

Nov. 7, 1939.

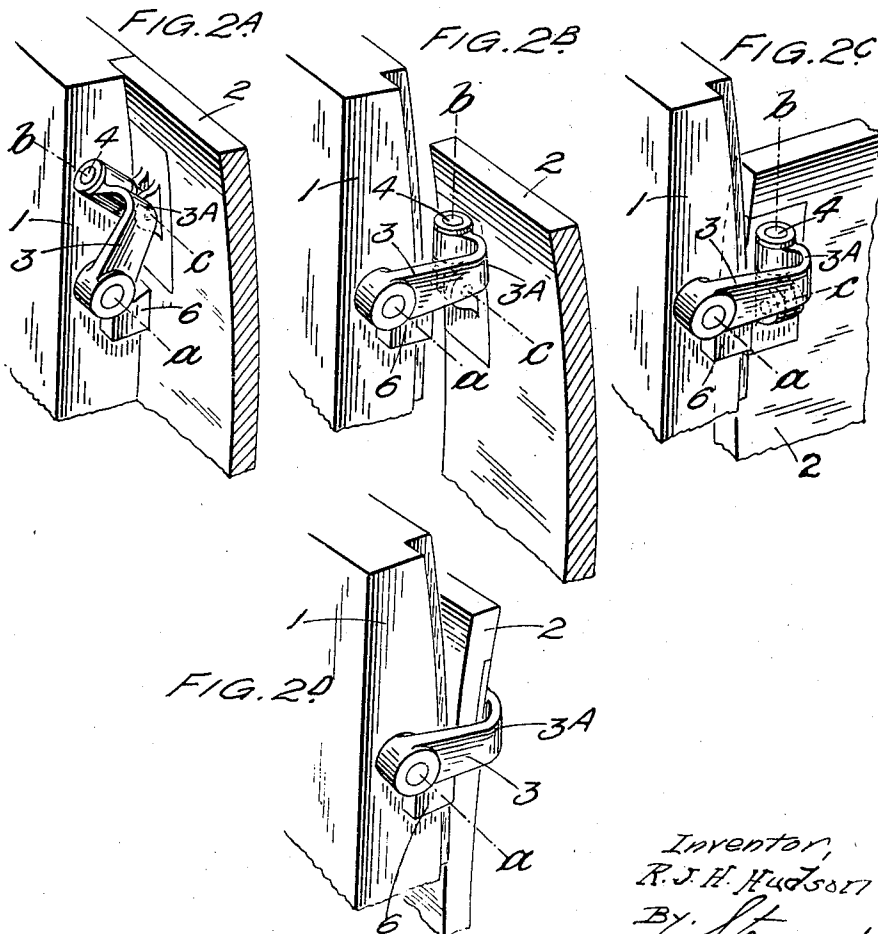
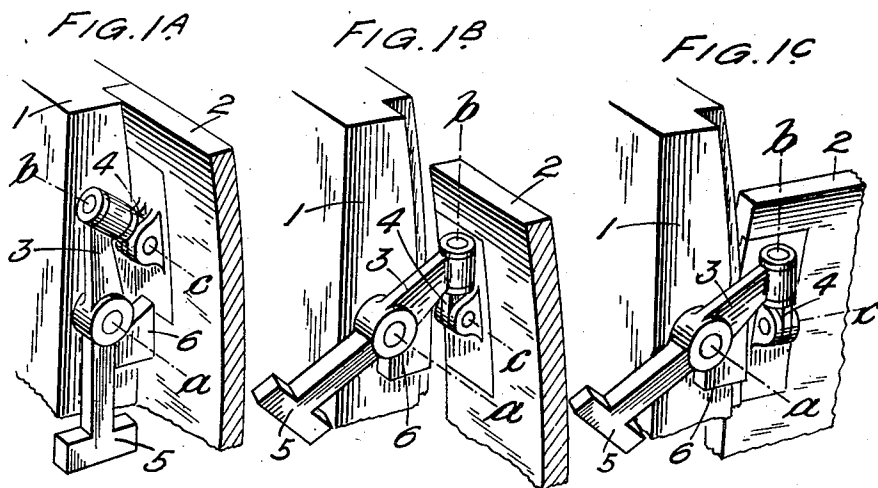
R. J. H. HUDSON

