

May 30, 1961

E. L. ALLEN ET AL
DOOR HOLDING DEVICES

2,985,908

Filed April 3, 1958

12 Sheets-Sheet 1

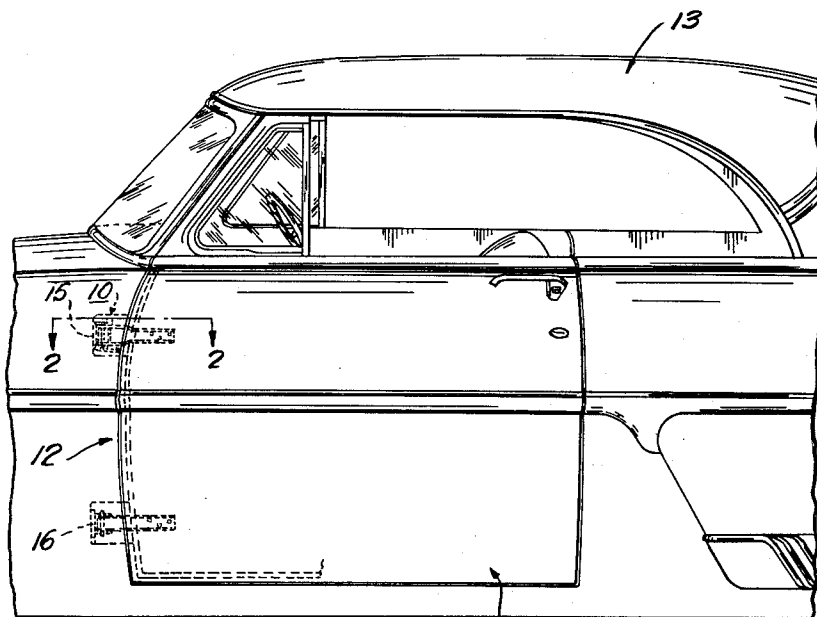


FIG. 1

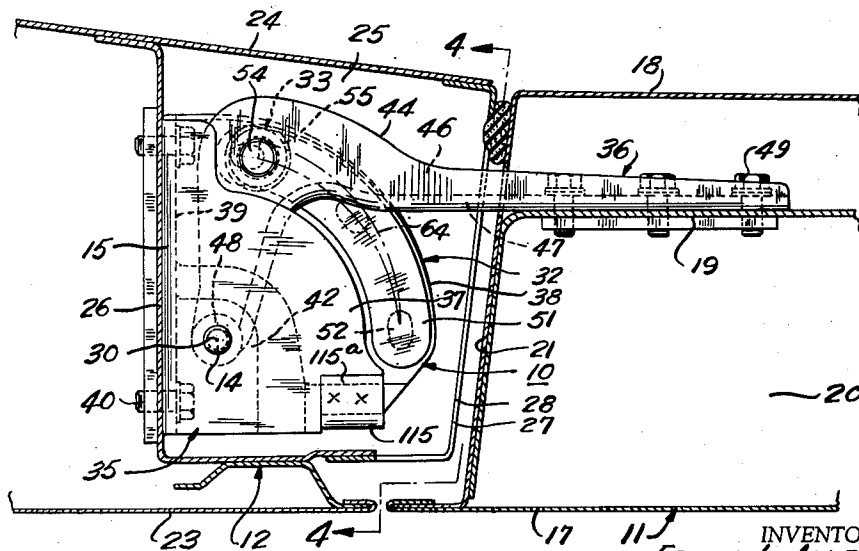


FIG. 2

INVENTORS
EDWIN L. ALLEN
ANGELO R. DeVITO
BY *Hughson, Boughton,*
Williams, David & Hoffmann
ATTORNEYS

May 30, 1961

E. L. ALLEN ET AL
DOOR HOLDING DEVICES

2,985,908

Filed April 3, 1958

12 Sheets-Sheet 2

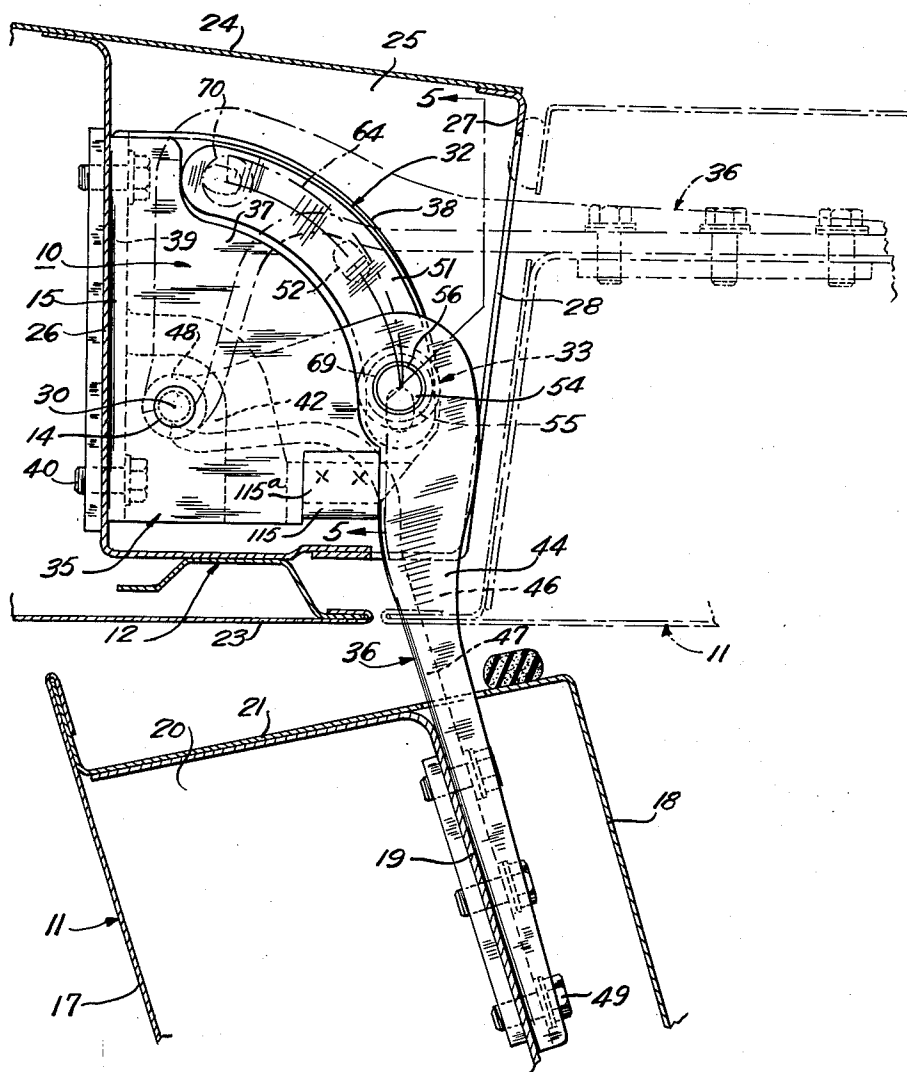


FIG. 3

INVENTORS
EDWIN L. ALLEN
BY ANGELO R. DEVITO
Hudson, Boughton
Williams, David & Hofmann
ATTORNEYS

May 30, 1961

E. L. ALLEN ET AL
DOOR HOLDING DEVICES

2,985,908

Filed April 3, 1958

12 Sheets-Sheet 3

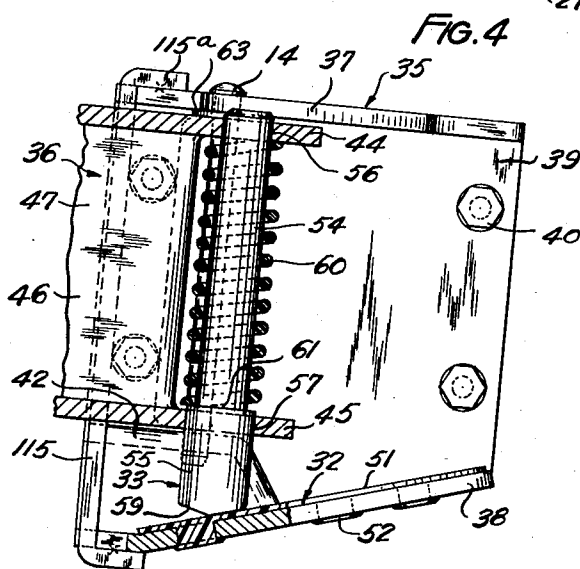
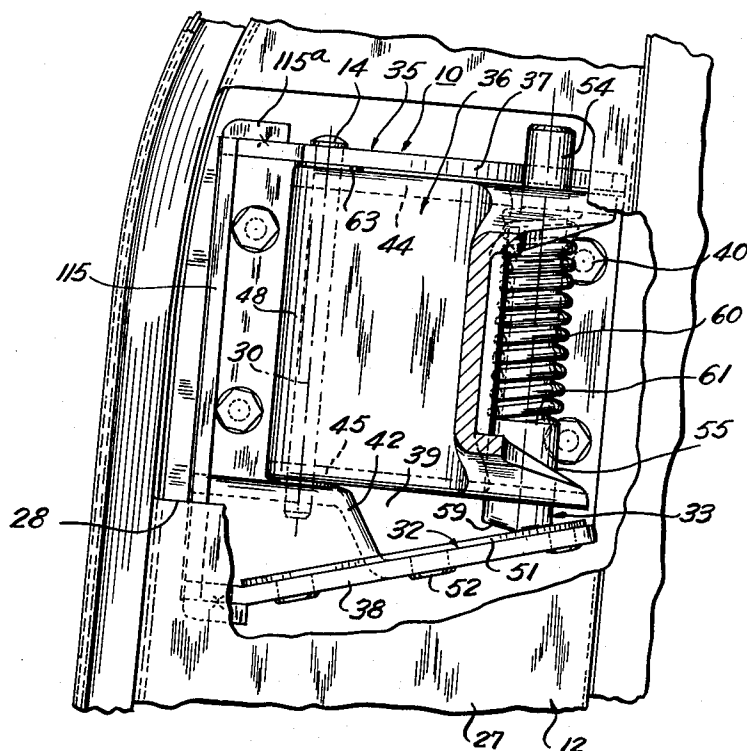


FIG. 5

INVENTORS
EDWIN L. ALLEN
ANGELO R. DEVITO
BY *Hudson, Boughton,*
Williams, David & Hoffmann
ATTORNEYS

