June 11, 1963 A. R. BAER 3,092,870

HINGE

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FIG. 1

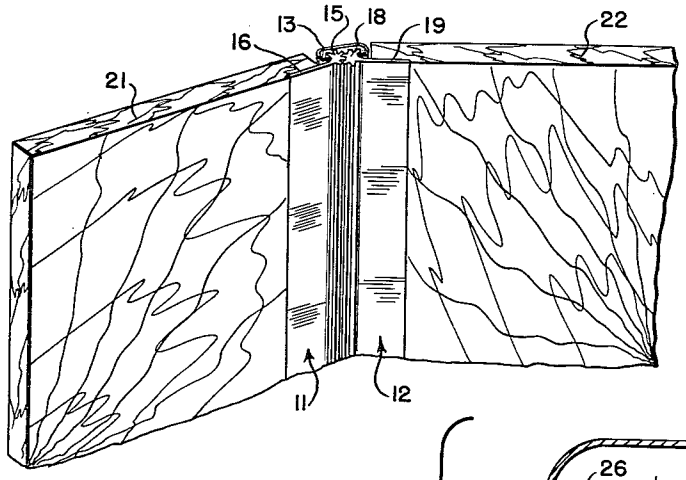

FIG. 2

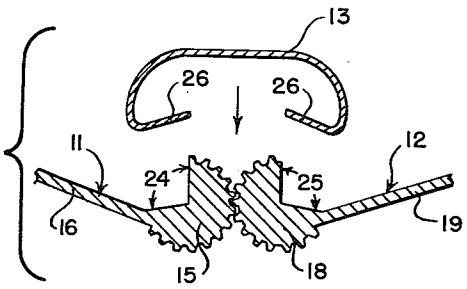

FIG. 3

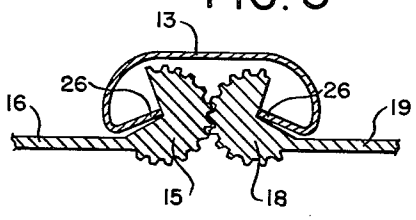

FIG. 4

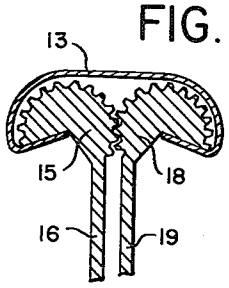

FIG. 5

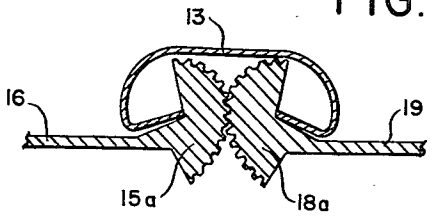

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FIG. 6

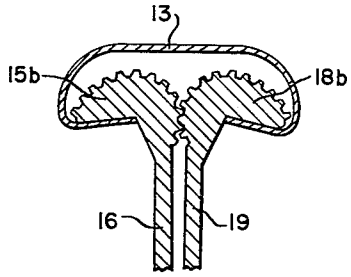


FIG. 7

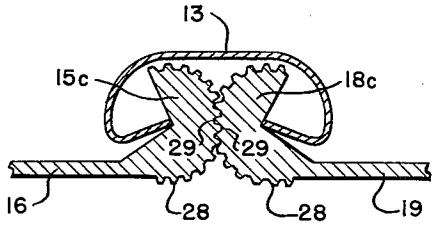


FIG. 8

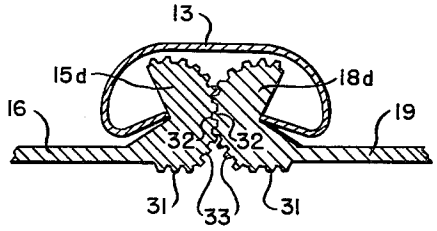


FIG. 9

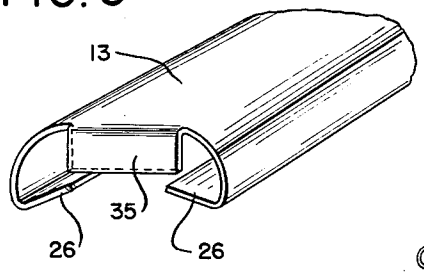
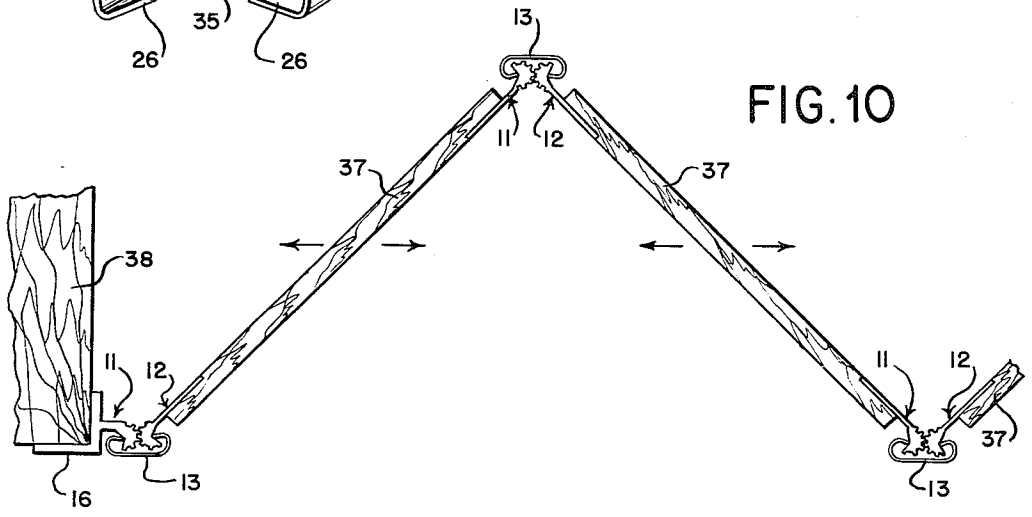


FIG. 10



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3,092,870
HINGE

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8 Claims. (Cl. 16—128)

This invention relates to a novel hinge structure for doors and the like.

Long metal hinges of the so-called "piano hinge" type are costly to produce and do not present a very attractive appearance. I have now developed a new hinge structure that is especially well adapted to be used in the same type of service as are piano hinges, my new hinge having a neat and attractive appearance and being inexpensive to manufacture and simple to assemble and install. The hinge may be fabricated from a wide variety of metal or plastic materials by extruding, rolling, drawing, machining, or molding of these materials. In a preferred embodiment it comprises two intermeshed geared hinge members each comprising a gear segment and an outwardly extending leg portion integrally formed therewith, the two geared hinge members being held in mesh by a clamp member bearing against each gear segment at the axis of rotation thereof. The clamp member preferably comprises a C-shaped element formed of springy material, each gear segment having a pie-shaped sector somewhat in excess of 90° cut out from the gear to accommodate the C-shaped clamp member in the manner hereinafter described.

My new hinge structure allows for rotation of the hinge through an angle of 180°, and in addition to the usual or "standard" type of hinge action which permits smooth and uniform movement of the hinge parts through the full arc of travel of the hinge, the hinge structure of my invention can be modified so that it has a self-closing or self-opening action and further can be modified to provide a two-position (i.e., normally open and normally closed) or three-position (i.e., normally open, normally half-open and normally closed) hinge action. Moreover, as previously noted the hinge can be formed from a wide variety of metals and plastic materials, and can be manufactured by extrusion, rolling, drawing, machining, molding, and other forming operations.

