Oct. 26, 1943. N. T. MacKENZIE 2,332,652

MANUFACTURE OF BOX-LIKE STRUCTURE

Filed May 10, 1940 3 Sheets-Sheet 1

Fig. 1

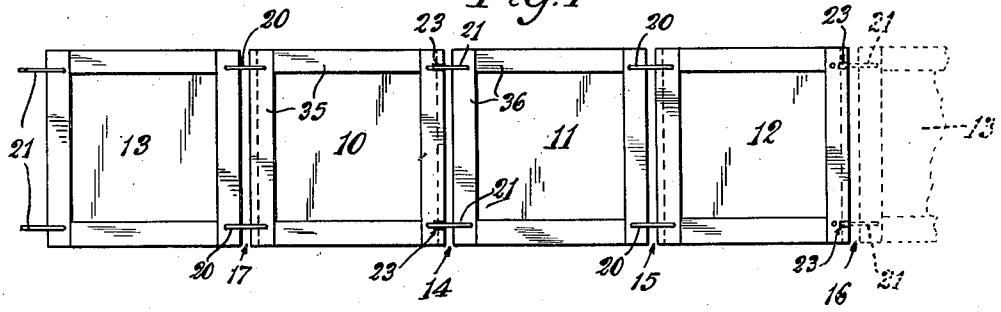


Fig. 2

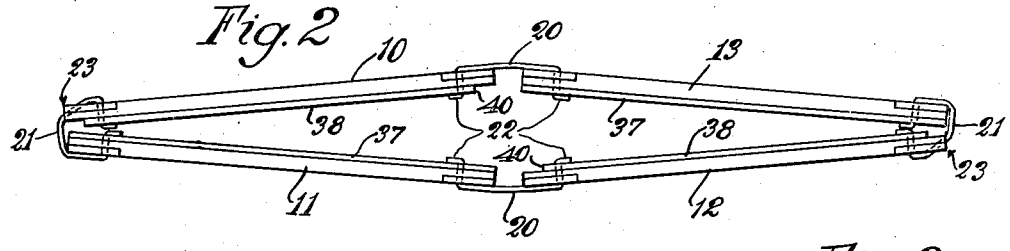


Fig. 4

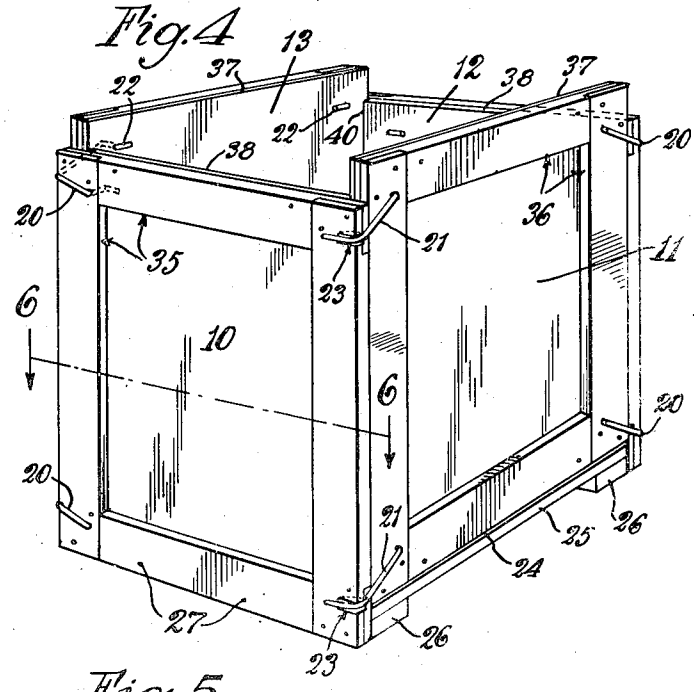


Fig. 3

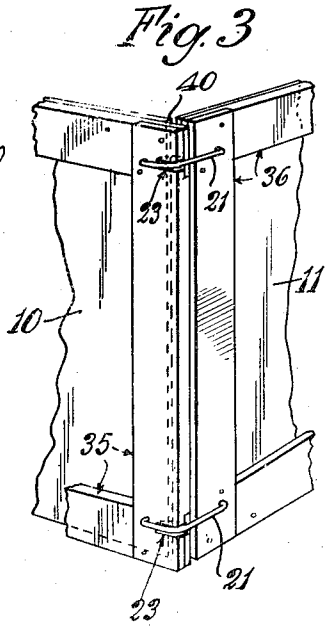
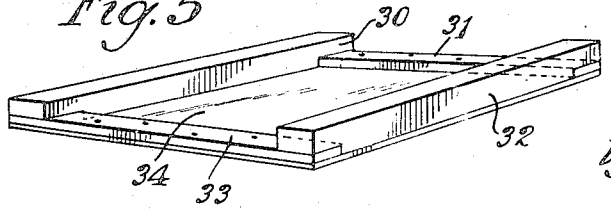


