19, the depth of each of the open cavities being defined by the distance between the back flanges 17 and the inside

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surface of the body portion 15 of the individual panels. Each of the open cavities 21 extends substantially the height of each individual panel between the upper and lower hat sections 19. Sound deadening means in the form of a rectangular board 27 may be affixed in the cavity of each door panel as described in the last-mentioned copending application previously referred to. Also a door pull 32 as described in this copending application may be provided on the outside panel 9 of each door section.

The guide means employed on the door construction of the present invention preferably comprises identical upper and lower tracks 43, but if a single track is employed, it is preferable that it be the upper track. The exploded view of Fig. 2 shows the construction and arrangement of the door sections with respect to the upper and lower tracks 43, together with the necessary hardware. Preferably, there is provided an anchoring member 45 through which the upper track is secured to the door arch. The lower track is secured in the floor across the closet or door opening. Associated with the upper and lower tracks 43 and with each of the outside panels 9 are a pair of pivot pins 47 preferably constructed of nylon material and as described in the first-mentioned copending application referred to. Each of the pivot pins 47 is secured to an L-shaped bracket 49, which in turn is adapted to be fastened to the outside panels in pairs, one at the top, and one at the bottom by way of hat sections 19. The hat sections 19 on the outside panels have apertures as at 48 for threadably engaging screws as at 50 (Fig. 2) which extend through slots 52 in the L-shaped brackets 49 for securing the same to the hat sections. The slots provided for relative movement between the L-shaped brackets and the outside panels so that the vertical distance between each pair of pivot pins can be adjusted. When the pivot pins 47 are thus secured to the outside panels, they are adapted to be disposed within the tracks 43, and each pair defines a vertical axis about the corresponding outside panel pivots. Fig. 3 shows in greater detail the disposition within the upper and lower tracks 43 of the pivot pins 47 for an outside panel 9. Each of the pivot pins 47 is rotatably supported in a bushing 54 which is pressed into a suitable recess in each of the tracks 43. While the pivot pins 47 are free to rotate in their supports, they are prevented from moving axially along the tracks.

Also associated with the upper and lower tracks 43 but with each of the inside panels, is a pair of guide pins 51 secured to L-shaped brackets 53. The guide pins 51, as well as the brackets 53 to which they are secured, are also constructed and located as described in the above copending application (i.e., the axis of pins 51 is further from the axis of hinges 14 than is the axis of pins 47 so as to prevent binding or sticking in the tracks), and are similar to the pivot pins 47 and the brackets 49 previously described, but the manner in which they are disposed within the tracks and their function differentiate them from the pivot pins 47. The guide pins 51 through their brackets 53 are secured in pairs to the free end of each of the inside panels, one at the top and one at the bottom thereof. The guide pins are adapted to slide axially in the tracks 43. Each pair of guide pins thus defines a vertical axis for the free end of one of the inside panels about which the inside panel pivots as it is being actuated to the open position. For each door section, the location of the pair of guide pins on the inside panel with respect to the location of the pair of pivot pins on the outside panel must be such that the distance between the hinges or axis of hinging and the axis defined by the pair of pivot pins is smaller than the corresponding distance between the same axis of hinging and the axis defined by the pair of guide pins to permit the pair of panels to fold together and slide without binding, as set forth and described in detail in my first-mentioned copending application. The sectional

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view of Fig. 4 through the free end of the inside panel 11 shows in greater detail the disposition of the pair of guide pins 51 within the upper and lower tracks 43, and as can be seen from reference to this figure, the guide pins do not support the weight of the inside panel 11, the support for the latter panel being derived from outside panel 9. Each of the tracks 43, the cross-section of which is shown in Figs. 3 and 4, is generally arch-shaped and has a longitudinally extending channel 55 with vertical side walls 56 depressed therein which is unsymmetrically located with respect to the transverse width of the track. A pair of step portions of unequal width, viz., a narrow step portion 57 and a wide step portion 59 extending from the vertical side walls 56 of the longitudinally extending channel 55 along the length thereof. With respect to the lower track, the narrow step portion 57 is disposed on the entrance side of the door opening so as to present a minimum of obstruction in the room in which the closet is located or from which the door opening is an exit. The wide step portion 59 is disposed on the closet or exit side of the door opening. The upper track is similarly disposed with the narrow step portion 57 on the entrance side of the door opening so that suitable trim as at 58 may be located as close as practicable to the door construction.