My invention will be better understood from the following description of the hinge structure in conjunction with the accompanying drawings of which:

FIG. 1 is a perspective view of my new hinge structure as employed to provide a hinged connection between two door panels;

FIG. 2 is a cross-section view of the major three element comprising the hinge structure showing these elements in position for assembly together;

FIG. 3 is a cross-section view of the assembled hinge in its "closed" position (i.e., closed with reference to the door or other object to which the hinge is attached);

FIG. 4 is a cross-section view of the assembled hinge in its "open" position;

FIG. 5 is a cross-section view of a self-closing modification of my hinge structure;

FIG. 6 is a cross-section view of a self-opening modification of my hinge structure;

FIG. 7 is a cross-section view of a two-position modification of my hinge structure;

FIG. 8 is a cross-section view of a three-position modification of my hinge structure;

FIG. 9 is a perspective view of a C-shaped clamp member showing one means for maintaining the three elements of the hinge structure in vertical register; and

FIG. 10 is a view from above of a multi-panel folding door employing my new hinge structure.

As will be seen best in FIG. 1 of the drawing my new hinge structure comprises three basic elements—namely, a first geared hinge member 11, a second geared hinge member 12 intermeshed therewith, and a clamp member 13 that maintains the geared hinge members in mesh. The first geared hinge member 11 comprises a gear segment 15 having an outwardly extending leg portion 16 integrally formed therewith, and the second geared hinge member 12 comprises a gear segment 18 intermeshed with the gear segment 15 and having an outwardly extending leg portion 19 integrally formed therewith, the clamp member 13 maintaining the gear segments 15 and 18 in mesh by contacting and advantageously bearing against each gear segment at is axis of rotation and thus preventing the gear segments (and geared hinge members) from separating. In the embodiment of my hinge structure shown in FIG. 1, the clamp member comprises a C-shaped element the in-turned ends of which bear against each gear segment at the axis of rotation thereof, the gear segments having a pie-shaped sector cut out therefrom to accommodate the C-shaped clamp member 13. Moreover, the leg portions 16 and 19 of the hinge members 11 and 12 shown in FIG. 1 are secured respectively to door panels 21 and 22. However, as hereinafter more fully explained, in other embodiments of my invention the leg portions of the hinge members can be configured and/or extended to provide, for example, an integrally formed door jamb, an integrally formed channel for window or plate glass, a complete solid door panel, and the like. The hinge elements can be formed from a wide variety of metals, plastics and other materials, and can be fabricated by machining the elements from bar stock of appropriate cross-section, or by rolling, drawing, molding, die-casting or, preferably, by extruding these materials. In the latter case any extrudable material of the requisite strength may be employed, such, for example, as brass, aluminum, thermoplastic polymers, and the like.

In the usual case it is desirable that a hinge operate smoothly and uniformly throughout its full arc of travel without any tendency to assist or resist movement to or from its open or closed position, and FIGS. 2, 3 and 4 show an advantageous embodiment of my invention for use as such a "standard" hinge.

As will be seen best in FIG. 2, each of the geared hinge members 11 and 12 of the aforementioned standard hinge comprises a gear segment 15 and 18 of substantially circular cross-section having an approximately pie-shaped sector 24 and 25 removed therefrom, each gear segment having an outwardly extending leg portion 16 and 19 formed integrally therewith. The pie-shaped sector removed from each gear segment is somewhat more than 90°, say, about 100°, in extent, and the apex of the sector coincides approximately with the axis of rotation of that gear segment. (For convenience, the portions of the gear segments 15 and 18 nearest the respective pie-shaped sectors 24 and 25 are hereinafter referred to as the rearward portions of said gear segments, and the portions of said gear segments nearest the respective leg portions 16 and 19 are hereinafter referred to as the front or forward portions of said gear segments.) Although other forms of clamp member (e.g., a pair of axially disposed pivot pins connected by a coil spring or the like) can be employed, the clamp member 13 advantageously comprises a C-shaped element formed of metal or plastic. The C-shaped clamp member 13 is configured so that the inwardly turned ends 26 of the clamp member can enter the pie-shaped sectors 24 and 25 and bear against the gear segments 15 and 18 of the hinge at the axis of rotation of each geared hinge member. Moreover, the C-shaped clamp member 13 can be formed either from a relatively rigid material or advantageously from a springy material

that will tend to maintain spring pressure against the gear segments at their axes of rotation when the hinge elements are assembled together.

