Oct. 14, 1969 A. J. BIRO 3,472,543

METHOD AND STRUCTURE FOR TIGHTENING SECURED MATCHED ABUTTING TUBULAR STILES AND RAILS BY THE CONTRACTION OF THE JOINED TUBULAR MEMBERS ON A GUSSET

Filed June 21, 1967 3 Sheets-Sheet 1

Fig. 1

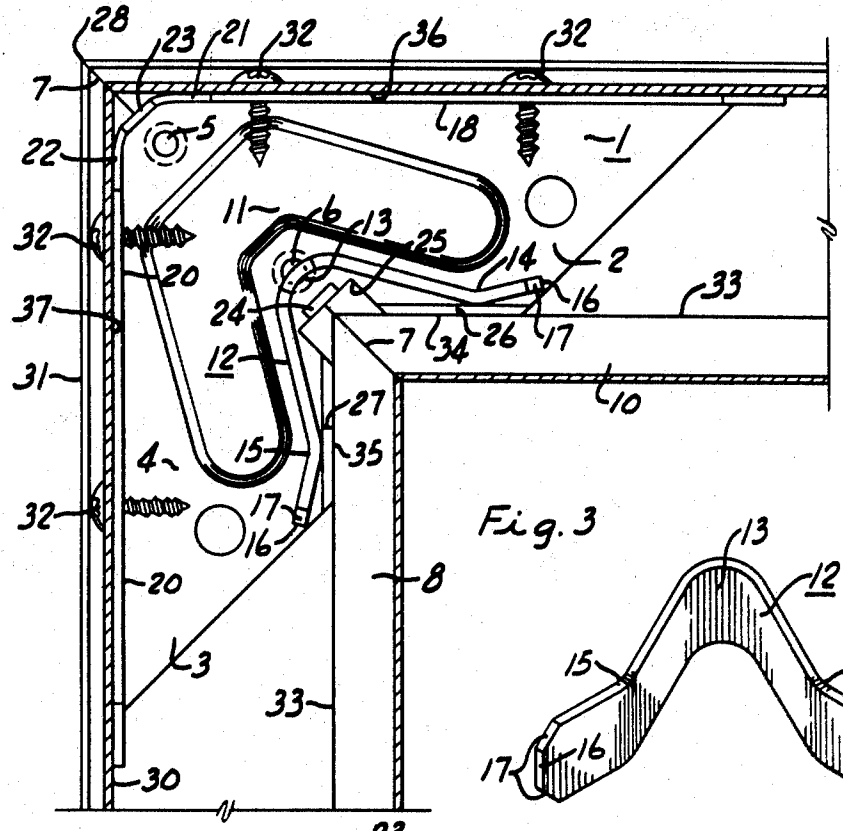

Fig. 3

Fig. 2

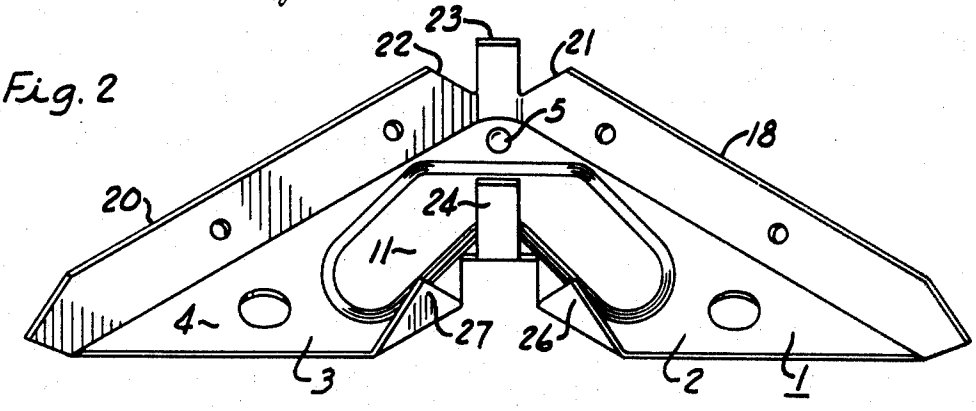

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Fig. 4

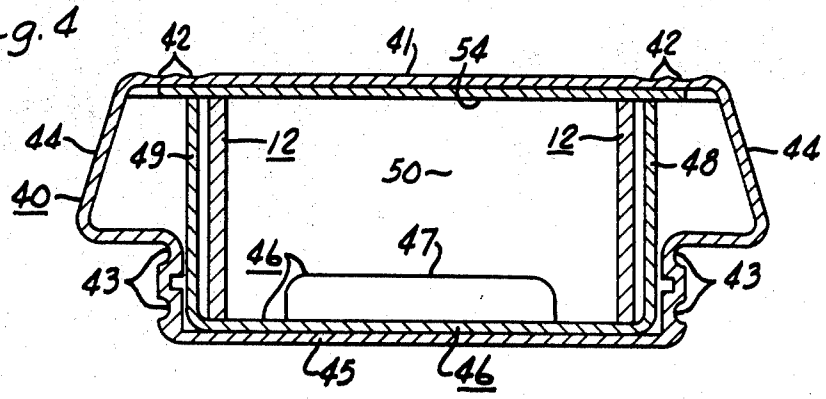

Fig. 5

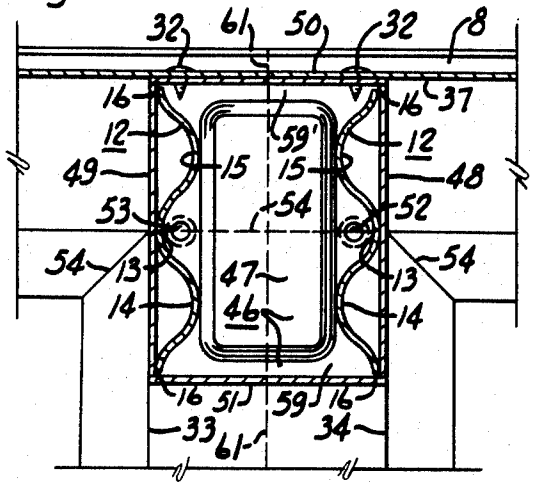

Fig. 7

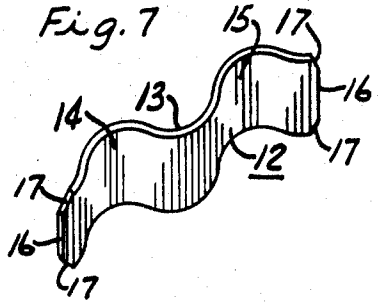

Fig. 6

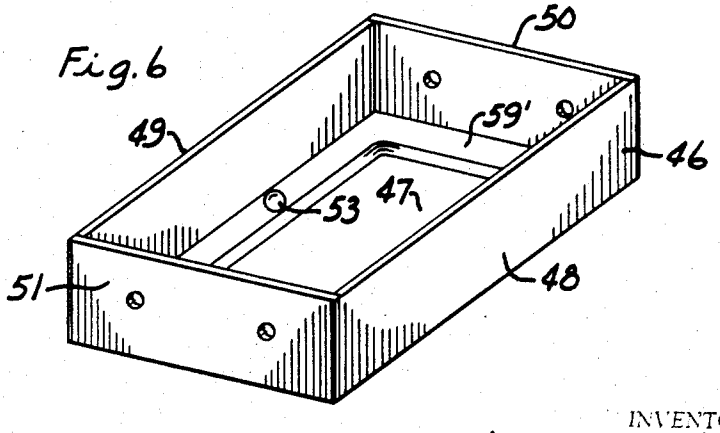

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Fig. 9

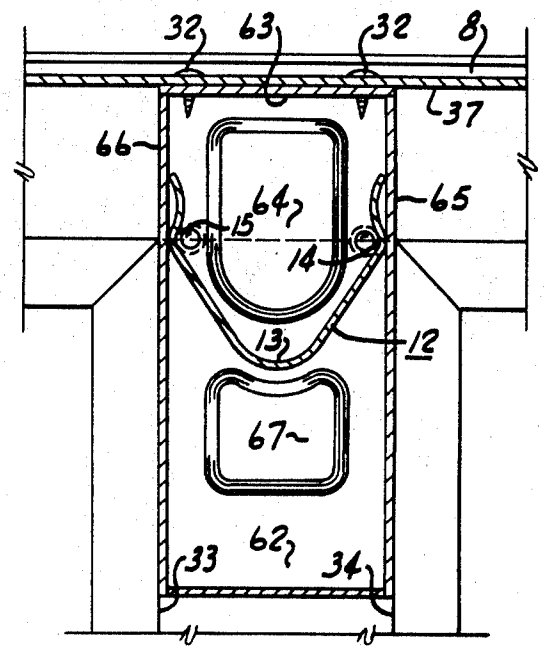


Fig. 10

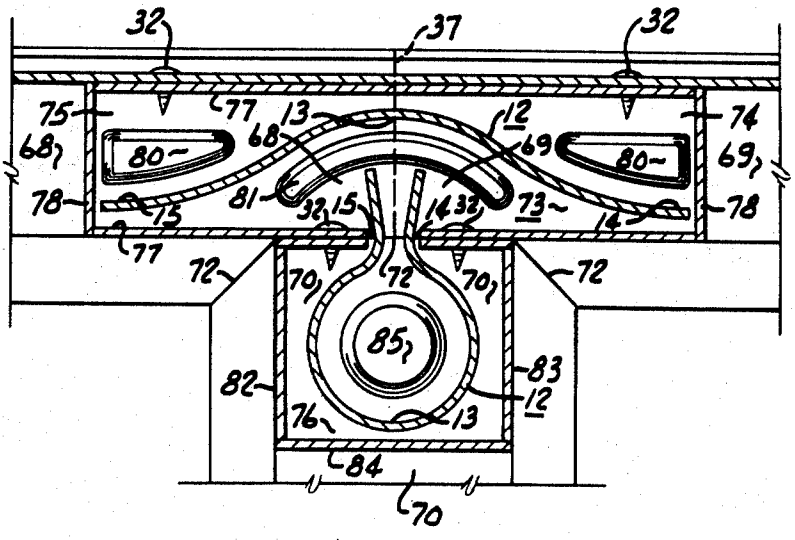
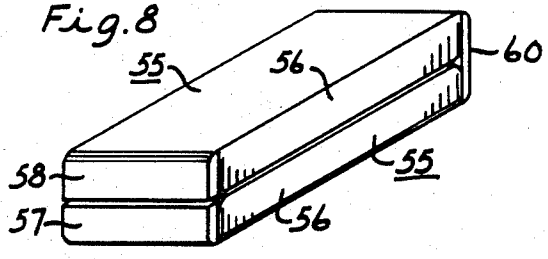


Fig. 8



