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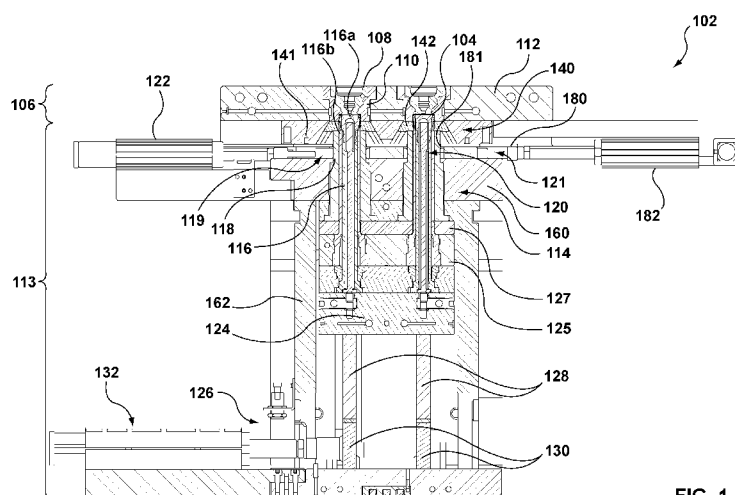
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- (54) **Title:** MOLD SLIDE ACTUATOR AND MOLD INCORPORATING SAME

**FIG. 1**

- (57) **Abstract:** There is disclosed a split insert assembly (140). The split insert assembly (140) is positionable, in use, in a mold (102), the mold (102) for producing a molded article (104). The split insert assembly (140) comprises: at least one split insert (142, 2142); a split inserts positioner (202, 242) juxtaposed, in use, with the at least one split insert (142, 2142), the split inserts positioner (202, 242) including: a linking member (206, 244) coupled to the at least one split insert (142, 2142); a sliding interface defined between the linking member (206, 244) and the at least one split insert (142, 2142); a positioner actuator (228, 245) coupled to the linking member (206, 244), the positioner actuator (228, 245) for actuating the movement of the linking member (206, 244) in unison with the repositioning of a portion of the mold (102) between a molding configuration and a molded article ejection configuration.

MOLD SLIDE ACTUATOR AND MOLD INCORPORATING SAME**TECHNICAL FIELD**

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The present technology relates to injection molding systems in general and specifically to a mold slide actuator and a mold incorporating same.

BACKGROUND

10 Molding is a process by virtue of which a molded article can be formed from molding material by using a molding system. Various molded articles can be formed by using the molding process, such as an injection molding process. One example of a molded article that can be formed, for example, from Polyethylene Terephthalate (PET) material is a preform that is capable of being subsequently blown into a beverage container, such as, a bottle and the like.

15 As an illustration, injection molding of PET material involves heating the molding material (ex. PET pellets, etc.) to a homogeneous molten state and injecting, under pressure, the so-melted PET material into a molding cavity defined, at least in part, by a female cavity piece and a male core piece mounted respectively on a cavity plate and a core plate of the mold. The cavity plate and the core plate are urged together and are held together by clamp force, the clamp force being sufficient
20 enough to keep the cavity and the core pieces together against the pressure of the injected PET material. The molding cavity has a shape that substantially corresponds to a final cold-state shape of the molded article to be molded. The so-injected PET material is then cooled to a temperature sufficient to enable ejection of the so-formed molded article from the mold. When cooled, the molded article shrinks inside of the molding cavity and, as such, when the cavity and core plates are
25 urged apart, the molded article tends to remain associated with the core piece. Accordingly, by urging the core plate away from the cavity plate, the molded article can be demolded, i.e. ejected off of the core piece. Ejection structures are known to assist in removing the molded articles from the core halves. Examples of the ejection structures include stripper plates, ejector pins, etc.

30 A typical mold assembly is comprised of several plates, each plate housing a component of the mold assembly. For example, a typical mold assembly may include a cavity plate housing one or more

cavity inserts and a core plate housing one or more cavity inserts. The typical mold assembly may further include a stripper assembly, which in case of the preform mold, may house one or more neck rings. The mold assembly may further include one or more plates associated with the hot runner, such as a manifold plate, a backing plate and the like.

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There is a known requirement in the industry that the various plates within the mold assembly align therebetween in the operational state. There are several procedures known in the art to align the plates within the mold assembly when the mold assembly is first assembled or when re-assembled after maintenance or a mold-assembly-component change. One known approach to alignment of the various plates within the mold assembly is to use leader pins, also referred to sometimes as guide pins. For example, leader pins are used when assembling together the cavity plate and the manifold plate.

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PCT patent application 2011/130847 teaches, amongst other things, a molding apparatus, comprising a stripper sleeve (116) for use in a first stack portion (110) of a mold stack (142), wherein the stripper sleeve (116) is configured to open a slide pair (122) of the first stack portion (110) and to strip a molded article (106) from the first stack portion (110).

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US patent 3,779,688 discloses, in a mold for casting parts of complex shape having a central core and multiple flat elements parallel to each other and in spaced relation of the same type as cam units of injectable or thermosetting plastic material and for the automatic ejection of the parts during opening of the mold which can be employed in an automatic press and comprising a stationary portion, a first group of slides which are mounted on two slide-blocks displaceable within the stationary portion in opposite directions at right angles to the movement of opening of the mold and which serve to define the interval between the elements of the molded part and a second group of slides which are mounted on two further slide-blocks displaceable in opposite directions at right angles to the first and which serve to define the profiles of the part elements, the four slide-blocks being closed in the centripetal direction in the position of closure of the mold and maintained towards the center of the mold by the conical wall of a movable cap of the mold and separated at the time of opening of the mold by inclined columns rigidly fixed to the movable cap and adapted to form ramps which are intended to cooperate with inclined bores formed in the slide-blocks, the essential property which lies in the fact that the inclined bores are of greater diameter than the

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columns in order to provide the columns with play which can be taken up at the beginning of the opening travel of the mold so that the opening of the mold can be initiated prior to commencement of lateral displacement of the slide-blocks in the centrifugal direction.

5 US patent 3,905,740 teaches an injection mold for making a polygonal plastic article having a closed bottom and an open top is disclosed. A first mold section corresponds to the exterior dimensions of the bottom wall and a portion of the contiguous side walls of the article while a second mold section composed of plural elements defines the interior surface of the article. Plural side wall elements are movable relative to both of the mold sections from an open position spaced
10 from both sections to a closed position wherein the side wall members interlock with both mold sections to form the mold enclosure. Linkage elements interconnect various of the mold elements to provide a coordinated movement. Other features are disclosed.

US patent 5,219,594 discloses a molding apparatus which includes (A) a mold for making an
15 undercut part which includes coring sandwiched between top and bottom cavity halves, where the coring is divided into three or four sections; and (B) a press for (1) separating the coring from the top and bottom cavity halves; and (2) separating the sections from each other.

US patent 5,232,718 teaches an injection molding system that is used to mold a preform having an
20 undercut. The molding system includes an injection core mold, and three injection cavity molds, which are a neck mold for defining a neck of the preform, a first cavity mold including two mold halves for defining an outer wall of the preform having the undercut, and a second cavity mold for defining a remaining outer wall of the preform. The molding system also includes a clamping unit for opening and clamping the foregoing molds and a mold half opening mechanism for opening and
25 clamping mold halves of the first cavity mold.

US patent 5,536,161 disclose a mold for forming an article having one or more substantial radial protrusions. The mold includes a core movable along a molding axis, a stripper ring movable a limited distance along one set of guide rods with axes parallel to the molding axis, a split ring
30 having segments movable adjacent to the stripper ring for the limited distance and movable relative to the stripper ring on a second set of guide rods at an angle to the molding axis, and a cavity. The article is removable from the mold when the core is moved away from the cavity, the stripper ring is

moved its limited distance, and the split ring segments are moved with the stripper ring and then relative to the stripper ring at an angle to the molding axis.

US patent 6,235,231 teaches a process for production of shaft passages in a molded plastic part, a mold, and the use of the process of production in, for example, a flap device particularly for a feed system for internal combustion engines, characterized in that it consists of: providing a recess by the advance of a slide of the molding tool between two adjacent bearings each associated with sites of different moving parts, and forming a bearing portion on each side of the sites of each moving part by a moving wedge relative to a slide, whereby the wedge carries a pin that is intended to form a bearing portion of one side of the moving part.

US patent 6,814,224 discloses a molded link (11) for a conveyor chain of the type individualizing a conveyance plane below which is a joint body from which guiding tabs project laterally and parallel to the conveyance plane a mold (10) comprising a molding chamber (17) individualizing the conveyance plane, the joint body and the link guiding tabs is proposed. Sliding boxes (18, 19) with ends which mold cavities (16) in the lower face of the link conveyance plane enter into the molding chamber (17).

US patent 7,901,202 teaches an injection-molding tool (1) for plastics having a tool core (3, 5), an ejector (8) and a sliding tool portion (11) for forming an undercut, each of which is displaceable, the sliding tool portion (11) being displaceable both in the push-out direction (A) of the plastics molded component (4) produced in the tool and perpendicular to this direction, while the ejector and the tool core (3, 5) are displaceable in the ejection direction (A) and both the travel of the tool core (3, 5) and that of the sliding tool portion are derived from the travel of the ejector (8).

PCT patent application 2011/020171 disclose, amongst other things, a molding apparatus that includes a collet (116, 316) for use in a first stack portion (110, 310) of a mold stack (106, 306). The mold stack (106, 306) is associated, in use, with an injection mold (100). The collet (116, 316) is structured to define a plurality of molding fingers (140, 340) that are resiliently deflectable, in use, between a neutral configuration and a deflected configuration, the plurality of molding fingers (140, 340) being cooperable to define an encapsulated portion (145) of a molding cavity (101) when arranged in abutment. Furthermore, each of the plurality of molding fingers (140, 340) defines a

cam follower (142, 342) that is cooperable, in use, with a bearing (170) with which to link the cam follower (142, 342) with a cam (150, 250) for the exercising thereof between the neutral configuration and the deflected configuration.

5 PCT patent application 2011/063499 teaches an in-mold shutter (142) for embedding in an injection mold (100, 200, 300) is described herein. The in-mold shutter (140, 240, 340, 440, 540) includes a shutter actuator (148, 548) that is configured to selectively engage a first mold shoe (130) of the injection mold (100, 200, 300) with a platen of a mold clamping assembly (996) to hold the first mold shoe (130) in an extended position (E), along a mold-stroke axis (X), during a step of molding
10 a first molded article (102A) in the injection mold (100, 200, 300). Also described herein is a molded article transfer device (150, 250) for use with the injection mold (100, 200, 300). The molded article transfer device (150, 250) includes a shuttle (154) that is slidably arranged, in use, within the injection mold (100, 200, 300). The shuttle (154) defines a first aperture (156A), at least in part, that alternately accommodates: (i) a first mold stack (106A, 206A, 306A) arranged therein;
15 and (ii) a first molded article (102A) received therein with opening of the first mold stack (106A, 206A, 306A).

PCT patent application 2011/069237 discloses a molded article transfer device (150, 250) that is associated, in use, with an injection mold (100, 200). The molded article transfer device (150, 250)
20 includes a transfer structure (151, 251) that defines, amongst other things, a first aperture (154A) that is structured to receive a first molded article (102A) from a first mold stack (106A, 206A) of the injection mold (100). The transfer structure (151, 251) also defines a first branch channel (156A) and a first trunk channel (158A) through which the first molded article (102A) is passable. The first branch channel (156A) connects the first aperture (154A) with the first trunk channel (158A) for
25 passing, in use, the first molded article (102A) thereto, whereafter it passes through the first trunk channel (158A) towards an exit (164A) thereof.

Known mold designs are also disclosed in Japanese laid-open application JPS6232017 and JP2006035543.

SUMMARY

Embodiments of the present technology have been developed based on inventors' appreciation of at least one shortcoming associated with the prior art solutions and approaches to actuating slides in an injection mold.

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According to a first broad aspect of the present technology, there is provided a split insert assembly. The split insert assembly is positionable, in use, in a mold, the mold for producing a molded article. The split insert assembly comprises: at least one split insert; a split inserts positioner juxtaposed, in use, with the at least one split insert, the split inserts positioner including:
10 a linking member coupled to the at least one split insert; a sliding interface defined between the linking member and the at least one split insert; a positioner actuator coupled to the linking member, the positioner actuator for actuating the movement of the linking member in unison with the repositioning of a portion of the mold between a molding configuration and a molded article ejection configuration.

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In some implementations of the present technology, the split insert assembly the split inserts positioner is implemented as an opening split inserts positioner.

In some implementations of the present technology, the opening split insert positioner further comprises a split insert guiding interface defined on a portion of the at least one split insert.

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In some implementations of the present technology, the split insert guiding interface is configured to cooperate with a mold guiding interface defined within a portion of the mold.

In some implementations of the present technology, the portion of the mold comprises a split insert
25 plate that houses the at least one split insert.

In some implementations of the present technology, the split insert guiding interface and the mold guiding interface are configured in a complementary sloped manner.

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In some implementations of the present technology, the split insert guiding interface and the mold guiding interface define a path of travel for the at least one split insert there-along and wherein the complementary slope of the split insert guiding interface and the mold guiding interface translates

axial movement of the at least one split insert into lateral movement of the at least one split insert relative to a complimentary other split insert.

In some implementations of the present technology, the split insert guiding interface and the mold
5 guiding interface define a path of travel for the at least one split insert there-along and wherein the positioner actuator is configured to actuate the at least one split insert movement along the path of travel between the molding configuration and the molded article ejection configuration.

In some implementations of the present technology, the at least one split insert is retained in the
10 molded article ejection configuration by virtue of the linking member being arrested by the positioner actuator.

In some implementations of the present technology, the positioner actuator comprises an air spring.

In some implementations of the present technology, the air spring comprises a plurality of air
15 springs.

In some implementations of the present technology, the sliding interface comprises a key-slot
interconnection.

In some implementations of the present technology, the split inserts positioner is implemented as a
20 closing split inserts positioner.

In some implementations of the present technology, the closing split inserts positioner comprises a
25 linking member.

In some implementations of the present technology, the sliding interface between the linking
member and the at least one split insert comprises an abutment arrangement.

In some implementations of the present technology, the spit insert assembly further comprises a
30 positioner actuator.

In some implementations of the present technology, the positioner actuator is configured to cooperate with a core plate of the mold.

5 In some implementations of the present technology, movement of the core plate between the molding configuration and the molded article ejection configuration causes the positioner actuator to move the at least one split insert between the molded article ejection configuration and the molding configuration.

10 In some implementations of the present technology, the linking member is implemented in a C-shape configuration.

In some implementations of the present technology, an arch defined by the C-shape configuration is configured to accommodate a portion of a core assembly of the mold.

15 In some implementations of the present technology, the molded article is a closure.

In some implementations of the present technology, the at least one split insert comprises a molding surface for molding a portion of the closure.

20 In some implementations of the present technology, the portion of the closure is a portion of a bridge defined between a skirt of the closure and a tamper evident band of the closure.

In some implementations of the present technology, there is provided an injection mold that incorporates the split mold assembly.

25 In some implementations of the present technology, the injection mold is implemented as a non-opening mold.

30 In some implementations of the present technology, the injection mold further comprises a first mold half and a second mold half, the first mold half being a cavity half and the second mold half being a core half.

In some implementations of the present technology, the second mold half comprising a core assembly and a shutter assembly, the shutter assembly configured to selectively actuate the core assembly between the molding configuration and the molded article ejection configuration thereof.

- 5 In some implementations of the present technology, the injection mold further comprises a molded article transfer assembly for ejection of the molded article.

In some implementations of the present technology, the at least one split insert comprising four split inserts.

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- In some implementations of the present technology, the at least one split insert comprising four split inserts and the positioner actuator actuates the movement of the linking member in unison with the repositioning of a portion of the mold from the molding configuration and the molded article ejection configuration, and wherein the repositioning of the portion of the mold from the
- 15 molded article ejection configuration to the molding configuration is executed by a movement of a plate housing the portion of the mold.

- According to another broad aspect of the present technology, there is provided a mold for making a molded article. The mold comprises: a core assembly including: a core member comprised of an
- 20 inner core and an outer core, the inner core and the outer core cooperating to define, in use, a portion of an inner skin of the molded article; a split insert assembly cooperable, in use, with the core assembly to define a portion of an outer skin of the molded article, the split insert assembly comprising at least one split insert defining a split insert guiding interface that is configured, in use, to cooperate with a mold guiding interface defined within a portion of the mold for guiding
- 25 the at least one split insert along a travel path between a molding configuration and a molded article ejection configuration; the outer core defining an undercut and the at least one split insert defining a protrusion; the protrusion and the undercut being configured to cooperate to actuate the at least one split insert over a portion of the travel path with a repositioning of the core assembly between the molding configuration and the molded article ejection configuration.

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In some implementations of the present technology, the split insert assembly further comprises: a positioner actuator coupled to the split insert assembly, the positioner actuator for actuating the movement of the at least one split insert in unison with the repositioning of the core assembly.

- 5 In some implementations of the present technology, the positioner actuator is configured to actuate the at least one split insert movement along an entirety of the path of travel between the molding configuration and the molded article ejection configuration.

10 In some implementations of the present technology, after the at least one split insert has travelled the portion of the travel path between the molding configuration and the molded article ejection configuration, the protrusion and the undercut are configured to disengage.

15 In some implementations of the present technology, the split insert guiding interface and the mold guiding interface are interconnected by a complementary slope, the complementary slope configured to translate axial movement of the at least one split insert into lateral movement of the at least one split insert relative to a complimentary other split insert.

20 In some implementations of the present technology, the lateral movement of the at least one split insert relative to a complimentary other split insert causes the disengagement of the protrusion and the undercut.

25 In some implementations of the present technology, the positioner actuator comprises a piston and a complementary air cylinder defined within a cavity plate.

In some implementations of the present technology, the complementary air cylinder is charged with repositioning of the mold into the molding configuration.

30 In some implementations of the present technology, the positioner actuator comprises an air spring.

In some implementations of the present technology, the air spring comprises a plurality of air springs.

In some implementations of the present technology, the molded article is a closure.

In some implementations of the present technology, the at least one split insert comprises a molding surface for molding a portion of the closure.

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In some implementations of the present technology, the portion of a closure is a portion of a bridge defined between a skirt of the closure and a tamper evident band of the closure.

