Aug. 5, 1952 R. B. MELLER 2,605,955

SELF-LOCKING FOLDING BOX

Filed Dec. 26, 1947 2 SHEETS—SHEET 1

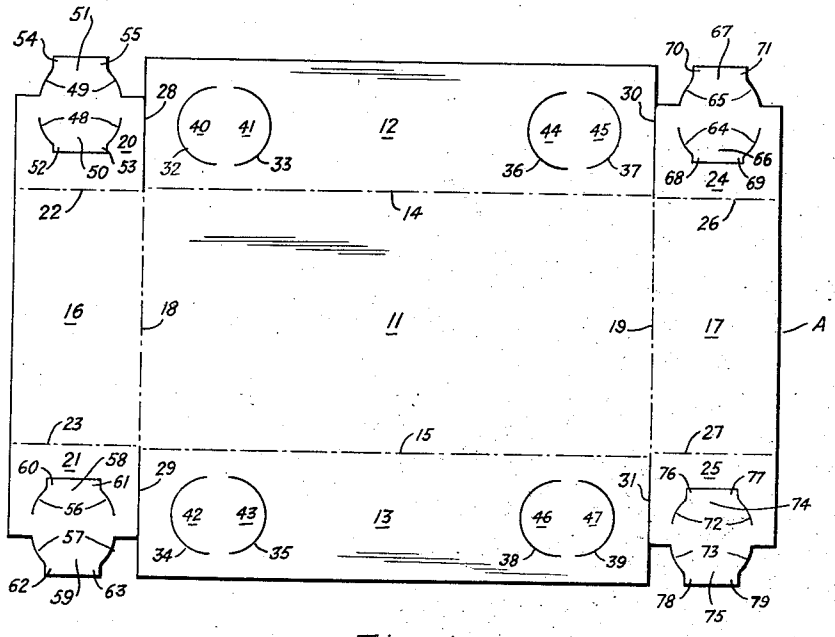


Fig. 1

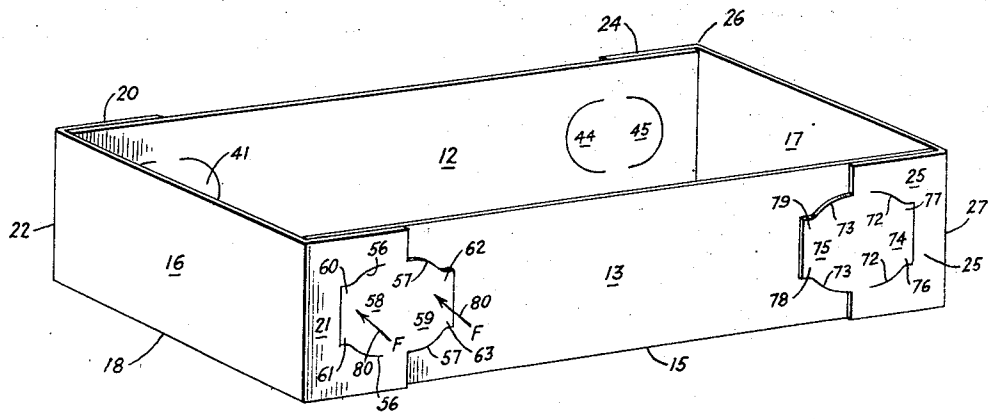


Fig. 2

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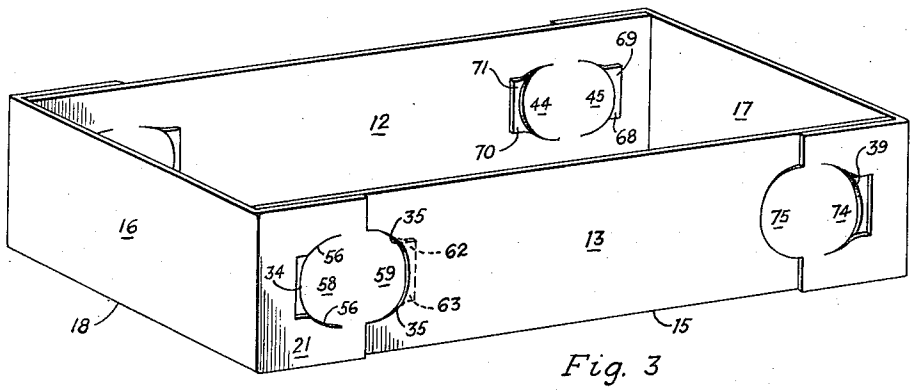


