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(54) MACHINE FOR FORMING BASES OR LIDS FOR PRISM-SHAPED BOXES BY FOLDING AND JOINING DIE-CUT SHEETS

(57) The machine for forming prismatic box bases or lids by bending and attaching die cut plates comprises a molding cavity (11) with an inlet opening and a plunger (70) moved by a drive mechanism between an extracted position and an introduced position with respect to the molding cavity (11). The molding cavity (11) comprises an integer number greater than two of simple wall bending elements (12) and an equal integer number greater than two of composite wall bending elements (13, 13X, 13Y) arranged around the path of the plunger and intercalated with one another defining a polygon, and an equal integer number greater than two of pairs of pressure blades (14) arranged such that the pressure blades (14) of each pair flank one of the composite wall bending elements (13, 13X, 13Y). The pressure blades (14) are moved by blade actuators (15) between a retracted position and a pressure position.

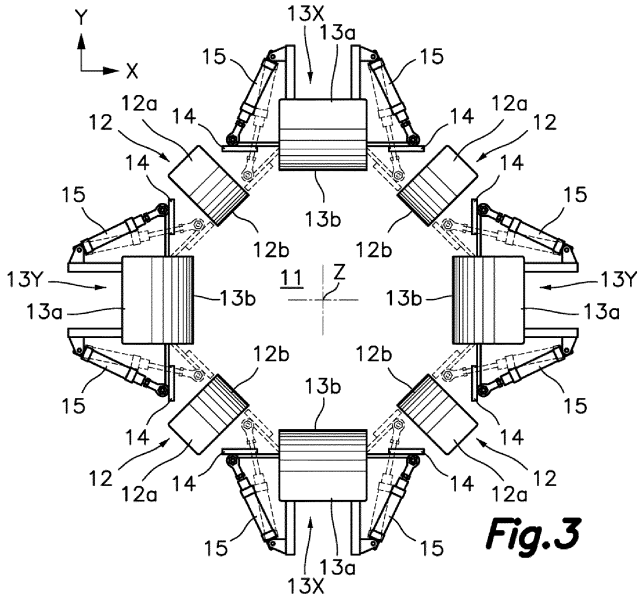

Fig.3

EP 3 305 514 A1

Description

Field of the Art

[0001] The present invention relates to a machine for forming prismatic box bases or lids from bending and attaching initially planar die cut plates made of a sheet of relatively rigid material, such as, for example, cardboard, corrugated cardboard, plastic, corrugated plastic, and the like. In one of its possible applications, known in the sector as a "bag in box", the mentioned prismatic boxes are usable for containing hermetically sealed and optionally pasteurized flexible sacks or bags filled with a liquid, ground or shredded product.

Background of the Invention

[0002] Machines for forming boxes or box lids, generally having a rectangular base, by bending and attaching initially planar die cut plates made of a sheet of relatively rigid material, such as cardboard, corrugated cardboard, plastic, corrugated plastic, and the like, are known.

[0003] Patent documents ES 235835 and US 2798416 describe respective examples of machines for forming boxes having a rectangular base by bending and attaching die cut plates essentially comprising a molding cavity that is fixed with respect to a structure and provided with an inlet opening on which the die cut plates are placed one by one, and a plunger moved in a guided manner by a drive mechanism along a path with respect to the structure between an extracted position, in which the plunger is outside the molding cavity, and an introduced position, in which the plunger is inside the molding cavity. In its movement between the extracted position and the introduced position, the plunger presses against a portion of the die cut plate which is arranged on the inlet opening of the molding cavity and inserts it into the molding cavity, so different parts of the die cut plate are bent and attached in cooperation with several either inert or active elements of the molding cavity to form a box or a box lid.

[0004] In the machines of the mentioned patent documents ES 235835 and US 2798416, the molding cavity has, on two of its opposite sides, two corresponding pairs of elements, and the two elements of each pair are mounted in a sliding manner on a guide and have nuts fixed thereto coupled respectively to two threaded sections having opposite thread directions of a spindle parallel to the guide, such that a rotation of the spindle causes a mutual approaching or distancing of the two elements of each pair to adapt the molding cavity to boxes having different dimensions. Nevertheless, these machines are not capable of forming bases or lids for prismatic boxes having six, eight or more sides by bending and attaching die cut plates.

[0005] In turn, patent documents DE 202004005667 U1, ES 2394186 T3 and ES 1057235 U disclose respective bases or lids for prismatic boxes having an octagonal base formed from bending and attaching parts of a die cut plate. The die cut plate has an octagonal base wall demarcated by eight bending lines and eight side walls, each of which extends from one of the eight sides. The eight side walls comprise four side walls with side flaps alternating with four side walls with an upper flap. Each of the side walls with side flaps has two attachment flaps extending from side edges thereof, and each of the side walls with an upper flap has a retaining flap extending from an edge thereof opposite the corresponding bending line, the height of the retaining flap being equivalent to the height of the wall.

[0006] According to the mentioned patent documents DE 202004005667 U1, ES 2394186 T3 and ES 1057235 U, the base or lid is formed by manually bending the side walls to a position perpendicular to the base wall, then by bending the attachment flaps, then by bending the retaining flaps above the attachment flaps, and finally by introducing tabs projecting from edges of the retaining flaps in corresponding openings formed in the base wall in positions adjacent to the bending lines, such that the attachment flaps are trapped between the retaining flaps and the corresponding side walls. Nevertheless, a drawback of this construction is that the manual formation of bases or lids is relatively tedious and requires a lot of manual labor. Another drawback is that the need to provide the retaining flaps with a height equivalent to the height of the wall involves a considerable extension of the die cut plate, resulting in a high consumption of sheet material.

[0007] Automatic machines for forming prismatic box bases or lids from die cut plates such as the one described, for example, in mentioned patent document ES 2394186 T3, are known.

Disclosure of the Invention

[0008] The present invention contributes to mitigating the preceding and other drawbacks by providing a machine for forming prismatic box bases or lids by bending and attaching die cut plates where each of the die cut plates comprises a base wall in the form of a polygon with an even number of sides greater than four, a plurality of simple side walls and composite side walls alternating with one another and connected to the sides of the base wall by respective bending lines, and attachment flaps connected to opposite side edges of the composite side walls.

[0009] The machine of the present invention comprises a structure, a molding cavity that is fixed with respect to the structure, the molding cavity having an inlet opening and side elements defining a polygon having an even number of sides greater than four consistent with the die cut plate, a plunger moved in a guided manner by a drive mechanism along a path parallel to a first direction Z with respect to the structure between an extracted position, in which the plunger is outside the molding cavity and an introduced position, in which the plunger is inside the molding cavity.

[0010] During operation, and more specifically when the plunger is operated from the extracted position to the introduced position, the plunger presses against a portion of an initially planar die cut plate arranged on the inlet opening of the molding cavity and inserts the die cut plate into the molding cavity, thereby causing different parts of the die cut plate to be bent and attached in cooperation with the side elements of the molding cavity to form a prismatic box base or lid. The first direction Z in which the plunger moves is usually a vertical direction, although this is not an essential condition.

[0011] The side elements of the molding cavity of the machine of the present invention comprise an integer number greater than two of simple wall bending elements arranged around the path of the plunger, an equal integer number greater than two of composite wall bending elements also arranged around the path of the plunger in positions intercalated between the simple wall bending elements, and an equal integer number greater than two of pairs of pressure blades arranged such that the pressure blades of each pair flank one of the composite wall bending elements.

[0012] Each simple wall bending element has an inlet bending surface bending a simple side wall of the die cut plate and a front surface parallel to the first direction Z keeping this simple side wall in a position perpendicular to a base wall of the die cut plate. Each composite wall bending element has an inlet bending surface bending a composite side wall of the die cut plate and a front surface parallel to the first direction Z keeping this composite side wall in a position perpendicular to the base wall of the die cut plate.

[0013] The mentioned pressure blades are moved by blade actuators between a retracted position, in which the pressure blades are approximately aligned with or more withdrawn than the front surface of the adjacent composite wall bending elements, and a pressure position, in which the pressure blades are approximately aligned with or more advanced than the front surface of the adjacent simple wall bending elements. With the movement from the retracted position to the pressure position, the pressure blades bend attachment flaps extending from opposite side edges of each composite side wall of the die cut plate and/or press these attachment flaps against the simple side walls of the die cut plate, with the interposition of glue, in cooperation with anvil surfaces of the plunger.

[0014] The mentioned front surfaces of the simple wall bending elements and of the composite wall bending elements intercalated with one another define a polygon having an even number of sides, which is twice the mentioned integer number greater than two. For example, if the integer number greater than two is three, the polygon will have six sides, in other words, it will be a hexagon, and the molding cavity will be useful for forming bases or lids for prismatic boxes having a hexagonal cross-section; if the integer number greater than two is four, the polygon will have eight sides, in other words, it will be an octagon, and the molding cavity will be useful for forming bases or lids for prismatic boxes having an octagonal cross-section, and so on and so forth.

[0015] The plunger will obviously be configured according to the number of sides of the polygon and the die cut plate will be configured accordingly. Although theoretically there is no limit to the number of sides of the polygon, six and eight are considered suitable numbers, and particularly a polygon having eight faces is the most preferred because it facilitates implementing regulations in the molding cavity in second and third directions X, Y perpendicular to one another and perpendicular to the first direction Z adapting the molding cavity to bases and lids having different dimensions. Furthermore, prismatic boxes having an octagonal cross-section are widely used in different logistics applications.

[0016] Therefore, in a preferred embodiment the molding cavity includes four simple wall bending elements and four composite wall bending elements intercalated with one another, and four pairs of pressure blades flanking the composite wall bending elements. Two of the composite wall bending elements are arranged with their front surfaces facing one another and parallel to the mentioned second direction X, and the other two composite wall bending elements are arranged with their front surfaces facing one another and parallel to the mentioned third direction Y. The four simple wall bending elements are arranged with their front surfaces inclined at obtuse angles with respect to the front surfaces of the composite wall bending elements oriented in both the second and third directions. These obtuse angles are conventionally angles of 135 degrees, although other angles are possible.

[0017] In a more complex version of the preferred embodiment, each of the composite wall bending elements is divided into two halves. The two halves of each of the two composite wall bending elements having their front surfaces parallel to the second direction X have respective first guide followers fixed thereto and coupled in a sliding manner to a first guide parallel to the second direction X, and the two halves of each of the two composite wall bending elements having their front surfaces parallel to the third direction Y have respective second guide followers fixed thereto and coupled in a sliding manner to a second guide parallel to the third direction Y.

[0018] Thus, the halves of the composite wall bending elements can be moved and fixed in selected positions along the corresponding first and second guides to adapt the molding cavity to bases and lids having different dimensions.

[0019] Preferably, the two halves of each of the two composite wall bending elements having their front surfaces parallel to the second direction X furthermore have respective first nuts fixed thereto and coupled respectively to two threaded sections having opposite thread directions of a first spindle parallel to the first guide, and the two halves of each of the two composite wall bending elements having their front surfaces parallel to the third

direction Y have respective second nuts fixed thereto and coupled respectively to two threaded sections having opposite thread directions of a second spindle parallel to the second guide.

[0020] Thus, a rotation of the mentioned first spindle causes a mutual approaching or distancing of the two halves of the composite wall bending element having its front surfaces parallel to the second direction X along the first guide parallel to the second direction X, and a rotation of the mentioned second spindle causes a mutual approaching or distancing of the two halves of the composite wall bending element having its front surfaces parallel to the third direction Y along the second guide parallel to the third direction Y to adapt the molding cavity to bases and lids having different dimensions.

[0021] In one embodiment, the rotation of the first and second spindles is performed manually by means of cranks or the like, although rotation could alternatively be performed by means of electric motors or motors of another type. The coupling between the nuts and spindles is irreversible, such that when the rotation of the first and second spindles is stopped, the halves of the composite wall bending elements are immobilized by the first and second spindles in selected fixed positions along the corresponding first and second guides.

[0022] In the structure of the machine and on two sides of the molding cavity opposite in the second direction X, two first base guides are fixed parallel to the third direction Y, two first carriages have first base guide followers fixed at the ends thereof and coupled in a sliding manner to the two first base guides, and one of the two first guides, together with the corresponding first spindle and the two halves of the corresponding composite wall bending element having its front surfaces parallel to the second direction X are installed on each of the two first carriages.

[0023] Similarly, in the structure of the machine and on two sides of the molding cavity opposite in the third direction Y, two second base guides are fixed parallel to the second direction X, two second carriages have second base guide followers fixed at the ends thereof and coupled in a sliding manner to the two second base guides, and one of the two second guides, together with the corresponding second spindle and the two halves of the corresponding composite wall bending element having its front surfaces parallel to the third direction Y are installed on each of the two second carriages.

[0024] Thus, the two first carriages and the two second carriages, carrying the corresponding first and second guides, first and second spindles, and halves of the composite wall bending elements, can be moved and fixed in desired positions along the corresponding first and second base guides to adapt the molding cavity to bases and lids having different dimensions.

[0025] Preferably, two corresponding first base spindles are installed in positions parallel and adjacent to the first base guides, and two corresponding second base spindles are installed in positions parallel and adjacent to the second base guides, where each of the first and second base spindles has two threaded sections having opposite thread directions.

[0026] The two first carriages furthermore have respective first base nuts fixed at the ends thereof and coupled respectively to the two threaded sections having opposite thread directions of the two first base spindles, and the two second carriages furthermore have respective second base nuts fixed at the ends thereof and coupled respectively to the two threaded sections having opposite thread directions of the two second base spindles.