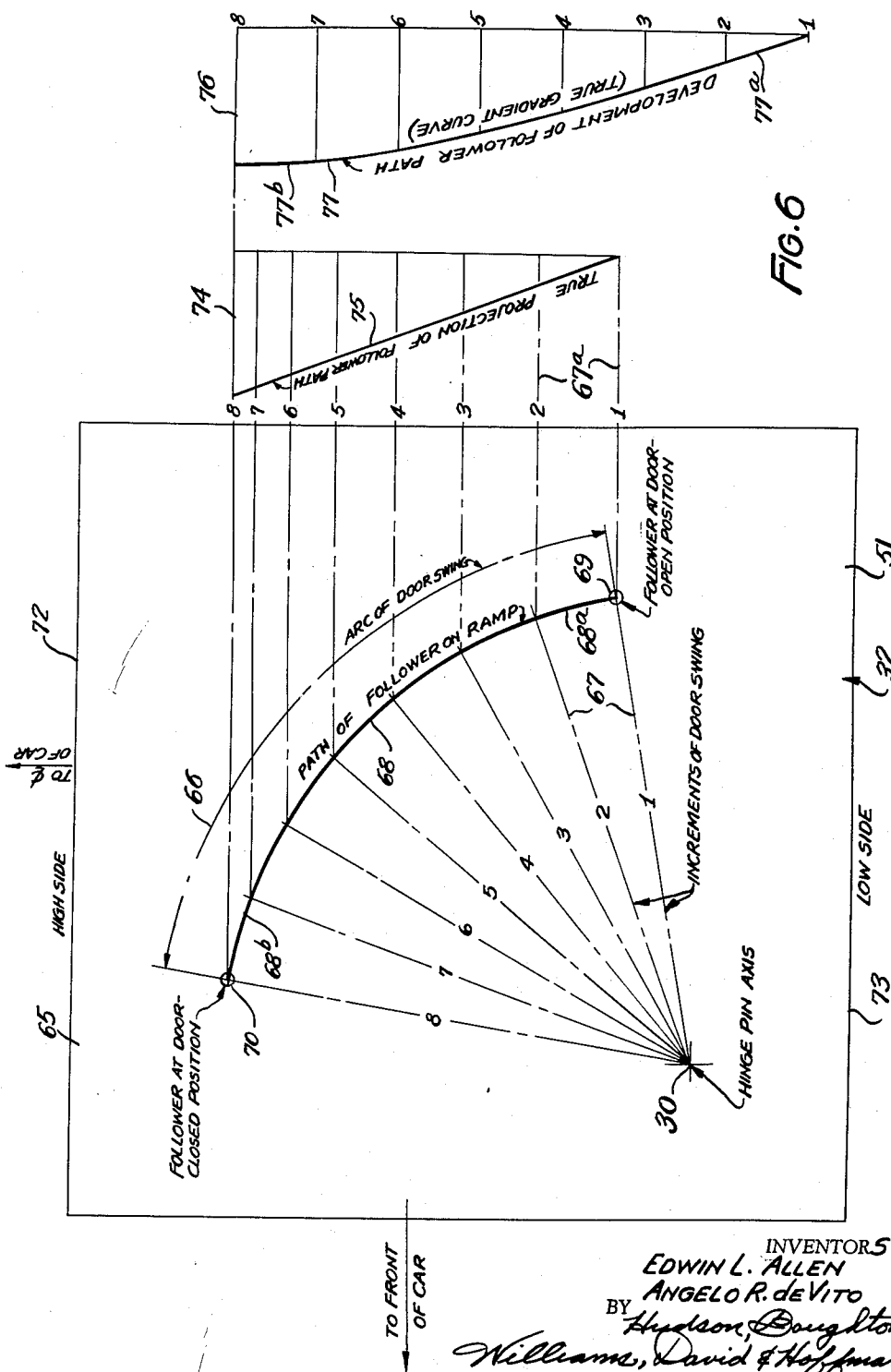
May 30, 1961

E. L. ALLEN ET AL
DOOR HOLDING DEVICES

2,985,908

Filed April 3, 1958

12 Sheets-Sheet 4



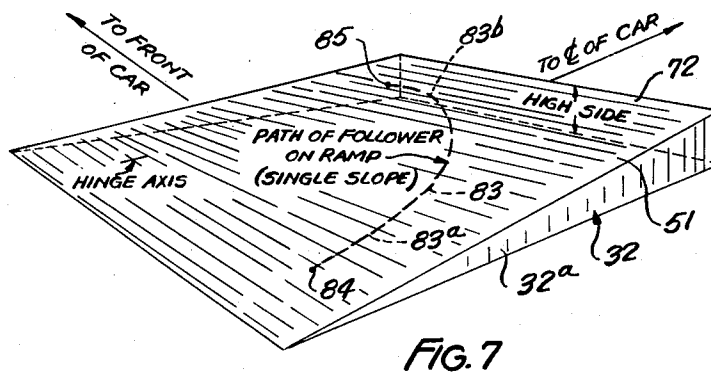
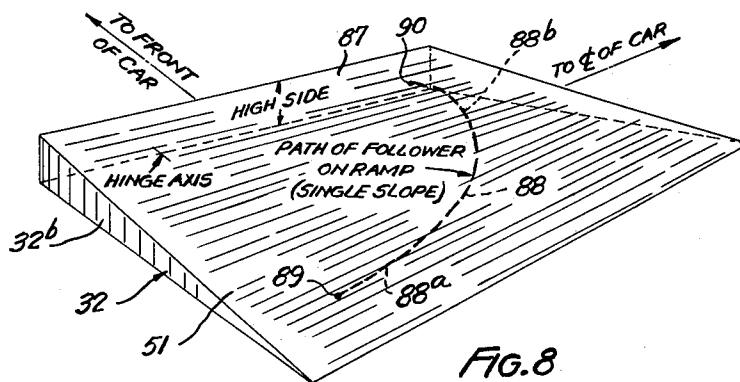
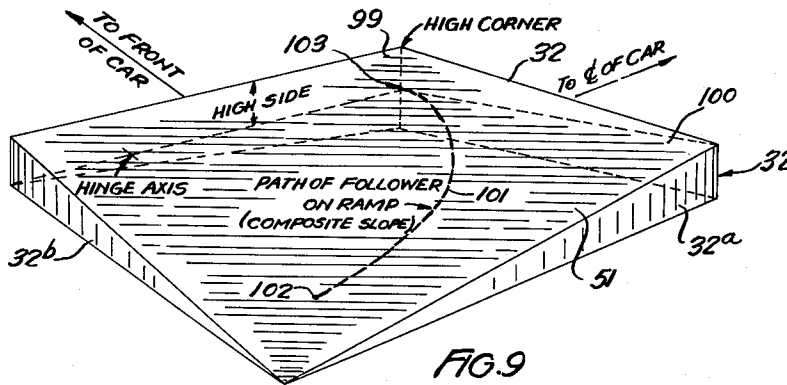
May 30, 1961

E. L. ALLEN ET AL
DOOR HOLDING DEVICES

2,985,908

Filed April 3, 1958

12 Sheets-Sheet 5



INVENTORS
EDWIN L. ALLEN
ANGELO R. de VITO
BY *Hudson, Baughman,*
Williams, David & Hoffmann
ATTORNEYS

May 30, 1961

E. L. ALLEN ET AL
DOOR HOLDING DEVICES

2,985,908

Filed April 3, 1958

12 Sheets-Sheet 6

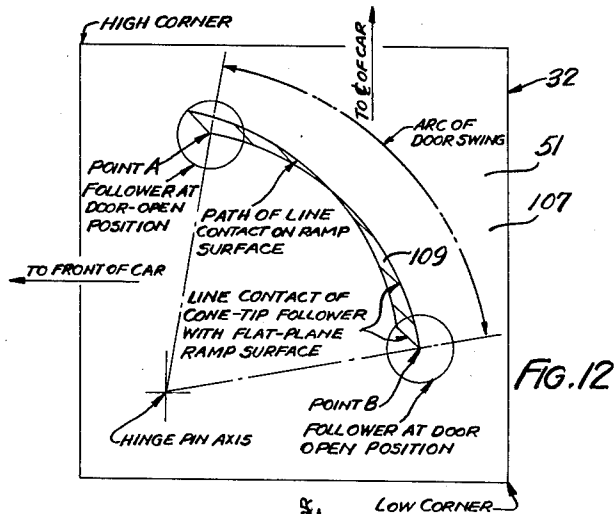


FIG. 12

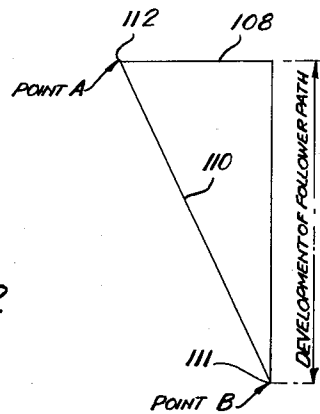


FIG. 14

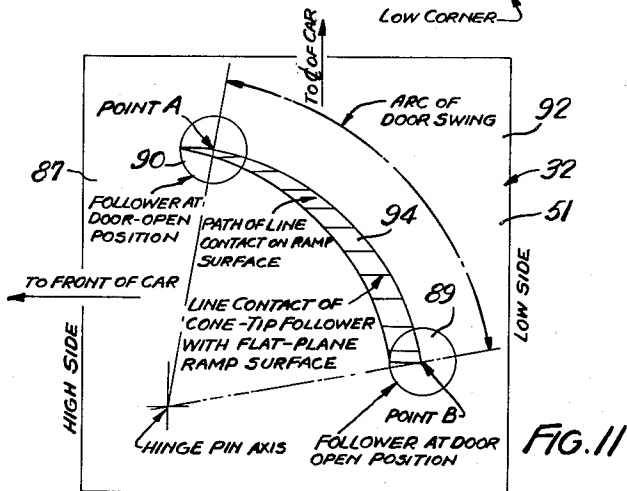


FIG. 11

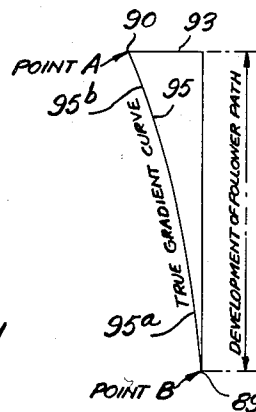


FIG. 13

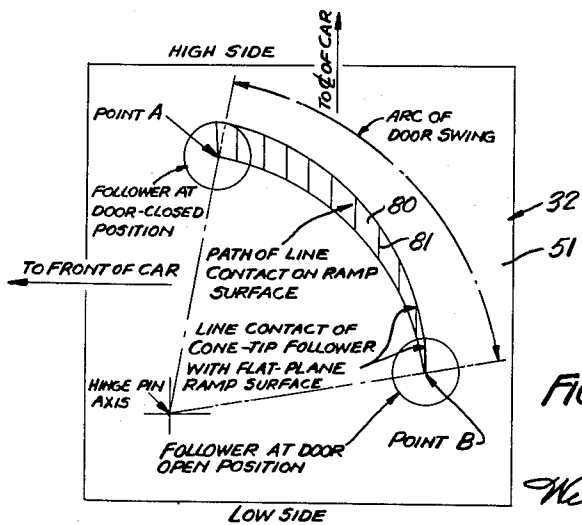


FIG. 10

INVENTORS
EDWIN L. ALLEN
BY ANGELO R. DE VITO
Hudson, Boughton,
Williams, David & Hoffmann
ATTORNEYS