Fig. 3

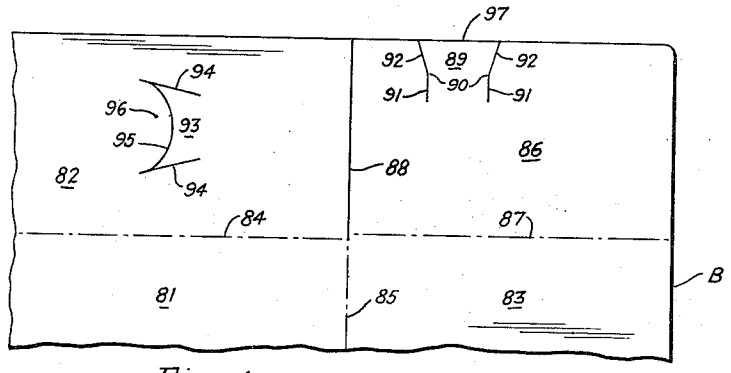


Fig. 4

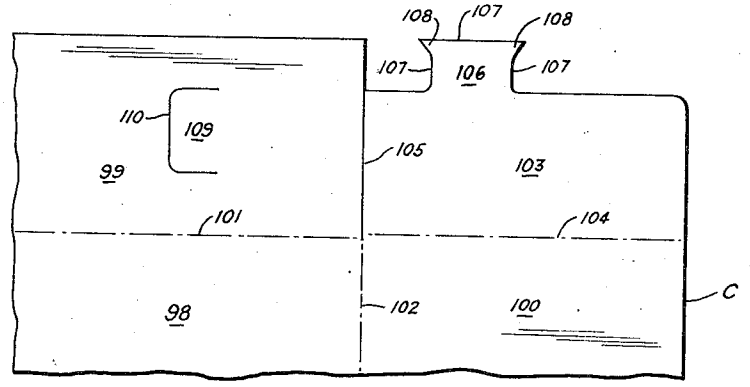


Fig. 5

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UNITED STATES PATENT OFFICE

2,605,955

SELF-LOCKING FOLDING BOX

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Application December 26, 1947, Serial No. 793,817

6 Claims. (Cl. 229—35)

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This invention relates to improvements in cartons, boxes, trays, or other structures made from blanks of cardboard, paperboard, or other suitable foldable sheet material, hereinafter collectively referred to as "boxes" or "folding boxes."

The invention provides, among other features, an improved interlock for rigidly connecting together overlapping portions of a blank of foldable sheet material. The improved interlock requires no glue, staples, rivets or other conventional securing means, but is entirely formed from and by the stock of the sheet material itself and may be brought into inter-engaging position either by hand or by automatic high speed box machinery of relatively simple construction. It provides a box structure which, after assembly, is free from play or lost motion and has the strength and rigidity of a glued box, but can be set up at a much faster rate since no adhesive bond is formed and no time for setting of adhesive is required.

The interlock formed according to the present invention owes its strength and rigidity to the fact that the interlock is formed by abutting cut edges which interengage not in point-to-point fashion as do the conventional hook locks, but in edge-to-edge fashion so that a cut edge of substantial length or area of one panel engages a cut edge of comparable size on another panel. This is accomplished by providing a deflectable portion on at least one panel which is flexed out of the plane of that panel into the plane of another panel whereby an edge of the deflectable portion of the one panel engages an edge of the other panel. In order to prevent disengagement of the interlock due to the tendency of the board to return to its initial position after flexing, by reason of its inherent stiffness, means are provided for maintaining or arresting one portion of the lock in deflected position so that it cannot return to its original position. This is accomplished by certain locking tabs which are so arranged with respect to a cut edge on a cooperating panel that they extend beyond the confines of that edge. The last named edge is moved past the locking tab on assembly, and thereafter the tabs prevent movement of the edge past the tab by reason of the stiffness of the board.

