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(54) Title: CLOSURE

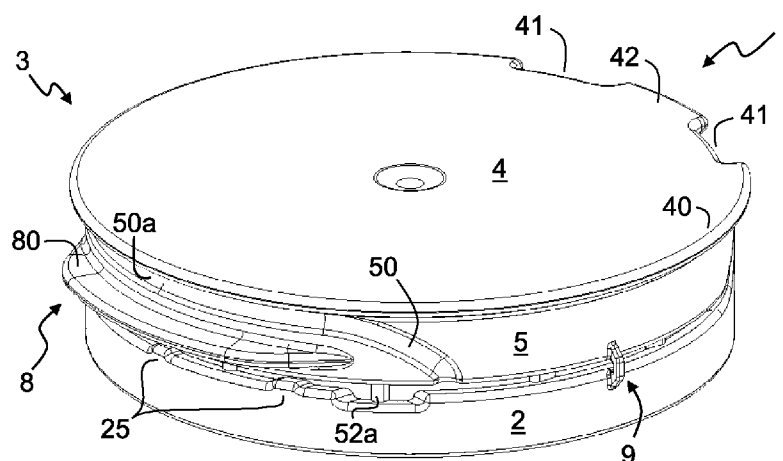


FIG. 1

(57) Abstract: A closure (1) with a shell (2) for securement to a container neck (11) and a lid (3) pivotally connected to the shell (2) by a pair of hinge elements (6). The closure (1) also includes a pair of bridges on opposite sides of the closure (1). Each of the bridges is in the form of a C-shaped loop that projects radially outwardly from each of the shell (2) and the lid (3) such that it straightens, in use, before breaking when the lid (3) is pivoted relative to the shell (2) toward an open position.



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## CLOSURE

### FIELD OF THE INVENTION

5 This invention relates generally to a closure and in particular to a closure for engaging the neck of a container. More specifically, although not exclusively, this invention relates to such closures which are made from molded plastics material for sealingly closing beverage containers, such as glass or plastic bottles and the like.

### BACKGROUND OF THE INVENTION

10 Plastic beverage bottles and closures are well known. There is an established need to improve the security of such bottle and closure designs, in order to ensure that its contents are fresh and untainted at the time of consumption. However, there is also an established need to drive down manufacturing costs and reduce waste, and so design parameters are normally established with a  
15 view to balancing these competing factors.

Plastic beverage closures normally include four main functional elements: a tubular body, securing feature(s), sealing feature(s) and tamper evidence feature(s). The body typically includes a top  
20 wall, usually circular, with an annular side wall depending from the top wall. The side wall is typically in the form of a cylindrical skirt extending perpendicularly from the periphery of the top wall. The securing feature usually includes either a screw thread, or a snap on feature, both of which are known in the art. The securing feature is normally formed integrally with the side wall on the inner surface thereof and adjacent to the container opening, for example the neck of a bottle.  
25 Several different sealing features are known in the art which can be applied in isolation or in various combinations. Similarly, several different tamper evidence features have been developed which can also be applied in isolation or in various combinations.

There is a demand, especially in the beverage and food industry, for closures which can be  
30 sealingly fitted onto the neck of a container with liquid contents and have a pivotable lid that can be held in an open position. In general, such closures include a shell for securing the closure to a container neck and a lid pivotally connected to the shell by a hinge. In many cases, such closures also include means for locking the lid in an open position relative to the shell. The lid is normally connected to the shell by frangible bridges, which break upon first opening of the closure to  
35 provide tamper evidence in the event that the opening is unauthorised.

WO 2019/113681 A1 discloses a closure of the aforementioned type, which includes a ratchet member projecting from the shell between a pair of elongate hinge elements on a first side of the closure. The lid engages the ratchet member when it is in an open position, thereby to lock the lid in place. The shell includes a plurality of cams that engage a tamper-evidence bead projecting from the container neck to retain the shell thereon. The lid includes a top panel with a depending side wall joined to the shell by frangible bridges. The lid includes an opening side, opposite the hinge, at which the height of the side wall increases, with a corresponding decrease in the height of the shell. This region of increased height of the side wall provides a latch for releasably securing the lid in a closed position. An engaging tab projects inwardly from the side wall at the base of the latch, and engages the tamper-evidence bead to retain the lid in the closed position. The lid also includes a gripping tongue projecting outwardly from the side wall above the engaging tab, which is reinforced by a series of ribs beneath it to provide additional rigidity. The gripping tongue is configured to be gripped by a user for urging the lid upwardly to open the closure.

The lid is frangibly connected to the shell by a series of bridges that join the lower edge of the side wall of the lid to the upper edge of the shell. These bridges are distributed evenly about the front and sides of the closure and are configured to break, in use, when the lid is pivoted relative to the shell from a closed position toward an open position. When the lid is pivoted back to the closed position, the container is closed once again, and sealed to prevent its contents leaking. However, the broken bridges provide evidence that the closure has been opened, and are therefore provide evidence of tampering in the usual way.

## SUMMARY OF THE INVENTION

The present invention is directed, in particular but not exclusively, to a closure for sealingly closing a neck opening of a container. The present invention is also directed to a mold stack, a mold and a molding system for molding such a closure. Aspects of the invention provide a closure having a shell, e.g. for securing the closure to a container neck. The closure may comprise a lid, which may be pivotally connected to the shell, for example by a hinge. The closure may comprise a bridge, which may connect, e.g. frangibly connect, the lid to the shell. The bridge may project radially outwardly from at least one or each of the shell and lid, for example such that it straightens, in use, before breaking when the lid is pivoted relative to the shell toward an open position.

According to a first broad aspect of the present invention, there is provided a closure for sealingly closing a neck opening of a container, the closure comprising a shell for securing the closure to a container neck, a lid pivotally connected to the shell by a hinge and a bridge connecting, e.g. frangibly connecting, the lid to the shell, wherein the bridge projects radially outwardly from each  
5 of the shell and lid such that it straightens and/or stretches, in use, before breaking when the lid is pivoted relative to the shell toward an open position.

The inventors have determined that the inclusion of such a radial bridge, which straightens and/or stretches before breaking, provides more conspicuous evidence of tampering.

10 The bridge may be rotationally offset with respect to the hinge. The bridge may be offset by approximately 90 degrees. The hinge may be at a rear or rear side of the closure. The bridge may be at a side, e.g. a lateral side, of the closure.

15 The bridge may be one of two or more bridges, e.g. a pair of bridges. The bridge may be one of a pair of bridges on opposite sides, e.g. lateral sides, of the closure. The or each bridge may comprise a witness line, e.g. a split line or parting line, which may be formed, e.g. by a mold, when the closure is molded. The witness line may be along a periphery of the bridge. The witness line may be central of the periphery of the bridge, or along an edge, e.g. a front or rear edge, of the periphery  
20 of the bridge. The or each bridge may comprise a flat side, e.g. a flat rear side or a flat front side. The witness line may describe or delineate the flat side of the bridge.

The or each bridge may be curved, e.g. in plan. The or each bridge may comprise a loop. The bridge or loop may project radially outwardly from the shell and/or curve or loop back to join the  
25 lid. The bridge or loop may project radially outwardly from the shell and/or curve or loop back to join the lid. The bridge or loop may project radially outwardly from the lid and/or curve or loop back to join the shell. The or each bridge may be substantially C-shaped. The centre of the loop or C-shaped bridge may comprise a void, hole, aperture, opening and/or may be devoid of material.

30 The or each bridge may comprise a cross-sectional area or thickness that is greater at or adjacent its ends than intermediate of its ends. The or each bridge may comprise a cross-sectional area or thickness that is greater at or adjacent its connection with the shell and/or at its connection with the lid than its cross-sectional area or thickness therebetween, e.g. thereby to provide a region of weakness.

The or each bridge may comprise end portions, for example at or adjacent its connection with the shell and/or at its connection with the lid or side wall. One or both end portions of the bridge may comprise a first cross-sectional area or thickness. The or each bridge may comprise a first cross-sectional area or thickness at or adjacent its connection with the shell and/or at its connection with the lid or side wall.

The or each bridge may comprise an intermediate portion, e.g. between its connection with the shell and its connection with the lid. The intermediate portion may be at or adjacent the centre of the or each bridge. The intermediate portion may comprise a second cross-sectional area or thickness. The or each bridge may comprise a second cross-sectional area or thickness between its end portions or between its connection with the shell and/or at its connection with the lid or side wall.

The first cross-sectional area or thickness may be greater than the second cross-sectional area or thickness. The second cross-sectional area or thickness may be less than the first cross-sectional area or thickness. The intermediate portion or the second cross-sectional area may provide a region of weakness. The intermediate portion or the second cross-sectional area or the region of weakness may comprise or provide a breakage region. The bridge may be configured such that breakage is encouraged in the intermediate portion or the second cross-sectional area or the region of weakness.

In examples, the or each bridge comprises a region of weakness at or adjacent one of its ends, e.g. at or adjacent its connection with the shell or at its connection with the lid or side wall. The or each bridge may comprise a reduced cross-sectional area or thickness at or adjacent its connection with the shell or at its connection with the lid or side wall, thereby to provide a region of weakness.

The or each region or weakness may comprise or provide a breakage region. The or each bridge may be configured to break, in use, at the region of weakness. The bridge or each may be configured to break, in use, at or adjacent its connection with the shell or at its connection with the lid or side wall. The connection between the or each bridge and the shell may comprise a frangible connection. The connection between the or each bridge and the lid or side wall may comprise a frangible connection.

