ABSTRACT

“BISTABLE DEVICE BASED ON TOGGLES WITH FILM HINGES”

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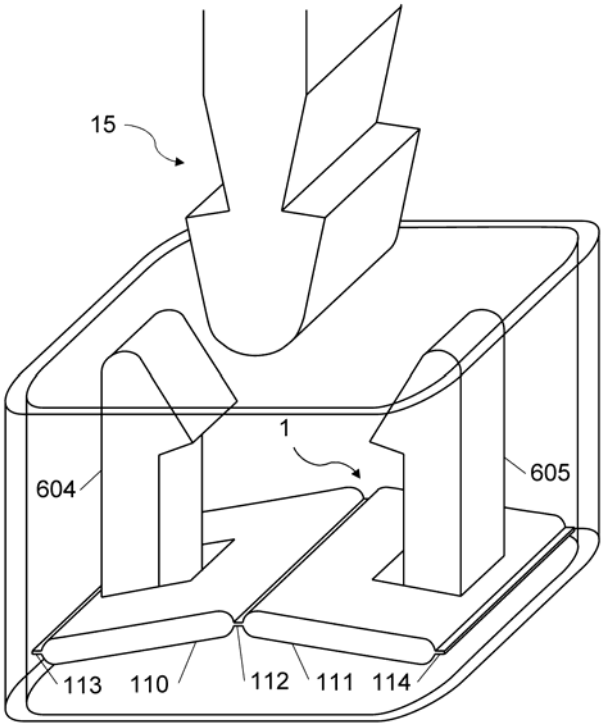
Bistable device, constituted by a toggle (1), composed of two levers (110, 111), hinged to film hinges (112, 113, 114), which, by the elastic flexure of an element, can extend itself and switch between two opposite rest positions. One or more hooks protruding from said levers (110, 111) may be added to realize push-pull latches for doors or panels.

In a configuration, a male element (15), by pushing said two levers (110, 111) of said toggle (1), can switch it into a closed position and become engaged by said hooks (604, 605). Said male element (15), by retracting itself, can switch said toggle (1) into an open position and disengage itself from said hooks (604, 605).

In other configurations, command levers applied to said two levers (110, 111) of said toggle (1) drive other mechanical elements, as electrical contacts, and make them to switch between two distinct positions.



“BISTABLE DEVICE BASED ON TOGGLES WITH FILM HINGES”

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DESCRIPTION

FIELD OF THE INVENTION

The present invention relates to a mechanical bistable device, based on a toggle with film hinges, and to its applications in devices wherein a mechanical element is required to switch between two different positions, like latches for doors, glove compartments and panels, electrical switches, etc.

BACKGROUND OF THE INVENTION

Currently, a wide variety of technical solutions are known and used to realize bistable mechanical devices, like latches for doors, glove compartments and panels, electrical switches, etc. However, it may be noted that such devices, generally cannot achieve, wholly and optimally, all the following objectives, which are highly appreciated in many applications:

being composed of a minimum number of components;

being completely made of plastics;

having a shape which can be integrated with other elements, when these are made of plastics;

being able to perform an high number of commutations, without deterioration of their characteristics.

Current devices, in fact, are generally subject to one or more of the following limitations:

many devices, in order to realize the elasticity required for them to work, use at least a metallic spring;

other devices, although being completely made of plastics, cannot withstand an high number of commutations, since they loose their mechanical characteristics after a limited number of cycles;

other devices, although being completely made of plastics, are shaped so as they cannot be integrated with other plastic components.

Hence, the demand for devices which can optimally achieve all the above listed objectives, is very strong.

SUMMARY OF THE INVENTION

The present invention, as will be better understood from the following descriptions, allows to realize bistable mechanical devices, for various applications, like latches for doors, glove compartments and panels, electrical switches, etc., which:

are composed of a minimum number of components;

can be wholly made of plastics;

may be directly integrated with other components, when these are made of plastics, and may be manufactured in the same injection moulding operation, with zero components and zero manufacture and assembly costs;

can withstand an high number of commutations, without loosing their mechanical characteristics.

A **first embodiment** of the present invention is a toggle, hinged to three film hinges, composed of:

two adjacent levers, disposed so as to form a toggle;

a central film hinge, linking the adjacent edges of said two levers;

two lateral film hinges, linking the external edges of said two levers, to two anchorage edges of a support.

A **second embodiment** of the present invention is a toggle, hinged to two film hinges, composed of:

two adjacent levers, disposed so as to form a toggle, wherein one of said two levers is a flexible and elastic prolongation of a support;

a central film hinge, linking the adjacent edges of said two levers;

a lateral film hinge, linking the external edge of the second of said levers, to an anchorage edge of said support.

A **third embodiment** of the present invention is a toggle, hinged to a single film hinge, composed of:

two adjacent levers, disposed so as to form a toggle, in which said two levers are flexible and elastic prolongations of a support;

a central film hinge, linking the adjacent edges of said two levers.

In all of the three embodiments of the present invention described above, at least one of the following elements is flexible and elastic:

said two levers of said toggle;

the structures of said support, to which said two levers are anchored.

A temporary flexure of at least one of said elastic elements allows said toggle to extend itself and switch between two opposite rest positions, and to stay in said rest positions, until an external force, applied to at least one of said two levers, makes said toggle to switch into its opposite rest position.

A **further embodiment** of the present invention, is a push-pull latch for a door, based on a toggle, according to one of the former three embodiments described above, and composed of:

said toggle, fixed to the wing of a door, provided with a forked hook, protruding from one of said levers of said toggle;

a rod, fixed to the frame of said door.

In the first rest position of said toggle, named open position, said hook is arranged so as to be engaged, during the closing of said wing, by said rod, fixed to the frame of said door.

In the second rest position of said toggle, named closed position, said hook is engaged by said rod, fixed to the frame of said wing, so as to retain the wing of said door in its closed position.

During the closing of said wing, said rod, fixed to the frame of said door, slips between the two fingers of said hook and pushes said hook, making said toggle to switch into its closed position.

During the opening of said wing, said rod, fixed to the frame of said door, pulls said hook, making said toggle to switch into its open position, and disengaging itself from said hook.

A **further embodiment** of the present invention, is a push-pull latch for keeping a wing of a door in a determined position, for example its open position, based on a toggle, according to one of the former three embodiments described above, and composed of:

said toggle, fixed to the wing of a door, provided with a forked hook, protruding from one of said levers

of said toggle;

a rod, fixed to the frame of said door.

In the first rest position of said toggle, named open position, said hook is arranged so as to be engaged, during the opening of said wing, by said rod, fixed to the frame of said door.

In the second rest position of said toggle, named closed position, said hook is engaged by said rod, fixed to the frame of said door, so as to retain the wing of said door in its open position.

During the opening of said wing, said rod, fixed to the frame of said door, slips between the two fingers of said hook and pushes said hook, making said toggle to switch into its closed position.

During the closing of said wing, said rod, fixed to the frame of said door, pulls said hook, making said toggle to switch into its open position, and disengaging itself from said hook.

A **further embodiment** of the present invention, is a push-pull latch for a door or a panel, based on a toggle, according to one of the former three embodiments described above, and composed of:

a male element, fixed to the wing of a door, made of a shank, having a mushroom-shaped section, whose head is provided with two retention teeth;

a female element, fixed to the frame of said door, composed of said toggle, provided with two hooks, each of them provided with a retention tooth, protruding from the two levers of said toggle, and anchored to a ringoidal shaped elastic support, which allows said toggle to extend itself and switch between two opposite rest positions.

In the first rest position of said toggle, named open position, said two hooks are spaced from each other and allow said male element to enter and exit freely from said female element.

In the second rest position of said toggle, named closed position, said two hooks are near to each other, and are able to retain the head of said male element, through said retention teeth, which said hooks and the head of said male element are provided with.

During the closing of said wing, said male element pushes the area of the central film hinge of said toggle, making said toggle to switch into its closed position, and becoming engaged by said hooks.

During the opening of said wing, said male element, through said retention teeth of its head, pulls the retention teeth of said two hooks, making said toggle to switch into its open position.

A **further embodiment** of the present invention, is a bistable driver for driving other mechanical elements, based on a toggle, according to one of the former three embodiments described above, and composed of:

said toggle, provided with a command lever, linked to one of the two levers of said toggle;

a driving lever, linked to one of said two levers of said toggle.

Said bistable driver can drive other mechanical elements, such as a lever, a cursor or an electrical contact, making them to switch between two different positions.

Said bistable driver will stay in one of its two rest positions, until a force applied to said command lever or to said drive lever makes it to switch into its opposite rest position.

BRIEF DESCRIPTION OF THE DRAWINGS

A detailed description of the invention is hereinafter described, with specific reference being made to the drawings, in which:

FIG. 1A is an isometric view of an embodiment of the present invention, in which a toggle is composed of two levers and three film hinges.

FIG. 1B is an isometric view of the embodiment of FIG. 1, in which said toggle is in its opposite rest position.

FIG. 2 is an isometric view of an embodiment of the present invention, in which a toggle is composed of two levers and two film hinges.

FIG. 3 is an isometric view of an embodiment of the present invention, in which a toggle is composed of two levers and a single film hinges.

FIG. 4 is an isometric view of a push-pull latch composed of a toggle provided with two levers and three film hinges, a forked hook protruding from one of said two levers, wherein one of the two supports, said toggle is anchored to, is flexible.

FIG. 5A is a longitudinal sectional view of the device of FIG. 4, shown in its open position.

FIG. 5B is a longitudinal sectional view of the device of FIG. 4, shown in the course of its closing.

FIG. 5C is a longitudinal sectional view of the device of FIG. 4, shown in its closed position.

FIG. 6 is an isometric view of a push-pull latch composed of a toggle provided with two levers and three film hinges, a forked hook protruding from one of said two levers, wherein one of said levers is flexible.

FIG. 7 is a longitudinal sectional view of the device of FIG. 6, shown in the course of its closing.

FIG. 8 is an isometric view of a push-pull latch composed of a toggle provided with two levers and two film hinges, a forked hook protruding from one of said two levers, wherein one of said levers is flexible.

FIG. 9 is a longitudinal sectional view of the device of FIG. 8, shown in the course of its closing.

FIG. 10 is an isometric view of a device which avoids hook of a push-pull latch, such as those of FIG. 4 or 6 or 8, from accidentally switching into its closed position.

FIG. 11A is a longitudinal sectional view of the device of FIG. 10, shown in its open position.

FIG. 11B is a longitudinal sectional view of the device of FIG. 10, shown at the beginning of its closing.

FIG. 11C is a longitudinal sectional view of the device of FIG. 10, shown in the course of its closing.

FIG. 11D is a longitudinal sectional view of the device of FIG. 10, shown in its closed position.

FIG. 12 is an isometric view of a push-pull latch, for keeping a wing in its open position, composed of a toggle provided with two levers and three film hinges, and a forked hook protruding from one of said two levers.

FIG. 13A is a longitudinal sectional view of the device of FIG. 12, shown in its closed position, corresponding to the open position of said wing.

FIG. 13B is a longitudinal sectional view of the device of FIG. 12, shown in the course of its closing, at the beginning of the closing of said wing.

FIG. 13C is a longitudinal sectional view of the device of FIG. 12, shown at the end of its opening, in the course of the closing of said wing.

FIG. 13D is a longitudinal sectional view of the device of FIG. 12, shown in its open position, and in which the wing is in its closed position.

