

[54] **DOOR STIFFENER**

[75] Inventor: **Torsti T. T. Jerila**, Baldwin Park, Calif.

[73] Assignee: **Acme General Corporation**, San Dimas, Calif.

[22] Filed: **Mar. 14, 1974**

[21] Appl. No.: **450,995**

[52] U.S. Cl. **52/632; 52/720; 52/613**

[51] Int. Cl.² **E04G 25/00**

[58] Field of Search 52/291, 204, 455, 475, 52/627, 456, 629, 624, 613, 632, 731, 753 C, 720, 758 C, 753 B, 484, 502, 498; 49/411; 403/274, 278, 281

[56] **References Cited**

UNITED STATES PATENTS

2,098,752	11/1937	Miller	52/731
3,081,849	3/1963	Hubbard	52/498
3,093,217	6/1963	Doede	52/498
3,411,258	11/1968	Kessler	52/456
3,784,144	1/1974	Ollinger	52/484

FOREIGN PATENTS OR APPLICATIONS

646,523	5/1937	Germany	52/629
624,049	9/1950	Italy	52/624

Primary Examiner—Frank L. Abbott

Assistant Examiner—Robert Farber

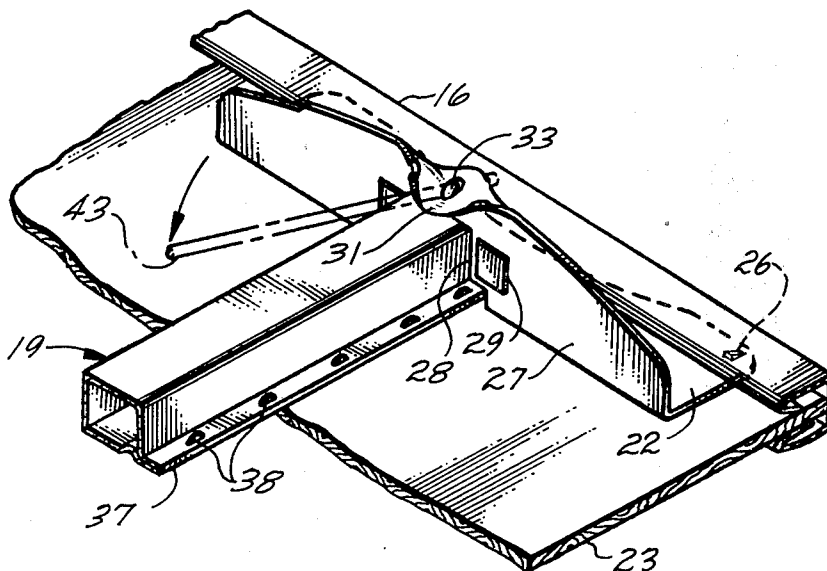
Attorney, Agent, or Firm—Christie, Parker & Hale