The closure may comprise a catch, e.g. at least one catch associated with the or each bridge. The or each bridge may be configured to engage, in use, the catch, for example when the lid is pivoted

relative to the shell from the open position toward a closed position. The engagement between the or each bridge and an associated catch may deform the bridge inwardly when the lid is moved to the closed position, which may provide a more conspicuous evidence of tampering.

- 5 The or each catch may be at or adjacent the or each region of weakness or frangible connection. The or each catch may be at or adjacent the portion or region of the or each bridge that is configured to break. The catch may comprise a projection. The or each catch may comprise a barb and/or may taper toward an apex. The or each catch, barb or projection may taper away from the region of weakness, frangible connection or the portion or region of the or each bridge that is configured to  
10 break.

The or each bridge comprises a first cross-sectional area or thickness at or adjacent its connection with the lid or side wall, a second cross-sectional area or thickness along the intermediate portion and a third cross-sectional area or thickness at or adjacent its connection with the shell. The first  
15 cross-sectional area or thickness may be greater than the third cross-sectional area. The second cross-sectional area or thickness may be greater than the third cross-sectional area. Alternatively, the second cross-sectional area and/or the third cross-sectional area may be greater than the first cross-sectional area.

- 20 The lid or closure may comprise a top wall. The lid or closure may comprise a side wall. The side wall may depend from the top wall. The closure or lid or top wall may comprise a flange or overhang, hereinafter flange. The flange may comprise a radial flange. The flange may extend radially, e.g. from the top wall. The or each bridge may be connected to and/or project from, e.g. project radially from, the side wall. The or each bridge may join the side wall to the shell. At least  
25 one of the bridges may be located radially inboard of the flange. The flange may overhang at least one of the bridges and/or may extend radially beyond at least one of the bridges.

The closure may comprise an axis, e.g. a rotational axis. The closure may comprise an axial direction, e.g. along or parallel to the axis of the closure. The closure may comprise a radial  
30 direction, e.g. perpendicular or orthogonal to the axis of the closure.

- The or each bridge may have an axial dimension, which may be along the axis or axial direction of the closure. The closure may comprise an axial dimension, which may be along the axis or axial direction thereof. The axial dimension may extend from the top of the lid to the bottom of the shell.  
35 The axial dimension of the or each bridge may be at least 20% of the axial dimension of the closure.

The axial dimension of the or each bridge is preferably at least 25% of the axial dimension of the closure. The axial dimension of the or each bridge is more preferably at least 30% of the axial dimension of the closure. In some cases, the axial dimension of the or each bridge is at least 35%, or even at least 40%, of the axial dimension of the closure. The applicant has determined that the increased axial length of the bridge(s) provides a more conspicuous evidence of tampering.

The closure may comprise at least one void or cut out, which may be aligned with and/or inboard of part of the or a respective bridge. The closure may comprise a void or cut out that is aligned with and/or inboard of the centre of the loop or C-shaped bridge. The closure may comprise a void or cut out that is aligned with and/or inboard of the void, hole, aperture or opening of the bridge. The or each void or cut out may be described in the lid and/or the shell. The lid or side wall may comprise a void or cut out at or adjacent its connection with the bridge. The shell may comprise a void or cut out at or adjacent its connection with the bridge.

The applicant has determined that the void or cut out provides a more conspicuous evidence of tampering, especially when combined with one or more of the relatively long bridge, the frangible connection and/or the catch, as described above.

The or each bridge may comprise a radial bridge or radially projecting bridge. The closure may comprise one or more, e.g. a plurality of, axial bridges. The axial bridge(s) may connect the lid to the shell. The axial bridges may join facing portions of the lid and shell. At least one or some of the axial bridge(s) may be at the front of the closure. At least one or some of the axial bridge(s) may be at the side(s) and/or rear of the closure. The axial bridge(s) may be spaced equally about the circumference of the closure.

At least one or some of the axial bridge(s) may be configured to break, in use, before the radial bridge(s) or radially projecting bridge(s), for example when the lid is pivoted relative to the shell toward the open position, e.g. from a closed position. The axial bridge(s) at the front of the closure may be configured to break, in use, before the radial bridge(s) or radially projecting bridge(s), for example when the lid is pivoted relative to the shell toward the open position, e.g. from a closed position.

In some examples, all of the axial bridges are configured to break, in use, before the radial bridge(s) or radially projecting bridge(s), for example when the lid is pivoted relative to the shell toward the open position, e.g. from a closed position. At least one or each axial bridge may comprise a cross-

sectional area that is less than the cross-sectional area, e.g. the second cross-sectional area, of the or each radial bridge or radially projecting bridge.

When the radial or radially extending bridge(s) is or are combined with axial bridges connecting the lid to the shell, a user is able to determine the extent to which the closure has been opened. More particularly, the axial bridges at the front of the closure, or on the opposite side of the closure to the hinge, break as the closure starts to open, followed by those at the lateral sides and eventually, the radial or radially extending bridge(s).

The side wall may comprise a void. The hinge may be within or located within the void. The side wall or void may comprise a relief, e.g. such that the lid clears, in use, a rim of the container neck as the lid is pivoted from a closed position to an open position. The side wall or void may comprise a relief on at least one side of the hinge. The side wall or void may comprise a relief on each side of the hinge. The side wall may taper or diverge away from the hinge, for example such that the relief is tapered. The or each relief may taper or comprise a tapering relief.

The or each relief may taper away from the hinge, e.g. from the top wall or adjacent the top wall and/or toward the shell. The relief may be larger at or adjacent a lower edge of the side wall, e.g. than at or adjacent the top wall. The side wall may comprise opposed tapered portions or edges. Each tapered portion or edge may at least partially describe the or a respective relief. The or each relief may be substantially triangular. The tapered portions or edges may be straight or curved, e.g. concave or convex.

The shell may comprise a portion, e.g. a projecting portion. The shell may comprise a portion that projects into the void. The portion may project between the side wall and the hinge. The portion of the shell that projects into the void may comprise one or more projections or tabs. The shell may comprise a projection or tab on each side of the hinge. The or each projection or tab may extend from an upper edge of the shell and/or into the or a respective relief, e.g. to inhibit tampering of the closure. The or each projection or tab may fill the void created by the relief. The shape of the or each projection or tab may correspond substantially to that of the or the respective relief. The or each projection or tab may be triangular, or substantially triangular. In some examples, the or each projection or tab may have a curved edge and/or may be quarter-circular.

The shell may comprise one or more projections, which may project inwardly and/or from an inner surface of the shell. The projections may comprise cams. Each projection may comprise an

engaging surface, which may face the top wall and/or may extend substantially radially. Each projection may comprise a lead-in, e.g. on an opposite side to the engaging surface. The lead-in may comprise an angled or tapered surface. The projections may be for engaging, or may be configured to engage, a tamper-evidence bead of a container neck.

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The closure may comprise a grip tab, which may project outwardly and/or radially, e.g. from an outer surface of the side wall. The closure may comprise an engaging tab, which may project inwardly from an inner surface of the lid or side wall. The engaging tab may comprise a ridge or lip, which may extend about the inner circumference of the side wall. The engaging tab preferably extends about only a portion of the circumference of the side wall, e.g. opposite the hinge.

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The engaging tab may be configured to engage the tamper-evidence bead of the container neck. Preferably, the engaging tab is for engaging, or may be configured to engage, a lip of the container, which may be located above the tamper-evidence bead and/or between the tamper-evidence bead and an opening or mouth of the container neck.

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The lid or side wall may comprise a latch, e.g. a deformable latch. The side wall may comprise a hinge line that may delineate a portion of the side wall, for example an arc portion or latch portion. The side wall portion delineated by the hinge line may provide the deformable latch. The side wall portion delineated by the hinge line may include the grip tab and/or the engaging tab. The hinge line may be configured such that the side wall deforms, in use, therealong, e.g. when the opening force is applied to the grip tab.

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The hinge line may comprise or describe a living hinge or living hinge portion, which may comprise a reduced radial thickness relative to the rest of the side wall. The hinge line, or the living hinge or living hinge portion, may extend between the grip tab and/or engaging tab and the top wall. The hinge line may extend from a lower edge of the side wall, for example on either side of the grip tab and/or of the engaging tab. The hinge line may be described or defined by a recess or groove, hereinafter groove.

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The flange may be contiguous with the top wall. The lid may be configured such that the opening force may be applied, in use, to the grip tab by urging, pinching or clamping the flange and grip tab toward one another.

The shell or the side wall may comprise an annulus. Each of the shell and the side wall comprises an annulus. The or each annulus may have a substantially constant axial depth. The side wall may be substantially cylindrical. The side wall may comprise an edge, e.g. a free edge, which may be connected to an adjacent edge of the shell, e.g. by the axial bridges. The shell may be substantially cylindrical.

The shell may comprise a recess or cutout, which may be aligned with one of the axial bridges. The axial bridge aligned with the cutout may join a base of the cutout to an adjacent portion of the lid, e.g. the deformable latch or latch portion. The lid, e.g. the deformable latch or latch portion, may comprise a recess or cutout, which may be aligned with one of the axial bridges. The axial bridge aligned with the cutout may join a base of the cutout of the lid to an adjacent portion of the shell. The shell may comprise one or more projections, which may extend toward the lid and/or be configured to limit the deformation of the axial bridges. The lid may comprise one or more projections, which may extend toward the shell and/or be configured to limit the deformation of the axial bridges.