FIG. 14 is an isometric view of a push-pull latch composed of a mushroom-shaped male element and a female element, composed of a toggle provided with two levers and a film hinge, and a ringoidal elastic support, represented as transparent.

FIG. 15A is a longitudinal sectional view of the device of FIG. 14, shown in its open position, at the beginning of its closing cycle.

FIG. 15B is a longitudinal sectional view of the device of FIG. 14, shown in its intermediate position in the course of its closing cycle.

FIG. 15C is a longitudinal sectional view of the device of FIG. 14, shown in its closed position, at the end of its closing cycle.

FIG. 16A is a longitudinal sectional view of the device of FIG. 14, shown in its closed position, at the beginning of its opening cycle.

FIG. 16B is a longitudinal sectional view of the device of FIG. 14, shown in its intermediate position in the course of its opening cycle.

FIG. 16C is a longitudinal sectional view of the device of FIG. 14, shown in its open position, at the end of its opening cycle.

FIG. 17A is a longitudinal sectional view of the device of FIG. 14, shown in its closed position, at the beginning of its re-opening cycle.

FIG. 17B is a longitudinal sectional view of the device of FIG. 14, shown in its intermediate position, in the course of its re-opening cycle.

FIG. 17C is a longitudinal sectional view of the device of FIG. 14, shown in its open position, at the end of its re-opening cycle.

FIG. 18A is a bottom plan view of the device of FIG. 14, in which said toggle is in one of its two rest positions.

FIG. 18B is a bottom plan view of the device of FIG. 14, in which said toggle is in its intermediate position, between its two rest positions.

FIG. 19A is a longitudinal sectional view of the female element of the device of FIG. 14, sectioned along its central film hinge.

FIG. 19B is a cross-sectional view of the female element of an oblique embodiment of the device of FIG. 14.

FIG. 20 is a longitudinal sectional view of the device of FIG. 14, in which said male and female elements are respectively integrated with the wing and the frame of a door.

FIG. 21 an isometric view of the device of FIG. 14, which shows a third element locking said toggle in its closed position.

FIG. 22A is an isometric view of a bistable driving device, in which two driving levers are protruding from a lever of a toggle.

FIG. 22B is an isometric view of the device of FIG. 22A, in which said toggle is in its opposite rest position.

DETAILED DESCRIPTION OF THE INVENTION

The foregoing detailed description is given by way of illustration and example only of some significant embodiments of the present invention and is not intended to limit the scope of the claims in any manner, the spirit and scope of the present invention being limited solely by the appended claims.

FIG. 1A and 1B show a **first embodiment** of the present invention, consisting of a bistable device, based on a toggle 1, composed of:

two adjacent levers 110,111, disposed so as to form a toggle 1;

a central film hinge 112, linking the adjacent edges 115, 116 of said two levers 110,111;

two lateral film hinges 113, 114, linking the external edges 117, 118 of said two levers 110, 111, to two anchorage edges 119, 120 of a support 121.

At least one of the following elements is flexible and elastic:

said two levers 110, 111 of said toggle 1;

the structures of said support 121, near said anchorage edges 119, 120.

A temporary flexure of at least one of said elastic elements allows said toggle 1 to extend itself and switch between two opposite rest positions, respectively shown in Fig. 1A and 1B, and to stay in said rest positions, until an external force, applied to at least one of said two levers 110, 111, makes said toggle 1 to switch into its opposite rest position.

FIG. 2 shows a **second embodiment** of the present invention, consisting of a bistable device, based on a toggle 2, composed of:

two adjacent levers 210, 211, disposed so as to form a toggle 2, in which the lever 210 is a flexible and elastic prolongation of a support 221;

a central film hinge 212, linking the adjacent edges 215, 216 of said two levers 210, 211;

a lateral film hinge 214, linking the external edge 218 of said lever 211, to an anchorage edge 220 of said support 221.

One or more of the following elements, besides said lever 210, may be flexible and elastic:

said two lever 211 of said toggle 2;

the structures of said support 221, near said anchorage edge 220 of said lever 211, and near the anchorage area 219 of said lever 210.

A temporary flexure of said elastic elements allows said toggle 2 to extend itself and switch between two opposite rest positions and to stay in said rest positions, until an external force, applied to at least one of said two levers 210, 211, makes said toggle 2 to switch into its opposite rest position.

FIG. 3 shows a **third embodiment** of the present invention, consisting of a bistable device, based on a toggle 3, composed of:

two adjacent levers 310, 311, disposed so as to form a toggle 3, in which said two levers 310, 311 are flexible and elastic prolongations of a support 321;

a central film hinge 312, linking the adjacent edges 315, 316 of said two levers 310, 311.

One or more of the following elements, besides said levers 310, 311, may be flexible and elastic:

the structures of said support 321, near the anchorage areas 319, 320 of said two levers 310, 311.

A temporary flexure of said elastic elements allows said toggle 3 to extend itself and switch between two opposite rest positions and to stay in said rest positions, until an external force, applied to at least one of said two levers 310, 311, makes said toggle 3 to switch into its opposite rest position.

FIG. 4, 5A, 5B and 5C show a **further embodiment** of the present invention, consisting of a push-pull latch for a door, based on a toggle 1, composed of two levers 110, 111 and three film hinges 112, 113, 114, analogous to the toggle shown in FIG. 1A, comprising:

said toggle 1, fixed to the wing 4 of a door, provided with a forked hook 131 with two fingers 132, 133, protruding from said lever 111;

a rod 135, linked at both of its ends to the frame 5 of said door.

In the first rest position of said toggle 1, named open position, shown in FIG. 5A, said hook 131 is arranged so as to be engaged, during the closing of said wing 4, by said rod 135.

In the second rest position of said toggle 1, named closed position, shown in FIG. 5C, said hook 131 is engaged by said rod 135, so as to retain the wing 4 of said door in its closed position.

During the closing of said wing 4, said rod 135 slips between the two fingers 132, 133 of said hook 131 and pushes said finger 133, making said toggle 1 to switch into its closed position.

During the opening of said wing 4, said rod 135 pulls said finger 132 of said hook 131, making said toggle 1 to switch into its open position, and disengages itself from said hook 131.

During the opening or the closing of said wing 4, the flexible support 134 of said film hinge 114 flexes itself, as shown in FIG. 5B, allowing said toggle 1 to extend itself and switch into its opposite rest position.

FIG. 6 and 7 show a **further embodiment** of the present invention, consisting of a push-pull latch for a door, based on a toggle 1, composed of two levers 110, 111 and three film hinges 112, 113, 114, analogous to the toggle shown in FIG. 1A, comprising:

said toggle 1, fixed to the wing 6 of a door, provided with a forked hook 131 with two fingers 132, 133, protruding from said lever 111;

a rod 135, linked at both of its ends to the frame 7 of said door.

In the first rest position of said toggle 1, named open position, said hook 131 is arranged so as to be engaged, during the closing of said wing 6, by said rod 135.

In the second rest position of said toggle 1, named closed position, said hook 131 is engaged by said rod 135, so as to retain said wing 6 of said door in its closed position.

During the closing of said wing 6, said rod 135 slips between the two fingers 132, 133 of said hook 131 and pushes said finger 133, making said toggle 1 to switch into its closed position.

During the opening of said wing 6, said rod 135 pulls said finger 132 of said hook 131, making said toggle 1 to switch into its open position, and disengaging itself from said hook 131.

During the opening or the closing of said wing 6, the flexible lever 110 of said toggle 1 flexes itself, as shown in FIG. 7, allowing said toggle 1 to extend itself and switch into its opposite rest position.

FIG. 8 and 9 show a **further embodiment** of the present invention, consisting of a push-pull latch for a door, based on a toggle 2, composed of two levers 210, 211 and two film hinges 212, 214, analogous to the toggle shown in FIG. 2, comprising:

said toggle 2, fixed to the wing 8 of a door, provided with a forked hook 231 with two fingers 232, 233, protruding from said lever 211;

a rod 235, linked at both of its ends to the frame 9 of said door.

In the first rest position of said toggle 2, named open position, said hook 231 is arranged so as to be engaged, during the closing of said wing 8, by said rod 235.

In the second rest position of said toggle 2, named closed position, said hook 231 is engaged by said rod 235, so as to retain said wing 8 of said door in its closed position.

During the closing of said wing 8, said rod 235 slips between the two fingers 231, 232 of said hook 231 and pushes said finger 233, making said toggle 2 to switch into its closed position.

During the opening of said wing 8, said rod 235 pulls said finger 232 of said hook 231, making said toggle 2 to switch into its open position, and disengaging itself from said hook 231.

During the opening or the closing of said wing 8, the flexible lever 210 of said toggle 2 flexes itself, as

shown in FIG. 9, allowing said toggle 2 to extend itself and switch into its opposite rest position.

FIG. 10, 11A, 11B, 11C and 11D show a **variation** of the embodiments of the present invention shown in FIG. 4, 6 and 8, consisting of a push-pull latch for a door, provided with a lock device, which, when the wing 10 is open, prevents the hook 431 from switching into its closed position, comprising:

a hook 431, which differs from the hooks 131 or 231 of FIG. 4, 6 or 8, for said finger 433 having, at its tip, a retention tooth 436;

a retention tooth 441, linked to two flexible tongues 442, 443, fixed to the wing 10 of said door;

two wedge elements 444, 445, protruding from the tips of said two flexible tongues 442, 443;

a rod 435, linked at both of its ends to the frame 11 of said door;

a slit 450, on the frame 11 of said door, provided with two edges 451, 452.

When the wing is in its open position, as shown in FIG. 10 and 11A, said retention tooth 436 of said hook 431, abuts said retention tooth 441, preventing said hook 431 from accidentally switching into its closed position.

During the closing of said wing 10, as shown in FIG. 11B, said wedge elements 444, 445, slip into said slit 450, interfere with said edges 451, 452, compel said flexible tongues 442, 443 to flex, and displace said retention tooth 441, which disengages itself from said retention tooth 436 of said hook 431, so that said rod 435, by pushing said finger 433, pushes said hook 431, which starts switching into its closed position.

FIG 11C shows the balance position of said hook 431, before it switches into its closed position, and evidences that said wedge elements 444, 445 are still engaged by said edges 451, 452.

Fig. 11D shows said wing 10 in its closed position, in which said hook 431 switched into its closed position, said finger 432 of said hook 431 is engaged by said rod 435 and retains said wing 10 in its closed position, said wedge elements 444, 445 are no more interfering with said edges 451, 452 and said flexible tongues 442, 443 are no more flexed and are back in their original shape.

FIG. 12, 13A, 13B, 13C and 13D show a **further embodiment** of the present invention, consisting of a push-pull latch for keeping a wing of a door in a determined position, for example its open position, based

on a toggle 1, composed of two levers 110, 111 and three film hinges 112, 113, 114, analogous to the toggle shown in FIG. 1A, comprising:

said toggle 1, fixed to the wing 12 of a door, provided with a forked hook 531 with two fingers 532, 533, protruding from said lever 111;

a rod 535, linked at both of its ends to the frame 13 of said door.

In the first rest position of said toggle 1, named open position, shown in FIG. 13C and 13D, said hook 531 is arranged so as to be engaged, during the opening of said wing 12, by said rod 535.

In the second rest position of said toggle 1, named closed position, shown in FIG. 12 and 13A, said hook 531 is engaged by said rod 535, so as to retain the wing 12 of said door in its open position.

During the opening of said wing 12, said rod 535 slips between the two fingers 532, 533 of said hook 531 and pushes said finger 533, making said toggle 1 to switch into its closed position.