The three elements of the hinge structure are assembled together to form a complete hinge by first placing the two geared hinge members **11** and **12** together as shown in FIG. 2 so that the gear teeth intermesh and so that the rearward surfaces of the pie-shaped cut-out portions **24** and **25** of the two gear segments **15** and **18** are substantially parallel to each other. When the gear segments are so positioned, the outwardly extending leg portions **16** and **19** of the two geared hinge members are at an obtuse angle of about 220°. The C-shaped clamp member **13** is then pressed down onto the rearward side of the gear segments as indicated by the arrow in FIG. 2. If the clamp member is formed of a springy material, the inwardly turned ends **26** thereof are first separated or spread apart slightly to allow these ends to be slipped or pressed downwardly onto the rearward side of the gear segments, or the geared hinge members are rotated slightly beyond the position shown in FIG. 2 so that the divergence of the rearward surfaces of the cut-out sectors **24** and **25** acts to spread the ends of the clamp **13** as it is pressed into its proper final position. When the C-shaped clamp is in its proper position the inwardly turned ends of the C-shaped clamp member bear against the gear segments of the geared hinge members at the axis of rotation of each gear segment. The geared hinge members **11** and **12** are then rotated so that the leg portions **16** and **19** thereof are at an angle of 180° as shown in FIG. 3. When in this position the C-shaped clamp member is locked into place by the rearwardly extending surfaces of the pie-shaped cut-out sectors **24** and **25** of the two gear segments. The position of the hinge shown in FIG. 3 is referred to herein as its "closed" position, as this is the position the hinge would assume when the door or other object to which it is attached is in its closed position. The hinge is moved or rotated to its "open" position shown in FIG. 4 simply by moving the leg portions **16** and **19**, or the door panels to which these leg portions are attached, through an angle of 180°.

In the embodiment of my hinge structure shown in FIG. 5 of the drawing, the hinge has an automatic self-closing action. The gear teeth of one or both of the gear segments **15***a* and **18***a* are formed on the surface of a segment of a spiral the radius of which increases from the rear to the front of the respective gear segment so that, when the geared hinge members **11** and **12** are rotated from their normally closed position shown in FIG. 5 to their open position corresponding to that shown in FIG. 4, the axes of rotation of the two gear segments (e.g. the centers of the spirals) are moved apart. Moreover, the C-shaped clamp member **13** is formed from a spring material that exerts a positive inwardly directed spring pressure against the gear segments at their respective axes of rotation. As a result, when the hinge members are rotated from their normally closed position to their open position the axes of rotation of the two gear segments **15***a* and **18***a* move outwardly against the inwardly directed spring pressure of the clamp member **13**, and when the now-open hinge members are released the inwardly directed spring pressure of the clamp member causes the gear segments to rotate in the direction that will move their axes of rotation closer together; that is to say, there is a positive tendency for the gear segments **15***a* and **18***a* to rotate to the normally closed position of the hinge structure.

In the embodiment of my hinge structure shown in FIG. 6 of the drawing, the hinge has an automatic self-opening action. As in the case of the self-closing hinge of FIG. 5, the gear teeth of one or both of the gear segments **15***b* and **18***b* are formed on the surface of a segment of a spiral the radius of which increases from the front to the rear of the respective gear segment so that, when the geared hinge members **11** and **12** are rotated from their normally open position shown in FIG. 6 to their closed position corresponding to that shown in FIG. 3, the axes of rotation of the two gear segments (e.g. the centers of the spirals) are moved apart. Moreover, as before the C-shaped clamp member **13** is formed from a spring material that exerts a positive inwardly directed spring pressure against the gear segments at their respective axes of rotation. As a result, when the hinge members are rotated from their normally open position to their closed position the axes of rotation of the two gear segments **15***b* and **18***b* move outwardly against the inwardly directed spring pressure of the clamp member **13**, and when the now-closed hinge members are released the inwardly directed spring pressure of the clamp member causes the gear segments to rotate in the direction that will move their axes of rotation closer together; that is to say, there is a positive tendency for the gear segments **15***b* and **18***b* to rotate to the normally open position of the hinge structure.