The closure may be injection molded or compression molded or formed by any other suitable process. The closure may, but need not, be formed of a plastics material, such as high density polyethylene, polypropylene or any other suitable material. The closure may be for, e.g. adapted for use with, a bottle or container to be filled with a still beverage or other liquid.

The closure may comprise a locking means or mechanism, e.g. for locking the lid in an open position relative to the shell. The locking means or mechanism may be configured for locking or operable to lock the lid in one of two or more open positions, for example a fully open position and one or more (e.g. two or more) intermediate open positions.

The closure may comprise a ratchet mechanism, as disclosed in WO 2019/113681 A1, the contents of which are incorporated herein by reference.

The closure or top wall may comprise a tongue, which may be adjacent the hinge. The hinge may comprise a pair of hinge elements, which may be elongate. The hinge elements may be spaced apart from each other. The closure or shell may comprise a ratchet member, which may be disposed between the hinge elements.

The hinge elements may be formed integrally with the shell and/or with the top wall. Each hinge element may have a lower portion and an upper portion. The wall thickness of the lower portion may be substantially the same as the wall thickness of the shell. The wall thickness of the upper portion may be less than the wall thickness of the lower portion.

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Each hinge element may have an intermediate portion, which may join the lower and upper portions together. The intermediate portion may comprise a step or slope, for example which provides a transition between the wall thicknesses of the upper and lower portions. The step or slope may be on an external surface of the hinge element.

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The ratchet member may be formed integrally with the shell. The ratchet member may have an outer contour, which may comprise one or more recesses, e.g. upper and lower recesses. The recesses may be configured or operable to guide and/or engage an end portion of the tongue, e.g. during opening of the lid. The or each recess may be configured or operable to retain the tongue in an intermediate position, e.g. a respective intermediate position. The ratchet member, e.g. an upper end thereof, may be configured or operable to retain the tongue in a fully open position.

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Another aspect of the invention provides a package comprising a container and a closure as described above. The container may comprise a tamper evidence bead, e.g. for engaging the projections or cams of or on the shell. The container may comprise a lip, which may surround a mouth of the container, e.g. for engaging the engaging tab of the closure or lid or latch portion.

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Another aspect of the invention provides a mold stack comprising a plurality of mold inserts which, when in a molding configuration, together describe a molding cavity for molding a closure, e.g. as described above.

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The mold stack or mold inserts may comprise one or more, e.g. a pair of, slides. The slides may be separable, e.g. along a split line. The bridge may be aligned with the split line. The bridge may be described in part by each of the slides.

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According to another broad aspect of the invention, there is provided a mold stack comprising a plurality of mold inserts which, when in a molding configuration, together describe a molding cavity for molding a closure comprising a shell for securing the closure to a container neck, a lid pivotally connected to the shell by a hinge and a bridge connecting, e.g. frangibly connecting, the lid to the shell and projecting radially outwardly from each of the shell and lid, wherein the

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plurality of mold inserts comprise a pair of slides which are separable along a split line and the bridge is aligned with the split line and is described in part by each of the slides.

One of the slides may comprise one or more substantially planar split line or parting line surfaces.

- 5 The substantially planar split line or parting line surface(s) may describe one side of the bridge. The other of the slides may comprise a recess, which may describe the rest of the bridge.

- According to another broad aspect of the invention, there is provided a slide for a mold stack, e.g. described above. The slide may comprise one or more molding surfaces describing at least a portion of a lid of a closure. The slide may comprise one or more molding surfaces describing at least a portion of a shell of the closure. The slide may comprise one or more molding surfaces describing at least a portion of a hinge of the closure, which may pivotally connect the lid to the shell. The slide or molding surfaces may describe a recess describing at least a portion of a bridge, which may frangibly connect the lid to the shell and/or project radially outwardly from each of the shell and lid.
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The bridge may be one of two or more, e.g. a pair of bridges. The pair of bridges may be on opposite sides of the closure. The pair of bridges may be aligned with the split line or parting line of the slide(s). Each bridge may be described in part by one or each of the slides.

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The or one of the slides may comprise a pair of recesses. Each of the pair of recesses may describe the rest of one of the bridges. The other slide may comprise a pair of substantially planar split line or parting line surfaces. Each substantially planar split line or parting line surface may describe one side of one of the bridges.

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The mold stack may comprise any one or more features that correspond to those described above in relation to the closure.

- The slide(s) may describe an outer surface of at least part of the lid. The slide(s) may describe an outer surface of at least part of the top wall, for example a lower and/or radial outer part thereof. The slide(s) may describe an outer surface of at least part of the side wall. The slide(s) may describe an outer surface of at least part of the shell.
- 30

- The mold stack may comprise a core or core assembly, which may describe one or more inner surfaces of the closure, e.g. inner surfaces of the top wall and/or of the side wall and/or of the shell.
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The core or core assembly may comprise an inner core and/or an outer core, e.g. between which an annular sealing element may be described.

The mold stack may comprise a cavity or cavity assembly, which may describe one or more outer surfaces of the closure, e.g. outer surfaces of the top wall and/or of the side wall and/or of the shell. The cavity assembly may comprise a gate pad and/or a gate insert, which may together describe at least part of the top wall, e.g. a top and/or radial outer part thereof. The slides may describe one or more outer surfaces of the closure, e.g. outer surfaces of the top wall and/or of the side wall and/or of the shell.

Another aspect of the invention provides a mold. The mold may comprise at least one molding cavity for molding a closure, e.g. as described above. The mold may comprise at least one mold stack, e.g. as described above.

Another aspect of the invention provides a molding system. The molding system may comprise at least one molding cavity for molding a closure, e.g. as described above. The molding system may comprise at least one mold stack, e.g. as described above. The molding system may comprise a mold as described above.

Another aspect of the invention provides a computer program element comprising and/or describing and/or defining a three-dimensional design, e.g. of the closure, inner or outer core, gate pad, gate insert, one of the slides, mold stack, mold or molding system described above or an embodiment thereof. The three-dimensional design may be for use with a simulation means or an additive or subtractive manufacturing means, system or device.

The computer program element may be for causing, or operable or configured to cause, an additive or subtractive manufacturing means, system or device to manufacture the closure, inner or outer core, gate pad, gate insert or slide described above or an embodiment thereof. The computer program element may comprise computer readable program code means for causing an additive or subtractive manufacturing means, system or device to execute a procedure to manufacture the closure, inner or outer core, gate pad, gate insert or slide described above or an embodiment thereof.

A yet further aspect of the invention provides the computer program element embodied on a computer readable medium.

For the avoidance of doubt, any of the features described herein apply equally to any aspect of the invention. Within the scope of this application it is expressly intended that the various aspects, embodiments, examples and alternatives set out in the preceding paragraphs, in the claims and/or  
5 in the following description and drawings, and in particular the individual features thereof, may be taken independently or in any combination. That is, all embodiments and/or features of any embodiment can be combined in any way and/or combination, unless such features are incompatible.

10 For the avoidance of doubt, the terms “may”, “and/or”, “e.g.”, “for example” and any similar term as used herein should be interpreted as non-limiting such that any feature so-described need not be present. Indeed, any combination of optional features is expressly envisaged without departing from the scope of the invention, whether or not these are expressly claimed. The applicant reserves the right to change any originally filed claim or file any new claim accordingly, including the right  
15 to amend any originally filed claim to depend from and/or incorporate any feature of any other claim although not originally claimed in that manner.

### **BRIEF DESCRIPTION OF THE DRAWINGS**

20 Embodiments of the invention will now be described by way of example only with reference to the accompanying drawings in which:

FIG. 1 depicts a front perspective view of a closure according to an embodiment of the invention;

25 FIG. 2 depicts a front view of the closure of FIG. 1;

FIG. 3 depicts an enlarged view of area E in FIG. 2;

30 FIG. 4 depicts a rear view of the closure of FIGs 1 to 3;

FIG. 5 depicts a side view of the closure of FIGs 1 to 4;

35 FIG. 6 depicts a partial perspective view of the closure of FIGs. 1 to 5 from below, illustrating the cams of the shell and the engaging tab at the front of the closure;

FIG. 7 depicts a section view of the closure of FIGs. 1 to 6 through the centre of the grip tab and ratchet member, with the closure mounted to the neck of a container;

5 FIG. 8 depicts a section view similar to that of FIG. 7 illustrating the deformation of the latch immediately before the engaging tab disengages the lip at the mouth of the container;

FIG. 9 depicts a section view similar to that of FIGs. 7 and 8 illustrating the lid after it is disengaged from the neck of the container, after the axial bridges have broken and as the  
10 radial bridges begin to break;

FIG. 10 is a partial section view of a mold stack for molding the closure of FIGs. 1 to 9;

FIG. 11 is a schematic view of a molding system including a mold incorporating multiple  
15 mold stacks as illustrated in FIG. 10;

FIG. 12 depicts a front view of a closure according to another embodiment of this invention;

FIG. 13 depicts an enlarged area of area F in FIG. 12; and  
20

FIG. 14 is a similar enlarged view to that of FIG. 13, but showing a bridge according to yet another embodiment of the invention.