Fig. 5



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MANUFACTURE OF BOX-LIKE STRUCTURE

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Fig. 6

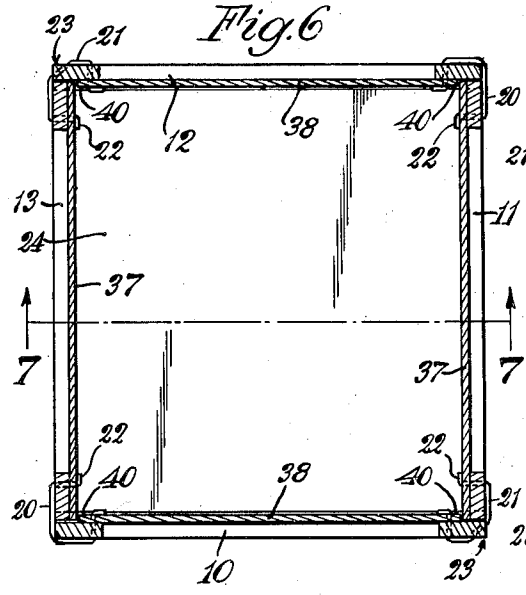


Fig. 7

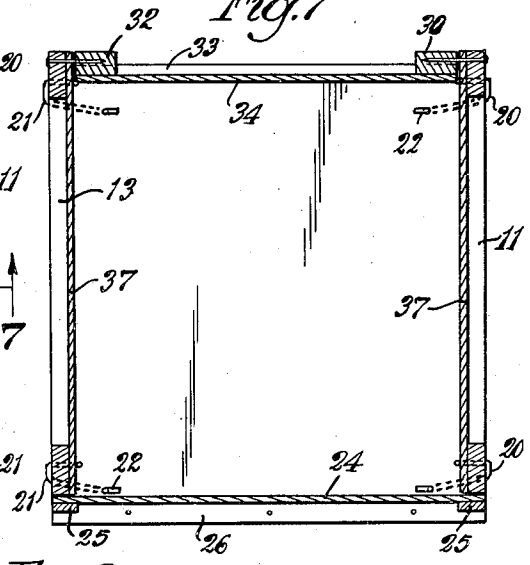


Fig. 8

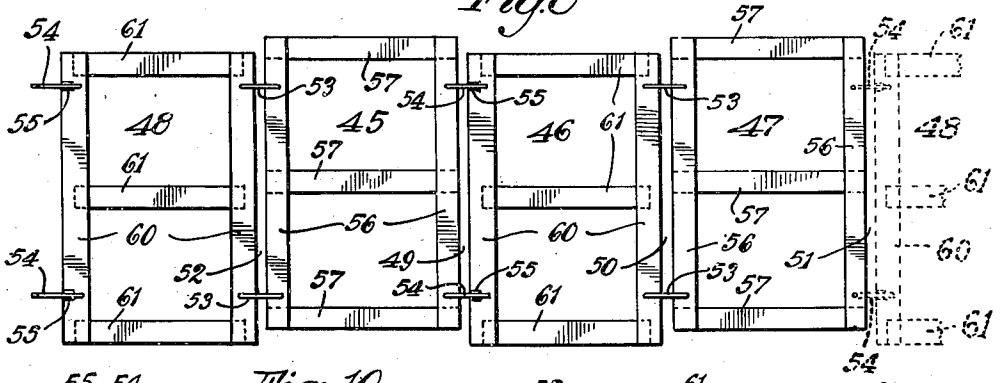


Fig. 10

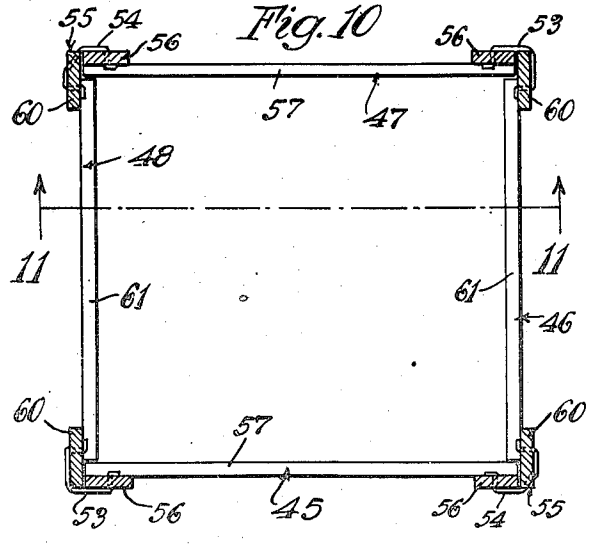
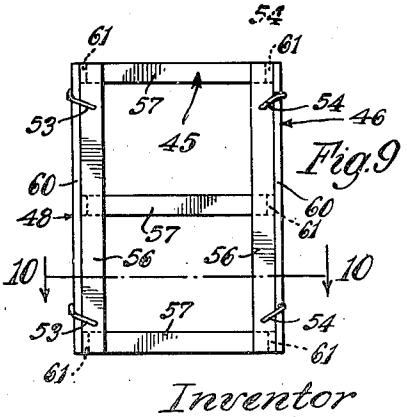


Fig. 9



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MANUFACTURE OF BOX-LIKE STRUCTURE