May 30, 1961

E. L. ALLEN ET AL
DOOR HOLDING DEVICES

2,985,908

Filed April 3, 1958

12 Sheets-Sheet 8

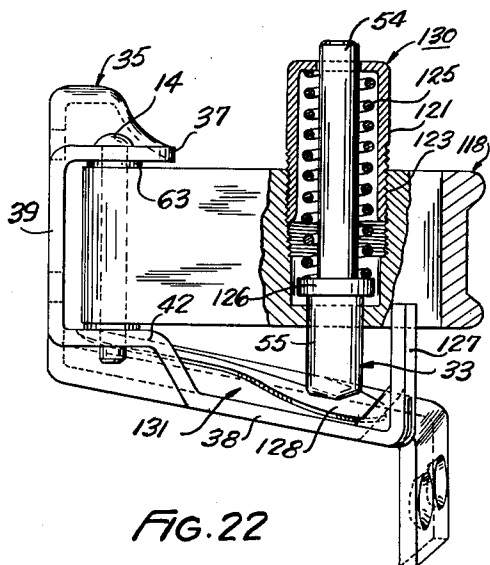


FIG. 22

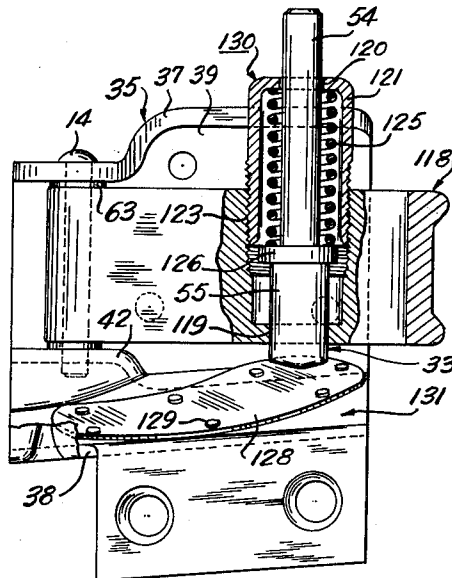


FIG. 21

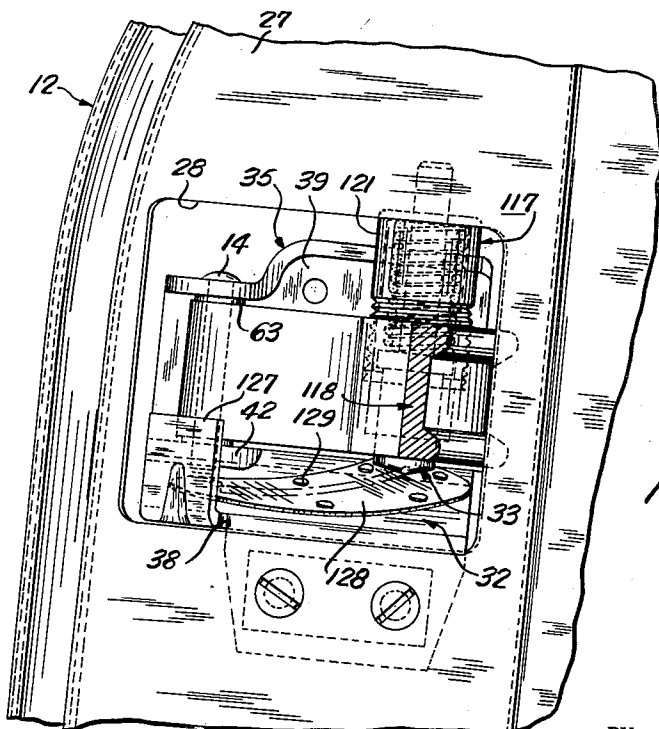


FIG. 16

INVENTORS
EDWIN L. ALLEN
ANGELO R. DEVITO
BY *Hudson, Boughton,*
Williams, David & Hoffmann
ATTORNEYS

May 30, 1961

E. L. ALLEN ET AL

2,985,908

DOOR HOLDING DEVICES

Filed April 3, 1958

12 Sheets-Sheet 9

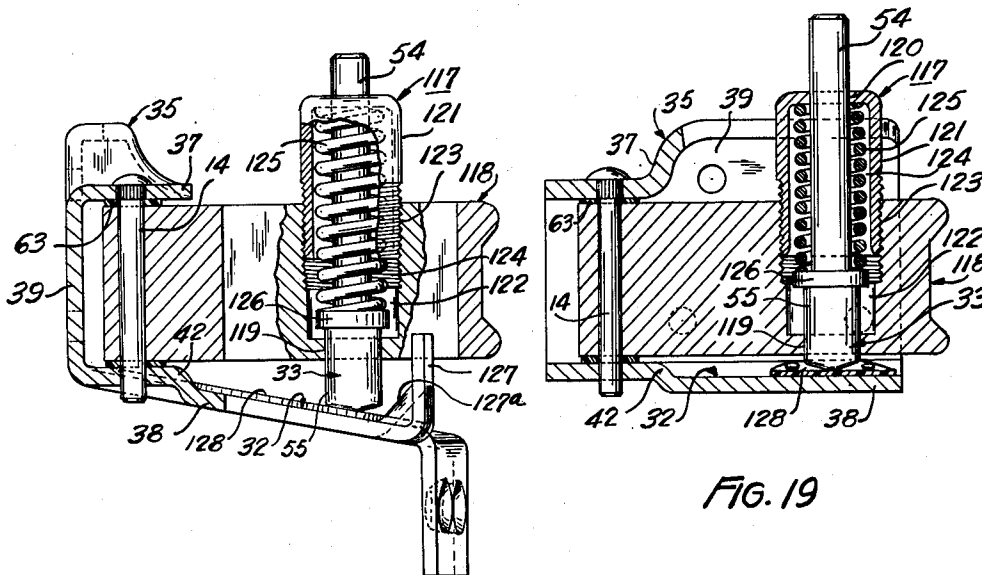
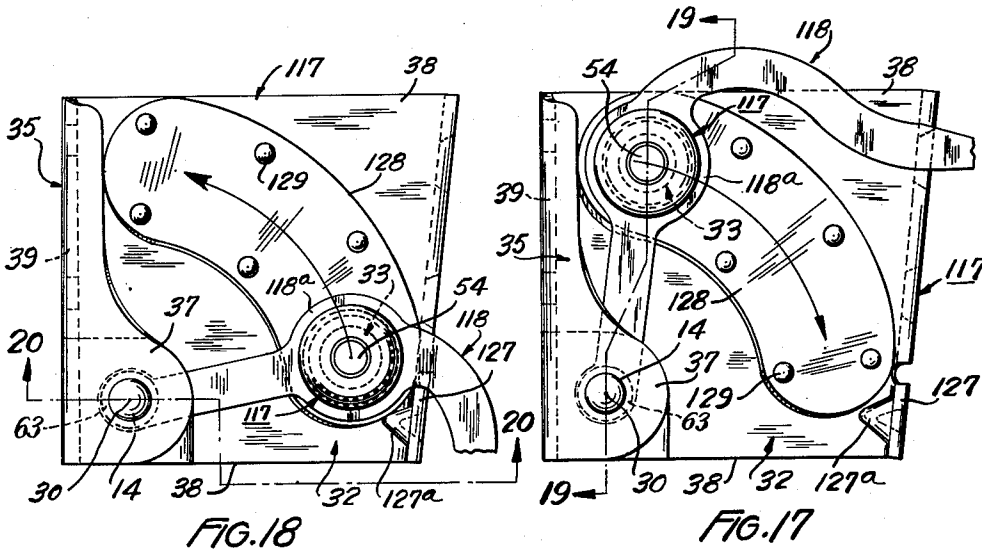


FIG. 20

FIG. 19

INVENTORS
EDWIN L. ALLEN
ANGELO R. DEVITO
BY *Hudson, Doughton,
Williams, David & Hoffmann*
ATTORNEYS

May 30, 1961

E. L. ALLEN ET AL
DOOR HOLDING DEVICES

2,985,908

Filed April 3, 1958

12 Sheets-Sheet 10

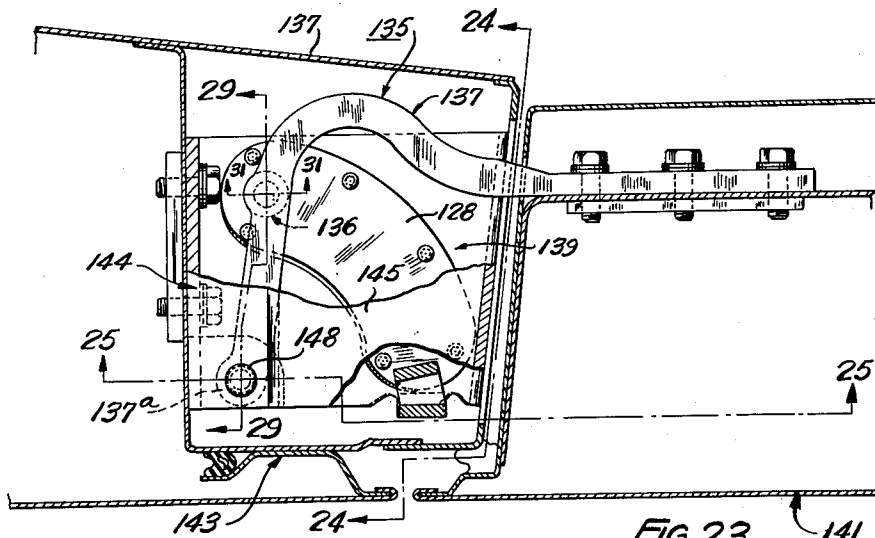


FIG. 23

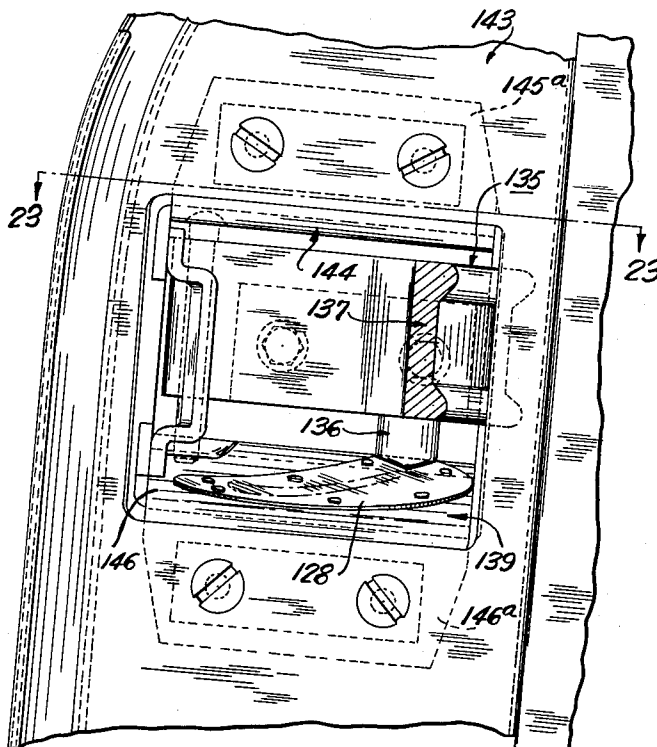


FIG. 24

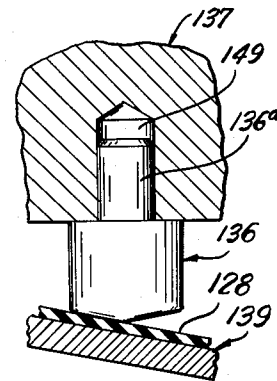


FIG. 31

INVENTOR.S
EDWIN L. ALLEN
ANGELOR. DEVITO
BY
Hudson, Doughton,
Williams, David & Hoffmann
ATTORNEYS