During the closing of said wing 12, said rod 535 pulls said finger 532 of said hook 531, making said toggle 1 to switch into its open position, and disengaging itself from said hook 531.

During the opening or the closing of said wing 12, said flexible lever 110 of said toggle 1 flexes itself, as shown in FIG. 13B, allowing said toggle 1 to extend itself and switch into its opposite rest position.

FIG. 14 shows a **further embodiment** of the present invention, consisting of a push-pull latch for a door or a panel, based on a toggle 1, composed of two levers 110, 111 and three film hinges 112, 113, 114, analogous to the toggle shown in FIG. 1A, comprising:

a male element 15, fixed to the wing (or to the frame) of a door or of a panel, constituted of a shank with a mushroom-shaped section, whose head 601 is provided with two retention teeth 602, 603;

a female element 14, fixed to the frame (or on the wing) of said door or panel, composed of said toggle 1, provided with two hooks 604, 605 with retention teeth 606, 607, protruding from said two levers 110, 111; said toggle 1 is anchored to an ringoidal shaped elastic support 612, which allows said toggle 1 to extend itself and switch between its two opposite rest positions; said two levers 110, 111 are provided with two slits 608, 609, which allow moulding of said two retention teeth 606, 607, which otherwise would

be undercut.

In the first rest position of said toggle 1, named open position, shown in FIG. 14, 15A and 16C, said two hooks 604, 605 are spaced from each other and allow said male element 15 to enter and exit freely from said female element 14.

In the second rest position of said toggle 1, named closed position, shown in FIG. 15C and 16A, said two hooks 604, 605 are near to each other and are able to retain said male element 15, through the interference among said retention teeth 606, 607, and said retention teeth 602, 603, of said male element 15.

During the closing of said wing, as shown in sequence in FIG. 15A, 15B and 15C, said male element 15 pushes the area of the central film hinge 112 of said toggle 1, makes said toggle 1 to switch into its closed position, and becomes engaged, through said retention teeth 602, 603, by said retention teeth 606, 607 of said hooks 604, 605.

During the opening of said wing, as shown in sequence in FIG. 16A, 16B and 16C, said male element 15, through its retention teeth 602, 603, pulls said retention teeth 606, 607 of said hooks 604, 605, makes said toggle 1 to switch into its open position, and disengages itself from said hooks 604, 605.

Said two hooks 604, 605 are provided with angled ramps 608, 609, which allow, as shown in sequence in FIG. 17A, 17B e 17C, said male element 15 to slip into said female element 14 even if said toggle 1 accidentally switched into its closed position. FIG. 17B and 17C show said male element 15, wedging itself between said angled ramps 608, 609, spreading said hooks 604, 605 and making said toggle 1 to switch into its open position.

The force needed to open or close said toggle 1 is determined by the reaction opposed by said elastic ringoidal support 612 to the extension of said toggle 1, and is due to the shape of said elastic support 612, and particularly, referring to the bottom view shown in FIG. 18A, it depends from:

the thickness of the perimetrical walls 621, 622, 623, 624 and of the curved corners 625, 626, 627, 628 of said elastic support 612;

the shape, straight or curved, of said walls 623, 624 of said elastic support 621;

the height of said front and back walls 623, 624 of said elastic support 621;

the bending radius of said curved corners 625, 626, 627, 628.

By varying said geometric features of said elastic support 612, it is possible to calibrate the force needed to open and to close said toggle 1 within a wide range of values, thus allowing to design variations of the device which can fit the needs of a wide spectrum of applications.

Said elastic support 612 can keep its elasticity, needed for a good working of the device, notwithstanding its small dimensions and the poor elasticity of plastics, since:

it undergoes temporary deformations, only during the extension of said toggle 1;

the amount of said deformations is small and is within the limits of elastic deformation, since said toggle 1 transforms a rather large excursion of said hooks 604, 605, into an extension, whose amount is about an order of magnitude smaller;

the ringoidal shape of said elastic support 612, distributes said small deformation along its whole perimeter, as shown in FIG. 18B.

If said female element 14 is manufactured as a separate part, to be assembled on a wing or on a frame of a door or of a panel, as in the embodiment shown in FIG. 14:

the upper belt 613 of said elastic support 612 and the element to which it will be assembled, may be provided with fastening features, like: pierced flanges, press or snap anchorages, or others, not described herein, since widely known;

the lower belt 614 of said elastic support 612 must be left free, so that it can flex itself when said toggle extends itself.

FIG. 19B shows a cross-sectional view of a **variation** of the embodiment of the present invention shown in FIG. 14, wherein said female element 14, in order to fit particular application needs, is embodied in oblique form, inclined along directrices parallel to a plane perpendicular to the plane passing through the axes of said two lateral film hinges 113, 114. Fig 19A shows, for comparison, a cross-sectional view of a

not oblique embodiment of said female element 14 of FIG. 14.

FIG. 20 shows a **further variation** of the embodiment of the present invention shown in FIG. 14, wherein said female element 14 is integrated with the frame or the wing of a door or a panel, and is manufactured in the same injection moulding operation, in which:

the upper edge 613 of said elastic support 612 is integrated with the body 632, which holds it, by a tapered connection 631;

the lower edge 614 of said elastic support 612 is left free, is free, so as it can flex itself when said toggle 1 extends itself.

The variation shown in FIG. 20 may be embodied even in oblique form, as shown in FIG. 19B, in order to allow the integration of the female element 14 with the frame or the wing of a door or of a panel, even when their shape requires the mould's closing plan to be oblique with respect to the axis of the male element 15.

FIG. 21 shows a **further variation** to the embodiment of the present invention shown in FIG. 14, in which said elastic support 612 of said female element 14 is provided with a lateral cut out 641, through which, when said toggle 1 is in its closed position, a movable element 16, driven by other mechanical elements, like a handle, a lock or other, can be inserted,. Said movable element 16, by interposing itself between the back side 643 of said hook 605 and the inner side 642 of said elastic support 612, locks said hook 605 and prevents said toggle 1 from switching into its open position and said male element 15 from disengaging from said hooks 604, 605.

FIG. 22A and 22B show a **further embodiment** of the present invention, consisting of a bistable device for driving other mechanical elements, based on a toggle 2, composed of two levers 210, 211 and two film hinges 212, 214, analogous to the toggle shown in FIG. 2, comprising:

a command lever 701, protruding from said lever 211 of said toggle 2, by means of which it is possible to make said toggle 2 to switch between its two opposite rest positions;

a drive lever 702, protruding from said lever 211 of said toggle 2, which drives other movable

mechanical elements cooperating with it, like a lever, a cursor or an electrical contact, and make them to switch between two distinct positions.

Said bistable device stays in one of its two rest positions, until an external force, applied to said command lever 701, or to said drive lever 702, makes it to switch into its opposite rest position.

While only some preferred embodiments of the present invention have been shown and described, it will be understood that various modifications and changes could be made thereunto, in order to adapt the invention to the requirements of specific applications. The present description should not be intended to give a comprehensive list of all the possible variations of the present invention. It should be noted, however, that variations of dimensions, thicknesses or profiles of the embodiments shown and described may cause even significant variations of the device, without departing the spirit and scope of the invention disclosed.

CLAIMS

1. A toggle, composed of:

two adjacent levers, disposed so as to form a toggle;

a central film hinge, linking the adjacent edges of said two levers;

two lateral film hinges, linking the external edges of said two levers, to two anchorage edges of a support.

2. A toggle, composed of:

two adjacent levers, disposed so as to form a toggle, wherein one of said two levers is a flexible and elastic prolongation of a support;

a central film hinge, linking the adjacent edges of said two levers;

a lateral film hinge, linking the external edge of the second lever, to an anchorage edge of said support.

3. A toggle, composed of:

two adjacent levers, disposed so as to form a toggle, wherein said two levers are flexible and elastic prolongations of a support;

a central film hinge, linking the adjacent edges of said two levers.

4. A bistable toggle device, according to claims 1 or 2 or 3, wherein at least one of the following elements is flexible and elastic:

the two levers of said toggle;

the two structures of said support, to which said two levers are anchored, directly or through said film hinges;

so as a temporary flexure of at least one of said elastic elements allows said toggle to extend itself and switch between its two opposite rest positions, and to stay in said rest positions, until an external force, applied to at least one of said two levers, makes said toggle to switch into its opposite rest position.

5. A bistable toggle device, according to claim 4, composed of:

said toggle, anchored to a first support;

a forked hook, protruding from one of said two levers of said toggle;

a rod, linked at its ends, to a second support.

6. A bistable toggle device, according to claim 5, wherein said first support is fixed to the frame of a door and said second support is fixed to the wing of said door.

7. A bistable toggle device, according to claim 5, wherein said first support is fixed to the wing of a door and said second support is fixed to the frame of said door.

8. A bistable toggle device, according to claims 6 or 7, performing the function of a push-pull latch, for keeping closed a wing, wherein the orientation of said hook with respect to said lever of said toggle, from which it protrudes, and the position of said first support and said second support on the wing or on the frame of said door, are such as:

when said toggle is in one of its two rest positions, named open position, during the closing of said door, said rod slips between the two fingers of said hook and, by pushing said hook, makes said toggle to switch into its opposite rest position, named closed position, and becomes engaged by said hook;

and when said toggle is in its closed position, and said hook retains said rod between its fingers, during the opening of said door, said rod, by pulling said hook, makes said toggle to switch into its open position, and becomes disengaged from said hook.

9. A bistable toggle device, according to claims 6 or 7, performing the function of a push-pull latch for keeping a wing in a defined position, wherein the orientation of said hook with respect to said lever of said toggle, on which it is placed, and the position of said first support and said second support on the wing or on the frame of said door, are such as:

when said toggle is in one of its two rest positions, named open position, during the opening of said door, said rod slips between the two fingers of said hook and, by pushing said hook, makes said toggle to switch into its opposite rest position, named closed position, and becomes engaged by said hook;

and when said toggle is in its closed position, and said hook retains said rod between its fingers,

during the closing of said door, said rod, by pulling said hook, makes said toggle to switch into its open position, and becomes disengaged from said hook.

10. A bistable device, according to claim 8 or 9, performing the function of a push-pull latch for keeping closed a wing or for keeping a wing in a defined position, wherein said first support, said levers of said toggle, said film hinges and said hook, anchored to said support, are integrated with the frame or the wing of a door so as to be manufactured in the same injection moulding operation of said frame or said wing of said door.

11. A bistable toggle device, according to claim 4, performing the function of a push-pull latch for a door or a panel, wherein:

a female element, composed by said bistable toggle device, provided with two hooks, protruding from the two levers of said toggle, provided with retention teeth;

a male element, constituted by a mushroom-shaped shank, whose head is provided with retention teeth;

in one of the two rest positions of said toggle, named open position, said two hooks are distanced from each other and allow said male element to enter freely into said female element, to push said toggle and make said toggle to switch into its closed position;

and in the closed position of said toggle, said two hooks are near to each other and, through their retention teeth, retain said male element, which, if pulled, pulls said hooks, makes said toggle to switch into its open position, and becomes disengaged from said two hooks.

12. A bistable toggle device, according to claim 11, performing the function of a push-pull latch for a door or a panel, wherein said support to which said toggle is anchored, is an elastic ringoidal element, contouring said toggle.

13. A bistable toggle device, according to claim 12, performing the function of a push-pull latch for a door or a panel, wherein said elastic ringoidal support has, along its perimeter, a non constant thickness and height.

