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

(57) The mandrel (70) comprises a pressing element (71) providing a pressing surface perpendicular to a longitudinal direction (Z) parallel to a path of movement of the mandrel (70), the pressing surface having a polygonal-shaped outer contour with an even number of sides greater than four, die walls (72) providing die surfaces parallel to longitudinal direction (Z), side walls (24), and a connecting element (73) which is connected to a movable member of a mandrel operating mechanism. The die walls (72) being fixed to the pressing element (71) and associated with alternate sides of the polygonal shape and the side walls (24) being fixed to the pressing element (71) and/or to the die walls (72) and associated with the remaining alternate sides of the polygonal shape not associated with the die walls (72).

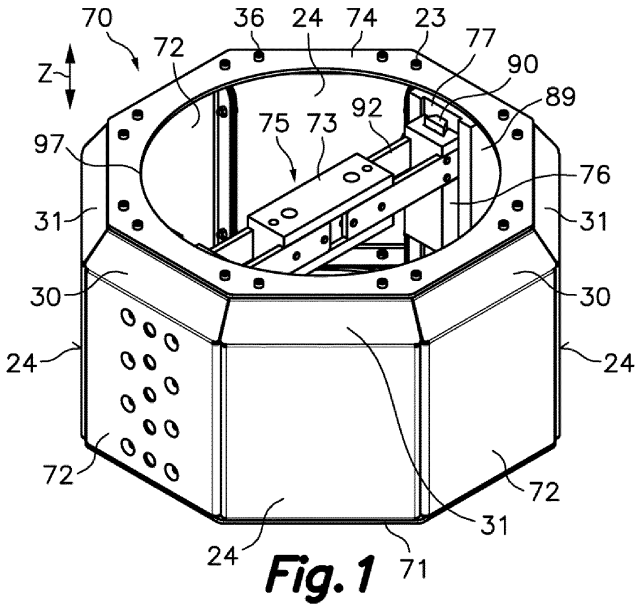

Fig. 1

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Description

Field of the Art

[0001] The present invention generally relates to a mandrel which can be applied in a machine for forming bases or lids of prismatic boxes by folding and joining die-cut blanks, and more particularly to a mandrel for a machine forming bases or lids of prismatic boxes having a polygonal base with an even number of sides greater than four.

Background of the Invention

[0002] Spanish patent application number P201530802 belonging to the same inventor as the present application discloses a machine for forming bases or lids of prismatic boxes having a polygonal base with an even number of sides greater than four. The machine comprises an adjustable mold and a movable mandrel operated such that it successively introduces initially planar die-cut blanks by means of a back and forth movement into the mold to form the bases or lids by folding and joining the die-cut blanks. The die-cut blanks are made of a sheet of relatively rigid material, such as a sheet of cardboard, a sheet of corrugated cardboard, a sheet of plastic, a sheet of corrugated plastic, and similar materials, for example, and are provided with perforated lines and cuts defining walls, tabs, and flaps which will form the elements of the base or lid once they are folded and joined by the mandrel collaborating with the different elements making up the mold.

[0003] Spanish patent application number P201531635, which is a divisional application of the mentioned Spanish patent application number P201530802, relates to a mandrel for a machine forming bases or lids of prismatic boxes by folding and joining die-cut blanks, the invention comprising a pressing element providing a pressing surface perpendicular to a longitudinal direction parallel to a path of movement of the mandrel, side walls fixed to the pressing element, and a connecting element which is connected to a movable member of a mandrel operating mechanism. The pressing element has a polygonal-shaped outer contour with an even number of sides greater than four. The side walls are die walls associated with alternate sides of the polygonal shape of the contour of the pressing element and these die walls provide die surfaces parallel to the longitudinal direction.

Disclosure of the Invention

[0004] The present invention provides a mandrel for a machine forming bases or lids of prismatic boxes by folding and joining die-cut blanks, wherein the mandrel comprises a pressing element providing a pressing surface perpendicular to a longitudinal direction parallel to a path of movement of the mandrel, die walls providing die surfaces parallel to the longitudinal direction and a connecting element which is connected to a movable member of a mandrel operating mechanism. The pressing surface has a polygonal-shaped outer contour with an even number of sides greater than four, and the die walls are fixed to the pressing element and associated with alternate sides of the polygonal shape of the contour of the pressing surface.

[0005] The mandrel comprises side walls associated with the remaining alternate sides of the polygonal shape of the contour of the pressing surface not associated with the die walls, said side walls being fixed to the pressing element and/or to the die walls.

[0006] During operation, the mandrel performs a back and forth movement along the mentioned path of movement of the mandrel, including an introduction stroke, whereby the mandrel is introduced into the mold of the machine, and an extraction stroke, whereby the mandrel is extracted from the mold of the machine. Throughout this description, the terms "front" and "rear" are used in relation to the mentioned introduction stroke of the movement of the mandrel.

[0007] In one embodiment, each of the die walls is obtained from a cut-out and bent plate element having a front tab fixed to the pressing element and a rear tab fixed to a structural element opposite the pressing element. The pressing element and the mentioned structural element are made of respective planar plate elements that are parallel to one another. The front tabs of the die walls are bent inward, parallel to the pressing element, and fixed to the pressing element by means of screws installed through respective holes that are aligned with one another. The rear tabs of the die walls are bent inward, parallel to the structural element, and fixed to the structural element by means of screws installed through respective holes that are aligned with one another.

[0008] In one embodiment, each of the side walls is likewise obtained from a cut-out and bent plate element having a side surface parallel to the longitudinal direction, a front tab fixed to the pressing element, and a rear tab fixed to the structural element. The front tabs of the side walls are bent inward, parallel to pressing element, and fixed to the pressing element by means of screws installed through respective holes that are aligned with one another. The rear tabs of the side walls are bent inward, parallel to the structural element, and fixed to the structural element by means of screws installed through respective holes that are aligned with one another.

[0009] Preferably, the die walls and the side walls have respective side tabs arranged against one another and connected together by screws installed through respective holes that are aligned with one another. Optionally, the die walls and the side walls have respective rear bevel portions tilting inward, and the structural element has a polygonal-shaped outer contour which is similar to the contour of the pressing surface and has a smaller dimension than the contour of the pressing surface.

[0010] In a variant of this embodiment, the even number of sides greater than four of the polygonal shape

of the contour of the pressing surface is eight, and accordingly, the die walls are four in number and the side walls are four in number. In this case, the structural element has a central opening, and the mentioned connecting element is fixed to a support bridge having opposite ends connected to two of the opposite die walls or to two of the opposite side walls.

[0011] In another variant of this embodiment, the even number of sides greater than four of the polygonal shape of the contour of the pressing surface is six, and accordingly, the die walls are three in number and the side walls are three in number. In this case, the structural element has a central opening, and the connecting element is fixed to a support bridge having a first end connected to one of the die walls and a second end connected to one of the opposite side walls.

[0012] In another embodiment, each of the die walls is obtained from a solid cut and/or machined element having a front surface fixed to the pressing element and a rear surface fixed to a structural element opposite the pressing element, for example by means of screws. Similarly, each of the side walls is obtained from a solid cut and/or machined element having a lower surface fixed to the pressing element and an upper surface fixed to the structural element, for example by means of screws.

[0013] In a variant of this embodiment, the number of sides of the polygonal shape of the contour of the pressing surface is eight, the die walls are four in number and the side walls are four in number. In another variant of this embodiment, the number of sides of the polygonal shape of the contour of the pressing surface is six, the die walls are three in number and the side walls are three in number.

[0014] In another embodiment, the pressing element has cut-outs facing the alternate sides of the polygonal shape of the pressing surface associated with the side walls, and the side walls are located adjacent to these cut-outs in more inward positions than the corresponding sides of the polygonal shape of the pressing surface. In this case, each of the side walls is obtained from a solid element having, for example, a side surface parallel to the longitudinal direction. This solid element is fixed at the edges thereof to appendices of the die walls, and alternatively or additionally to the pressing element, and alternatively or additionally to the structural element.

[0015] Rocker arms that pivot between an active position and an inactive position about respective pivoting shafts supported in the side walls are installed in the cut-outs of the pressing element. The pivoting shafts are perpendicular to the longitudinal direction and parallel to the corresponding sides of the polygonal shape of the contour of the pressing surface.

[0016] The rocker arms have a front surface which is coplanar with and complementary to the pressing surface of the pressing element in the active position, and tilted forward with respect to the pressing surface of the pressing element in said inactive position, and an outer edge which provides the corresponding side of the polygonal shape of the contour of the pressing surface in the active position, and which is displaced inward with respect to the corresponding side of the polygonal shape of the contour of the pressing surface in the inactive position.

[0017] Between each rocker arm and the corresponding side wall there is arranged an elastic element which drives the rocker arm to the active position, and the active position of each rocker arm is determined by a stop. In a possible embodiment, the elastic element is a torsion coil spring arranged around said pivoting shaft. In a possible embodiment, the stop is an adjustable stop which is attached to a threaded rod coupled to a threaded hole formed in a stop support fixed to the side wall.

[0018] In a variant of this embodiment of the mandrel with rocker arms, the even number of sides greater than four of the polygonal shape of the contour of the pressing surface is eight, and accordingly, the die walls are four in number and the side walls are four in number. In this case, the structural element has a central opening, and the mentioned connecting element is fixed to a support bridge having opposite ends connected to two of the opposite die walls or to two of the opposite side walls.

[0019] In another variant of this embodiment of the mandrel with rocker arms, the even number of sides greater than four of the polygonal shape of the contour of the pressing surface is six, and accordingly, the die walls are three in number and the side walls are three in number. In this case, the structural element has a central opening, and the connecting element is fixed to a support bridge having a first end connected to one of the die walls and a second end connected to one of the opposite side walls.

[0020] In yet another embodiment, the mandrel includes two or more common wall members obtained from cut-out and bent plate elements, each common wall member including one or more sections of die wall and one or more sections of side wall alternating with one another and connected together at their adjacent side edges.