2,178,908

HINGE MOUNTING FOR DOORS, PANELS, HATCHWAYS, OR THE LIKE

Filed Nov. 8, 1938

3 Sheets-Sheet 1



Inventor,
R. J. H. HUDSON
By *Stearns and Davis*
Attorneys

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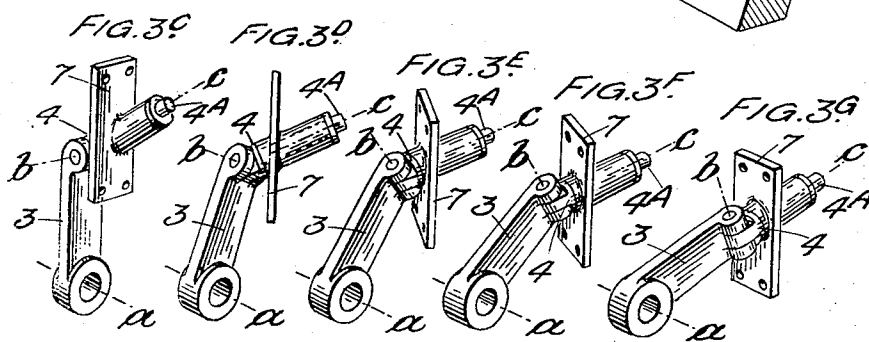
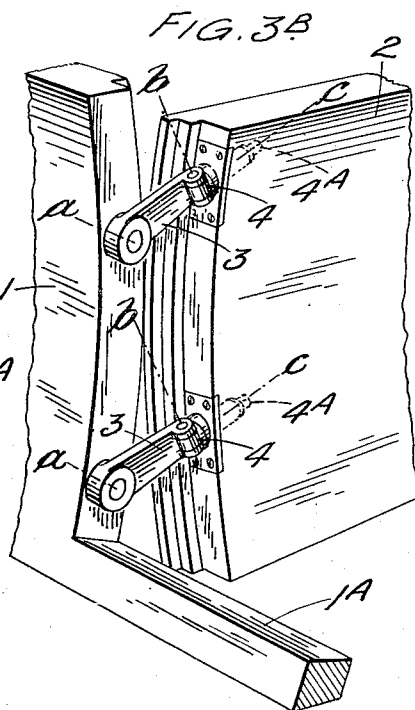
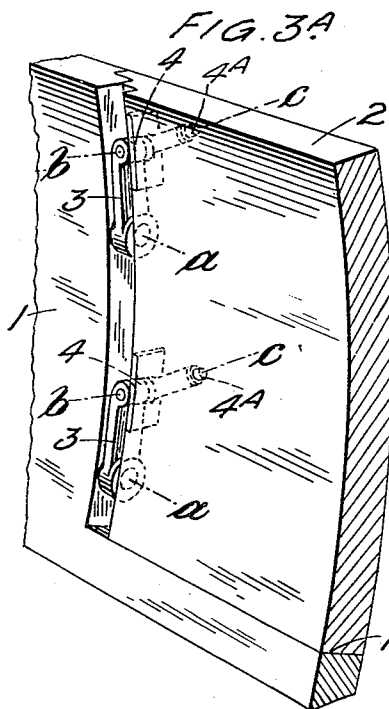
R. J. H. HUDSON

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HINGE MOUNTING FOR DOORS, PANELS, HATCHWAYS, OR THE LIKE

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3 Sheets-Sheet 2



Inventor,
R. J. H. Hudson

By *Stevens and Davis*
Attorneys

Nov. 7, 1939.