May 30, 1961

E. L. ALLEN ET AL

2,985,908

DOOR HOLDING DEVICES

Filed April 3, 1958

12 Sheets-Sheet 11

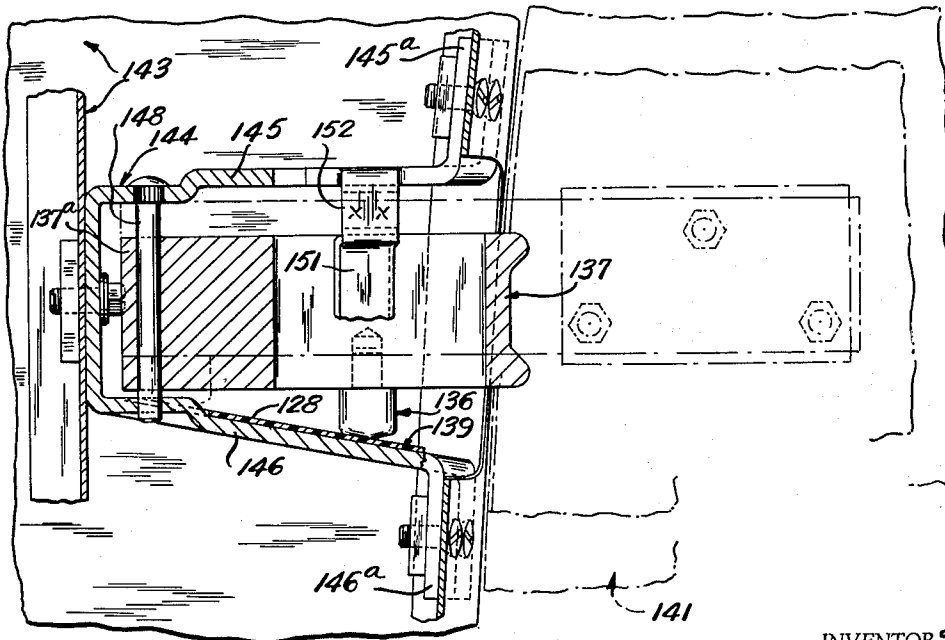
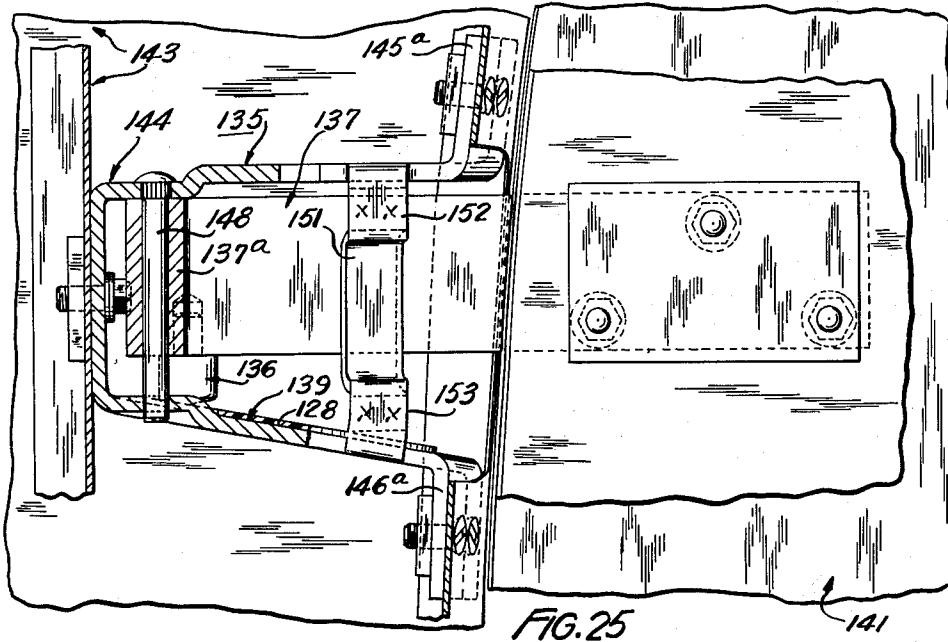


FIG. 26

INVENTORS
EDWIN L. ALLEN
ANGELO R. DeVITO
BY *Hudson, Boughton,*
Williams, David & Hoffmann
ATTORNEYS

May 30, 1961

E. L. ALLEN ET AL
DOOR HOLDING DEVICES

2,985,908

Filed April 3, 1958

12 Sheets-Sheet 12

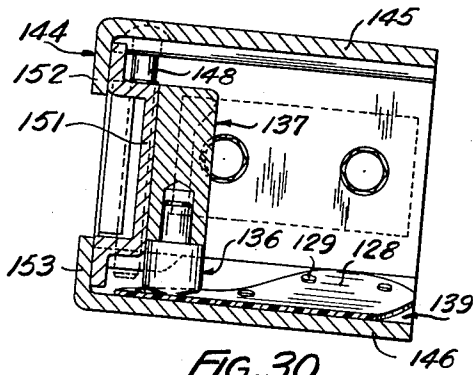


FIG. 30

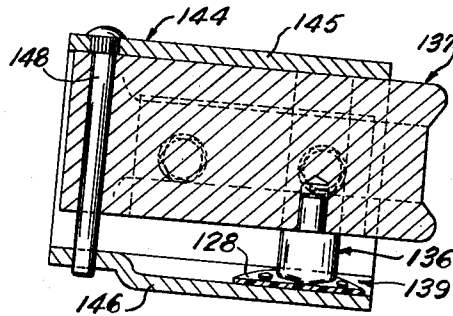


FIG. 29

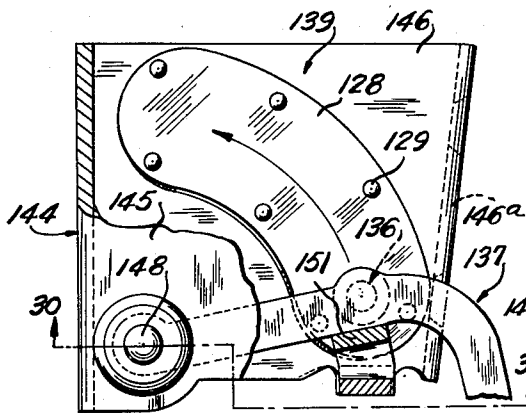


FIG. 28

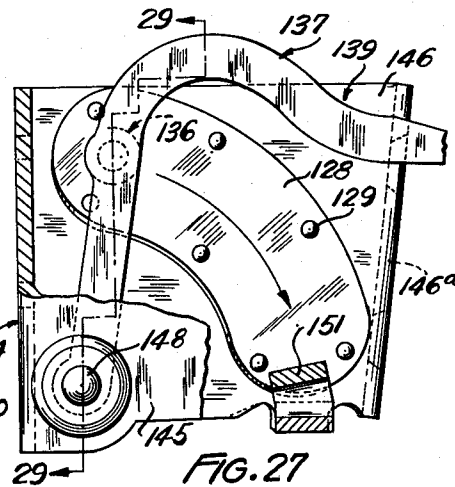


FIG. 27

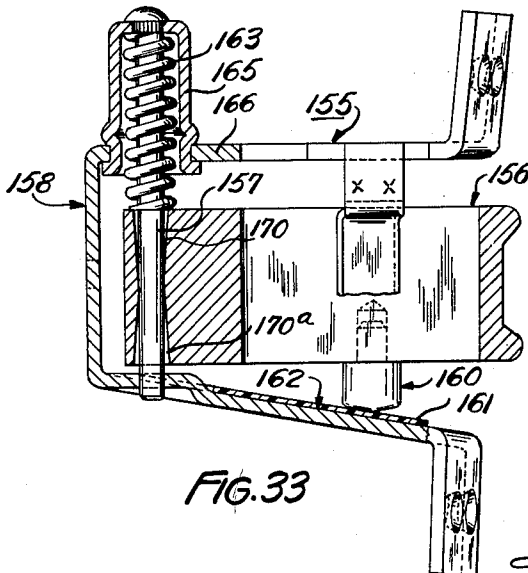


FIG. 33

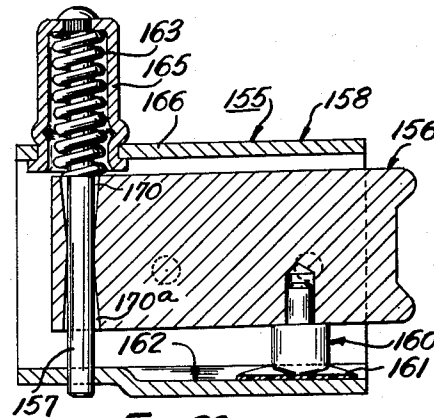


FIG. 32

INVENTORS
EDWIN L. ALLEN
BY ANGELO R. DEVITO
Hudson, Boughton
Williams, David & Hoffmann
ATTORNEYS

1

2,985,908

DOOR HOLDING DEVICES

Edwin L. Allen and Angelo R. de Vito, Cleveland Heights, Ohio, assignors to Lisle W. Menzimer, Rockford, Ill., trustee

Filed Apr. 3, 1958, Ser. No. 726,235

13 Claims. (Cl. 16—141)

This invention relates to a holding device for a swingable door and by which an automobile door or the like can be controlled or held with respect to the swinging movement thereof to eliminate the annoying tendency of such a door to swing shut when it is desired that the door remain open.

The tendency for an automobile door to swing shut is frequently the result of, or influenced by, an inclined hinge axis incident to body design requirements or other factors, and may also be produced by various other causes such as by the transverse curvature or crown of a pavement or road, by the slope of a hill, or by a gust of wind. Such a closing tendency of an automobile door causes the same to strike the legs of a person entering or leaving the automobile, but is prevented or minimized by the holding means of the present invention which is effective to hold the door in any open position in which it is left standing, without preventing a relatively free manual movement of the door to any other desired position.

As one of its objects the present invention accordingly provides, in an automobile or the like, a novel door holding means of a simple and practical form comprising co-operating ramp means and follower means and which is effective to hold a substantially vertically hinged door in any open position in which it is left standing, without preventing a relatively free manual movement of the door to any other of its positions.

Another object is to provide such a co-operating ramp and follower type of holding means for use with an automobile door or the like having an inclined hinge axis and a normal tendency to fall shut, and in which relative sliding between the ramp means and follower means is in an uphill direction during the closing movement of the door for resisting the tendency to fall shut.

Still another object is to provide door holding means of the above-indicated ramp and follower type and wherein the portion of the ramp means which is slidably engaged by the follower means is a flat-plane thrust surface obtainable without need for intricate and costly machining procedures and can be variably sloped in accordance with the holding power needed for various different automobile doors.

Yet another object is to provide a novel ramp and follower type of holding device for automobile door use in which one of the co-operating ramp and follower members, preferably the ramp member, has a nonmetallic or plastic thrust means slidably engaged by a metal contact portion on the other member for smoothness and quietness of operation, and wherein the sliding engagement comprises at least a line contact between the members.

The present invention also provides such a ramp type holding device for use with an automobile door swingably connected with a support structure by a substantially vertical-axis hinge means and wherein the hinge axis and the co-operating ramp and follower members are located in a recess of the support structure.

As a further object thereof, this invention also pro-

2

vides such a ramp and follower type of holding means for a vertically hinged door and wherein spring means, preferably a preloaded spring means, presses the follower means against the ramp means and the sloped condition of the latter is such that a loading flexure of the spring means opposes the closing movement of the door and an unloading flexure assists the opening movement of the door.

It is also an object of this invention to provide novel ramp type holding means for use with an automobile door supported by a substantially vertical-axis hinge means and having a gravity movement along such axis, and wherein the follower means is pressed against the ramp means by the force of the gravity action, or by the combined force of the gravity action and a preloaded spring means.

Additionally, this invention provides a novel ramp and follower type of holding means for a door supported by hinge means comprising a hinge bracket connected with a support structure and a hinge arm connected with the door, and wherein the ramp means is located on the hinge bracket and the follower means is located on the hinge arm.