Brief Description of the Drawings

[0021] The foregoing features will be better understood based on the detailed description of several embodiments in reference to the attached drawings, in which:

Figure 1 is a perspective view of a mandrel according to a first embodiment of the present invention, showing the rear side thereof;

Figure 2 is a perspective view of the mandrel of Figure 1, showing the front side thereof;

Figure 3 is an exploded perspective view of the mandrel of Figures 1 and 2;

Figure 4 is a cross-section view of the mandrel of Figures 1 and 2 taken along a central plane parallel to a longitudinal direction of the mandrel;

Figure 5 is a partial cross-section view of the mandrel of Figures 1 and 2 taken along a plane perpendicular

to the longitudinal direction;

Figure 6 is a perspective view of a mandrel according to a second embodiment of the present invention, showing the rear side thereof;

Figure 7 is a perspective view of the mandrel of Figure 6, showing the front side thereof;

Figure 8 is a perspective view of a mandrel according to a third embodiment of the present invention, showing the rear side thereof;

Figure 9 is a perspective view of the mandrel of Figure 8, showing the front side thereof;

Figure 10 is a cross-section view of the mandrel of Figures 8 and 9 taken along a central plane parallel to a longitudinal direction of the mandrel;

Figure 11 is a partial cross-section view of the mandrel of Figures 8 and 9 taken along a plane perpendicular to the longitudinal direction;

Figure 12 is a perspective view of a mandrel according to a fourth embodiment of the present invention, showing the rear side thereof;

Figure 13 is a perspective view of the mandrel of Figure 8, showing the front side thereof;

Figure 14 is a cross-section view of the mandrel of Figures 12 and 13 taken along a central plane parallel to a longitudinal direction of the mandrel;

Figure 15 is a cross-section view of the mandrel of Figures 12 and 13 taken along a plane perpendicular to the longitudinal direction;

Figure 16 is an exploded perspective view of a mandrel according to a fifth embodiment of the present invention;

Figure 17 is an exploded perspective view of a mandrel according to a sixth embodiment of the present invention; and

Figure 18 is a cross-section view of a mandrel according to a seventh embodiment of the present invention taken along a plane perpendicular to the longitudinal direction.

Detailed Description of Several Embodiments

[0022] First, in relation to Figures 1 to 5, reference number 70 generally designates a mandrel according to a first embodiment of the present invention, which comprises a pressing element 71 located at a front end, a structural element 74 located at a rear end, as well as die walls 72 and side walls 24 connected to the pressing element 71 and structural element 74. The mandrel 70 further includes a connecting element 73 which is connected to a movable member of a mandrel operating mechanism.

[0023] The pressing element 71 provides a pressing surface perpendicular to a longitudinal direction Z parallel to a path of movement of the mandrel 70. The pressing surface has an octagonal-shaped outer contour. The die walls 72 are four in number and are associated with alternate sides of the octagonal shape of the contour of the pressing surface, whereas the side walls 24 are four in number and are associated with the remaining alternate sides of the octagonal shape of the contour of the pressing surface not associated with the die walls 72. The die walls 72 and the side walls 24 provide die surfaces and side surfaces, respectively, which are parallel to the longitudinal direction Z and parallel to the corresponding sides of the octagonal shape of the contour of the pressing surface.

[0024] Each of the die walls 72 is obtained from a cut-out and bent plate element having a front tab 20 that is bent inward, a rear tab 21 that is bent inward, and side tabs 27 that are bent inward. Each of the side walls 24 is likewise obtained from a cut-out and bent plate element having a front tab 25 that is bent inward, a rear tab 26 that is bent inward, and side tabs 28 that are bent inward. The pressing element 71 and the structural element 74 are made of respective planar plate elements that are parallel to one another, and the front and rear tabs 20, 21 of the die walls 72 and the front and rear tabs 25, 26 of the side walls 24 are parallel to the pressing element 71 and to the structural element 74.

[0025] Both the die walls 72 and the side walls 24 have respective rear bevel portions 30, 31 tilting inward, and the structural element 74 has an octagonal-shaped outer contour similar to the contour of the pressing surface although of a smaller dimension than the contour of the pressing surface.

[0026] The front tabs 20 of the die walls 72 and are fixed to the pressing element 71 by means of screws 22 installed through respective holes that are aligned with one another, and the rear tabs 21 of the die walls 72 are fixed to the structural element 74 by means of screws 23 installed through respective holes that are aligned with one another. Similarly, the front tabs 25 of the side walls 24 are fixed to the pressing element 71 by means of screws 35 installed through respective holes that are aligned with one another, and the rear tabs 26 of the side walls 24 are fixed to the structural element 74 by means of screws 36 installed through respective holes that are aligned with one another. Furthermore, the side tabs 27, 28 of the die walls 72 and of the side walls 24 are arranged against one another and connected together by screws 29 installed through respective holes that are aligned with one another.

[0027] The mentioned connecting element 73 is fixed to a support bridge 75 having opposite ends connected to two of the opposite die walls 72, although they may be connected to two of the opposite side walls 24 with an equivalent result. The structural element 74 has a central opening 97 which provides access to the inside of the mandrel and through which the connecting element 73 is connected to the mentioned movable member of the mandrel operating mechanism. The pressing element 71 also has a central opening 96 providing access to the inside of the mandrel.

[0028] Support bodies 89 are fixed to two of the opposite die walls 72 by means of screws 91. The support bodies 89 have bridge guides 77 formed thereon parallel

to the longitudinal direction Z. The support bridge 75 comprises arms 92 having adjacent ends fixed to the connecting element 73 by means of screws 94 and opposite ends fixed to runners 76 by means of screws 93. The runners 76 are slidingly coupled to the bridge guides 77 and have respective channels with a trapezoidal cross-section parallel to the longitudinal direction Z in which clamping strip 90 with a matching trapezoidal cross-section are slidingly coupled. Regulating elements 78 formed by clamping screws are installed in the corresponding holes existing in the die walls 72 and coupled into threaded holes formed in the clamping strips 90. The regulating elements 78 allow fixing the runners 76 in a selected position along the bridge guides 77.

[0029] Figures 6 and 7 show a mandrel according to a second embodiment of the present invention, which has a construction similar to that of the first embodiment described above in relation to Figures 1 to 5, with the only difference being that in this second embodiment, the shape of the contour of the pressing surface is hexagonal, the die walls 72 are three in number, and the side walls 24 are three in number. Accordingly, in this second embodiment each of the die walls 72 is arranged parallel to and opposite one of the side walls 24, and the opposite ends of the arms 92 of the support bridge 75 supporting the connecting element 73 are thereby respectively connected to one of the die walls 72 and to one of the side walls 24 that are arranged opposite one another.

[0030] Figures 8 to 11 show a mandrel according to a third embodiment of the present invention, which comprises a pressing element 71 located at a front end, a structural element 74 located at a rear end, die walls 72 and side walls 24 connected to the pressing element 71 and structural element 74, and a connecting element 73 which is connected to a movable member of a mandrel operating mechanism. The pressing surface has an octagonal-shaped outer contour. The die walls 72 are four in number and are associated with alternate sides of the octagonal shape of the contour of the pressing surface, whereas the side walls 24 are four in number and are associated with the remaining alternate sides of the octagonal shape of the contour of the pressing surface not associated with the die walls 72. The die walls 72 provide die surfaces parallel to the longitudinal direction Z and parallel to the corresponding sides of the octagonal shape of the contour of the pressing surface.

[0031] In this third embodiment, the construction of the die walls 72 and their fixing to the pressing element 71 and to the structural element 74 is similar to that of the first embodiment described above in relation to Figures 1 to 5. Nevertheless, in this third embodiment, the side walls 24 are moved towards the inside of the mandrel and the pressing element 71 has cut-outs 32 formed thereon facing the alternate sides of the octagonal shape of the pressing surface associated with the side walls 24, and the side walls 24 are located adjacent to an inner side of the cut-outs 32. The structural element 74 also has cut-outs 42 located in line with the cut-outs 32 of the pressing element 71.

[0032] The plate elements forming the die walls 72 have appendices 98 extending into the mandrel. Each of the side walls 24 is obtained from a solid cut or machined element having a side surface parallel to the longitudinal direction Z and parallel to the corresponding side of the octagonal shape of the pressing surface, and this solid element is fixed to the appendices 98 of the die walls 72 by means of screws 95. Alternatively, the solid elements forming the side walls 24 may be fixed by means of screws to the pressing element 71 and/or to the structural element 74 with an equivalent result.

[0033] The side walls 24 support respective pivoting shafts 34 perpendicular to the longitudinal direction Z and parallel to the corresponding sides of the octagonal shape of the contour of the pressing surface. Rocker arms 33 are installed in cut-outs 32 such that they can pivot about the pivoting shafts 34 between an active position (depicted by means of solid lines in Figure 10) and an inactive position (depicted by means of dashed lines in Figure 10).

[0034] Each of the rocker arms 33 has a front surface 33a and an outer edge 33b. In the active position, the front surface 33a is coplanar with and complementary to the pressing surface of the pressing element 71 and the outer edge 33b provides the corresponding side of the octagonal shape of the contour of the pressing surface. In the inactive position, the front surface 33a is tilted forward with respect to the pressing surface of the pressing element 71 and the outer edge 33b is displaced inward with respect to the corresponding side of the octagonal shape of the contour of the pressing surface.

[0035] An elastic element 37 formed by a torsion coil spring having one end connected to the corresponding rocker arm 33 and the other end connected to the corresponding side wall 24 is arranged around each pivoting shaft 34. This elastic element 37 drives the rocker arm 33 to the active position. The active position of each rocker arm 33 is determined by an adjustable stop 38, which is attached to a threaded rod 39 coupled to a threaded hole formed in a stop support 40 fixed to the side wall 24 by means of screws 41. By rotating the threaded rod 39, the position of the stop 38 is adjusted and the position of the stop 38 is fixed by means of a locknut.

[0036] Furthermore, in the third embodiment the pressing element 71 and the structural element 74 have respective central openings 76, 77, and the connecting element 73 is fixed to a support bridge 75 having opposite ends connected to two of the opposite side walls 24. The construction of the support bridge 75 is similar to that described above in relation to the first embodiment with the exception that the bridge guides 77 are formed directly in the side walls 24 instead of in the supports 89 of the first embodiment. Alternatively, the opposite ends of the support bridge 76 may be connected to two of the opposite die walls 72, for example by using supports fixed to the die walls 72 and provided with the bridge guides 77, with an equivalent result.