14. A bistable toggle device according to claims 11 or 12 or 13, performing the function of a push-pull latch for a door or a panel, wherein the head of said male element and said hooks of said female element, are provided with angled ramps, which allow said male element to wedge itself between said hooks even when said toggle is in its closed position, and to make said toggle switch into its open position, by spreading said hooks.

15. A bistable toggle device, according to claims 11 or 12 or 13 or 14, performing the function of a push-pull latch for a door or a panel, wherein said female element is oblique, inclined according to directrices parallel to a plane perpendicular to the plane passing through the external wedges of said two levers of said toggle.

16. A bistable toggle device, according to claims 11 or 12 or 13 or 14 or 15, performing the function of a push-pull latch for a door or a panel, wherein said female element is provided with one or more slits, trough which, when said toggle is in its closed position, one or more movable elements can enter and, placing themselves on the back side of one or both of said hooks, prevent said hooks from moving, said toggle from switching into its open position, and said male element from disengaging itself from said hooks.

17. A bistable toggle device, according to claims 11 or 12 or 13 or 14 or 15 or 16, performing the function of a push-pull latch for a door or a panel, wherein said female element is integrated with the frame or with the wing of a door or a panel, and is manufactured in the same injection moulding operation of said frame or said wing of said door or panel.

18. A bistable toggle device, according to claim 4, wherein:

a command lever, protruding from one of the two levers of said toggle, by means of which said toggle can be made to switch between its two opposite rest positions;

a drive lever, protruding from one of said two levers of said toggle, or from said command lever, which drives other cooperating movable elements and makes them to switch between two different positions.

19. Bistable toggle device, according to claim 18, wherein, when said command lever makes said toggle

to switch, said drive lever drives, directly or indirectly, one or more electrical contacts, and makes them to switch between two distinct positions, and consequently opens or closes said electrical contact or contacts.

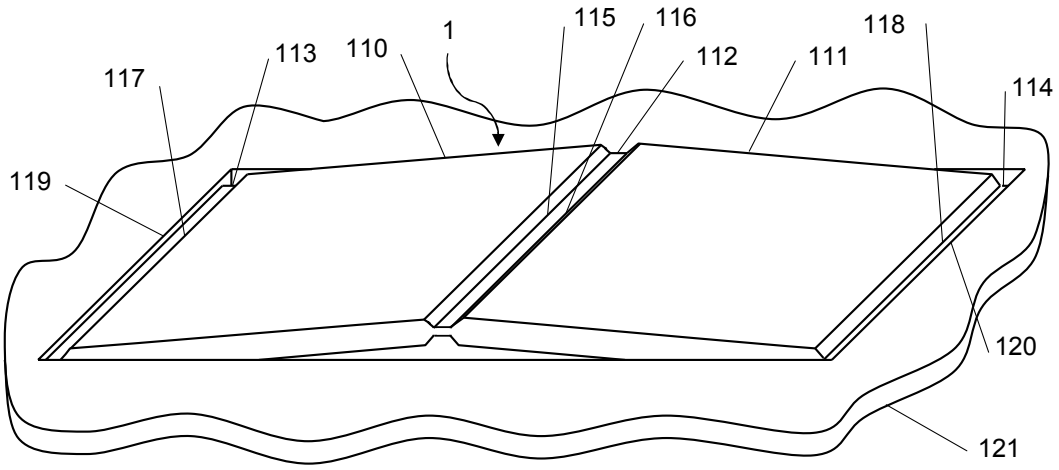
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Fig. 1A

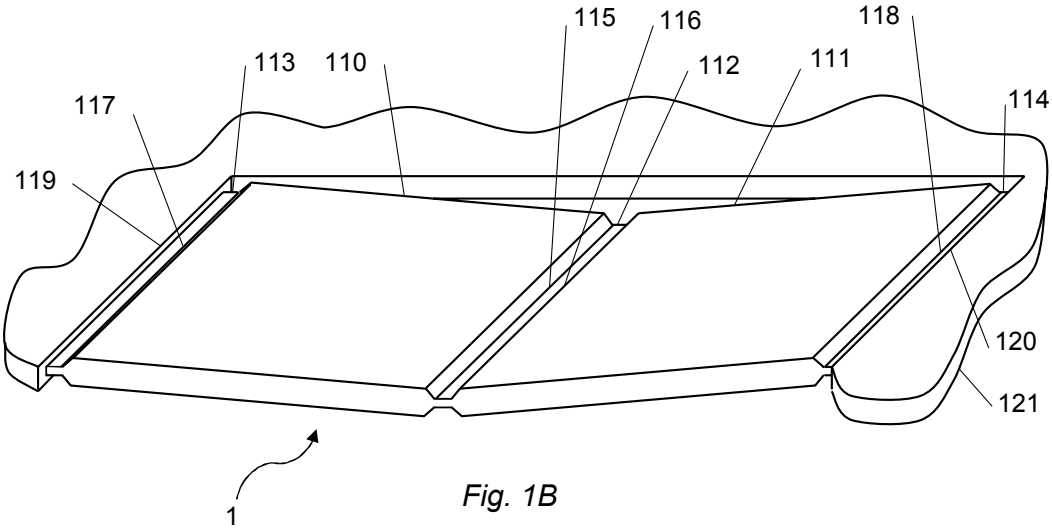
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Fig. 1B

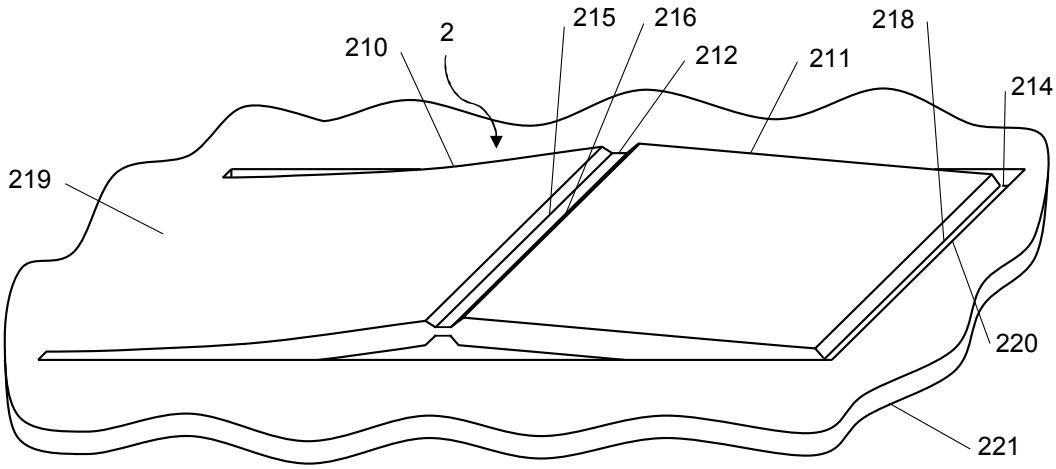
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Fig. 2

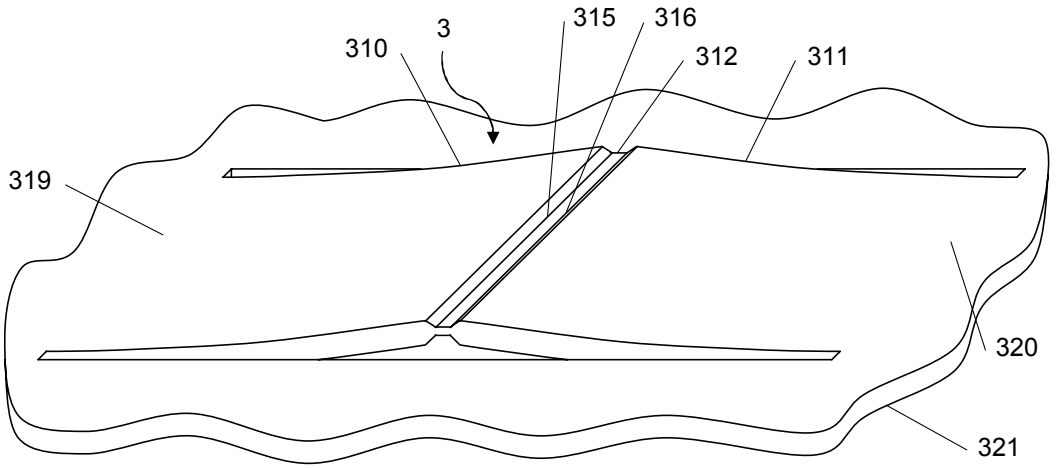
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Fig. 3