10 According to another broad aspect of the present technology, there is provided a mold for making a molded article. The mold comprises: a cavity insert defining a portion of a molding cavity for defining a portion of a molding cavity for defining an outer skin of the molded article; a core assembly cooperable, in use, with the cavity insert to define, in use, another portion of the molding cavity for defining a portion of an inner skin of the molded article; a split insert assembly cooperable, in use, with the cavity insert and the core assembly to define, in use, another portion of
15 the molding cavity for defining another portion of the outer skin of the molded article;
a molded article transfer assembly having a molded article transfer plate housing a molded article receptacle, the molded article receptacle being selectively positionable: (i) around a portion of the core assembly for receiving the molded article from the core assembly with a repositioning of the core assembly along the molded article transfer assembly and through the molded article receptacle
20 and (ii) away from the portion of the core assembly for removal of the molded article from within the mold; a covering plate positioned, in use, between the cavity insert and the split insert assembly for selective blockage of the molded article receptacle from the molding cavity.

25 In some implementations of the present technology, the mold further comprises a covering plate actuator configured to selectively position for selective blockage of the molded article receptacle.

In some implementations of the present technology, the covering plate actuator comprising a servo motor.

30 In some implementations of the present technology, the covering plate comprises a plurality of spaced apertures, the plurality of spaced apertures intermeshed with a respective given land of the covering plate.

In some implementations of the present technology, in a selective unblocked position, a given aperture of the covering plate is positioned in-line with the molding cavity and around a portion of the core assembly.

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In some implementations of the present technology, in a selective blocked position, the respective given land is positioned at least partially in-line with the molding cavity.

10 In some implementations of the present technology, in the selective blocked position, the respective given land is configured to prevent the molded article from re-entering the molding cavity.

15 These and other aspects and features of non-limiting embodiments will now become apparent to those skilled in the art upon review of the following description of specific non-limiting embodiments in conjunction with the accompanying drawings.

DETAILED DESCRIPTION OF THE DRAWINGS

20 The non-limiting embodiments will be more fully appreciated by reference to the accompanying drawings, in which:

Figure 1 depicts a cross-section view of a mold, the mold being implemented in accordance with non-limiting embodiments of the present technology.

25 Figure 2 depicts a perspective view of a portion of the mold of Figure 1, the mold being implemented as a 4-cavity mold in accordance with some embodiments of the present technology.

Figure 3 depicts a top view of the portion of the mold of Figure 2.

30 Figure 4 depicts a perspective sectional view of a portion of the mold of Figure 2, the sectional view taken through a line A-A of Figure 2.

Figure 5 depicts another perspective view of the portion of the mold of Figure 2.

Figure 6 depicts a portion of the mold of Figure 1 at an end of the molding cycle, namely at the end of the cooling portion of the molding cycle, where the ejection portion of the molding cycle is about to commence.

Figure 7 depicts the portion of the mold of Figure 1 during a first stage of the ejection portion of the molding cycle.

Figure 8 depicts the portion of the mold of Figure 1 during a second stage of the ejection portion of the molding cycle.

Figure 9 depicts the portion of the mold of Figure 1 during a third stage of the ejection portion of the molding cycle.

Figure 10 depicts the portion of the mold of Figure 1 during a fourth stage of the ejection portion of the molding cycle.

Figure 11 depicts the portion of the mold of Figure 1 during a fifth stage of the ejection portion of the molding cycle.

Figure 12 depicts the portion of the mold of Figure 1 during a sixth stage of the ejection portion of the molding cycle.

Figure 13 depicts the portion of the mold of Figure 1 during a seventh stage of the ejection portion of the molding cycle.

Figure 14 depicts the portion of the mold of Figure 1 during an eighth stage of the ejection portion of the molding cycle.

Figure 15 depicts the portion of the mold of Figure 1 during a ninth stage of the ejection portion of the molding cycle.

Figure 16 depicts the portion of the mold of Figure 1 during a tenth stage of the ejection portion of the molding cycle.

5 Figure 17 depicts the portion of the mold of Figure 1 during an eleventh stage of the ejection portion of the molding cycle.

Figure 18 depicts the portion of the mold of Figure 1 during a twelve stage of the ejection portion of the molding cycle.

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Figure 19 depicts the portion of the mold of Figure 1 during a thirteenth stage of the ejection portion of the molding cycle.

Figure 20 depicts a cross-sectional view of a portion of the mold of Figure 1.

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Figure 21 depicts a sectional view of a portion of the mold implemented in accordance with another embodiment of the present technology.

Figure 22 depicts a perspective view of a split insert of the mold of Figure 21, the split insert being
20 implemented in accordance to alternative embodiments of the present technology.

Figure 23 depicts a perspective view of the portion of the mold of Figure 21.

Figure 24 depicts a top view of the portion of the injection mold of the Figure 21.

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Figure 25 depicts a cross-sectional view of the portion of the mold of Figure 21, the mold being in a split insert open configuration.

Figure 26 depicts a perspective view of a portion of the mold implemented in accordance with an
30 alternative embodiment of the present technology.

Figure 27 depicts a front view of the portion of the mold of Figure 26.

Figure 28 depicts a perspective view of a non-limiting embodiment of a molded article that can be produced using the mold of Figure 1.

5 Figure 29 depicts a cross section of the non-limiting embodiment of the molded article of Figure 28.

The drawings are not necessarily to scale and may be illustrated by phantom lines, diagrammatic representations and fragmentary views. In certain instances, details that are not necessary for an
10 understanding of the embodiments or that render other details difficult to perceive may have been omitted.

DETAILED DESCRIPTION OF THE NON-LIMITING EMBODIMENT(S)

15 Reference will now be made in detail to various non-limiting embodiment(s) of a mold slide actuator and a mold incorporating same. It should be understood that other non-limiting embodiment(s), modifications and equivalents will be evident to one of ordinary skill in the art in view of the non-limiting embodiment(s) disclosed herein and that these variants should be considered to be within scope of the appended claims.

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Furthermore, it will be recognized by one of ordinary skill in the art that certain structural and operational details of the non-limiting embodiment(s) discussed hereafter may be modified or omitted (i.e. non-essential) altogether. In other instances, well known methods, procedures, and components have not been described in detail.

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Figure 1 depicts a schematic representation of a mold 102, implemented according to non-limiting embodiments of the present technology. The mold 102 is positionable, in use, within an injection molding machine (not depicted). Injection molding machines are well known in the art and, as such, will not be described here at any length. A detailed description of these known injection
30 molding machines may be referenced, at least in part, in the following reference books (for example): (i) "Injection Molding Handbook" authored by OSSWALD/TURNIG/GRAMANN (ISBN: 3-446-21669-2), (ii) "Injection Molding Handbook" authored by ROSATO AND

ROSATO (ISBN: 0-412-10581-3), (iii) "Injection Molding Systems" 3rd Edition authored by JOHANNABER (ISBN 3-446-17733-7) and/or (iv) "Runner and Gating Design Handbook" authored by BEAUMONT (ISBN 1-446-22672-9).

5 The mold 102 is operable to mold a molded article 104 (as best seen in Figure 28 and Figure 29, in which Figure 28 depicts a perspective view of a non-limiting embodiment of the molded article 104 and Figure 29 depicts a cross section of the non-limiting embodiment of the molded article 104 of Figure 28) such as, for example, a container closure (such as those for closing beverage containers and the like), which can be simply referred to as a "closure". It should be expressly
10 understood that teachings provided herein are not specifically limited to the molded article 104 being implemented as the container closure. As such, those of skill in the art will be able to modify teachings presented herein to accommodate molding the molded articles 104 of different shape, configuration or functional purpose. Structure of the container closures are well known in the art. Specifically, the mold 102 is configured to mold the container closure of a type that has in-molded
15 bridges 109 (as opposed to being slit) defined between a skirt 111 and a tamper evident band 106 of the container closure.

Also, those skilled in the art will appreciate that even though description to be presented herein use the mold 102 as an example environment for implementing teachings presented herein, these
20 teachings are not so limited. As such, it should be understood that these teachings are equally applicable to other types of molding systems and molds, such as injection-compression based systems, compression molding based systems, transfer molding based systems and the like.

Furthermore, the example of the mold 102 to be described herein, as an example of the
25 implementation environment, should not be used as limiting for every embodiments of the present technology. More specifically and as will be described in greater detail herein below, the mold 102 presented herein is implemented as not requiring a "day-light" opening in-between the mold halves during the molded article removal portion of the molding cycle (hence, it can be thought of as a "non-opening" mold). In other words and as will be shown below, within the non-opening
30 implementation of the mold 102, the molded article 104 can be removed from the mold 102 without any substantial movement of a moving platen and a stationary platen of the injection

molding machine (all not depicted) and without creating a “day light” clearance between the mating faces of the mold halves of the mold 102.

However, in alternative embodiments, a traditional implementation of the mold 102 (i.e. the one where the mold halves separate during the mold-opening phase and where the moving platen of the injection molding machine moves relatively to the stationary platen of the injection molding machine during the appropriate portions of the molding cycle) can be used for implementing teachings of the present technology.

Returning to the description of the mold 102 depicted in Figure 1, the mold 102 includes a first mold half 106 and a second mold half 113. The first mold half 106 is generally referred to as a “cavity half” and to that end, the first mold half 106 houses a gate insert 108 and a cavity insert 110. The gate insert 108 cooperates with a nozzle (not depicted) of a hot runner (not depicted) for directing molding material into the cavity insert 110. The purpose of the cavity insert 110 is to define a portion of a molding cavity (not numbered) to define, in use, an outer skin of the molded article 104. The gate insert 108 and the cavity insert 110 are housed in a cavity plate 112. The gate insert 108 and the cavity insert 110 can be implemented as two separate structural entities. Alternatively, the gate insert 108 and the cavity insert 110 can be implemented as a singular structural entity.

The second mold half 113 is generally referred to as a “core half” and to that end, the second mold half 113 houses a core assembly 114. The core assembly 114 cooperates with the cavity insert 110 to define another portion of the molding cavity for defining, in use, an inner skin of the molded article 104. Implementations of the core assembly 114 are not particularly limited. However, in the depicted embodiments, the core assembly 114 comprises a core member 116 and a stripper sleeve 118. In the depicted embodiment, the core member 116 comprises an inner core 116a and an outer core 116b. The inner core 116a and the outer core 116b cooperate to define certain portions of the inner skin of the closure, such as a plug seal 107 (Figure 29) or the like.

The foregoing mold inserts are connected to respective plates within a “plate package” (not separately numbered) that is itself moveably arranged within an ejector box 162. More particularly, the inner core 116a of the core assembly 114 is coupled to a core plate 124, the outer

core 116b of the core assembly 114 is coupled to an outer core plate 125, the stripper sleeve 118 of the core assembly 114 is coupled to a stripper plate 127. The various plates (i.e. the core plate 124, the outer core plate 125 and the stripper plate 127) of the plate package are axially moveable relative to one another to affect positioning of the inserts between molding and ejection configurations.

The mold 102 also includes a split insert assembly 140 that is associated with the first mold half 106 and disposed in-between the second mold half 113 and the first mold half 106. The split insert assembly 140 comprises a split insert plate 141 that houses *inter alia* a pair of split inserts 142. The pair of inserts 142 includes molding surfaces (not numbered) that cooperate with the core member 116 to define undercuts within the molded article 104. In the present example of the molded article 104 being a container closure, the pair of split inserts 142 cooperate with the core member 116 to mold the undercuts in-between the skirt 111 (Figure 29) and the tamper evident band 106 (Figure 29) of the container closure to define a plurality of the bridges 109 (Figure 29) therebetween. Other components of the split insert assembly 140 will be described in greater detail herein below.

As shown, the mold 102 may also include a shutter assembly 126 – although in other non-limiting embodiments the shutter assembly 126 may instead be integral with a platen (not shown) of the mold clamp (not shown). Generally speaking, the shutter assembly 126 is configured to (i) lock the core plate 124 (along with the other plates of the plate package) in a molding configuration during the appropriate portions of the molding cycle (namely, injection, hold and cooling portions of the molding cycle) and (ii) to allow the core plate 124 and the other plates of the plate package (and accordingly the respective mold inserts of the core assembly 114) to move away from the cavity plate 112 during other portions of the molding cycle (namely, the molded article 104 ejection portion of the molding cycle).

The shutter assembly 126 comprises several first linking members 128 coupled to the core plate 124.

The shutter assembly 128 further comprises several second linking members 130 that are coupled to a shutter actuator 132. Within embodiments of the present technology, the shutter actuator 132

can be implemented as a servo motor or any other suitable motive means for reciprocal actuation (shuttling) of the second linking member 130 in a lateral (left-right) direction as viewed in Figure 1 between a “shutter open” and a “shutter closed” configuration.

- 5 The shutter assembly 126 is depicted in the shutter closed configuration in Figure 1. Within this configuration, the first linking members 128 and the second linking members 130 are substantially aligned and abut one another. In this configuration, an applied clamping force and reaction forces due to injection of molding material into the molding cavity can be directed, at least in part, through the first and second linking members 128, 130. More particularly, the shutter assembly
- 10 126 (and, specifically, the second linking member 130 and the first linking member 128) hold the core plate 124 and the other plates of the plate package (and therefore the associated inserts of the core assembly 114) in the molding configuration. Within the molding configuration: (i) the core member 116, the cavity insert 110, the gate insert 108 and the pair of split inserts 142 cooperate to define the molding cavity (not numbered) for defining the molded article 104 by accepting, under
- 15 pressure, a stream of molding material through a gate (not numbered) defined in the gate insert 108 and packing and cooling the molded article 104; (ii) the core assembly 114 is held in place, against the injection pressure, and is prevented from moving away from the cavity plate 112 (in a downward direction as viewed in Figure 1).
- 20 Conversely, with the shutter assembly 126 arranged in the shutter open configuration (not shown) the second linking members 130 are positioned beside the first linking members 128 whereby the core plate 124 and the other plates of the plate package may be axially moved to affect ejection of the molded article and then returned to a molding configuration.
- 25 More particularly, in the shutter open configuration (not depicted), the shutter actuator 132 actuates the second linking member 130 into the shutter open configuration, which is in the illustration of Figure 1 means moving the second linking member 130 to the left. Within this shutter open configuration, the second linking member 130 is no longer aligned with the first linking member 128. Within this configuration, the shutter assembly 126 (and, specifically, the
- 30 misalignment of second linking member 130 and the first linking member 128) allow the core plate 124, the outer core plate 125 and the stripper plate 127 (and therefore the inserts of the core assembly 114) to transition to the molded article ejection configuration. In some embodiments of

the present technology, this movement of the core plate 124 and the other plates may be actuated by an ejector (not shown) that is associated with the mold clamp (not shown).

Within the molded article ejection configuration: (i) the core member 116 is allowed to move away
5 from the cavity insert 110, the pair of split inserts 142 are allowed to move laterally away from the core member 116 as will be described below to allow the molded article 104 to be removed from the molding cavity (not numbered) and positioned within the molded article receptacle 120; (ii) the core assembly 114 is allowed to move in a downward direction as viewed in Figure 1.

10 The mold 102 further includes a front plate 160 that is connected to the ejector box 162 to enclose, in part, a spaced defined therein within which the plate package and the associated core assembly 114 are moveable. The front plate 160 slidably supports a molded article transfer assembly 119 thereon.

15 The molded article transfer assembly 119 is configured to remove molded articles 104 from within the mold 102, after the molded articles 104 have been molded and have had time to cool to a removal temperature (the temperature selected to be sufficient for removal of the molded articles 104 without substantial structural deformations).

20 The molded article transfer assembly 119 comprises a molded article transfer plate 121 housing a molded article receptacle 120, the molded article receptacle 120 (e.g. shuttle) being selectively laterally positionable: (i) in a receiving position wherein the molded article receptacle 120 is positioned to surround a portion of the core member 116 during molding of the molded article and otherwise receive the molded article 104 for transfer with subsequent retraction of the core
25 member 116 from the molded article receptacle 120 and ejection of the molded article from the core member 116, as will be described in greater detail below; (ii) in a transfer position that is beside the mold cavity defining inserts and aligned with a removal means, such as a drop chute which is not depicted, for removal of the molded article 104 from within the mold 102.

30 The molded article transfer assembly 119 further includes a molded article transfer actuator 122. The molded article transfer actuator 122 can be implemented as a servo motor or any other suitable

motive means for shuttling reciprocation of the molded article transfer plate 121 in the lateral (left-right) direction as viewed in the depiction of Figure 1.

The mold 102 also includes a covering plate 180. Within embodiments of the present technology,
5 the covering plate 180 is located between (i) the split insert assembly 140 and (ii) the molded article transfer assembly 119.

The covering plate 180 is configured to provide a selective blockage of the molded article receptacle 120 from the molding cavity (not numbered) where the molded article 104 is produced.
10 To provide this selective blockage, the cover plate 180 is configured to be laterally shuttled (left and right, as viewed in figure 1) by a covering plate actuator 182. The covering plate actuator 182 can be implemented as a servo motor or any other suitable motive means. The covering plate 180 comprises a plurality of spaced apertures 181.

15 In the selective unblocked position, a given aperture 181 of the covering plate 180 is positioned in-line with the molding cavity and around portions of the core assembly 114. Within the selective blocked position, a given land 183 (see Figure 12, for example) located in-between two neighboring apertures 181 of the covering plate 180 is positioned at least partially in-line with the molding cavity. The blocked position is useful for preventing the molded article 104 from
20 accidentally re-entering the molding cavity during ejection. Operation of the covering plate 180 will be described in greater detail herein below.

Now, we will turn our attention to description of the split insert assembly 140, which is implemented in accordance with non-limiting embodiments of the present technology. With
25 reference to Figure 2, Figure 3 and Figure 4, there is depicted a portion of the mold 102 of Figure 1, the portion of the mold 102 being implemented in accordance with non-limiting embodiments of the present technology.

More specifically, Figure 2 depicts a perspective view of the portion of the mold 102 (having 4
30 molding cavities), specifically depicting the split insert assembly 140 and a portion of the core assembly 114. Figure 3 depicts a top view of the portion of the mold 102 of Figure 2, the top view

depicting the split insert assembly 140. Figure 4 depicts a perspective sectional view of the portion of the mold 102 of Figure 2, the section taken through a line A-A of Figure 2.

With continued reference to Figure 2, Figure 3 and Figure 4, it may be appreciated that the split insert assembly 140 comprises several pairs of split inserts 142. Within the depicted embodiment, each pair of split inserts 142 is depicted as a pair of slides. Naturally, the given implementation of the mold 102 can house multiple instances of the pairs of split inserts 142 within the split insert plate 141. Within the illustrated embodiments, each of the pairs of split inserts 142 defines two molding cavities, but this number does not need to be the same in all embodiments of the present technology. As such, the number of cavities associated with each of the pairs of split inserts 142 can be selected based on the overall cavitation of the mold 102 and other considerations.