[0037] Figures 12 to 15 show a mandrel according to a fourth embodiment of the present invention, which has a construction similar to that of the third embodiment described above in relation to Figures 8 to 11, with the difference being that in this fourth embodiment, the shape of the contour of the pressing surface is hexagonal, the die walls 72 are three in number and the side walls 24 are three in number. Accordingly, in this fourth embodiment, each of the die walls 72 is arranged parallel to and opposite one of the side walls 24, and the opposite ends of the arms 92 of the support bridge 75 supporting the connecting element 73 are thereby respectively connected to one of the die walls 72 and to one of the side walls 24 that are arranged opposite one another.

[0038] In this fourth embodiment, the plate elements forming the die walls 72 have appendices 98 extending into the mandrel, and the side walls are fixed to the pressing element 71 and to the structural element 74 by means of respective screws 35, 36. The side wall 24 to which one of the ends of the support bridge 75 is connected has one of the bridge guides 77 directly formed therein. The die wall 72 to which the other end of the support bridge 75 is connected has additional appendices 99 extending from the appendices 98 into the mandrel and the other bridge guide 77 is formed in a support 39 fixed to additional appendices 99 of the die wall 72.

[0039] Figure 16 shows a fifth embodiment of the present invention in which the mandrel comprises a front pressing element 71 which provides a pressing surface having an octagonal-shaped outer contour and is perpendicular to a longitudinal direction Z parallel to a path of movement of the mandrel, a rear structural element 74 arranged parallel to and opposite the pressing element 71, and which also has an octagonal-shaped contour, and four die walls 72 and four side walls 24 intercalated with one another and associated with alternate sides of the octagonal shape of the pressing element 71 and the structural element 74.

[0040] Each of the die walls 72 and each of the side walls 24 is obtained from a solid cut and/or machined element having a front surface fixed to the pressing element 71 by means of screws 22, 35, and a rear surface fixed to the structural element 74 by means of screws 23, 36. Two of the opposite die walls 72 have respective bridge guides 77 for installing and holding a bridge that supports a connecting element as described above, for example in relation to Figures 1 to 5.

[0041] Figure 17 shows a mandrel according to a sixth embodiment of the present invention which, as a whole, is similar to that described above in relation to Figure 16 with the exception that the pressing element 71 and the structural element 74 have a hexagonal-shaped outer contour, and both the die walls 72 and the side walls 24 are three in number. In this case, one of the die walls 72 and one of the side walls 24 that are arranged opposite one another have respective bridge guides 77.

[0042] Figure 18 shows a mandrel 70 according to a seventh embodiment of the present invention which, as a whole, is similar to that described above in relation to Figures 1 to 5 with the exception that each pair of adjacent die wall 72 and side wall 24 is formed by a common wall member 43 obtained from a cut-out and bent plate element having a section of die wall 72 and a section of side wall 24 connected at their adjacent side edges, front tabs 20, 25, and rear tabs (not shown in Figure 18) that are bent inward extending from the section of die wall 72 and the section of side wall 24, respectively, and side tabs 27, 28 that are bent inward extending from the free side edges of the section of die wall 72 and the section of side wall 24, respectively.

[0043] The pressing element 71 and the structural element (not shown in Figure 18) are made of respective planar plate elements that are parallel to one another, and the front and rear tabs 20, 25; 21, 26 are parallel and fixed to the pressing element 71 and to the structural element 74, respectively, by means of screws 22, 35, and the adjacent side tabs 27, 28 are arranged against one another and fixed together by means of screws 29.

[0044] In the seventh embodiment shown in Figure 18, the pressing element 71 has an octagonal-shaped contour and the mandrel 70 includes four common wall members 43 providing four elements of die wall 72 and four elements of side wall 24. Support bodies 89 are fixed to two of the opposite elements of die wall 72 by means of screws 91. The support bodies 89 have bridge guides 77 formed thereon parallel to the longitudinal direction Z, where the ends of the bridge supporting the connecting element are fixed on said support bodies as described above in relation to Figures 1 to 5.

[0045] Nevertheless, in another non-depicted variant of this seventh embodiment, the pressing element has a hexagonal-shaped contour and the mandrel includes three common wall members providing three elements of die wall and three elements of side wall. In this case, the support bodies supporting the bridge are fixed to one of the sections of die wall and to one of the opposite sections of side wall by means of screws 91.

[0046] The constructive system of this seventh embodiment can be applied indiscriminately by providing two or more common wall members, each common wall member including one or more sections of die wall and one or more sections of side wall alternating with one another and connected together at their adjacent side edges.

[0047] The scope of the present improvements is defined by the attached claims.

Claims

1. A mandrel for a machine forming bases or lids of prismatic boxes by folding and joining die-cut blanks, said mandrel (70) comprising:

   a pressing element (71) providing a pressing surface perpendicular to a longitudinal direction (Z) parallel to a path of movement of the mandrel

(70), said pressing surface having a polygonal-shaped outer contour with an even number of sides greater than four;
die walls (72) providing die surfaces parallel to said longitudinal direction (Z), said die walls (72) being fixed to the pressing element (71) and associated with alternate sides of said polygonal shape of the contour of the pressing surface; and
a connecting element (73) which is connected to a movable member of a mandrel operating mechanism;
characterized by further comprising side walls (24) associated with the remaining alternate sides of the polygonal shape of the contour of the pressing surface not associated with the die walls (72), said side walls (24) being fixed to the pressing element (71) and/or to the die walls (72).

2. The mandrel according to claim 1, **characterized in that** each of said die walls (72) is obtained from a cut-out and bent plate element having a front tab (20) fixed to the pressing element (71) and a rear tab (21) fixed to a structural element (74) opposite the pressing element (71).

3. The mandrel according to claim 1, **characterized in that** each of said die walls (72) is obtained from a solid cut and/or machined element having a front surface fixed to the pressing element (71) and a rear surface fixed to a structural element (74) opposite the pressing element (71).

4. The mandrel according to claim 2, **characterized in that** the pressing element (71) and said structural element (74) are made of respective planar plate elements that are parallel to one another and the front tabs (20) of the die walls (72) are bent inward, parallel to the pressing element (71), and fixed to the pressing element (71) by means of screws (22) installed through respective holes that are aligned with one another, and the rear tabs (21) of the die walls (72) are bent inward, parallel to the structural element (74), and fixed to the structural element (74) by means of screws (23) installed through respective holes that are aligned with one another.

5. The mandrel according to claim 4, **characterized in that** each of the side walls (24) is obtained from a cut-out and bent plate element having a side surface parallel to the longitudinal direction (2), a front tab (25) fixed to the pressing element (71), and a rear tab (26) fixed to the structural element (74).

6. The mandrel according to claim 3, **characterized in that** each of the side walls (24) is obtained from a solid cut and/or machined element having a front surface fixed to the pressing element (71) and a rear surface fixed to the structural element (74).

7. The mandrel according to claim 5, **characterized in that** the front tabs (25) of the side walls (24) are bent inward, parallel to the pressing element (71), and fixed to the pressing element (71) by means of screws (35) installed through respective holes that are aligned with one another, and the rear tabs (26) of the side walls (24) are bent inward, parallel to the structural element (74), and fixed to the structural element (74) by means of screws (36) installed through respective holes that are aligned with one another.

8. The mandrel according to claim 7, **characterized in that** the die walls (72) and the side walls (24) have respective side tabs (27, 28) arranged against one another and connected together by screws (29) installed through respective holes that are aligned with one another.

9. The mandrel according to claim 7 or 8, **characterized in that** the die walls (72) and the side walls (24) have respective rear bevel portions (30, 31) tilting inward, and the structural element (74) has a polygonal-shaped outer contour which is similar to the contour of the pressing surface and has a smaller dimension than the contour of the pressing surface.

10. The mandrel according to any one of the preceding claims, **characterized in that** said even number of sides greater than four of the polygonal shape of the contour of the pressing surface is eight, the die walls (72) are four in number, and the side walls (24) are four in number.

11. The mandrel according to claim 10, **characterized in that** said structural element (74) has a central opening, and said connecting element (73) is fixed to a support bridge (75) having opposite ends connected to two of the opposite die walls (72) or to two of the opposite side walls (24).

12. The mandrel according to any one of claims 1 to 9, **characterized in that** said even number of sides greater than four of the polygonal shape of the contour of the pressing surface is six, the die walls (72) are three in number and the side walls (24) are three in number.

13. The mandrel according to claim 12, **characterized in that** said structural element (74) has a central opening, and said connecting element (73) is fixed to a support bridge (75) having opposite ends connected to one of the die walls (72) and to one of the side walls (24), respectively.

14. The mandrel according to any one of claims 1 to 4,

characterized in that the pressing element (71) has cut-outs (32) facing the alternate sides of the polygonal shape of the pressing surface associated with the side walls (24), the side walls (24) are located adjacent to said cut-outs (32), and rocker arms (33) that pivot between an active position and an inactive position about respective pivoting shafts (34) supported in the side walls (24) are installed in the cut-outs (32), said pivoting shafts (34) being perpendicular to the longitudinal direction (Z) and parallel to the corresponding sides of the polygonal shape of the contour of the pressing surface.

15. The mandrel according to claim 14, **characterized in that** each of said rocker arms (33) has a front surface (33a) which is coplanar with and complementary to said pressing surface of the pressing element (71) in said active position, and tilted forward with respect to the pressing surface of the pressing element (71) in said inactive position, and an outer edge (33b) which provides the corresponding side of the polygonal shape of the contour of the pressing surface in the active position, and is displaced inward with respect to the corresponding side of the polygonal shape of the contour of the pressing surface in the inactive position.

16. The mandrel according to claim 15, **characterized in that** between each rocker arm (33) and the corresponding side wall (24) there is arranged an elastic element (37) which drives the rocker arm (33) to the active position, and the active position of each rocker arm (33) is determined by a stop (38),

17. The mandrel according to claim 16, **characterized in that** said elastic element (37) is a torsion coil spring arranged around said pivoting shaft (34) and said stop (38) is an adjustable stop attached to a threaded rod (39) coupled to a threaded hole formed in a stop support (40) fixed to the side wall (24).

18. The mandrel according to any one of claims 14 to 17, **characterized in that** each of the side walls (24) is obtained from a solid element fixed to appendices (98) of the die walls (72), and/or to the pressing element (71), and/or to the structural element (74).