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METHOD AND STRUCTURE FOR TIGHTENING SECURED MATCHED ABUTTING TUBULAR STILES AND RAILS BY THE CONTRACTION OF THE JOINED TUBULAR MEMBERS ON A GUSSET

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U.S. Cl. 287—189.36 13 Claims

ABSTRACT OF THE DISCLOSURE

A frame structure with matched abutting tubular stiles and rails secured together and tightened by the tubular contractual forces of the joined stile and rail members as applied on an inserted gusset plate bridging the joint, wherein these contractual forces of compression are created by lineally applied strip producing wedging forces between the gusset plate surfaces and the opposite inner tubular surfaces of the stiles and rails.

Background of the invention

Tubular metal stiles, rails and mullions are known and different types of gusset plates have been employed at the corners and joints. Where possible, these gusset plates have been secured to the door edges.

Such gusset plates have a snug fit in the adjacent open tubular ends of the joint which they bridge and secure together. However, they produce a flimsy structure which is due to the fact that the gusset plate is not held tightly along its marginal edges and the extent of its flat surfaces. The mere screw clamping the gusset plate to the door edges does not tighten the gusset plate, nor does it tighten the joint, nor does it uniformly match the edges of the joined tubular members at the joint.

The mere screwing of an inner gusset, bracket or channel member to the inner edges of the joined tubular members do not make a joint tight.