As may be appreciated with reference to the operational sequences depicted in FIGS. 6-10 and 16-19, each pair of split inserts 142 is configured to slide within the split insert plate 141 to affect an opening or closing movement thereof. To support the foregoing, each split insert of every pair of split inserts 142 may be slidably connected to the split insert plate 141 along an inclined keyway as shown in Figure 4. More particularly, the split insert plate 141 defines a slide guiding interface 220 and each member of the pair of split inserts defines a mold guiding interface 222 that is complementary thereto. The slide guiding interface 220 and the mold guiding interface 222 are configured in complementary sloped manner. More specifically, the slide guiding interface 220 defines a male slope (key), while the mold guiding interface 222 defines a female slope (keyway). The slide guiding interface 220 and the mold guiding interface 222, together, define a path of travel for the respective one of the pair of the split inserts 142 between a molding configuration (as is depicted in Figure 4) and a molded article ejection configuration (as depicted with reference to Figure 10 for example).

As the respective one of the pair of the split inserts 142 travels along the path of travel along the slide guiding interface 220 and the mold guiding interface 222, the respective one of the pair of the split inserts 142 can be the to travel axially, i.e. in the direction away from the cavity plate 112. The axial travel together with the sloped interface between the slide guiding interface 220 and the mold guiding interface 222, causes the respective one of the pair of the split inserts 142 to also travel laterally, i.e. away from the other one of the pair of the split inserts 142. Therefore, it can be

said, that the sloped interface defined between the slide guiding interface 220 and the mold guiding interface 222 translates the axial movement of the pair of the split inserts 142 into lateral movement of one of the pair of the split inserts 142 relative to the other one of the pair of the split inserts 142.

5

The movement of the pair of the split inserts 142 is coordinated with the axial movement of the core assembly 114 away from the cavity plate 112 (as will be described in greater detail herein below). The lateral travel of the pair of the split inserts 142 away from each other allows for the molding surfaces of the pair of the split inserts 142 to clear the undercuts of the molded article 142. That, in turn, allows the molded article 142 to move without causing deformation to the molded article 142 (as it moves with the core assembly 140).

10

The pair of split inserts 142 is associated with a split inserts positioner 202, operatively coupled, in use, to the pair of split inserts 142. Generally speaking, the split inserts positioner 202 is configured to actuate the split insert assembly 140 between an open configuration and a closed configuration and/or *vice versa* with a repositioning of the mold 102 between molding configuration and molded article ejection configuration.

15

In some embodiments of the present technology, the split insert positioner 202 may include an opening split insert positioner 204.

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According to embodiments of the present technology, the opening split insert positioner 204 comprises a linking member 206. The linking member 206 is juxtaposed and contacts a respective one of the pair of split inserts 142. In some embodiments of the present technology, the linking member 206 is juxtaposed with the respective one of the pair of split inserts 142 via a sliding interface 208, as is best seen in Figure 5, which depicts another perspective view of the portion of the mold 102. As is depicted in the illustrated embodiment, the linking member 206 can be juxtaposed with more than a single instance of the pair of split inserts 142.

25

Within the illustrated embodiment, the sliding interface 208 is depicted as a key-slot type interconnection between the linking member 206 and the respective one of the pair of split inserts 142.

30

The opening split insert positioner 204 also comprises a positioner actuator 228 coupled to the linking member 206 by means of a linking member coupler 902 (Figure 10). Generally speaking, the positioner actuator 228 is configured to actuate the movement of the linking member 206 (and therefore the pair of the split inserts 142) in unison with the repositioning of the portions of the mold 102 between mold closed and mold open positions (namely, with the repositioning of the core assembly 114 relative to the cavity assembly 112).

In the depicted embodiment, the positioner actuator 228 is implemented as an air spring. However, this needs not be so in every embodiment of the present technology. As such, other types of the positioner actuator 228 can be equally used.

In some embodiments of the present technology, the positioner actuator 228 comprises a piston (not numbered) and a complementary air cylinder (not numbered) defined within the cavity plate 112. The air cylinder may be charged with pressure after the mold 102 is actuated into the molding configuration— thereby providing the ‘air spring’ effect.

The number of instances of the positioner actuators 228 within the mold 102 will depend on the size of cavitation of the mold 102 and on the force that the positioner actuators 228 are capable of exerting onto the linking member 206 (and therefore the pair of the split inserts 142). In the depicted embodiment, as is best seen in Figure 2, there can be six instances of the positioner actuators 228. Naturally, any other number of the instances of the positioner actuators 228 can be used.

During the appropriate portions of the molding cycle (namely, at the end of the cooling portion of the molding cycle and as the ejection cycle commences), the positioner actuator 228 actuates the pair of the linking member 228 and thus drives the pair of the split inserts 142 (as well as other instances of the pairs of the split inserts 142 potentially coupled thereto) to move along the path of travel along the slide guiding interface 220 and the mold guiding interface 222.

Effectively, this allows for the molded article 104 to be released from the molding surfaces associated with the pair of the split inserts 142.

In some embodiments of the present technology, the split insert positioner 202 may include a closing split insert positioner 242.

According to embodiments of the present technology, the closing split insert positioner 242 comprises a linking member 244. The linking member 244 is juxtaposed with a respective one of the pair of split inserts 142. In some embodiments of the present technology, the linking member 244 is juxtaposed with the respective one of the pair of split inserts 142 via a sliding interface 246, as is best seen in Figure 5. Within these embodiments of the present technology, the sliding interface 246 between the linking member 246 and the respective one of the pair of split inserts 142 means that the linking member 246 and the respective one of the pair of split inserts 142 abut each other, but are not otherwise physically connected there between.

The closing split insert positioner 242 also comprises a positioner actuator 245 coupled to the linking member 344. Generally speaking, the positioner actuator 245 is configured to actuate the movement of the linking member 344 (and therefore the pair of the split inserts 142) in unison with the repositioning of the portions of the mold 102 apparatus between mold open and mold closed positions (namely, with the repositioning of the core assembly 114 relative to the cavity assembly 112) in a direction opposite to the direction of the operation of the opening split insert positioner 204.

In the depicted embodiment, the positioner actuator 245 is implemented as a pair of rods, one end of each is coupled to the linking member 344 and another end is connected to the stripper plate 127 (Figure 16).

During the appropriate portions of the molding cycle (namely, at the end of the ejection cycle and right before the new injection portion of the molding cycle commences), the movement of the core plate 124 towards the cavity plate 112 eventually pushes the other plates of the plate package including the stripper plate 127 to thereby drive the positioner actuator 245 to move the linking member 244 and the pair of the split inserts 142 (as well as other instances of the pairs of the split inserts 142 potentially coupled thereto) towards the molding configuration.

Within the depicted embodiments, the linking member 244 is implemented in a C-shape configuration. The arch defined by the C-shape of the linking member 244 is configured to accommodate the generally cylindrical shape of the core assembly 114.

5 Given the architecture described above, the operation of the mold 102 will now be described in greater detail. The description to be presented below will focus specifically on the operation of the opening split insert positioner 204 and the closing split insert positioner 242. Reference will now be made to Figure 6 to Figure 19, in which each of the Figures shows (i) on the very left, a view of the closing split insert positioner 242; (ii) in the middle, the view of the pair of split inserts 142
10 and the core assembly 114 and (iii) on the very right, the opening split insert positioner 204.

Figure 6 shows the closing split insert positioner 242, the pair of split inserts 142, the core assembly 114, the opening split insert positioner 204 and the molded article transfer assembly 119 at the end of the molding cycle, namely at the end of the cooling portion of the molding cycle,
15 where the ejection portion of the molding cycle is about to commence.

To this end, the molded article 104 has been molded and has solidified enough to reach the temperature that is safe for ejection. The pair of split mold inserts 142 abuts the cavity insert 110. The cavity insert 110, the core member 116 and the pair of split inserts 142 are all in the molding
20 configuration, where they cooperate to define the molding cavity (not numbered) to mold the molded article 104. Portions of the molding surface (not numbered) of the pair of split mold inserts 142 are “trapped” within the undercuts molded within the molded article 104.

Figure 7 shows the closing split insert positioner 242, the pair of split inserts 142, the core
25 assembly 114, the opening split insert positioner 204 and the molded article transfer assembly 119 at the first stage of the ejection portion of the molding cycle.

At this stage, the positioner actuator 228 has been actuated to urge the linking member 206 and, thus, the pair of split inserts 142 away from the cavity insert 110 along the path of travel defined
30 by the slide guiding interface 220 and the mold guiding interface 222 (i.e. in the downward direction as viewed in Figure 7). At this point, portions of the molding surface (not numbered) of

the pair of split mold inserts 142 are still “trapped” within the undercuts molded within the molded article 104.

Figure 8 shows the closing split insert positioner 242, the pair of split inserts 142, the core assembly 114, the opening split insert positioner 204 and the molded article transfer assembly 119 at the second stage of the ejection portion of the molding cycle.

At this stage, the pair of split inserts 142 continues to move along the path of travel defined by the slide guiding interface 220 and the mold guiding interface 222. At this point, the pair of split inserts 142 has moved a pre-determined distance “D1” along the slope of the path of travel defined by the slide guiding interface 220 and the mold guiding interface 222. At this point, the slope defined between the slide guiding interface 220 and the mold guiding interface 222 causes the pair of split inserts 142 to continue moving laterally away from each other. At this point, portions of the molding surface of the pair of split mold inserts 142 are nearly released from the undercuts molded within the molded article 104 as it continues to travel with the core member 116 away from the cavity insert 110.

Figure 9 shows the closing split insert positioner 242, the pair of split inserts 142, the core assembly 114, the opening split insert positioner 204 and the molded article transfer assembly 119 at the third stage of the ejection portion of the molding cycle.

At this stage, the pair of split inserts 142 continues to move along the path of travel defined by the slide guiding interface 220 and the mold guiding interface 222. At this point, the pair of split inserts 142 has moved a pre-determined distance “D2” along the slope of the path of travel defined by the slide guiding interface 220 and the mold guiding interface 222. At this point, the pair of split inserts 142 has continued to move laterally away from each other. At this point, portions of the molding surface of the pair of split mold inserts 142 has completely cleared the undercuts molded within the molded article 104 as it continues to travel with the core member 116 away from the cavity insert 110. During the ejection process from this point onwards, the split mold inserts 142 are driven to their open configuration by the split insert positioner 204.

Figure 10 shows the closing split insert positioner 242, the pair of split inserts 142, the core assembly 114, the opening split insert positioner 204 and the molded article transfer assembly 119 at the fourth stage of the ejection portion of the molding cycle.

5 At this stage, the pair of split inserts 142 has completed its path of travel defined by the slide guiding interface 220 and the mold guiding interface 222. The position of the linking member 206 is arrested by the positioner actuator 228 having reached the end of its stroke (i.e. piston bottoms out in the cylinder)

10 At this point, the molded article 104 has cleared both the molding surface of the cavity insert 110 and the molding surface of the pair of the split inserts 114.

Figure 11 shows the closing split insert positioner 242, the pair of split inserts 142, the core assembly 114, the opening split insert positioner 204 and the molded article transfer assembly 119
15 at the fifth stage of the ejection portion of the molding cycle.

At this stage, the core assembly 114 continues its path of travel and the molded article 104 starts to enter the molded article receptacle 120 of the molded article transfer plate 121 of the molded article transfer assembly 119.

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Figure 12 shows the closing split insert positioner 242, the pair of split inserts 142, the core assembly 114, the opening split insert positioner 204 and the molded article transfer assembly 119 at the sixth stage of the ejection portion of the molding cycle.

25 At this stage, the core assembly 114 continues its path of travel and the molded article 104 has completely entered the molded article receptacle 120 of the molded article transfer plate 121 of the molded article transfer assembly 119.

Within some embodiments of the present technology, at this point the covering plate 180 is
30 actuated to provide blockage between the molded article receptacle 120 and the molding cavity (not numbered) where the molded article 104 has been produced. More specifically, the covering plate 180 is shuttled (left and right, as viewed in Figure 12) by the covering plate actuator 182.

Figure 13 shows the closing split insert positioner 242, the pair of split inserts 142, the core assembly 114, the opening split insert positioner 204 and the molded article transfer assembly 119 at the seventh stage of the ejection portion of the molding cycle.

5

At this stage, the core assembly 114 continues its path of travel. At this stage, the molded article 104 is stripped off the core member 116. As the core assembly 114 continues to travel, a portion of the molded article 104 (namely the lower-most edge of the tamper evident band) gets trapped by the stripper sleeve 118. As the core assembly 114 continues to move, the molded article 104 is pushed off the core member 114 by the stripper sleeve 118. The compliancy in the molded article 104 allows the undercuts of the molded article 104 to clear the protrusions of the molding surface of the core member 116.

10

Figure 14 shows the closing split insert positioner 242, the pair of split inserts 142, the core assembly 114, the opening split insert positioner 204 and the molded article transfer assembly 119 at the eighth stage of the ejection portion of the molding cycle.

15

At this point, the molded article transfer actuator 122 actuates the molded article transfer plate 121. More specifically, the molded article transfer actuator 122 actuates the molded article transfer plate 121 laterally (in the left-bound direction) as viewed in Figure 14.

20

Figure 15 shows the closing split insert positioner 242, the pair of split inserts 142, the core assembly 114, the opening split insert positioner 204 and the molded article transfer assembly 119 at the ninth stage of the ejection portion of the molding cycle.

25

At this point, the molded article transfer plate 121 has completed its shuttle path and the molded article 104 has been shuttled away. A second instance of the molded article receptacle 120 that is defined in the molded article transfer plate 121 is now aligned with the core assembly 114.

30

Figure 16 shows the closing split insert positioner 242, the pair of split inserts 142, the core assembly 114, the opening split insert positioner 204 and the molded article transfer assembly 119 at the tenth stage of the ejection portion of the molding cycle.

At this point, the core assembly 114 is actuated towards the mold closing position, i.e. in the direction towards the cavity plate 112. At this point, the closing split insert positioner 242 starts to actuate the pair of split inserts 114 towards the mold closed position, i.e. towards the cavity plate 112.

More specifically, the movement of the core plate 112 drives movement of the plate package and with it the core assembly 114, and in so doing the stripper plate 127 causes the positioner actuator 245 (and hence the linking member 244) to move toward the cavity plate 112. This, in turn, causes the pair of split inserts 114 to start movement towards the cavity plate and the resetting of the opening split insert positioner 204 (e.g. compressing of the air in the cylinder).

Figure 17 shows the closing split insert positioner 242, the pair of split inserts 142, the core assembly 114, the opening split insert positioner 204 and the molded article transfer assembly 119 at the eleventh stage of the ejection portion of the molding cycle.

At this point, the core assembly 114 continues to move towards the mold closing position, i.e. in the direction towards the cavity plate 112. The continued movement of the stripper plate 127 continues to cause the positioner actuator 242 (and hence the linking member 244) to move toward the cavity plate 112. This, in turn, continues to cause the pair of split inserts 142 to continue their movement towards the cavity plate 112.

Figure 18 shows the closing split insert positioner 242, the pair of split inserts 142, the core assembly 114, the opening split insert positioner 204 and the molded article transfer assembly 119 at the twelve stage of the ejection portion of the molding cycle.

At this point, the core assembly 114 continues to move towards the mold closing position, i.e. in the direction towards the cavity plate 112. The movement of the stripper plate 127 continues to cause the positioner actuator 242 (and hence the linking member 244) to move toward the cavity plate 112. This, in turn, continues to cause the pair of split inserts 142 to continue their movement towards the cavity plate 112.

As can also be seen in Figure 18, the molded article 104 previously positioned within the molded article receptacle 120 has been removed. In some embodiments, the molded article receptacle 120 positioned in the arrangement of Figure 18 is aligned with the drop chute (not depicted) so that the molded article 104 can be removed by the force of gravity or with assistance of air jets and the like. It should be noted that the exact timing of the molded article 104 evacuation from the molded article receptacle 120 is not particularly limited and can commence at any point after the arrangement in Figure 15 is reached.

Figure 19 shows the closing split insert positioner 242, the pair of split inserts 142, the core assembly 114, the opening split insert positioner 204 and the molded article transfer assembly 119 at the thirteenth stage of the ejection portion of the molding cycle.

At this point, the core assembly 114 continues to move towards the mold closing position, i.e. in the direction towards the cavity plate 112. The movement of the stripper plate 127 continues to cause the positioner actuator 242 (and hence the linking member 244) to move toward the cavity plate 112. This, in turn, continues to cause the pair of split inserts 142 to continue their movement towards the cavity plate 112.

The movement of the core assembly 114 eventually ceases with the return thereof to the arrangement depicted in Figure 6, whereafter the next molding cycle commences and another instance of the molded article 104 can be molded.

Reference will now be made to Figure 20, which depicts a cross-sectional view of a portion of the mold 102 implemented in accordance with some other embodiments of the present technology. Within these alternative embodiments of the present technology, in addition or instead of the positioner actuator 228, the actuation of the linking member 206 and the pair of the split inserts 142 (as well as other instances of the pairs of the split inserts 142 potentially coupled thereto) to move along the path of travel along the slide guiding interface 220 and the mold guiding interface 222 can be executed as follows.

Within these alternative embodiments, each of the pair of split inserts 142 comprises a projection 2002. The outer core 116b comprises an undercut 2004. The portion of the mold stack of the mold

102 in Figure 20 is depicted in the mold closed configuration, similar to that of Figure 6. Within this configuration, the projection 2002 is positioned within the undercut 2004 and, is effectively, trapped therein in the axial direction – i.e. in the upward-downward direction, as viewed in Figure 20.

5

During the initial stages of repositioning of the mold 102, the movement of the core assembly 114, and more specifically the entrapment of the projection 2002 within the undercut 2004, causes the core assembly 114 to pull the pair of the split inserts 140 in the downward direction, as viewed in Figure 20. This “dragging along” affect can exist, for example, while the pair of split inserts 142 travel to the distance D1, as is seen in Figure 8. As the pair of split inserts 142 reach the distance D2, as is seen in Figure 9, the pair of split inserts 142 starts the lateral movement away from each other, which leads to the projection 2002 being removed from the undercut 2004.

10

It is noted that in the above described embodiments, the opening split insert positioner 204 and the closing split insert positioner 242 have been described as separate structural entities. In alternative embodiments of the present technology, functionality of the opening split insert positioner 204 and the closing split insert positioner 242 can be implemented in a unitary structure. For example, the positioner actuator 228 rather than being implemented as a push-actuator (such as, the air spring and the like), can be implemented as push-pull actuator, such as a servo motor or the like.