The interlock owes its strength and rigidity primarily to the fact that forces exerted on it in the ordinary use of the folding box, for example by pressure of box contents against the walls of the folding box are exerted substantially in the plane of the interlocked box panel portion so that the stock at the interlock is subjected to compressive stress and not, as in the conventional hook lock, for example, to tear stress. Compressive stress is the stress which the board resists better than any other kind of stress.

The invention offers the particular advantage

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of making it possible to select the dimensions of the interengaging edges according to the load which is to be sustained so that the relative compressive stress per area unit of interengaging edges may be maintained low. This makes interlocks embodying the invention superior to interlocks of the conventional point-to-point engagement type where, as is easy to see, the compressive stress at the point of interlock increases with the load, frequently to a point where the board is deformed or tears.

The various objects, features and advantages of the invention will appear more fully from the detailed description which follows accompanied by drawings showing, for the purpose of illustration, preferred embodiments and applications of the invention.

The invention also consists in new and improved details of construction hereinafter set forth and claimed.

Although the characteristic features of this invention which are believed to be novel will be particularly pointed out in the claims appended hereto, the invention itself, its objects and advantages, and the manner in which it may be carried out may be better understood by referring to the following description taken in connection with the accompanying drawings forming a part of it in which:

Figure 1 is a plan view of a flat box blank embodying the invention, the inside surface of the blank facing the observer;

Figure 2 is a perspective view of the blank of Figure 1 after folding of the blank into hollow box form, but before engagement of the interlocks;

Figure 3 shows the box of Figure 2 after completion of the interlock;

Figure 4 is a fragmentary plan view of a corner portion of a blank embodying a lock of modified configuration; and

Figure 5 is a fragmentary plan view of a corner portion of a blank embodying another lock of modified configuration.

In the following description and in the claims, various structural details will be identified by specific names for convenience. The names, however, are intended to be as generic in their application as the art will permit. Corresponding reference characters refer to corresponding parts in the several figures of the drawings.

In the drawings accompanying, and forming part of, this specification, certain specific disclosure of the invention is made for the purpose of explanation of broader aspects of the invention, but it is understood that the details may be modified in various respects without departure from the principles of the invention, and that the invention may be applied to structures other than the ones shown.

The blank A shown in Figure 1 is substantially rectangular in outline and may be cut from stock of larger size with a minimum waste of material. The blank may be cut and scored in multiple from a large sheet or roll of paperboard or other suitable foldable material on an automatic cutting and scoring machine. Only one side of the blank need be decoratively finished or imprinted since only one side of the blank appears as the outside of the finished box.

The blank A is subdivided by several scored fold lines to provide a bottom panel 11 to which side wall panels 12 and 13 are hinged along side fold lines 14 and 15. End panels 16 and 17 are hingedly connected to the bottom panel 11 along end fold lines 18 and 19, respectively. Lock panels 20 and 21 are hingedly connected to the end panel 16 along fold lines 22 and 23, respectively. The fold lines 22 and 23 are either aligned with, or parallel and slightly offset with respect to, the side fold lines 14 and 15 to compensate for the thickness of the board in the succeeding folding operations, as is customary in the art.

Lock panels 24 and 25 are hingedly connected to the end panel 17 along fold lines 26 and 27 in a similar manner as just described. The lock panels 20, 21, 24 and 25 are separated from the side panels 12 and 13 by cuts 28, 29, 30 and 31, respectively, each of the cuts extending to the intersections of fold lines 14 and 15 with the fold lines 18 and 19.