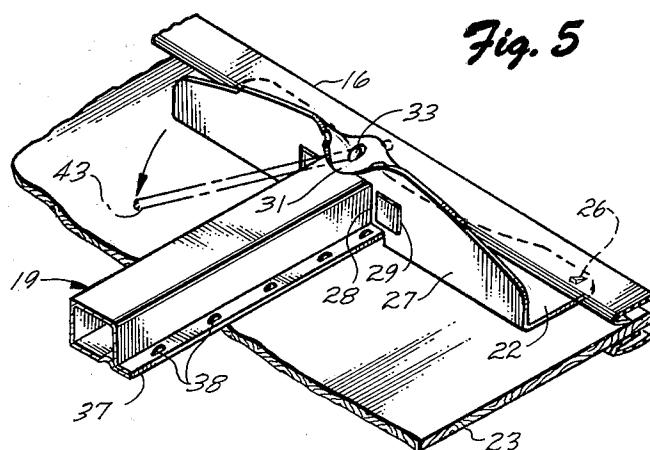
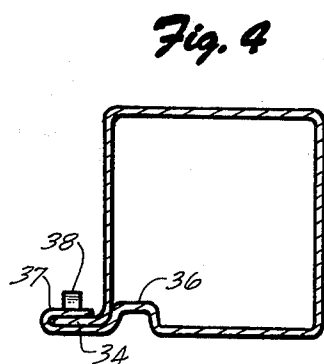
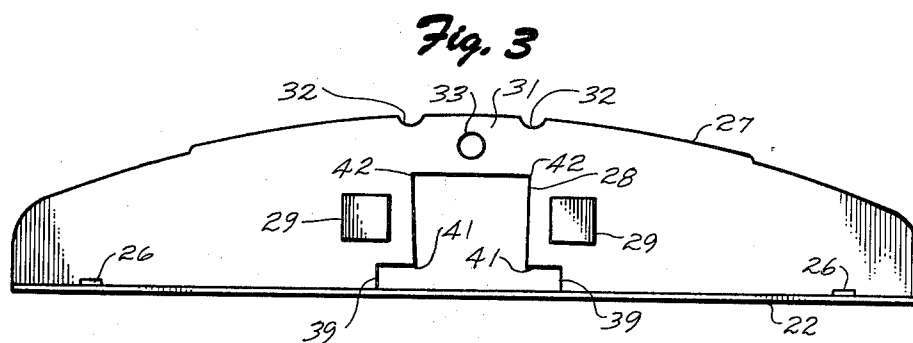
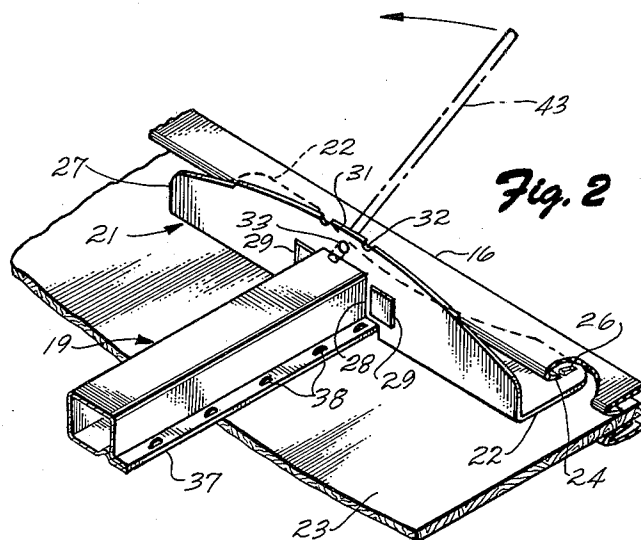
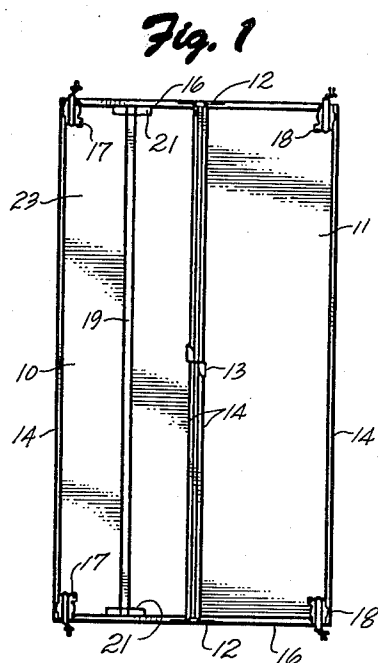
[57] **ABSTRACT**

A torsion bar is provided for stiffening lightweight paneled doors having a thin wood or composition panel and metal stiles and rails around the periphery so that the doors do not twist or rack. The stiffener has a torsion bar extending the height of the door and an L-shaped clamp at each end for connection of the bar to the door. Each clamp has a flat face sheet held tightly against the face of the door by sliding a barbed edge under the rail. The other sheet forming the L-shaped clamp has a window through it complementary to the cross section of the torsion bar and defining a centrally located web of metal near the free edge of the clamp remote from the face of the door.

To lock the clamp in place on the torsion bar the web is twisted out of the plane of the sheet, preferably by tilting a pin in a hold through the web, which pulls the sides of the window tightly against the torsion bar. In a preferred embodiment the torsion bar is a square, roll formed, box section.

14 Claims, 5 Drawing Figures





DOOR STIFFENER

BACKGROUND

It has become popular in home, apartment, and mobile home construction to use lightweight closet doors that slide or fold. These doors have a thin panel, typically 3/16 or 1/4 inch thick, providing the principal surface area of the door. A vertically extending steel stile is clipped onto the panel along each side edge and a steel rail is similarly mounted at the top and bottom of the panel. Special corner connectors that engage the stile and rail are provided at each corner for securing the door components together into an integral structure. These corner connectors also have door mounting hardware, such as wheels or guides for sliding doors. Some installations have a pair of folding doors interconnected by hinges between adjacent corner connectors. The corner connectors on the door nearest the jamb have pivots that support the two doors and permit folding. The corner connectors furthest from the jamb on the second door have guides that run in tracks within the door frame to maintain the doors in alignment.