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Therefore, it should be expressly understood that in some embodiments of the present technology, the mold 102 can include the split insert positioner 202 implemented as both the opening member and the closing member. In alternative embodiments, the mold 102 can include the split insert positioner 202 implemented as one or the other of the opening member and the closing member.

25

With reference to Figures 21 to 25, there are depicted some alternative non-limiting embodiments of the present technology.

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More specifically, Figure 21 depicts a sectional view of a portion of the mold 102 implemented in accordance with another embodiment of the present technology. Figure 22 depicts a perspective view of a split insert of the mold 102 of Figure 21, the split insert being implemented in accordance to alternative embodiments of the present technology. Figure 23 depicts a perspective

view of the portion of the mold 102 of Figure 21. Figure 24 depicts a top view of the injection mold of the Figure 21. Figure 25 depicts a sectional view of the portion of the mold 102 of Figure 21, the mold 102 being in a split insert open configuration.

5 With reference to Figure 21, there is provided a split insert assembly 2340 implemented to alternative embodiments of the present technology. The split insert assembly 2340 comprises a split insert plate 2341 and a plurality of split inserts 2142 (as depicted in Figure 22 and Figure 24). With reference to Figure 24, the plurality of split inserts 2142 comprises a first split insert 2142a, a second split insert 2142b, a third split insert 2142c and a fourth split insert 2142d. Each of the
10 plurality of split inserts 2142 comprises an insert guiding interface 2120 and a guiding projection 2124.

The insert guiding interface 2120 cooperates with a mold guiding interface 2122, much akin to what has been described above in association with the slide guiding interface 220 and the mold
15 guiding interface 222. The guiding projection 2124 cooperates with a guiding pocket 2126 for providing lateral guidance to the first split insert 2142a, the second split insert 2142b, the third split insert 2142c and the fourth split insert 2142d as they travel laterally away from each other to release the undercuts of the molded article 104. As is shown in Figure 25, by travelling an axial distance 2502 and a lateral distance 2504, the first split insert 2142a, the second split insert 2142b,
20 the third split insert 2142c and the fourth split insert 2142d clear the undercuts of the molded article 104.

During the mold opening operation (i.e. transitioning between the between molding and ejection configurations), the plate (not separately numbered) where the guiding pocket 2126 is defined is
25 pushed away from the cavity plate 112 through air springs, similar to the operation of the opening split insert positioner 204 actuating of the linking member 206 described above. During the mold closing operation, the plate is pushed towards the cavity plate 112 by the stripper sleeve 118. As such, embodiment of Figure 21 can be implemented without a structure similar to the closing split inserts positioner (242) that has been described above.

30 With reference to Figures 26 and 27, there are depicted some alternative non-limiting embodiments of the present technology.

More specifically, Figure 26 depicts a perspective view of a portion of the mold 102 implemented in accordance with some alternative embodiments of the present technology. Figure 27 depicts a front view of the portion of the mold 102 of Figure 26.

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Embodiments depicted herein with reference to Figures 26 and 27 are substantially similar to what has been described above but for the specific differences to be explained momentarily. The pair of slides 2642, within these embodiments, cooperate with a plurality of cams 2622 and 2624. Each of the plurality of cams 2622 and 2624 defines a respective cam guiding interface 2620a and 2620b, cooperating with respective slide guiding interfaces 2621a and 2621b.

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It should be expressly understood that various technical effects mentioned throughout the description above need not be enjoyed in each and every embodiment of the present technology. As such, it is anticipated that in some implementations of the present technology, only some of the above-described technical effects may be enjoyed. While in other implementations of the present technology, none of the above enumerated technical effects may be present, while other technical effects not specifically enumerated above may be enjoyed. It should be expressly understood that the above enumerated technical effects are provided for illustration purposes only, to enable those skilled in the art to better appreciate embodiments of the present technology and by no means are provided to limit the scope of the present technology or of the claims appended herein below.

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It is noted that the foregoing has outlined some of the more pertinent non-limiting embodiments. It will be clear to those skilled in the art that modifications to the disclosed non-limiting embodiment(s) can be effected without departing from the spirit and scope thereof. As such, the described non-limiting embodiment(s) ought to be considered to be merely illustrative of some of the more prominent features and applications. Other beneficial results can be realized by applying the non-limiting embodiments in a different manner or modifying them in ways known to those familiar with the art. This includes the mixing and matching of features, elements and/or functions between various non-limiting embodiment(s) is expressly contemplated herein so that one of ordinary skill in the art would appreciate from this disclosure that features, elements and/or functions of one embodiment may be incorporated into another embodiment as skill in the art would appreciate from this disclosure that features, elements and/or functions of one embodiment

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may be incorporated into another embodiment as appropriate, unless described otherwise, above. Although the description is made for particular arrangements and methods, the intent and concept thereof may be suitable and applicable to other arrangements and applications.

WHAT IS CLAIMED IS:

1. A split insert assembly (140) positionable, in use, in a mold (102), the mold (102) for producing a molded article (104), the split insert assembly (140) comprising:

at least one split insert (142, 2142);

a split inserts positioner (202, 242) juxtaposed, in use, with the at least one split insert (142, 2142), the split inserts positioner (202, 242) including:

a linking member (206, 244) coupled to the at least one split insert (142, 2142);

a sliding interface defined between the linking member (206, 244) and the at least one split insert (142, 2142);

a positioner actuator (228, 245) coupled to the linking member (206, 244), the positioner actuator (228, 245) for actuating the movement of the linking member (206, 244) in unison with the repositioning of a portion of the mold (102) between a molding configuration and a molded article ejection configuration.
2. The split insert assembly (140) of claim 1, wherein the split inserts positioner (202, 242) is implemented as an opening split inserts positioner (202).
3. The split insert assembly (140) of claim 2, wherein the opening split insert positioner (202) further comprises a split insert guiding interface (220) defined on a portion of the at least one split insert (142, 2142).
4. The split insert assembly (140) of claim 3, wherein the split insert guiding interface (220) is configured to cooperate with a mold guiding interface (222) defined within a portion of the mold (102).
5. The split insert assembly (140) of claim 4, wherein the portion of the mold (102) comprises a split insert plate (141) that houses the at least one split insert (142, 2142).
6. The split insert assembly (140) of claim 4, wherein the split insert guiding interface (220) and the mold guiding interface (222) are configured in a complementary sloped manner.

7. The split insert assembly (140) of claim 6, wherein the split insert guiding interface (220) and the mold guiding interface (222) define a path of travel for the at least one split insert (142, 2142) there-along and wherein the complementary slope of the split insert guiding interface (220) and the mold guiding interface (222) translates axial movement of the at least one split insert (142, 2142) into lateral movement of the at least one split insert (142, 2142) relative to a complimentary other split insert (142).
8. The split insert assembly (140) of claim 6, wherein the split insert guiding interface (220) and the mold guiding interface (222) define a path of travel for the at least one split insert (142, 2142) there-along and wherein the positioner actuator (228) is configured to actuate the at least one split insert (142, 2142) movement along the path of travel between the molding configuration and the molded article ejection configuration.
9. The split insert assembly (140) of claim 8, wherein the at least one split insert (142, 2142) is retained in the molded article ejection configuration by virtue of the linking member (206) being arrested by the positioner actuator (228).
10. The split insert assembly (140) of any of the preceding claims 2 to 9, wherein the positioner actuator (228) comprises an air spring.
11. The split insert assembly (140) of claim 10, wherein the air spring comprises a plurality of air springs.
12. The split insert assembly (140) of claim 2, wherein the sliding interface comprises a key-slot interconnection.
13. The split insert assembly (140) of claim 1, wherein the split inserts positioner (202, 242) is implemented as a closing split inserts positioner (242).
14. The split insert assembly (140) of claim 13, wherein the closing split inserts positioner (242) comprises a linking member (244).
15. The split insert assembly (140) of claim 14, wherein the sliding interface between the linking member and the at least one split insert (142, 2142) comprises an abutment arrangement.

16. The split insert assembly (140) of claim 14, further comprising a positioner actuator (245).
17. The split insert assembly (140) of claim 16, wherein the positioner actuator (245) is configured to cooperate with a core plate (124) of the mold (102).
18. The split insert assembly (140) of claim 17, wherein movement of the core plate (124) between the molding configuration and the molded article ejection configuration causes the positioner actuator (245) to move the at least one split insert (142, 2142) between the molded article ejection configuration and the molding configuration.
19. The split mold assembly (142) of claim 13, wherein the linking member (244) is implemented in a C-shape configuration.
20. The split mold assembly (142) of claim 19, wherein an arch defined by the C-shape configuration is configured to accommodate a portion of a core assembly (114) of the mold (102).
21. The split mold assembly (142) of any of the preceding claims 1 to 20, wherein the molded article (104) is a closure.
22. The split mold assembly (142) of claim 21, wherein the at least one split insert (142, 2142) comprises a molding surface for molding a portion of the closure.
23. The split mold assembly (142) of claim 22, wherein the portion of the closure is a portion of a bridge defined between a skirt of the closure and a tamper evident band of the closure.
24. An injection mold (102) incorporating the split mold assembly (142) of any one of claims 1 to 23.
25. The injection mold (102) of claim 24 being implemented as a non-opening mold.
26. The injection mold (102) of claim 25, further comprising a first mold half (106) and a second mold half (113), the first mold half (106) being a cavity half and the second mold half (113) being a core half.
27. The injection mold (102) of claim 26, wherein the second mold half (113) comprising a core assembly (114) and a shutter assembly (126), the shutter assembly (126) configured to

selectively actuate the core assembly (114) between the molding configuration and the molded article ejection configuration thereof.

28. The injection mold (102) of claim 25 further comprising a molded article transfer assembly (119) for ejection of the molded article (104).
29. The injection mold of claim 1, the at least one split insert (142, 2142) comprising four split inserts (2141).
30. The injection mold of claim 29, the at least one split insert (142, 2142) comprising four split inserts (2141), wherein the positioner actuator (228, 245) actuates the movement of the linking member (206, 244) in unison with the repositioning of a portion of the mold (102) from the molding configuration and the molded article ejection configuration, and wherein the repositioning of the portion of the mold (102) from the molded article ejection configuration to the molding configuration is executed by a movement of a plate housing the portion of the mold (102).
31. A mold (102) for making a molded article (104), the mold (102) comprising:
 - a core assembly (114) including:
 - a core member (116) comprised of an inner core (116a) and an outer core (116b), the inner core (116a) and the outer core (116b) cooperating to define, in use, a portion of an inner skin of the molded article (104);
 - a split insert assembly (140) cooperable, in use, with the core assembly (114) to define a portion of an outer skin of the molded article (104), the split insert assembly (140) comprising at least one split insert (142, 2142) defining a split insert guiding interface (220) that is configured, in use, to cooperate with a mold guiding interface (222) defined within a portion of the mold (102) for guiding the at least one split insert (142, 2142) along a travel path between a molding configuration and a molded article ejection configuration;
 - the outer core (116b) defining an undercut (2004) and the at least one split insert (142, 2142) defining a protrusion (2002);

the protrusion (2002) and the undercut (2004) being configured to cooperate to actuate the at least one split insert (142, 2142) over a portion of the travel path with a repositioning of the core assembly (114) between the molding configuration and the molded article ejection configuration.

32. The mold (102) of claim 31, the split insert assembly (140) further comprising:
a positioner actuator (228) coupled to the split insert assembly (140), the positioner actuator (228) for actuating the movement of the at least one split insert (142, 2142) in unison with the repositioning of the core assembly (114).
33. The mold (102) of claim 32, wherein the positioner actuator (228) is configured to actuate the at least one split insert (142, 2142) movement along an entirety of the path of travel between the molding configuration and the molded article ejection configuration.
34. The mold (102) of claim 31, wherein after the at least one split insert (142, 2142) has travelled the portion of the travel path between the molding configuration and the molded article ejection configuration, the protrusion (2002) and the undercut (2004) are configured to disengage.
35. The mold (102) of claim 34, wherein the split insert guiding interface (220) and the mold guiding interface (222) are interconnected by a complementary slope, the complementary slope configured to translate axial movement of the at least one split insert (142, 2142) into lateral movement of the at least one split insert (142, 2142) relative to a complimentary other split insert (142).
36. The mold (102) of claim 35, wherein the lateral movement of the at least one split insert (142, 2142) relative to a complimentary other split insert (142) causes the disengagement of the protrusion (2002) and the undercut (2004).
37. The mold of claim 32, wherein the positioner actuator (228) comprises a piston and a complementary air cylinder defined within a cavity plate (112).
38. The mold of claim 37, wherein the complementary air cylinder is charged with repositioning of the mold (102) into the molding configuration.
39. The mold (102) of claim 32, wherein the positioner actuator (228) comprises an air spring.

40. The mold (102) of claim 39, wherein the air spring comprises a plurality of air springs.
41. The mold (102) of any of the preceding claims 30 to 40, wherein the molded article (104) is a closure.
42. The mold (102) of claim 41, wherein the at least one split insert (142, 2142) comprises a molding surface for molding a portion of the closure.
43. The mold (102) of claim 42, wherein the portion of a closure is a portion of a bridge defined between a skirt of the closure and a tamper evident band of the closure.
44. A mold (102) for making a molded article (104), the mold (102) comprising:
- a cavity insert (110) defining a portion of a molding cavity for defining a portion of a molding cavity for defining an outer skin of the molded article (104);
 - a core assembly (114) cooperable, in use, with the cavity insert (110) to define, in use, another portion of the molding cavity for defining a portion of an inner skin of the molded article (104);
 - a split insert assembly (140) cooperable, in use, with the cavity insert (110) and the core assembly (114) to define, in use, another portion of the molding cavity for defining another portion of the outer skin of the molded article (104);
 - a molded article transfer assembly (119) having a molded article transfer plate (121) housing a molded article receptacle (120), the molded article receptacle (120) being selectively positionable: (i) around a portion of the core assembly (114) for receiving the molded article (104) from the core assembly (114) with a repositioning of the core assembly (114) along the molded article transfer assembly (119) and through the molded article receptacle (120) and (ii) away from the portion of the core assembly (114) for removal of the molded article (104) from within the mold (102);
 - a covering plate (180) positioned, in use, between the cavity insert (110) and the split insert assembly (140) for selective blockage of the molded article receptacle (120) from the molding cavity.

45. The mold (102) of claim 44, further comprising a covering plate actuator (182) configured to selectively position for selective blockage of the molded article receptacle (120).
46. The mold (102) of claim 45, the covering plate actuator (182) comprising a servo motor.
47. The mold (102) of claim 44, wherein the covering plate (180) comprises a plurality of spaced apertures (181), the plurality of spaced apertures (181) intermeshed with a respective given land (181) of the covering plate (180).
48. The mold (102) of claim 47, wherein in a selective unblocked position, a given aperture (181) of the covering plate (180) is positioned in-line with the molding cavity and around a portion of the core assembly (114).
49. The mold (102) of claim 47, wherein in a selective blocked position, the respective given land (183) is positioned at least partially in-line with the molding cavity.
50. The mold (102) of claim 49, wherein in the selective blocked position, the respective given land (183) is configured to prevent the molded article (104) from re-entering the molding cavity.