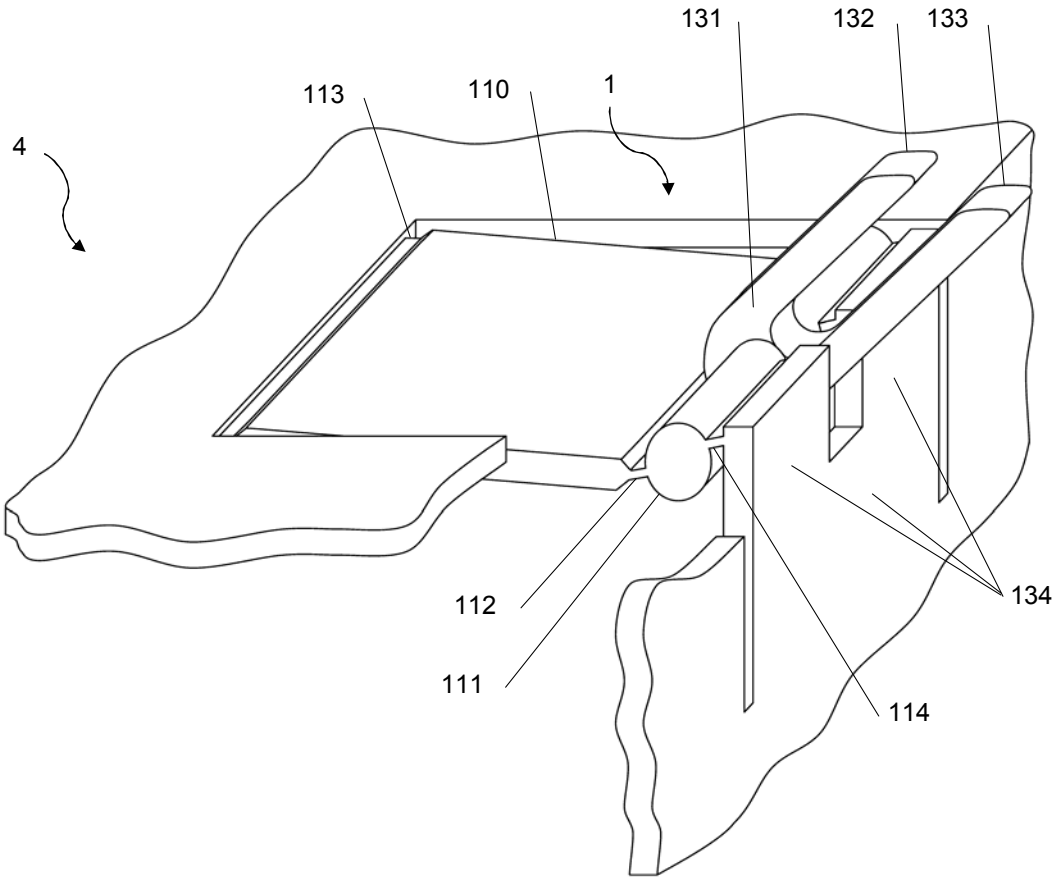

Fig. 4

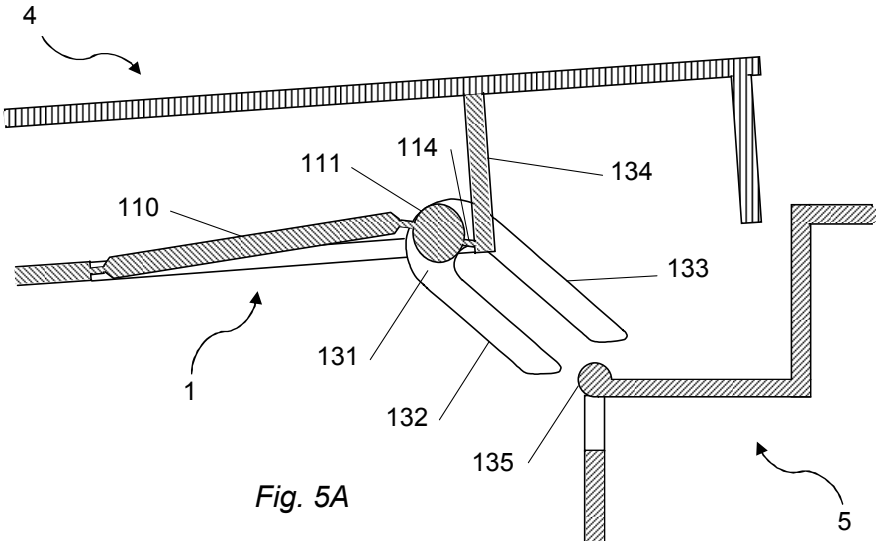

Fig. 5A

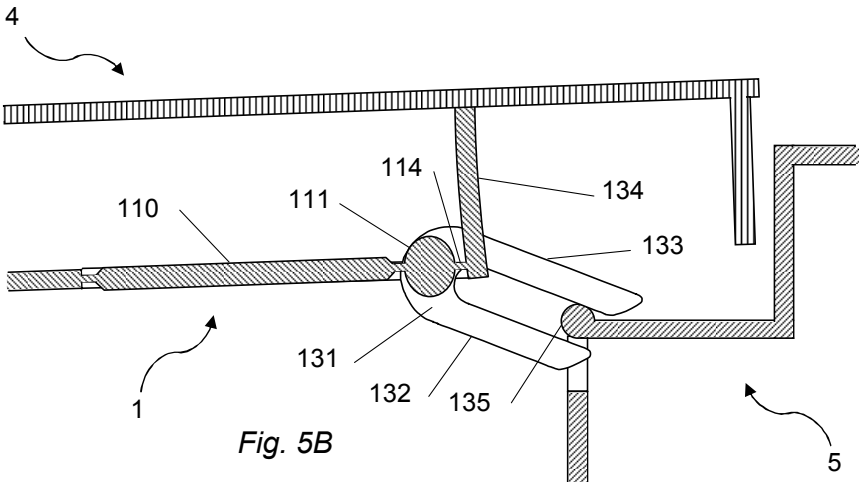

Fig. 5B

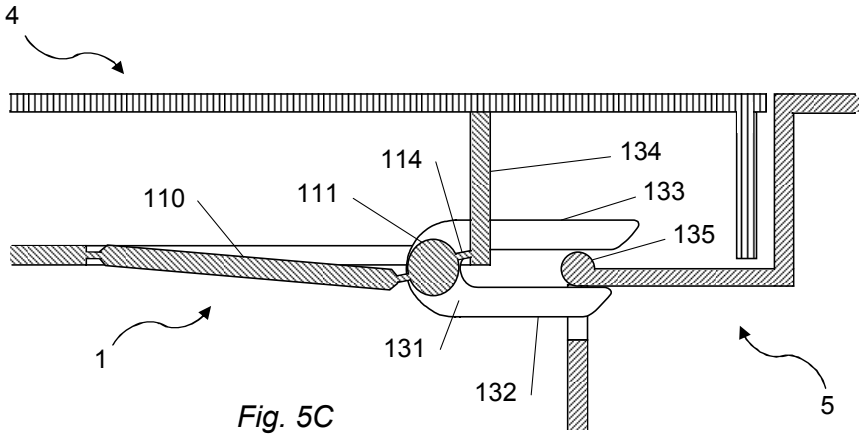

Fig. 5C

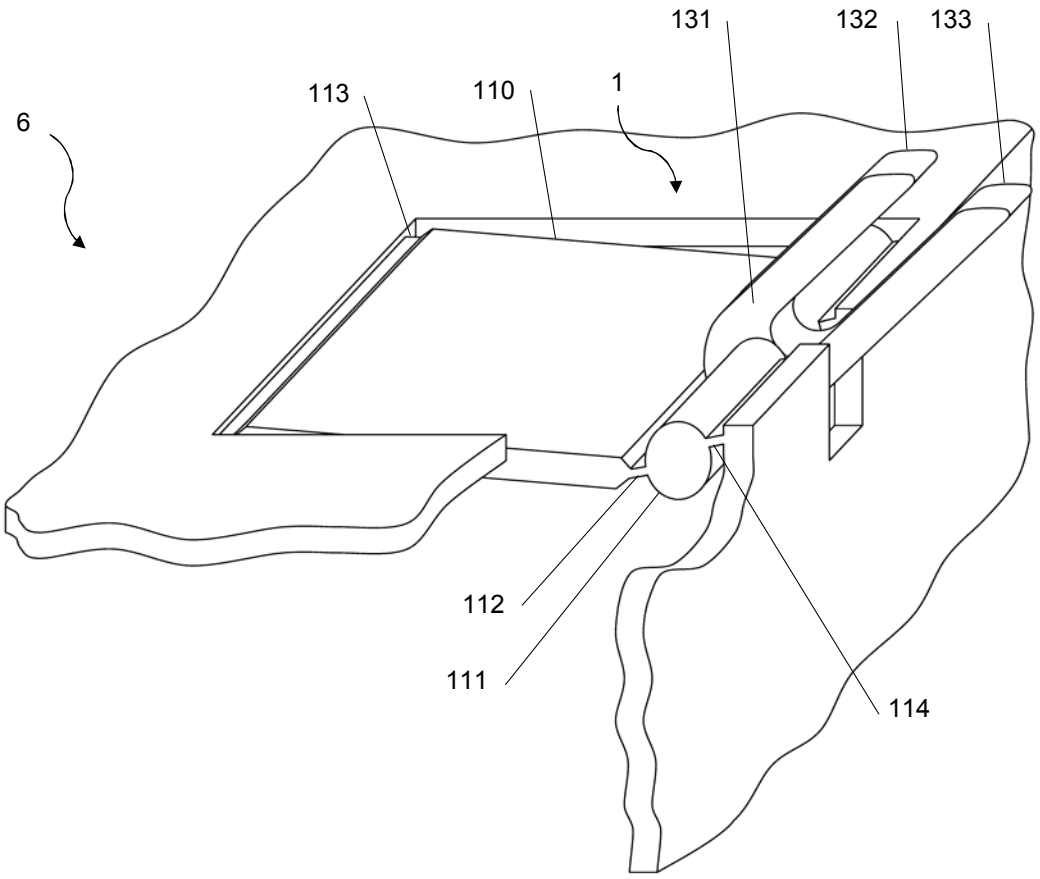
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Fig. 6

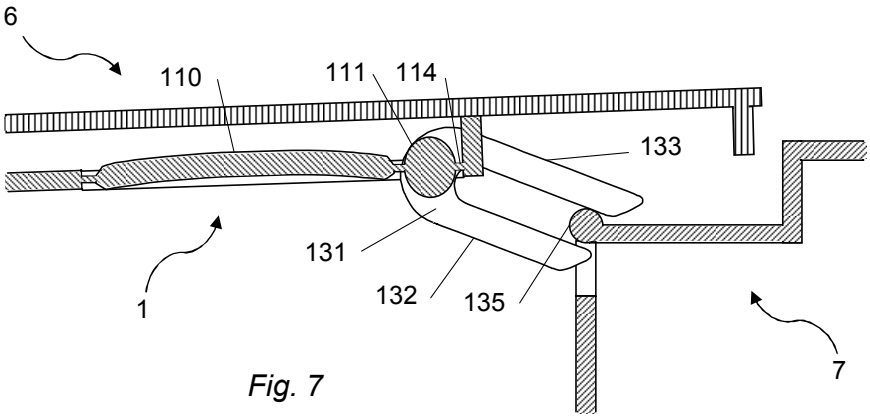
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Fig. 7

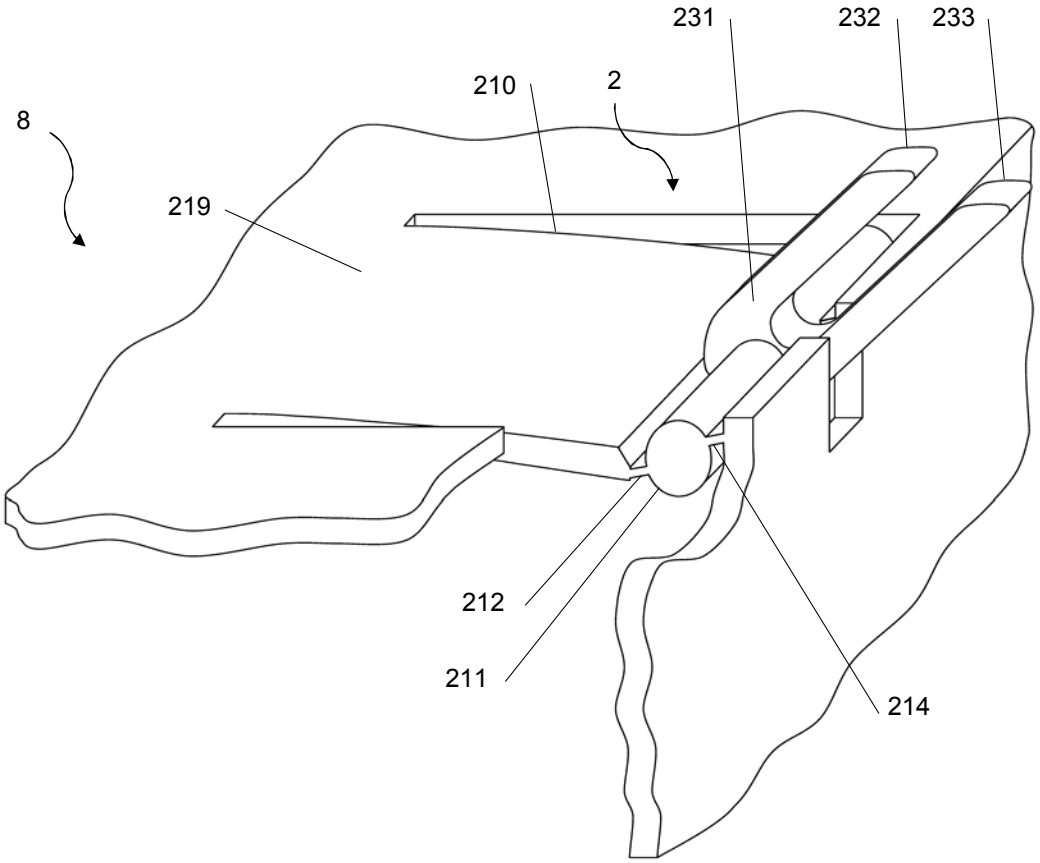
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Fig. 8