19. The mandrel according to any one of claims 14 to 18, **characterized in that** said even number of sides greater than four of the polygonal shape of the contour of the pressing surface is eight, the die walls (72) are four in number and the side walls (24) are four in number.

20. The mandrel according to claim 19, **characterized in that** said structural element (74) has a central opening, and said connecting element (73) is fixed to a support bridge (75) having opposite ends connected to two of the opposite die walls (72) or to two of the opposite side walls (24).

21. The mandrel according to any one of claims 14 to 18, **characterized in that** said even number of sides greater than four of the polygonal shape of the contour of the pressing surface is six, the die walls (72) are three in number and the side walls (24) are three in number.

22. The mandrel according to claim 19, **characterized in that** said structural element (74) has a central opening, and said connecting element (73) is fixed to a support bridge (75) having a first end connected to one of the die walls (72) and a second end connected to one of the opposite side walls (24).

23. The mandrel according to claim 1, **characterized in that** the mandrel includes at least two common wall members (43) obtained from cut-out and bent plate elements, each common wall member (43) including at least one section of die wall (72) and at least one section of side wall (24) alternating with one another and connected together at their adjacent side edges.

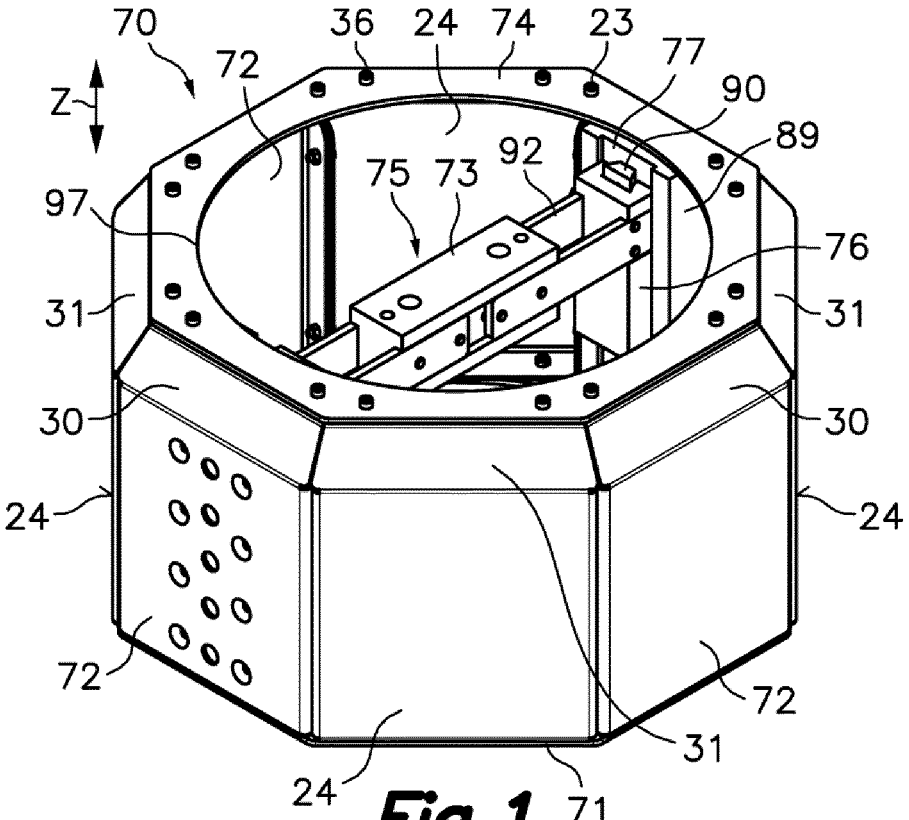
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Fig. 1

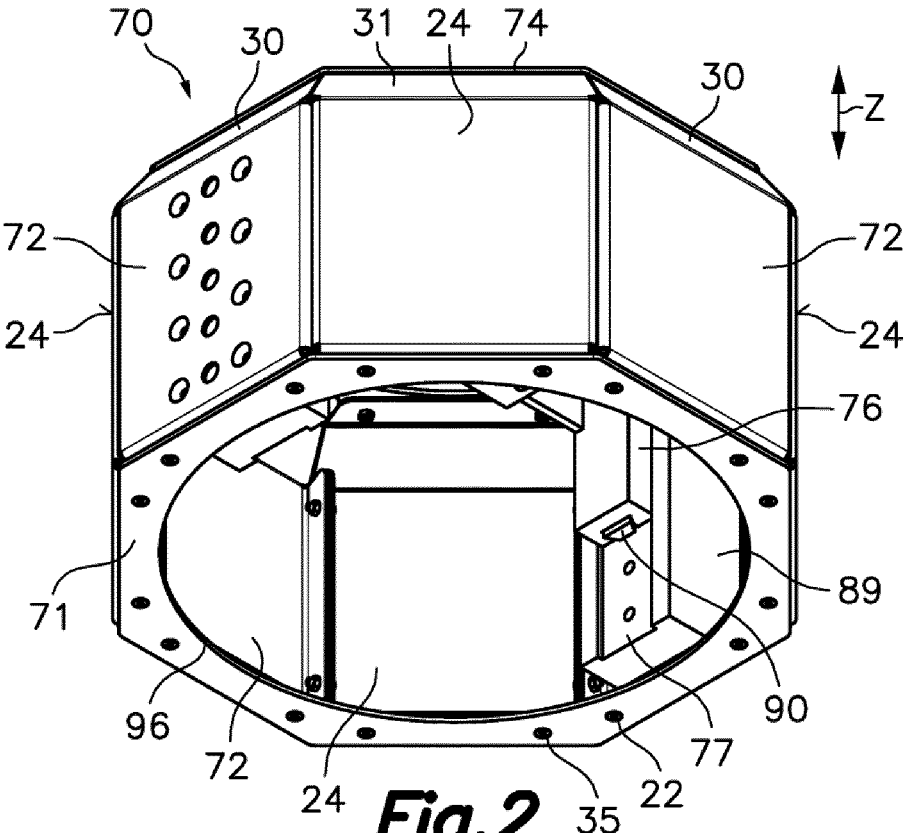
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Fig. 2

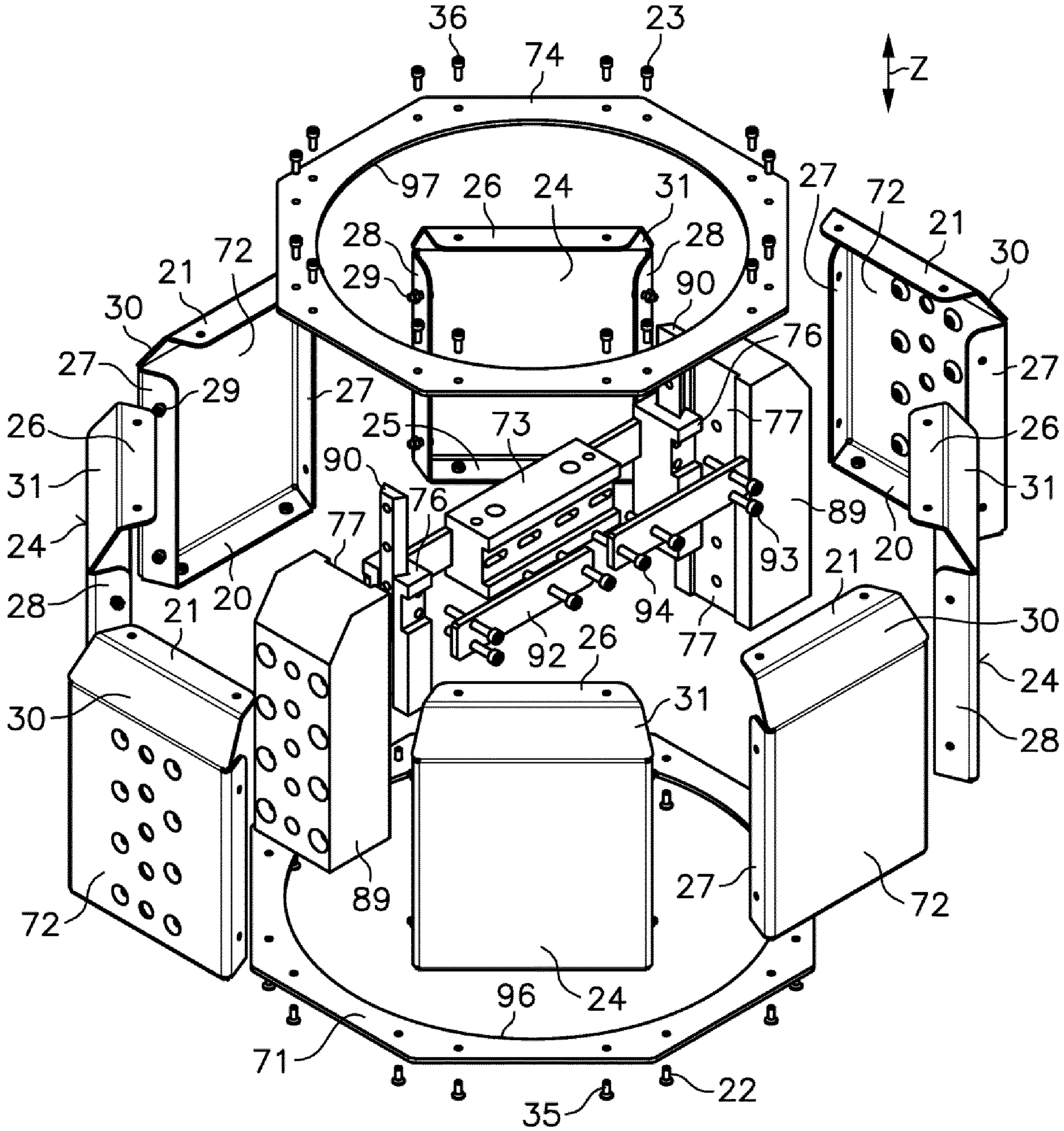
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Fig.3