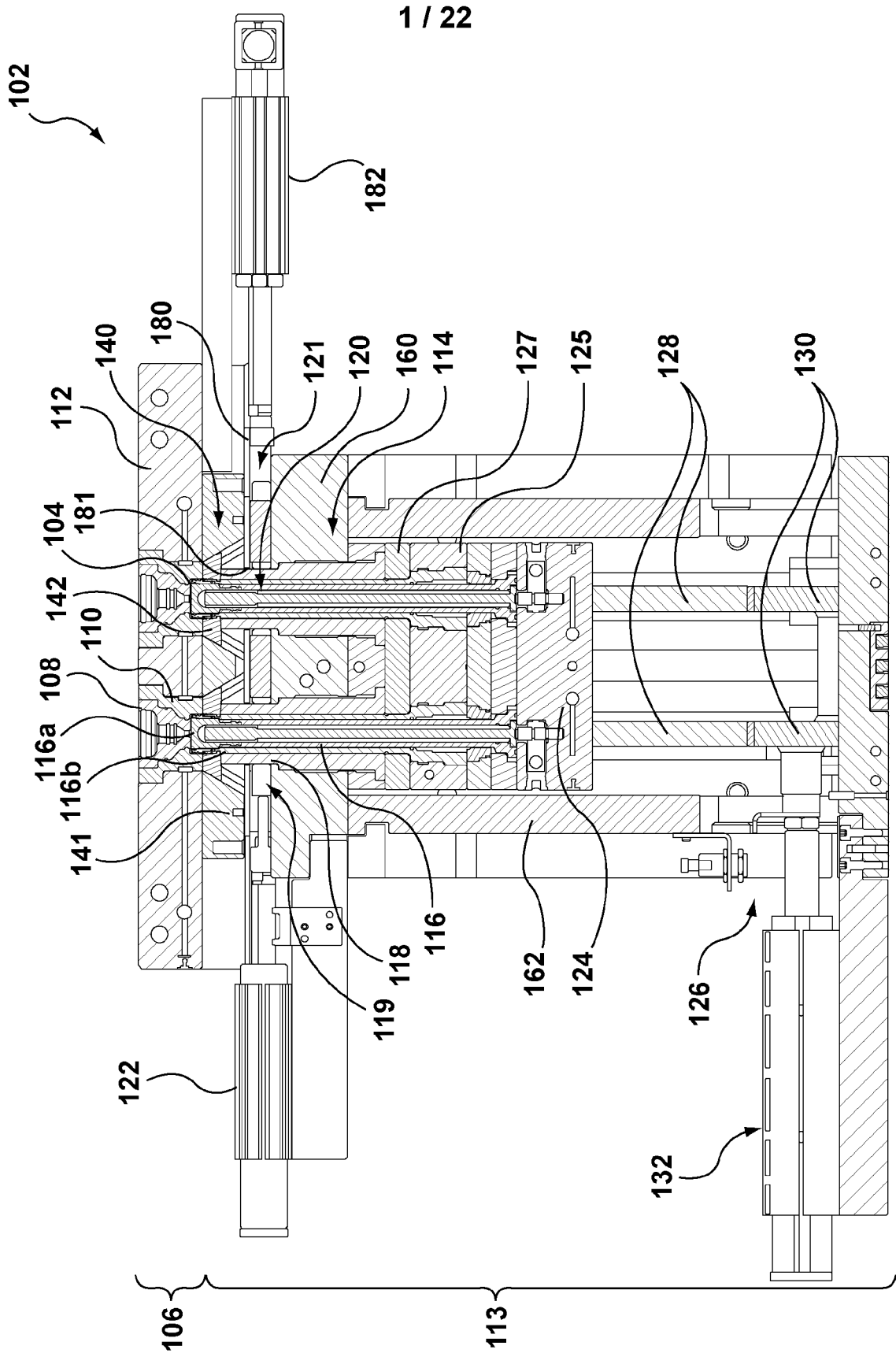
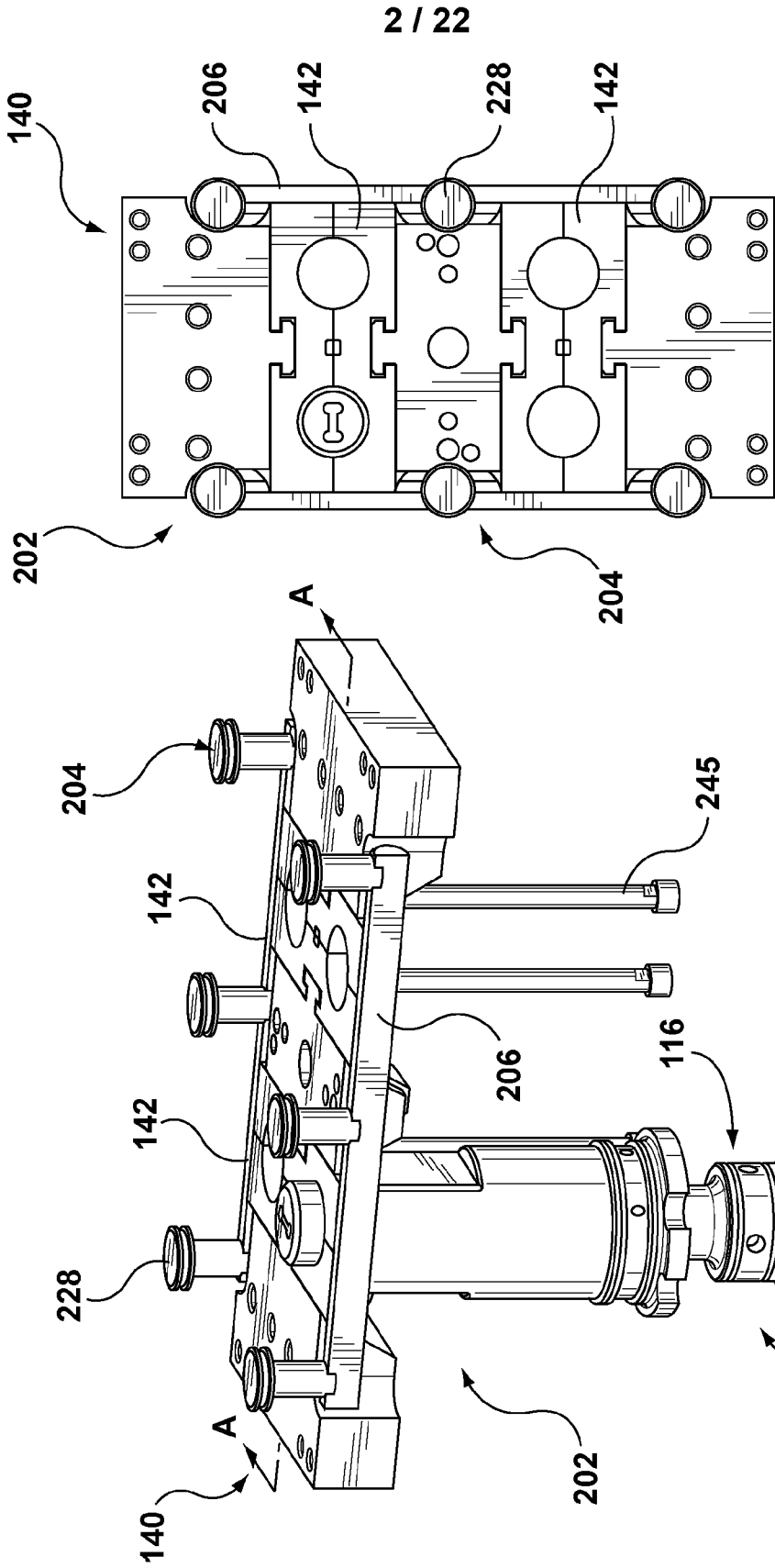