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Fig. 11

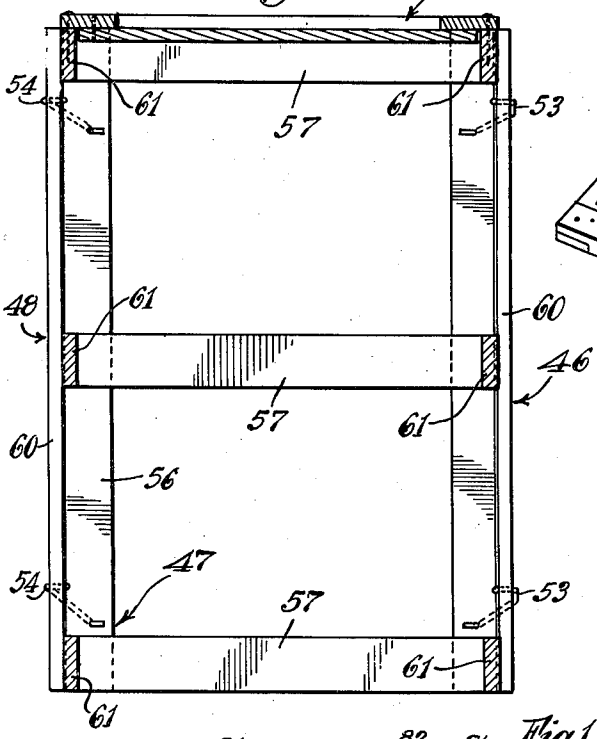


Fig. 12

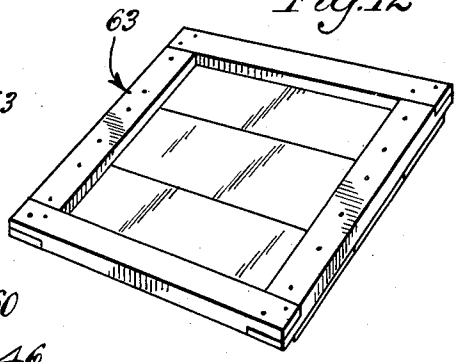


Fig. 14

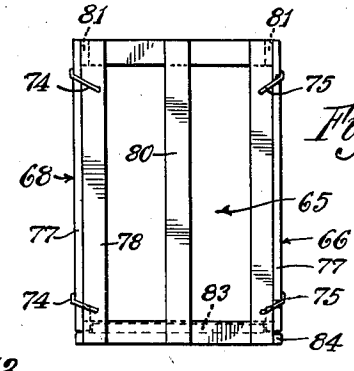


Fig. 13

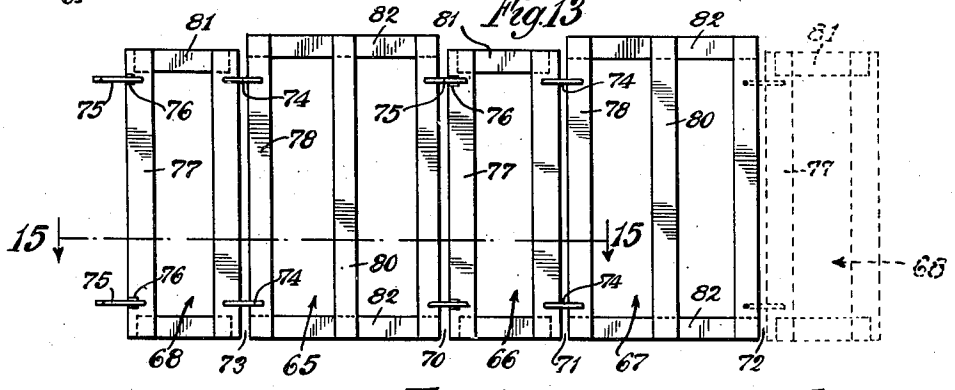


Fig. 15

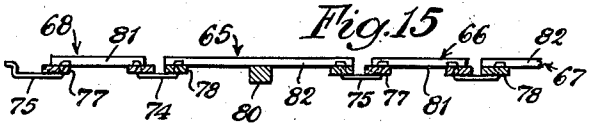


Fig. 16

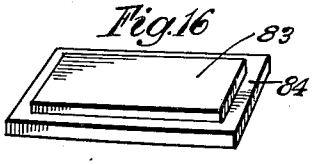


Fig. 17

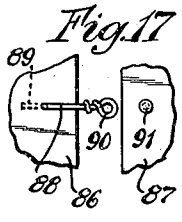


Fig. 18

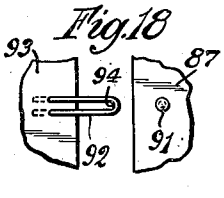
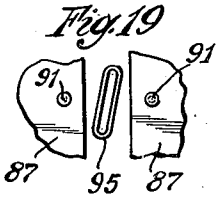


Fig. 19



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Patented Oct. 26, 1943 2,332,652

UNITED STATES PATENT OFFICE

2,332,652

MANUFACTURE OF BOXLIKE STRUCTURES

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Application May 10, 1940, Serial No. 334,321

15 Claims. (Cl. 217—43)

The present invention relates generally to collapsible structures such as boxes, crates, frames and the like, and more particularly to such structures with a closed chain of panels, which may be folded flat, opened up to a frame form, as for box-sides, and then subjected to a simple operation to rigidify the structure.

The entry of corrugated paper cartons into the container field has met with great success, in part due to convenience of form. For example, a flat folded carton structure may be opened up into box form and, by use of the bottom-forming flaps, it may be substantially rigidified as a box. This is all due to the facility with which corrugated paper board may be creased to form a folding structure, utilizing the flexibility of the material. Wood and other rigid materials lack the qualities of providing a flexible joint between joined panels.