## DETAILED DESCRIPTION OF THE INVENTION

25 With reference to FIGs. 1 to 9, there is depicted a closure 1 for sealingly closing a container neck 11. The closure 1 includes a shell 2 for securing the closure to the container neck 11, a lid 3 with a top wall 4 and a side wall 5, a pair of spaced hinge elements 6 pivotally connecting the top wall 4 of the lid 3 to the shell 2 and a ratchet member 7 projecting from the shell 2 between the hinge  
30 elements 6 and toward the top wall 4 of the lid 3. The closure 1 also includes a deformable latch portion 8 and a pair of radial bridges 9 joining the side wall 5 to the shell 2 at each side of the closure 1.

The closure 1 is formed of a plastics material, such as high density polyethylene, polypropylene  
35 or any other suitable material. The closure 1 is injection molded in this embodiment, but it will be

appreciated that other methods of manufacture are also envisaged, such as compression molding. The container neck 11 forms part of a bottle in this embodiment, which is configured to be filled with a still beverage or other liquid.

5 The shell 2 is substantially cylindrical in shape, with a series of cams 20 projecting from its internal surface. Each cam 20 includes an upper, engaging surface 21, which faces the top wall 4 and extends substantially radially for engaging a tamper-evidence bead 12 of the container neck 11. Each cam 20 also includes a tapered lead-in 22, on an opposite side to the engaging surface 21, for  
10 engaging the tamper-evidence bead 12 to gradually deform the shell 2 as the closure 1 is urged onto the container neck 11 in the usual way. The shell 2 also includes an upper edge 23 with a pair of spaced cutouts 24 and three spaced projections 25 between the cutouts 24, which are on the opposite side of the shell 2 to the hinge elements 6.

The top wall 4 of the lid 3 is circular in plan and the side wall 5 depends from the top wall 4  
15 adjacent, but spaced inwardly from, its periphery. As a result, the lid 3 includes a radial flange 40 about the periphery of the top wall 4. The radial flange 40 includes a pair of interruptions 41 where the hinge elements 6 join the top wall 4, which also creates a tongue 42 between the interruptions 41. The side wall 5 includes a void V to accommodate the hinge elements 6 and ratchet member 7. The top wall 4 also includes a plug seal 43, which is formed integrally therewith and is  
20 configured to sealingly fit into the opening of the container neck 11.

The hinge elements 6 are similar to those disclosed in WO 2019/113681 A1, and are formed integrally with the shell 2 and the top wall 4 of the lid 3. Each hinge element 6 has a lower portion  
25 60 projecting from the shell 2 and an upper portion 61 depending from the top wall 4. The lower portion 60 has a wall thickness equivalent to that of the shell 2, while the wall thickness of the upper portion 61 is substantially less. The hinge portions 60, 61 are joined together by an external step 62, which provides the transition in wall thickness therebetween.

The ratchet member 7 is also similar to those disclosed in WO 2019/113681 A1, and is formed  
30 integrally with the shell 2. The ratchet member 7 has an outer contour with upper and lower recesses 70, 71. The ratchet member 7 and its recesses 70, 71 guide and engage an end portion of the tongue 42 during opening of the lid 3, to retain it in intermediate and/or fully open positions, as explained in more detail in WO 2019/113681 A1.

The side wall 5 also includes a deformable latch portion 8 on the opposite side to the hinge elements 6. The deformable latch portion 8 is delineated by hinge line 50 formed by a groove in the outer surface of the side wall 5. The hinge line 50 follows an arcuate path from a lower edge 51 of the side wall 5 to an upper portion thereof, along and adjacent the radial flange 40, and back  
5 down to the lower edge 51, delineating an arc portion of the side wall that provides the deformable latch 8.

The deformable latch portion 8 includes a grip tab 80 projecting radially from its outer surface 81 and an engaging tab 82 projecting from its inner surface 83. The engaging tab 82 is located axially  
10 between the grip tab 80 and the top wall 4, on the inside of the lid 3 to engage a lip 13 surrounding the mouth of the container neck 11.

The portion of the hinge line 50 that extends along and adjacent the radial flange 40, above both the grip tab 80 and the engaging tab 82, describes a living hinge 50a. As such, the grip tab 80 and  
15 engaging tab 82 of the latch portion 8 are able to pivot about the living hinge 50a, thereby to perform a latching operation.

As illustrated in FIGs. 4 and 5, the void V in the side wall 5 is in the form of a truncated triangle described between opposed tapered portions 53 of the side wall 5. The tapered portions 53 of the  
20 side wall 5 provide a tapered relief R on each side of the hinge elements 6, forming a triangular gap between the shell 2, the hinge element 6 and the side wall 5 of the lid 3.

This, tapered relief R in the side wall 5 on each side of the hinge elements 6 inhibits interference between the side wall 5 and the container neck 11 during opening. It has been observed that, in the  
25 absence of the tapered reliefs R, the opposed portions of side wall 5 on each side of the hinge elements 6 may interfere with the container neck 11 as the lid 3 of the closure 1 is pivoted from the closed position to the open position. This would cause the side wall 5 to deform on opening, which increases the force necessary to open the lid 3. This interference may also cause the side wall 5 to fold toward the top wall 4 as the lid 3 is re-closed, which inhibit re-closing and/or may  
30 damage the side wall 5. The tapered relief R inhibits such interference, which facilitates both opening and closing operations of the closure 1, and may also avoid damage to the side wall 5 in use.

The radial bridges 9 are included on each lateral side of the closure 1, offset by 90° with respect to  
35 the hinge elements 6 and with respect to the deformable latch portion 8. Each radial bridge 9 is in

the form of a C-shaped loop and includes first and second radial portions 90, 91 projecting from the shell 2 and side wall 5 respectively, and an axial portion 92 joining the radial portions 90, 91 to form the C-shaped loop.

5 Each radial bridge 9 also includes a rear, hinge side 93 and a front, latch side 94. The rear side 93 is flat and is delineated by the outermost peripheral edges 90a, 91a, 92a and the innermost peripheral edges 90b, 91b, 92b. Each radial bridge 9 also includes witness lines, which extend along the peripheral edges 90a, 90b, 91a, 91b, 92a, 92b at the rear side 93. The skilled person will appreciate the cause of these witness lines, but this is also discussed further below with respect to  
10 the mold stack illustrated in FIG. 10. Each radial bridge has a front side 94 having a tapering, curved profile extending from the peripheral edges 90a, 90b, 91a, 91b, 92a, 92b at the rear side 93, as illustrated more clearly in FIGs. 1 and 5.

The first, lower radial portion 90 projects from the shell 2 and includes a lower edge 90a that tapers  
15 upwardly. The second, upper radial portion 91 projects from the side wall 5 and includes an upper edge 91a that tapers downwardly. The axial portion 92 includes an outer edge 92a that extends vertically. As such, the outer periphery of each radial bridge 9 provided by the edges 90a, 91a, 92a forms a truncated triangular shape, with converging upper and lower edges 90a, 91a.

20 Conversely, the first, lower radial portion 90 includes an upper edge 90b that extends radially and the second, upper radial portion 91 includes a lower edge 91b that also extends radially. The axial portion 92 also includes an inner edge 92b that extends vertically. As such, the inner periphery of each radial bridge 9 provided by the edges 90b, 91b, 92b forms a U-shape, with parallel upper and lower edges 90b, 91b.

25 Thus, the effective thickness of the radial bridges 9 at their junction with the shell 2 and side wall 5 is greater than their effective thickness along the axial portion 92. The axial portion 92 therefore provides a region of weakness, encouraging the bridges 9 to break in this region.

30 The lid 3 is also connected to the shell 2 by eight axial bridges 52, 52a, 52b in this example, which join the lower edge 51 of the side wall 5 to the upper edge 23 of the shell 2. The axial bridges 52, 52a, 52b are spaced equally about the closure 1, with the exception of the region incorporating the hinge elements 6 and the ratchet member 7. However, the number of axial bridges 52, 52a, 52b may vary depending on specific requirements.

35

A first pair of axial bridges 52a are aligned with the cutouts 24 of the shell 2, which are longer as each of them joins the base of a respective one of the cutouts 24 to an adjacent portion of the lower edge 51 of the latch portion 8. The cutouts 24 improve the visibility of the axial bridges 52a, enhancing their tamper evidence function by alerting more readily a user to unauthorised opening  
5 of the closure 1.

A second pair of axial bridges 52b join the lower edge 51 of the latch portion 8 to the shell 2 between pairs of the projections 25. The projections 25 limit the deformation of the lid 3 toward shell 2 during capping, which protects the axial bridges 52b from excessive deformation and  
10 damage. As such, the deformable latch portion 8 is connected to the shell 2 by four axial bridges 52a, 52b, whilst the remaining four axial bridges 52 (visible in FIG. 5) connect the rest of the side wall 5 to the shell 2.

In use and when the closure 1 is mounted to a container neck 11 as shown in FIG. 7, a user (not  
15 shown) urges the grip tab 80 upwardly, for example by urging, pinching or clamping the radial flange 40 of the top wall 4 and the grip tab 80 toward one another. This causes the deformable latch portion 8 of the side wall 5 to deform preferentially along the entire hinge line 50. This deformation causes the engaging tab 82 to pivot about the living hinge 50a such that it rides up the lip 13 surrounding the mouth of the container neck 11, as shown more clearly in FIG. 8.