Summary of invention

The principal feature and object of this invention is the provision of a door, window or other similar frame structure with matched tubular members such as stile and rail and mullion members, secured together with an inner gusset plate fastened to the edges of one or more of the tubular members and tightened by contractual forces of the tubular members themselves and the method of performing the same. To perform this method of tightening the fastened gusset, a pressure locking link or longitudinal wedge is inserted in the joint against the inner face of the gusset. This link or wedge is preferably constructed of a strip of low modulus of elasticity with some length such as an aluminum strip approximately two millimeters in thickness and of sufficient width to cause the tubular surfaces wedged to spread and slightly arch. The corner ends of this wedge or pressure locking link are notched or cut at an angle of approximately 45 degrees so that the strip will enter the tubing when on the gusset plate surfaces. The length of the strip may be shorter than the extent of the gusset plate but a strip of four inches in length has been found to be adequate.

To make the wedge or pressure locking link stand as it is being inserted, bends are placed therein between its ends. This somewhat shortens a more or less straight link. At times the link is bent in a U shape so that the notched corner ends are disposed in the same direction or provided with a reverse curve in the legs to dispose them approximately at right angles to each other.

Ordinarily, one wedge or link is necessary to force out or slightly bulge the tubular walls of the stile and rail

members for a single joint. However, two wedges or links may be employed.

When the wedge or pressure locking link is inserted between the gusset and two tubular inner surfaces and they are forced to close the joint the slight bulge or expansion of the tubular surface adjacent the wedge or pressure locking link causes the edges of the tubular members to contract and compress on the edges of the gusset plate. If the edges of the gusset plate are spaced from the tubular members a greater distortion is required to contract them on the gusset plate. If the gusset plate has a sliding fit in the tubular members only a small wedge action is required.

If the gusset plate has marginal flanges a quicker contracting force is realized by a smaller wedge even though the edges of the flanges are spaced from the opposed tubular surfaces.

Thus gusset plates of prior constructions may be tightened in the manner by merely employing a wedge or pressure locking link.

With low flanges along the edges of the gusset plate that has a sliding fit in the adjacent tubular members provides an ideal assembly structure since the only resistance to insertion is that created by the wedge or pressure locking plate.

To keep this locking plate in position, drawn abutments may be made on the flat surface of the gusset plate. These abutments and the marginal flanges readily locate and support the pressure locking link in position as the parts are inserted to form the joint. After the joint is made the holes in the gusset flanges and the frame edges are aligned and machine or drive screws are inserted to hold the parts in this relation.

It is the contractual forces of the tubular members forming the joint that pull the sides and edges of the frame together and grip the whole edge and engaging surfaces of the gusset plate and the adjacent interior surface of the tubular members in tight embraced relation which produces a joint without play and is a strong and rigid as a materially heavy and solid frame or door or window.

Other objects and advantages of this invention appear hereinafter in the following description and claims.

The accompanying drawings show, for the purpose of exemplification without limiting the invention or the claims thereto, certain practical embodiments illustrating the principles of this invention wherein:

FIG. 1 is a sectional view of a frame corner joint between a stile and rail of aluminum extrusion tubular members with the gusset plate and pressure locking link in place.

FIG. 2 is a perspective view of the gusset plate in FIG. 1.

FIG. 3 is a perspective view of the pressure locking link of FIG. 1.

FIG. 4 is a sectional view of a frame having an intermediate joint between a stile and intermediate rail or mullion of aluminum extrusion tubular members and one form of gusset plate and wedge.

FIG. 5 is a sectional view similar to that of FIG. 4 showing a different character of gusset plate and two pressure locking links.

FIG. 6 is a perspective view of the gusset plate of FIG. 5.

FIG. 7 is a perspective view of the pressure locking link of FIG. 5.

FIG. 8 is a perspective view of a modified form of a gusset plate enclosing the pressure locking link.

FIG. 9 is a cross-sectional view of a modified structure.

FIG. 10 is a cross-sectional view of a further modified view of a rail to rail joint in a long screen joint.