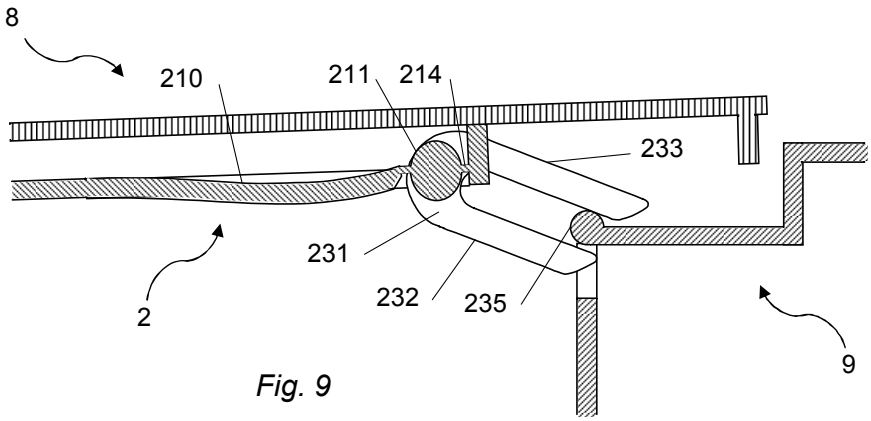
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Fig. 9