FIG. 1



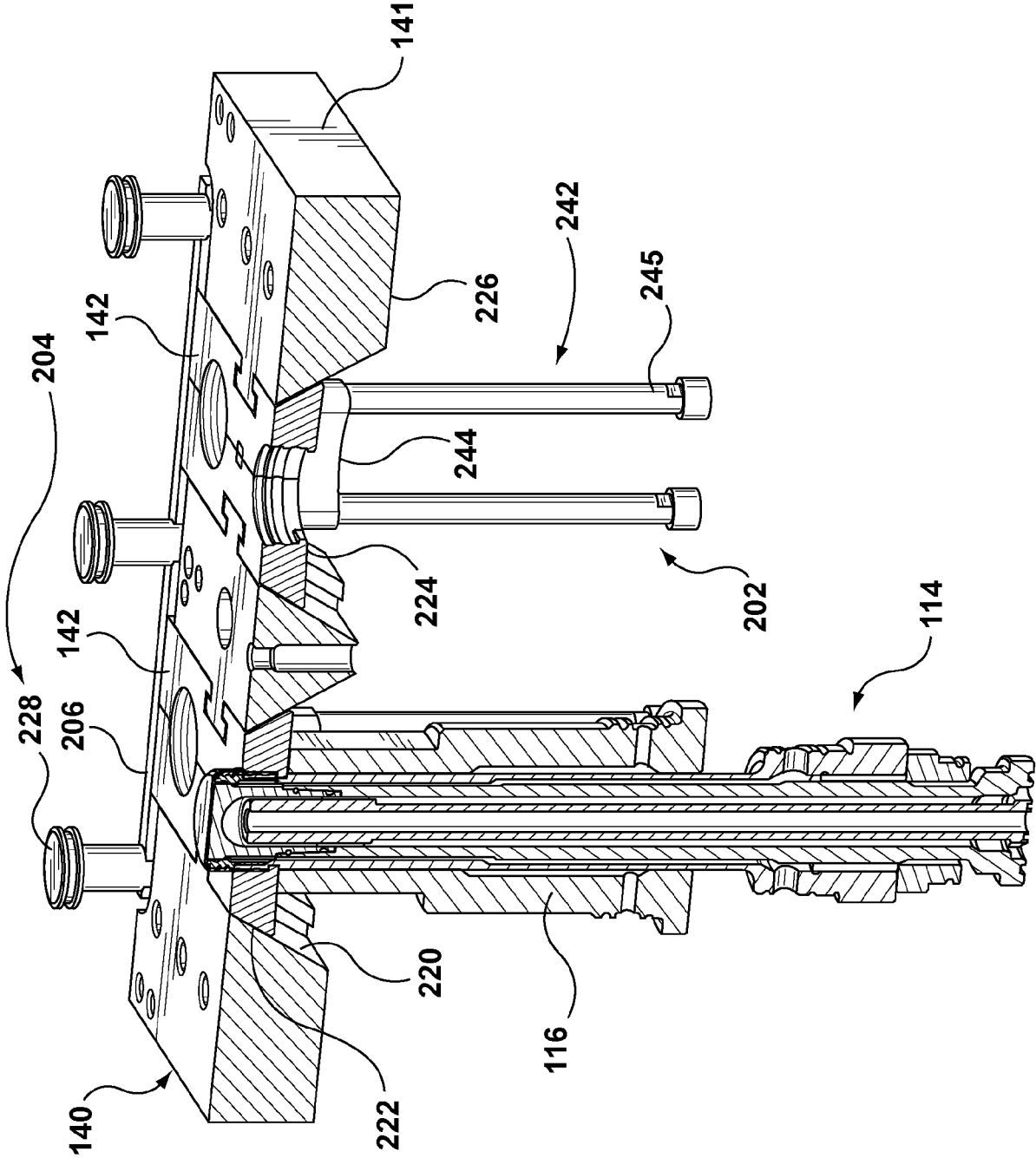


FIG. 4

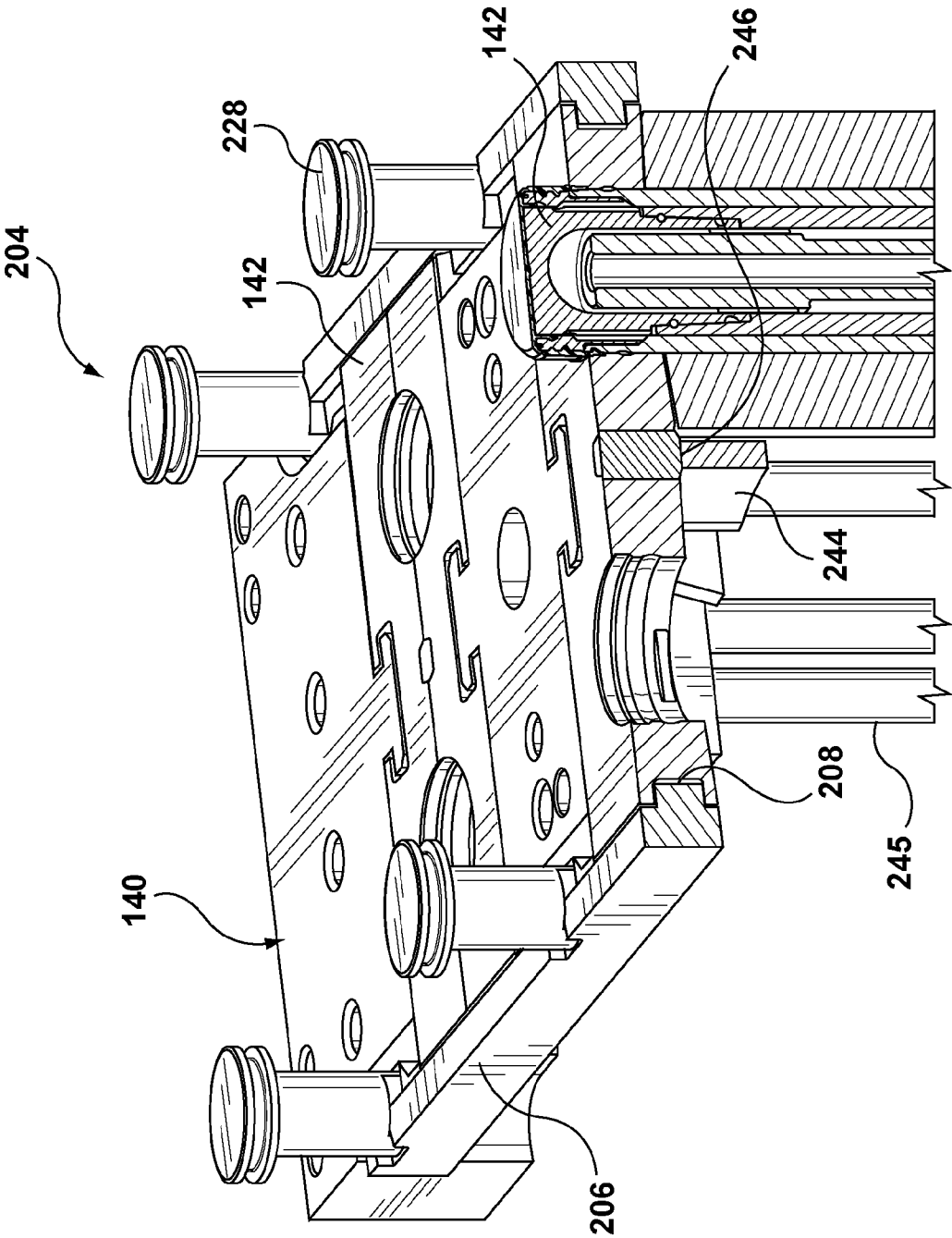


FIG. 5

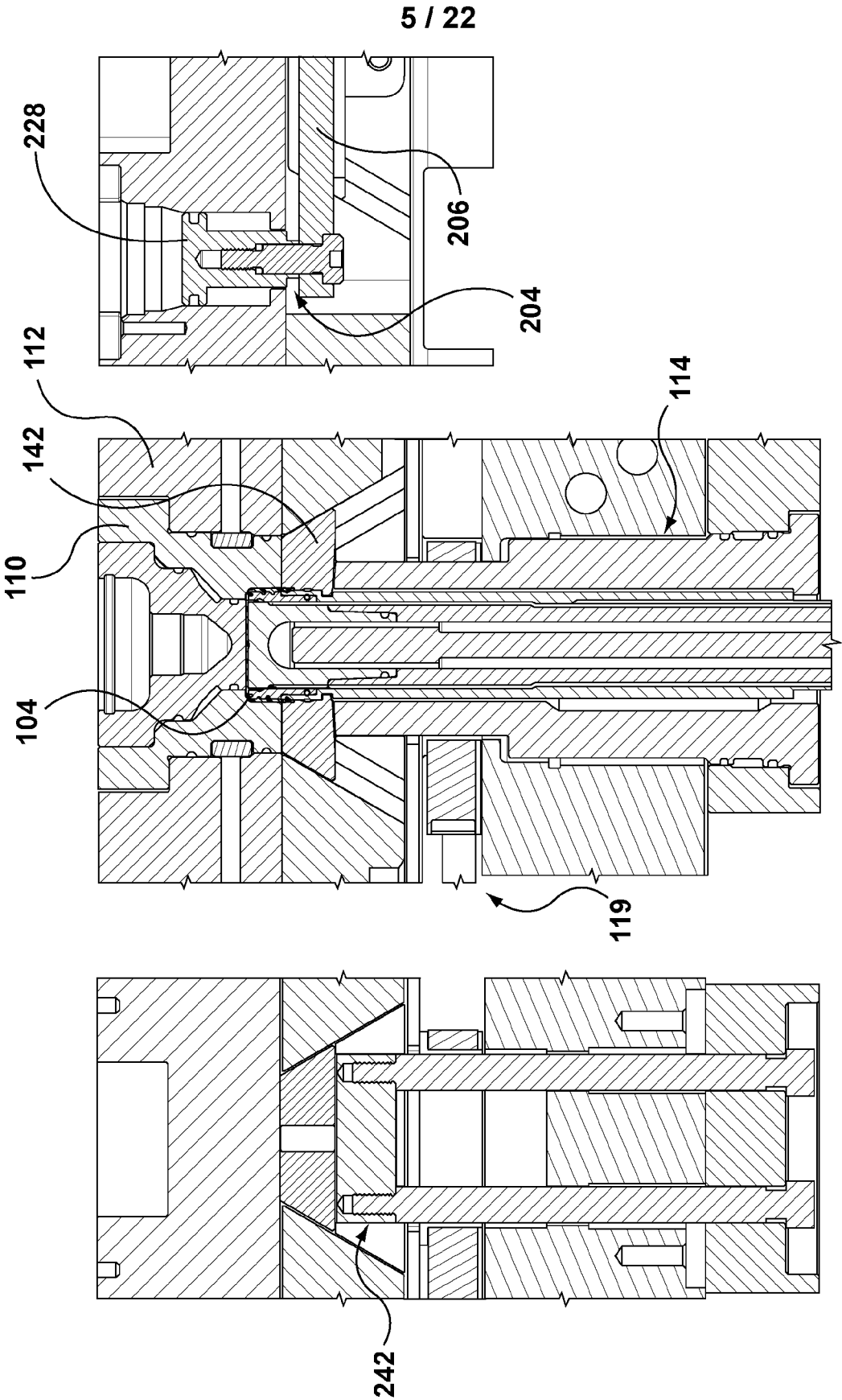


FIG. 6

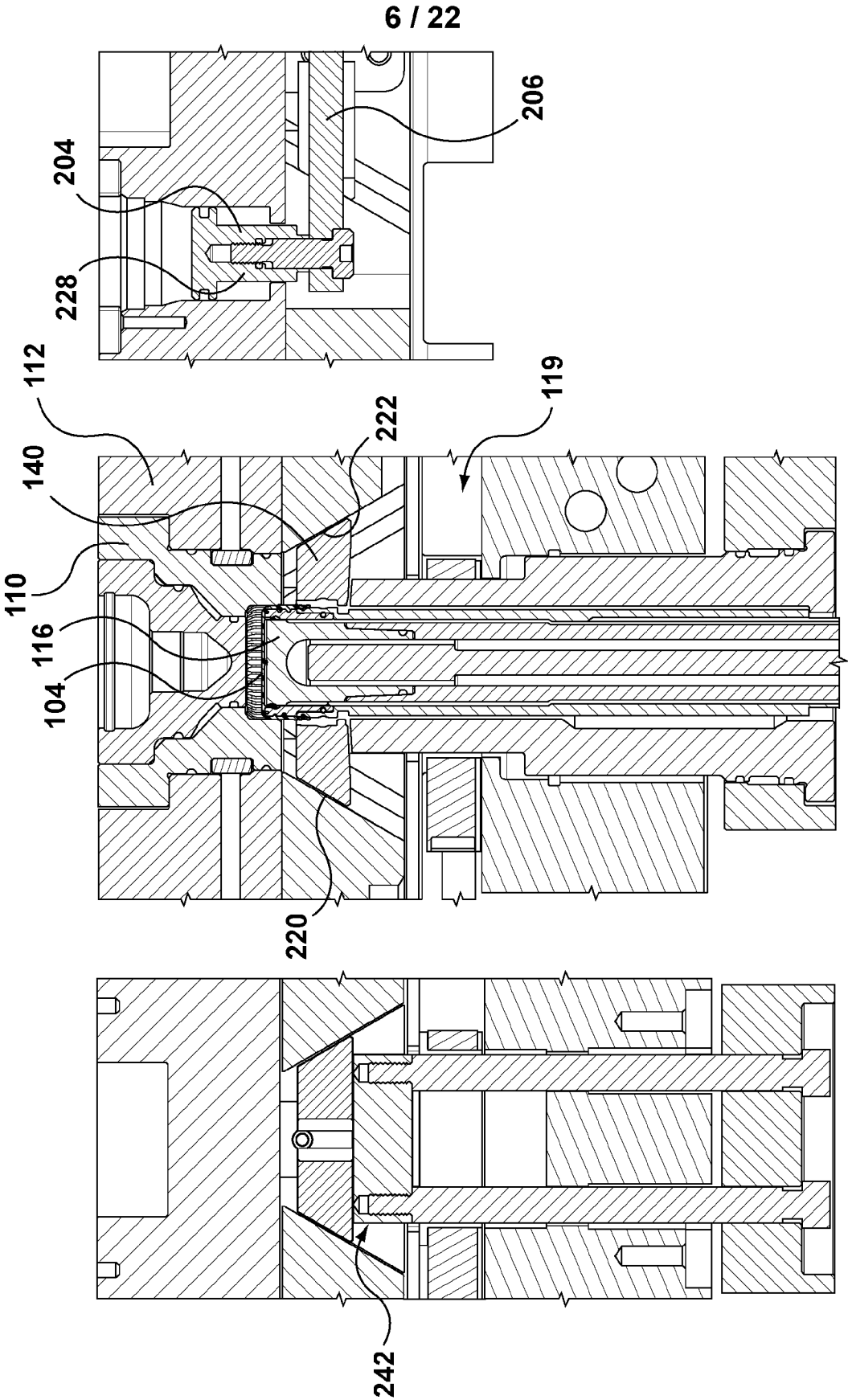


FIG. 7

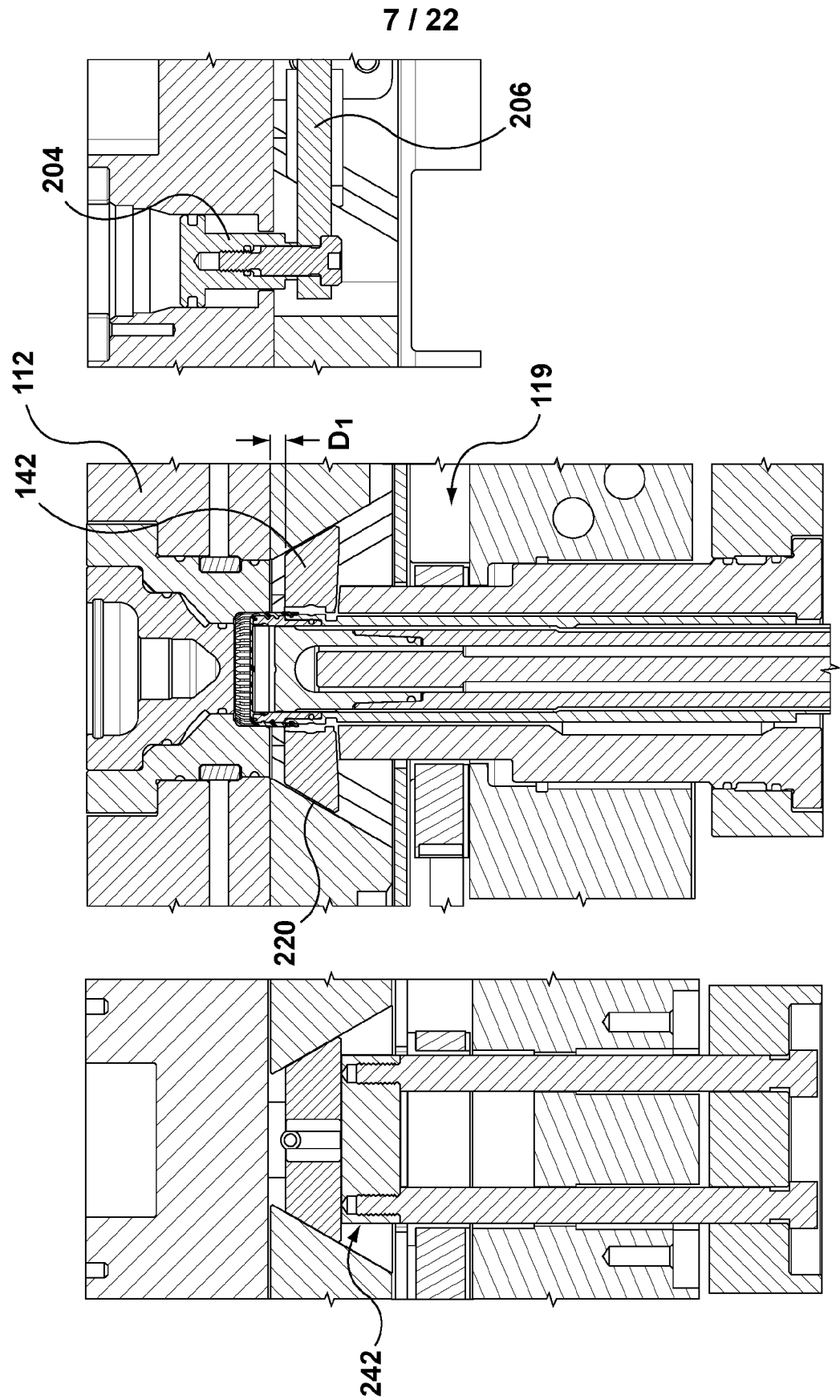


FIG. 8

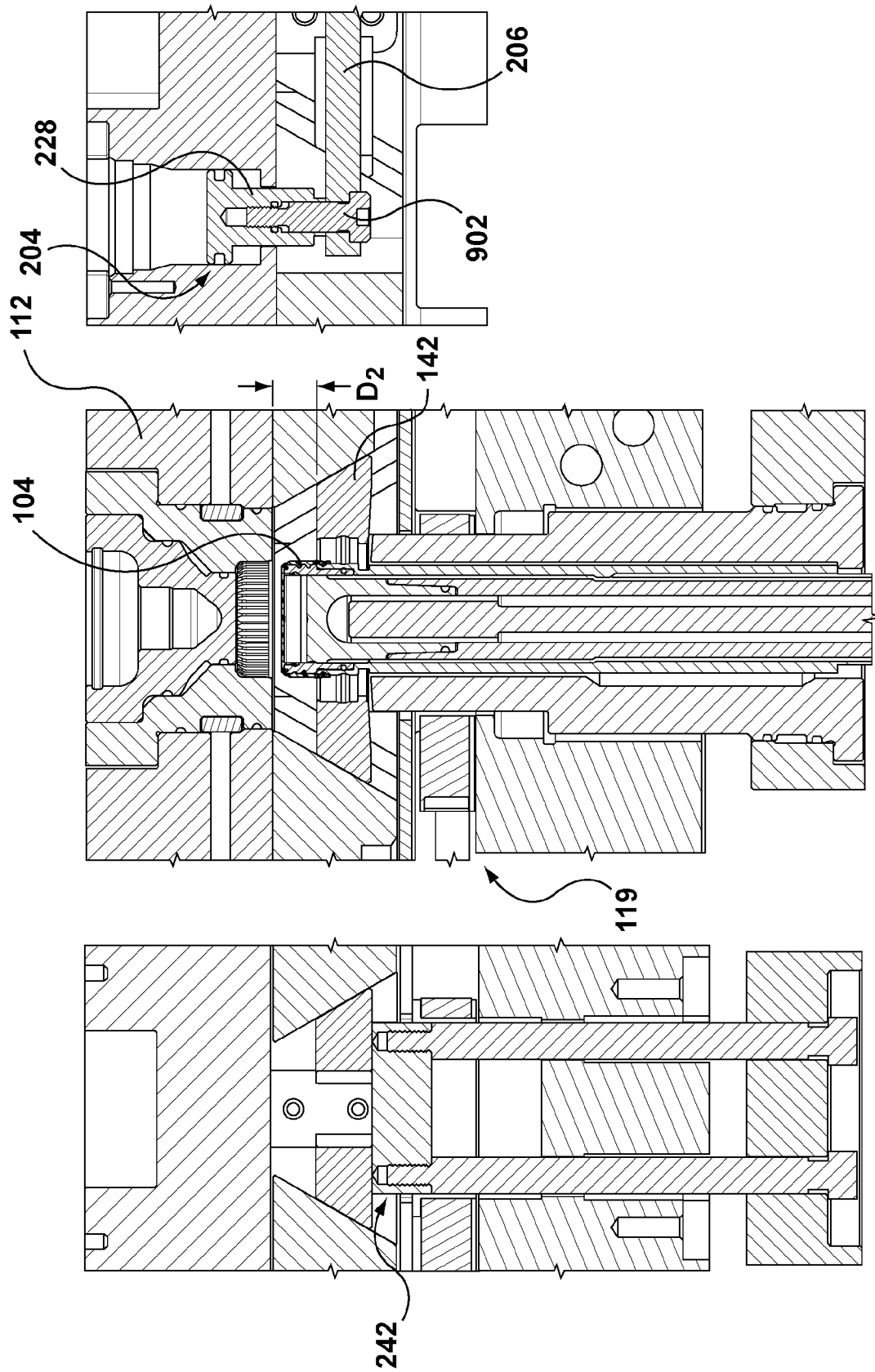


FIG. 9

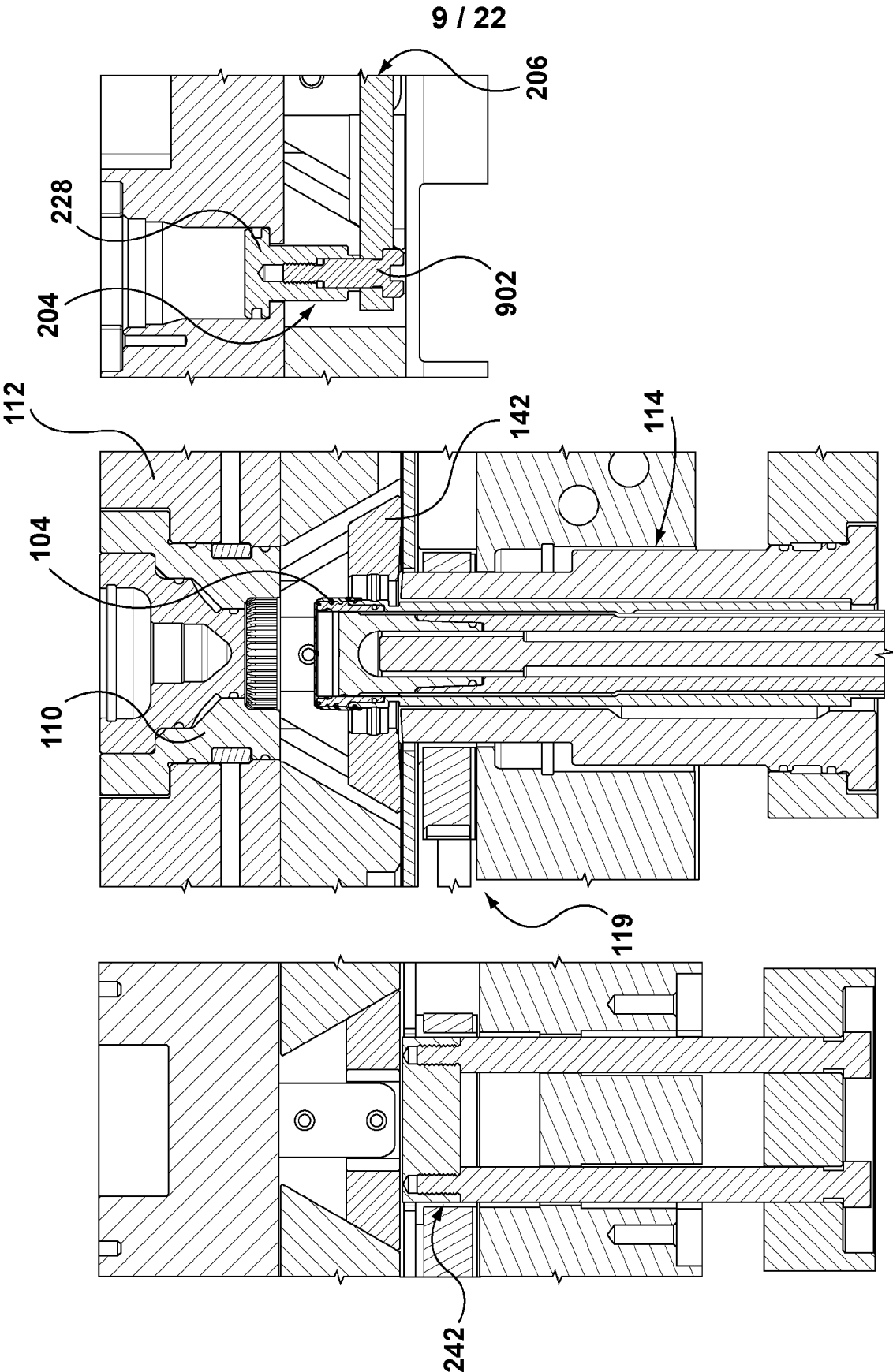
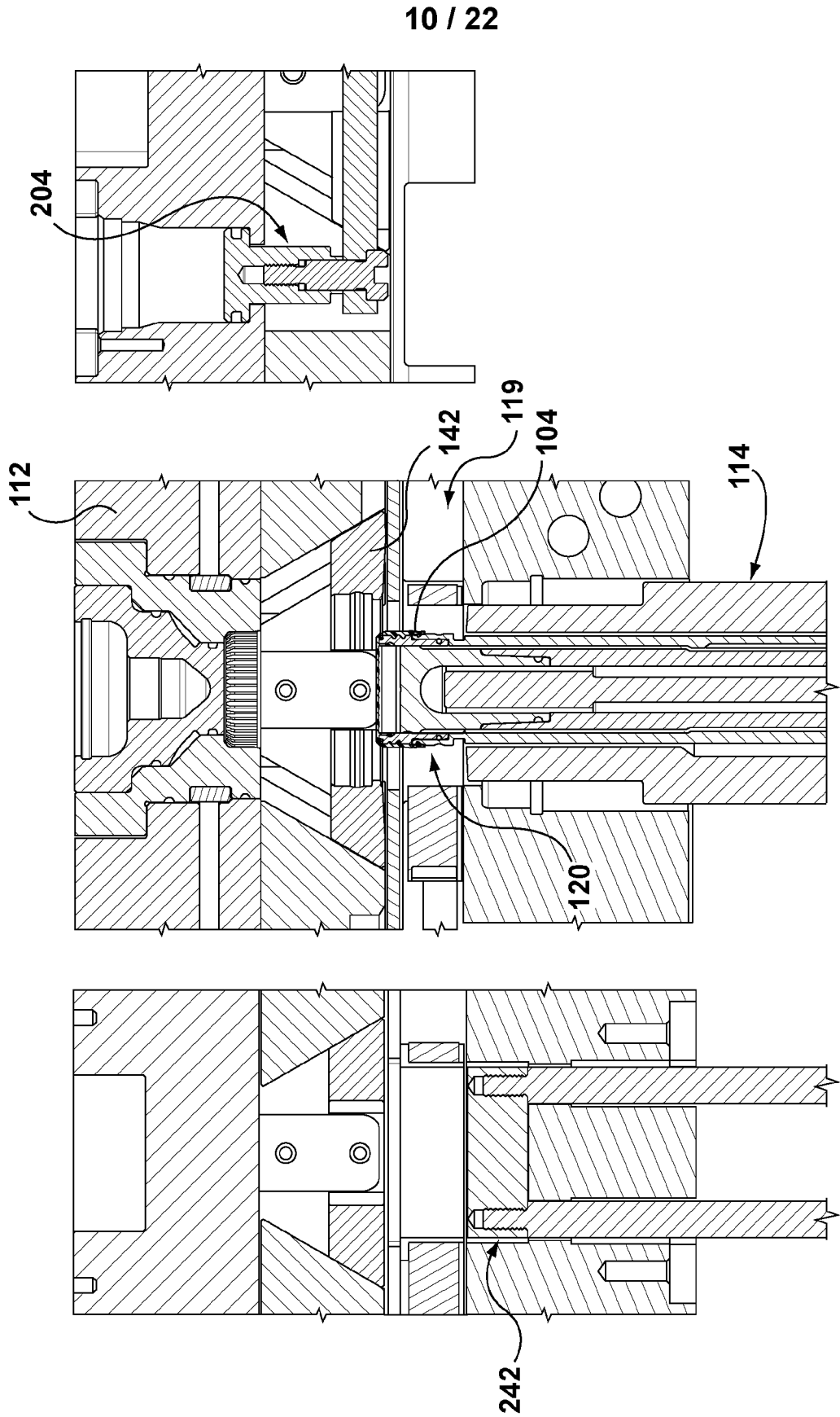