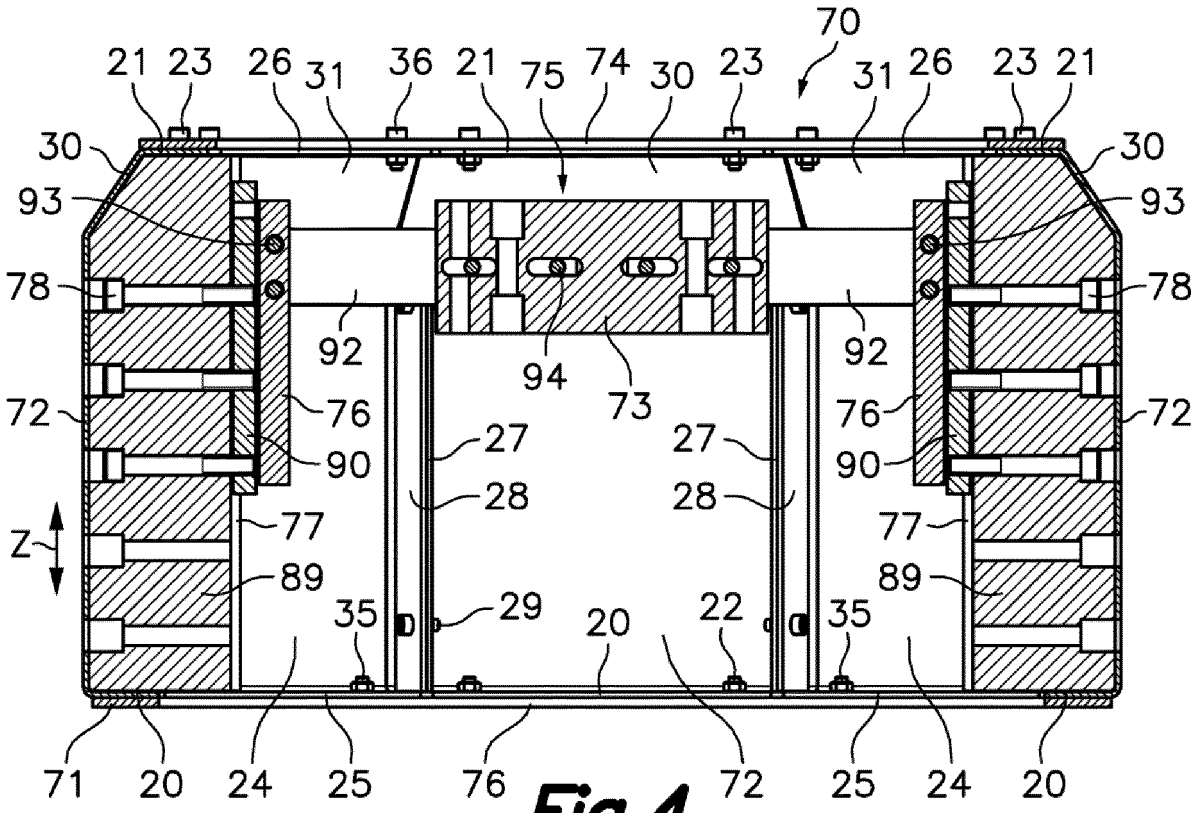
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Fig.4

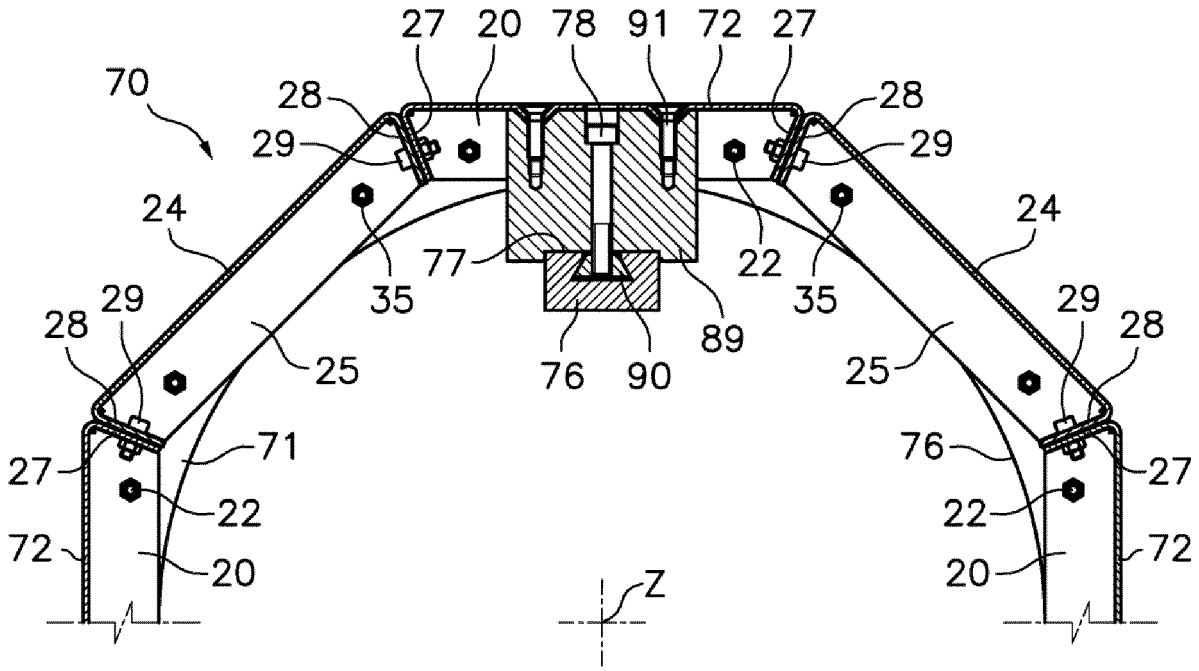
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Fig.5

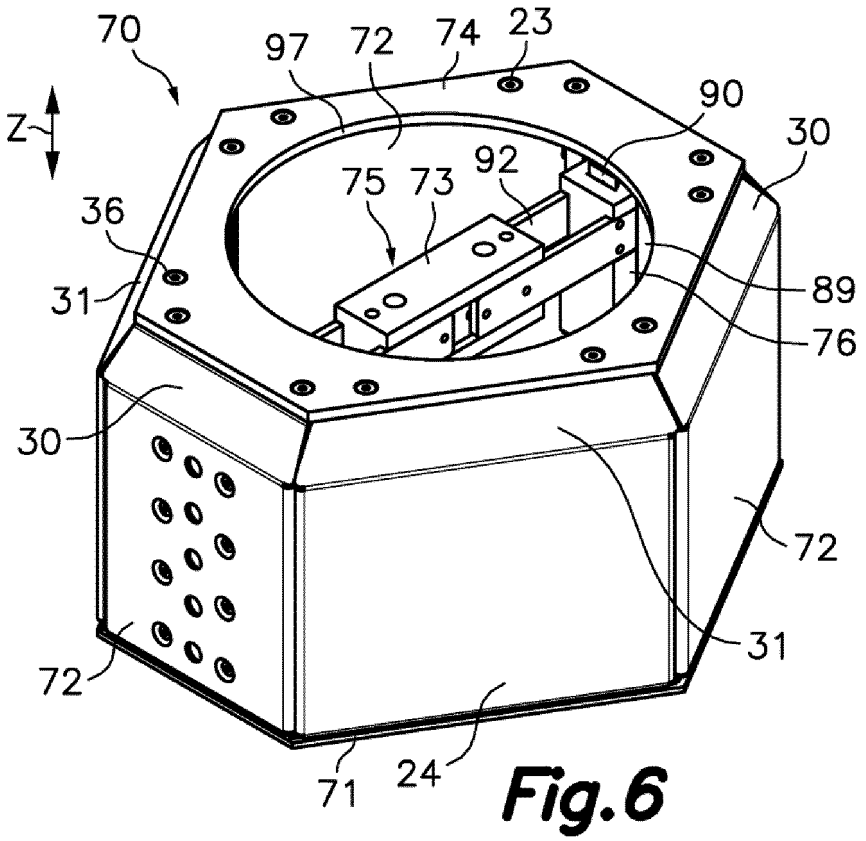
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Fig.6

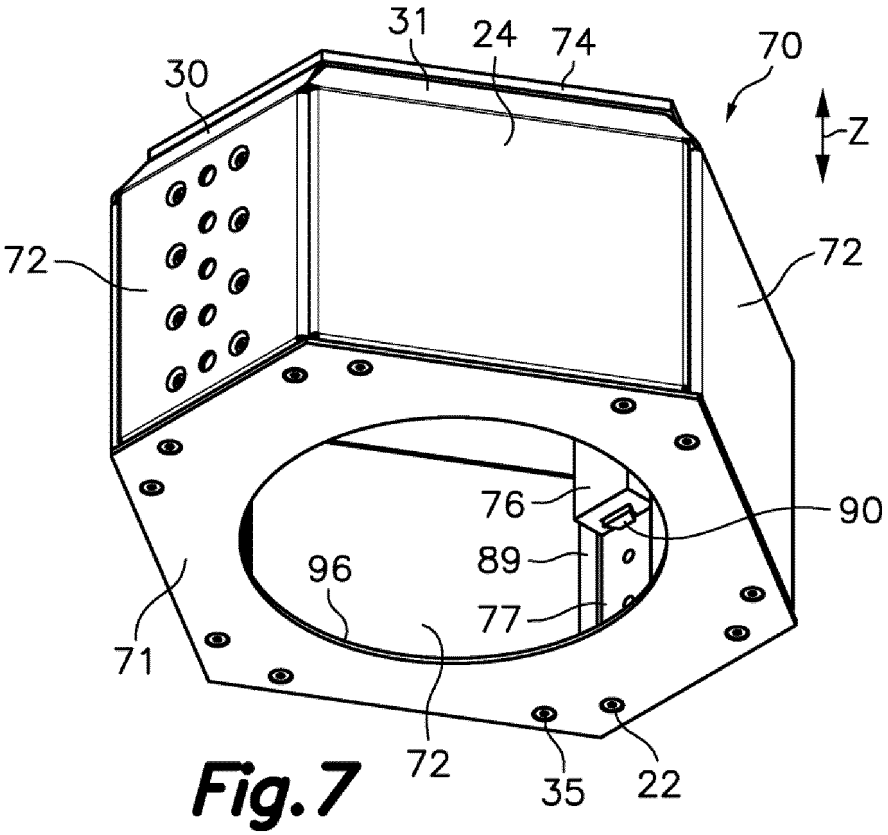
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Fig.7