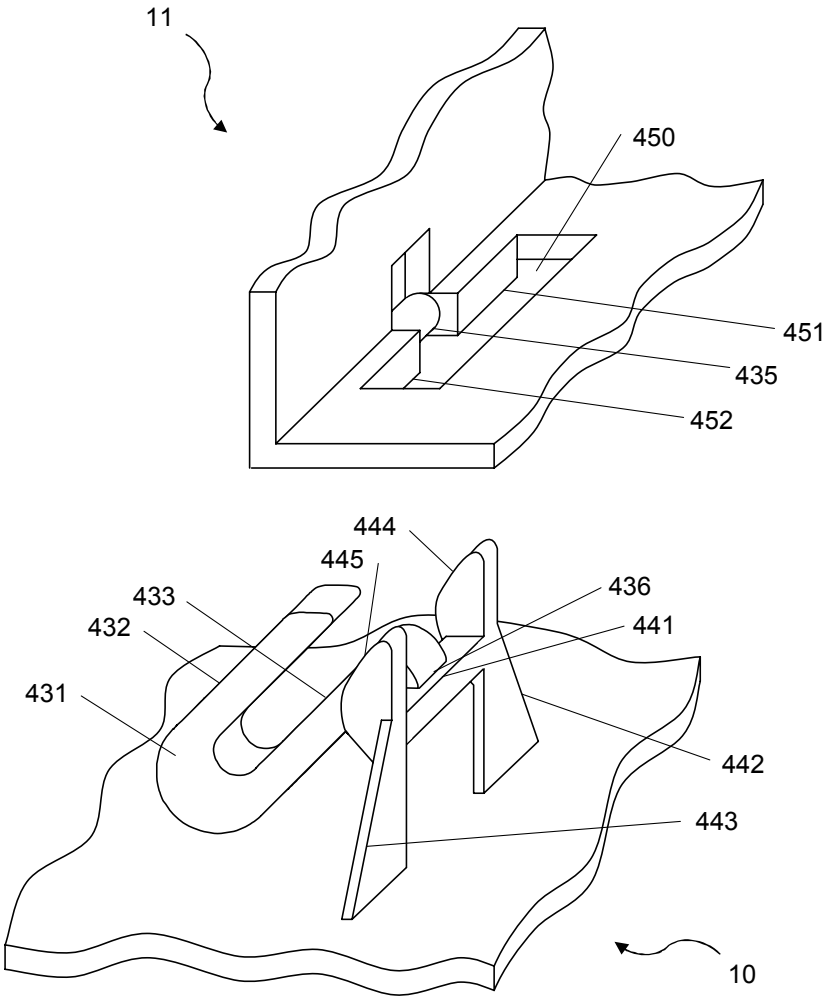

Fig. 10

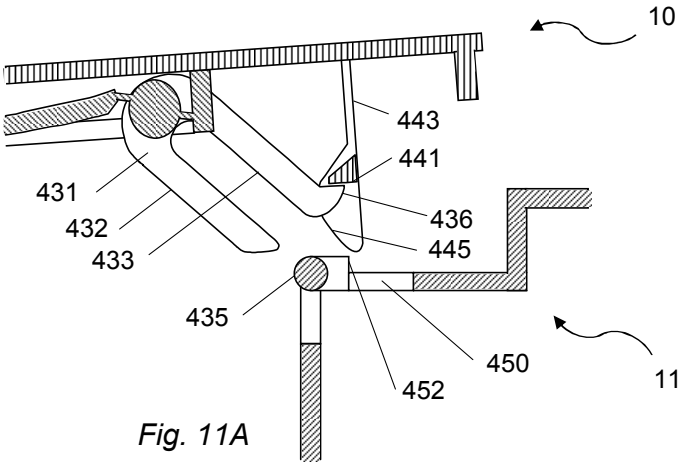

Fig. 11A

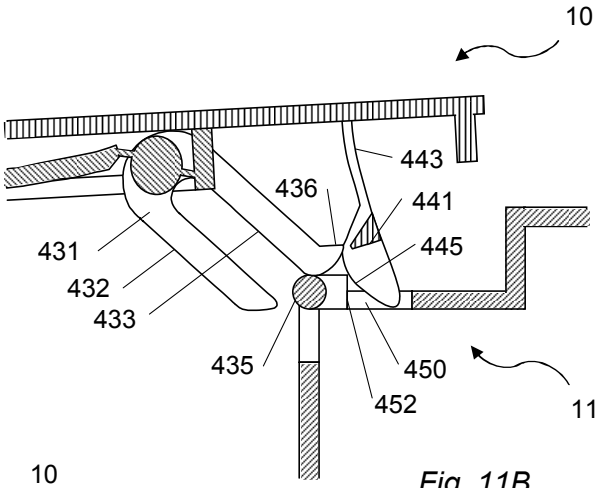

Fig. 11B

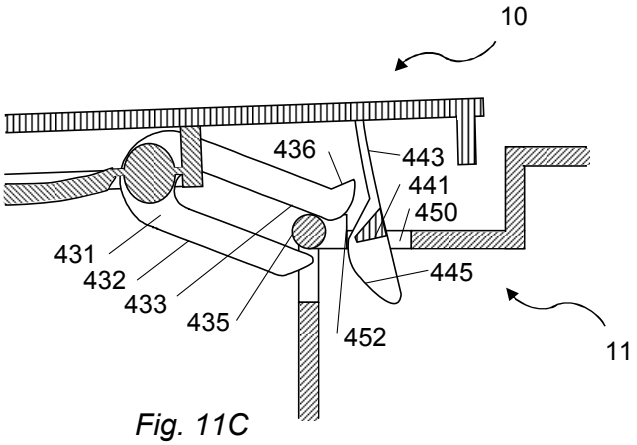

Fig. 11C

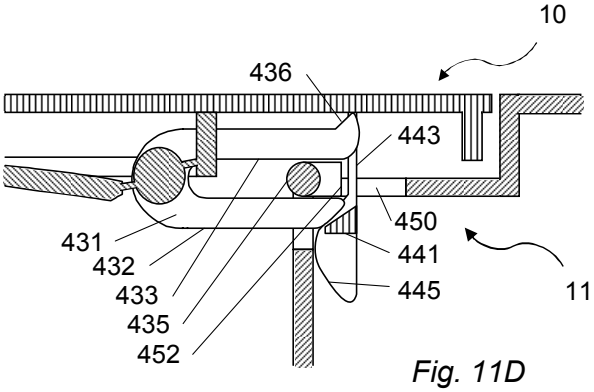

Fig. 11D

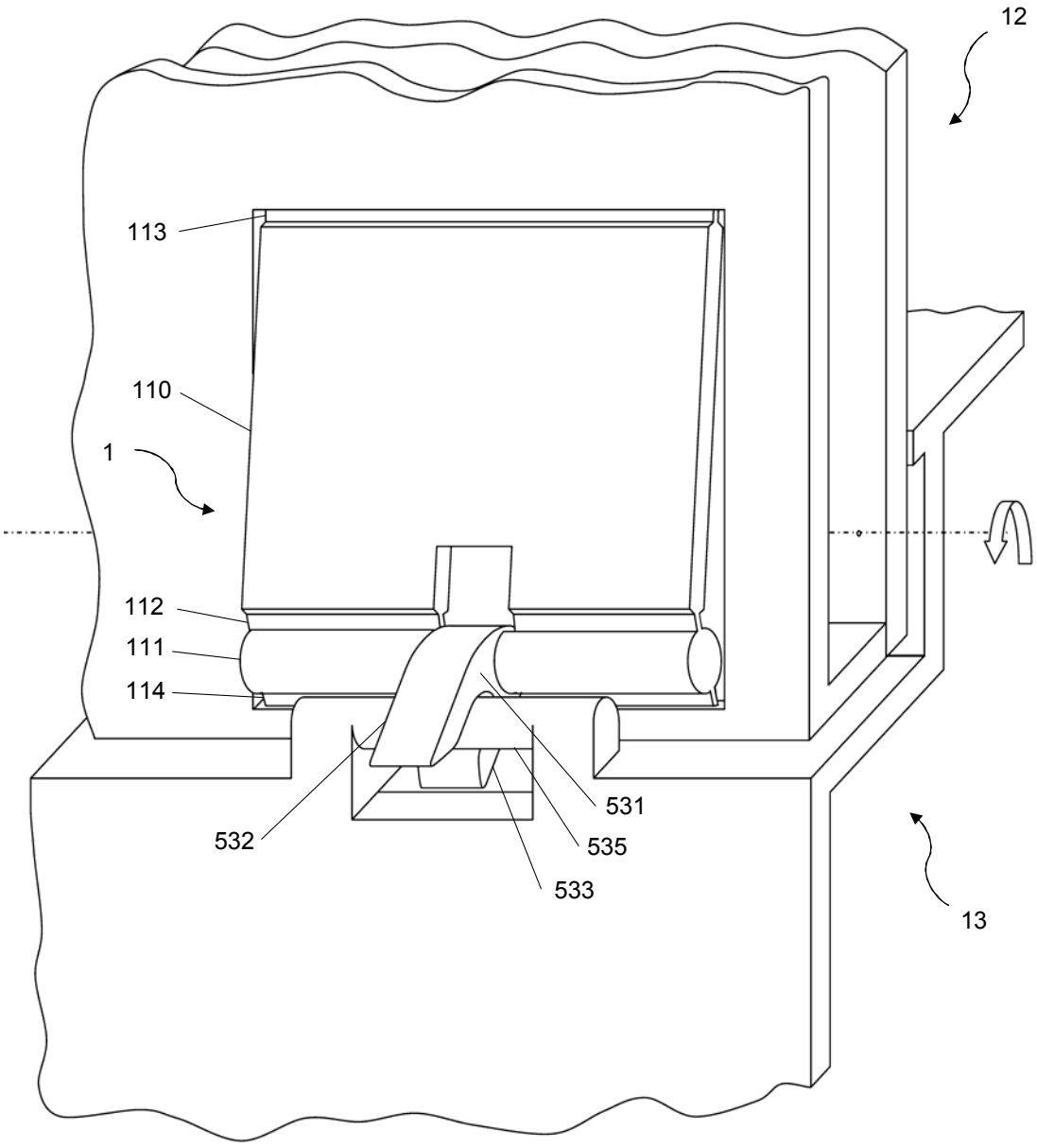

Fig. 12

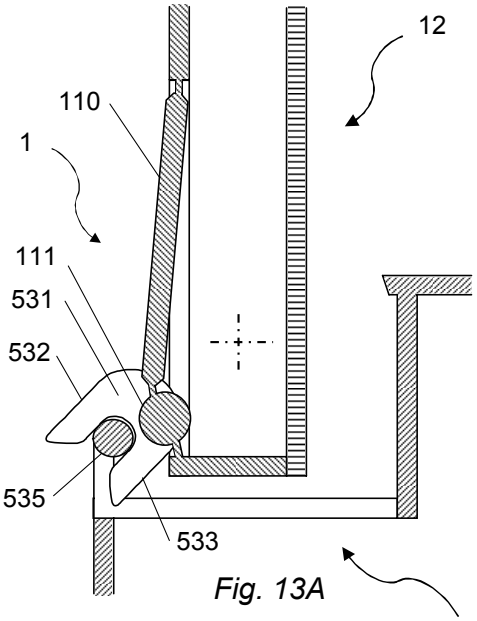

Fig. 13A

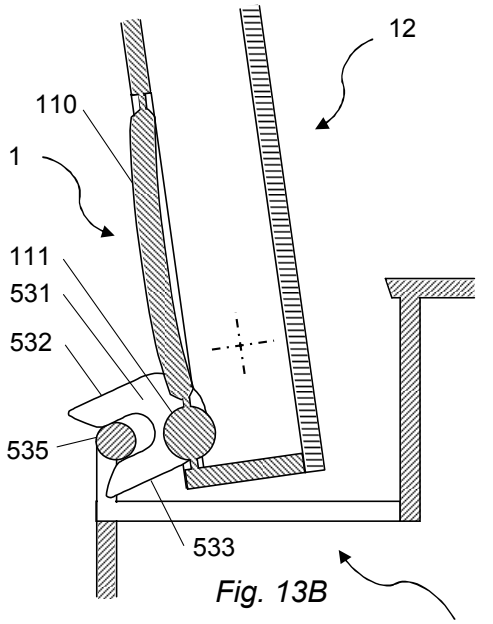

Fig. 13B

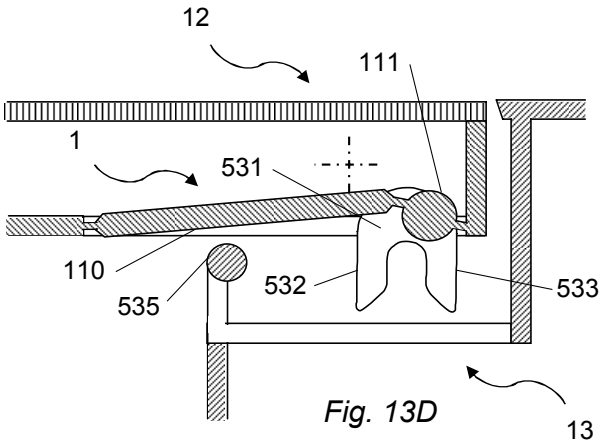

Fig. 13D

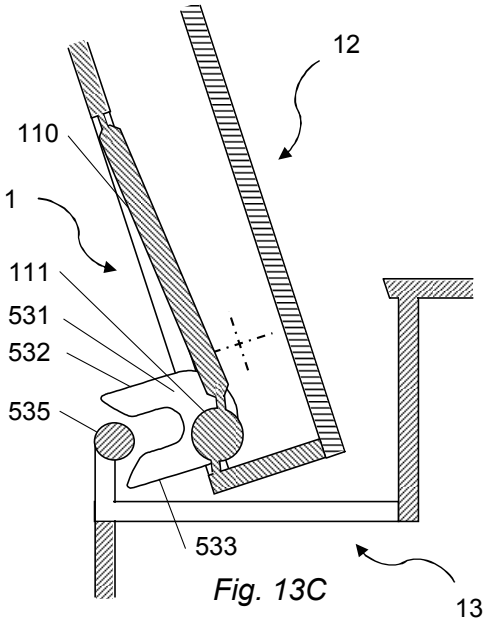

Fig. 13C

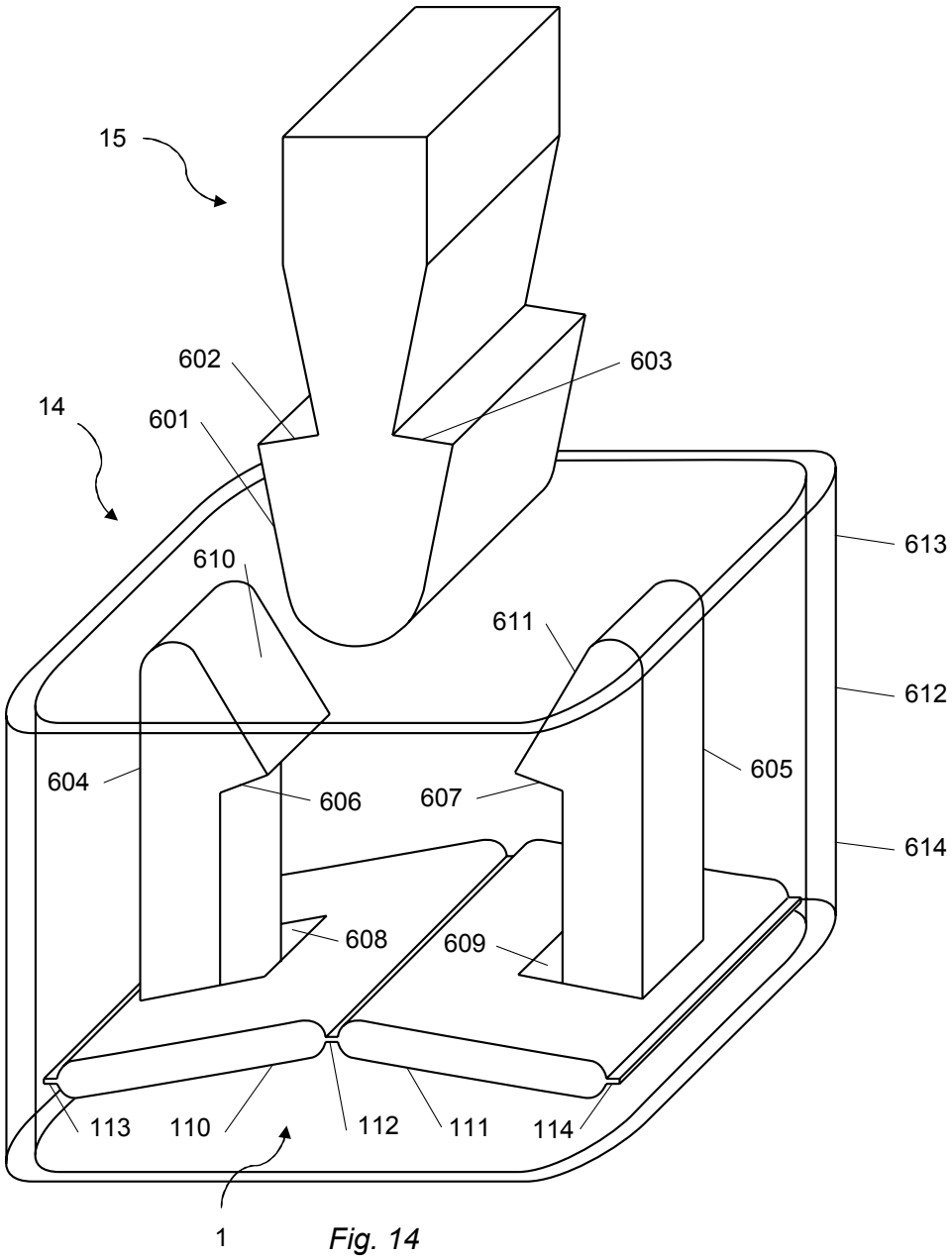
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Fig. 14