[0027] Thus, a rotation of the two first base spindles in unison causes a mutual approaching or distancing of the two first carriages along the first base guides parallel to the third direction Y resulting in a mutual approaching or distancing of the composite wall bending elements having their front surfaces parallel to the second direction X and being located on sides of the molding cavity opposite in the third direction Y, and a rotation of the two second base spindles in unison causes a mutual approaching or distancing of the two second carriages resulting in a mutual approaching or distancing of the composite wall bending elements having their front surfaces parallel to the third direction Y and being located on sides of the molding cavity opposite in the second direction X.

[0028] In one embodiment, the rotation of the first and second base spindles is performed manually by means of cranks or the like, although rotation could alternatively be performed by means of electric motors or motors of another type. Preferably, the two first base spindles are kinematically linked to one another by one or more transmission chains or belts such that the mentioned rotation of both in unison is obtained by acting on one of them, and similarly the two second base spindles are kinematically linked to one another by one or more transmission chains or belts such that the mentioned rotation of both in unison is obtained by acting on one of them.

[0029] The coupling between the nuts and the spindles is irreversible, such that when the rotation of the first and second base spindles is stopped, the first and second carriages are immobilized by the first and second base spindles in selected fixed positions along the corresponding first and second base guides.

[0030] Preferably, each of the mentioned pressure blades and its corresponding blade actuator are installed on one of the two halves of each composite wall bending element, such that they move together with the corresponding half of the composite wall bending element along the first or second guide.

[0031] In one embodiment, each of the two halves of each composite wall bending element comprises a base support having fixed thereto the mentioned first or second guide follower, the mentioned first or second nut, and one or more members providing the mentioned inlet bending surface and the mentioned front surface. One of the pressure blades is mounted on this base support such that it can move with respect to the base support in cooperation with guiding means between the mentioned retracted position and the mentioned pressure position.

For example, an active support movable with respect to the base support is mounted on the base support in cooperation with the mentioned guiding means, and the pressure blade is fixed to this active support. The corresponding blade actuator is connected to the base support and to the pressure blade or to the active support. Thus, activation of the blade actuator moves the pressure blade with respect to the base support between the retracted position and the pressure position.

[0032] In a specific embodiment, the guiding means comprise a shaft parallel to the first direction Z pivotally connecting the pressure blade or the active support to the base support, and the blade actuator, which can be, for example, a dynamic fluid piston and cylinder assembly, when activated pivots the pressure blade around the mentioned shaft between the retracted position and the pressure position. Alternatively, the guiding means can include one or more straight or curved guides. Alternatively, the blade actuator can be an electric motor or a motor of another type.

[0033] Each of the simple wall bending elements has a guide follower fixed thereto. Two of the guide followers fixed to two of the simple wall bending elements are coupled in a sliding manner to one of the previously mentioned first guides, and the other two guide followers fixed to the other two simple wall bending elements are coupled in a sliding manner to the other one of the first guides. Therefore, the simple wall bending elements can be moved and fixed in desired positions along the corresponding first guides to adapt the molding cavity to bases and lids having different dimensions.

[0034] Preferably, each of the simple wall bending elements furthermore has a nut fixed thereto. Two of the nuts fixed to two of the simple wall bending elements are coupled respectively to two threaded sections having opposite thread directions of an auxiliary spindle parallel to the first guides, and the other two nuts fixed to the other two simple wall bending elements are coupled respectively to two threaded sections having opposite thread directions of another auxiliary spindle parallel to the first guides. Thus, a rotation of each of the auxiliary spindles causes a mutual approaching or distancing in the second direction X of the two simple wall bending elements having their nuts coupled to the same auxiliary spindle.

[0035] Each of the simple wall bending elements comprises a first support bearing one or more members providing the mentioned inlet bending surface and the mentioned front surface and a second support having the guide follower and the nut fixed thereto. This second support furthermore has a first clamp fixed thereto and gripping a first regulating arm parallel to the third direction Y fixed to the first support. The first clamp has a first regulating element, such as a clamping screw or the like, fixing said first regulating arm to the first clamp in a selected position in the third direction Y.

[0036] Preferably, the first regulating arm is in turn fixed to a second clamp gripping a second regulating arm extending from the first support, for example in a direction perpendicular to the first direction Z and inclined with respect to the second and third directions X, Y. The second clamp has a second regulating element, such as a clamping screw or the like, fixing said second regulating arm to the second clamp in a selected position in a direction perpendicular to the first direction Z and forming an angle with both second and third directions X, Y.

[0037] An active bending member providing at least part of the inlet bending surface is mounted on the first support of each of the simple wall bending elements. This active bending member is movable with respect to the first support in cooperation with guiding means, and an inlet actuator is connected to the first support and to the active bending member. Activation of the inlet actuator therefore moves the active bending member with respect to the first support in cooperation with the guiding means between a standby position, in which the active bending member does not interfere with the simple side wall of the die cut plate, and a bending position, in which the active bending member pushes the simple side wall and bends it with respect to the base wall of the die cut plate in cooperation with the plunger.

[0038] In one embodiment, the mentioned guiding means comprise a shaft perpendicular to the first direction Z pivotally connecting the active bending member to the first support, and the inlet actuator can be, for example, a dynamic fluid piston and cylinder assembly. Thus, activation of the inlet actuator pivots the active bending member around the mentioned shaft between the standby position and the bending position.

[0039] The action of the active bending member is used for bending the simple side walls of the die cut plate in cooperation with the plunger in advance of the bending of the composite side walls done by the composite wall bending elements, which are inert, in cooperation with the plunger. This results in the attachment flaps extending from opposite side edges of the composite side walls being able to be subsequently bent and pressed against an outer surface of the simple side walls by the pressure blades.

[0040] In an alternative embodiment, the active bending members are associated with the composite wall bending elements, in which case the composite side walls of the die cut plate are bent before the simple side walls, and the attachment flaps are arranged on the inner side of the base or lid and are bent and pressed against an inner surface of the simple side walls by the action of the pressure blades on the simple side walls.

[0041] Alternatively, the bending in advance of the simple side walls or of the composite side walls can be determined by arranging inert inlet bending surfaces both in the simple wall bending elements and in the composite wall bending elements, but providing different configurations and/or arranging these inert inlet bending surfaces at different heights.

[0042] An arm having a retaining catch fixed at one end thereof is installed on the first support of each of the simple wall bending elements. This arm is movable in a

guided manner, for example pivoting around a shaft perpendicular to the first direction Z and parallel to the front surface of the corresponding simple wall bending element, between a retaining position determined by a stop, in which said retaining catch projects from the front surface, and a withdrawn position, in which the retaining catch does not project from the front surface. An elastic element is connected to the arm and to the first support such that it permanently pushes the lever towards the retaining position.

[0043] The plunger comprises a pressure element providing a pressure surface perpendicular to the first direction. This pressure element has an outer contour consistent with the polygon defined by the simple wall bending elements and composite wall bending elements of the molding cavity, and consistent with the outer contour of the base wall of the die cut plate. The plunger further comprises anvil walls providing the mentioned anvil surfaces, which are parallel to the front surfaces of the simple wall bending elements, and a connection element which is connected to a moving member of said drive mechanism of the plunger.

[0044] When the plunger is moved from the extracted position to the introduced position, the pressure element of the plunger presses against the base wall of the die cut plate and introduces it into the molding cavity, thereby causing the bending of the single and composite side walls in cooperation with the simple wall bending elements and composite wall bending elements, respectively, of the molding cavity.

[0045] When the plunger is in the introduced position inside the molding cavity, the anvil surfaces of the plunger are facing and close to the front surfaces of the simple wall bending elements, with the simple side walls of the die cut plate interposed between both. When the pressure blades are then moved to the pressure position and while the plunger is in the introduced position, the anvil walls of the plunger withstand the pressure exerted by the pressure blades against the attachment flaps and against the simple side walls of the die cut plate.

[0046] When the die cut plate is introduced by the plunger into the molding cavity, the lower edges of the box slip on inclined surfaces of the mentioned retaining catches, such that the retaining catches and their arms move out of the molding cavity against the force of the corresponding elastic elements until an upper edge of the bent simple side walls of the die cut plate surpass the position of the retaining catches, at which time the elastic elements return the retaining catches to their retaining positions.

[0047] In this situation, the upper edges of the simple side walls of the already bent die cut plate are below a lower surface of the retaining catches, and said lower surface of the retaining catches act as a stop, preventing the die cut plate from moving upwards when the pressure blades act. Finally, an additional stroke of the plunger expels the box through an outlet opening, opposite the inlet opening, of the molding cavity.

[0048] In one embodiment, the plunger further comprises a structural element, which can optionally have an outer contour consistent with the polygon, and the anvil walls have a first end fixed to the pressure element and a second end, opposite the first end, fixed to the structural element. Both the pressure element and the structural element have a central opening, and the connection element is fixed to a support bridge having opposite ends connected respectively to two of the opposite anvil walls.

[0049] Optionally, the mentioned opposite ends of the support bridge are fixed to respective slides coupled in a sliding manner to bridge guides, parallel to the first direction Z, fixed to the two opposite anvil walls. Regulating elements, such as clamping screws, fix the slides in a selected position along the bridge guides, thereby allowing regulation of the position of the plunger with respect to its drive mechanism in the first direction Z.

[0050] Preferably, in the structure of the machine is installed a glue applicator device depositing glue on predetermined areas of each die cut plate before the die cut plate is placed on the inlet opening of the molding cavity. These predetermined areas of the die cut plate on which glue is placed are conventionally the attachment flaps, although they could alternatively be areas of the simple side walls envisaged for being placed on and attached to the attachment flaps.

[0051] The mentioned glue applicator device can be a hot glue applicator device or a cold glue applicator device. The use of hot glue has the advantage of providing, while bending and attaching the die cut plate to form the base or lid, faster adhesion compared to the use of cold glue, which allows comparatively higher production rates. Nevertheless, the drawback of hot glue is that it melts at extremely high environmental temperatures, such as temperatures that can be reached due to exposure to the sun in the summer in warm climates, for example, while it crystallizes at extremely low environmental temperatures, such as temperatures that can be reached in a refrigeration chamber, for example. In contrast, cold glue neither melts nor crystallizes at these extreme environmental temperatures.

[0052] For this reason, in one embodiment the glue applicator device comprises a hot glue applicator unit having one or more hot glue application elements depositing hot glue on the die cut plates and a cold glue applicator unit having one or more cold glue application elements depositing cold glue on the die cut plates. The mentioned hot glue and cold glue application elements can be, for example, hot glue and cold glue discharge nozzles. The hot glue and cold glue applicator units can be controlled to act alternatively to apply hot glue or cold glue, whichever is appropriate, or to act simultaneously to apply cold glue and hot glue in combination.

[0053] The use of cold glue and hot glue in combination has the advantage that the hot glue allows relatively high production rates, whereas the cold glue, which completely sets a time after the base or lid has been formed, provides the base or lid with good mechanical strength char-

acteristics.

[0054] In one embodiment, on the structure of the machine there are furthermore installed a sheet loader having a plurality of die cut plates stored therein and a conveyor device which conveys the die cut plates one by one from the sheet loader to an initial position on the inlet opening of the molding cavity. In this case, the glue applicator device is arranged between the sheet loader and the molding cavity such that it deposits glue on the die cut plates while the die cut plates are conveyed by said conveyor device.

Brief Description of the Drawings

[0055] The foregoing and other features and advantages will be better understood from the following detailed description of merely illustrative and non-limiting exemplary embodiments with reference to the accompanying drawings, in which:

Figure 1 is a schematic side view of a machine for forming prismatic box bases or lids by bending and attaching die cut plates according to one embodiment of the present invention, with a plunger in an extracted position outside a molding cavity;

Figure 2 is a schematic side view of the machine of Figure 1, with the plunger in the introduced position inside the molding cavity;

Figure 3 is a top view of elements defining the molding cavity according to one embodiment suitable for forming bases or lids having an octagonal cross-section;

Figure 4 is a perspective view of a plunger configured for cooperating with the molding cavity of Figure 3;

Figure 5 is a cross-section view of the plunger of Figure 4 taken along a plane perpendicular to a first direction Z;

Figure 6 is a front view of a die cut plate from which the machine forms the bases or lids having an octagonal cross-section using the molding cavity of Figure 3 in cooperation with the plunger of Figure 4;

Figure 7 is a top view of a base or lid having an octagonal cross-section obtained from the die cut plate of Figure 6;

Figure 8 is a perspective view of the base or lid of Figure 7;

Figure 9 is a top view of elements defining the molding cavity according to another embodiment suitable for forming bases or lids having a hexagonal cross-section;

Figure 10 is a cross-section view of a plunger configured for cooperating with the molding cavity of Figure 9 taken along a plane perpendicular to the first direction Z;

Figure 11 is a front view of a die cut plate from which the machine forms the bases or lids having a hexagonal cross-section using the molding cavity of Figure 9 in cooperation with the plunger of Figure 10;

Figure 12 is a top view of a base or lid having a hexagonal cross-section obtained from the die cut plate of Figure 11;

Figure 13 is a top view of elements defining an adjustable molding cavity according to one embodiment suitable for forming bases or lids having an octagonal cross-section of different dimensions, in a contracted situation;

Figure 14 is a top view of the elements defining the adjustable molding cavity of Figure 13 in an expanded situation;

Figure 15 is a perspective view of the elements defining the adjustable molding cavity of Figures 13 and 14 together with their regulating means, taken from an upper point of view;

Figure 16 is a perspective view of the elements of Figure 15 taken from a lower point of view;

Figure 17 is a perspective view of one half of a composite wall bending element and of a pressure blade forming part of the elements of the molding cavity of Figures 15 and 16;

Figure 18 is a perspective view of a simple wall bending element including an active bending member forming part of the elements of the molding cavity of Figures 15 and 16;

Figure 19 is a side view of the simple wall bending element of Figure 18; and

Figure 20 is a perspective view of a simple wall bending element including an inert bending member according to another embodiment of the present invention.