Referring to FIG. 1, the gusset plate 1 is triangular in shape and has one insert portion 2 at one end of the triangle and another insert portion 3 at the opposite end

of the triangle. This triangular gusset plate has a flat face 4 which is provided with buttons 5 and 6 that are on the diagonal line 7 representing the diagonal cut at the end of the stile 8 and the rail 10. The buttons 5 and 6 are merely indentations that raise the oppostie face from that shown in FIG. 1 from the under surface of the gusset plate. A raised abutment member 11 extends from the insert portion 2 to the insert portion 3. This raised abutment has two functons. It stiffens the plate 4 or the substantially flat surface of the gusset plate 1, and it also acts as a guide or abutment surface for the pressure locking link strip 12 which, in this instance, is an aluminum strip of uniform width throughout its length, having a deep central bend 13 and each of its legs are provided with a reverse curve or bend 14 and 15 and the ends 16 are notched at the corner as indicated at 17 so that they may be readily inserted into the adjacent tubular member when positioned on the gusset plate.

The outer angular edge of the gusset plate 1 is provided with a flange 18 on the insert portion 2 and a flange 20 on the insert portion 3. These flanges are pointed at their outer ends and are cut downwardly at the apex to form relief portions 21 and 22 on opposite sides of upstanding post member 23. A similar post 24 is shown on the inner corner angle of the gusset plate 1 being struck up from the metal leaving the square opening 25 and which opening would be further extended by the adjacent edges of the upstanding flanges 26 and 27. As shown in FIG. 1, the reverse curves 14 and 15 of the pressure locking link strip 12 may engage the inner surface of the upstanding flanges 26 and 27 and be guided thereby or they may be spaced from these flanges and engage the adjacent edges of the abutment 11 which extend in U shape as illustrated.

The purpose of this structure is to permit the pressure locking link strip 12 to be loosely installed on the abutment plate as one of the insert portions of the gusset plate as one of the insert portions of the gusset plate is being inserted into one of the open ends of the tubular member to be joined. Since the pressure locking link is merely a flat strip and preferably of metal having a low modulus of elasticity that would permit it to be formed within its elastic limit, which when gauged by the dimension between the gusset plate and the opposed inner surface of the tubular member into which it is inserted, such that it may be compressed within its elastic limit and at the same time flex the tubular member in which it is inserted.

As shown in FIG. 1, the outer flange member 20 of the gusset engages the inner surface 30 of the edge of the tubular member 8 the outer surface of which is defined by opposed flanges 31 and the actual edge of the door surface is recessed to remove the heads of the screws 32 from view. If such a recess was not formed in the outer surface of the door edge, the screwheads could be flat headed and be provided with a corresponding countersink so that they might be flush with the door. However, the metal doors, particularly of the aluminum type, are constructed in this manner. The flange 18 likewise has the screws 32 to support the gusset or anchor the same relatively to the stile 8 and the rail 10 with their mating edges smoothly maintained in abutting relation.

The post 24 being spaced from the pressure locking link strip 12 may protrude sufficiently high to engage either side of the joint 7 and maintain a surface alignment by supporting the inner surfaces adjacent to the abutment line 7. The adjacent button 5 has sufficient substantially flat width to engage the inner surface of the stile and rails underneath the gusset plate and perform the same function as that of the post 23 adjacent the corner or apex of the door 28.

Although the posts 23 and 24 are the same height on the gusset plane 1, the width of the pressure locking link strip 12 is materially higher. It may be in the order of a sixty-fourth of an inch higher. However, depending upon the thickness of the walls of the tubular members to be coupled and their resiliency, the gauge of the width of the pressure locking link strip 12 must be adjusted so that the pressure exerted against its opposite edges will not crush this strip beyond its elastic limit. This is obvious from assembling and re-assembling the same link which does not show distortion or wear. The link ends of course are reinforced by the bends 13, 14 and 15 which not only permit the pressure locking link strip 12 to stand alone but also prevent lateral forces from upsetting the same.

When the joint is inserted by force and the opposite edges of the pressure locking link strip 12 engage and slide longitudinally along the inner surfaces of the tubular stile and rail members, it will be noted that they extend substantially the full distance of the insert portions 2 and 3 where the link is positioned. This wedge action requires a considerable distortion of the tubular member and can readily be gauged by placing the straight edge across the face of the tubular member before and after insertion or for the length of the pressure locking link and a portion removed therefrom.