U. S. Pat. No. 3,750,337 entitled "Sliding Door Corner Connector" describes a typical door with steel rails and stiles and a typical corner connector. The door stiffener described herein is particularly adapted to such a panel door having rails as described in that patent. Principal utility is with folding rather than sliding doors. It will become apparent that it can easily be adapted to other panel doors.

When a pair of folding doors are mounted in a door frame, the weight of both doors is supported at the pivots on the one door nearest the jamb. This raises no problem when the doors are closed, that is, when the door panels are substantially coplanar. When the doors are open however the weight distribution of the supported door remote from the jamb tends to twist the supporting or "pivot" door nearer the jamb. The panel, stiles and rails in such a lightweight door may not have sufficient torsional stiffness to adequately resist the loading imposed and the supporting door may rack out of a plane. The effect is as if the top edge of the pivot door were twisted clockwise out of a plane and the bottom of the door counterclockwise (or vice versa). A relatively small twist, which can easily occur in a lightweight door, can cause the outer door to jam in the tracks and make opening and closing difficult.

It is therefore desirable to provide a means for enhancing the torsional rigidity of the supporting door to resist the twisting tendency.

BRIEF SUMMARY OF THE INVENTION

There is, therefore, provided in practice of this invention according to a presently preferred embodiment a door stiffener having a torsion bar extending substantially the length of the door. The torsion bar is connected to the door by clamps at the top and bottom, respectively. Each of the clamps has a flat face sheet connected tightly against the face of the door adjacent an end and a connector sheet normal to the face sheet and integral therewith. The connector sheet has a window defining a web of connector sheet between the window and the free edge of the sheet remote from the face of the door. The window has a shape complementary to the cross section of the torsion bar and sufficient clearance to permit sliding along the length of the bar. The

web adjacent the window is twistable out of the plane of the connector sheet for pulling the sides of the window tightly against the torsion bar.

DRAWINGS

These and other features and advantages of the present invention will be appreciated as the same becomes better understood by reference to the following detailed description of a presently preferred embodiment when considered in connection with the accompanying drawings wherein:

FIG. 1 is a rear view of a pair of folding doors with the door stiffener in place;

FIG. 2 is a perspective detail of one end of the door stiffener during an intermediate state of installation;

FIG. 3 is a face view of one of the door stiffener clamps;

FIG. 4 is a transverse cross section through the stiffener torsion bar; and

FIG. 5 is a perspective view similar to FIG. 2 with the stiffener fixed in place.

DESCRIPTION

FIG. 1 is a rear view of a pair of typical folding doors with which the door stiffener provided herein is useful. Such a view would be from inside a closet, for example. This assembly has a pivot door 10 which in use is mounted adjacent the door jamb (not shown). A second supported door 11 is connected to the pivot door by hinges 12 at the top and bottom respectively. Such hinges may, for example, be like those described in U. S. patent application Ser. No. 290,320 filed Sept. 19, 1972, entitled "Corner Connector and Hinge for Door with Hollow Stile" and assigned to Acme General Corporation, assignee of this application. If desired an optional center hinge 13 may be included between the top and bottom of the two doors.

Each of the doors 10 and 11 has a stile 14 extending along each side edge. Rails 16 are provided along the top and bottom edges of each of the two doors. A corner connector 17 including a pivot is provided in each corner of the pivot door adjacent the jamb. These pivots fit into conventional pivot brackets (not shown) for supporting the two doors. The supported door 11 has a corner connector 18 in each corner remote from the hinges, including guides that ride along conventional tracks (not shown) in the top and bottom of the door frame to maintain alignment of the doors during folding. The structure described to this point is all conventional and is similar to that described in the above-identified patent and patent application.

As mentioned above the pivot door in the pair can be subject to racking that makes opening and closing difficult. Stiffening of the pivot door is therefore provided by a door stiffener comprising a torsion bar 19 extending substantially the full height of the door and a pair of identical end clamps 21 at the top and bottom of the door, respectively.

An end of the torsion bar 19 and one of the end clamps 21 is illustrated in perspective in the fragmentary view of FIG. 2. The clamp is a generally L-shaped piece stamped and bent from sheet steel. One leg of the L is a face sheet 22 which lies flat against the back face of the door panel 23. An edge portion of the face sheet slips between the door panel and the rail 16. The rail in this embodiment has a generally U-shaped cross section and includes a doubled-back flange 24 that en-

gages the back face of the door panel and extends towards its edge. The face sheet 22 includes a pair of stamped barbs 26 that readily slide under the flange 24 but, in reverse, catch against it and prevent the clamp from being withdrawn. In a typical embodiment the rail 16 is sufficiently springy that the clamp can be readily pressed in place by hand pressure alone.