Detailed Description of Exemplary Embodiments

[0056] First in reference to Figures 1 and 2, reference number 100 generally designates a machine for forming prismatic box bases or lids by bending and attaching die cut plates according to one embodiment of the present invention. The machine 100 is suitable for forming bases or lids 6 having an octagonal cross-section, such as the one shown by way of example in Figures 7 and 8, from die cut plates 5, such as the one shown by way of example in Figure 6.

[0057] The die cut plate 5 of Figure 6 is made from a single piece of a sheet of a relatively rigid material, such as, for example, cardboard, corrugated cardboard, plastic, corrugated plastic, and the like, and comprises an octagon-shaped base wall 1, four simple side walls 2 and four composite side walls 3, alternating with one another, connected to the eight sides of the base wall 1 by respective bending lines, and attachment flaps 4 connected to opposite side edges of the composite side walls 3.

[0058] In the base or lid 6 of Figures 7 and 8, the simple side walls 2 and the composite side walls 3 are bent along the respective bending lines to positions perpendicular to the base wall 1, and the attachment flaps 4 are bent along the respective bending lines and superimposed on and adhered by means of glue to outer surfaces of the

simple side walls 2. In an alternative embodiment (not shown), the attachment flaps 4 are superimposed on and adhered by means of glue to inner surfaces of the simple side walls 2. The bases or lids 6 are stackable.

[0059] As schematically shown in Figures 1 and 2, the machine 100 comprises a structure 10 bearing a sheet loader 86, a conveyor device 80, a glue applicator device 81, a molding cavity 11 and a plunger 70. The sheet loader 86 houses a stack of die cut plates 5 arranged at one end of the conveyor device 80, and the conveyor device 80 comprises, for example, an endless belt 87 provided with one or more drive elements 88 interfering with the die cut plate 5 located on the lower level of the stack in the sheet loader 86 and transporting it until arranging the die cut plate 5 in an initial position on an inlet opening of the molding cavity (Figure 1).

[0060] The glue applicator device 81 is located on the path of the conveyor device 80 between the sheet loader 86 and the molding cavity 11 and comprises a hot glue applicator unit 82 having one or more hot glue application elements 83 depositing hot glue on the attachment flaps 4 or on selected areas of the simple side walls 2 of the die cut plates 5, and a cold glue applicator unit 84 having one or more cold glue application elements 85 depositing cold glue on the attachment flaps 4 or on selected areas of the simple side walls 2 of the die cut plates 5 while the die cut plates are moved by the conveyor device 80.

[0061] Alternatively, the glue applicator device 81 could include only the hot glue applicator unit 82 or only the cold glue applicator unit 84, and/or the glue applicator device 81 could be arranged below the conveyor device 80 to apply glue to the lower face of the die cut plates 5.

[0062] The molding cavity 11 has side elements defining an octagonal cavity consistent with the shape of the base wall 1 of the die cut plates 5. The plunger 70 is installed such as it can move along a guide 79 fixed to the structure 10. The guide 79 defines a path parallel to a first direction Z which, in the embodiment shown, is a vertical direction. The path of the plunger 70 is aligned and centered with respect to a central line of the molding cavity 11. A drive mechanism (not shown) moves the plunger 70 along the mentioned path between an extracted position (Figure 1), in which the plunger 70 is outside the molding cavity 11, and an introduced position (Figure 2), in which the plunger 70 is inside the molding cavity 11.

[0063] With the movement from the extracted position to the introduced position, the plunger 70 presses the base wall 1 of the die cut plate 5 which is located on the inlet opening of the molding cavity 11 and inserts it into the molding cavity 11, so the simple side walls 2 and the composite side walls 3 of the die cut plate 5 are bent to a position perpendicular to the base wall 1 in cooperation with some of the mentioned side elements of the molding cavity 11. While the plunger 70 remains inside the molding cavity 11, the attachment flaps 4 of the die cut plate 5 with glue previously applied thereto are bent and attached to the simple side walls 2 in cooperation with other side elements of the molding cavity to form a prismatic box base or lid 6.

[0064] The mentioned side elements of the molding cavity 11 are now described in relation to Figure 3. The side elements of the molding cavity 11 comprise four simple wall bending elements 12 arranged around said path of the plunger, four composite wall bending elements 13X, 13Y arranged around the path of the plunger in positions intercalated between said simple wall bending elements 12, and four pairs of pressure blades 14 arranged such that the pressure blades 14 of each pair flank one of said composite wall bending elements 13X, 13Y.

[0065] Each simple wall bending element 12 has an inlet bending surface 12a bending a simple side wall 2 of the die cut plate 5 in cooperation with the action of the plunger 70 and a front surface 12b parallel to the first direction Z keeping the simple side wall 2 in a position perpendicular to the base wall 1 of the die cut plate 5. Each composite wall bending element 13X, 13Y has an inlet bending surface 13a bending a composite side wall 3 of the die cut plate 5 in cooperation with the action of the plunger 70 and a front surface 13b parallel to the first direction Z keeping the composite side wall 3 in a position perpendicular to the base wall 1 of the die cut plate 5.

[0066] Two of the composite wall bending elements 13X are arranged with their front surfaces 13b facing one another and parallel to a second direction X perpendicular to the first direction Z, the other two composite wall bending elements 13Y are arranged with their front surfaces 13b facing one another and parallel to a third direction Y perpendicular to the first direction Z and to the second direction X, and the simple wall bending elements 12 are arranged with their front surfaces 12b inclined at obtuse angles, in this case, angles of 135 degrees, with respect to the front surfaces 13b of the composite wall bending elements 13X, 13Y oriented in the second and third directions X, Y. Therefore, the front surfaces 12b of the four simple wall bending elements 12 and the front surfaces 13b of the four composite wall bending elements 13X, 13Y define an octagon consistent with the octagonal shape of the base wall 1 of the die cut plate 5.

[0067] The pressure blades 14 are moved by blade actuators 15 between a retracted position (depicted by means of solid lines in Figure 3), in which the pressure blades 14 are approximately aligned with or more withdrawn than the front surface 13b of adjacent composite wall bending elements 13X, 13Y, and a pressure position (depicted by means of discontinuous lines in Figure 3), in which the pressure blades 14 are approximately aligned with or more advanced than the front surface 12b of adjacent simple wall bending elements 12.

[0068] The movement of the pressure blades 14 while the plunger 70 is still in the introduced position bends the attachment flaps 4 of the die cut plate 5 and presses them against the simple side walls 2 of the die cut plate 5 in cooperation with anvil surfaces of the plunger 70.

[0069] Figures 4 and 5 show the plunger 70 cooperating with the molding cavity 11 of Figure 3. The plunger 70 comprises a pressure element 71 consisting of a plate

providing a pressure surface perpendicular to the first direction Z and having an outer contour consistent with the octagonal shape of the base wall 1 of the die cut plate 5, and four anvil walls 72 associated with four alternating sides of the octagonal shape of the pressure element 71. These anvil walls 72 provide the mentioned anvil surfaces, which are perpendicular to the pressure element 71 and parallel to the front surfaces 12b of the simple wall bending elements 12 of the molding cavity 11.

[0070] The plunger further comprises a structural element 74 which, in the embodiment shown in Figure 4, has a configuration similar to the pressure element 71 and is parallel to same. The anvil walls 72 have a first end fixed to the pressure element 71 and a second end, opposite the first end, fixed to the structural element 74. Both the pressure element 71 and the structural element 74 have a central opening, and between two of the opposite anvil walls 72 there is arranged a support bridge 75 having a connection element 73 fixed thereto which is connected to a moving member of the drive mechanism of the plunger.

[0071] Bridge guides 77 are fixed to the two opposite anvil walls 72 parallel to the first direction Z and, slides 76 coupled in a sliding manner to the bridge guides 77 are fixed at opposite ends of the support bridge 75. Regulating elements 78, such as clamping screws installed in corresponding holes of the anvil walls 72, allow fixing the slides 76 in a selected position along the bridge guides 77.

[0072] When the plunger is moved from the extracted position to the introduced position, the pressure element 71 presses the base wall 1 of the die cut plate 5 and introduces it into the molding cavity 11. When the plunger is in the introduced position, the anvil walls 72 withstand the pressure exerted by the pressure blades 14.

[0073] Figure 9 shows the side elements of a molding cavity 11 according to another embodiment suitable for forming bases or lids 6 having a hexagonal cross-section, such as that shown by way of example in Figure 12, from die cut plates 5, such as that shown by way of example in Figure 11.

[0074] The die cut plate 5 of Figure 11 is made of a single piece of a sheet of relatively rigid material, such as, for example, cardboard, corrugated cardboard, plastic, corrugated plastic, and the like, and comprises a base wall 1 having the shape of a hexagon, three simple side walls 2 and three composite side walls 3, alternating with one another, connected to the six sides of the base wall 1 by respective bending lines, and attachment flaps 4 connected to opposite side edges of the composite side walls 3.

[0075] In the base or lid 6 of Figure 12, the simple side walls 2 and the composite side walls 3 are bent along the respective bending lines to positions perpendicular to the base wall 1, and the attachment flaps 4 are bent along the respective bending lines, and placed on and adhered by means of glue to outer surfaces of the simple side walls 2. In an alternative embodiment (not shown), the attachment flaps 4 are placed on and adhered by means of glue to inner surfaces of the simple side walls 2.

[0076] The side elements of the molding cavity of Figure 9 comprise three simple wall bending elements 12 arranged around the path of the plunger, three composite wall bending elements 13 arranged around the path of the plunger in positions intercalated between the simple wall bending elements 12, and three pairs of pressure blades 14 arranged such that the pressure blades 14 of each pair flank one of the composite wall bending elements 13.

[0077] The configuration and the operation of the simple wall bending elements 12, composite wall bending elements 13, and pressure blades 14 is similar to that described above in relation to Figure 3. Nevertheless, in this embodiment the front surfaces 12b, of the three simple wall bending elements 12 and the front surfaces 13b of the three composite wall bending elements 13 define a hexagon consistent with the hexagonal shape of the base wall 1 of the die cut plate 5.

[0078] The plunger 70 of Figure 10 cooperates with the molding cavity 11 of Figure 9, and comprises a pressure element 71 consisting of a plate providing a pressure surface perpendicular to the first direction Z and having an outer contour consistent with the hexagonal shape of the base wall 1 of the die cut plate 5 and three anvil walls 72 associated with three alternating sides of the hexagonal shape of the pressure element 71. These anvil walls 72 provide the anvil surfaces perpendicular to the pressure element 71 and parallel to the front surfaces 12b of the simple wall bending elements 12 of the molding cavity 11.

[0079] Figures 13 and 14 show the side elements of a molding cavity 11 according to yet another embodiment suitable for forming bases or lids 6 having an octagonal cross-section, such as that shown by way of example in Figures 7 and 8, from die cut plates 5, such as that shown by way of example in Figure 6.

[0080] The molding cavity 11 of Figures 13 and 14 is in all aspects similar to the embodiment described above in relation to Figure 3, except that here each of the two composite wall bending elements 13X having their front surfaces 13b parallel to the second direction X is divided into two halves 131X, 132X movable in the second direction X, each of the two composite wall bending elements 13Y having their front surfaces 13b parallel to the third direction Y is divided into two halves 131Y, 132Y movable in the third direction Y, and the simple wall bending elements 12 are movable in directions that are a combination of the second direction X and the third direction Y.

[0081] Figure 13 shows the simple wall bending elements 12 and the halves 131X, 132X; 131Y, 132Y of the composite wall bending elements 13X, 13Y in a compact position suitable for forming a base or lid having an octagonal-shaped cross-section according to a minimum dimension regulation. Figure 14 shows the simple wall bending elements 12 and the halves 131X, 132X; 131Y,

132Y of the composite wall bending elements 13X, 13Y in an expanded or partially expanded position suitable for forming a base or lid having an octagonal-shaped cross-section according to an intermediate or maximum dimension regulation.

[0082] Figures 15 and 16 illustrate mechanical regulating means whereby the positions of the simple wall bending elements 12 and the halves 131X, 132X; 131Y, 132Y of the composite wall bending elements 13X, 13Y can be regulated.

[0083] On two opposite sides of the molding cavity 11 there are installed two first base guides 26 parallel to the third direction Y fixed to the structure 10, and two corresponding first base spindles 30 parallel to the first base guides 26, where each first base spindle 30 has two threaded sections having opposite thread directions. Two first carriages 24 have first base guide followers 28 fixed at the ends thereof and coupled in a sliding manner to the mentioned first base guides 26. The two first carriages 24 also have first base nuts 32 fixed at the ends thereof and coupled respectively to the two threaded sections having opposite thread directions of the first base spindles 30. The two first base spindles 30 are linked to one another by a movement transmission, such as a first roller chain 56 mounted on gear wheels. Thus, a rotation in unison of the two first base spindles 30 causes a mutual approaching or distancing of the two first carriages 24.

[0084] On two other opposite sides of the molding cavity 11 there are installed two second base guides 27 parallel to the second direction X fixed to the structure 10, and two corresponding second base spindles 31 parallel to the second base guides 27, where each second base spindle 31 has two threaded sections having opposite thread directions. Two second carriages 25 have second base guide followers 29 fixed at the ends thereof and coupled in a sliding manner to the mentioned second base guides 27. Two second carriages 25 also have second base nuts 33 fixed at the ends thereof and coupled respectively to the two threaded sections having opposite thread directions of the second base spindles 31. The two second base spindles 31 are linked to one another by a movement transmission, such as a second roller chain 57 mounted on gear wheels. Thus, a rotation in unison of the two second base spindles 31 causes a mutual approaching or distancing of the two second carriages 25.