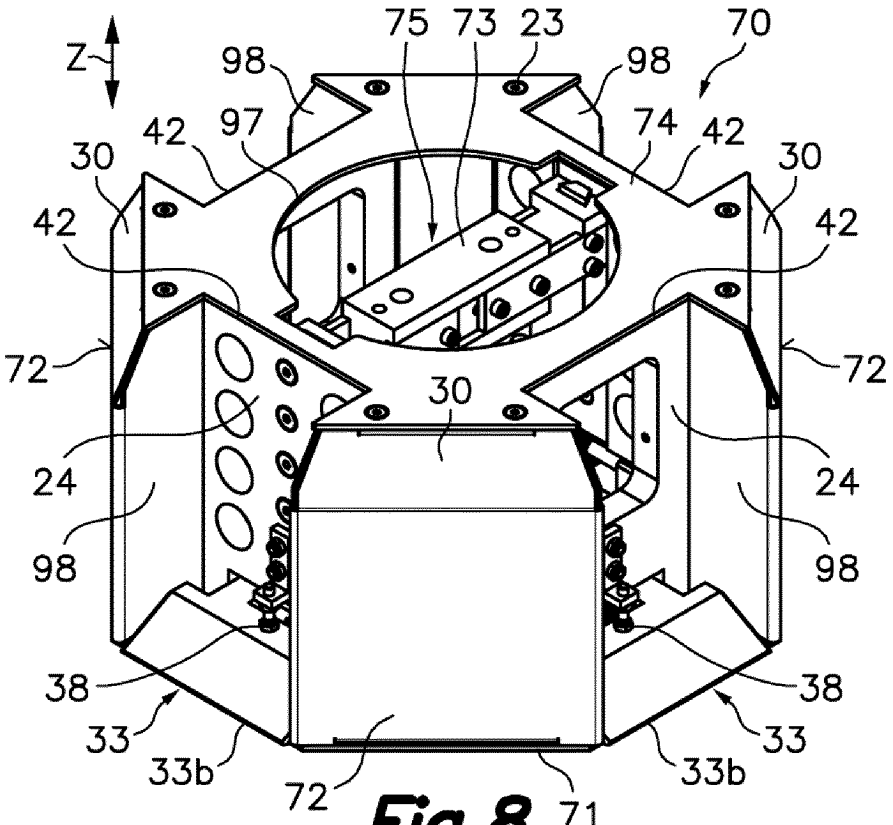
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Fig.8

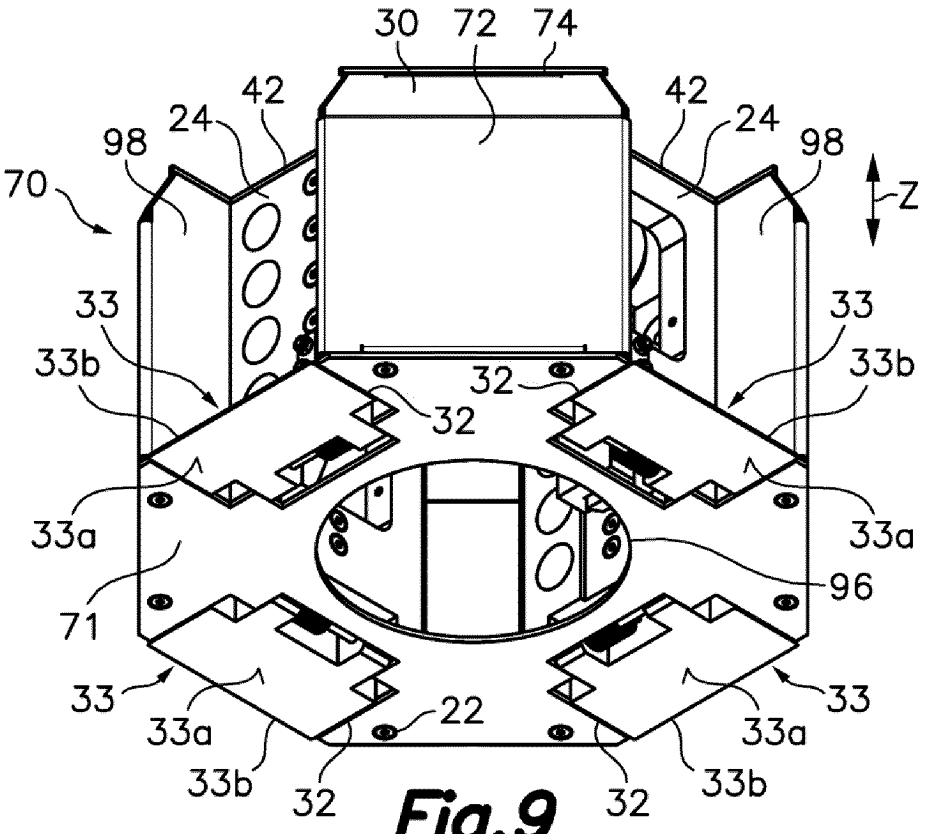
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Fig.9

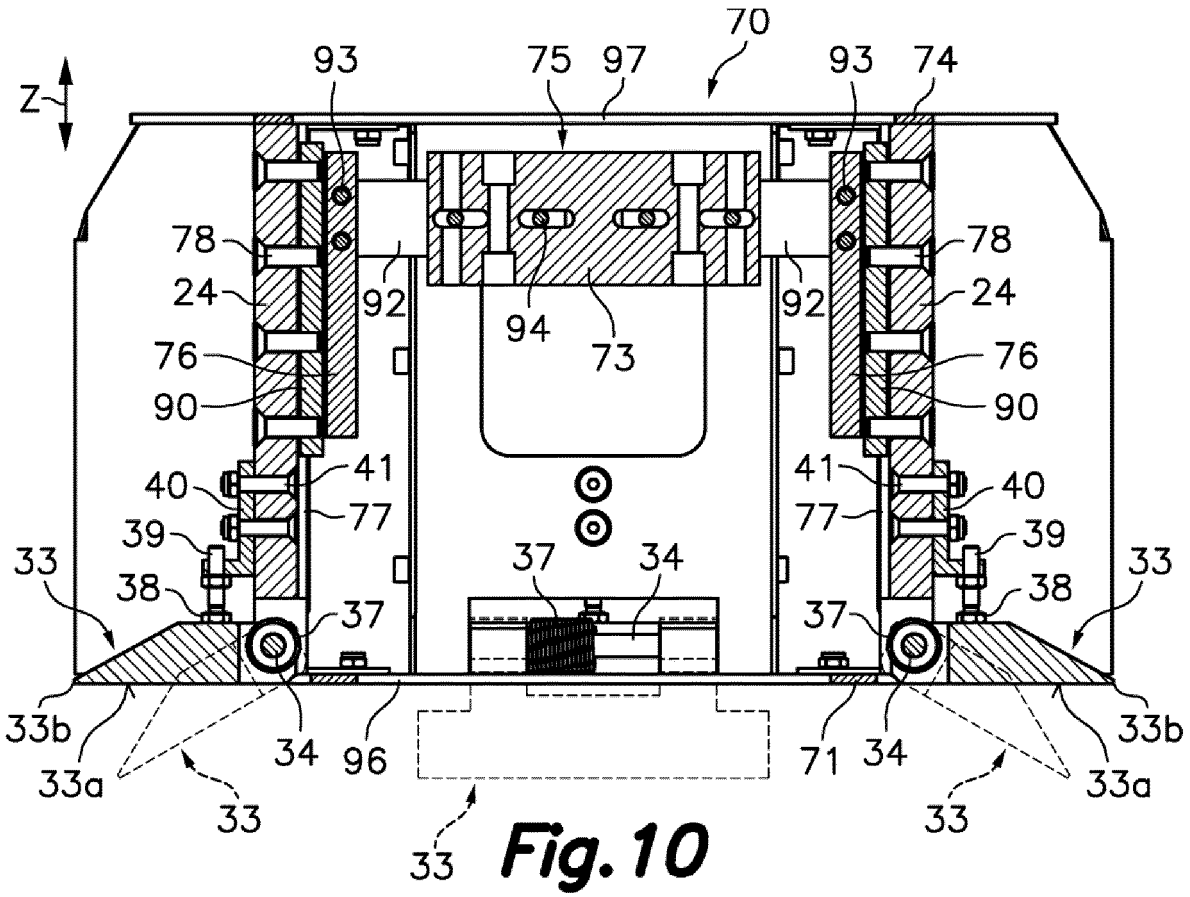
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Fig.10

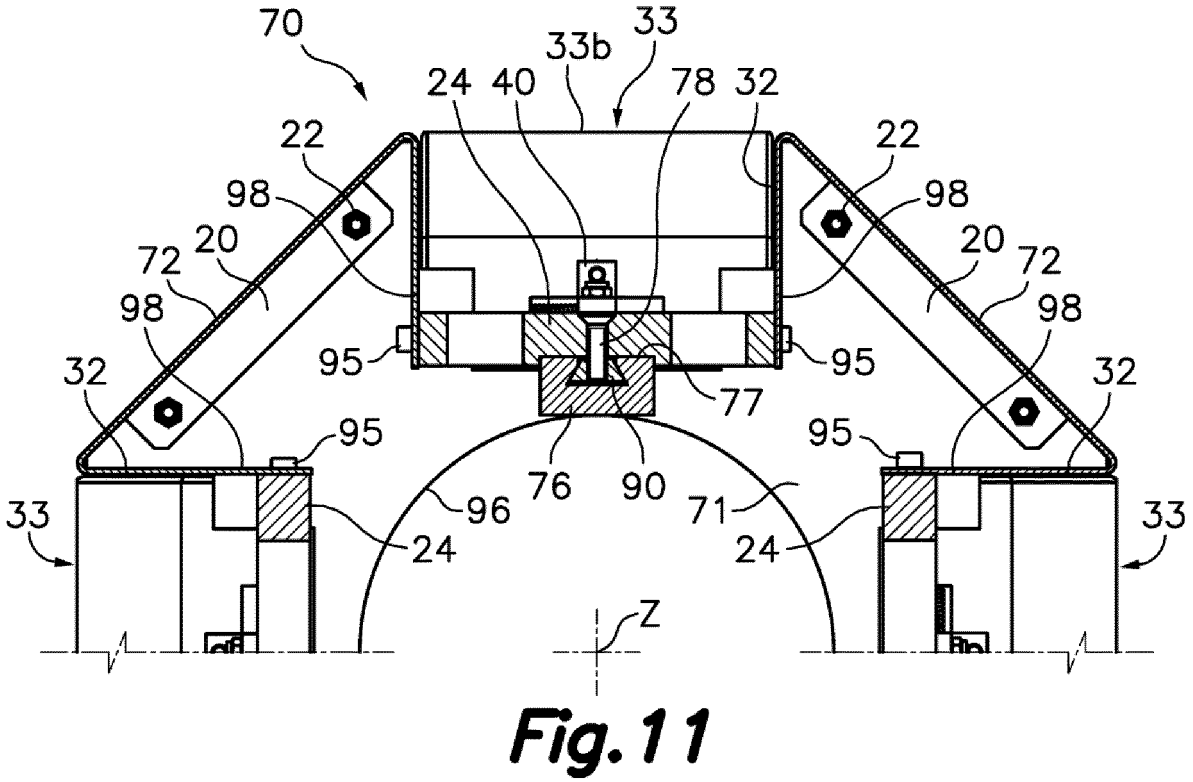
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Fig.11