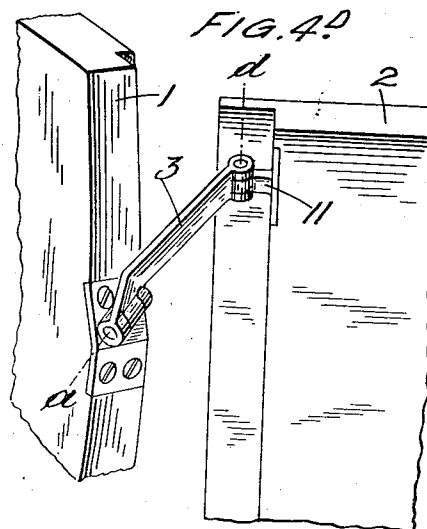
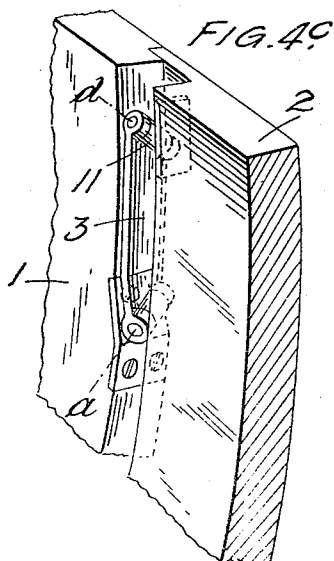
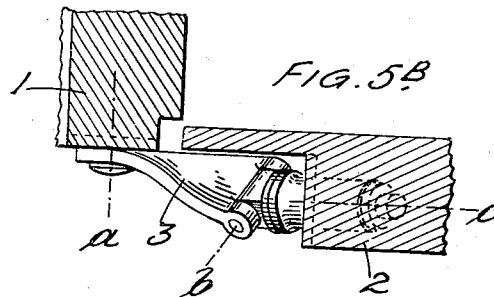
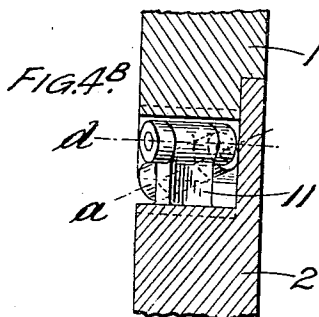
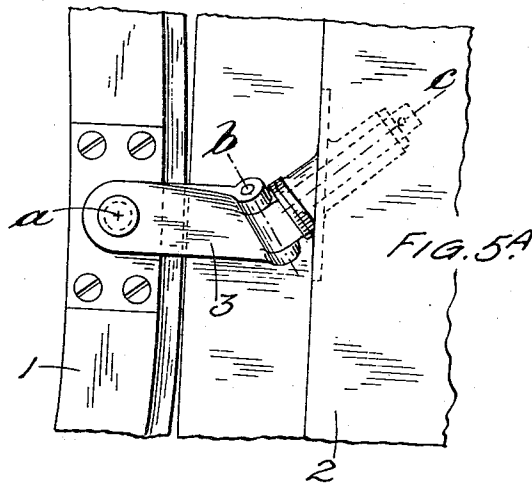
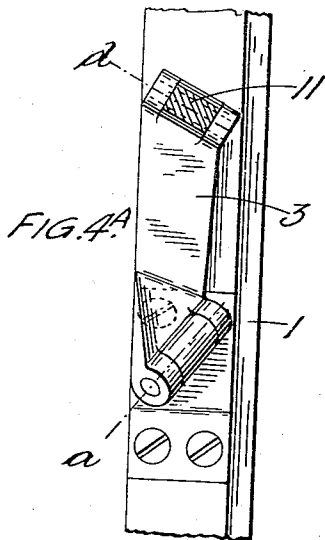
R. J. H. HUDSON