[0085] On each of the two first carriages 24 there are installed a first guide 16 parallel to the second direction X and a first spindle 20 parallel to the first guide 16, where the mentioned first spindle 20 has two threaded sections having opposite thread directions. Each of the two halves 131X, 132X of each of the two composite wall bending elements 13X having their front surfaces 13b parallel to the second direction X has fixed thereto a respective first guide follower 18 coupled in a sliding manner to the corresponding first guide 16 and a respective first nut 22 coupled to one of the two threaded sections having opposite thread directions of the first spindle 20. Thus, a rotation of the first spindle 20 causes a mutual approaching or distancing in the second direction X of the two halves 131X, 132X of the composite wall bending element 13X having their front surfaces 13b parallel to the second direction X.

[0086] On each of the two second carriages 25 there are installed a second guide 17 parallel to the third direction Y and a second spindle 21 parallel to the second guide 17, where the mentioned second spindle 21 has two threaded sections having opposite thread directions. Each of the two halves 131Y, 132Y of each of the two composite wall bending elements 13Y having their front surfaces 13b parallel to the third direction Y has fixed thereto a respective second guide follower 19 coupled in a sliding manner to the corresponding second guide 17 and a respective second nut 23 coupled to one of the two threaded sections having opposite thread directions of the second spindle 21. Thus, a rotation of the second spindle 21 causes a mutual approaching or distancing in the third direction Y of the two halves 131Y, 132Y of the composite wall bending element 13Y having their front surfaces 13b parallel to the third direction Y.

[0087] Figure 17 shows one of the two halves 132X of one of the composite wall bending elements 13X having their front surfaces 13b parallel to the second direction X, which comprises a base support 48 having the first guide follower 18, the first nut 22, and a member in the form of a bent plate providing the inlet bending surface 13a and the front surface 13b fixed thereto. An active support 49 is pivotally connected to the base support 48 by means of a shaft 50 parallel to the first direction Z, and one of the pressure blades 14 is fixed to the active support 49. One of the blade actuators 15 is connected to the base support 48 and to the active support 49 such that activation of the blade actuator 15 makes the active support 49 and the pressure blade 14 rotate with respect to the base support 48 around the shaft 50 between the retracted position (depicted by means of solid lines in Figures 13 and 14) and the pressure position (depicted by means of discontinuous lines in Figures 13 and 14).

[0088] The other one of the two halves 131X of each of the composite wall bending elements 13X has a construction that is symmetrical to that shown in Figure 17. The two halves 131Y and 132Y of each of the composite wall bending elements 13Y having their front surfaces 13b parallel to the third direction Y have the same elements described in relation to Figure 17 arranged symmetrically, although they are placed at different heights so as to not interfere with the guides and spindles installed in the molding cavity 11.

[0089] Again with reference to Figures 15 and 16, an auxiliary spindle 35 parallel to the first guides 16 is furthermore installed on each of the two first carriages 24, where the mentioned auxiliary spindle 35 has two threaded sections having opposite thread directions. Each of the simple wall bending elements 12 has a guide follower 34 and a nut 36 fixed thereto. The guide followers 34 fixed to two of the simple wall bending elements 12 are

coupled in a sliding manner to one of the first guides 16 and the guide followers 34 fixed to the other two simple wall bending elements 12 are coupled in a sliding manner to the other one of the first guides 16. The nuts 36 fixed to two of the simple wall bending elements 12 are coupled respectively to the two threaded sections having opposite thread directions of one of the auxiliary spindles 35, and the nuts 36 fixed to the other two simple wall bending elements 12 are coupled respectively to the two threaded sections having opposite thread directions of the other auxiliary spindle 35. Thus, a rotation of each of the auxiliary spindles 35 causes a mutual approaching or distancing in the second direction X of the two simple wall bending elements 12 which have their nuts 36 coupled to this auxiliary spindle 35.

[0090] In the embodiment shown in Figures 15 and 16, all the spindles can be manually actuated by means of a crank 58. Preferably, the first spindles 20, one of the first base spindles 30, one of the second base spindles 31, and the auxiliary spindles 35 have a coupling at one end. The second spindles 21 are linked by a movement transmission, such as an auxiliary roller chain 59, to auxiliary shafts 60 borne in supports fixed to the respective second carriages 25. Each of the auxiliary shafts 60 has a coupling at one end. The crank 58 can be coupled to and decoupled from any one of the mentioned couplings.

[0091] As best shown in Figure 18, each of the simple wall bending elements 12 comprises a first support 42 and a second support 37 connected to one another by regulating means. The first support 42 bears a member providing part of the inlet bending surface 12a and the front surface 12b. The second support 37 has the guide follower 34 and the nut 36 fixed thereto. The second support 37 furthermore has a first clamp 38 fixed thereto gripping a first regulating arm 39 parallel to the third direction Y. This first clamp 38 has a first regulating element 40, such as a clamping screw, fixing the first regulating arm 39 to the first clamp 38 in a selected position in the third direction Y. The first regulating arm 39 is fixed to a second clamp 41 gripping a second regulating arm 43 fixed to the first support 42 and extending from same. This second clamp 41 has a second regulating element 44, such as a clamping screw, fixing the second regulating arm 43 to the second clamp 41 in a selected position in a direction perpendicular to the first direction Z and forming an angle with both second and third directions X, Y.

[0092] Thus, by acting on the first and second regulating elements 40, 44 of the first and second clamps 38, 41, it is possible to regulate the position of the simple wall bending element 12 in a direction which is combination of the second direction X and the third direction Y. In an alternative embodiment (not shown), the simple wall bending element 12 includes means for further regulating the inclination of its front surface 12b with respect to both second and third directions X, Y, for example by means of an articulation between the second support 37 and the first clamp 38 or between the first regulating arm 39 and the second clamp 41, and locking means, such as a clamping screw, for example, to lock said articulation in a desired angular position.

[0093] Figures 18 and 19 further show an active bending member 45 mounted on the first support 42 of the simple wall bending element 12. This active bending member 45 provides another part of the inlet bending surface 12a and is connected to the first support 42 by means of a shaft 46 perpendicular to the first direction Z, such that the active bending member 45 can pivot with respect to the first support 42 around the shaft 46. An inlet actuator 47 is connected to the first support 42 and to the active bending member 45.

[0094] Thus, an activation of the inlet actuator 47 moves the active bending member 45 between a standby position (depicted by means of discontinuous lines in Figure 19), in which the active bending member 45 does not interfere with the simple side wall 2 of the die cut plate 5, and a bending position (depicted by means of solid lines in Figure 19), in which the active bending member 45 pushes the simple side wall 2 of the die cut plate 5 to bend it with respect to the base wall 1 in cooperation with the plunger 70. The movement of the active bending member 45 causes the simple side walls 2 of the die cut plate 5 to be bent before the composite side walls 3. Alternatively, the active bending member 45 could be installed on each of the halves 131X, 132X; 131Y, 132Y of the composite wall bending elements 13X, 13Y to cause the bending of the composite side walls 3 before the simple side walls 2.

[0095] Figure 20 shows an alternative embodiment of the simple wall bending element 12, in which the first support 42 of the simple wall bending element 12 has an inert member in the form of a bent plate fixed thereto providing the inlet bending surface 12a and the front surface 12b, with the particularity that the inlet bending surface 12a has a different curvature and a greater height than the inlet bending surface 13a of the halves 131X, 132X; 131Y, 132Y of the composite wall bending elements 13X, 13Y, which also causes the simple side walls 2 of the die cut plate 5 to be bent before the composite side walls 3 without requiring an actuator. Alternatively, the inlet bending surface 13a of the halves 131X, 132X; 131Y, 132Y of the composite wall bending elements 13X, 13Y could have a different curvature and/or a greater height than the inlet bending surface 12a to cause the bending of the composite side walls 3 before the simple side walls 2.

[0096] Figures 19 and 20 further show an arm 51 installed on the first support 42 of the simple wall bending element 12 such that it can pivot with respect to a shaft 52 perpendicular to the first direction Z. A retaining catch 53 is fixed to an end of the arm 51 opposite the shaft 52. The arm 51 abuts with the member in the form of a bent plate providing the front surface 12b such that the rotation of the arm 51 towards the inside of the molding cavity 11 is limited to a retaining position (depicted by means of solid lines in Figures 19 and 20) determined by this stop,

in which the retaining catch 53 projects from the front surface 12b towards the inside of the molding cavity 11. Nevertheless, the arm 51 can rotate freely in the opposite direction to a withdrawn position (depicted by means of discontinuous lines in Figures 19 and 20), in which the retaining catch 53 does not project from the front surface 12b. An elastic element 54, such as a compression coil spring, is connected to the arm 51 and to a support 55 fixed to the first support 42 such that the elastic element 54 pushes the arm 51 towards the retaining position.

[0097] The retaining catch 53 has an inclined surface on the upper side thereof, such that the arm 51 is moved from the retaining position to the withdrawn position by the die cut plate 5 when the latter is introduced in the molding cavity 11 by the plunger 70, and when the already bent simple side walls 2 surpass the position of the retaining catch 53, the latter returns to the retaining position by the action of the elastic element 54 preventing the already bent die cut plate 5 from moving upwards.

Claims

1. A machine for forming prismatic box bases or lids by bending and attaching die cut plates, comprising:

a structure (10);
a molding cavity (11) that is fixed with respect to said structure (10), said molding cavity (11) having an inlet opening and side elements defining a polygon with an even number of sides greater than four;
a plunger (70) moved in a guided manner by a drive mechanism along a path parallel to a first direction (Z) with respect to the structure (10) between an extracted position in which said plunger (70) is outside said molding cavity (11), and an introduced position in which the plunger (70) is inside the molding cavity (11);
where the plunger (70), when operated, presses against a portion of a die cut plate (5) arranged on said inlet opening of the molding cavity (11) and inserts it into the molding cavity (11) thereby bending and attaching different parts of the die cut plate (5) in cooperation with said side elements of the molding cavity to form a base or lid (6) of a prismatic box,
characterized in that the side elements of the molding cavity (11) comprise:

an integer number greater than two of simple wall bending elements (12) arranged around said path of the plunger, each simple wall bending element (12) having an inlet bending surface (12a) bending a simple side wall (2) of the die cut plate (5) and a front surface (12b) parallel to said first direction (Z) keeping said simple side wall (2) in a position perpendicular to a base wall (1) of the die cut plate (5);
an equal integer number greater than two of composite wall bending elements (13, 13X, 13Y) an arranged around the path of the plunger in positions intercalated between said simple wall bending elements (12), each composite wall bending element (13, 13X, 13Y) having an inlet bending surface (13a) bending a composite side wall (3) of the die cut plate (5) and a front surface (13b) parallel to said first direction (Z) keeping said composite side wall (3) in a position perpendicular to said base wall (1) of the die cut plate (5), said front surfaces (12b, 13b) of the simple wall bending elements (12) and composite wall bending elements (13, 13X, 13Y) defining said polygon; and
an equal integer number greater than two of pairs of pressure blades (14) arranged such that the pressure blades (14) of each pair flank one of said composite wall bending elements (13, 13X, 13Y),
where said pressure blades (14) are moved by blade actuators (15) between a retracted position, in which the pressure blades (14) are approximately aligned with or more withdrawn than the front surface (13b) of the adjacent composite wall bending elements (13, 13X, 13Y), and a pressure position, in which the pressure blades (14) are approximately aligned with or more advanced than said front surface (12b) of the adjacent simple wall bending elements (12) for bending attachment flaps (4) extending from opposite side edges of each composite side wall (3) of the die cut plate (5) and/or pressing said attachment flaps (4) against the simple side walls (2) of the die cut plate (5), with the interposition of glue, in cooperation with anvil surfaces of the plunger (70).

2. The machine for forming prismatic box bases or lids according to claim 1, **characterized in that** said integer number greater than two of simple wall bending elements (12), of composite wall bending elements (13X, 13Y) and of pairs of pressure blades (14) is four, and **in that** two of the composite wall bending elements (13X) are arranged with their front surfaces (13b) facing one another and parallel to a second direction (X) perpendicular to the first direction (Z), the other two composite wall bending elements (13Y) are arranged with their front surfaces (13b) facing one another and parallel to a third direction (Y) perpendicular to the first direction (Z) and to said second direction (X), and the simple wall bending elements (12) are arranged with their front surfaces (12b) inclined at obtuse angles with respect to both second

and third directions (X, Y).

3. The machine for forming prismatic box bases or lids according to claim 2, **characterized in that** each of the two composite wall bending elements (13X) having their front surfaces (13b) parallel to the second direction (X) is divided into two halves (131X, 132X) having fixed thereto respective first guide followers (18) coupled in a sliding manner to a first guide (16) parallel to the second direction (X), and each of the two composite wall bending elements (13Y) having their front surfaces (13b) parallel to the third direction (Y) is divided into two halves (131Y, 132Y) having fixed thereto respective second guide followers (19) coupled in a sliding manner to a second guide (17) parallel to the third direction (Y).