The grip tab 80 is then urged upwardly relative to the hinge elements 6, such that the engaging tab 82 is urged over the lip 13 and snaps out of engagement therewith, as shown more clearly in FIG.  
20 9. The axial bridges 52a, 52b joining the deformable latch portion 8 to the shell 2 sever or break as the engaging tab 82 disengages the lip 13. Further pivoting of the lid 3 relative to the shell 2  
25 also causes the remaining axial bridges 52 to break, thereby providing evidence of opening in the usual way.

In this example, the closure 1 is configured such that the radial bridges 9 begin to stretch as the axial bridges 52 along the lateral sides of the closure 1 break. Further pivoting of the lid 3 relative  
30 to the shell 2 causes both strain whitening and substantial deformation of the radial bridges 9, along the axial portion 92 in particular. Continued pivoting of the lid 3 relative to the shell 2 causes the axial portion 92 of the radial bridge 9 to stretch and break.

This causes both strain whitening and substantial deformation in the axial portion 92 of the radial  
35 bridges 9, before they break, allowing the lid 3 to be pivoted freely about the hinge elements 6 to

an open condition, thereby providing access to the contents of the container. This deformation and strain whitening, together with the location of the radial bridges 9 outboard of the body of the closure 1, provides a much more conspicuous indication that the closure 1 has been opened.

- 5 The skilled person will appreciate that the closure 1 may be opened at various intermediate or fully open positions, as described in WO 2019/113681 A1.

Turning now to FIG. 10, there is shown a mold stack 14 for molding the closure 1 of FIGs. 1 to 9. The mold stack 14 includes an inner core 15a, an outer core 15b, a gate pad 16a, a gate insert 16b  
10 and a pair of slides 17a, 17b. The inner core 15a and outer core 15b together form a core assembly 15 that describes the internal surfaces of the closure 1 and between which the plug seal 43 is described. The gate pad 16a and gate insert 16b form a cavity assembly 16 that describes the top surface of the closure 1. The slides 17a, 17b together describe the outer, circumferential surfaces of the closure 1.

15

A first slide 17a has substantially flat split line surfaces, which describe the rear sides 93 of the radial bridges 9. A second slide 17b includes a pair of recesses in its split line surface, each of which describes the tapering, curved profile of the front side 94 extending from the peripheral edges 90a, 90b, 91a, 91b, 92a, 92b at the rear side 93. The skilled person will also appreciate that  
20 the witness lines, which extend along the peripheral edges 90a, 90b, 91a, 91b, 92a, 92b at the rear side 93, are the result of the split line between the slides 17a, 17b.

Referring now to FIG. 11, there is shown a molding system 18, which includes an injection unit 18a, a clamp unit 18b and a mold 19 received within the clamping unit 18b in the usual way. The  
25 mold 19 includes a plurality of mold stacks 14, in order to mold a corresponding plurality of closures 1 with each cycle.

FIGs. 12 and 13 shows a closure 101 according to another example, which is similar to the closure 1 of FIGs. 1 to 9, wherein like references depict like features which are incremented by 100. The  
30 closure 101 according to this example differs from that of the closure 1 of FIGs. 1 to 9 in that the axial portion 192 of each radial bridge 109 is longer and the closure includes a void or cut out 195 aligned with and inboard of the axial portion 192.

In this example, each bridge 109 has an axial length BL that is nearly half of the axial length CL  
35 of the closure 101. As shown more clearly in FIG. 13, the length of the axial portion 192 of the

radial bridge 109 accounts for this increase in axial length BL relative to the bridges 9 of FIGS. 1 to 9. The increase in relative axial length BL/CL increases both the extent of deformation experienced by the axial portion 192 of the bridge 109 when the lid 103 is pivoted relative to the shell 102 toward the open position, and the visibility of the deformed bridge 109 when the closure 101 is pivoted back to the closed position.

To further enhance this increased visibility, a portion of the side wall 105 of the lid 103 along its lower edge 151 and a corresponding portion of the shell 102 along its upper edge 123 are omitted to describe the cut out 195. This cut out 195 further enhances the visibility of the deformed bridge 109 when the closure 101 is pivoted back to the closed position, thereby providing a more conspicuous tamper evidence.

Turning now to FIG. 14, there is shown a bridge 209 according to yet another example, which is similar to the bridge 109 of the closure 101 of FIGS. 12 and 13, wherein like references depict like features which are incremented by 200 relative to the example of FIGS. 1 to 9. The bridge 209 according to this embodiment differs from the bridge 109 shown in FIG. 13 in that it is configured to break adjacent its connection with the shell 202 and engage a catch 296 on the shell 202 when the closure 201 is moved back to a closed position.

More specifically, the cross-sectional area of the radial portion 290 projecting from the shell 202 is less than that of each of the radial portion 291 projecting from the side wall 205 and the axial portion 292 of the bridge 209. As such, the radial portion 290 projecting from the shell 202 provides a region of weakness that favours breakage in this region.

Moreover, only the side wall 205 includes an omitted portion describing the cut out 295, while a facing portion of the shell 202 includes the catch 296 projecting radially therefrom. The skilled person will appreciate that the bridge 209 will stretch and break adjacent its connection with the shell 202, on first opening of the closure 201, but as the closure 201 is then moved back to a closed position, the deformed bridge 209 will engage the catch 296 and be urged inwardly, into the cut out 295, thereby providing an alternative, but equally conspicuous tamper evidence to the arrangement of FIGS. 12 and 13.

In this example, the catch 296 is simply a straight projection, but it may advantageously taper to a point, for example to provide a barb-like projection to encourage engagement with and deformation of the deformed bridge 209. Other shapes are also envisaged.

It will be appreciated by those skilled in the art that several variations to the aforementioned embodiments are envisaged without departing from the scope of the invention. It will also be appreciated by those skilled in the art that any number of combinations of the aforementioned features and/or those shown in the appended drawings provide clear advantages over the prior art and are therefore within the scope of the invention described herein.

## CLAIMS

1. A closure for sealingly closing a neck opening of a container, the closure comprising a shell for securing the closure to a container neck, a lid pivotally connected to the shell by a hinge and a bridge frangibly connecting the lid to the shell, wherein the bridge projects radially outwardly from each of the shell and lid such that it straightens, in use, before breaking when the lid is pivoted relative to the shell toward an open position.
2. A closure according to claim 1, wherein the bridge is rotationally offset with respect to the hinge.
3. A closure according to claim 1 or claim 2, wherein the bridge is one of a pair of bridges on opposite sides of the closure.
4. A closure according to claim 3, wherein the hinge is at a rear of the closure and the bridges are on lateral sides of the closure.
5. A closure according to any preceding claim, wherein the or each bridge comprises a loop that projects radially outwardly from the shell and loops back to join the lid.
6. A closure according to any preceding claim, wherein the or each bridge is substantially C-shaped.
7. A closure according to any preceding claim, wherein the or each bridge has an axial dimension that is at least 30% of the axial dimension of the closure.
8. A closure according to claim 7 comprising at least one cut out aligned with the or a respective bridge, wherein the or each cut out is described in the lid and/or the shell.
9. A closure according to any preceding claim, wherein the or each bridge comprises a cross-sectional area or thickness that is greater at or adjacent its connection with the shell and at its connection with the lid than its cross-sectional area or thickness therebetween, thereby to provide a region of weakness.

10. A closure according to any one of claims 1 to 8, wherein the or each bridge comprises a reduced cross-sectional area or thickness at or adjacent its connection with the shell, thereby to provide a region of weakness.
11. A closure according to claim 10 comprising at least one catch associated with the or each bridge, wherein the or each bridge is configured to engage, in use, the catch when the lid is pivoted relative to the shell from the open position toward a closed position.
12. A closure according to any preceding claim, wherein the lid comprises a top wall, a side wall depending from the top wall and a flange extending radially from the top wall, the bridge(s) joining the side wall to the shell and being located radially inboard of the flange.
13. A closure according to any preceding claim further comprising a plurality of axial bridges joining facing portions of the lid and shell at the front of the closure, which are configured to break, in use, before the radially projecting bridges when the lid is pivoted relative to the shell toward an open position.
14. A mold stack comprising a plurality of mold inserts which, when in a molding configuration, together describe a molding cavity for molding a closure according to any preceding claim.
15. A mold stack comprising a plurality of mold inserts which, when in a molding configuration, together describe a molding cavity for molding a closure comprising a shell for securing the closure to a container neck, a lid pivotally connected to the shell by a hinge and a bridge frangibly connecting the lid to the shell and projecting radially outwardly from each of the shell and lid, wherein the plurality of mold inserts comprise a pair of slides which are separable along a split line and the bridge is aligned with the split line and is described in part by each of the slides.
16. A mold stack according to claim 15, wherein one of the slides comprises one or more substantially planar split line surfaces describing one side of the bridge and the other of the slides comprises a recess which describes the rest of the bridge.
17. A mold stack according to claim 15, wherein the bridge is one of a pair of bridges on opposite sides of the closure and aligned with the split line of the slides, each bridge being described in part by each of the slides.