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HINGE MOUNTING FOR DOORS, PANELS, HATCHWAYS, OR THE LIKE

Filed Nov. 8, 1938

3 Sheets-Sheet 3



Inventor,
R. J. H. Hudson
By *Stross and Davis*
Attorneys

UNITED STATES PATENT OFFICE

2,178,908

HINGE MOUNTING FOR DOORS, PANELS,
HATCHWAYS, OR THE LIKERichard John Harrington Hudson, Dousland,
South Devon, EnglandApplication November 8, 1938, Serial No. 239,569
In Great Britain October 7, 1937

13 Claims. (Cl. 16—164)

This invention relates to hinge mountings for doors, hatchways or like hinged flaps and structures which are required to be swung. An object of the invention is to provide hinging means which is useful in connection with doors, hatchways, or the like, which by virtue of curvature or irregularity of shape, or other special circumstance, render it desirable for hinging to take place outside the thickness of the door or part to which the door is to be hinged. It is well known in vehicle bodywork for example, that if the body has curved sides, then hinges must be used which are either of an elaborate nature in themselves, or are carried out as projections, in order that the hinge axis may lie outside the curvature in the appropriate position to allow free swinging or hinging of the door. Another object of the present invention is to provide hinging means which may be used in such circumstances so as to obviate the necessity for unsightly or otherwise undesirable projections beyond the surface which is being hinged. A further object of the invention is to provide hinging means which may be found particularly applicable to aircraft, where panels or doors of curved form are required to be hinged, whilst hinges comprising projections beyond the surface of the panel would be highly undesirable owing to the drag set up thereby.

Whilst for the sake of convenience the invention is about to be described in relation to what I have called a door and its frame, it is to be understood that it is applicable to doors, hatches, windows or like closures in connection with which it is required to provide for displacement of the door as well as swinging. The invention moreover is applicable to and includes combinations of aircraft wings and flaps carried thereby in which a composite motion is required of the flap such that it changes angle (i. e., swings), as well as being displaced bodily, e. g., to produce a gap between itself and the trailing edge of the wing. The invention also includes the combination of a door or the like with its frame including the hinging means about to be described and also having specially shaped complementary edges so as to allow for the peculiar movement of the door. In common with most other hinges the device itself, which forms part of the present invention, is intended to be used in pairs; one unit of such a pair falls within the invention and is referred to as a single set of fittings. It is conceivable that one set of fittings could be used to govern the action of a door, although in cases at present envisaged it would then be necessary to use it in conjunction with some other means

for guiding or supporting a door in another locality, through its required path.

Throughout the following description phraseology will be used such as "the plane of the door" and "the plane of the frame"; this is for convenience only since where the invention is used it is to be expected that neither the door nor the frame will in fact have a flat form. The context will however indicate clearly that the word "plane" in that connection is intended to mean the general two-dimensional orientation rather than any strict geometric plane.

According to this invention hinging means for doors, flaps or the like in which the door is both to swing and to be displaced relatively to a frame comprise a two-part attachment, the first part being an angularly movable arm borne by the frame on a first axis which is at right angles to the required direction of displacement, and the second part being a swivel part pivoted to the arm about a second axis, the orientation of which is changed by and in accordance with the movements of the arm and attached to the door, in most cases pivotally about a third axis, the orientation of which swivel part is changed by and during the swinging of the door, in such manner that the displacement and the swinging are interdependent, i. e., are either simultaneous in a determined relationship or consecutive, one being permitted only after completion of the other. Where reference is made to the fact that one part is carried by the frame and the other by the door it is to be understood that this relationship may be reversible, i. e., that the arm is carried by the door and the swivel part attached or pivoted to the frame; and also that the word "frame" has the same significance as the foundation to which the swinging member is hingedly attached, whilst the door has the significance of a flap or the like. The hinging means comprise an arm borne by the frame on a first axis lying in, or nearly in, the plane of the frame and door in closed position (i. e., the position where their planes are virtually common), and in, or nearly in, the plane of swinging; and the swivel part is pivoted to the arm on a second axis which is fixed relatively to the arm (and therefore swings therewith), and pivotally supports the door on a third axis which is fixed relatively to the door (and therefore swings therewith), and which lies in, or nearly in, the plane of the door. In some forms of the device the second axis lies in a plane which is tangential to an imaginary cylinder described on the first axis, whilst in another case the second axis lies in a plane which also contains the