4. The machine for forming prismatic box bases or lids according to claim 3, **characterized in that** said two halves (131X, 132X) of each of the two composite wall bending elements (13X) having their front surfaces (13b) parallel to the second direction (X) furthermore have fixed thereto respective first nuts (22) coupled respectively to two threaded sections having opposite thread directions of a first spindle (20) parallel to said first guide (16), such that a rotation of said first spindle (20) causes a mutual approaching or distancing in the second direction (X) of the two halves (131X, 132X) of the composite wall bending element (13X) having its front surfaces (13b) parallel to the second direction (X), and said two halves (131Y, 132Y) of each of the two composite wall bending elements (13Y) having their front surfaces (13b) parallel to the third direction (Y) furthermore have fixed thereto respective second nuts (23) coupled respectively to two threaded sections having opposite thread directions of a second spindle (21) parallel to said second guide (17), such that a rotation of said second spindle (21) causes a mutual approaching or distancing in the third direction (Y) of the two halves (131Y, 132Y) of the composite wall bending element (13Y) having its front surfaces (13b) parallel to the third direction (Y).

5. The machine for forming prismatic box bases or lids according to claim 4, **characterized by** comprising two first carriages (24) having first base guide followers (28) fixed at the ends thereof coupled in a sliding manner to two first base guides (26) parallel to the third direction (Y) fixed to the structure (10) on two opposite sides of the molding cavity (11), where one of the two first guides (16), together with the corresponding first spindle (20) and the two halves (131X, 132X) of the corresponding composite wall bending element (13X) having its front surfaces (13b) parallel to the second direction (X) are installed on each of said two first carriages (24), and two second carriages (25) having second base guide followers (29) fixed at the ends thereof coupled in a sliding manner to two second base guides (27) parallel to the second direction (X) fixed to the structure (10) on two other opposite sides of the molding cavity (11), where one of the two second guides (17), together with the corresponding second spindle (21) and the two halves (131Y, 132Y) of the corresponding composite wall bending element (13Y) having its front surfaces (13b) parallel to the third direction (Y) are installed on each of said two second carriages (25).

6. The machine for forming prismatic box bases or lids according to claim 5, **characterized in that** the two first carriages (24) furthermore have respective first base nuts (32) fixed at the ends thereof and coupled respectively to two threaded sections having opposite thread directions of two corresponding first base spindles (30) parallel to said first base guides (26), such that a rotation of said two first base spindles (30) in unison causes a mutual approaching or distancing of the two first carriages (24), and the two second carriages (25) furthermore have respective second base nuts (33) fixed at the ends thereof and coupled respectively to two threaded sections having opposite thread directions of two corresponding second base spindles (31) parallel to said second base guides (27), such that a rotation of said two second base spindles (31) in unison causes a mutual approaching or distancing of the two second carriages (25).

7. The machine for forming prismatic box bases or lids according to any one of claims 3 to 6, **characterized in that** each of the two halves (131X, 132X; 131Y, 132Y) of each composite wall bending element (13X, 13Y) comprises a base support (48) having fixed thereto said first or second guide follower (18, 19), said first or second nut (22, 23), and at least one member providing said inlet bending surface (13a) and said front surface (13b), and one of said pressure blades (14) is mounted on said base support (48) in a movable manner with respect to the base support (48) in cooperation with guiding means, and one of said blade actuators (15) is connected to the base support (48) and to the pressure blade (14) such that activation of the blade actuator (15) moves the pressure blade (14) with respect to the base support (48) in cooperation with said guiding means between said retracted position and said pressure position.

8. The machine for forming prismatic box bases or lids according to claim 7, **characterized in that** said guiding means comprise a shaft (50) parallel to the first direction (Z) pivotally connecting an active support (49) to the base support (48), and the pressure blade is fixed to said active support (49), such that activation of the blade actuator (15) pivots the pres-

sure blade (14) around said shaft (50) between the retracted position and the pressure position.

9. The machine for forming prismatic box bases or lids according to any one of claims 3 to 8, **characterized in that** each of the simple wall bending elements (12) has fixed thereto a guide follower (34), where said guide followers (34) fixed to two of the simple wall bending elements (12) are coupled in a sliding manner to one of the first guides (16) and the guide followers (34) fixed to the other two simple wall bending elements (12) are coupled in a sliding manner to the other one of the first guides (16).

10. The machine for forming prismatic box bases or lids according to claim 9, **characterized in that** each of the simple wall bending elements (12) furthermore has a nut (36) fixed thereto, where said nuts (36) fixed to two of the simple wall bending elements (12) are coupled respectively to two threaded sections having opposite thread directions of an auxiliary spindle (35) parallel to the first guides (16), and the nuts (36) fixed to the other two simple wall bending elements (12) are coupled respectively to two threaded sections having opposite thread directions of another auxiliary spindle (35) parallel to the first guides (16), such that a rotation of each of said auxiliary spindles (35) causes a mutual approaching or distancing in the second direction (X) of the two simple wall bending elements (12) which have their nuts (36) coupled to the auxiliary spindle (35).

11. The machine for forming prismatic box bases or lids according to claim 10, **characterized in that** each of the simple wall bending elements (12) comprises a first support (42) bearing at least one member providing said inlet bending surface (12a) and said front surface (12b) and a second support (37) having the guide follower (34) and the nut (36) fixed thereto, where said second support (37) furthermore has a first clamp (38) fixed thereto gripping a first regulating arm (39) parallel to the third direction (Y) fixed to said first support (42), and where said first clamp (38) has a first regulating element (40) fixing said first regulating arm (39) to the first clamp (38) in a selected position in the third direction (Y).

12. The machine for forming prismatic box bases or lids according to claim 11, **characterized in that** said first regulating arm (39) has a second clamp (41) fixed thereto gripping a second regulating arm (43) extending from said first support (42), where said second clamp (41) has a second regulating element (44) fixing said second regulating arm (43) to the second clamp (41) in a selected position in a direction perpendicular to the first direction (Z) and forming an angle with both second and third directions (X, Y).

13. The machine for forming prismatic box bases or lids according to any one of claims 1 to 10, **characterized in that** each of the simple wall bending elements (12) comprises a first support (42) on which an active bending member (45) providing at least part of said inlet bending surface (12a) is mounted, where said active bending member (45) is movable with respect to said first support (42) in cooperation with guiding means, and an inlet actuator (47) is connected to the first support (42) and to the active bending member (45) such that activation of said inlet actuator (47) moves the active bending member (45) with respect to the first support (42) in cooperation with said guiding means between a standby position, in which the active bending member (45) does not interfere with the simple side wall (2) of the die cut plate (5), and a bending position, in which the active bending member (45) pushes the simple side wall (2) to bend it with respect to the base wall (1) of the die cut plate (5) in cooperation with the plunger (70).

14. The machine for forming prismatic box bases or lids according to claim 13, **characterized in that** said guiding means comprise a shaft (46) perpendicular to the first direction (Z) pivotally connecting the active bending member (45) to the first support (42), such that activation of the inlet actuator (47) pivots the active bending member (45) around said shaft (46) between said standby position and said bending position.

15. The machine for forming prismatic box bases or lids according to any one of claims 1 to 10, **characterized in that** each of the simple wall bending elements (12) comprises a first support (42) on which there is installed an arm (51) having a retaining catch (53) fixed at one end and being movable in a guided manner between a retaining position determined by a stop, in which said retaining catch (53) projects from the front surface (12b), and a withdrawn position, in which the retaining catch (53) does not project from the front surface (12b), and an elastic element (54) connected to said arm (51) and to the first support (42) pushes the arm (51) towards said retaining position.

16. The machine for forming prismatic box bases or lids according to claim 1, **characterized in that** said plunger (70) comprises a pressure element (71) providing a pressure surface perpendicular to the first direction (Z) and having an outer contour consistent with the polygon, anvil walls (72) providing said anvil surfaces, which are parallel to the front surfaces (12b) of the simple wall bending elements (12), and a connection element (73) which is connected to a moving member of said drive mechanism of the plunger, where said pressure element (71) presses against the base wall (1) of the die cut plate (5) and

introduces it into the molding cavity (11) when the plunger is moved from said extracted position to said introduced position, and where said anvil walls (72) withstand the pressure exerted by the pressure blades (14) when the plunger (70) is in the introduced position.

17. The machine for forming prismatic box bases or lids according to claim 16, **characterized in that** the anvil walls (72) of the plunger (70) have a first end fixed to the pressure element (71) and a second end opposite said first end fixed to a structural element (74).

18. The machine for forming prismatic box bases or lids according to claim 16 or 17, **characterized in that** both the pressure element (71) and said structural element (74) have a central opening, and said connection element (73) is fixed to a support bridge (75) having opposite ends connected to two of the opposite anvil walls (72).

19. The machine for forming prismatic box bases or lids according to claim 16 or 17, **characterized in that** said support bridge (75) has slides (76) fixed thereto at said opposite ends and coupled in a sliding manner to bridge guides (77) parallel to the first direction (Z) fixed to said two opposite anvil walls (72), and a regulating elements (78) fixing said slides (76) in a selected position along said bridge guides (77) in the first direction (Z).

20. The machine for forming prismatic box bases or lids according to any one of the preceding claims, **characterized in that** a glue applicator device (81) is installed in the structure (10), wherein said glue applicator device (81) deposits glue on predetermined areas of each die cut plate (5) before the die cut plate (5) is arranged on the inlet opening of the molding cavity (11).

21. The machine for forming prismatic box bases or lids according to claim 16 or 17, **characterized in that** said glue applicator device (81) comprises a hot glue applicator unit (82) having at least one hot glue application element (83) depositing hot glue on the die cut plates (5) and a cold glue applicator unit (84) having at least one cold glue application element (85) depositing cold glue on the die cut plates (5).

22. The machine for forming prismatic box bases or lids according to claim 20 or 21, **characterized in that** a sheet loader (86) and a conveyor device (80) are installed in the structure (10), wherein said conveyor device (80) conveys the die cut plates one by one (5) from said sheet loader (86) to an initial position on the inlet opening of the molding cavity (11), and said glue applicator device (81) deposits glue on the die cut plates (5) while the die cut plates (5) are conveyed by said conveyor device (80).

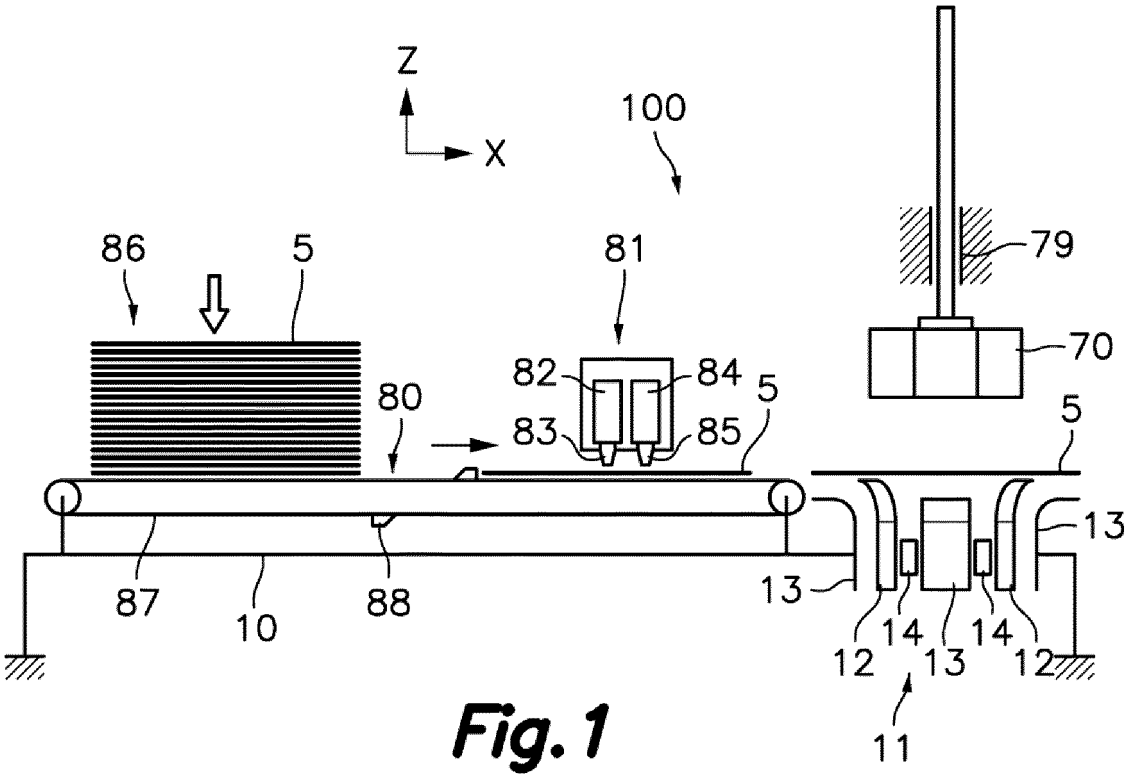
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Fig. 1