It is an object of the present invention to provide a flexible joint between panels which may be either flat folded one onto the other, or be coextensive with each other, for flexing the joint to form an angular bend, or particularly the corner of a rectangular box.

It is another object of the invention to join a plurality of panels in a chain, which may be flat folded for opening to provide box sides.

It is a particular object of the invention to provide a band comprising the four sides of a rectangular box-like structure, with flexing joints, for flat folding and for opening to set up the rectangular structure.

It is a further object of the invention to join two substantially rigid panels with a space between adjacent edges, using flexible tensile bridging members, whereby the panels may be set in an angular relation and shifted in a direction parallel to the joint to tighten and to set the joint connection.

Other and ancillary objects and advantages of the invention will become apparent from the following description and explanation of the invention as it is set forth below in reference to the several embodiments thereof illustrated in the accompanying drawings, in which:

Fig. 1 is a rectified view of four panels linked together in a chain or band as shown in folded form in Fig. 2.

Fig. 2 illustrates a slightly opened form of the collapsed closed structure of Fig. 1, or collapsed rectangular box-sides.

Fig. 3 is a detailed view of the folded joint of Fig. 2 as it is opened up to a 90° corner.

Fig. 4 is an illustration of the form of Fig. 2 in completed box form, with a bottom applied, the fore corner of the box being the same as the corner shown in Fig. 3.

Fig. 5 shows a cover for the open-top box of Fig. 4.

Fig. 6 is a section taken on line 6—6 of Fig. 4 showing in detail the panel structure and the corner relations.