For affixing the lower track to the floor and the upper track to the arch of the closet opening, means is provided in the wide step portion 59 hidden from view within the closet proper. A plurality of apertures 61 are formed in the wide step portion 59 to receive securing means, e.g., screws 62 which extend through the upper and lower tracks for affixing the same between the horizontal surfaces 10 of the closet or door opening.

Projecting laterally from each of the vertical side walls 56 into the longitudinally extending channel 55 in each of the tracks are rigid means in the form of inturned lip portions 63, 65 which are formed integral with each of the vertical sides 56 at the junction of the latter with each of the step portions 57, 59 respectively. The lip portions 63, 65 extend the length of each of the channels 55 and provide bearing surfaces that make substantially line contact with opposite sides of each of the guide pins 51 affixed to the inside panels. As can be seen from Fig. 4, the guide pins 51 project into the channels 55 out of contact with the side walls 56 and are adapted to freely slide in the channels 55. Each door section consisting of hinged outside panel and inside panels is suspended in cantilever fashion on the pivot pins 47 adjacent each vertical side of the closet opening. Thus, each door section receives no support from the tracks except at the pair of pivot pins 47 and, therefore, is free to slide between the same. When a single track is employed, it is still necessary to provide a pair of pivot pins for the outside panel of each door section and supports therefor, one of the pivot pins being supported in the single track and the other in a simple bushing support member substantially as described except that it is separated from the track proper. During movement of the inside panels, the lip portions 63, 65 make substantially line contact only with the opposite sides of the guide pins so that a minimum of friction develops between the guide pins and the tracks within which they slide. Consequently, there is less frictional wear on the guide pins and smoother manipulation of the door units is achieved.

The manner of affixing the tracks within the closet opening by securing means which are accessible after all of the associated parts of the door construction are in operative relation assures proper installation of the door construction, as will be apparent from the following description of the proper method of installing the door units. The anchor member 45 is first securely affixed to the arch of the closet opening, after which the upper track is affixed to the anchor member 45. To the pair of hinged inside and outside panels are affixed the pivot pins and guide pins by means of the L-shaped brackets.

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The lower track is laid on the floor and the outside panels are disposed so that the pivot pins affixed thereto engage the bushings in the tracks, and the inside panels are similarly disposed so that the guide pins are free to slide within the longitudinally extending channels in the tracks. The L-shaped brackets are adjusted to accommodate for the height of the particular closet opening. The door units are made plumb with the closet opening by shifting the lower track and following this, the lower track is fastened securely to the floor by the securing means in the wide step portion of the tracks. Final adjustments on the door units are made by raising or lowering the L-shaped brackets until the door units operate freely.

It will be evident from Fig. 5 that the axis defined by the hinges 14 between each pair of folding doors is located on the back of the door panels and is therefore offset to the rear of a horizontal line 99 connecting centers of the pivot 47 and guide pin 51 when the door section is in a flush closed position. However, the hinge axis will move across the line of center 99 or over-center, and swing through an arc about the pivot pin 47 when the doors are open. In accordance with my invention I take advantage of the over-center position of the hinge axis when the door is closed and use it as a means to yieldably hold each door unit in closed position. Preferably I provide means which is utilized by both door sections to hold them both in closed position.

This means includes a resilient, preferably rubber, snubber block 101 which is positioned centrally in the channels 55 of the upper and lower tracks 43. The transverse center line of the snubber block 101 is preferably located at the center line of the spacing 103 (Fig. 5) between the inside panels 11 of the two door sections. The snubber block is of sufficient width so that it fits very snugly in the track channel 55. The ends of the snubber 101 are tapered as at 102 on preferably a 30° angle with its transverse axis so that the snubber is, in elongation, a trapezoid with the short side at the front, i.e. opposite the location of hinges 14. The thickness or height of the rubber is preferably somewhat less than the depth of the track channel 55 as shown in Fig. 9, preferably enough so that it fits beneath the lips 63 and 65. As indicated above when both top and bottom tracks are used, preferably a snubber block 101 is provided in each track.