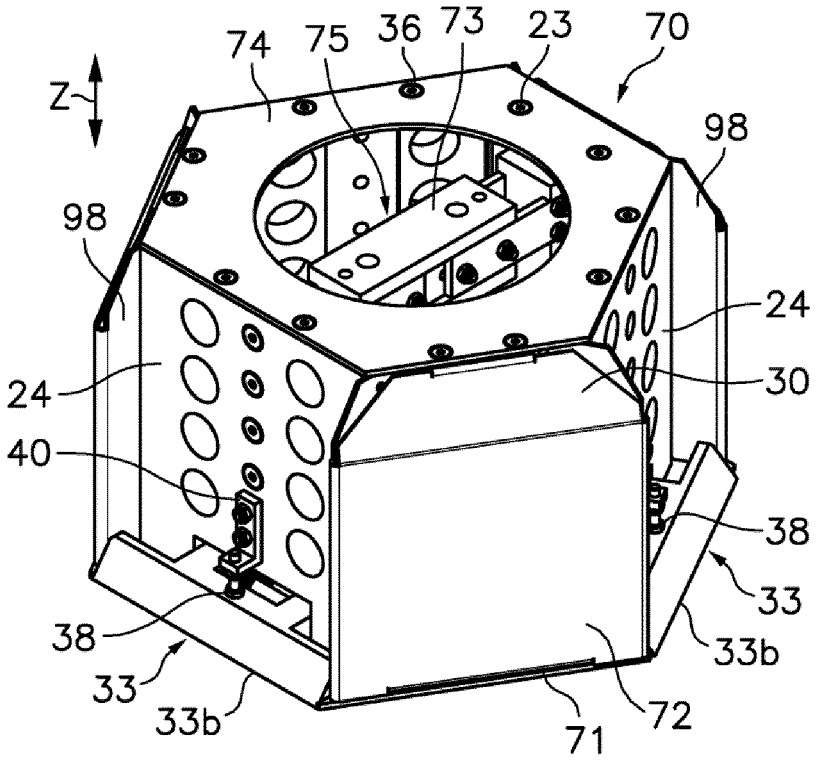
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Fig. 12

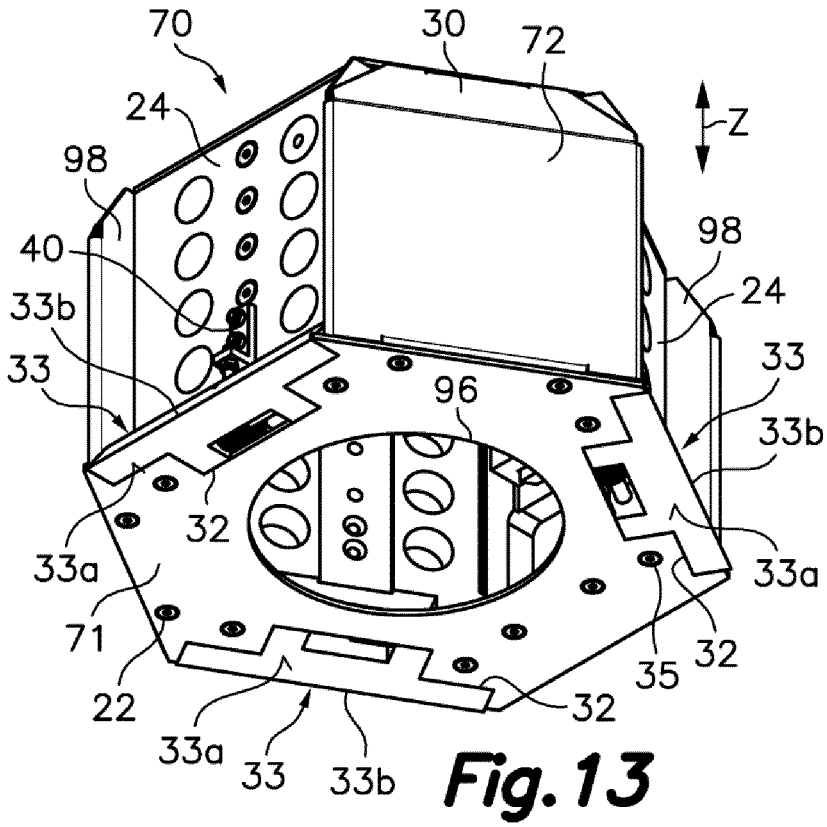
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Fig. 13

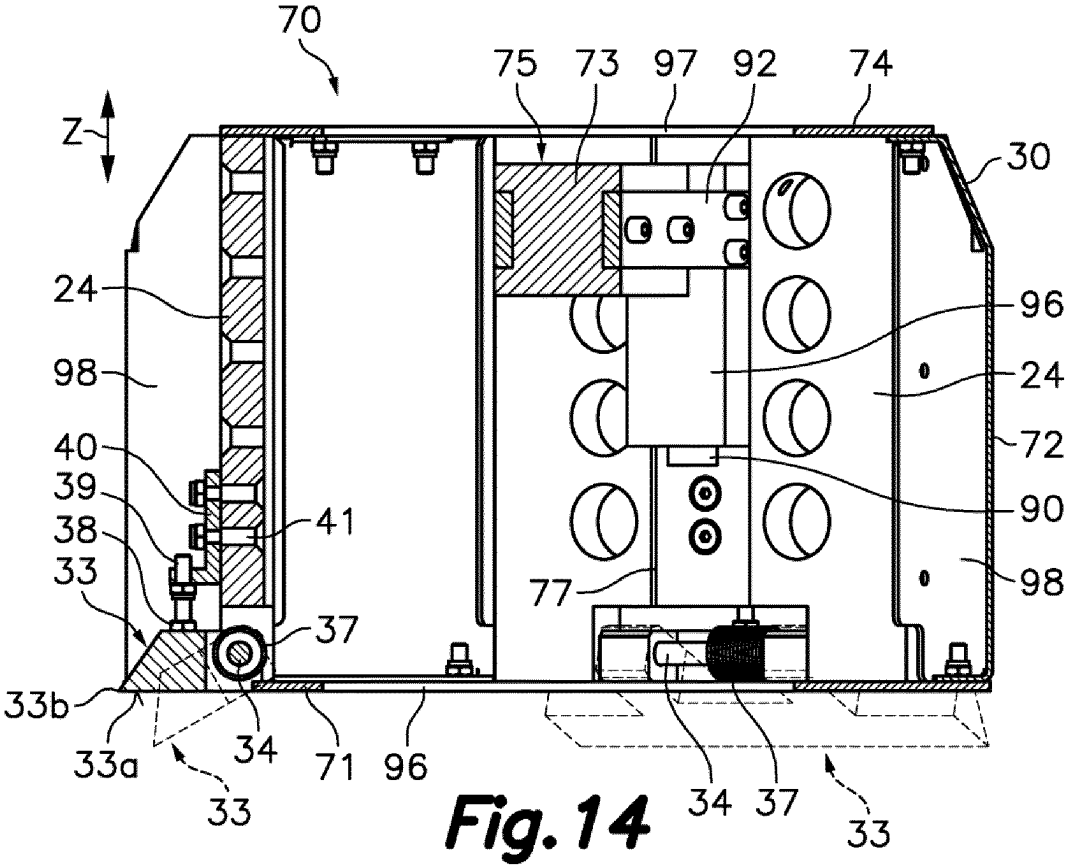
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Fig. 14

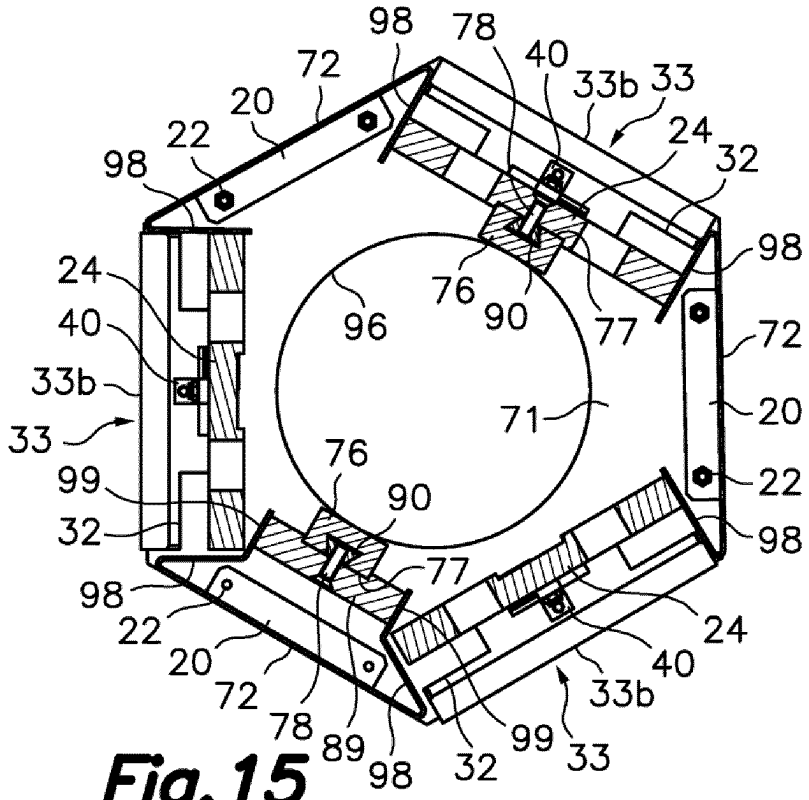
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Fig. 15