According to the present invention, glueless interlocks are provided for the several panels. These interlocks comprise internal cut lines 32, 33, 34, 35, 36, 37, 38 and 39, whereby internal tongues 40, 41, 42, 43, 44, 45, 46 and 47 are formed in the panels, each tongue being deflectable with respect to the remainder of the panel from which it is cut.

The cut edges formed in the stock of the blank by the several internal cuts 32 to 39, inclusive, provide cut edges with which cut edges of corresponding configuration on other portions of the blank may be brought into abutting position in order to provide an interlocking engagement therebetween. Such interengaging cut edges may be internal or external edges as will presently appear.

Internal cut edges 48 are formed on the lock panel 20, the curvature of the cut 48 being such that if the lock panel 20 lies face to face with the side wall panel 12, the cut edges 48 are in substantial coincidence with portions of the internal cut 32 in the side wall panel 12.

Similarly, external cut edges 49 are formed on the lock panel 20 to correspond in outline with portions of the internal cut 33 in the side wall panel 12.

The cuts 48 and 49 border an internal and an external tongue 50 and 51, respectively, which like tongues 40 and 41, are deflectable with respect to the remainder of the lock panel 20. The configuration of the lock tongues 50 and 51 with respect to the cuts 32 and 33 in the side wall panel 12, however, is such that certain portions of the tongues 50 and 51 extend beyond the confines of the tongues 40 and 41. The protruding portions are lock tabs 52, 53, 54 and 55 which resist passage of the lock tongues 50 and 51 through the apertures formed on the side wall panel 12 when the corresponding internal tongues 40 and 41 are deflected.

The lock flap design of the other lock panels 21, 24 and 25 corresponds to the design just described. Internal and external cut edges 56 and 57 form lock tongues 58 and 59 on the lock panel 21, and lock tabs 60, 61, 62 and 63 are formed on the lock tongues 58 and 59.

Similarly, internal and external cut edges 64 and 65 form lock tongues 66 and 67 on the lock panel, the said lock tongues being provided with lock tabs 68, 69, 70 and 71.

Finally, internal and external cut edges 72 and 73 form lock tongues 74 and 75 on the lock panel 25, the lock tongues being provided with lock tabs 76, 77, 78 and 79.

The assembly of the blank A into hollow box form may proceed as follows: The side panels 12 and 13 are first folded about their respective side fold lines 14 and 15 into upright position with respect to the bottom panel 11 as shown in Figure 2. The end panels 16 and 17 are also folded about their respective end fold lines 18 and 19 into upright position with respect to the bottom panel 11. Thereafter, or substantially simultaneously with the folding of the end panels 16 and 17, the lock panels 20, 21, 24 and 25 are folded with respect to the end panels 16 and 17 to which they are hinged about the fold lines 22, 23, 26 and 27 until they lie face to face with the side wall panels 12 and 13 as indicated in Figure 2. In this position, portions of the cut edges of the lock panels lie in substantial coincidence with the internal cuts in the respective side wall panels 12 and 13.

The interlocks may now be formed either by manually exerted pressure or preferably by pressure exerted by a mechanical assembly device against the several lock tongues in order to force the tongues from the position indicated in Figure 2 in which the respective lock tabs overlie the side wall panels 12 and 13, into a position in which the lock tabs underlie the side wall panels, that is, extend towards the inside of the box.

Considering one corner of the box for the purpose of illustration, if force F is exerted against the lock tongues 58 and 59 in the direction of the arrows 80, that is, substantially normal with respect to the surface of the tongues and if, at the same time, the side wall panel is sustained by pressure exerted in approximately the opposite direction near the internal cuts 34 and 35, the lock tabs 60, 61, 62 and 63 resiliently snap to the inside of the box as is apparent from Figure 3.