In the embodiment of my hinge structure shown in FIG. 7 of the drawing, the hinge has a decided tendency to assume and remain at one of two fixed positions. In this modification the generally circular cross-sections of one or both of the gear segments **15***c* and **18***c* are slightly flattened or out of round at two points—namely, at the front portion **28** of each gear segment and at the portion **29** midway between the front and the rear of the gear segment. As a result, when the hinge is assembled as shown it has a tendency to resist rotation whenever one of the flattened portions **28** or **29** of gear segment **15***c* is intermeshed with the corresponding flattened portion of gear segment **18***c*. Thus, the door or other object to which this hinge is attached has a decided tendency to assume one of two positions—namely, a normally closed position such as that shown in FIG. 7, or a normally open position corresponding to that shown in FIG. 4.

In the embodiment of my hinge structure shown in FIG. 8 of the drawing, the hinge has a decided tendency to assume and remain at one of three fixed positions. In this modification the generally circular cross-sections of one or both of the gear segments **15***d* and **18***d* are flattened or out of round at three points along the circumference of the gear segment. One of the flattened sections is at the front portion **31** of each gear segment and another of the flattened sections is at the portion **32** midway between the front and the rear of the gear segment, these portions **31** and **32** corresponding to the two flattened portions **28** and **29** of the gear segments shown in FIG. 7. The third flattened portion **33** of the gear segments shown in FIG. 8 lies intermediate the other two flattened portions **31** and **32** thereof so that the hinge assembly has a decided tendency to assume and to remain at one of three positions—namely, a closed position as shown in FIG. 8, a half-open position when the hinge is rotated so that the legs **16** and **19** (or the door panels to which the legs are attached) are at 90° to each other, or a fully open position corresponding to that shown in FIG. 4. It is obvious from the description of the modifications of my hinge structure shown in FIGS. 7 and 8 that the gear segments are not necessarily limited to those having two or three flattened portions, but that they may have only one flattened portion or as many as four or more such portions in accordance with my invention.

As previously noted, in each of the modifications shown in FIGS. 5 and 6, one or both of the gear segments are segments of a spiral of appropriate configuration. In the usual case both of the gear segments would be segments of spirals having the same configuration. However, under certain circumstances one of the gear segments is advantageously a segment of a spiral while the other gear segment has a "standard" or generally circular cross section such as that shown in FIGS. 2 to 4. Similarly, in each of the modifications of my hinge structure shown in FIGS. 7 and 8 one or both of the gear segments are provided with one or more flattened portions in order that the hinge have a tendency to remain in one or more fixed positions. In the usual case both gear segments

are provided with the same number and configuration of flattened portions, although in certain cases only one of the gear segments is provided with these flattened portions while the other gear segment has a generally circular cross section. Other combinations of intermeshed gear segments having irregular and/or dissimilar cross sections can be used when required. Thus, a gear segment having a spiral cross section can be used in conjunction with a gear segment having a flattened cross section or the like, these gear segments tending to rotate to the position or positions of minimum spacing of their axes of rotation under the inwardly directed spring pressure of the clamp member.

Referring now to FIG. 1, it will be appreciated that the clamp member 13 and the intermeshed gear members 11 and 12 of the hinge structure cooperate to prevent the hinge structure from separating or getting out of alignment in a horizontal direction. However, in certain applications means must be provided to prevent the hinge structure from getting out of alignment or register in a vertical direction, and this can be accomplished in a number of ways. For example, as shown in FIG. 9 each end of the C-shaped clamp member 13 can be provided with a folded-oved horizontal tab member 35 which serves to keep the gear segments 15 and 18 partially enclosed thereby in vertical registry.

My new hinge structure may be used in a wide variety of practical applications, one such application being the multi-panel folding door shown in FIG. 10 of the drawing. In the folding door shown in FIG. 10, each vertical end of each door panel 37 (save the last or outermost door panel) is provided or formed with one of the geared hinge members 11 or 12 of my hinge structure. Thus, the geared hinge member 12 at the inner end of the first door panel 37 is intermeshed with the geared hinge member 11 mounted on the vertical wall or door jamb 38 to which the first door panel is hinged, the geared hinge member 11 at the outer end of the first door panel 37 is intermeshed with a geared hinge member 12 at the inner end of the second door panel 37, and so on until the outer end of the last door panel 37 (not shown) is reached, this outermost end of the folding doors not being provided with a hinge element.