Since the stiles and the rails are made of the same material, however, their inner edge has a different configuration. The inner edge 33 of these members ordinarily have an entirely different configuration than the outer edge so that they may receive screen, glass, or solid metal panels. However, the inner flanges 26 and 27, although not usually as higher as the outer flanges 18 and 20, are of sufficient height to engage an inner portion of the wall surface of the stile and rail members and by reason of the fact that they do engage some portion of the inner surface of these members, as illustrated in FIG. 1 at 34 and 35. The expanding or arching or bulging of the surface engaged by the pressure locking link 12 slightly distorts the cross-sectional shape of the extrusion forming the stile and rail so that the inner surface of the inner edges 34 and 35 and the inner surface of the outer edges 36 and 37 are compressed toward each other or by the action of the pressure locking link. Thus, both end portions of the stile and rail that engage over the insert portions of the gusset plate tightly embrace and pull the bottom surface of the extrusion as well as the side surfaces against the gusset plate 1 and for the full length thereof as shown in FIG. 1, particularly along the marginal edges as defined by the engaging surfaces 34, 35, 36 and 37. This tight embrasure induces a strength that binds the gusset plate and employs its full strength in the joint regardless of the screws 32 which merely prevent the joints 8 and 10 from being vibrated to separate from one another. The net result is that the door seems to have a joint that is solid and so substantial that the joints will not have any flexure whatsoever. Thus, as heretofore stated, a joint connecting tubular extruded metal parts forming a door, rather than being the weakest becomes the strongest part of the structure and as the extrusions are designed so as to materially increase their tubular structure, the door is materially improved.

Referring to the structure as illustrated in FIG. 4 wherein the rail or mullion indicated at 40 provides a relatively flat outer face 41 with marginal trimming scores 42 and the opposite edges are similar being provided with a pair of window panel supporting grooves 43 which panels may contain a screen, a glass or glass plastic or solid sheet of metal. These screws are on the inside and edges extend materially beyond these grooves as illustrated at 44, the inner face 45 of the rail or mullion being a flat uniform surface.

This completely defined tubular member is similar to an extrusion formed in present door structures and is provided with a rectangular gusset plate indicated at 46 that has a central abutment member 47 and upstanding flange members 48 and 49. This particular gusset plate has its opposite ends turned upwardly as illustrated in FIG. 5 at 50 and 51. The end 50 as shown in FIG. 5 is secured to the inner surface 37 of the outer wall of the

stile 8 by the screws 32. Similar buttons, such as illustrated at 5 and 6, shown at 52 and 53 lie along the mating edge indicated by the dotted line 54, and indicates in FIG. 5 the under side of surfaces being joined and corresponding surfaces of the other side being cut away in this sectional view.

Here the pressure locking links 12 take a different form. They are merely similar aluminum strips and they loosely fit between the abutment 47 and their respective flanges 48 and 49 of the gusset plate 46. However, the inner curve 13 is materially flattened or opened out and the reverse curves 14 and 15 function to guide and maintain the pressure locking links upright while they are being inserted into engagement with the inner surfaces of the tubular members. It will be seen that the dividing line 54 forming the joint between these surfaces represents the center of each of the pressure locking links 12 employed in FIG. 5. The ends of the pressure locking links are notched at 17 so that they may be inserted in position. However, it is preferable that the very end edges 16 be spaced from the end walls 50 and 51 so that the links are actually loose and free to move when being inserted, but the abutment 47 is of course sufficiently high and cooperates with the upwardly extending flanges 48 and 49. Thus the insert portion 59 in the rail would be grasped between the inner edge surfaces 33 and 34. However, the surfaces of the stile are maintained in the same plane as the opposite sides of the surfaces of the rail so that the joint 54 is flush and tight and a clamping stress is not only placed on the under side of the insert portion 59 on the rail but also on the under side and against the end 50 on the insert portion 59' that extends into the stile.

If the rail as shown is adjacent the operating mechanism, there is sufficient area remaining for mounting the locking mechanism and for passing the axis of the knob at a generous spacing from that of the marginal edge of the stile, which heretofore has been a problem. In view of the flexibility of the structure, the present structure provides a more rigid combination that permits placing the door handle closer to the mating edge 54 in the center of the panel and still provide a solid and rigid door structure. If, however, the stile of FIG. 5 is one of the rails and the rail is a mullion, there is no problem of this character and the more solid door is provided.