In this position, the outer curved edges 48 and 49, 56 and 57, 64 and 65, and 72 and 73, lie in abutment with the edges of the internal cut 40, 41, 42, 43, 44, 45, 46 and 47, respectively, in the side wall panels 12 and 13 and lock the several lock panels 20, 21, 24 and 25 with respect to the side wall panels firmly against movement of the end panel 16 and 17 about their fold lines 18 and 19. The interlock is positive and is effective to prevent movement of the end wall panels either towards the inside of the box and towards the outside as would be the case if box contents bear against the walls.

Outfolding of the side wall panels 12 and 13 under pressure of the box contents is prevented by the lock panels by engagement of the ends of side wall panels 12 and 13 with the lock panels 20, 21, 24 and 25 immediately adjacent their respective fold lines 22, 23, 26 and 27.

The locking operation by which the locking tabs are forced from the outside of the side walls 12 and 13 to the inside may be performed manually or mechanically. The dimensions of the several lock tabs as represented, for example, by tabs 60, 61, 62 and 63 are so selected and the

force F is applied in such a place as to cause the lock tabs to snap past the internal cut edgs in the side wall panels towards the inside without breaking or permanently creasing the board so that the lock tabs remain substantially unweakened to prevent disengagement of the interlocks by resisting the tendency of the several deflected tongues both in the side wall panel and in the lock panel to return from the deflected position into the plane of the panels from which they were cut.

In the form of interlock shown in Figures 1 to 3, the lock tabs are on the lock tongues of the lock panels. A similar snap action interlock may be formed by putting them on the side walls and leaving them off the lock panels. This will become apparent from a consideration of a modification of the locking means as illustrated in Figure 4. Also, it will be noted that whereas in Figures 1 to 3, two separate interlocks were provided for each box corner, one lock is sufficient. In Figure 1, for example, the external locking tongue 51 interlocks with the cut edge 33 and the internal locking tongue 50 interlocks with the cut edge 32. Evidently, one of the two locks may be omitted and, for example, only an external tongue such as 51 be interlocked with an internal cut as represented by edge 33. This simplified modification is shown in Figure 4 illustrating a box corner of a blank.

The blank B comprises a bottom panel 81 to which a side wall panel 82 and an end panel 83 are hingedly connected along fold lines 84 and 85. A lock panel 86 is hingedly connected to the end panel 83 along a fold line 87. The lock panel 86 is severed from the side wall panel 82 by a cut 88 extending to the intersection of fold lines 85 and 87.

An external lock tongue 89 is formed on the lock panel 86 by a pair of cuts 90 extending into the body of the panel 86 from an outside edge. The cuts 90 may comprise substantially parallel portions 91 to insure flexibility of the locking tongue 89 and outwardly flaring portions 92 which provide cut edges on the tongue to interengage with similarly disposed edges in the side wall panel 82.

The side wall panel 82 has an internal tongue 93 formed therein bordered by two cuts 94 so directed as to coincide with cuts 92. A further arcuate cut 95 provides a lock tab 96 on the side wall panel 82.

The blank B is folded in a manner similar to blank A. A corner is formed of the illustrated portion of blank B by folding it at the fold lines 84, 85 and 87 to bring the lock panel 86 face to face with the side wall 82 in which position the flaring portions 92 of the external cut of the lock panel 86 coincide with the cuts 94 in the side wall.

An interlock is formed in either of two ways: It is either possible to force the lock tongue 89 through the internal cut 94, 95 in the side wall panel, as explained in connection with blank A, whereby the outer edge 97 of the lock tongue snaps past the lock tab 96. However, the interlock may also be formed by deflecting the lock tab 96 outwardly and guiding the lock tongue 89 underneath it while the blank is being folded about the fold line 85 with panels 82 and 86 in nearly face-to-face position.

In either event, the outer edges 92 of the lock tongue 89 engage the internal edges 94 in the side wall 82 and the lock tab 96 securely maintains or arrests the lock tongue 89 in the flexed position in which it engages the side wall 82.

The blank C shown in Figure 5 comprises a bottom panel 98 to which a side wall panel 99 and an end wall panel 100 are hingedly connected along fold lines 101 and 102. A lock panel 103 is hingedly connected to the end panel 100 along a fold line 104, the lock panel 103 being severed from the side wall panel 99 by a cut 105 extending to the intersection of the fold line 102 and 104.