Fig. 7 is a section on line 7—7 of Fig. 6, showing detailed relations of the parts.

Fig. 8 is a modified form in rectified form like Fig. 1 showing open panels of a crate, which is operable by another modification to be set up to form a box with flush top and bottom edges.

Fig. 9 is a face view of one panel of the frame of the crate formed from the structure of Fig. 8.

Fig. 10 is a section on line 10—10 of Fig. 9, showing details of the crate structure.

Fig. 11 is a section on line 11—11 of Fig. 10, showing details of the crate structure, with a cover closure added.

Fig. 12 is a view of an end closure for the crate, at the top or bottom, as applied in one manner to the top in Fig. 11.

Fig. 13 is a modified form rectified as in Fig. 1, in which the crate-forming panels are of unequal height whereby to form a frame with one opening having flush edges, and another opening having edges as illustrated at the top of Fig. 4.

Fig. 14 is a view of one face of the frame formed from the structure of Fig. 13, showing a flush-edge top.

Fig. 15 is a section line on line 15—15 of Fig. 13, showing the panel structure.

Fig. 16 represents a platform for operating on the structure, and on the platform a tool which may also be a closure for the box or crate.

Figs. 17, 18 and 19 show modified forms of the bridges.

Insofar as Figs. 1 and 2 are concerned, the structures may be considered as four box-forming panels connected by wires to provide hinging joints for flat folding and setting up, like a paper carton. Such a structure lacks rigidity, and it must be carefully assembled with control of spacing to approach a satisfactory rigidity.

The present invention contemplates that such a structure opened in fashion comparable to a carton, be operated upon to shift adjacent panels along the joint, thereby to place the bridging member on a bias around the corner, to take up slack in the bridging connections, to put them under tension, and to cause them to cut into the material of the panel in adjusting all the parts to final position.

Because of the relative movement of the adjacent panels, they must be initially assembled to provide the desired box. The drawings show three variations of the possibilities whereby the open top or open bottom of the frame providing the box or crate, is made flush or irregular, as desired. Also, numerous variations of panel structure are shown by way of example, and not as limitations.

Referring particularly to Fig. 1, four substantially square panels 10, 11, 12 and 13 are shown in rectified form, with separating spaces 14, 15, 16 and 17, each bridged by connecting means which provide the joints.

The bridging means is a wire-like material having flexibility and tensile strength. One or more, as desired may be used to provide the bridging connection, and two are illustrated over each space. Although the bridging members are the same in Fig. 1, they operate in two classes which are separately indicated at 20 and 21. Each of the wires 20 and 21 has a body portion crossing the inter-panel space, which is the portion lying outside the box and around the corners. Each has a portion passing through the panel and clinched on the other side, as shown by the ends 22 which is part of a Z-like union with the panel, serving better to lock the wire in operating the structure.

The wires 20 connect those panels which lie adjacent each other in collapsed form (Fig. 2), and wires 21 connect those panels which lie superimposed. Because of the bending of wires 21 in the collapsed form, strain on the wire is relieved, and sharper bends are avoided, by forming one or more grooves in which the wire may lie. In the structure illustrated a groove 23 in but one panel 10 or 12 is sufficient. This is shown particularly at the wires 21 in panel 10 (Figs. 3 and 4).

It will be observed that the four panels of Fig. 1 are all the same height with edges alined. In opening the structure of Fig. 2, a simple bending of the wires follows, opening the bend in wires 21, and producing a bend in wires 20. The corners then look like the structure in Fig. 3, with flush edges. The wires do not completely lock the panels tightly together. To rigidify the structure one pair of parallel panels is shifted vertically with respect to the other by applied force to produce a relation as shown in Fig. 4, with one pair of panels lower than the other. This effects an elongation of the linear distance occupied by the wire on the surfaces of the panels (including the surface of the groove 23) with the result that the wire cuts into the corner, drawing the panels tightly together and setting the wire against displacement.

This operation is easily effected with the structure shown, by use of the bottom closure comprising the bottom panel 24 of veneer, plywood, cardboard, board or like material secured to the frame comprising two parallel members 25 and skid-cleats 26. The thickness of closure 24 and the frame 25—26 is such as to equal the amount of shifting desired between the pairs of panels. Also the cleats 26 are spaced to lie against the inside of the down-pushed panels 10 and 12. Thus, by setting the bottom closure under the panels 11 and 13 as folded in Fig. 3, and resting the whole on a platform, the panels 10 and 12 are forced by hand, hammer or press, downwardly to the platform. Then the bottom may be secured, as by use of nails 27 in panel 10 (Fig. 4).