In addition to the rubber snubbers 101, I attach to the adjacent side or inside face 111 (Fig. 7) of one or both of the hinged panels along the hinged joint one or more, preferably three, sponge rubber compression or bumper pads 113, which may be circular in shape. These are preferably provided with an adhesive backing so that they can be simply pressed in a desired location against the face 111 and will adhere to it. Such adhesive backings are numerous and rubber strips provided with them and peel-off backing faces are available on the open market. The bumper pads 113 may be supplied to the customer in strip form pre-cut into circular shape ready to be punched out from the strip when the backing face is peeled off the strip to expose the adhesive backing. By providing the bumpers 113 with adhesive backing, the location of the bumpers can be individually adjusted when the door is installed to suit the requirements of each door. It will be appreciated that in the inexpensive mass manufacture of doors of this type there will be slight dimensional variations from one pair of panels to another which can be compensated for by this simple location of the bumpers 113 when the doors are installed.

The bumper pads 113 are of a thickness just slightly greater than the spacing between adjacent faces 111 when the two panels are flush with each other and with the wall. Being under a slight compression they hold the faces 111 apart and prevent metal to metal contact thereof and also impose some force on the panels which will act to hold them tightly in place. By adjusting the positions of the bumper 101 up and down along the face

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111 a suitable location can be found so that the compression of the bumpers 111 is just enough to result in the faces being flush when the door units are closed.

Working with the bumper pads 113 and acting to hold them in compressed condition are the snubbers 101. The snubbers 101 are of a length such that their ends 102 will be contacted by the guide pins 51 before the panels have reached a fully closed flush position, i.e., before the hinge axis passes over the center line 99. When the pins 51 hit the ends 102 further closing of the door sections meets with resistance from the snubber 101. Furthermore, the taper of the ends 102 tends to force the pins 51 toward the front edge of the track which in turn tends to drive the hinge axis over-center. When the hinge axis has reached its fully closed over-center position, the pins 51 will have compressed the snubber a slight amount, preferably around 1/8 inch at each end. The force within the snubber attempting to return it to its original length and acting on the pins 51 together with the co-operative disposition of the hinge axis over-center acts to yieldably hold each door section in its closed flush position. This force on each door section is transmitted from its inside panel to its outside panel through the hinge 14 and also through the rubber bumpers 113 as previously discussed. The snubbers 101 can simply be fitted into place and it is not necessary to attach them with cement or screws for it will be seen that the longitudinal compression occasioned by closing of each door section will result in expansion or an increase in width of the snubbers 101 so that they are wedged tightly against opposite sides of the track channel 55.

The engagement of the guide pins 51 with the snubbers 101 will prevent any rattling of the pins in the track and eliminate this type of noise. Furthermore, they put a yieldable load in the door panels and in the bumper pads 113 which will eliminate any tendency of the door panels to vibrate due to jolts or shocks which might be occasioned by unresisted movement of the doors such as occurs with the door constructions described in the aforementioned copending application. I have found that in the narrower doors the need for the cardboard soundproofing of the aforementioned copending joint application is less and that very quiet operation is obtained simply because of the rubber elements 101 and 113. Of course, if desired, the cardboard soundproofing can be used in combination with the rubber elements and this may be desirable in the case of wide door panels where there is greater possibility of bending or oilcanning though, as I have pointed out, the rubber itself will minimize vibration.

In addition to the adjustments provided by the adhesive backing on the bumper pads 113, another adjustment is possible and that is of the amount of compression of the snubbers 101. This is done by loosening the screws 50 which work in the slots in the brackets 53 that carry the pins 51. There is enough play between the bracket 53 and the screws so that the guide pin 51 can be tilted a few degrees on either side of vertical position. Thus, by tilting it way from the hinge axis a slight amount and then tightening up the screws 50, the compression of the snubber 101 may be increased. Alternatively, by tilting the pin 51 toward the hinge axis compression of the snubber 101 can be decreased.