An external lock tongue 106 is formed on the lock panel 103 bordered by external cuts 107. The configuration of the external cuts 107 is such as to provide lock tabs 108 on the tongue 106.

The side wall panel 99 has an internal tongue 109 therein formed by a substantially U-shaped cut 110.

The blank C is folded in a manner similar to blanks A and B. A corner is formed of the illustrated form of blank C by folding it at the fold lines 101, 102 and 104 to bring the lock panel 103 face to face with the side wall 99 in which position the lateral edges of the external tongue 106 coincide with the legs of the U-shaped cut 110. In the assembled position, the edges 107 coincide with the edges of the cut 110 except at the lock tabs which extend beyond the confines of the U-shaped cut.

The interlock is formed by pressure exerted approximately at right angles against the lock tongue 106 to deflect the tongue together with the internal tongue 109 which it overlies until the lock tabs 108 snap past the edge formed by the U-shaped cut 110. In this position, the lateral edges provided by the cut 107 engage the internal edges provided by the legs of the U-shaped cut 110 and interlock the several panels in corner forming position.

The invention thus provides a convenient, inexpensive and secure interlock between carton panels which, with respect to rigidity and reliability is comparable to a glued connection.

The invention is adapted to boxes designed for manual assembly as well as to boxes designed for automatic assembly on high speed machinery.

The present invention may be practiced on simple and relatively inexpensive equipment which may be operated at slow or high rates of speed, may be started and stopped, accelerated or slowed down according to production requirements without any effect on the uniformity and quality on the interlock formed. This is a particular advantage over glued connections requiring carefully timed automatic machinery in order to form reliable glue bonds.

Because of these features, the invention lends itself admirably to mass production of boxes with relatively inexpensive equipment.

Whereas the present invention has been explained by reference to boxes in which the wall panels form ninety degree angles with respect to one another, it is quite apparent that the invention may also be applied to the manufacture of boxes in which the angle between panels is greater or less than ninety degrees. Also, it is obvious that instead of providing the end panel of a box with a lock panel which is interlocked with a side wall the lock panel may be hinged to the side wall and locked to the end wall and, quite generally, be hinged to any wall and locked to another wall which lies face to face with the lock panel. Such applications are evident to persons skilled in the art after becoming acquainted with the principles of the present invention.

Thus, various additions, omissions, modifications, substitutions and other changes may be made without departing from the spirit and from the essence of this invention.

What is claimed is:

1. A folding box made from a sheet of foldable stock and comprising a main panel, a first wall panel hingedly connected to said main panel along a first fold line, a second wall panel hingedly connected to said main panel along a second fold line extending at an angle with respect to said first fold line, said panels being foldable about said fold lines with respect to one another into a position in which they form a box corner, and a lock flap hingedly connected to one of said wall panels and foldable with respect thereto into a position face-to-face with the other of said wall panels when said panels are in corner forming position, and an interlock between said lock flap and the other of said wall panels, the interlock comprising two cut edges of bent outline in said other panel presenting an internal cut edge in said other panel, and a locking tongue on said flap, said locking tongue being bordered by a bordering cut edge, a portion of said internal edge coinciding with a portion of said bordering cut edge when said two panels lie in corner forming position in which they are to be interlocked, said flap overlying said other panel, said locking tongue having a portion of increasing width and being deflectable with respect to the remainder of said flap, one of said cuts being so shaped as to present at least one projecting tab obstructing passage of said locking tongue through said internal cut, said tab being sufficiently small to permit said tongue to snap past the edge presented by the other cut without permanent creasing of the stock, when said locking tongue is forced through said internal cut by force exerted against said tongue in a direction substantially normal with respect to said tongue, whereby said tongue is brought into edge-to-edge engagement with said other panel, said locking tongue being so oriented that, if there were displacement between said panels in the direction in which the interlock is to be effective, portions of increasing width of the locking tongue would tend to move into engagement with said internal cut edge.