first axis, in which case the second axis is thus virtually radial to that axis and is radially disposed in regard to the arm. Again in some cases the third axis lies, when the door is closed, parallel with the first axis and in that case during swinging of the door, distinct from displacement thereof, rotation takes place about the second axis alone, but can only take place when full displacement of the door away from the frame has occurred. In other cases, however, swinging and displacement of the door occur simultaneously, the second and third axes being involved, and the third axis being inclined to the first in the closed and open conditions. In such a case the imaginary axis of swinging of the door, which may be regarded as the true hinge axis, is a resultant axis and does not correspond exactly with either the second or third axis. The arm may be cranked to permit the door to swing through a wide angle, as will be more clearly understood in the following description. The second and third axes may be at right-angles and the bearing at the third axis may conveniently be formed by making the swivel member with a stub spindle rotatable in a socket in the door, in which case inclination of the spindle from the horizontal can be so arranged that the door, whilst being readily removable from its hanging, will remain, normally by gravity, connected to the swivel part. The broader aspects of the invention thus having been stated, practical applications of it will be described with the aid of the accompanying diagrammatic drawings.

In these:

Figures 1A, 1B, and 1C illustrate one set of fittings connecting a door and frame which are convex when viewed from the side to which the door opens, such for example as a fuselage door of an aircraft;

Figures 2A to 2D illustrate a modification showing how the door can be allowed to swing through 180° instead of only 90°;

Figures 3A to 3G illustrate another form of a set of fittings, 3A and 3B showing the door closed and the door open in perspective and 3C to 3G showing the fittings only in five positions and between closed and open;

Figures 4A to 4D indicate in elevation and plan, and in two perspectives, an alternative construction of simple form in which the third axis disappears; and

Figures 5A to 5B represent in elevation and plan a modification of the 3-axis type of hinge device.

Turning to Figures 1A, 1B and 1C, part of a door frame is seen at 1 and part of a door at 2. Because of the convex form of the door and frame it is required that the door should displace outwardly and also swing in order to open. It is provided with a pair of sets of fittings, one of which is shown. Borne by the frame 1 upon axis *a* is an arm 3. The axis *a* lies in the plane of the frame 1 and door 2 when the latter is closed, consequently the arm 3 in swinging clockwise carries the door outwards, this being the required displacement. Pivotaly carried on the axis *b* by the arm 3 is a swivel member 4 which is in turn pivotaly connected to the door 2 about the axis *c*, which axis *c* is in the plane of the door and at right angles to axis *b*. It will be observed that axis *b* is tangential to an imaginary circle described on axis *a* and therefore changes its orientation during displacement of the door (and swinging of arm 3), itself in fact swinging

through the same angle as the arm. Axis *c*, however, only swings and changes orientation with swinging of the door 2. To open the door from the position of Figure 1A, one first of all pushes or pulls it to the displaced position of Figure 1B and then the axis *b* comes to be aligned with the like axis of the other set of the pair and the door is permitted to be swung to the open position of Figure 1C. Displacement and swinging are therefore consecutive and in closing the door they are of course consecutive although reversed in order. There is indicated in Figure 1A at 5 a counterpoise integral with the arm 3 and this is to show that the door may be balanced in its rise and fall during displacement. Such balancing may likewise be achieved by various other means. It will be noted that when the door is closed it is impossible for it to be swung because there is no hinging axis for it.