18. A mold stack according to claim 17, wherein one of the slides comprises a pair of substantially planar split line surfaces each describing one side of one of the bridges and the other of the slides comprises a pair of recesses each describing the rest of one of the bridges.
19. A slide for a mold stack according to any one of claims 14 to 18, wherein the slide comprises molding surfaces describing at least a portion of a lid of a closure, at least a portion of a shell of the closure at least a portion of a hinge of the closure pivotally connecting the lid to the shell and a recess describing at least a portion of a bridge frangibly connecting the lid to the shell and projecting radially outwardly from each of the shell and lid.
20. A mold comprising a mold stack according to any one of claims 14 to 18.
21. A molding system comprising a mold according to claim 20.
22. A computer program element comprising a three-dimensional design of a closure according to any one of claims 1 to 13, wherein the three-dimensional design is for use with a simulation means or an additive or subtractive manufacturing device.
23. A computer program element comprising a three-dimensional design of a slide according to claim 19, wherein the three-dimensional design is for use with a simulation means or an additive or subtractive manufacturing device.
24. A computer program element according to claim 23 comprising computer readable program code means for causing an additive or subtractive manufacturing system to execute a procedure to manufacture the slide.
25. A package comprising a container and a closure according to any one of claims 1 to 13 affixed to a neck thereof.

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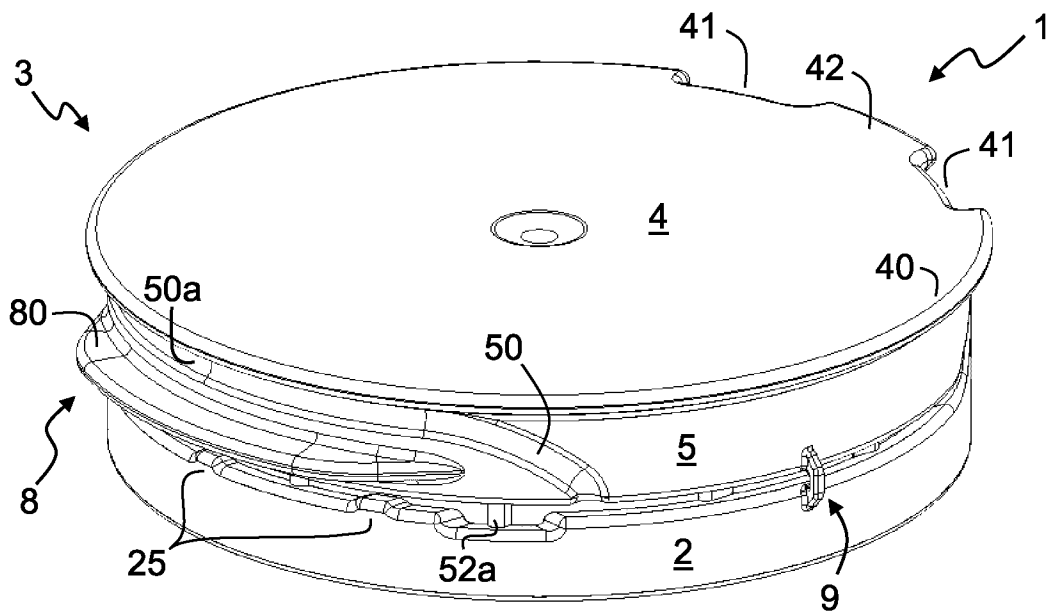


FIG. 1

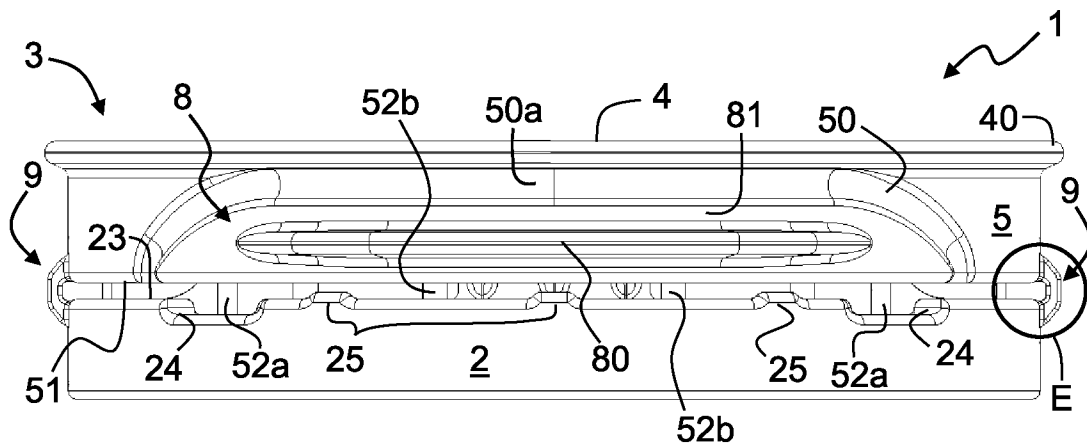


FIG. 2

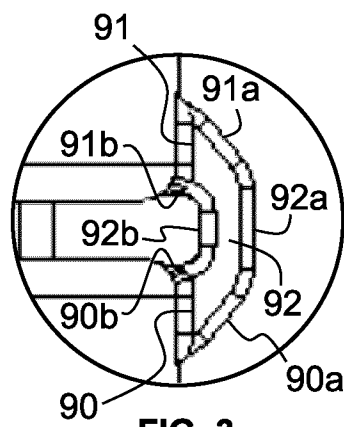


FIG. 3

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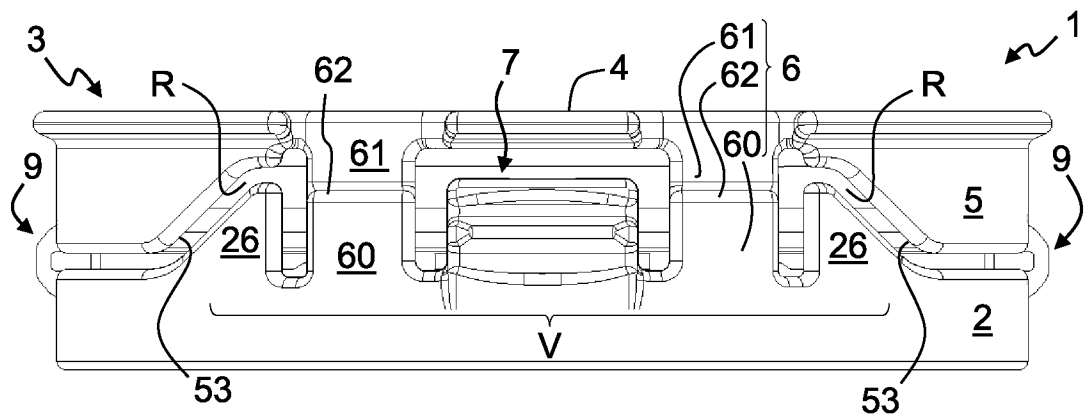