FIG. 10



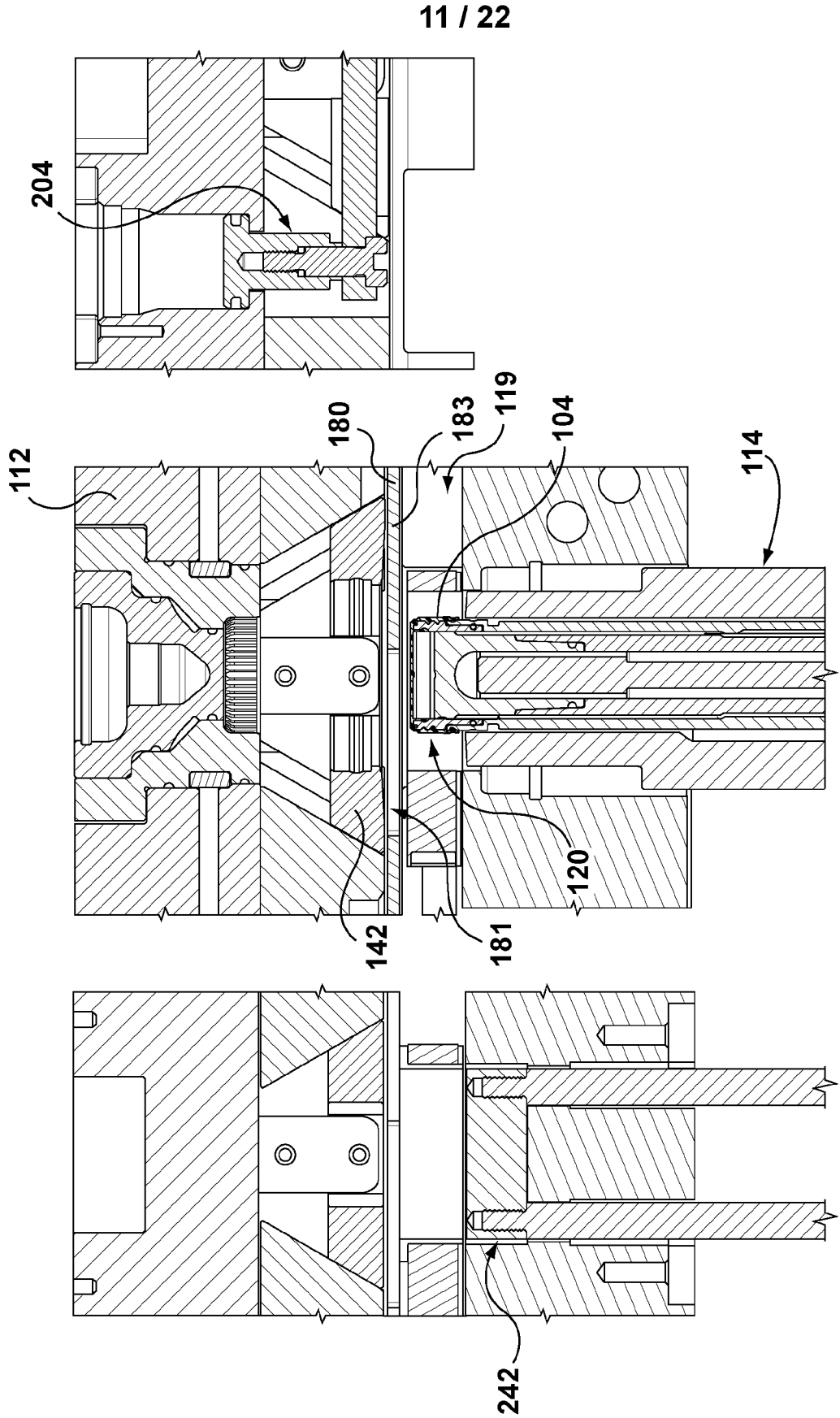


FIG. 12

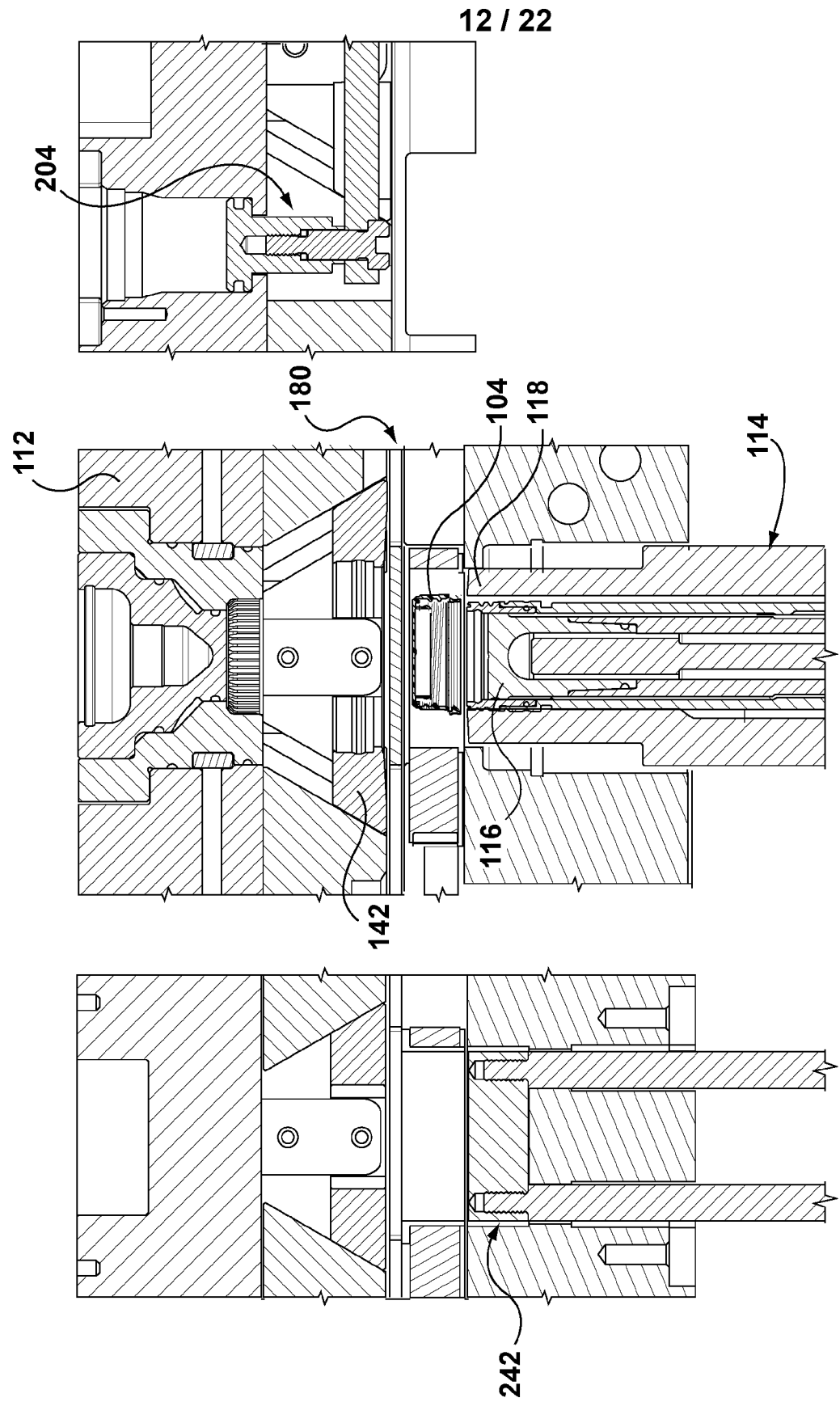


FIG. 13

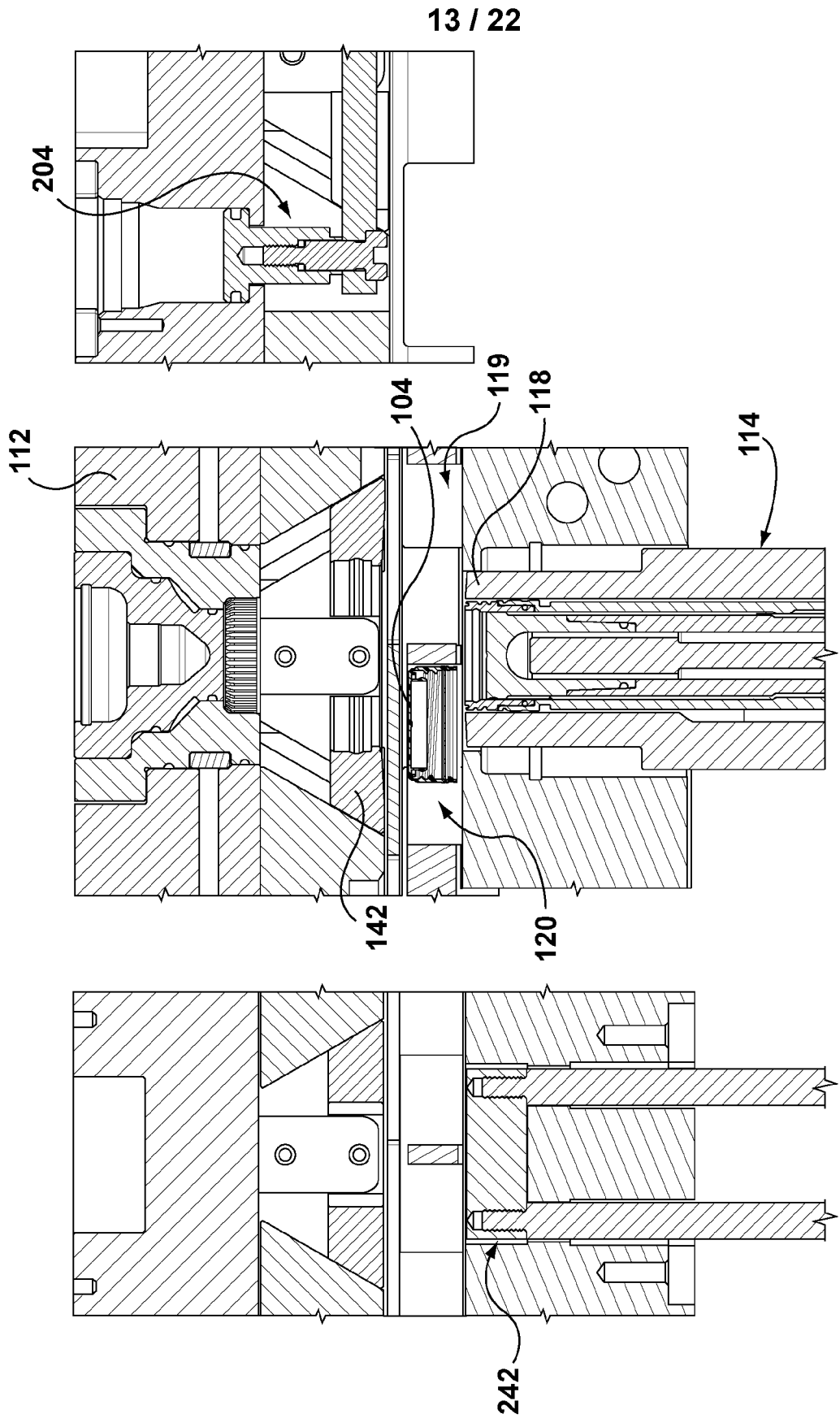
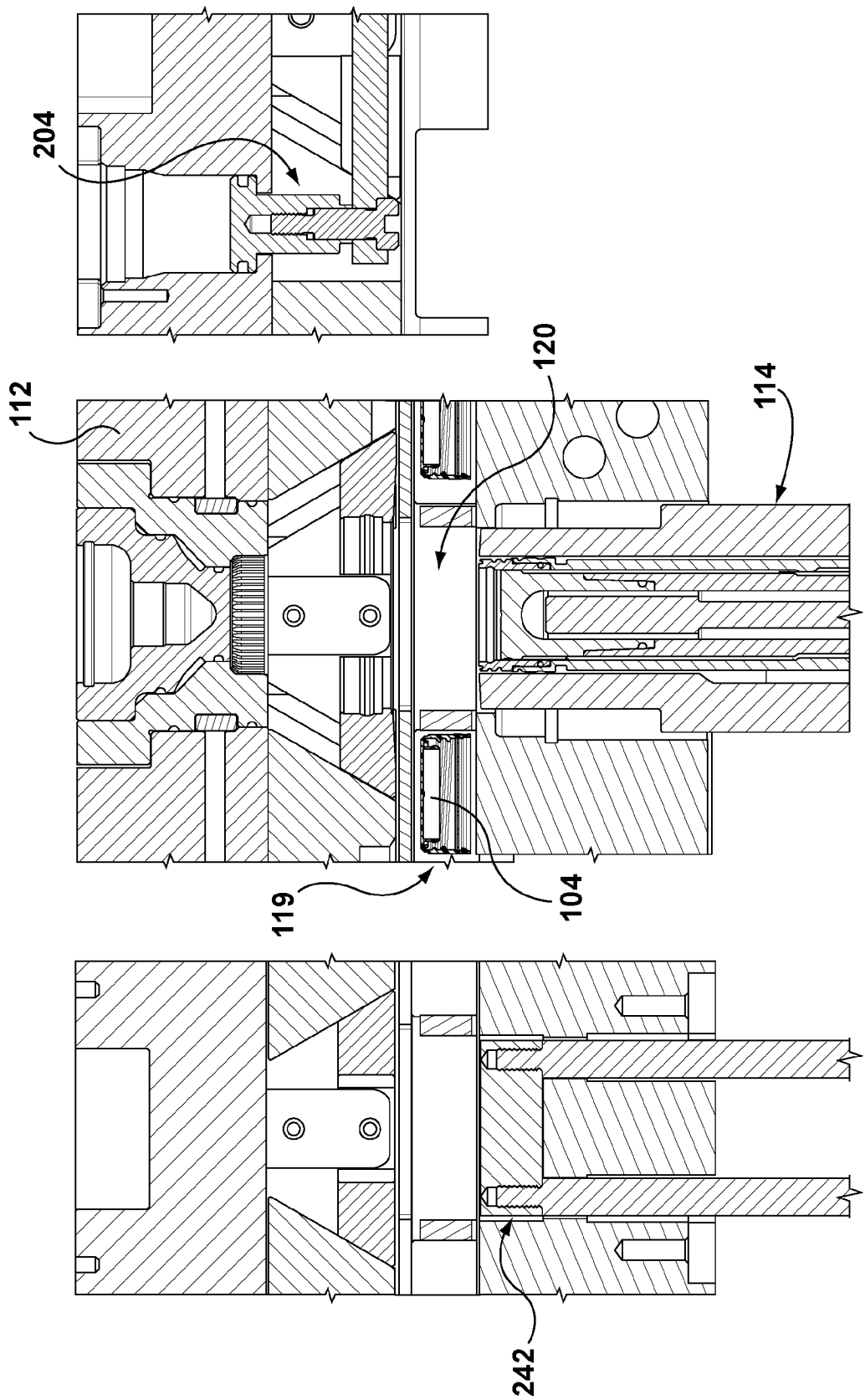