Turning to Figures 2A to 2D, there is shown in each case again the frame 1, door 2, arm 3 and swivel member 4 and the three axes *a*, *b*, and *c*. In this case, however, the arm 3 is cranked at 3A and this, as can be seen from Figure 2D affords clearance so that the door can be swung back through 180° instead of the 90° of Figure 1C. In the foregoing figures an abutment 6 has been indicated upon which the arm 3 rests when the door is displaced and this abutment may be in the nature of a firm cushion of hard rubber or the like.

Turning to Figures 3A and 3B, there are again shown in perspective closed and open door 2 carried by a frame 1. The lower edge of the frame can be seen to be formed sloping down at 1A in the outward sense, the complementary edge of the door 2 being likewise formed, thus providing for the path of movement of the door in opening and shutting. In these figures a pair of sets of fittings is shown and Figures 3C to 3G show with greater clarity how these are disposed. Each set comprises an arm 3 pivotaly borne by the frame 1 on the axis *a* as before. Pivotaly jointed on the axis *b* to the end of the arm is a swivel member 4 which is formed with a stub spindle 4A borne in a socket or bush formed in a plate 7 attachable to the edge of the door 2. The axis of the spindle 4A is the axis *c*. It will be observed that in this example, as can clearly be seen in Figures 3C to 3G which show progressive stages of opening, the displacement of the door due to swinging of the arm 3 is simultaneous with the swinging of the door and these movements take place in a predetermined relationship governed by the exact choice of the dispositions of the axes, in which regard there is considerable latitude. It will also be seen that there is at no time any one pivot which has an axis that can be regarded as the true hinge axis of the door and that the door swings about an axis which is a resultant of the axes *b* and *c*. It is sometimes found to be desirable in practice with a construction of this sort to place the axis *b* in a somewhat skewed relationship to the axis *a*, as shown in Figures 5A, 5B, since by skewing that axis greater advantage can be taken of the length of the arm 3, because a condition can be arrived at when, with the door fully open, the arm 3 is horizontal.

The device of Figures 4A-4D is one in which a possibly limited swing is afforded by sets of fittings which have only two axes. The arm 3 is borne by the frame 1 on the first axis *a* as in previous cases. The swivel part 11 is fixed

to the door 2. The arm 3 and part 11 are pivotally connected on an axis *d* which is so inclined and orientated in respect to axis *a* that, during swinging of arm 3, axis *d* describes the conical outline of an imaginary parabola about axis *a*. The angles which axes *a* and *d* make in two planes can be seen by comparing the elevation (Figure 4A) and plan (Figure 4B). The angles and dimensions in this case may be somewhat critical and the angle of the door at maximum opening may be less than 90° as indicated in Figures 4C and 4D.

In Figures 5A and 5B there is shown in elevation and plan, a set of fittings analogous to those of Figures 3A-3G, but with which a somewhat greater outward displacement of door is allowed for a given length of arm. This is by virtue of the fact that the arm 3 supports the axis *b* in a skewed orientation in two planes as shown (see Figures 5A and 5B) and the axis *c* is inclined to the horizontal (see Figure 5A) when the door is fully open and arm 3 lies horizontal.

The angles and dimensions of the device are governed by such constructions as the weight of the door and the mechanical advantage necessary to lift it during closing, and the clearance necessary to accommodate the convexity or shape. The limits of angle within which the device has been found to be workable are considerable. For example, although the axis *a* has been described as being in the plane of the frame and closed door, this is chiefly in order that it and the arm may be accommodated conveniently and cause the displacement of the door with a convenient initial movement.

I claim:

1. Hinging means for closures by which a closure may both swing and be displaced with respect to an opening, which comprises a first pivotal means supported by the frame of the opening and defining an axis arranged substantially at right angles to the direction of displacement of the closure, an arm carried by said first pivotal means and adapted to outwardly displace said closure from said frame, a second pivotal means carried by said arm that defines an axis which is arranged at an angle to the axis of said first pivotal means so that the axial direction of said second pivotal means is changed by movements of the arm about said first pivotal means, and means connecting said second pivotal means to said closure, said second pivotal means being adapted to permit the swinging of the closure when said closure is displaced outwardly from said frame whereby said closure may be both swung and displaced with respect to said opening.