Any suitable cover for the box of Fig. 4, may be provided, such as that shown in Fig. 5. This is adapted to fit between the upper ends of panels 11 and 13 flush with their top edges, and to lie over panels 10 and 12. The cover comprises frame members 30, 31, 32 and 33, and a veneer or plywood panel 34.

The detailed structure of the panels may vary in many ways. In those shown, each comprises a rectangular frame of which only the frame 35 of panel 10, and frame 36 of panel 11 are designated. Each frame has a closure panel closing it, of plywood veneer, cardboard or other sheet material. On the frames 36 of box panels 11 and 13, the closure panels 37 completely cover the frame to abut edgewise the frame members of box panels 10 and 12. The closure panels 38 of box panels 10 and 12 are shorter than the box panel by an amount equal to the thickness of the box panels 11 and 13, thus providing shoulders 40 to lie against the interior face of box panels 11 and 13. Thus, matched corners are secured.

The panels forming the box-frame on the top or bottom closures need not be solid panels, but may be one or all, open to provide whole or partial crate effects. Also, the panels may be secured together for collapse, in an offset relation, so that upon opening and shifting, the resulting box has one or more flush-edge openings.

In Fig. 8, a rectified view of panels is shown, which will form a crate frame with flush top and bottom edges. The panels are in different pairs, and are composed of two upright and three horizontal members, the latter being short to provide abutments, like the shoulders 40 in the box above described. The general arrangements and operations are the same.

The crate panels are designated generally 45, 46, 47 and 48, with the spacings 49, 50, 51 and 52 between them as they are formed into a collapsible chain or band by the bridges in the form of wires 53 and 54. Wires 53 are those which may lie open in the collapsed form to close in setting up the crate. Wires 54 are those which are folded over in the collapsed blank to open in setting up the crate. Grooves 55 are provided for the wires 54 in the collapsed position of the blank.

Panels 45 and 47 have the upright members 56, and the horizontal members 57. Panels 46 and 48 have the upright members 60 and the horizontal members 61. All the upright members 56 and 60 are of the same height to form the corners of the ultimate box, with their ends flush in the same plane. For this reason the panel pairs are offset in Fig. 8 by the amount of shifting desired or necessary according to the spacing between panels, the panel thickness, and the amount of cutting-in by the wires that is to be permitted. Horizontal members 57 are in length the full width of the panel. Horizontal members 61 terminate short of the edge of the panel, by the thickness of the members of the adjacent panel, or wherever the abutment is to be provided by the end of the member.

Fig. 12 represents any conventional closure for other or both ends of the crate frame formed from the structure of Figs. 8, 9 and 10. The closure is designated 63 and in Fig. 11 it is shown as a top closure. Although no closure is shown on the bottom, it is to be understood that where one is required, a suitable one such as closure 63 may be used.

Figs. 13, 14 and 15 show a modified crate struc-

ture, which may as well be applied to a closed box structure, in which one opening of the set-up frame has flush edges, and the other has one pair of panels extending beyond the tops of the other pair. The crate also illustrates a narrow elongated set-up frame. As illustrated, the top is a flush top, while the bottom has two longer sides, permitting a closure of the type shown in Fig. 4, which may be similarly used in shifting the panels after opening the collapsed form.

In Fig. 13, the panels **65**, **66**, **67** and **68** are secured together in a closed band (shown rectified), with spacings **70**, **71**, **72** and **73**, spanned by the bridging members. The bridges are represented by wires **74** which lie open in the collapsed blank, and wires **75** which are folded over in the collapsed blank. Grooves **76** are provided for the wires **75**. Panels **65** and **67** are longer than panels **66** and **68** by the amount of shifting to be used in setting up to rigid form. The crate sets up as shown in Fig. 14, with a flush top.

The structure of the panels may vary widely. As shown, the structure is much like the crate previously described, except that in addition to the frames **77** and **78** defining the two types of panels, the wider panels **65** and **67** have additional upright members **80**, which are thicker than the uprights of the frames **78**. The horizontal members **81** of panels **66** and **68**, are shortened to provide abutments for the inner faces of the horizontal members **82** of the frames **78** of panels **65** and **67**.