2. A folding box made from a sheet of foldable stock and comprising a main panel, a first wall panel hingedly connected to said main panel along a first fold line, a second wall panel hingedly connected to said main panel along a second fold line extending at an angle with respect to said first fold line, said panels being foldable about said fold lines with respect to one another into a position in which they form a box corner, and a lock flap hingedly connected to one of said wall panels and foldable with respect thereto into a position face-to-face with the other of said wall panels when said panels are in corner forming position, and an interlock between said lock flap and the other of said wall panels, the interlock comprising two cut edges of bent outline in said other panel forming an internal deflectable tongue therein, said cut presenting an internal cut edge in said other panel, and a locking tongue on said flap, said locking tongue being bordered by an external cut edge, a portion of said internal edge coinciding with a portion of said external bordering edge when said two panels lie face to face in corner forming position in which they are to be interlocked, said flap overlying said other panel, said locking tongue having a portion of increasing width and being deflectable with respect to the remainder of said flap substantially into the plane of said other panel and

the said internal tongue being deflectable out of the plane of its panel towards the inside of the box, one of said cuts being so shaped as to present at least one projecting tab obstructing passage of said locking tongue through said internal cut, said tab being sufficiently small to permit said tongue to snap past the edge presented by the other cut without permanent creasing of the stock, when said locking tongue is forced through said internal cut by force exerted against said tongue in a direction substantially normal with respect to said tongue, whereby said tongue is brought into edge-to-edge engagement with said other panel, said locking tongue being so oriented that, if there were displacement between said panels in the direction in which the interlock is to be effective, portions of increasing width of the locking tongue would tend to move into engagement with said internal cut edge.

3. A folding box made from a sheet of foldable stock and comprising a main panel, a first wall panel hingedly connected to said main panel along a first fold line, a second wall panel hingedly connected to said main panel along a second fold line extending at an angle with respect to said first fold line, said panels being foldable about said fold lines with respect to one another into a position in which they form a box corner, and a lock flap hingedly connected to one of said wall panels and foldable with respect thereto into a position face-to-face with the other of said wall panels when said panels are in corner forming position, and an interlock between said lock flap and the other of said wall panels, the interlock comprising two cut edges of bent outline in said other panel presenting an internal cut edge in said other panel, and a locking tongue on said flap, said locking tongue being bordered by an external cut edge, a portion of said internal edge coinciding with a portion of said external edge when said two panels lie face to face in corner forming position in which they are to be interlocked, said flap overlying said other panel, said locking tongue having a portion of increasing width and being deflectable with respect to the remainder of said flap, said locking tongue having at least one projecting ear obstructing passage of said tongue through said internal cut, said ear being sufficiently small to permit said tongue to be resiliently flexed to snap past the edge formed by said internal cut without permanent creasing of the stock, when said locking tongue is forced through said internal cut by force exerted against said tongue in a direction substantially normal with respect to said tongue causing said tongue to snap from a position entirely overlying said other panel into a position partially underlying said other panel, whereby said tongue is maintained in edge-to-edge engagement with said one panel, said locking tongue being so oriented that, if there were displacement between said panels in the direction in which the interlock is to be effective, portions of increasing width of the locking tongue would tend to move into engagement with said internal cut edge.

4. A folding box made from a sheet of foldable stock and comprising a main panel, a first wall panel hingedly connected to said main panel along a first fold line, a second wall panel hingedly connected to said main panel along a second fold line extending at an angle with respect to said first fold line, said panels being foldable about said fold lines with respect to one another into a position in which they form a box corner, and a lock flap hingedly connected to one of said