2. Hinging means for closures by which a closure may both swing and be displaced with respect to an opening, which comprises a first pivotal means supported by the frame of the opening and defining an axis arranged substantially at right angles to the direction of displacement of the closure, an arm carried by said first pivotal means which supports a second pivotal means that defines an axis which is arranged at an angle to the axis of said first pivotal means so that the axial direction of said second pivotal means is changed by movements of the arm about said first pivotal means, stop means associated with said arm to limit the outward displacement thereof, and means connecting said second pivotal means to said closure, whereby said closure may be both swung and displaced with respect to said opening.

3. Hinging means for closures by which a closure may both swing and be displaced with respect to an opening, which comprises a first pivotal means supported by the frame of the opening and defining an axis arranged substantially at right angles to the direction of displacement of the closure, an arm carried by said first pivotal means which supports a second pivotal means that defines an axis which is arranged at an angle to the axis of said first pivotal means so that the axial direction of said second pivotal means is changed by movements of the arm about said first pivotal means, and a third pivotal means connecting said second pivotal means to said closure, said second and third pivotal means defining axes which lie substantially in the same plane and substantially perpendicular to each other.

4. Hinging means for closures by which a closure may both swing and be displaced with respect to an opening, which comprises a first pivotal means supported by the frame of the opening and defining an axis arranged substantially at right angles to the direction of displacement of the closure, an arm carried by said first pivotal means which supports a second pivotal means that defines an axis which is arranged at an angle to the axis of the said first pivotal means so that the axial direction of said second pivotal means is changed by movements of the arm about said first pivotal means, and a third pivotal means connecting said second pivotal means to said closure and lying in substantially the same plane as said first pivotal means but extending in opposite directions from the arm when the closure is in closed position, whereby said closure may be both swung and displaced with respect to said opening.

5. Hinging means for closures by which a closure may both swing and be displaced with respect to an opening, which comprises a first pivotal means supported by the frame of the opening and defining an axis lying substantially in the plane of said frame, said axis being arranged substantially at right angles to the direction of displacement of the closure, an arm carried by said first pivotal means which supports a second pivotal means that defines an axis which is arranged at an angle to the axis of said first pivotal means so that the axial direction of said second pivotal means is changed by movements of the arm about said first pivotal means, and means connecting said second pivotal means to said closure, whereby said closure may be both swung and displaced with respect to said opening.

6. Hinging means for closures by which a closure may both swing and be displaced with respect to an opening, which comprises a first pivotal means supported by the frame of the opening and defining an axis lying substantially in the plane of said frame, said axis being arranged substantially at right angles to the direction of displacement of the closure, an arm carried by said first pivotal means which supports a second pivotal means that defines an axis which is arranged at an angle to the axis of said first pivotal means so that the axial direction of said second pivotal means is changed by movements of the arm about said first pivotal means, a link supported by said second pivotal means and connected to said closure by a third pivotal means which is secured to said closure and defines an axis which lies parallel to the plane of said closure, whereby said closure may

be swung and displaced with respect to said opening.