Other objects and advantages of this invention will be apparent in the following detailed description and in the accompanying sheets of drawings forming a part of this specification and in which,

Fig. 1 is a partial side elevation of an automobile body having the door holding means of the present invention applied thereto;

Fig. 2 is a partial transverse horizontal section taken on section line 2—2 of Fig. 1 and showing the door holding means on a larger scale;

Fig. 3 is a partial transverse section similar to that of Fig. 2 but showing the door in an open position;

Fig. 4 is a partial vertical section taken on section line 4—4 of Fig. 2 and showing the door-closed condition of the holding means;

Fig. 5 is another partial vertical section taken on section line 5—5 of Fig. 3 and showing the door-open condition of the holding means;

Fig. 6 is a diagram graphically illustrating various design and functional characteristics of the door holding means;

Fig. 7 is a perspective-view diagram illustrating certain characteristics of the ramp member;

Figs. 8 and 9 are perspective-view diagrams similar to that of Fig. 7 but showing different conditions of slope for the ramp member;

Fig. 10 is a plan-view diagram of the ramp member and showing the path of follower contact with the ramp for the ramp slope illustrated in Fig. 7;

Figs. 11 and 12 are similar plan-view diagrams showing the path of follower contact with the ramp for the ramp slopes illustrated in Figs. 8 and 9;

Figs. 13 and 14 are diagrams showing the development length and true gradient characteristics of the follower paths of Figs. 11 and 12;

Fig. 15 is a partial transverse section similar to that of Fig. 3 but showing a first modified form of door holding means;

Fig. 16 is a partial vertical section taken as indicated by section line 16—16 of Fig. 15 and showing the condition of the first modified holding means when the door is in the closed position;

Figs. 17 and 18 are partial plan views showing the modified holding means of Fig. 15 removed from the vehicle body for clearer illustration, Fig. 17 showing the door-closed condition of the holding means and Fig. 18 showing the door-open condition thereof;

Figs. 19 and 20 are vertical sectional views taken re-

3

spectively on section lines 19—19 and 20—20 of Figs. 17 and 18;

Figs. 21 and 22 are vertical sectional views similar to those of Figs. 17 and 18 but showing a second modified form of door holding means;

Fig. 23 is a transverse horizontal section taken substantially as indicated by section line 23—23 of Fig. 24 and showing a third modified form of door holding means;

Fig. 24 is a partial vertical section taken on section line 24—24 of Fig. 23 and further illustrating such third modified form of door holding means;

Fig. 25 is a partial vertical section taken on section line 25—25 of Fig. 23 and showing the condition of the holding means for the door-closed position;

Fig. 26 is a partial vertical section similar to that of Fig. 25 but showing the door-open condition of the holding means;

Figs. 27 and 28 are plan views, with portions in section, showing the door holding means of Figs. 23 to 26 removed from the vehicle body for clearer illustration, Fig. 27 showing the door-closed condition of the holding means and Fig. 28 showing the door-open condition thereof;

Figs. 29 and 30 are vertical sections taken respectively on section lines 29—29 and 30—30 of Figs. 27 and 28;

Fig. 31 is a fragmentary vertical section taken through a portion of the third modified door holding means as indicated by section line 31—31 of Fig. 23; and

Figs. 32 and 33 are vertical sectional views similar to those of Figs. 29 and 30 but showing a fourth modified form of door holding means.

Proceeding now with a more detailed description of the door holding means of this invention and the application thereof to an automobile or the like, Figs. 1 to 5 inclusive of the drawings show a preferred embodiment of such a door holding means or device 10 associated with door and door support structures 11 and 12 of an automobile body 13. The door 11 is swingable on a substantially vertical hinge axis provided by the hinge pins 14 of a pair of vertically spaced hinges 15 and 16 and comprises a hollow structure having spaced outer and inner side walls 17 and 18 and a hinge anchorage means 19 located in the chamber or space 20 between such walls. The door 11 also includes an upright edge wall 21 which faces toward the support structure 12 when the door is in its closed position as shown in Figs. 1 and 2.

The door support structure 12 is formed by an upright portion of the automobile body 13 comprising outer and inner side walls 23 and 24 spaced apart to provide a chamber or recess 25 between the planes of such outer and inner side walls, and an upright anchorage wall 26 extending between the side walls and facing rearwardly toward the door opening. The support structure 12 may also include an upright edge wall 27 spaced rearwardly from the upright anchorage wall 26 and with respect to which the upright edge wall 21 of the door 11 occupies an opposed position when the door is in its closed condition. The upright edge wall 27 can be omitted from the support structure but, when used, is provided with suitable clearance openings 28 therein for the hinges 15 and 16.

The design of the automobile body 13 is here shown as being such that the hinge pins of the hinges 15 and 16 provide an upright hinge axis 30 for the door 11 which is inclined from the vertical and the direction of the inclination is usually such that the door has a normal tendency to fall shut when it has been manually swung to an open position and released by the operator. The holding device 10 of the present invention counteracts this tendency of the door to fall shut and, as explained in greater detail hereinafter, provides a substantially balanced condition for the door such that the door will be held in any open position to which it has been moved

4

but will nevertheless be readily movable to any other of its positions to which the operator may wish to move it.

The holding device 10 of the present invention comprises co-operating ramp and follower members 32 and 33 which are associated with the door and door support structures 11 and 12, and which produce the door holding function mentioned just above. In the door holding device 10 as herein disclosed, the ramp member 32 is associated with the door support structure 12 and the follower member 33 is associated with the door 11. The holding device 10 is also disclosed herein as being associated with the hinge means of the door 11, in this case the upper hinge 15 thereof. In the embodiment of the door holding device 10 herein disclosed, the ramp member 32 is associated with the portion of the hinge 15 which is attached to the door support structure 12 and the follower member 33 is associated with the portion of the hinge which is attached to the door 11.

The hinge 15 comprises a hinge bracket 35 mounted on the door support structure 12, and a hinge arm 36 attached to the door 11 and pivotally connected with the hinge bracket by the hinge pin 14. The hinge bracket 35 is here shown as being a die-formed metal member, preferably a stamped sheet metal member, having upper and lower flanges 37 and 38 and an upright attaching wall 39 connecting such flanges and providing for attachment of the bracket to the anchorage wall 26 by suitably located screws 40. The bracket 35 also comprises a formed knee portion 42 on, or adjacent to, the flange 38 and forming a pivot anchorage for the lower end of the hinge pin 14.

The hinge arm 36 is here shown as being a die-formed metal member, preferably a stamped sheet metal member, having the form of a channel-shaped bell crank lever. More specifically, the hinge arm 36 comprises upper and lower longitudinal flanges 44 and 45 forming the sides of a longitudinal channel recess 46, and an upright wall or web 47 connecting the flanges and forming the back wall of the channel recess. At the front end thereof, the hinge arm is provided with an eye portion 48 which is received between the upper flange 37 and the knee portion 42 of the bracket 35 and is pivoted on the hinge pin 14. The rear end of the hinge arm 36 projects from the door support structure 12 and into the chamber 20 of the door 11, and has the door mounted thereon by suitable attaching screws 49 which connect the anchorage means 19 with the hinge arm.

The ramp member 32 of the door holding device 10 is here shown as formed by the lower flange 38 of the hinge bracket 35, and the follower member 33 is here shown as being in the form of a plunger having a guided movement in guide means provided on the hinge arm 36. In utilizing the lower flange 38 of the hinge bracket as the ramp member, this flange is canted or inclined from a horizontal plane to the relatively tilted position shown in Fig. 4, so that the ramp member 32 will slope in an uphill direction for movement of the follower member 33 therealong in a direction toward the center line of the automobile body 13 which is the direction of the closing movement of the door 11.

The angle of tilt of the ramp member 32 can be any suitable value and is selected to be appropriate for the requirements of the vehicle door in question, particularly with respect to the weight of the door and the direction and extent of inclination of the hinge axis. In the door holding device 10 shown in Figs. 1 to 5 inclusive, the ramp member 32 is tilted or sloped in one direction only, and can therefore having a flat-plane thrust surface or element 51 on the top thereof for co-operation with the follower member 33.

The sliding engagement of the follower member 33 with the ramp member 32 can be a sliding engagement directly with the flat-plane thrust surface of the flange 38 but, in accordance with the present invention, the thrust element or surface 51 comprises a nonmetallic member

made of a suitable plastic material, such as nylon, and is preferably in the form of a substantially uniform-thickness layer of such plastic material which is secured to the ramp member and preferably has substantially the same tilt and flat-plane thrust surface characteristic. The thrust element 51 is here shown as being of a curved or kidney-like shape in plan outline. By the use of the plastic thrust element 51 on the ramp member 32, the sliding engagement of the follower member thereon will have a desired uniform friction coefficient and will provide for a smooth and quiet functioning of the door holding device with minimum abrasion or wear on the ramp member.

The plastic thrust element 51 is flexible and resilient in character, rather than hard or brittle, and is sufficiently yieldable and pliable to be indented somewhat by the follower member 33 when the latter is in a rest position. This indentation by the follower member is temporary only, inasmuch as the resilient character of the plastic causes the thrust element 51 to restore itself to a smooth and flat condition promptly after the follower member is moved away from such a rest position. The temporary indentation thereof causes the plastic thrust member 51 to provide a factor of additional resistance to movement of the follower member away from a rest position and this added resistance factor contributes to the effectiveness of the holding device 10 in holding the door 11 in any open position to which it is moved and left standing.

The plastic thrust element 51 can be secured on the ramp member 32 as by cementing, bonding, riveting or any other suitable attaching medium, but is here shown as being secured to the ramp member by rivets 52 which are formed by upset integral portions of the thrust element itself and which extend through the ramp member and have their upset heads in holding engagement with the underside of the latter, as shown in Figs. 4 and 5.

The follower member 33 is here shown as being a movable plunger comprising a stem 54 and a head 55 mounted on, or formed integral with, the lower end of the stem. The follower member 33 is guidedly supported by the flanges 44 and 45 of the hinge arm 36 by having its stem and head portions slidable in guide openings 56 and 57 provided in such flanges. The portion of the follower member which is in sliding engagement with the ramp member 32, or with the thrust element 51 thereof, can be of any desired shape suitable for the most satisfactory co-operation with the ramp member, but when the ramp member has the above-described flat-plane characteristic, the engaging portion of the follower member is preferably a cone-shaped contact portion 59 on the head 55 and which cone-shaped contact portion will always provide substantially a line contact engagement with the flat-plane surface of the thrust element.

The door holding device 10 also includes a spring means, preferably a preloaded spring means, which is effective on the follower member 33 for pressing the same against the ramp member 32 and which spring means is here shown as being a coil spring 60 disposed in surrounding relation to the stem 54. The upper end of the spring 60 is seated against the underside of the upper flange 44 of the hinge arm, and the lower end of the spring is seated against an annular shoulder 61 provided by the exposed portion of the upper end of the head 55. The holding device 10 preferably also includes a thrust washer 63 made of nylon or the like and interposed between the upper flanges 37 and 44 of the hinge bracket and hinge arm. The washer 63 carries the thrust reaction resulting from the expansive action of the spring 60, and from the co-operation of the follower member 33 with the ramp member 32, and contributes to a smooth and quiet functioning of the holding device.