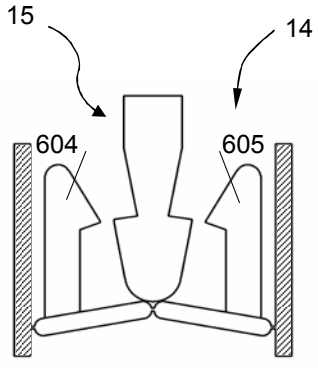


Fig. 15A

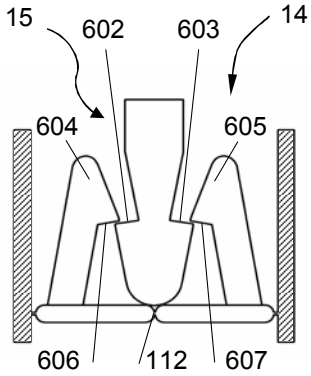


Fig. 15B

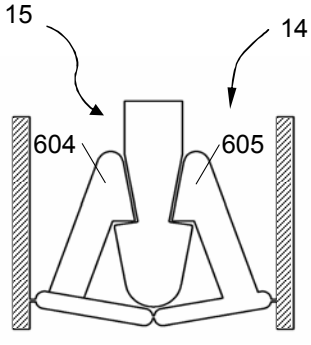


Fig. 15C

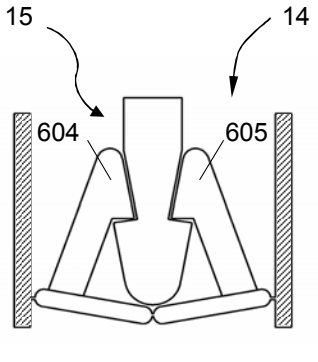


Fig. 16A

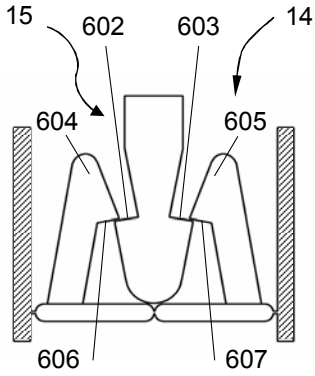


Fig. 16B

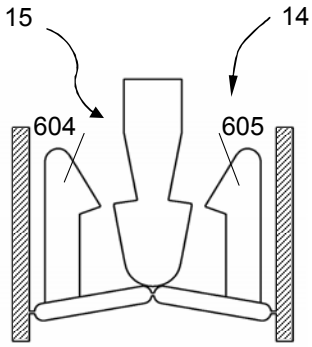


Fig. 16C

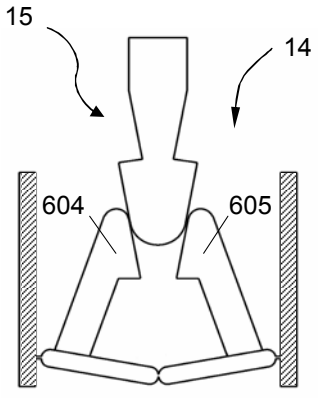


Fig. 17A

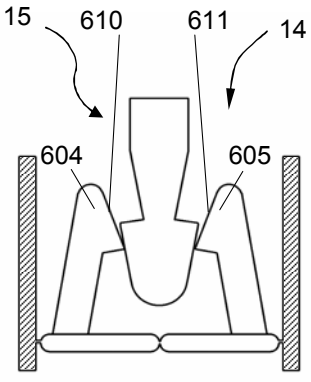


Fig. 17B

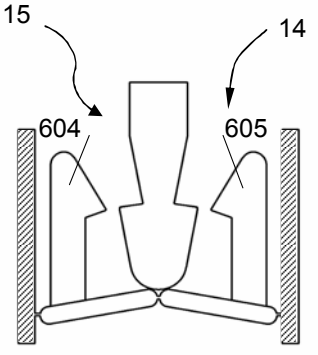


Fig. 17C

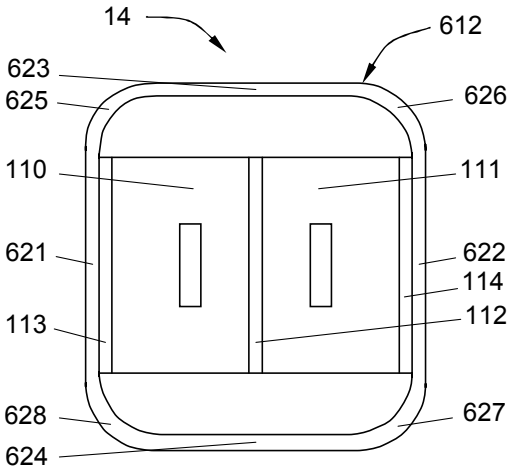


Fig. 18A

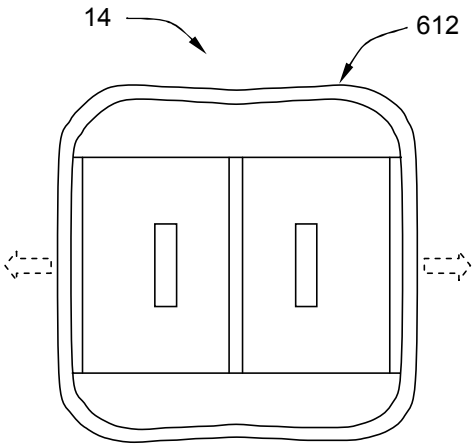


Fig. 18B

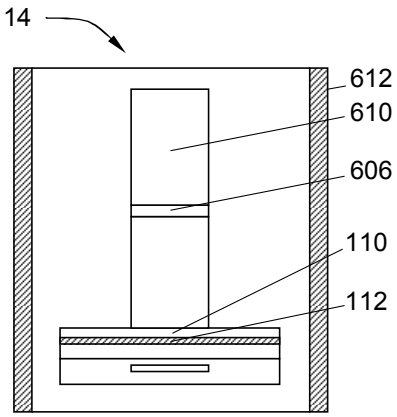


Fig. 19A

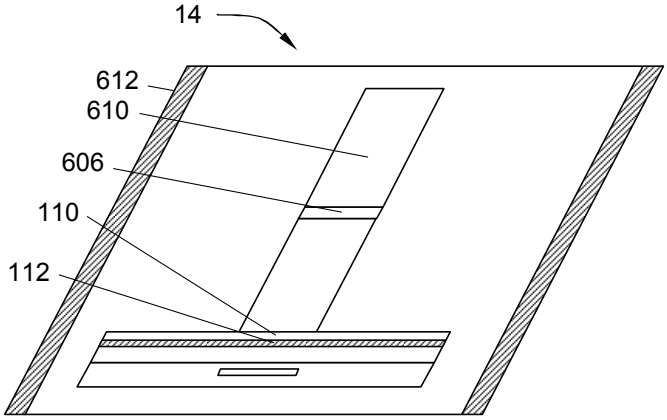
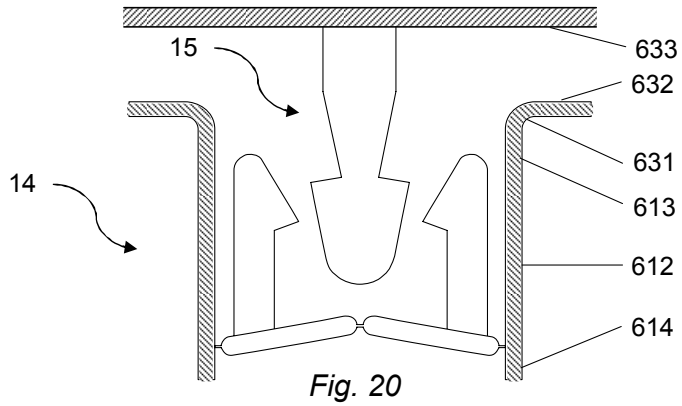


Fig. 19B



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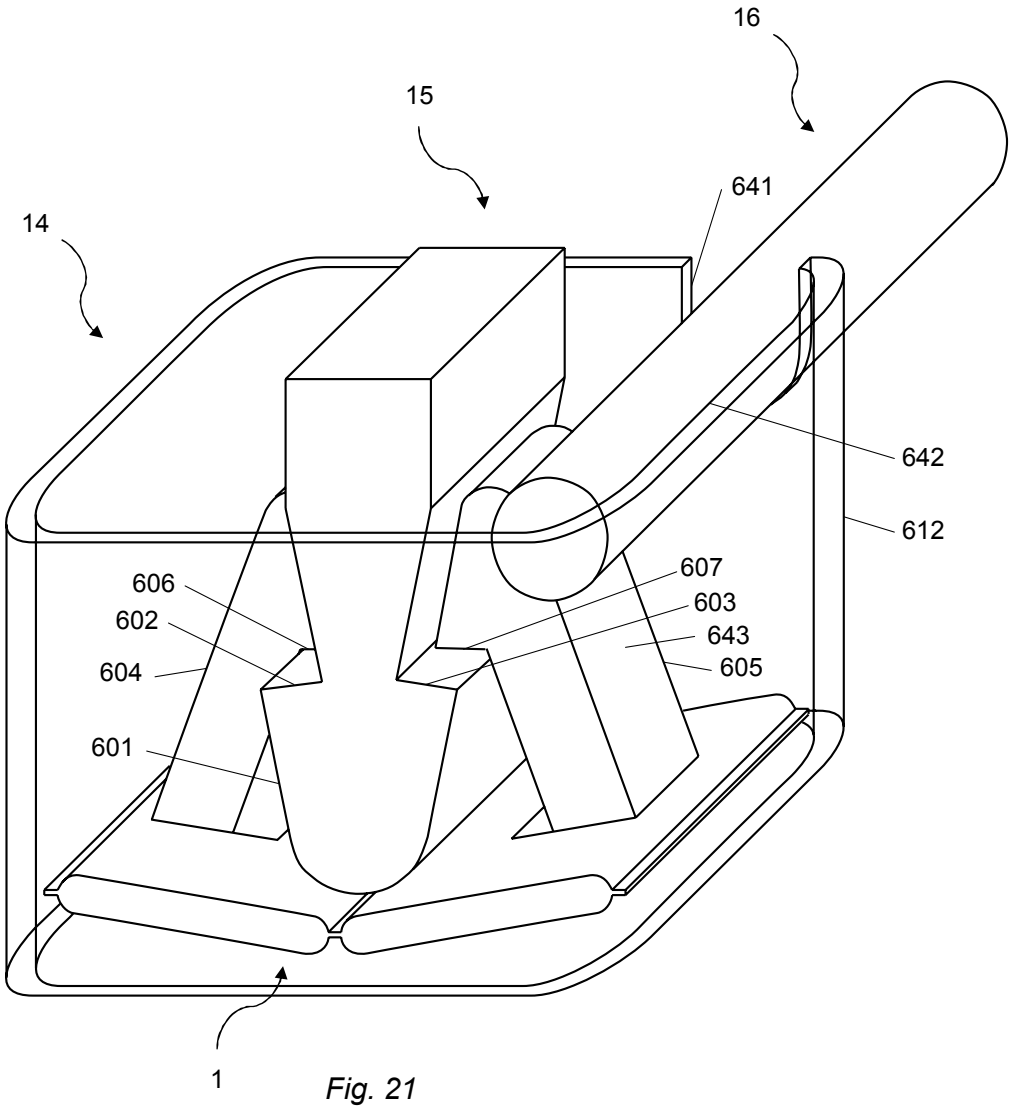

Fig. 21

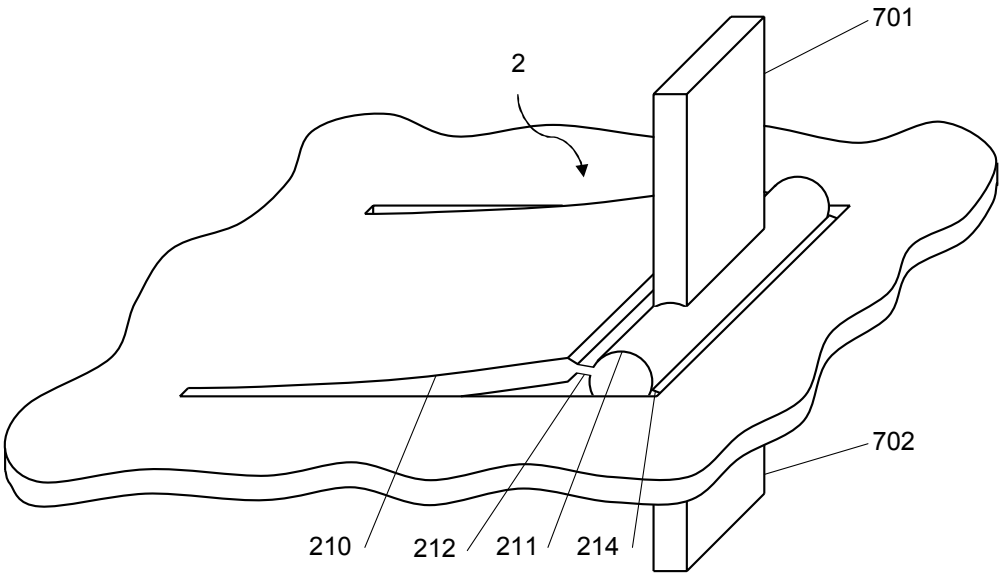

Fig. 22A

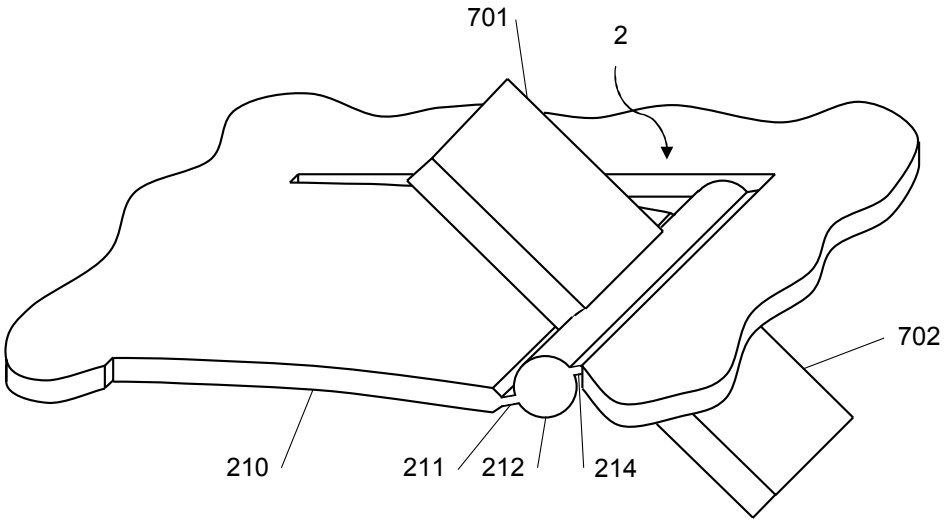

Fig. 22B