Fig. 16 shows a board **83** which is cut in width to fit between the wide panels **65** and **67**, in length to lie under the ends of the narrow panels **66** and **68**, and in thickness to equal the difference in height of the panels. Thus, the board **83** may be placed in position under the panels **66** and **68** after setting up and before shifting. Then the panels **65** and **67** may be forced down to the support on which the board rests. The board **83** may be considered not only as a closure, but also as a working tool, when on a platform **84**, to facilitate and control the shifting operation.

The foregoing illustrates the invention in its preferred and most useful embodiments in rectangular containers. It is of course to be understood that other polygonal forms may be made. In some of these, for example a triangular structure, it would be impossible to have a closed band which collapses to a flat form. This may readily be avoided by not having a closed circuit of the required panels. A single chain or several chained or single elements may be adapted to be coupled together to form the closed circuit in open form before shifting. A splice or couple may be made within the area of a panel, as by use of a common tongue and groove joint with means to lock the joint against separation, such as ordinary staples or wire stitching. However, it is preferred to have the splice at the joint, keeping the panels integral as shown. This is readily accomplished by a simple modification of the bridging construction.

In Figs. 17, 18 and 19, modified forms of bridging means are shown which permit use of them at one joint, or even at all the joints so that separate panels may be assembled.

In Fig. 17, two panels **86** and **87** are shown which come together at a joint to be bridged. Panel **86** carries a wire bridge **88** mounted therein as previously described with the retaining part **89** on the inner side of the panel. There is a loop **90** formed at the free end, which may be hooked over a headed nail **91** in panel **87**, prior to the shifting which tautens the bridge. In Fig. 18, the same nail-head panel **87** is shown, for a bridge **92** secured in panel **93**, at two ends to form a loop **94** for the nail **91**. In Fig. 19, two nail-head panels **87** are shown which may be bridged by a bridging circle or band of wire **95**. Band **95** may be of stiff single strand wire, or it may be of very flexible stranded wire, like picture wire. It is also to be understood that the permanently secured bridges, such as those described for Fig. 1, need not be of stiff single strand wire, and may be flexible stranded wire, with adequate fastening means, of which the nail-heads **91** are examples. The bridges need not be round wire, and may be in flat strip form. However, the round wire-like form is preferred to cut a groove into the panels in the shifting operation.

With respect to polygonal forms it is to be noted that in the case of an even number of sides, alternate panels have been described as shifted in the same direction with respect to the others. However, the direction of shifting is immaterial, so long as the panels and bridges are suitably designed. Thus, in the case of a triangular structure, two panels may be shifted with respect to the third, the two shifted ones being moved also with respect to each other, one being moved more than the other with respect to the third.

Numerous other modifications are contemplated as falling within the scope of the invention as expressed in the appended claims.

I claim:

1. A box-like frame structure having a plurality of substantially rigid panels forming the sides of the structure, at least one pair of adjacent panels at their mutual corner being relatively slidable in the direction of the joint, a bridging member of flexible tensile material passing around the corner and secured against tension with one end to each panel, said member extending on a bias around the corner and being under tension as a result of a previous sliding of the panels to produce the biased location of said member.

2. A box-like frame structure having a plurality of substantially rigid panels forming the sides of the structure, each set of adjacent panels at their mutual corners being relatively slidable in the direction of the joint, a bridging member of flexible tensile material passing around each corner and secured against tension with one end to each panel, said member extending on a bias around the corner and being under tension as a result of a previous sliding of the panels to produce the biased location of said member.

3. The method of forming a closed frame structure comprising a plurality of substantially rigid panels, which comprises placing said panels substantially in frame-forming position with edges of adjacent panels defining corners, connecting each set of adjacent corner defining panels with flexible tensile members having their ends secured against tension to the respective panels and passing around the corners, and shifting each panel relative to each adjacent panel in a direction in the line of the corner to tighten the said connecting members.

4. Two substantially rigid box-forming panels connected together with an intervening space between straight-line edges of the panels which edges are adapted to slide with respect to each other when in contacting position to form a closed corner of a structure, and at least one flexible tensile bridging member having one of

its two ends separately secured against tension to each panel in position to span said space and to pass around said corner, whereby said panels in contact in corner-forming position may be relatively shifted in a direction in the line of the corner to tighten the said bridging member and move it into a biased position around the corner, said panels being relatively offset in the direction of their corner relative to the ultimate relation in the completed box, and said bridging member extending substantially perpendicularly to the said edges in said offset relation.