As shown in FIG. 10, the geared hinge members 11 and 12 can be separate items of hardware that are mounted on suitable door panels obtained from conventional sources, the hinge elements being secured to these door panels in the usual manner such as by screws, adhesives, and the like. In addition, door panels and other objects having geared hinge members at one or both ends thereof can be integrally formed by extruding the panel and hinge elements in one piece by conventional extrusion processes. Moreover, the outwardly extending portions of the geared hinge members can be configured to serve a wide variety of functions. For example, the outwardly extending leg portion can be provided with an L-shaped extension such as that shown in FIG. 10 to permit mounting the hinge member on a corner of a wall, or door jamb or the like. Similarly, the outwardly extending leg portion can be formed with channels adapted to receive sheets of glass for use in shower doors or windows and the like, or to receive decorative panels in the manufacture of special doors or similar objects.

From the foregoing description of my new hinge it will be seen that I have made an important contribution to the art to which my invention relates.

I claim:

1. A hinge structure comprising two intermeshed geared hinge members and a clamp member maintaining said geared hinge members in mesh, each geared hinge member comprising a gear segment having an outwardly extending leg portion, each gear segment being formed with a pie-shaped cutout sector the apex of which coincides with the axis of rotation of said gear segment, said clamp member comprising a C-shaped element the inwardly turned ends of which contact the gear segment of each geared hinge member at the axis of rotation thereof.

2. The hinge structure according to claim 1 in which the gear teeth of at least one of the gear segments are formed on a surface of irregular radius, and in which said clamp member exerts a positive inwardly directed spring pressure against the gear segments at their respective axes of rotation, whereby the gear segments tend to rotate to the position or positions of minimum spacing of their axes of rotation.

3. The hinge structure according to claim 1 in which the gear teeth of at least one of the gear segments are formed on the surface of a segment of a spiral the radius of which increases from the rear to the front of the respective gear segment, and in which said clamp member exerts a positive inwardly directed spring pressure against the gear segments at their respective axes of rotation, whereby the gear segments tend to rotate to the normally closed position of the hinge structure.

4. The hinge structure according to claim 1 in which the gear teeth of at least one of the gear segments are formed on the surface of a segment of a spiral the radius of which increases from the front to the rear of the respective gear segment, and in which the clamp member exerts a positive inwardly directed spring pressure against the gear segments at their respective axes of rotation, whereby the gear segments tend to rotate to the normally open position of the hinge structure.

5. The hinge structure according to claim 1 in which at least one of the gear segments is slightly flattened at at least one point on the generally circular circumference of said gear segment, and in which the clamp member exerts a positive inwardly directed spring pressure against the gear segments at their respective axes of rotation, whereby the hinge tends to assume and to remain at at least one relatively fixed position corresponding to said flattened portion of said gear segment.

6. The hinge structure according to claim 1 in which at least one of the gear segments is slightly flattened at the front portion thereof and at the portion midway between the front portion and the rear of the gear segment, and in which the clamp member exerts a positive inwardly directed spring pressure against the gear segments at their respective axes of rotation, whereby the hinge tends to assume and to remain at its normally closed position and at its normally open position.

7. The hinge structure according to claim 1 in which at least one of the gear segments is slightly flattened at the front portion of said gear segment, at the portion midway between the front and the rear of the gear segment and at a portion intermediate the aforesaid two flattened portions, and in which the clamp member exerts a positive inwardly directed spring pressure against the gear segments at their respective axes of rotation, whereby the hinge tends to assume and to remain at its normally closed position, at a position intermediate its normally closed and its normally open positions, and at its fully open position.

8. The hinge structure according to claim 1 in which the outwardly extending leg portion of at least one of the geared hinge members is attached to a door panel.

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