The clamp also has a connector sheet 27 normal to the face sheet 22 so that when installed on the door the connector sheet extends rearwardly. As may be better seen in FIG. 3 the connector sheet has a hat-shaped window 28 having its base adjacent the face sheet 22 and extending away from it. A pair of small bosses 29 are stamped in the connector sheet to provide some stiffening adjacent the corners 41 extending into the window. The outer portion of the window 28 nearer the free edge of the connector sheet, that is remote from the door panel when installed, defines a web 31 of the connector sheet, the importance of which will appear hereinafter. Small notches 32 opposite the outer corners 42 of the window 28 narrow and somewhat weaken the web. A circular hole 33 is also provided through the center portion of the web.

The torsion bar 19, which is seen in transverse cross section in FIG. 4, is preferably roll formed from steel. The torsion bar is generally square in cross section and one leg has a longitudinally extending flange 34. The adjacent leg has an inwardly directed channel 36 and an extending edge 37 that curls around the flange 34. The flange 34 and curled edge 37 collectively form a side flange running the length of the torsion bar. The curled edge 37 keeps the flange 34 from shifting outwardly and the channel 36 keeps it from shifting inwardly, thereby firmly locking the adjacent legs of the torsion bar together.

The longitudinally extending flange is periodically stamped through the flange 34 and both layers of the curled edge 37 to produce raised half-moon bumps 38 on one face and corresponding dimples on the opposite face. These intermittent stamped regions shearing through all three layers firmly lock the longitudinal flange together. It will be apparent to one skilled in the art that this cross section of torsion bar can be readily made by progressive roll forming. It will also be apparent that, if desired, a bar of generally similar rectangular cross section, with or without a lateral flange, can be made by extrusion or welding.

The window 28 in the connector sheet has a shape complementary to that of the torsion bar 19 so that the clamp readily slides along the length of the bar. The base openings 39 of the hat-shaped window simply provide clearance for the flange along one edge of the torsion bar, and if a completely square cross section is used, these base portion openings can be eliminated and a substantially square window provided through the connector sheet. Two base portions 39 are provided even though there is but a single flange on the torsion bar so that similar clamps can be used at the top and bottom of the door.

The window 28 is not quite square for a square torsion bar. The window is actually slightly trapezoidal with the protruding corners 41 closer together than the window corners 42 adjacent the web. The taper is slight, amounting to only about 0.012 inch greater width in a window nominally $\frac{3}{4}$ inch square. The result is that there is about 0.006 inch greater clearance on

each side of the torsion bar adjacent the web than there is adjacent the protruding corners 41.

To install the door stiffener the torsion bar is placed against the back of the door with the two clamps mounted thereon so that their face sheets point in opposite directions and can lie flat against the door panel. The torsion bar is positioned with its ends close to but not overlapping the end rails 16 at the top and bottom of the door respectively, and preferably it is centered between the stiles and parallel thereto. The two end clamps are then each pushed under their respective rails so that the barbs 26 pass beyond the flanges 24.

One then inserts a pin 43 through the hole 33 from the side towards the end of the door as illustrated in phantom in FIG. 2. A nail set, punch, or other strong pin can be used. The outer end of the pin is then tilted or swung around as indicated by the arrows to bring the pin down to a position adjacent the torsion bar as illustrated in FIG. 5. The pin is removed after this single operation.

Tilting the pin while in the hole 33 twists the web 31 out of the plane of the connector sheet 27. The center part of the web between the hole 33 and torsion bar is twisted out of the plane in one direction and the portion on the opposite side of the hole is twisted out of the plane in the opposite direction. The resultant twist blends relatively gradually into the balance of the connector sheet, although it is more pronounced between the window corners 41 and the notches 32. The twisting shortens the effective length of the web and pulls the sides of the window tightly against the sides of the torsion bar. Because of the lever like action very tight engagement of the clamp on the torsion bar is obtained. This tight engagement prevents sliding of the bar and clamps relative to each other, but most importantly it enables transmission of torsion loads therebetween. Torsional forces as the door attempts to rack are conveyed from the panel to the connector sheet, one edge of which is against the panel. These forces are in turn transmitted to the torsion bar at its engagement with the sides of the window. The torsional rigidity of this inexpensive and easily installed torsion bar effectively eliminates racking of the pivot door in a folding door set.