5. A folding structure for forming a box or the like, comprising four substantially rigid panels joined together in a closed circuit and having interpanel spaces when considered in rectified position of any two adjacent panels, and flexible wire-like tensile bridging means secured to adjacent panels as connecting means joining them together each extending substantially perpendicularly to the length of the said bridged space whereby the resulting structure may be flat-folded and then openable to form a box-like frame, adjacent panels being connected together in said folded form in a relation offset with respect to the ultimate relation in the completed box-like structure thereby to permit relative shifting of adjacent panels into said ultimate relation in the direction of the joint-corner between them, the width of the interpanel space and the length of the bridging means being relatively such that upon forming a corner and shifting the adjacent panels into said ultimate position the bridging means is in tension and on a bias around the corner.

6. The structure of claim 5 in which the width of the space and the length of the bridging means is such that on forming a corner and shifting the panels the bridging means cuts into the material at the corner.

7. The structure of claim 5 in which one pair of opposite panels is constructed and arranged to fit against the edges of the other pair in the ultimate position and have internally of the structure means forming abutments for the inner faces of the said other pair.

8. The structure of claim 5 in which the panels at a corner are arranged such that the inner face of one panel lies against an edge of the other and carries an abutment for the inner face of said other.

9. The structure of claim 5 in which the flat-folded panels have one set of their edges alined, whereby one pair of opposite panels may be shifted equally with respect to the other pair and provide an open end with two opposite panels projecting equally from the remaining panels for receiving a closure member between the projecting panels.

10. The structure of claim 5 in which the flat-folded panels have both sets of their edges alined, whereby one pair of opposite panels may be shifted equally with respect to the other pair and provide two open ends each with two opposite panels projecting equally from the remaining panels for receiving a closure member between the projecting panels.

11. The structure of claim 5 in which at least one of the superimposed panels in the flat-folded form is grooved to accommodate a bridging means which joins the edges of the superimposed panels.

12. In a collapsible structure for forming a completed box-like frame, two substantially rigid panels secured together at their corner-forming edges with a space between them, and wire-like flexible tensile bridging means secured to each panel and spanning said interpanel space on the box-exterior side of said panels, the position of the panels in the structure being offset in the direction of the space between them relative to the ultimate position in the completed structure whereby the panels may be relatively shifted in forming a corner of the completed structure, the width of the interpanel space and the length of the bridging means being relatively such that upon forming a corner by shifting the adjacent panels into said ultimate position the bridging means is resultingly in tension and on a bias around the corner.

13. In a collapsible structure for forming a box-like frame, two substantially rigid panels having edges for meeting at the corner of a box, said panels being positioned in the collapsible structure in relation offset in the direction of said corner from the ultimate relation in the completed box, said panels being adapted at said edges for sliding one panel with respect to the other in box-forming position in the direction of the corner, a flexible wire-like tensile bridging member for passing around the said corner outside the box, means to secure an end of said bridging member to each panel when said member passes around the corner, whereby when said panels are slid relatively the said bridging member is tightened in its connection of panel to panel around the corner.

14. A chain of substantially rigid panels for forming the sides of a closed box-like structure by a folding and shifting operation, adjacent panels being separated by a space, and flexible wire-like tensile bridging members secured to the box-exterior sides of said panels over the spaces and extending substantially perpendicularly to the length of the spaces, said panels at the connected edges being adapted to slide relatively in the direction of the joint between them when in frame-forming position, whereby the bridging members are tightened over the resulting corners, the ends of the panels being positioned in the chain such that after shifting the panels the ends cooperate to form both the top and bottom of the box-like structure.

15. A folding structure for forming a box or the like by a folding and a shifting operation, comprising four substantially rigid panels joined together in a closed circuit with interpanel spaces when any two adjacent panels are considered in rectified position, and flexible tensile bridging means secured to and connecting panels each extending substantially perpendicularly to the length of the bridged space whereby the resulting structure may be flat-folded and then openable to form a box-like frame, adjacent panels being connected together in said folded form in a relation offset with respect to the ultimate relation in the completed box-like structure thereby to permit relative shifting of adjacent panels into said ultimate relation in the direction of the joint-corner between them, the width of the interpanel space and the length of the bridging means being relatively such that upon forming a corner by shifting the adjacent panels into said ultimate position the bridging means is resultingly in tension and on a bias around the corner.

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