wall panels and foldable with respect thereto into a position face-to-face with the other of said wall panels when said panels are in corner forming position, and an interlock between said lock flap and the other of said wall panels, the interlock comprising two cut edges of bent outline in said other panel forming an internal deflectable tongue therein, said cut presenting an internal cut edge in said other panel, and a locking tongue on said flap panel, said locking tongue being bordered by an external cut edge, a portion of said internal edge coinciding with a portion of said external edge when said two panels form a box corner, said flap overlying said other panel, said locking tongue on said flap being deflectable with respect to the remainder of said flap substantially into the plane of said other panel and the said internal tongue being deflectable out of the plane of its panel towards the inside of the box, said internal cut being so shaped as to form a projecting tab on said other panel obstructing passage of said locking tongue, said tab being sufficiently small to permit said tongue to snap past it without permanent creasing of the stock, when said locking tongue is forced through said internal cut by force exerted against said tongue in a direction substantially normal with respect to said tongue causing said tongue to snap from a position entirely overlying said other panel into a position partially underlying said other panel, whereby said tongue is brought into edge-to-edge engagement with said other panel, said locking tongue being of increasing width in the sense that its narrowest portion is leading if there were displacement between the panels in the direction in which the interlock is to be effective.

5. A folding box made from a sheet of foldable stock and comprising a main panel, a first wall panel hingedly connected to said main panel along a first fold line, a second wall panel hingedly connected to said main panel along a second fold line extending at an angle with respect to said first fold line, said panels being foldable about said fold lines with respect to one another into a position in which they form a box corner, and a lock flap hingedly connected to one of said wall panels and foldable with respect thereto into a position face to face with the other of said wall panels when said panels are in corner forming position, and an interlock between said lock flap and the other of said wall panels, the interlock comprising two cut edges of bent outline formed on said lock flap and the other of said wall panels, respectively, one of said cut edges bordering a locking tongue on said lock flap, portions of said two cut edges coinciding when said other panels and lock flap lie face to face in the position in which they are to be interlocked, said locking tongue being deflectable with respect to the remainder of the lock flap substantially into the plane of said other wall panel, the locking tongue being so shaped as to increase in width with an increase in distance from the hinge line of the lock flaps, one of the cut edges being so shaped as to form at least one projecting tab obstructing free passage of said locking tongue through the internal cut in said other wall panel, said tab being sufficiently small to snap past the edge presented by one of the cuts without permanent creasing of the stock, when said locking tongue is forced through said internal cut by force exerted against said tongue in a direction substantially normal to the surface of said tongue causing said locking tongue to snap from a position entirely overlying said other panel into a position partially underlying said other panel, whereby said tongue is retained by said tab in a position of edge-to-edge engagement with said other panel.

6. A folding box made from a sheet of foldable stock and comprising a main panel, a first wall panel hingedly connected to said main panel along a first fold line, a second wall panel hingedly connected to said main panel along a second fold line extending at an angle with respect to said first fold line, said panels being foldable about said fold lines with respect to one another into a position in which they form a box corner, and a lock flap hingedly connected to one of said wall panels and foldable with respect thereto into a position face to face with the other of said wall panels when said panels are in corner forming position, and an interlock between said lock flap and the other of said wall panels, the interlock comprising, an internal cut of bent outline in said other wall panel forming an internal deflectable tongue therein, said cut forming an internal cut edge in said other panel, and a locking tongue on said lock flap, said locking tongue being bordered by a cut edge, a portion of said internal edge coinciding with said bordering cut edge when said lock flap lies face to face with said other wall panel in which position it is to be interlocked with said other wall panel, said locking tongue having a portion of increasing width with respect to increasing distance from the hinge line of the lock flap, said locking tongue being deflectable substantially into the plane of said other panel and the said internal tongue being deflectable out of the plane of its panel, one of the two cuts being so shaped as to form a projecting tab obstructing free passage of said locking tongue through said internal cut in said other wall panel, said tab being of a size sufficiently small for resilient flexing without permanent creasing of the stock by a movement of said locking tongue into interengaging position with said internal edge by a force exerted substantially normal with respect to the surface of said tongue causing said locking tongue to snap from a position entirely overlying said other panel into a position partially underlying said other panel in which position it then retains said locking tongue to resist disengagement.

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