From the construction and functioning of the door holding device 10 as above described, it will now be understood that during the swinging of the door 11 about the axis of the hinge pin 14, the follower member 33 will slide on the thrust element 51 of the ramp member 32 and the

line contact of the follower member will follow or scribe an arcuate path 64 on the thrust element having the truncated crescent shape shown in Figs. 2 and 3 of the drawings. It will likewise be seen that, during the closing movement of the door 11, the follower member 33 will have an arcuate uphill sliding movement on the ramp member and that such sliding movement will be resisted by the uphill slope, by the friction between the ramp and follower members, and by the preloaded condition and loading flexure of the spring 60. These resistance factors for the closing swinging movement of the door will provide a substantially balanced condition for the door which will overcome the tendency of the door to fall shut and will cause the door to be held in any open position to which it is moved and left standing. Notwithstanding this balanced condition of the door, it will still be readily movable to any other desired position by a mere pushing force or shove manually applied to the door.

It will also be seen that during the opening movement of the door, the follower member 33 will have a downhill sliding movement on the ramp member 32 and the spring 60 will be subjected to an unloading flexure. This downhill movement of the follower member and the thrust action and unloading flexure of the spring 60 will constitute assisting factors tending to assist the opening movement of the door.

In addition to the characteristics and advantages already described above for the door holding device 10, the present invention also achieves other important advantages by reason of the novel design of the holding device which renders the same highly flexible in the sense that it is readily adaptable to the doors of a wide variety of different vehicles. This is achieved by varying the slope or tilt of the ramp member and can be accomplished without departing from the above-mentioned flat-plane surface characteristic of the ramp member 32 and thrust element 51. This flat-plane surface characteristic is highly desirable from the standpoint that it can be economically produced either on the hinge bracket 35 or, if desired, on a part to be attached to the door support structure 12 adjacent the hinge bracket, without intricate machining or forming operations of the kind which would be needed if the ramp member were provided with a curved thrust surface of any kind.

To facilitate the explanation of the variable door holding action obtainable from the holding device 10, reference will now be made to the diagrams shown in Figs. 6 to 14 inclusive. The diagram of Fig. 6 graphically illustrates the design characteristics and functioning of the door holding means 10 by showing in the diagram portion 65 a plan view of the ramp member 32 with an arc 66 thereon representing the arcuate swinging movement of the door 11 and radial lines 67 emanating from the hinge pin axis 30 and representing angular increments of door swinging movement. The arcuate line 68 represents the path of the follower member 33 on the ramp member 32 and extends from a door-open follower position 69 to a door-closed follower position 70.

As shown in Figs. 4 and 5 of the drawings and as represented in the diagram of Fig. 6, the ramp member 32 has its high side or edge 72 disposed toward the center line of the car or vehicle and its low side or edge 73 disposed toward the outside of the vehicle. With the diagram of Fig. 6 representing a holding means applied to the left-hand door of the vehicle, it will accordingly be seen that opening movement of the door 11 and the downhill sliding travel of the follower member on the ramp member, produce a relative sliding movement of the ramp member along the arcuate path 68 in a direction of travel from the follower position 70 to the follower position 69, and that closing movement of the door produces a relative sliding movement of the follower member on the ramp member in the opposite or uphill direction along the arcuate path 68.

It will also be understood from the diagram of Fig. 6

7

that the portion 68^a of the follower path adjacent the door-open position 69 follows a direction which extends more transversely of the vehicle than it does longitudinally thereof, whereas the path portion 68^b adjacent the door-closed position 70 of the follower member extends more longitudinally of the vehicle than it does transversely thereof. This is important in connection with the door holding force which it is desired to have the holding device 10 develop during the operation thereof for the corresponding portions of the closing movement of the door, as will be further explained hereinafter.

The diagram portion 74 of Fig. 6 includes an inclined line 75 which represents a true projection of the follower path 68 and shows the flat-plane surface characteristic of the thrust element 51 of the ramp member throughout the full path of arcuate sliding travel of the follower member thereon. The lines 67^a are projection lines by which the location points establishing the slope of the line 75 are plotted.

The diagram portion 76 of Fig. 6 includes a curve 77 which is a development of the follower path 68 and represents the true gradient or slope variation of the thrust surface of the ramp member 32. The portion 77^a of the curve 77 represents the relatively steep slope of the end portion 68^a of the ramp path which is nearest the door-open follower position 69 and the portion 77^b illustrates more gradual or relatively flatter slope of the portion 68^b of the ramp path which is nearest the door-closed follower position 70. The significance of these relatively steep and relatively flat slope portions 77^a and 77^b of the curve 77 is very important and illustrates the characteristic of the holding device 10 by which a desired holding action or power is obtainable in accordance with the particular desire of any given automobile manufacturer.

Thus, the relatively steeper curve portion 77^a represents the slope of the portion 68^a of the follower path which is being traversed by the follower member 33 when the door 11 is moving in the closing direction from its full-open position. This movement of the follower member along this relatively steeper portion of the follower path will result in the development by the holding device of a more powerful or maximum holding force and, as the door approaches its closed position, the follower member will be moving along the portion 68^b of the path which has the relatively flatter slope represented by the curve portion 77^b and the holding power developed by the device will be of a lower or minimum value. This relatively lower holding power during the final portion of the door closing movement will readily permit the door to move to its fully-closed and latched condition without likelihood of the door remaining in its partially-latched or safety-latched position.

The diagram of Fig. 10 is similar to and supplements the diagram portion 65 of Fig. 6 and is further descriptive of the functioning of the door holding device 10 by showing the area of the ramp surface traversed by the line contact of the follower member 33 therewith as a crescent-shaped area 80 corresponding with the crescent-shaped path 64 of Fig. 3. When the follower member 33 has the cone-shaped contact portion 59 mentioned above, the line contact of the cone shape with the flat-plane tilted surface of the ramp member 32 will assume the various different positions represented by the lines 81 of the crescent-shaped area 80. It will accordingly be seen that the follower member has a substantial area of contact with the thrust element 51 of the ramp member 32 and that the thrust will be distributed over a substantial area of the ramp member as represented by the crescent-shaped diagram portion 80, with the result that the sliding engagement of the ramp member on the follower member will be smooth and quiet with no tendency of the follower member to chatter or to abrade or dig into the thrust surface of the ramp member.

The sloped character of the flat-plane thrust surface or element 51 of the ramp member 32 is further illus-

8

trated in the perspective-view diagram of Fig. 7 wherein the follower member is represented as a wedge 32^a and the arcuate path of the follower member on the thrust element is represented by a broken-line curve 83. The diagram of Fig. 7 also shows the tilt of the flat-plane thrust surface of the ramp member 32 which is obtained by having the high side or edge 72 of the ramp member disposed toward the center line of the car or vehicle. The shape and position of the curve 83 also illustrates the varying gradient of the follower path and portrays the above-explained relatively steep gradient represented by the curve portion 83^a corresponding with the closing swinging movement of the door away from the door-open follower position 84 and the relatively flatter portion of the follower path represented by the curve portion 83^b and corresponding with the portion of the follower movement on the ramp surface when the door is approaching the door-closed position 85 of the follower member.

The diagram of Fig. 8 shows how the holding force developed by the holding device 10 can be varied to suit the desire of another automobile manufacturer, or to suit the requirements of a door of a different vehicle, by using a different slope position for the ramp member 32 and without departing from the single-slope flat-plane surface characteristic of the thrust surface of the ramp member. Thus Fig. 8 portrays the ramp member 32 in the form of a wedge 32^b and shows that, when the high side or edge 87 of the ramp member is disposed toward the front or hinge axis of the vehicle, the path of the follower member on the thrust surface of the ramp member will have a different slope characteristic and will result in a different holding power being developed by the device for the door.

The path of the follower member 33 is represented in Fig. 8 by the broken-line curve 88 and the door-open and door-closed positions of the follower member are represented by the points 89 and 90 at the ends of this curve. It will now also be apparent from Fig. 8, that for the positioning or orientation of the ramp slope as represented therein, the end portion 88^a of the follower path nearest the door-open follower position 89 and which extends more transversely than longitudinally of the vehicle is the relatively flatter portion of the path, whereas the end portion 88^b nearest the door-closed follower position 90 and which extends more longitudinally than transversely of the vehicle is the relatively steeper portion of the path.

Figs. 11 and 13 show diagrams 92 and 93 which further explain and supplement the diagram of Fig. 8 and the co-operation of the follower member 33 with a ramp member 32 having its high side or edge 87 disposed toward the front of the car or vehicle. The diagram 92 of Fig. 11 is a plan-view diagram of the ramp member 32 when the latter has the slope disposition illustrated in Fig. 8 and shows the crescent-shaped area 94 of the line contact of the cone tip 59 follower member with the flat-plane thrust element 51 of the ramp member.

The curve 95 of Fig. 13 is a development of the follower path 88 and 94 of Figs. 8 and 11 and is also a true gradient curve showing the variable slope characteristic of the follower path. From the shape of the curve 95 it will be seen that the curved portion 95^a which is nearest the door-open position 89 of the follower member has the above-explained relatively flatter or more gradual slope, and the curve portion 95^b which is nearest the door-closed position 90 of the follower member has the relatively steeper slope.

It will therefore be seen from the diagrams of Figs. 8, 11 and 13 that when the ramp member 32 is disposed or oriented with the high side or edge 87 thereof disposed toward the front of the vehicle or car, the follower member 33 will traverse the relatively flatter and relatively steeper path portions corresponding with the portions 95^a and 95^b of the gradient curve 95 as the door swings from its full-open position toward its fully-closed position,

Because of the inclination of the hinge axis 30 and the gravity and inertia effects on the door 11 in association with such inclined hinge axis, the tendency of the door to fall shut will cause a progressively increased acceleration of the door as it moves toward its closed position. When the ramp member 32 is disposed with its slope in the orientation represented in Figs. 8, 11 and 13, it compensates for this increased acceleration of the door as it approaches its closed position by developing a relatively greater holding force when the follower member travels along the relatively steeper portion of its path represented by the curve portion 95^b. It will accordingly be seen that when the ramp member has the orientation and sloped relation represented in Figs. 8, 11 and 13, this greater holding force will be developed with increasing effectiveness as the door approaches its closed position and will result in a controlled and balanced condition of the door which will prevent any dangerous or damaging slamming thereof as it reaches its fully-closed position.

Figs. 9, 12 and 14 of the drawings further illustrate the variable holding action obtainable from the door-holding device 10 and represent the condition and functioning of the device when the ramp member 32 has its slope disposed so that the high corner 99 of its flat-plane thrust surface or element 51 is located in an intermediate position approximately halfway between the two positions of the high sides 72 and 87 of the wedges 32^a and 32^b shown in Figs. 7 and 8. In the diagram 100 of Fig. 9 this high-corner orientation of the ramp member 32 is shown as having been achieved by locating the wedge 32^b in superposed relation on the wedge 32^a.

The ramp member 32 of Fig. 9 accordingly has a slope which can be referred to as a composite slope but which still has the flat-plane thrust surface or element 51. The curve 101 represents the path of the follower member 33 on the flat-plane thrust surface of the ramp member 32 when the latter is disposed with the high corner 99 thereof in the relative position shown in Fig. 9 and extends from a door-open position 102 of the follower member to a door-closed position 103.