7. Hinging means for closures by which a closure may both swing and be displaced with respect to an opening which comprises a first pivotal means supported by the frame of the opening and defining an axis arranged substantially at right angles to the direction of displacement of the closure, an arm carried by said first pivotal means which supports a second pivotal means that defines an axis which is arranged at an angle to the axis of said first pivotal means so that the axial direction of said second pivotal means is changed by movements of the arm about said first pivotal means, and a swivel means connecting said second pivotal means to said closure, the several pivotal means rotating simultaneously so that the displacement and swinging of said closure are simultaneous.
8. Hinging means for closures by which a closure may both swing and be displaced with respect to an opening which comprises a first pivotal means supported by the frame of the opening and defining an axis lying substantially in the plane of said frame, said axis being arranged substantially at right angles to the direction of displacement of the closure, an arm carried by said first pivotal means which supports a second pivotal means that defines an axis which is arranged at an angle to the axis of said first pivotal means so that the axial direction of said second pivotal means is changed by movements of the arm about said first pivotal means, a link supported by said second pivotal means and connected to said closure through a third pivotal means which is secured to said closure and defines an axis lying substantially parallel to the plane thereof, the arrangement being such that rotation about the second axis alone is involved in the swinging of the closure and that swinging may be effected only when the closure is fully displaced from the frame.
9. Hinging means for closures by which a closure may both swing and be displaced with respect to an opening, which comprises a first pivotal means supported by the frame of the opening and defining an axis lying substantially in the plane of said frame, said axis being arranged substantially at right angles to the direction of displacement of the closure, an angular arm carried by said first pivotal means which supports a second pivotal means that defines an axis which is arranged at an angle to the axis of said first pivotal means so that the axial direction of said second pivotal means is changed by movements of the arm about said first pivotal means, a link supported by said second pivotal means and connected to said closure by a third pivotal means which is secured to the inner wall of said closure and defines an axis lying substantially parallel to the plane thereof, the arrangement being such that said closure may swing substantially through 180°, rotation about the second axis alone being involved in the swinging of the closure.
10. Hinging means for closures by which a closure may both swing and be displaced with respect to an opening which comprises a first pivotal means supported by the frame of the opening and defining an axis lying substantially in the plane of said frame, said axis being ar-

ranged substantially at right angles to the direction of displacement of the closure, an arm carried by said first pivotal means which supports a second pivotal means that defines an axis which is arranged at an angle to the axis of said first pivotal means so that the axial direction of said second pivotal means is changed by movements of the arm about said first pivotal means, a link supported by said second pivotal means and connected to said closure by a third pivotal means which is secured to said closure and defines an axis lying substantially in the plane thereof, whereby said closure may be swung and displaced with respect to said opening.

11. Hinging means for closures by which a closure may both swing and be displaced with respect to an opening which comprises a first pivotal means supported by the frame of the opening and defines an axis lying substantially in the plane of said frame, said axis being arranged substantially at right angles to the direction of displacement of the closure, an arm carried by said first pivotal means which supports a second pivotal means that defines an axis which is arranged at an angle to the axis of said first pivotal means so that the axial direction of said second pivotal means is changed by movements of the arm about said first pivotal means, a link supported by said second pivotal means and connected to said closure by a third pivotal means which comprises a stub spindle adapted to cooperate with a socket within said closure, whereby said closure may be swung and displaced with respect to said opening.

12. Hinging means for closures by which a closure may both swing and be displaced with respect to an opening, which comprises a first pivotal means supported by the frame of the opening and defines an axis arranged substantially at right angles to the direction of displacement of the closure, an arm carried by said first pivotal means which supports a second pivotal means that defines an axis which is arranged at an angle to the axis of said first pivotal means so that the axial direction of said second pivotal means is changed by movements of the arm about said first pivotal means, counterbalancing means connected with said arm, and means connecting said second pivotal means to said closure, whereby said closure may be swung and displaced with respect to said opening.

13. Hinging means for closures by which a closure may both swing and be displaced with respect to an opening, which comprises a first pivotal means supported by the frame of the opening and defines an axis arranged substantially at right angles to the direction of displacement of the closure, an arm carried by said first pivotal means which supports a second pivotal means that defines an axis which is arranged at an angle to the axis of said first pivotal means so that the axial direction of said second pivotal means is changed by movements of the arm about said first pivotal means, and a third pivotal means connecting said second pivotal means to said closure, said arm being arranged to become substantially aligned with the third pivotal means when the closure is in open position whereby said closure may be swung and displaced with respect to said opening.

R. J. HARRINGTON HUDSON.