When twisting of the web closes the sides of the window against the sides of the torsion bar there is a greater degree of closure nearer the web than nearer the face sheet. It will be recalled that the window is not quite square but is slightly trapezoidal and relatively wider adjacent the web. As the window closes on the torsion bar the sides become more nearly parallel and engagement of the sides of the window with the torsion bar extends over an appreciable length of the window side instead of merely being at the corners 42 as would be the case if the window were originally square. The same effect is obtained from a square window and slightly trapezoidal torsion member. It will also be noted that the bosses 29 limit twisting of the connector sheet in the region adjacent the sides of the windows and prevent the protruding corners 41 from twisting out of the plane of the connector sheet.

Since the door panel is relatively lightweight and the torsion bar extends the full length thereof there is a possibility of some flutter or rattling of the door as it is used. This possibility can be readily avoided by placing a thin rubber bumper between torsion bar and door

panel near the middle, or some flexible mastic or adhesive can be put in the same location.

Although a hollow square torsion bar is preferred because of its inherent torsional rigidity and the large area of contact between the connector sheet and torsion bar, other cross-sectional shapes may also be suitable. Preferably the bar is polygonal rather than circular in cross section since there is difficulty in transmitting the torsion loads to a circular torsion bar by clamping action and welding or mechanical fasteners are expensive or relatively unsuitable for field application. When the torsion bar has more sides than four, it tends to approach circularity and transfer of loads thereto by clamping action is more difficult than with a square bar. A triangular torsion bar fitted through a triangular window can be employed with the apex of the triangle relatively nearer the door so that its base lies parallel to the face sheet and defines a connector sheet web for twisting. The area of engagement between the clamp and a triangular torsion bar is generally less than available when the torsion bar is square.

Many other modifications and variations in the present invention will be apparent to one skilled in the art. Thus, for example, the end clamps on the torsion bar can be connected to the face of the door panel by other means such as strong adhesive or mechanical fasteners. Modifications of the face sheet for engagement with other rails for holding the face sheet in engagement with the door panel can also be provided. Various patterns of stiffening ribs or weakening notches can also be provided in the clamps so that they can be fabricated of lighter gauge steel.

It will also be noted that in lieu of twisting the web in a direction in line with the torsion bar that the same result of closing the window can be obtained by a transverse twist. A spanner type tool straddling the web can be used for applying such a twist or one can simply use strong pliers. Twisting as described hereinabove is preferred, however, since one is reacting one portion of the web against another portion and there is no resultant twist on the clamp as a whole which might tend to disengage it from the rail. A similar effect could be obtained with a threaded member interconnecting separated portions of the connector sheet on opposite sides of the window, but this would be more costly to make and install. Many other modifications and variations will be apparent to one skilled in the art and it is therefore to be understood that within the scope of the appended claims the invention may be practiced otherwise than as specifically described.

What is claimed is:

1. A door stiffener comprising:

a torsion bar having a length approximating the length of a door; and

a pair of clamps for connecting the torsion bar to a door, each of said clamps comprising:

a flat face sheet;

means for connecting the face sheet tightly against the face of a door in a substantially fixed position adjacent an edge of the door;

a connector sheet normal to the face sheet and integral therewith;

a window through the connector sheet having one edge adjacent the face sheet and extending away from it towards the free edge of the connector sheet remote from the face sheet defining a web of connector sheet between the window and the

free edge, said window having a shape complementary to the cross section of the torsion bar and having sufficient clearance therefrom to permit longitudinal sliding of the clamp along the torsion bar with the connector sheet normal to the length thereof; and

said web being twistable from a first position in the plane of the connector sheet with the window clearing the torsion bar to a second position at least partly twisted out of the plane of the connector sheet with the window pulled closed against the sides of the torsion bar.

2. A door stiffener as defined in claim 1 wherein each clamp includes a hole through the center of the web for receiving a pin for twisting the web.