Figs. 12 and 14 show diagrams 107 and 108 which supplement the diagram 100 of Fig. 9 and further illustrate the characteristics of the follower path and the functioning of the door-holding device when the thrust surface of the ramp member has the high-corner orientation explained above. The crescent-shaped diagram portion 109 of Fig. 12 represents the area traversed by the line contact of the cone-shaped follower tip 59 with the flat-plane thrust element 51 of the ramp member. The curve 110 of Fig. 14 is a development of the follower path indicated at 101 and 109 of Figs. 9 and 12 and represents the true gradient or slope of the thrust surface of the ramp member along the follower path.

It will be seen from Fig. 14 that the gradient curve 110 is a substantially straight line and has approximately the same slope at all points therealong from the door-open follower position 111 to the door-closed follower position 112. The uniform slope of the gradient curve 110 signifies that, for all portions of the sliding travel of the follower member along its path 101 and 109 of Figs. 9 and 12, a uniform holding force will be developed by the holding device and that such a uniform holding force, if desired by a particular automobile manufacturer or if needed for a particular vehicle door, can be readily achieved by the use of a ramp member disposed in the high-corner sloped relation illustrated in Figs. 9 and 12.

The door holding means 10 preferably embodies check means for limiting the opening movement of the door 11 when it arrives at its full-open position shown in Fig. 3. This check means is here shown as comprising a stop 115 in the form of a strap carried by the hinge bracket 35 and located in a position to be engaged by a portion of the hinge arm 36. The strap forming the stop 115 has flange portions 115^a at the ends thereof which are secured, as by welding, in an overlying relation to the

flanges 37 and 38 of the hinge bracket such that the strap also serves as a reinforcing means for the hinge bracket.

Figs. 15 to 20 inclusive of the drawings show door-holding means or device 117 which is generally similar to the holding device 10 described above and wherein corresponding parts of the holding device and corresponding parts of the door and door support structures are designated by the same reference characters. In the modified door holding device 117 the hinge arm 118 is also of die-formed construction but is in the form of a forging or the like instead of a sheet metal stamping. In this modified holding device, the guide means provided on the hinge arm 118 for the follower member 33 is formed by a guide opening 119 in the lower portion of the arm and through which opening the head portion 55 of the follower member extends and a guide opening 120 provided in the upper end of a tubular cap or housing member 121 and through which the stem portion 54 of the follower member projects.

The hinge arm 118 is provided with a counterbore 122 and the tubular cover 121 has a threaded engagement 123 in the counterbore and co-operates with the latter in forming a spring chamber 124. As shown in Figs. 15, 17 and 18 the hinge arm 118 may be provided with an enlargement or boss 118^a in which the counterbore 122 is formed. The upper flange 37 of the hinge bracket 35 is cut away, as shown in Figs. 15 to 20, to provide clearance for the cover 121 and the stem 54 of the follower member.

A preloaded spring is provided in the spring chamber 124 in the form of a coil spring 125 disposed around the stem portion 54 of the follower member 33 and which spring presses the follower member against the ramp member 32. The lower end of the spring is seated against a shoulder 126 provided on the follower member, and the upper end of the spring is seated against the transverse end wall of the cover member 121. The threaded connection 123 provides for adjustment of the position of the cover member 121 relative to the hinge arm 118 for varying the compression loading of the spring 125.

The door holding device 117 preferably embodies a check means equivalent to the check means of the door holding means 10 and provided for the same purpose. In the holding device 117, however, the check means is in the form of a lug 127 on the hinge bracket 35 and which extends into the path of movement of the hinge arm 118 and is engageable by a portion of the latter when the door 11 arrives at its full-open position. The stop lug 127 is here shown as formed by an up-turned integral portion of the lower flange 38 of the hinge bracket 35. The connection of the lug 127 with the flange 38 is reinforced by a corner web 127^a provided by a deformed integral bracket portion located at the junction of the lug with the flange.

The modified door-holding device 117 functions in substantially the same manner as the holding device 10 and the description and explanation given above in connection with the diagrams of Figs. 6 to 14 inclusive is equally applicable to this modified holding device. The showing of the holding device 117 in Figs. 15 to 20 inclusive is with the tilted flat-plane thrust surface or element of the ramp member 32 disposed in the sloped relation represented by the diagrams of Figs. 8, 11 and 13. In other words, the ramp member of the holding device 117 is in a sloped position with the high side or edge 87 thereof disposed toward the front of the vehicle or car as indicated in Figs. 8 and 11 and the slope gradient of the path of sliding contact of the follower member 33 on the ramp member 32 corresponds with the slope variation represented by the gradient curve 95 of Fig. 13.

In the door holding device 117, the ramp member 32 is also provided with a plastic thrust element 128 of nylon or the like and similar to the thrust element 51 described above for the holding device 10. The thrust element 128 is here shown as being secured in place on

the bracket flange 38 by fastening elements or rivets 129 which extend through the thrust element and its support flange. Spacer and thrust washers 63 of nylon or the like are interposed between both edges of the hinge arm 118 and the flanges 37 and 38 of the hinge bracket 35.

When the plastic thrust element is secured on the bracket flange 38 by fastening elements or rivets formed integral with the thrust element, as in the case of the rivets 52 of the thrust element 51 of Figs. 1 to 5 inclusive, the thrust element can be of a relatively narrower width. This is an advantage for the holding device 10 because a smaller hinge bracket can be used and will be more readily accommodated in the limited space available in the door support structure 12.

Figs. 21 and 22 of the drawings show a door holding means or device 130 which is quite similar to the door holding device 117 described above but differs therefrom in that the ramp member 131 is sloped or tilted in two directions, that is to say has a composite slope. The ramp member 131 corresponds with the composite slope illustrated in the diagram of Fig. 9, and is obtained by having the flange 38 of the hinge bracket 35 disposed in the desired tilted or angular relation. Parts of the holding device 130 which are the same as corresponding parts in the holding devices 10 and 117 have been designated by the same reference characters.

The characteristics of the co-operating ramp and follower members 131 and 33, and the functioning of this holding device 130, correspond with the characteristics and functioning illustrated in the diagrams of Figs. 12 and 14. The path of the sliding movement of the follower member 33 on the ramp member 131 is represented by diagram portions 101 and 109 of Figs. 9 and 12. The uniform slope gradient of the path of the follower member 33 is represented by a substantially straight-line substantially uniform-slope gradient curve 110 of Fig. 14.

The holding device 130 is here shown as having its follower member 33 mounted in the same manner, and on a hinge arm 118 of the same form, as the follower member of the holding device 117 described above. A lug-type stop 127 is also provided on the hinge bracket 35 as a check means.

Figs. 23 to 31 inclusive show another modified door holding means or device 135 which is generally similar to the door-holding devices 10 and 117 described above but differs therefrom in that the follower member 136 is substantially fixed on the hinge arm 137 and is pressed against the flat-plane plastic thrust element 128 of the sloped ramp member 139 solely by the gravity action and movement of the hinge arm and the swingable door 141 connected therewith.

The door support structure 143 is similar to the door support structure 12 described above and the door 141 is swingably connected therewith by the hinge arm 137 and an associated hinge bracket 144 which is of a somewhat different form than the above-described hinge bracket 35. The hinge bracket 144 has upper and lower flanges 145 and 146 which are provided with attaching lugs 145^a and 146^a, and the ramp member 139 is formed by a portion of the lower flange and is of the same sloped and flat-plane characteristic as the ramp member 32.

To provide for the above-mentioned gravity movement of the door-carrying hinge arm 137, the flanges 145 and 146 of the hinge bracket 144 are spaced apart a distance somewhat greater than the width of the hinge arm, as shown in Figs. 24, 25 and 26, and the eye portion 137^a of the hinge arm which is pivoted on the hinge pin 148 of the bracket is slidable along the hinge pin during the

opening and closing movements of the door. The follower member 136 can be mounted on the hinge arm in the manner shown in Fig. 31 as by having a stem portion 136^a inserted into an opening or socket 149 provided in the lower edge of the hinge arm.

Figs. 24, 25, 27 and 29 of the drawings show the holding device 135 in the condition corresponding with the closed position of the door 141, at which time the follower member 136 is at the uphill end of its path of sliding movement on the ramp member 139 and the hinge arm 137 is in a relatively lifted position on the hinge pin 148. Figs. 26, 28 and 30 show the condition of the holding device 135 when the door 141 is in its full-open position, at which time the follower member 136 is at the downhill end of its path of sliding movement on the ramp member 139 and the hinge arm 137 has been slidably moved downwardly on the hinge pin 148 by the gravity action of the hinge arm and door.

The door holding device 135 embodies check means for limiting the movement of the door 141 when it arrives at its full-open position. This check means is here shown as being a stop member in the form of a strap 151 connected to lug projections 152 and 153 of the hinge bracket 144.

The door holding device 135 functions in a generally similar manner and accomplishes the same purposes as the above-described door holding devices 10 and 117 with the exception that the thrust load of the follower member 136 against the ramp member 139 is supplied solely by the gravity action of the door and hinge arm. The diagrams of Figs. 6 to 14 inclusive are equally applicable to the door holding device 135 in illustrating and explaining the characteristics of the co-operating ramp and follower members and the functional performance of this holding device. The ramp member 139 of Figs. 23 to 30 inclusive has the sloped position represented by the diagrams of Figs. 8, 11 and 13, and the diagrams of these views illustrate the slope and contact area characteristics of the path of the follower member 136 in the same manner as has been described above in connection with the holding device 117.

Figs. 32 and 33 of the drawings show still another modified door holding means or device 155 which, in certain respects, is similar to the door holding device 135 and in other respects is similar to the door holding devices 10, 117 and 130. The door holding device 155 resembles the door holding device 135 in that the hinge arm 156 is capable of a gravity movement along the hinge pin 157 of the hinge bracket 158. The door holding device 155 resembles the door holding devices 10, 117 and 130 in that the follower member 160 is pressed against a plastic thrust element 161 of the ramp member 162 by the expansive force of a preload compression spring 163, but this action of the spring is in addition to the force of the gravity action on the door and hinge arm.

The spring 163 is located in a tubular spring housing 165 which is mounted in an opening of the upper flange 166 of the hinge bracket 158 and is disposed in surrounding relation to the upper portion of the hinge pin 157. The spring seats against the upper edge of the hinge arm 156.

To prevent binding of the hinge arm 156 on the hinge pin 157 during sliding of the hinge arm on the latter, the opening 170 of the arm through which the hinge pin extends is an opening of variable width and whose coneshaped portions 170^a are disposed with their oppositely tapered or divergent ends extending to the top and bottom edges of the hinge arm. By reason of the variable width of the opening 170, the hinge arm 156 will be capable of adapting itself to minor misalignment or irregularities in the hanging of the door such that any binding of the arm on the hinge pin during the gravity movements of the door will be avoided, regardless of the existence of such misalignment or irregularities.

13

The slope characteristics for the ramp member 162, and the co-operative sliding engagement of the follower member 160 thereon, are the same as are illustrated in the diagrams of Figs. 6 to 14 inclusive and are usable in and applicable to the holding device 155 in the same manner as has been described above for the holding devices 10, 117 and 135. The ramp member 162 shown in Figs. 32 and 33 is disposed so that the slope orientation thereof and the path of sliding movement of the follower member 160 thereon correspond with the illustration given in Figs. 8 and 11, and the slope characteristic of the path of the follower member on the ramp member is represented by the gradient curve 95 of Fig. 13.