**FIG. 4**

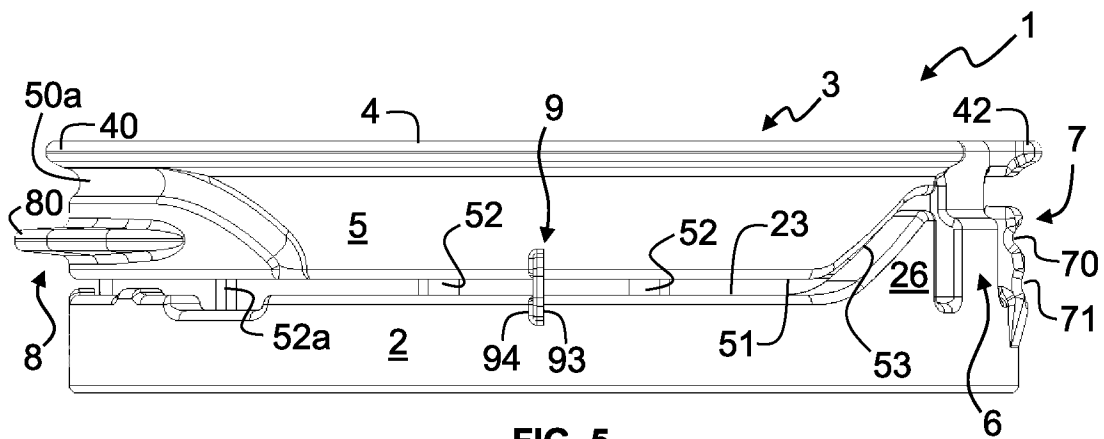


FIG. 5

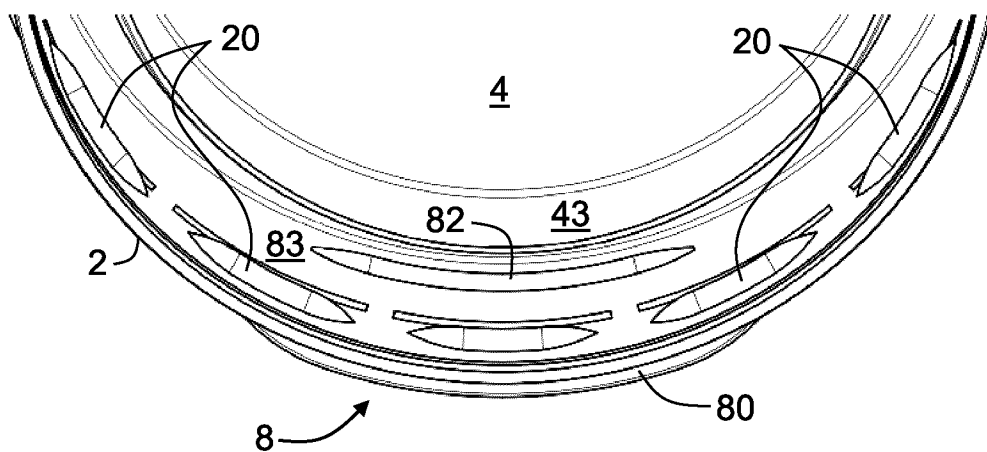


**FIG. 6**

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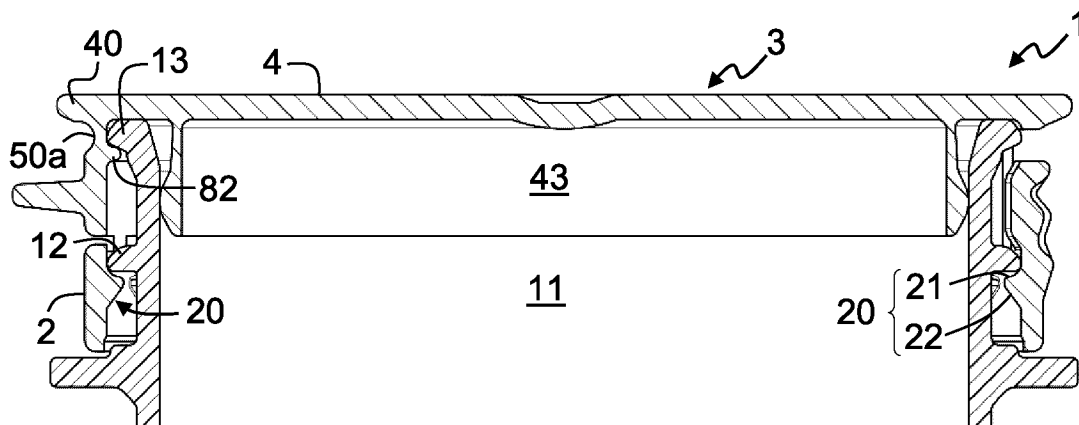


FIG. 7

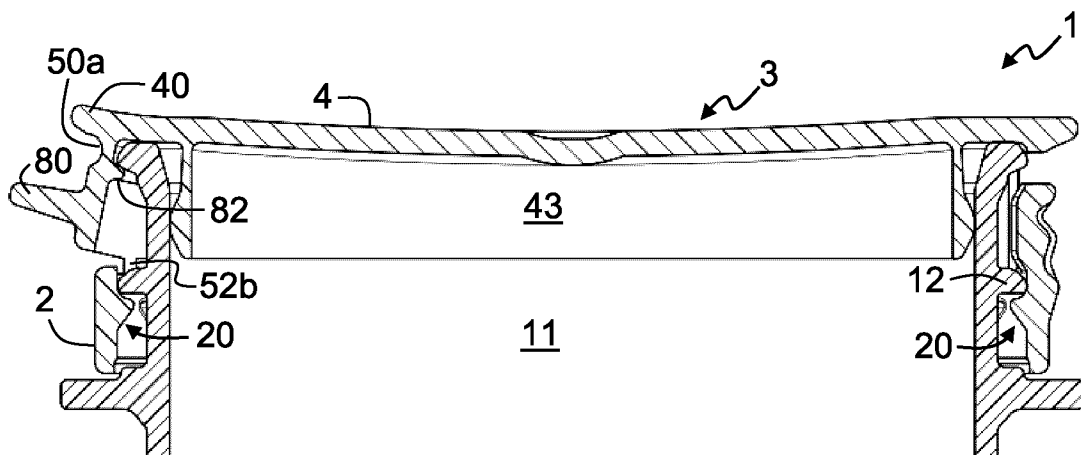


FIG. 8

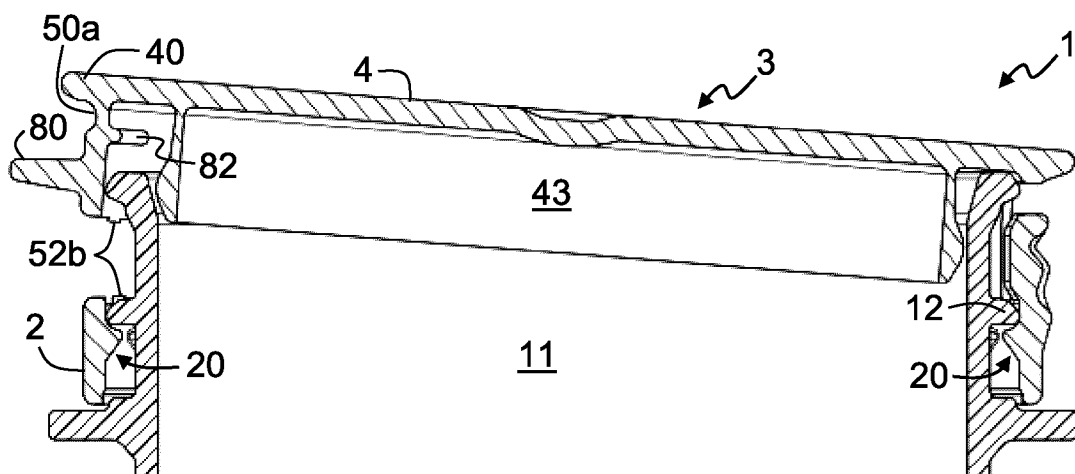


FIG. 9

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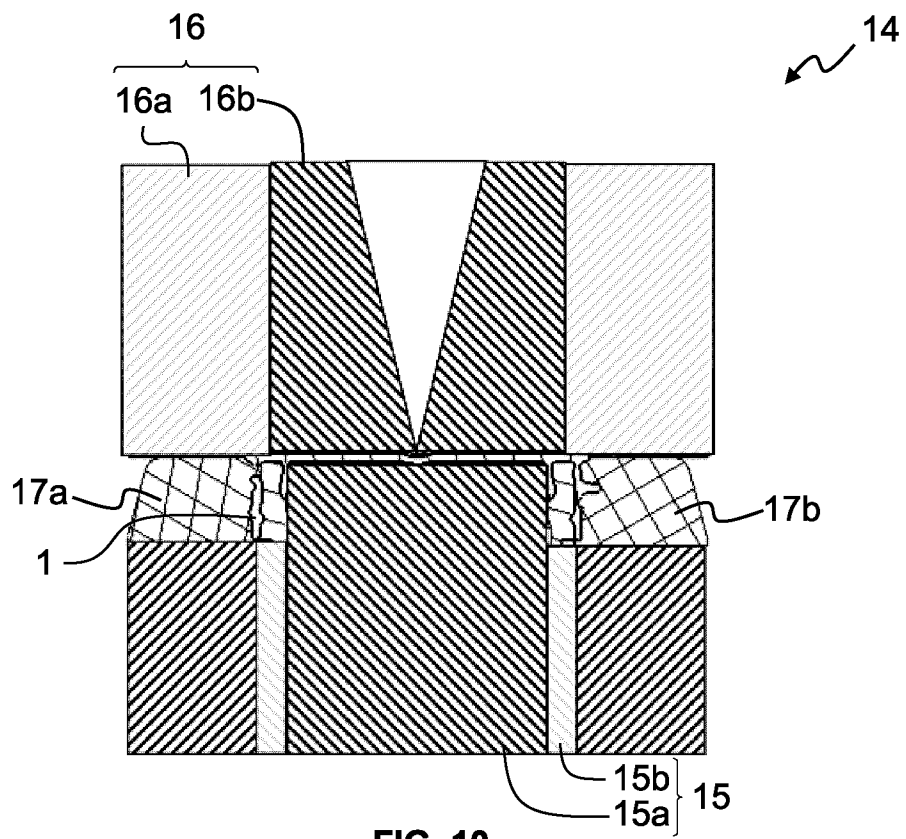