It will now be seen that I have provided a simple means adaptable without change in dimension, to various sizes and designs of folding door units for holding them in closed flush position and for eliminating rattles and metallic noise. Furthermore, this means, and its component elements, are adjustable at the time of installation so that the builder or installer can make final precise adjustments to obtain perfect results.

In Figs. 10 and 11 I show a modified type of panel which may use the hardware and rubber devices described herein. According to this arrangement the panels are louvered to provide openings 201 and outwardly pressed

sections 203. The ends of these sections are drawn in graceful curves so that a very attractive appearance is obtained.

It will be appreciated that variations in the specific constructions shown and described can be made without departing from the spirit and scope of the invention.

What I claim is:

1. In a folding door construction, a pair of door panels hinged together along an axis, means on the outer edge of one of the door panels providing a pivot for the pair of door panels, means on the other door panel providing a guide pin, track means providing a channel to receive and guide said guide pin, said panels being actuable into a closed position flush with each other, said hinge axis being offset from a straight line between said pivot and said guide pin and movable thereover in the closing movements of the door panels, and a compressible rubber element engageable by said guide pin in the closing movements of the door panels to exert a reaction against the panels yieldably resisting the movement of said hinge axis over said line and retaining it in an over-center position with respect thereto, said compressible rubber element comprising a rubber block fitted in said track channel and held in position solely by frictional engagement with said track.

2. In a folding door construction, a pair of door panels hinged together along an axis, means on the outer edge of one of the door panels providing a pivot for the pair of door panels, means on the other door panel providing a guide pin, said panels being actuable into a closed position flush with each other, said hinge axis being offset from a straight line between said pivot and said guide pin and movable thereover in the closing movements of the door panels, and a compressible rubber element engageable by said guide pin in the closing movements of the door panels to exert a reaction against the panels yieldably resisting the movement of said hinge axis over said line and retaining it in an over-center position with respect thereto whereby said panels are yieldably and compressively retained in said closed position, said compressible rubber element having a cam surface which is engaged by said guide pin to force it into a further offset position relative to the hinge axis in said closed position of the door panels.

3. In a folding door construction, a pair of door panels hinged together along an axis, means on the outer edge of one of the door panels providing a pivot for the pair of door panels, means on the other door panel providing a guide pin, a track disposed in the plane of movement of said guide pin and slidably guiding the same, said panels being actuable into a closed position flush with each other, said hinge axis being offset from a

straight line between said pivot and said guide pin and movable thereover in the closing movements of the door panels, and a compressible rubber snubber block fitted in and extending across the width of said track having one of its ends engageable by said guide pin in the closing movements of the door panels to exert a reaction against the panels yieldably resisting the movement of said hinge axis over said line and retaining it in an over-center position with respect thereto whereby said panels are yieldably and compressively retained in said closed position.

4. In a folding door construction for a doorway, a pair of sheet metal panels hinged together along an axis, one panel being pivotally connected to and supported by the other panel so as to fold against said other panel and having a free end which slides across the doorway into a closed position in which the panels are flush with each other, means on the outer edge of said other panel providing a stationary pivot for the pair of panels, a track disposed in the plane of the doorway and having a longitudinally extending channel with side walls formed therein, means operatively related to said one panel for guiding the movement of the free end thereof, said means having a guide pin projecting into said channel so as to slide therein, said hinge axis being movable over a straight line along the center of said channel in the closing movements of the door panels to an offset position with respect to said line, a compressible rubber snubber block fitted in said channel having one of its ends engageable by said guide pin in the closing movements of the door panels to exert a reaction against the panels yieldably resisting the movement of said hinge axis over said line and retaining it in an over-center position with respect thereto, and a plurality of compressible rubber pads in the hinged joint between the panels to be compressed in the closing movements of the panels to transmit said reaction between said panels and across the axis of hinging thereof, whereby said panels are yieldably and compressively retained in said closed position, said snubber block having its said one end tapered so that it yieldably urges said guide pin to the side of said channel opposite that last approached by the hinge axis.

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