From the accompanying drawings and the foregoing detailed description it will now be readily understood that this invention provides door holding means of a simple and practical form which can be readily incorporated in an automobile body in association with the door and door frame structures thereof, and which will be effective to provide a substantially balanced condition for the door such that the door will be held in any open position to which it is moved and left standing and the annoying tendency of the door to fall shut will be prevented, even though the door will still be readily capable of being moved to any other desired position by a simple manual push or pull applied thereto by the operator. It will now also be understood that the door holding means provided by this invention will be smooth, quiet and efficient in operation and will render trouble-free service during a prolonged life span. Since the many novel features and advantages of the door holding means of this invention have already been pointed out in the foregoing specification, they need not be here repeated.

Although the door holding means of the present invention has been illustrated and described herein to a somewhat detailed extent, it will be understood, of course, that the invention is not to be regarded as being limited correspondingly in scope but includes all changes and modifications coming within the terms of the claims hereof.

Having described our invention, we claim:

1. In an automobile or the like having a door support structure containing a recess, and an associated door structure; hinge means connecting said door structure with said support structure for movement to open and closed positions by swinging about a generally upright hinge axis; and door holding means comprising ramp means associated with one of said structures, and follower means associated with the other of said structures and co-operating with said ramp means; said follower means being located on said other structure at a point offset from said hinge axis; said hinge axis and at least a portion of said holding means being located in the recess of said support structure; said ramp means being slidably engaged by said follower means and sloped so that the resistance to relative sliding between the ramp means and follower means is effective to hold the door structure in any open position to which it is moved between its closed and full-open positions; said ramp means and follower means having continuously engaged contact portions between which the relative sliding takes place and at least one of which contact portions is a plastic material; the contact portion of said ramp means having a flat thrust surface lying in a plane extending transverse to said hinge axis at a predetermined inclined angular relation thereto to provide the slope of said ramp means.

2. In an automobile or the like having door holding means comprising co-operating ramp means and follower means as defined in claim 1 and wherein the contact portion of said follower means is of convex shape and the coefficient of friction for the sliding engagement between said contact portions is at least as great as the friction coefficient for sliding engagement between metal and nylon.

14

3. In an automobile or the like having a door support structure and an associated door structure; hinge means connecting said structures and providing for movement of said door structure in opening and closing directions by swinging about a generally upright hinge axis; said hinge axis being inclined from the vertical at an angle such that said door structure has a normal tendency to fall shut; ramp means associated with one of said structures; and follower means associated with the other of said structures at a point offset from said hinge axis and co-operating with said ramp means; said ramp means having a thrust surface slidably engaged by said follower means along a contact path lying wholly in a flat plane; said ramp means being sloped so that the relative sliding movement of the follower means thereon is an uphill travel during swinging of the door structure in the closing direction; the resistance to said relative sliding between said follower means and thrust surface and the sloped condition of the latter providing for a substantially balanced condition of said door structure and being effective to normally hold said door structure in any open position to which it is moved.

4. In an automobile or the like having co-operating ramp means and follower means as defined in claim 3 and wherein the portion of follower means engaging said thrust surface comprises a cone-shaped contact portion and the sliding engagement of said contact portion with said thrust surface is a line contact only for all operating positions of said follower means along said path.

5. In an automobile or the like having co-operating ramp means and follower means as defined in claim 3 and wherein the portion of said ramp means providing said thrust surface is made of plastic and the portion of said follower means in sliding engagement with said thrust surface is a cone-shaped metal portion.

6. In an automobile or the like having a door support structure and an associated door structure; hinge means connecting said structures and comprising a hinge bracket connected with said support structure and a hinge arm connected with said door structure; said hinge means having a hinge axis inclined from the vertical and providing for swinging of said door structure with a normal tendency to fall shut; ramp means on said hinge bracket; and follower means on said hinge arm and co-operating with said ramp means; said follower means being located on said hinge arm at a point offset from said hinge axis; said ramp means being slidably engaged by said follower means during swinging of said door structure in opening and closing directions and sloped so that the relative sliding of said follower means thereon is an uphill travel during the closing movement of said door structure for resisting said tendency to fall shut; the resistance to relative sliding between said ramp means and follower means providing a substantially balanced condition for said door structure and being effective to normally hold said door structure in any open position to which it is moved; said ramp means comprising a thrust member made of plastic material having a flexible characteristic so as to be temporarily deformable to a limited extent by the action of said follower means thereagainst.

7. In an automobile or the like having co-operating ramp means and follower means as defined in claim 6 and wherein the plastic thrust member of said ramp means is secured on said hinge bracket by attaching elements formed integral with said thrust member, and having locked engagement in openings of said ramp means.

8. In an automobile or the like having a support structure containing a recess, and an associated door structure; co-operating hinge members forming a hinge means connecting said structures and comprising a hinge bracket connected with said support structure and a hinge arm connected with said door structure; said hinge means having a hinge axis inclined from the vertical and providing for swinging of said door structure with a normal tendency

15

to fall shut; said door structure and hinge arm being shiftable substantially in the direction of and along the hinge axis and relative to said hinge bracket; ramp means associated with one of said hinge members; follower means associated with the other of said hinge members at a point offset from said hinge axis and pressed against said ramp means by the gravity action of said door structure; said ramp means being slidably engaged by said follower means along a path extending part-way around said hinge axis and being disposed so that the relative sliding of said follower means thereon is an uphill travel and is also opposed by the gravity action of the door structure during the closing movement of the latter for resisting said tendency to fall shut; the resistance to relative sliding between said ramp means and follower means providing a substantially balanced condition for said door structure and being effective to normally hold said door structure in any open position to which it is moved; said hinge bracket and said ramp means and said follower means being all located in the recess of said hollow support structure; said ramp means having a thrust surface of plastic material lying in a flat plane and the portion of said follower means slidably engaging said thrust surface being a convex metal contact portion whose engagement with said thrust surface is a line contact only for all operative positions of the follower means along the path of the sliding engagement.

9. In an automobile or the like having co-operating ramp means and follower means as defined in claim 8 and wherein the hinge bracket and hinge arm are pivotally connected by a hinge pin of the bracket extending through the passage of an apertured portion of the hinge arm; said passage being of tapered width along the axis of the hinge pin to permit limited tilting of said door structure substantially in its own plane and relative to said hinge axis.

10. In an automobile or the like having a support structure and an associated swingable door structure; hinge means connecting said door structure with said support structure and having a hinge axis inclined from the vertical at an angle such that said door structure has a normal tendency to fall shut; said hinge means comprising, as co-operating hinge members, a hinge bracket connected with said support structure and a hinge arm connected with said door structure; guide opening means on one of said hinge members and providing a guide axis in an offset relation to said hinge axis; a ramp member on the other of said hinge members and having a thrust surface lying in a flat plane extending in a transverse and inclined relation to said guide axis; a follower member movable in said guide opening means in opposite directions along said guide axis; said follower member having a contact portion in engagement with said thrust surface and slidable thereon during swinging of said door structure in opening and closing directions; said guide opening means and said ramp member being disposed so that the sliding movement of said contact portion on said thrust surface is an uphill sliding movement during swinging of said door structure toward its closed position and a downhill sliding movement during swinging of said door structure toward its full-open position; and spring means engaged between said one hinge member and said follower member and effective on the latter for extending the same for varying distances relative to said guide opening means for holding said contact portion in said sliding engagement with said thrust surface; said spring means being subject to loading flexure by movement of said follower member in one direction along said guide axis, during swinging of said door structure in the closing direction, for resisting said tendency to fall shut and subject to unloading flexure by movement of said follower member in the other direction along said guide axis, during swinging of the door structure in the opening direction, for assisting the opening movement of the door structure; the resistance to relative sliding between said con-

16

tact portion and thrust surface and the action of said spring means on said follower member providing a substantially balanced condition of said door structure and being effective to normally hold said door structure in any open position to which it is moved.

11. In an automobile or the like having a door support structure and an associated door structure; co-operating hinge members providing a hinge axis and swingably connecting said door structure with said support structure; said hinge members comprising a hinge bracket connected with said support structure and a hinge arm connected with said door structure; ramp means on said hinge bracket; said hinge arm having spaced wall portions carrying hollow guide elements providing a guide axis located in an offset relation to said hinge axis; said ramp means comprising a thrust member made of plastic material and having a thrust surface lying in a flat plane extending transverse to said guide axis; follower means movable in said guide elements in opposite directions along said guide axis and having a convex contact portion in continuous engagement with said thrust surface; and preloaded spring means seated against one of said wall portions and said follower means and effective against the latter for pressing the contact portion thereof into said continuous engagement with said thrust surface for sliding thereon during opening and closing swinging movements of said door structure; the resistance to sliding of said follower means on said thrust surface under the action of said spring means being effective to hold said door structure in any open position to which it is moved.

12. In an automobile or the like having a door support structure and an associated door structure; co-operating hinge members providing a hinge axis and swingably connecting said door structure with said support structure; said hinge members comprising a hinge bracket connected with said support structure and a hinge arm connected with said door structure; ramp means on said hinge bracket; said hinge arm having spaced flange portions containing substantially aligned guide openings providing a guide axis in an offset relation to said hinge axis; a follower member movable in said guide openings in opposite directions along said guide axis and co-operating with said ramp means; and spring means disposed between said flange portions and in surrounding relation to said follower member; said spring means being seated against one of said flange portions and said follower member and effective on the latter for pressing the same against said ramp means; said follower member being slidable on said ramp means during swinging of said door structure and said ramp means being sloped in an inclined relation to said guide axis so that the resistance to relative sliding between said ramp means and follower member is effective to hold said door structure in any open position to which it is moved.

13. In an automobile or the like having a support structure and an associated door structure swingable in opposite directions during opening and closing movements of the latter; hinge means connecting said door structure with said support structure for such swinging and having a hinge axis inclined from the vertical at an angle such that said door structure has a normal tendency to swing in a given direction; said hinge means comprising a hinge bracket connected with said support structure and a hinge arm connected with said door structure; ramp means on said hinge bracket; said hinge arm having wall portions arcuately movable relative to said ramp means and spaced apart in the general direction in which said hinge axis extends; hollow guide elements on said wall portions and providing a guide axis substantially parallel to said hinge axis and offset therefrom; a plunger movable in said guide elements; said ramp means comprising a plate portion having a thrust surface of plastic material lying in a flat plane extending transverse to said guide axis in a non-perpendicular relation thereto; said

17

plunger having a convex contact portion slidable on said thrust surface along a contact path lying in the flat plane of said thrust surface in response to swinging of said door structure in said opposite directions; and preloaded spring means disposed between said wall portions and in surrounding relation to said plunger; said spring means being effective against one of said wall portions and said plunger for urging the latter along said guide axis in a direction to press said contact portion against said thrust surface; said ramp means being sloped so that the sliding of said contact portion on said thrust surface in response to swinging of the door structure is an uphill travel during movement of said door structure in said given direction so that the normal tendency of said door structure to swing is resisted by said uphill travel and by said spring means; the resistance to the sliding of said contact portion on said

18

thrust surface for swinging of said door structure in either direction providing a substantially balanced condition of said door structure and being effective to normally hold said door structure in any open position to which it is moved.

References Cited in the file of this patent

UNITED STATES PATENTS

700,694	Le Marr	May 20, 1902
1,839,665	Ferris	Jan. 5, 1932
2,095,866	Hallenback	Oct. 12, 1937
2,246,086	Austin	June 17, 1941
2,342,531	Dean	Feb. 22, 1944
2,804,181	Haynes	Aug. 27, 1957
2,812,536	Ragsdale	Nov. 12, 1957