FIG. 10

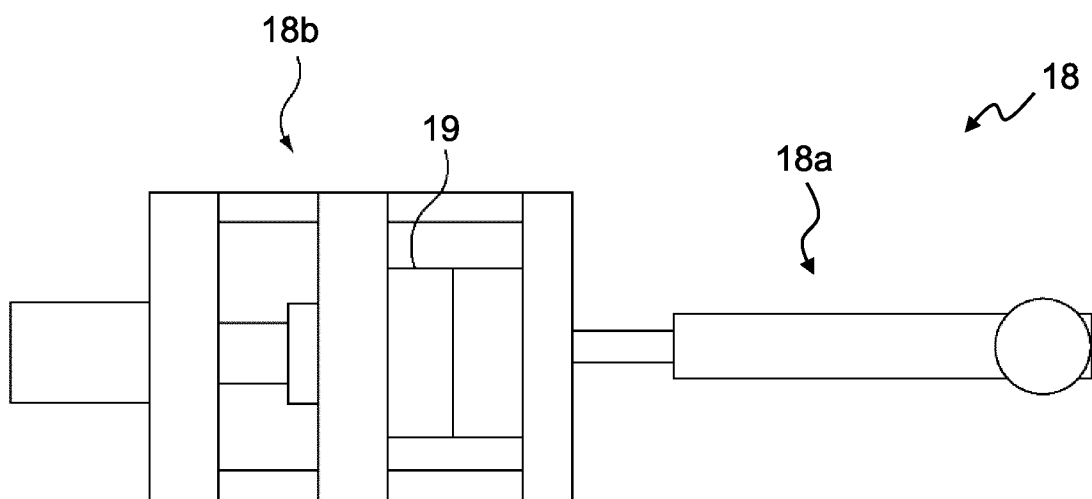


FIG. 11

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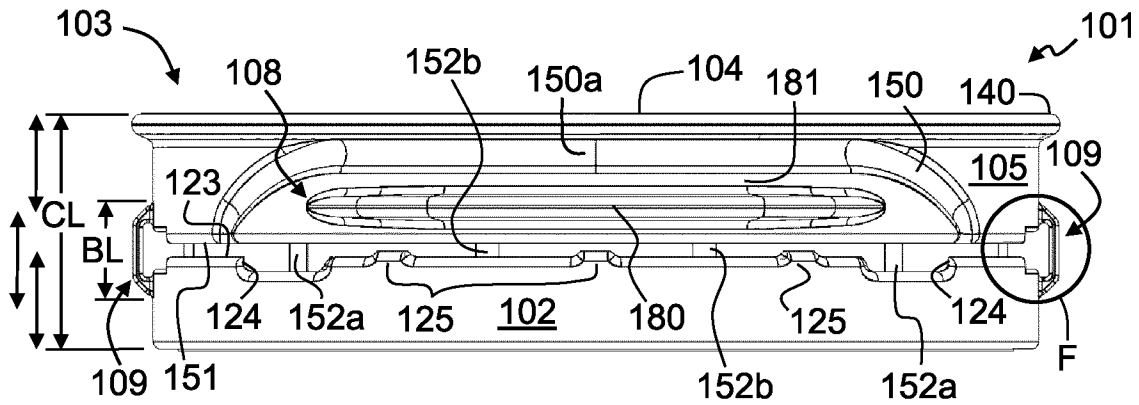


FIG. 12

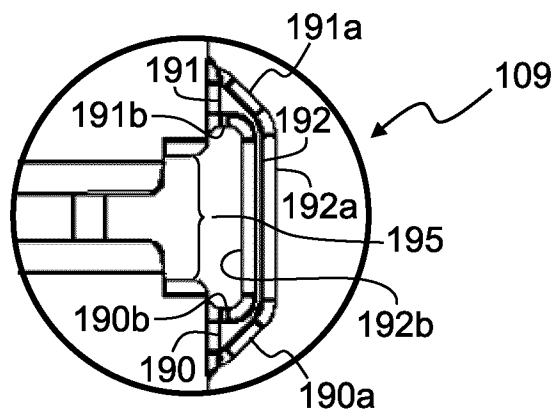


FIG. 13

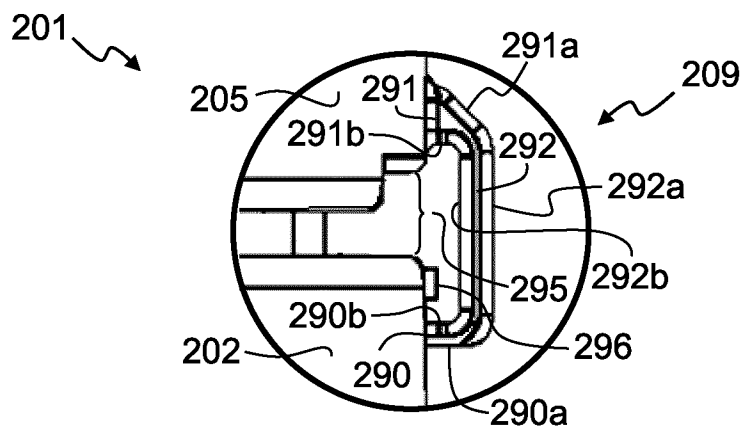


FIG. 14

## INTERNATIONAL SEARCH REPORT

International application No.

**PCT/CA2021/051774**

## A. CLASSIFICATION OF SUBJECT MATTER

IPC: **B65D 43/16** (2006.01), **B29C 45/17** (2006.01), **B65D 50/00** (2006.01), **B65D 55/06** (2006.01), **G06F 30/10** (2020.01)

CPC: , **B29C 45/17** (2020.01), **B65D 2401/15** (2020.05), **B65D 2555/02** (2020.01), **B65D 43/163** (2020.01), **B65D 50/00** (2020.01) (more CPCs on the last page)

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)

IPC: **B65D 43/16**, **B29C 45/17**, **B65D 50/00**, **B65D 55/06**, **G06F 30/10**; (continued on last page)

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

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

*Questel/Orbit*: bridge, cover, flex, frangible, stretch, deform, elastic, tamper, tamper\_evident, child-proof, hinge, flip, straighten, elongate, break, lid

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category* | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|-----------|------------------------------------------------------------------------------------|-----------------------|
| X         | US 20110100990 A1 (CLODFELTER, C., et al) 5 May 2011 (05-05-2011)                  | 1-10, 25              |
| Y         | <i>*abstract; figs 1-5, 9 and 10; pars. [0018], [0022], [0024]-[0030]*</i>         | 13                    |
| Y         | WO 2019/113681 A1 (NEUMAN, T. et al.) 20 June 2019 (20-06-2019)                    | 13                    |
|           | <i>*abstract; figs. 1 and 2; par. [0044] and [0045]*</i>                           |                       |
| A         | US 20050167889 A1 (ANCTIL, A., et al.) 04 August 2005 (04-08-2005)                 | 14-21                 |
|           | <i>*figs. 2-5; pars.[par. 0031], [0032], [0036]*</i>                               |                       |

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

|                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|---------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| *<br>"A"<br>"D"<br>"E"<br>"L"<br>"O"<br>"P" | Special categories of cited documents:<br>document defining the general state of the art which is not considered to be of particular relevance<br>document cited by the applicant in the international application<br>earlier application or patent but published on or after the international filing date<br>document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)<br>document referring to an oral disclosure, use, exhibition or other means<br>document published prior to the international filing date but later than the priority date claimed | "T"<br>"X"<br>"Y"<br>"&" | 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<br>document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone<br>document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art<br>document member of the same patent family |
|---------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

Date of the actual completion of the international search  
17 January 2022 (17-01-2022)

Date of mailing of the international search report  
18 March 2022 (18-03-2022)

Name and mailing address of the ISA/CA  
Canadian Intellectual Property Office  
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Authorized officer

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# INTERNATIONAL SEARCH REPORT

International application No.  
**PCT/CA2021/051774**

## Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of the first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☒ Claim Nos.: 22-24  
because they relate to subject matter not required to be searched by this Authority, namely:  
Claim 22-24 are directed to a computer program, which the International Search Authority is not required to search under PCT Rule 39.1(vi). The claim is directed merely to a program describing executable code, which is not embodied on a computer-readable medium.
2. ☐ Claim Nos.:  
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
3. ☐ Claim Nos.:  
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

## Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claim Nos.:
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claim Nos.:

- Remark on Protest**
- ☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
  - ☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
  - ☐ No protest accompanied the payment of additional search fees.

**INTERNATIONAL SEARCH REPORT**  
Information on patent family members

International application No.

**PCT/CA2021/051774**

| Patent Document<br>Cited in Search Report | Publication<br>Date         | Patent Family<br>Member(s)                                                                                                                                                                                | Publication<br>Date                                                                                                                                                                                                                                                                                                                                                                                                      |
|-------------------------------------------|-----------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| US2011100990A1                            | 05 May 2011 (05-05-2011)    | US8439212B2<br>US2013153575A1<br>US8584875B2                                                                                                                                                              | 14 May 2013 (14-05-2013)<br>20 June 2013 (20-06-2013)<br>19 November 2013 (19-11-2013)                                                                                                                                                                                                                                                                                                                                   |
| WO2019113681A1                            | 20 June 2019 (20-06-2019)   | CA3082235A1<br>CN111386229A<br>CN111386229B<br>EP3749585A1<br>EP3749585A4<br>US2020377268A1<br>US11040806B2                                                                                               | 20 June 2019 (20-06-2019)<br>07 July 2020 (07-07-2020)<br>24 December 2021 (24-12-2021)<br>16 December 2020 (16-12-2020)<br>29 September 2021 (29-09-2021)<br>03 December 2020 (03-12-2020)<br>22 June 2021 (22-06-2021)                                                                                                                                                                                                 |
| US2005167889A1                            | 04 August 2005 (04-08-2005) | US7214341B2<br>BRPI0506497A<br>BRPI0506497B1<br>CA2553642A1<br>CA2553642C<br>CN1914019A<br>CN100450744C<br>EP1713630A1<br>EP1713630B1<br>MXPA06008395A<br>US2007154590A1<br>US7455518B2<br>WO2005075175A1 | 08 May 2007 (08-05-2007)<br>13 February 2007 (13-02-2007)<br>03 November 2015 (03-11-2015)<br>18 August 2005 (18-08-2005)<br>18 September 2012 (18-09-2012)<br>14 February 2007 (14-02-2007)<br>14 January 2009 (14-01-2009)<br>25 October 2006 (25-10-2006)<br>10 October 2012 (10-10-2012)<br>25 August 2006 (25-08-2006)<br>05 July 2007 (05-07-2007)<br>25 November 2008 (25-11-2008)<br>18 August 2005 (18-08-2005) |

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IPC:

CPC:

B65D 55/06 (2020.01), G06F 2113/10 (2020.01), G06F 2113/20 (2020.01), G06F 30/10 (2020.01)

Cont. minimum fields searched:

CPC: B29C 45/17 (2020.01), B65D 2401/15 (2020.05), B65D 2555/02 (2020.01),  
B65D 43/163 (2020.01), B65D 50/00 (2020.01), B65D 55/06 (2020.01), G06F 2113/10 (2020.01), G06F 2113/20  
(2020.01), G06F 30/10 (2020.01)