3. A door stiffener comprising:

a torsion bar having a length approximating the length of a door; and

a pair of clamps for connecting the torsion bar to a door, each of the clamps comprising:

a flat face sheet;

means for connecting the face sheet tightly against the face of a door in a substantially fixed position adjacent an edge of the door;

a connector sheet normal to the face sheet and having one edge integral therewith and a free edge remote therefrom;

a window through the connector sheet extending from the face sheet towards the free edge of the connector sheet remote from the face sheet defining a web of connector sheet between the window and the free edge, said window having a shape complementary to the cross section of the torsion bar with one side parallel to the plane of the face sheet for defining one edge of the web, and having sufficient clearance therefrom to permit longitudinal sliding of the clamp along the torsion bar with the connector sheet normal to the length thereof;

said web being twistable from a first position in the plane of the connector sheet with the window clearing the torsion bar to a second position at least partly twisted out of the plane of the connector sheet with the window pulled closed against the sides of the torsion bar;

a notch in the free edge adjacent each end of the web defining window edge for partially localizing twist of the web; and

a hole through the center of the web for receiving a pin for twisting the web.

4. A door stiffener as defined in claim 1 wherein the torsion bar has a substantially cross section and the principal portion of the window through each clamp is substantially square.

5. A door stiffener as defined in claim 1 wherein the principal portion of the window in each clamp is slightly trapezoidal with greater clearance from the torsion bar adjacent the web than adjacent the face sheet.

6. A door stiffener as defined in claim 1 wherein the torsion bar has a substantially square cross section with a laterally extending flange along the length thereof adjacent a corner of the cross section and each window has a generally hat shape with base adjacent the face sheet.

7. A door stiffener comprising:

a substantially square torsion bar having a length approximating the length of a door and a laterally extending flange along the length thereof; and
 a pair of clamps for connecting the torsion bar to a door, each of said clamps comprising:
 a flat face sheet;
 means for connecting the face sheet tightly against the face of a door in a substantially fixed position adjacent an edge of the door;
 a connector sheet normal to the face sheet and integral therewith;
 a generally hat shaped window through the connector sheet with base adjacent the face sheet and extending from the face sheet towards the free edge of the connector sheet remote from the face sheet defining a web of connector sheet between the window and the free edge, said window having a shape generally complementary to the cross section of the torsion bar including a slightly trapezoidal portion so that there is relatively greater clearance from the torsion bar nearer the web than there is nearer the face sheet and having sufficient clearance therefrom to permit longitudinal sliding of the clamp along the torsion bar with the connector sheet normal to the length thereof;
 said web being twistable from a first position in the plane of the connector sheet with the window clearing the torsion bar to a second position at least partly twisted out of the plane of the connector sheet with the window pulled closed against the sides of the torsion bar; and
 a hole through the center of the web for receiving a pin for twisting the web.

8. A door stiffener as defined in claim 1 for cooperation with a panel door having a door edge rail along each end thereof clamped on the door wherein the means for connecting the face sheet against the face of a door comprises a portion of face sheet for extending between the door edge rail and the door and a pair of barbs on the extending portion for inhibiting withdrawal of the face sheet from between the rail and door.

9. A door stiffener comprising:
 a torsion bar having a hollow polygonal transverse cross section; and
 a pair of clamps slidably movable along the length of the torsion bar for connecting the torsion bar to a

door, each of said clamps comprising:
 a generally L-shaped member having one sheet for engaging the face of a door and a second sheet for engaging the torsion bar;
 a window through a center portion of the second sheet having a shape substantially complementary to the cross section of the torsion bar and sufficient clearance therefrom to permit longitudinal sliding of the clamp along the torsion bar subdividing the second sheet into two parts; and
 means connecting the two parts of the second sheet on opposite sides of the window for pulling the two parts closer together and against the side of a torsion bar in a window.

10. A door stiffener as defined in claim 9 wherein the means for connecting the two parts of the second sheet comprises:
 a strip-like web integral with the two parts of the second sheet and adjacent the window; and
 a hole through the center of the web for receiving a pin for twisting the web out of the plane of the second sheet.

11. A door stiffener as defined in claim 10 wherein the torsion bar is substantially square and the window is substantially square.

12. A torsion bar clamp for connecting a door stiffening torsion bar to a door comprising:
 a flat face sheet for engaging a face of a door;
 a connector sheet normal to the face sheet and integral therewith;
 a polygonal window through the connector sheet extending from the face sheet towards the free edge of the connector sheet, said window having a pair of corners at the lateral edge thereof relatively nearer the free edge of the connector sheet remote from the face sheet for defining a strip-like web between the window and the free edge; and
 a hole through the center of the web for receiving a pin for twisting the web.

13. A clamp as defined in claim 12 wherein the principal portion of the window has a generally square shape with a pair of side edges approximately normal to the face sheet.

14. A clamp as defined in claim 13 wherein the side edges of the window diverge slightly in a direction away from the face sheet.

* * * * *

50

55

60

65