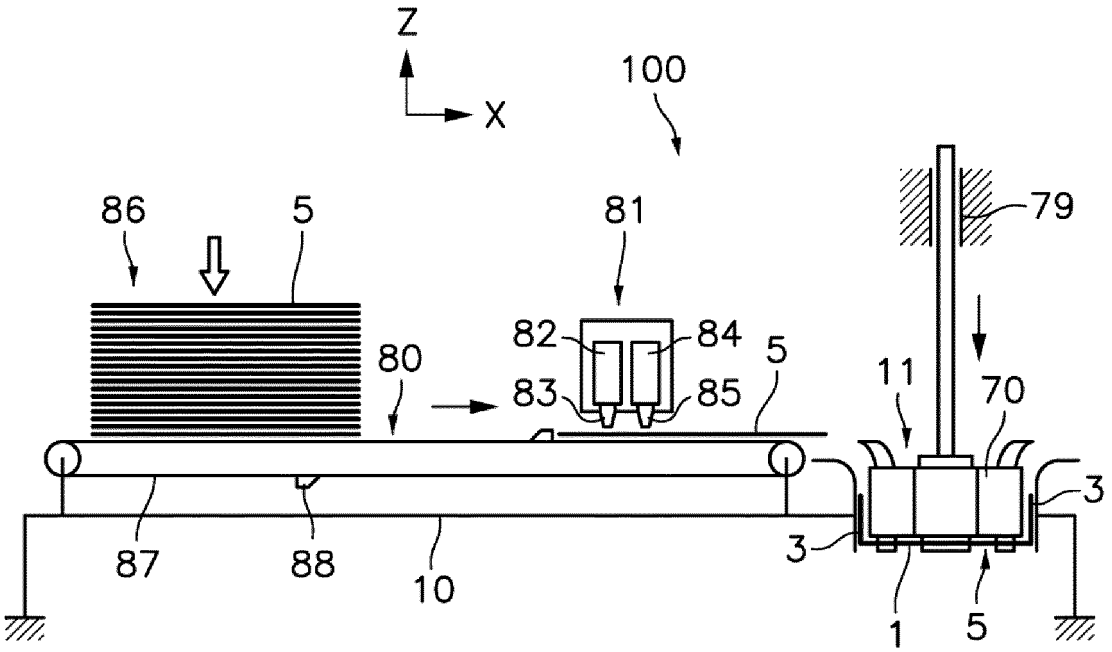
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Fig. 2

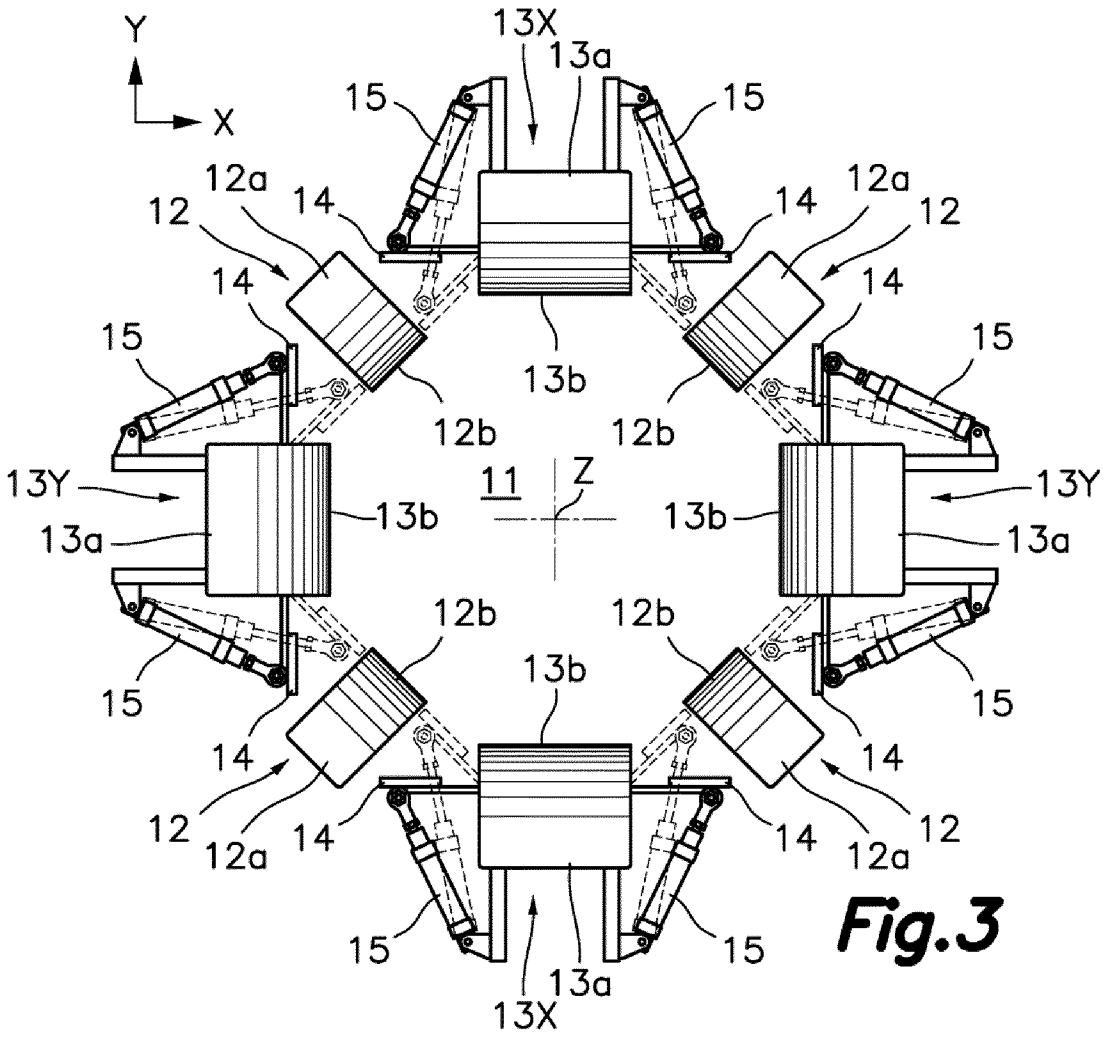

Fig.3

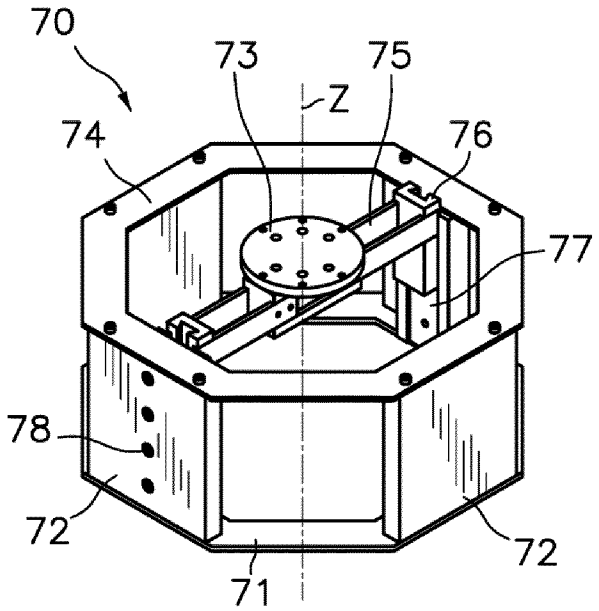

Fig.4

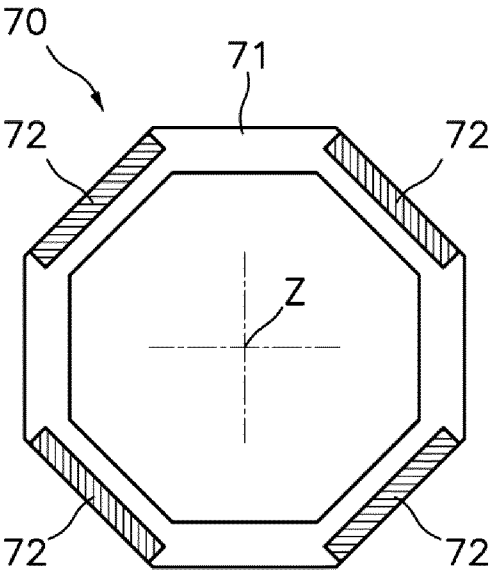

Fig.5

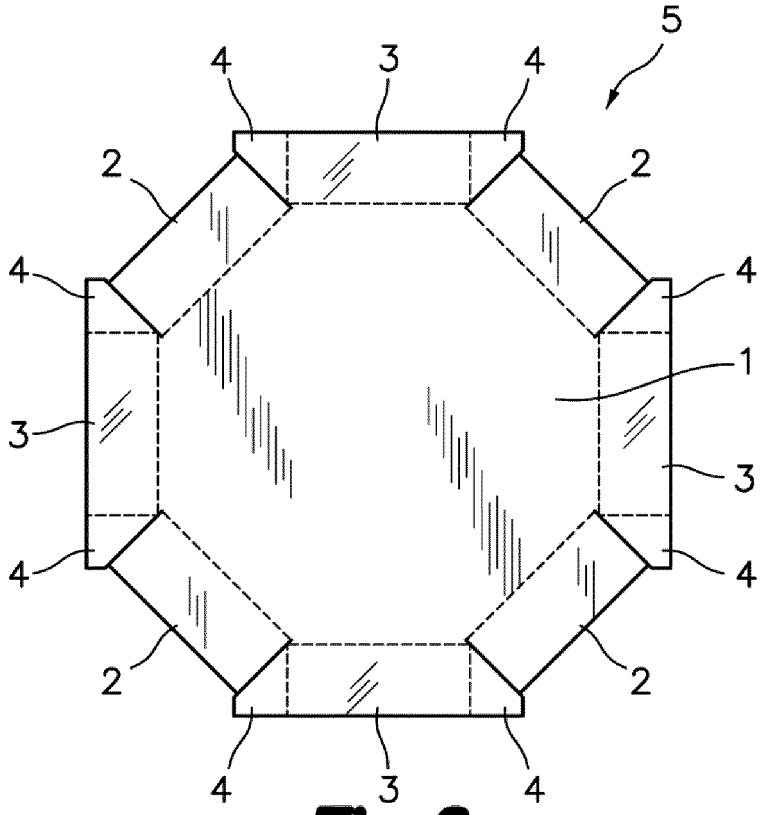

Fig.6

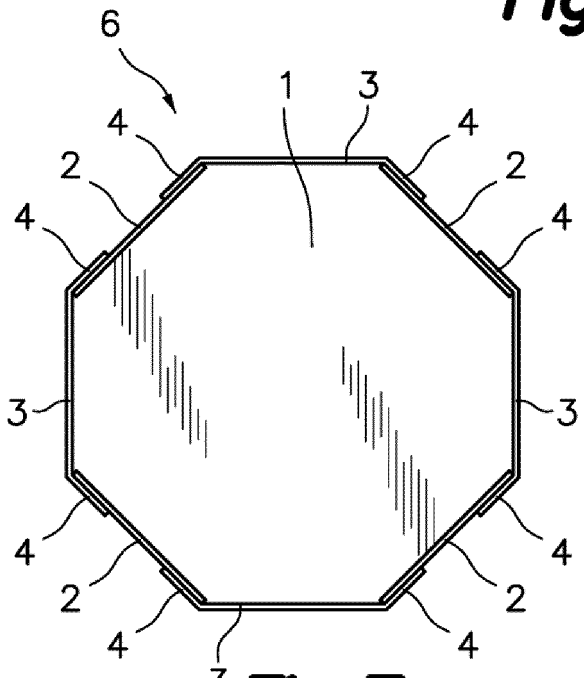

Fig.7

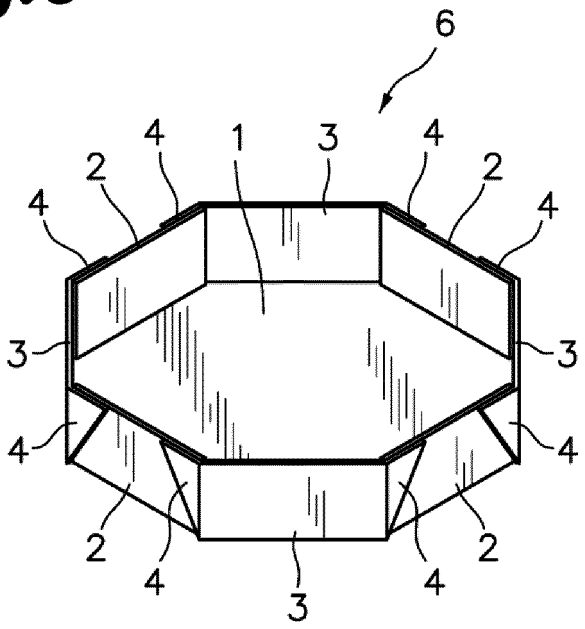

Fig.8

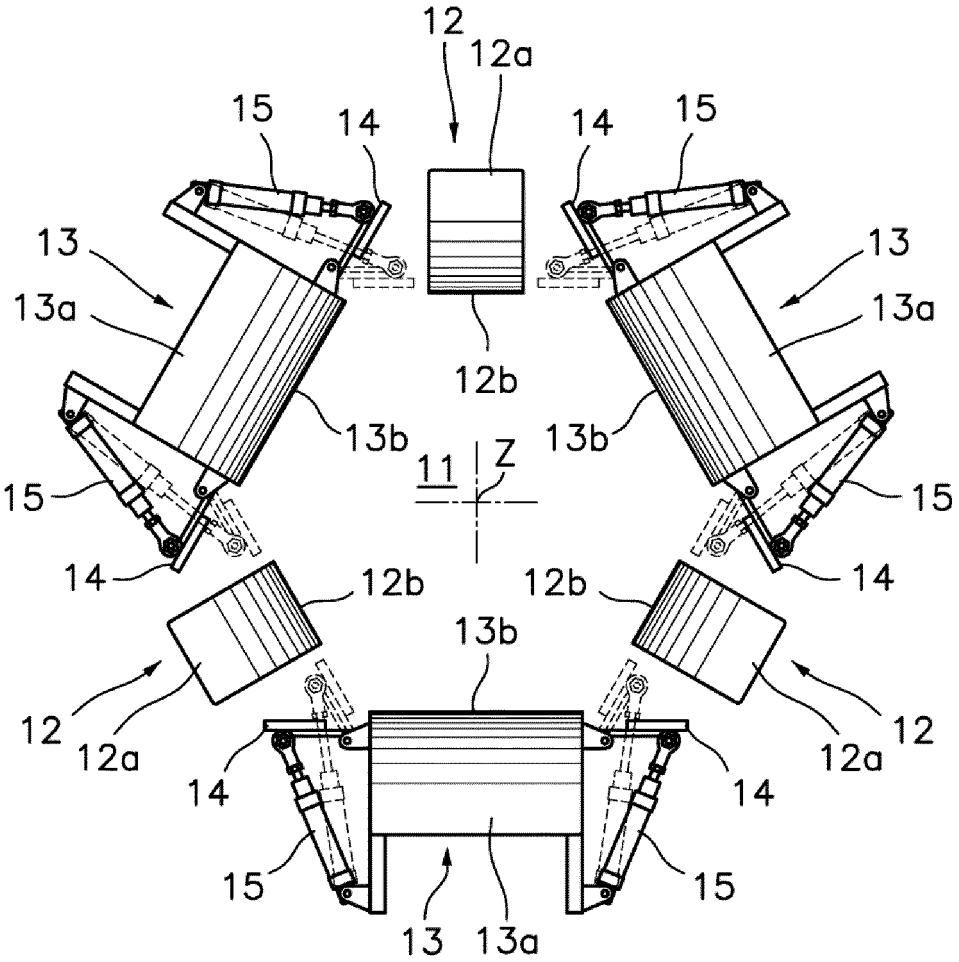
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Fig.9