Referring again to FIG. 4, if it is desired to provide a more substantial surface against which the pressure locking links strip 12 engage the tubular member opposite to that of the gusset plate 46, a second gusset plate may be inserted which could be more of a stiffer material such as steel in place of aluminum or such as aluminum in conjunction with plastic extrusions or a stiffer plastic material in case of plastic extrusions forming door and window structures of this character.

As shown in FIG. 8, the gusset plate 55 and the corner such as illustrated in FIG. 5 may be constructed in two sections or one section as illustrated. Here, each section of the gusset plate has side walls 56 and end walls 57 and 58 and a connecting wall 60. This gusset member may have the properly disposed buttons, such as illustrated at 5 and 6 in FIG. 1 and 52 and 53 in FIG. 5 and may have the same type of formed abutments 47 as shown in FIG. 5, the only difference being the fact that before the duplicate ends of the gusset 55 are closed, the two pressure locking links strips 12 are inserted therein which would be shaped similar to that shown in FIG. 5 and the ends of the gusset plate 56 would be shaped in the manner of 17 so that either end would readily enter the opening of the adjacent tubular members to be joined, the only difference being that when the pressure locking links 12 are omitted the gusset 55 would readily slip in place, but when the pressure locking links 12 are inserted, then the same resistance would be subjected to the whole of the opposed sides of the gusset plate 55. In all other respects, the device would function is the same manner.

Here again a structure of the kind illustrated in FIGS. 4 to 8 may also be employed to join the abutting ends of a long tubular member such as that required for joining sections of a screen porch made of material of this character. Under such a circumstance the joint would merely extend axially of the two members or if one gusset member such as illustrated at 46 could be inserted longitudinally joining members cut along the center line indicated at 61 and another similar gusset member in the rail structure as illustrated in FIG. 5 joining the side thereof. Such a structure would function in the same manner to extend the surfaces of the tubular members to compress and clamp them tightly against the gussets inserted therein for producing a strong joint.

In FIG. 9 a gusset plate 62 has an upturned end 63 held by the screws 32 against the inner edge surface 37 of the stile and it is provided with an upwardly extending abutment member 64 together with the longitudinal flange members 65 and 66. It is also provided with a second upwardly extending abutment member 67 and with the other abutment member 64 retains the pressure locking link strip 12 having its deep bend 13 and its reverse curves 14 and 15. This structure illustrates the use of the pressure locking link of the same shape of that of FIG. 1 employed with the legs thereof forming that portion that engages the abutting surfaces at the joint being reinforced.

As in the other structures, the pressure locking link will pull the cut edges 33 and 34 of the stile where the gusset plate passes through as well as the same sides in the rail which are drawn laterally in when the pressure locking links are inserted in assembling these joints.

Referring specifically to the structure of FIG. 10, let it be assumed that sixteen feet is the only convenient length for shipping knockdown structures that produce enclosures for screens, windows and other types of panels employing tubular rail and still members and it is necessary to join two length of sixteen feet each, in which case the rail end 68 and the rail end 69 are being joined to the vertical riser or mullion 70 with the vertical split at 71 and the horizontal split at 72. In this case we could provide an integral gusset member 73 having three insert parts 74, 75 and 76. The latter may be made independently by providing inturned flanges connected together as shown, otherwise the structure would be merely impressed from one plate which would be preferable.

The inserts 74 and 75 have a common upturned side flange 77 and an upturned end flange 78. They are also provided with symmetrical abutments pressed in the face of the plate forming the gusset 73 as illustrated by the triangular abutments 80 and the U-shaped abutment 81. These abutments as heretofore guide the pressure locking link strip 12 with its central bend 13 somewhat opened and its lateral reverse bends 14 and 15 spread apart to cover the length of the joint.

If a lateral insert 76 is not an integral part of the principal gusset plate, its side flanges 82 and 83 are preferably turned upwardly as shown and its end 84 is also turned upwardly and the same style of pressure locking link strip 12 is used with its bend 13 at the bottom and its extending ends encircling the abutment 85 so that its outer ends are positioned to join the adjacent surfaces. The reverse curves 14 and 15 forming the legs of the link strip 12 engage the abutting surfaces of the rail ends 68 and 69 and the abutting surface of the mullion 70 at the joint to be reinforced. As previously stated, the screws 32 may be omitted when the insert portion 76 is pressed from the same steel plate as that of the insert portions 74 and 75, each corner appearing similar to the structure shown in FIGS. 1 and 2.