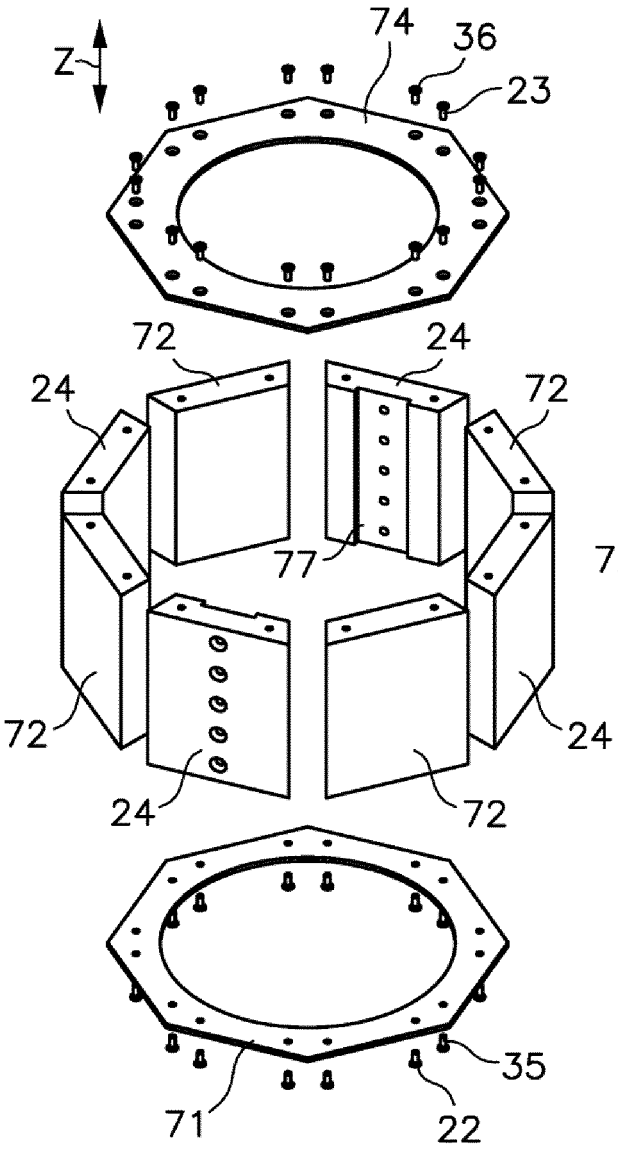
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Fig. 16

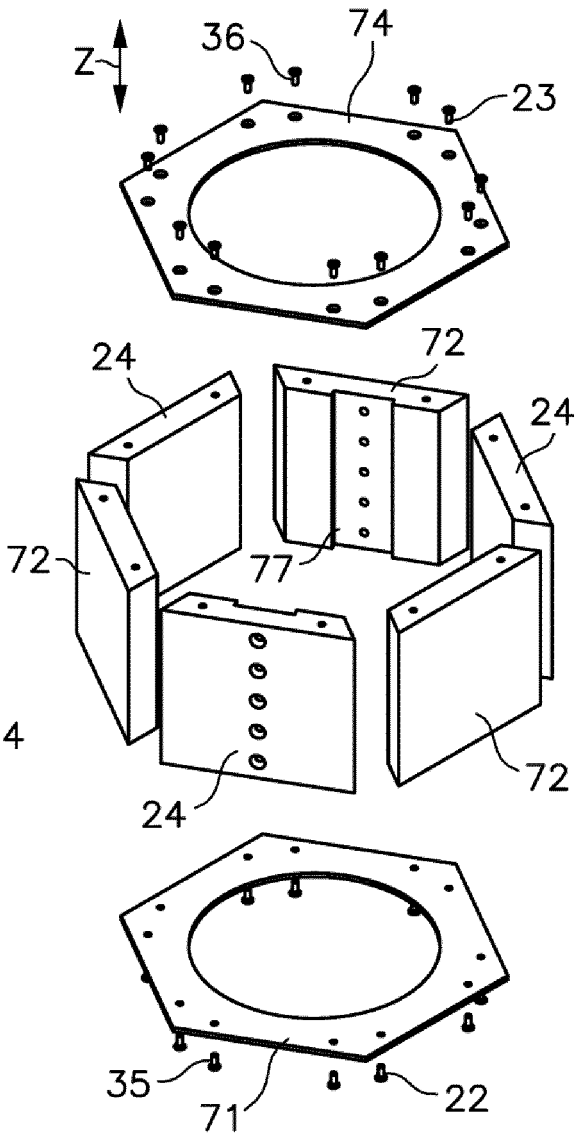
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Fig. 17

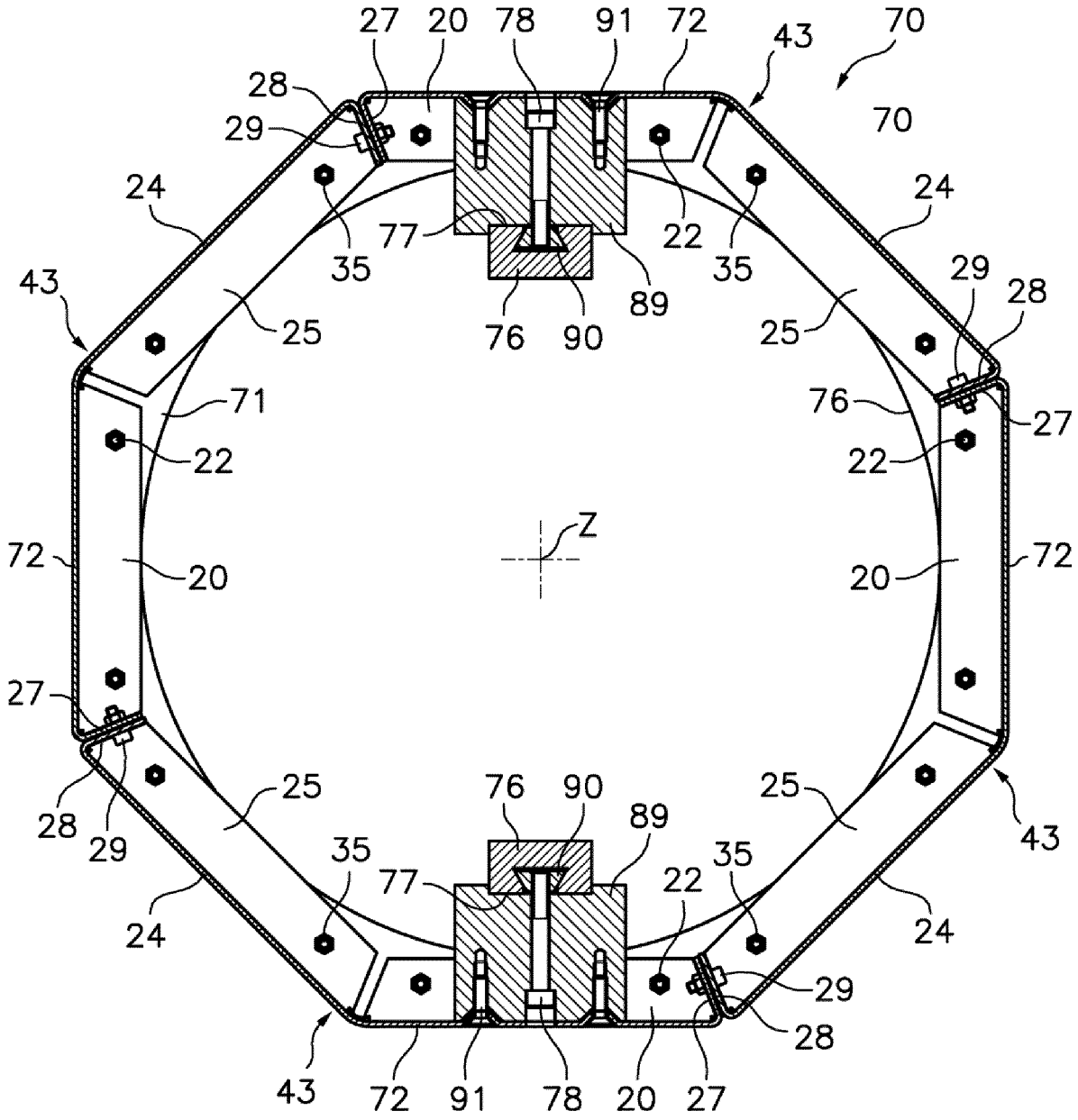
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Fig. 18

INTERNATIONAL SEARCH REPORT

International application No.
PCT/ES2016/000128

A. CLASSIFICATION OF SUBJECT MATTER

B31B50/48 (2017.01)
B31B50/60 (2017.01)
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, Columns 1-4; figures 1-5	1-13
A	US 3283673 A (GETTELMAN GILBERT C) 08/11/1966, Columns 6-7; figures 1-10	1-13
A	JP 2010222024 A (RENGO CO LTD) 07/10/2010, Figures & Abstract from Database EPODOC. Retrieved in EPOQUE; AN- JP-2009069710-A	1-13
A	JP 2009067566 A (KIMURA KIGATA KK) 02/04/2009, Figures & abstract from DataBase EPODOC. Retrieved in EPOQUE; AN- JP-2007239698-A	1-13

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

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"O" document referring to an oral disclosure use, exhibition, or other means.
"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
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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
21/03/2017	**(27/03/2017)**
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

Form PCT/ISA/210 (second sheet) (January 2015)

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.
PCT/ES2016/000128

Patent document cited in the search report	Publication date	Patent family member(s)	Publication date
US2696612 A	14.12.1954	NONE	
US3283673 A	08.11.1966	NONE	
JP2010222024 A	07.10.2010	JP5541589B B2	09.07.2014
JP2009067566 A	02.04.2009	JP5041939B B2	03.10.2012

Form PCT/ISA/210 (patent family annex) (January 2015)

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- ES P201530802 **[0002] [0003]**
- ES P201531635 **[0003]**