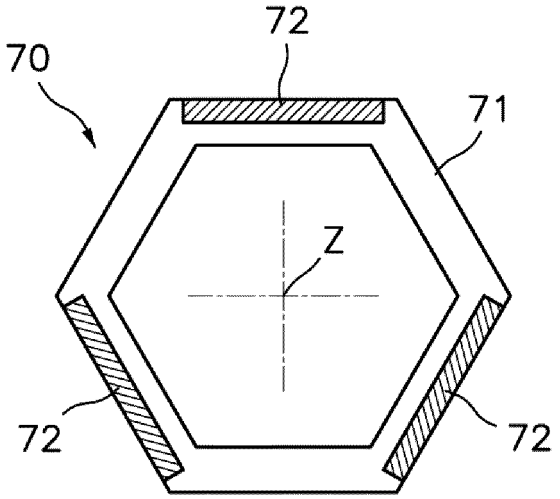
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Fig.10

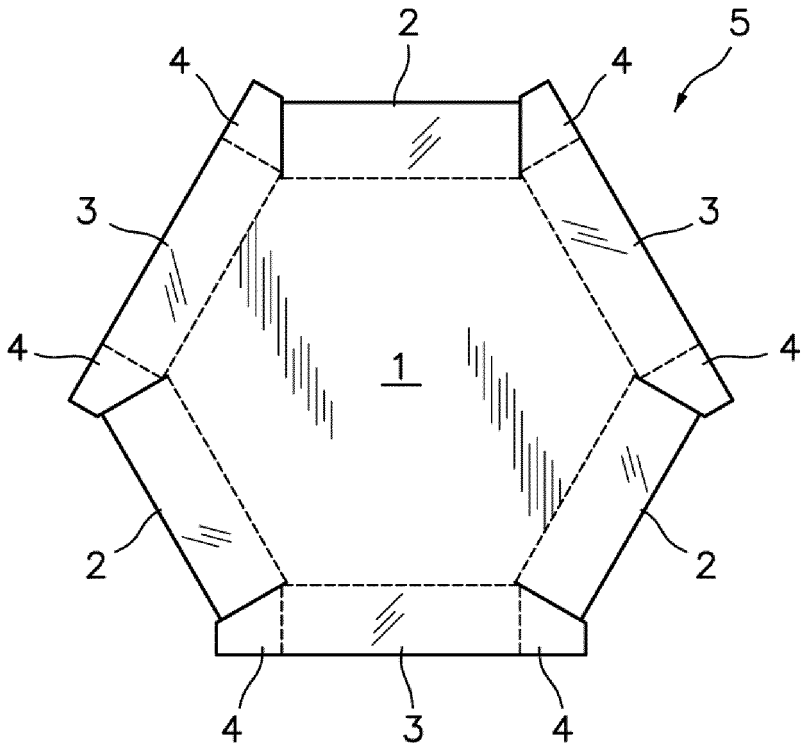

Fig. 11

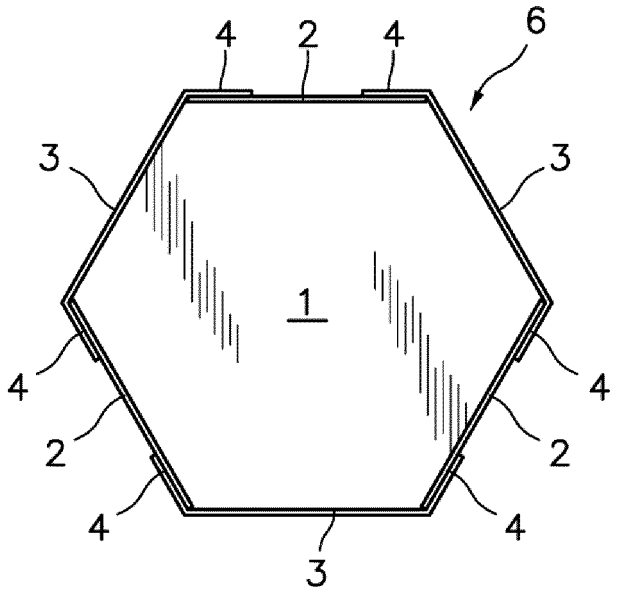

Fig. 12

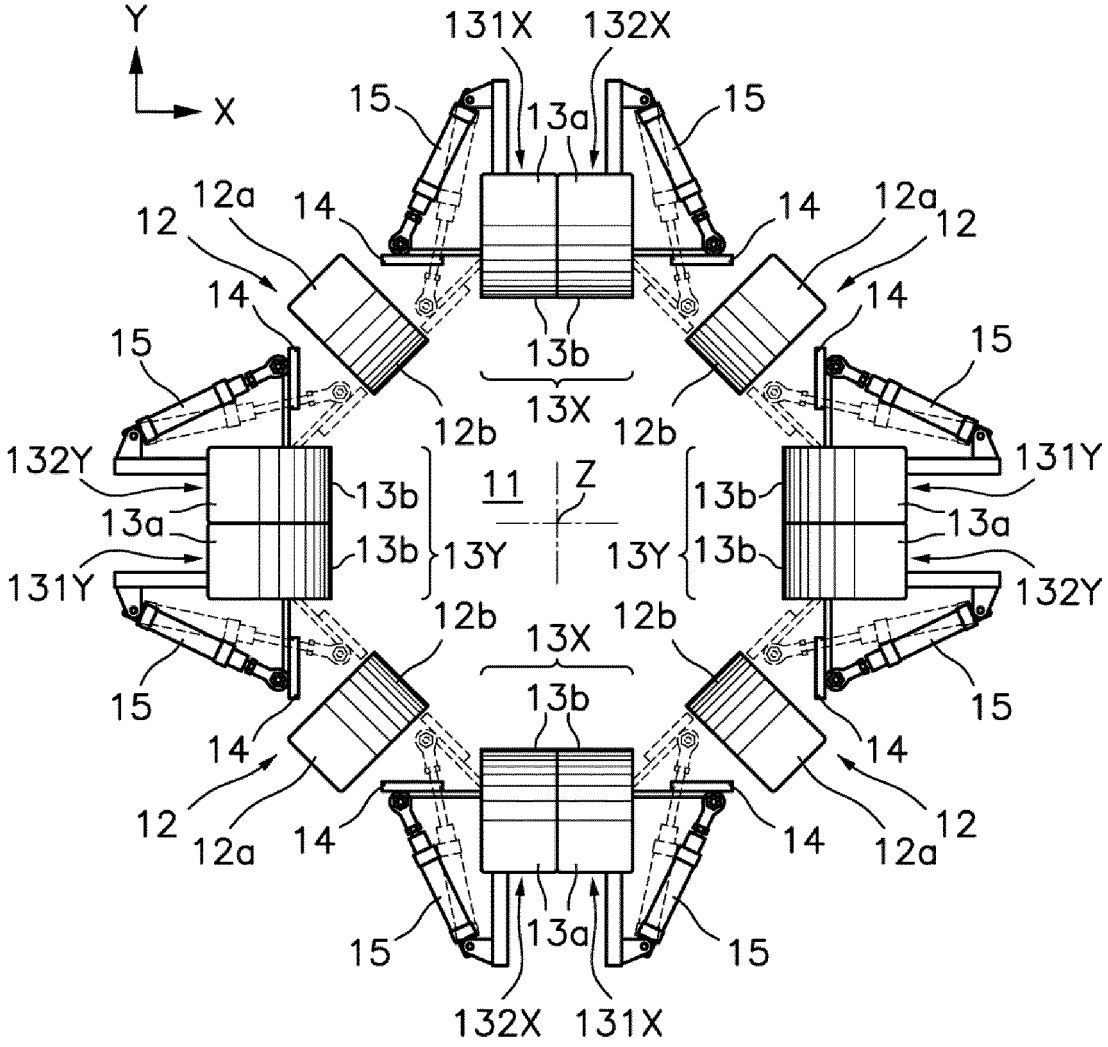
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Fig. 13