In any event, the hairpin shaped pressure locking link 12 may correspondingly remain the way it is shown or the legs may be spread further apart when the adjacent edges of the flanges may be removed.

In this manner a very long tubular section may be supported by a vertical structure which is either of the

rail or mullion type and at the same time the joint will be very tight because of the pressure locking link causing a constriction on the flanges **77** of the horizontal section and of the flanges **83** of the vertical section owing to the respective pressure locking links **12** in the upper member and **12** in the lower member, both of which are the same, only one being bent so that its curve **13** brings the legs together rather than extends them openly as illustrated in the drawing.

I claim:

1. A frame joint between mating tubular members including a stiffener gusset plate having insert portions the outer surfaces of which extend in and engage the adjacent inner surfaces of tubular members to be joined with mating abutting edges, each insert portion having an inner surface enclosed in a channel formed by opposed flange edges the outer bottom and flange surfaces of which engage selected respective inner side and edge surfaces of the mating tubular members, characterized by at least one pressure locking link strip having one edge engaged on said inner surface of the gusset plate and its other edge exerting pressure against the opposite inner surfaces of said tubular members but spaced from said inner edge surfaces of each abutting tubular member adjacent the jointure of said tubular members to contract the inner side and edge surfaces of said respective tubular members into frictional and tensional embrace with said outer bottom and flange engaging surfaces of each insert portion of said gusset plate to provide a rigid frame joint and hold the said tubular members mating edges in smooth abutting relation.

2. The frame joint between mating tubular members of claim **1** characterized by fastening means between said flange edges of said gusset insert portion and selective of said edge surfaces of the embracing tubular members to interlock them against relative sliding movement.

3. The frame joint between mating tubular members of claim **1** characterized by at least one central bend in said pressure locking link strip to provide ends extending angularly from each other.

4. The frame joint between mating tubular members of claim **2** characterized in that said tubular members are the rail and stile and the direction of the link strip ends are longitudinally of the axes of said rail and stile.

5. The frame joint between mating tubular members of claim **3** characterized by a bend adjacent each end of said locking link strip to space its end edges from the inner flange surfaces of said abutment and flanges.

6. The frame joint between mating tubular members of claim **5** characterized by a reverse bend in each end of said locking link strip to space the end edges from said inner flange surfaces.

7. The frame joint between mating tubular members of claim **1** characterized by a bend adjacent each end of said locking link strip and the ends thereof may engage the flanges of said gusset plate.

8. The frame joint between mating tubular members of claim **1** characterized in that said gusset plate is triangular and has spaced projections on said triangular surface adjacent its respective inner and outer angles which engage the respective inner surfaces adjacent said mating edges of said tubular members in smooth abutting relation.

9. The frame joint between mating tubular members of claim **8** characterized in that said spaced projections on said triangular surface are raised buttons on its outer surface.

10. The frame joint between mating tubular members of claim **8** characterized in that said spaced projections on said triangular surface are spaced raised posts on its inner surface.

11. The frame joint between mating tubular members of claim **9** characterized by spaced projections in said triangular outer surface of said gusset plate adjacent its respective inner and outer angles engage the respective inner surfaces adjacent said mating edges of said tubular members in smooth abutting relation.

12. The method of providing a strengthened frame joint between mating tubular members comprising the steps of

(1) cutting the adjoining edges of adjacent ends of the tubular members to fit in mating abutting relation,

(2) fitting a reinforcing gusset bridge member into the open adjacent ends of the tubular members being jointed to bridge each adjoining abutting edges,

(3) inserting a pressure locking link strip between the fitted gusset member and the opposite inner side surfaces of the tubular members when joined to apply pressure thereto for contracting the edges of the tubular members to frictionally embrace the same along the sides of the bridging gusset member and securely tighten the frame joint.

13. The method of claim **12** characterized by interlocking the clamped reinforcing gusset bridge member with each tubular member.

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