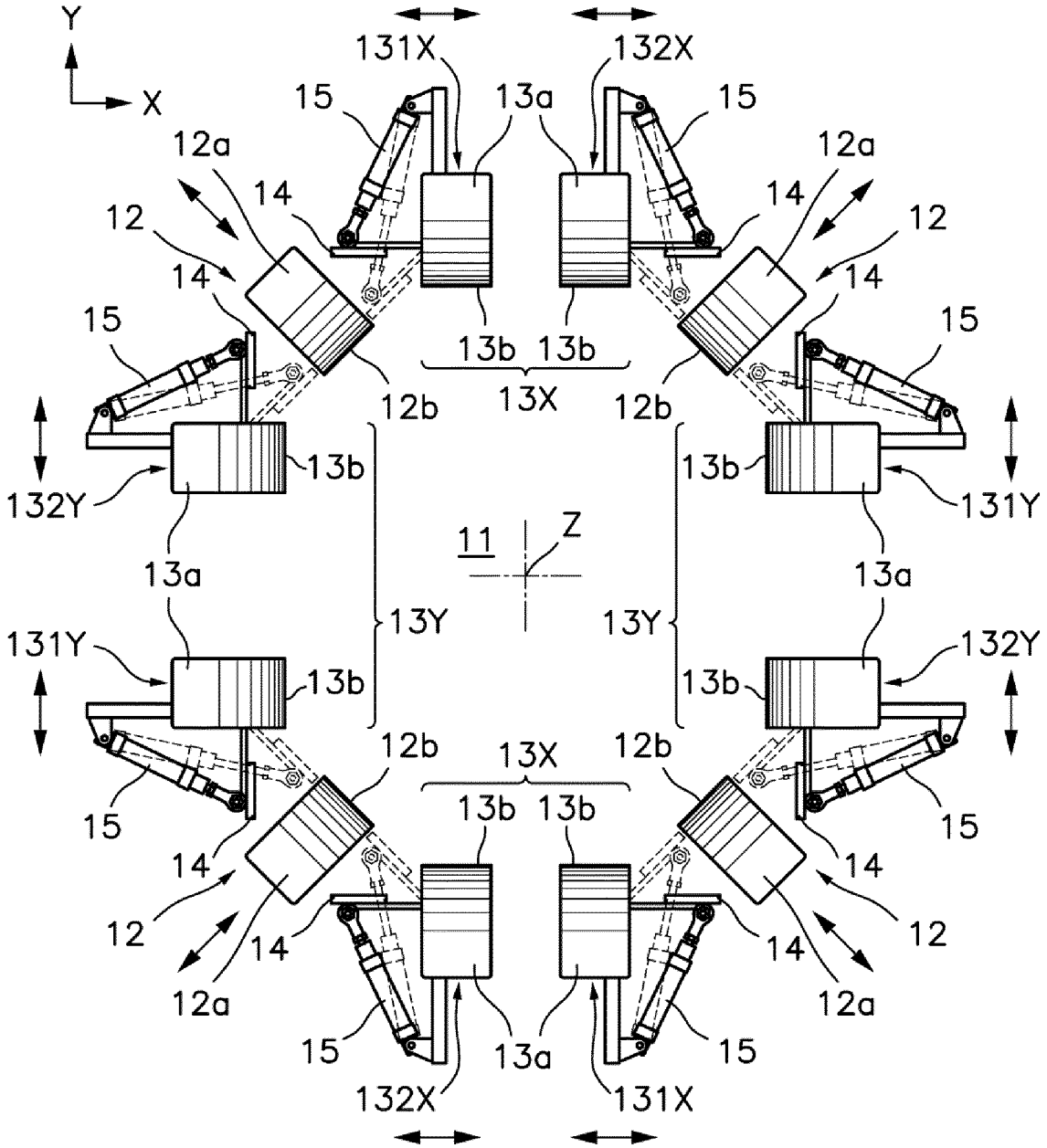

Fig. 14

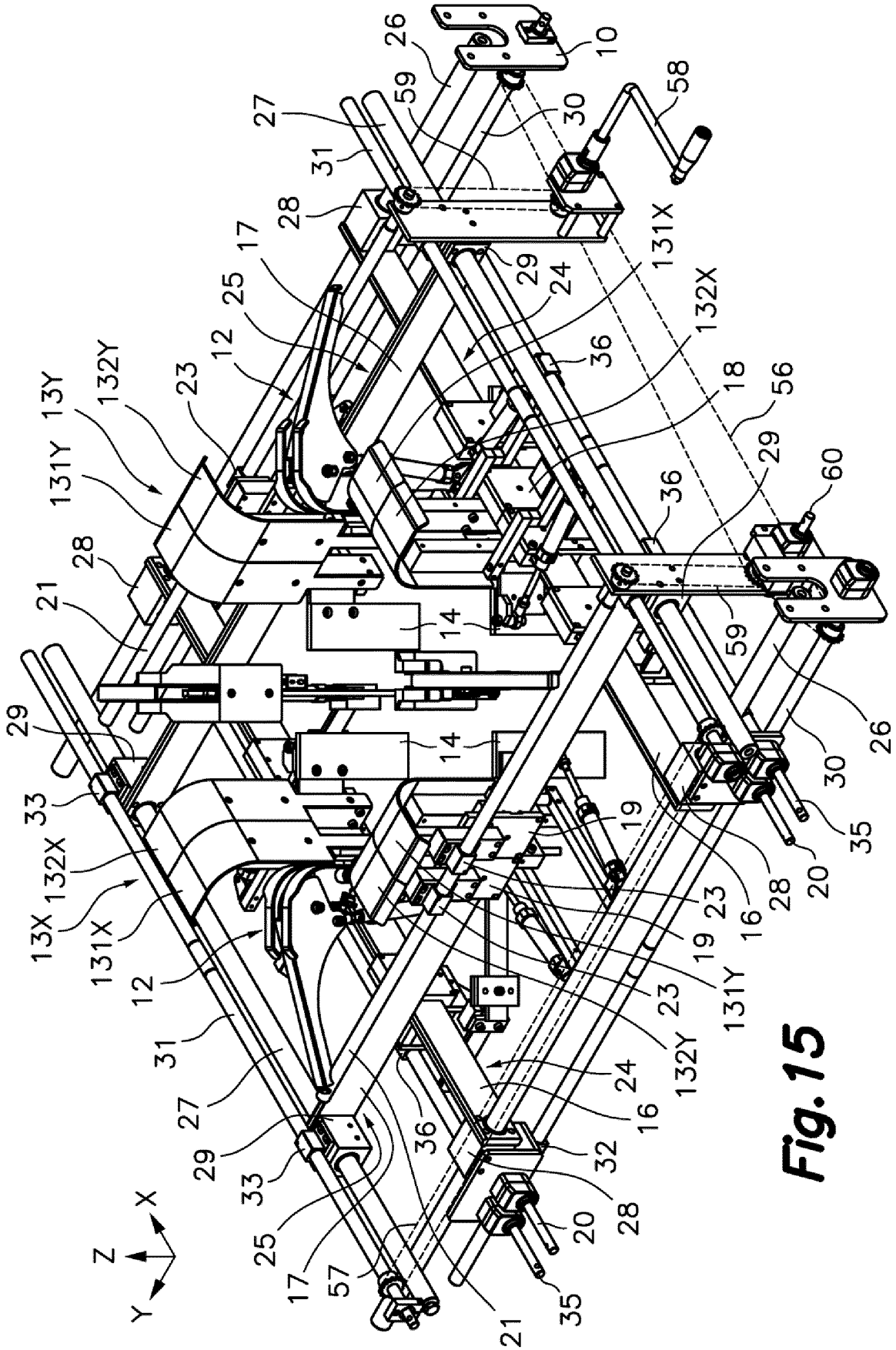
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Fig.15

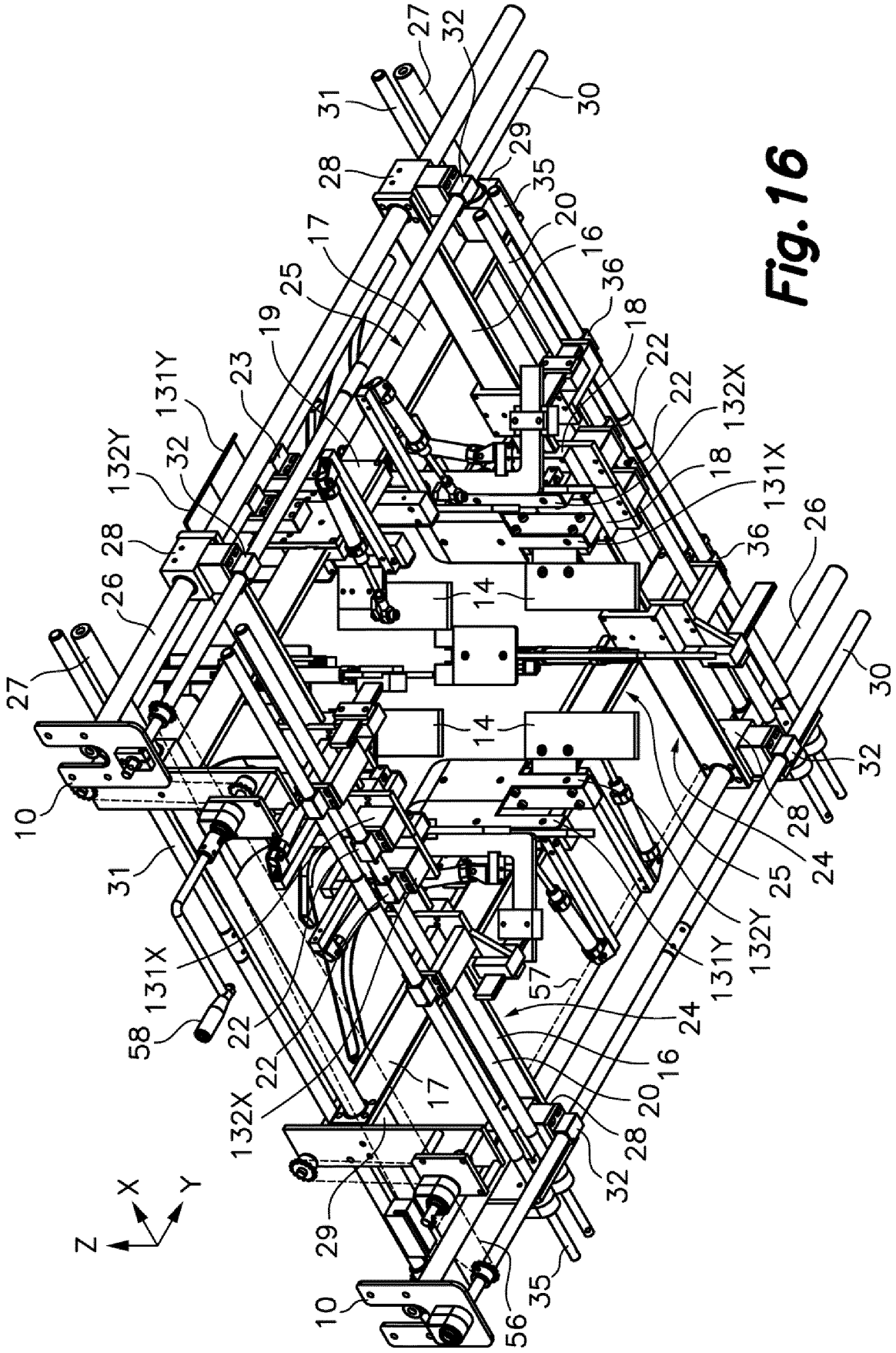
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Fig.16

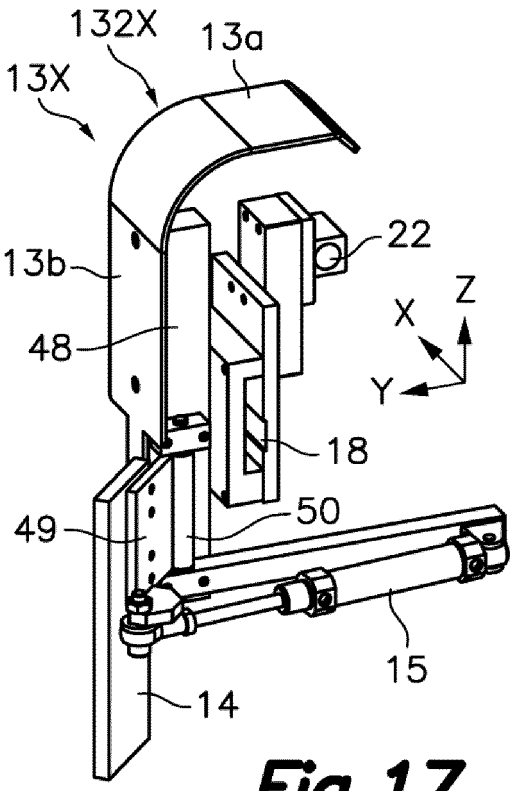

Fig.17

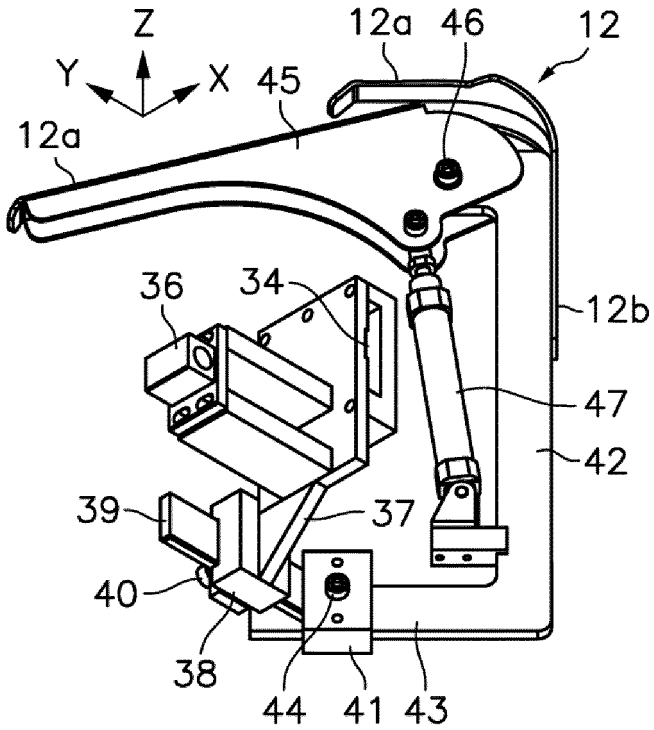

Fig.18

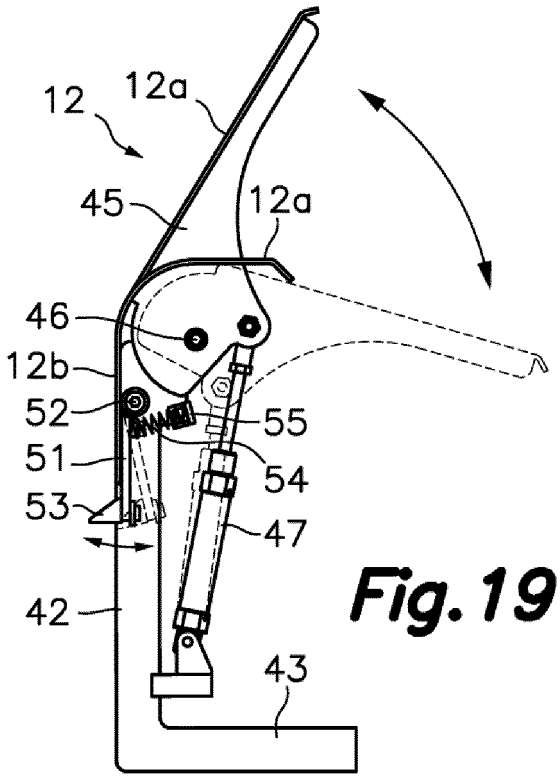

Fig.19

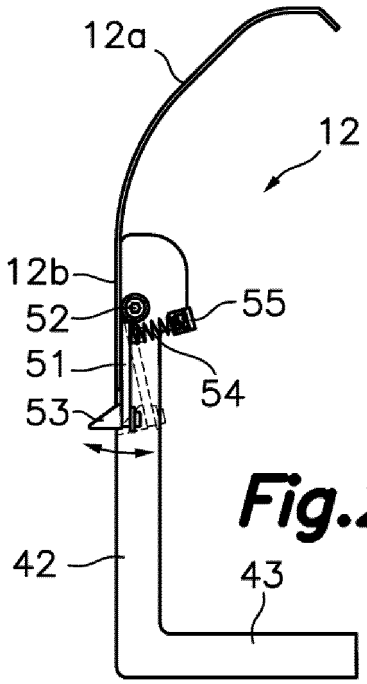

Fig.20

INTERNATIONAL SEARCH REPORT

International application No.
PCT/ES2016/000065

A. CLASSIFICATION OF SUBJECT MATTER

B31B1/48 (2006.01)
B31B1/60 (2006.01)
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
B31B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPODOC, INVENES

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2696612 A (RICKUS GEORGE M) 14/12/1954, Columnas 1-4; figures 1-5	1, 16
A	US 3283673 A (GETTELMAN GILBERT C) 08/11/1966, Columnas 6-7; figures 1-10	1, 16
A	JP 2010222024 A (RENGO CO LTD) 07/10/2010, Figures & abstract from DataBase EPODOC. Retrieved in EPOQUE; AN- JP-2009069710-A	1, 16
A	JP 2009067566 A (KIMURA KIGATA KK) 02/04/2009, Figures & abstract from DataBase EPODOC. Retrieved in EPOQUE; AN- JP-2007239698-A	1, 16

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
11/07/2016	**(12.07.2016)**
Name and mailing address of the ISA/ OFICINA ESPAÑOLA DE PATENTES Y MARCAS Paseo de la Castellana, 75 - 28071 Madrid (España) Facsimile No.: 91 349 53 04	Authorized officer J. Hernández Cerdán Telephone No. 91 3495339

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/ES2016/000065

C (continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of documents, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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A	ES 1073027U U (BOIX MAQUINARIA SA BOIX MAQUINARIA SA ET AL.) 20/10/2010, Page 5; figures 1-4	1

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.
PCT/ES2016/000065

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