FIG. 14



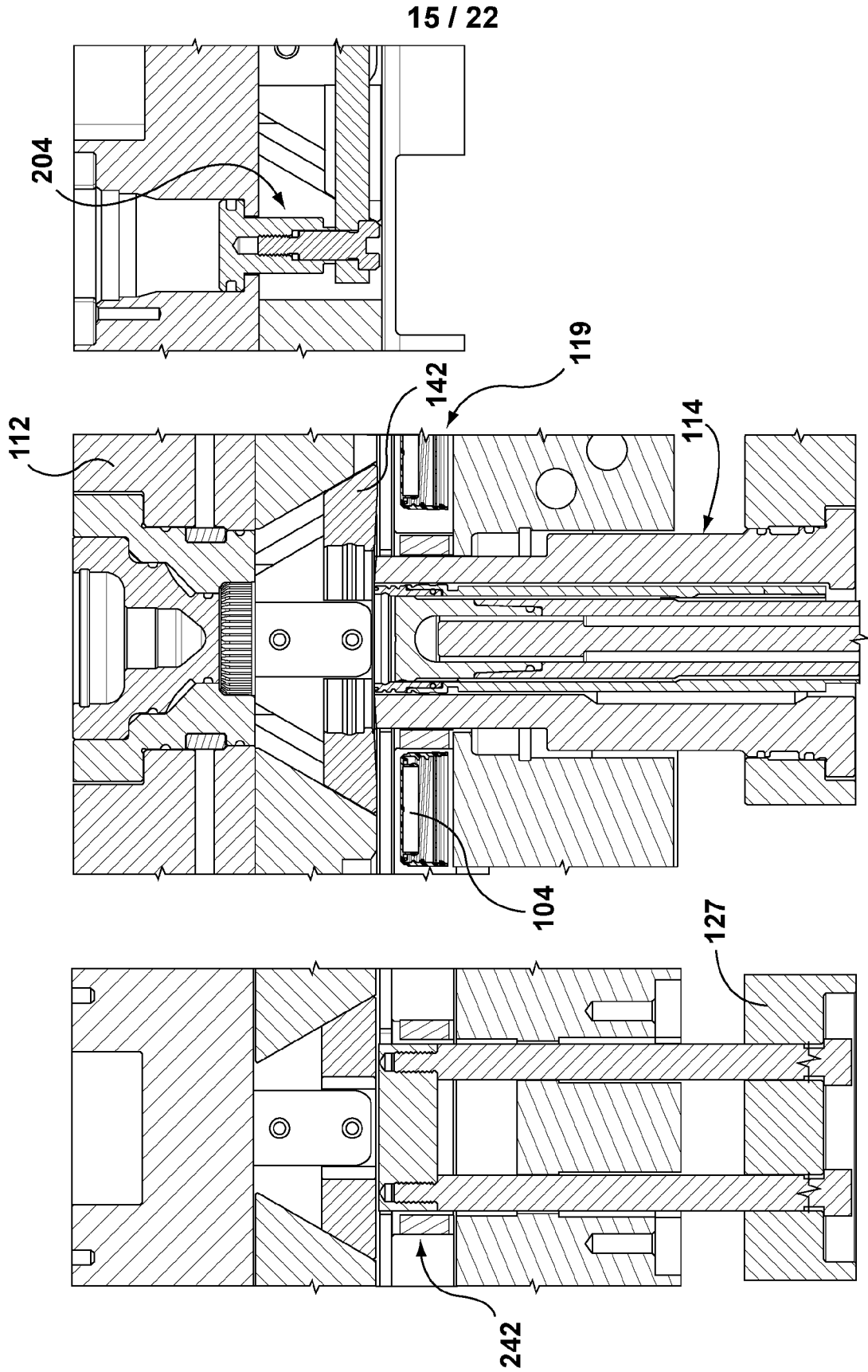


FIG. 16

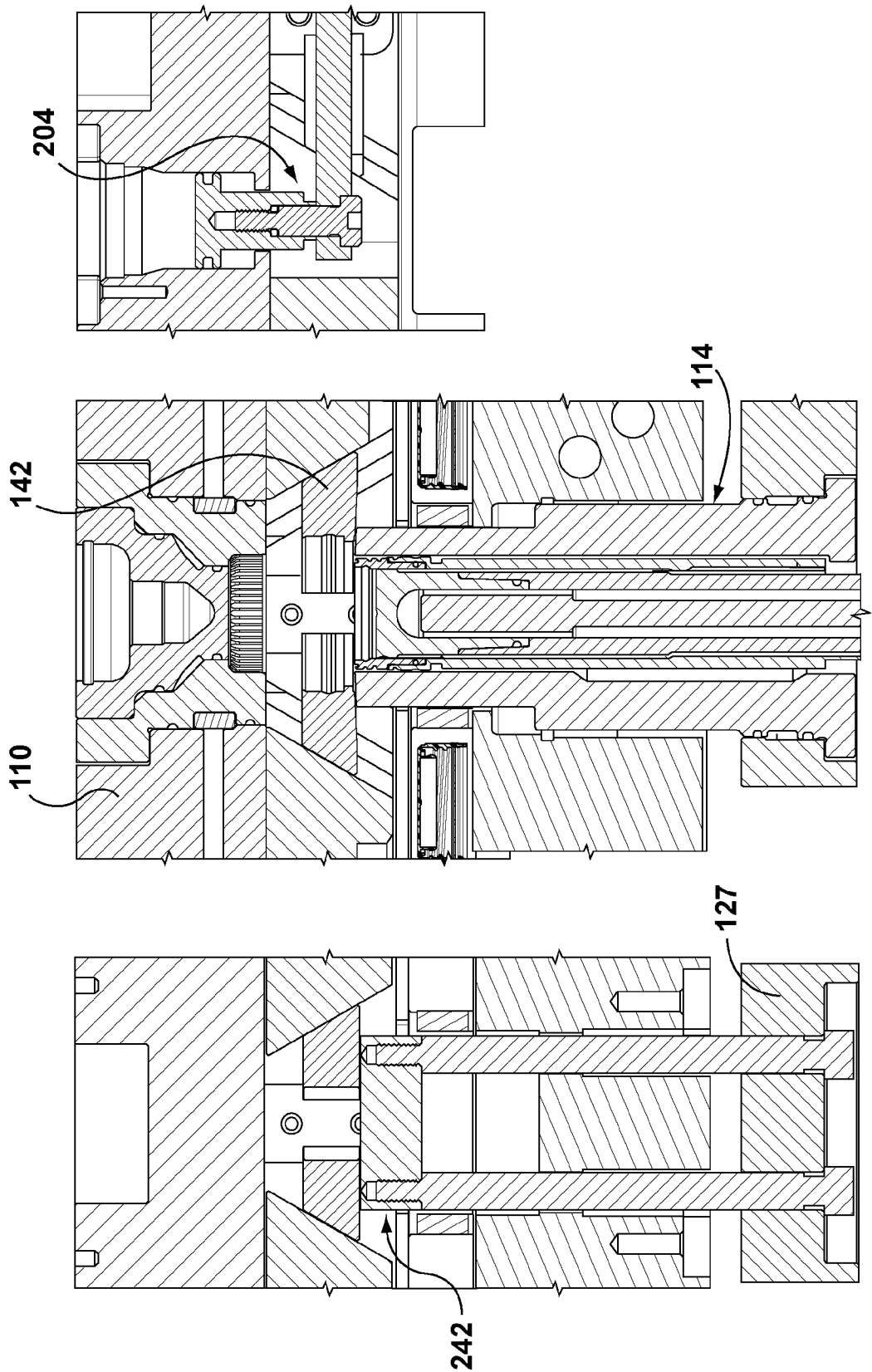


FIG. 17

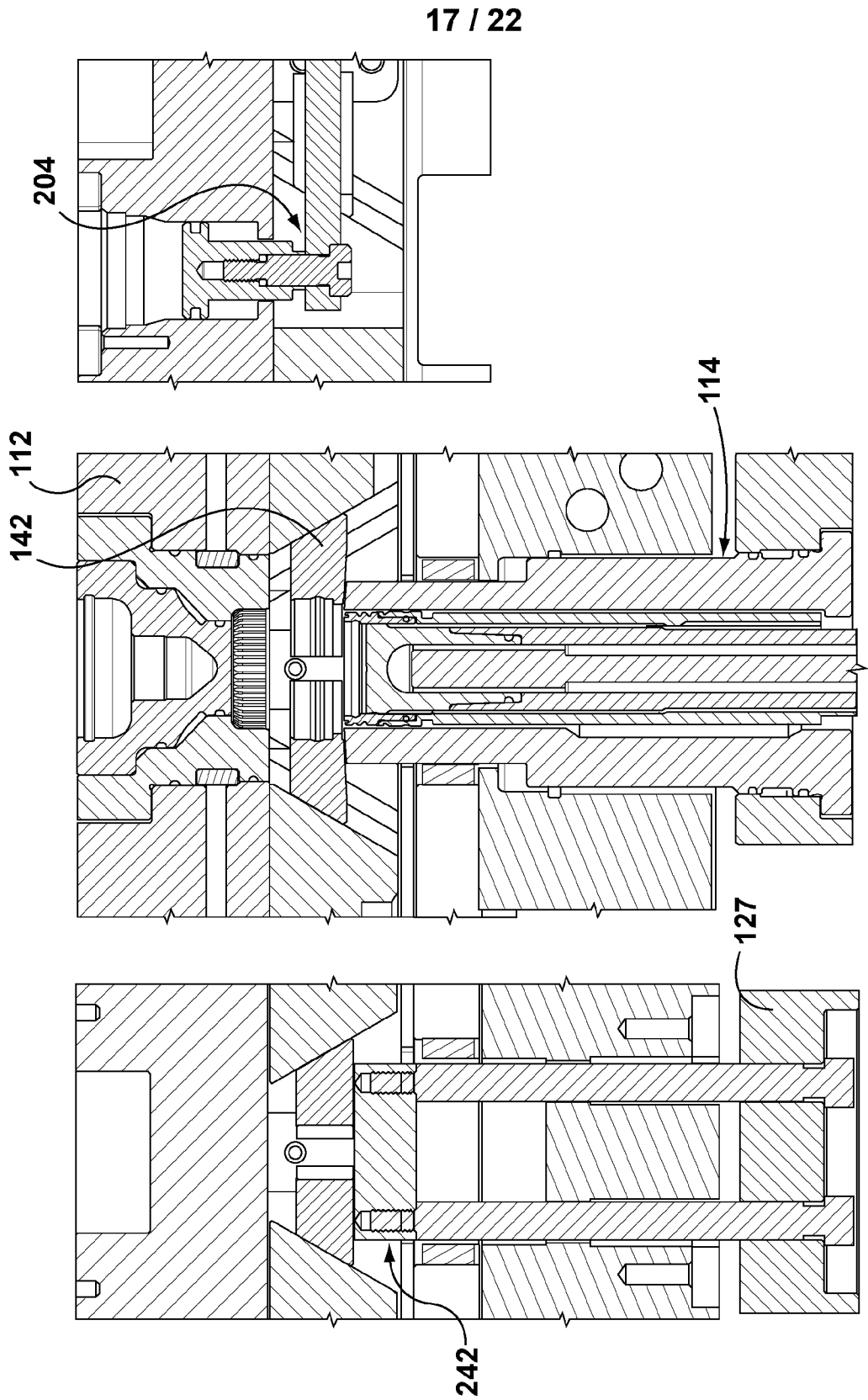


FIG. 18

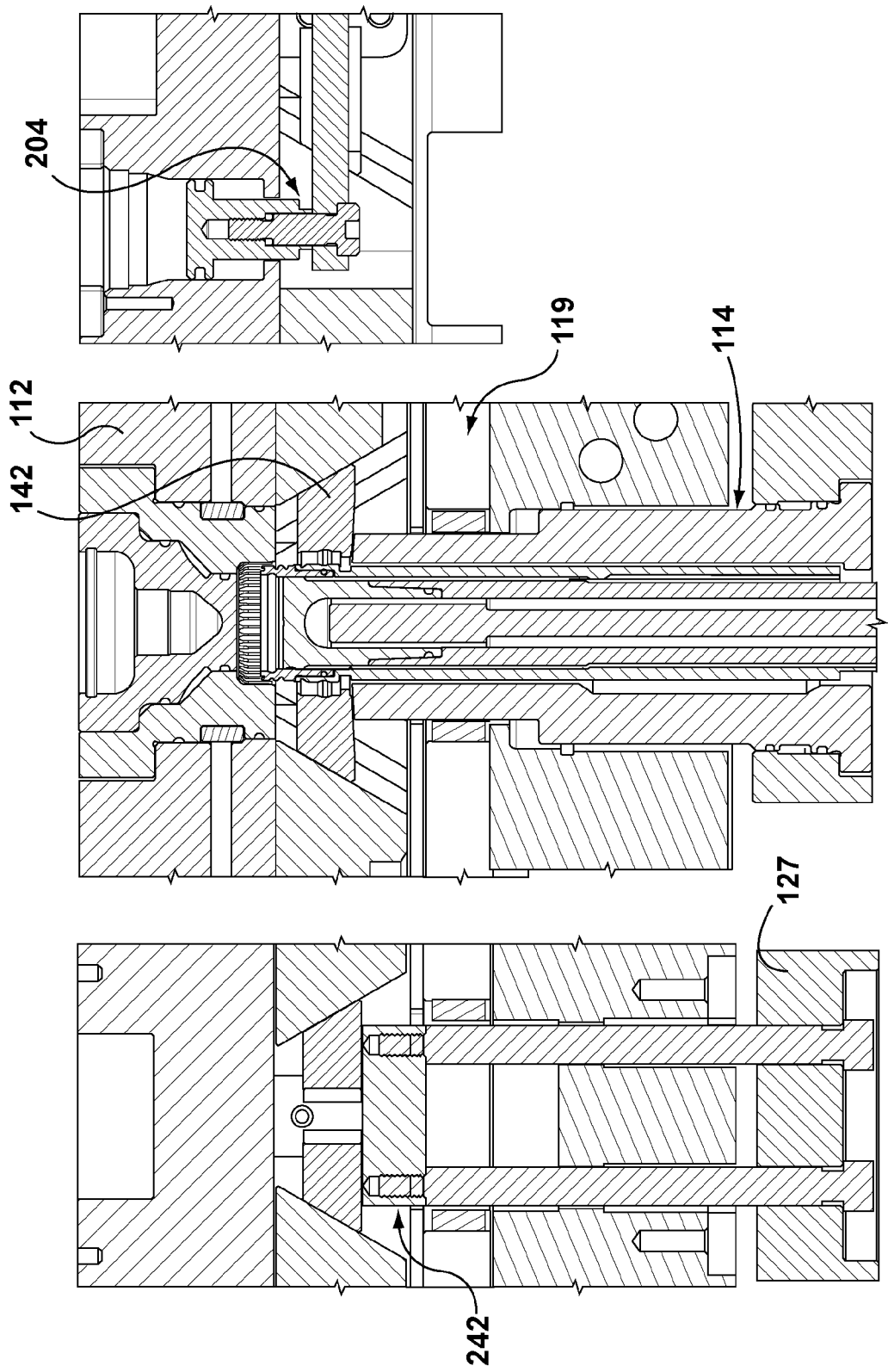


FIG. 19

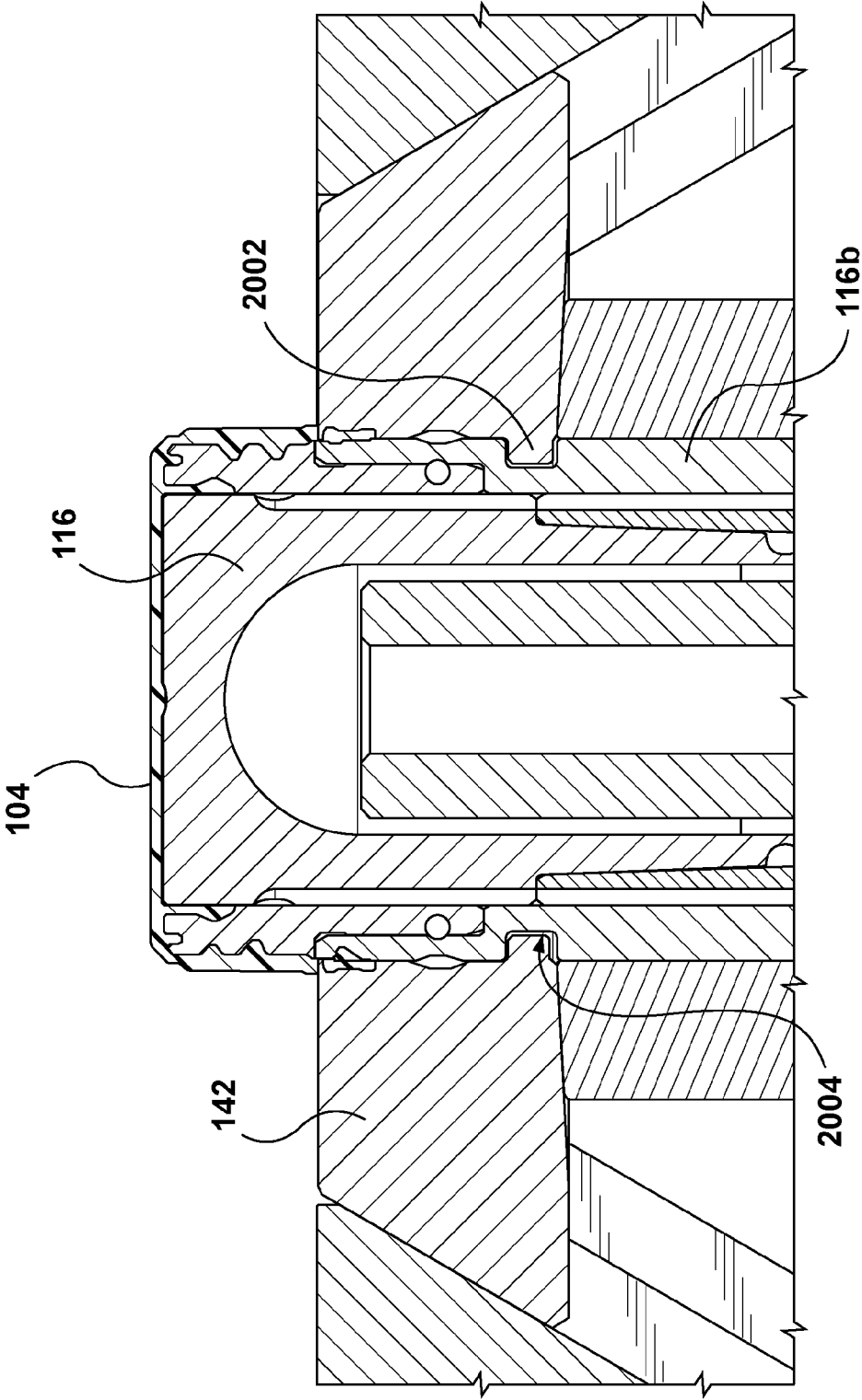


FIG. 20

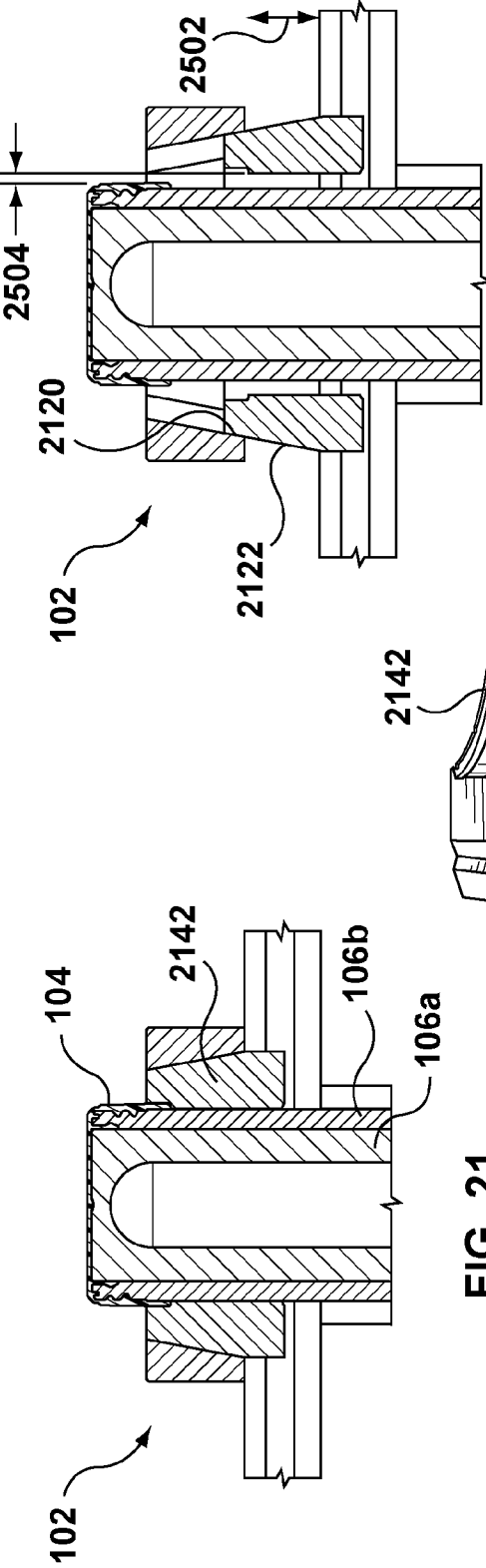


FIG. 25

FIG. 21

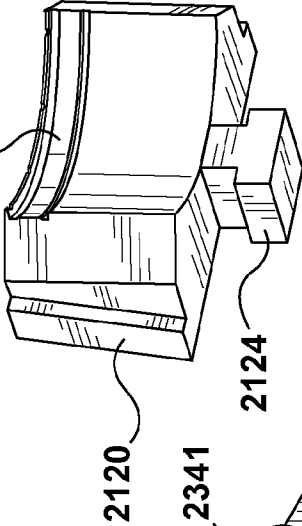


FIG. 22

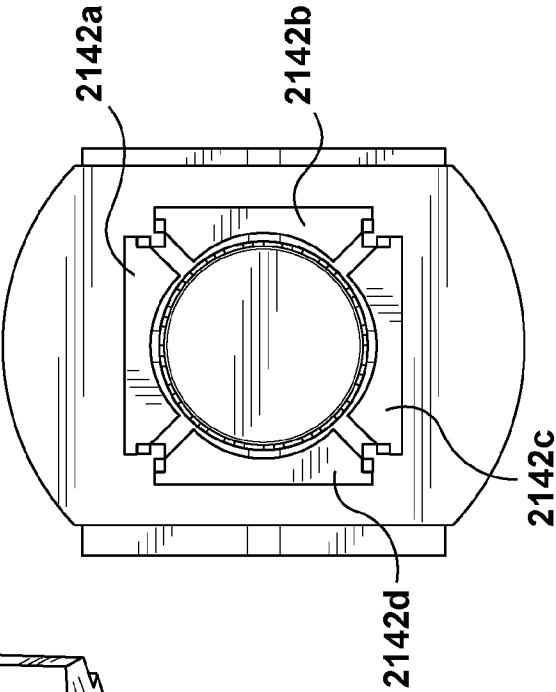


FIG. 24

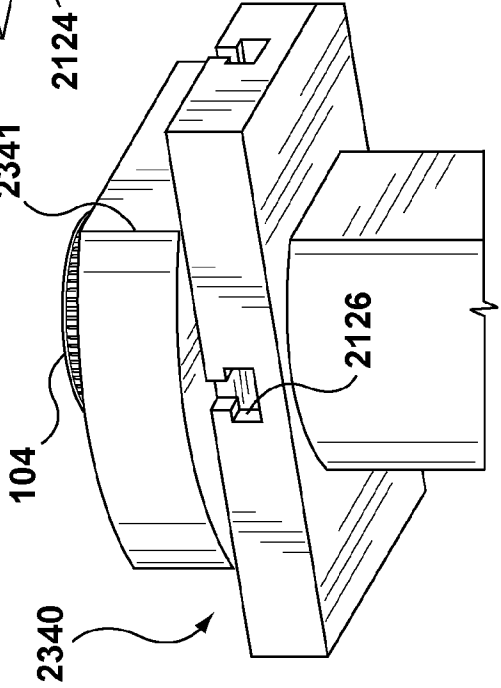


FIG. 23

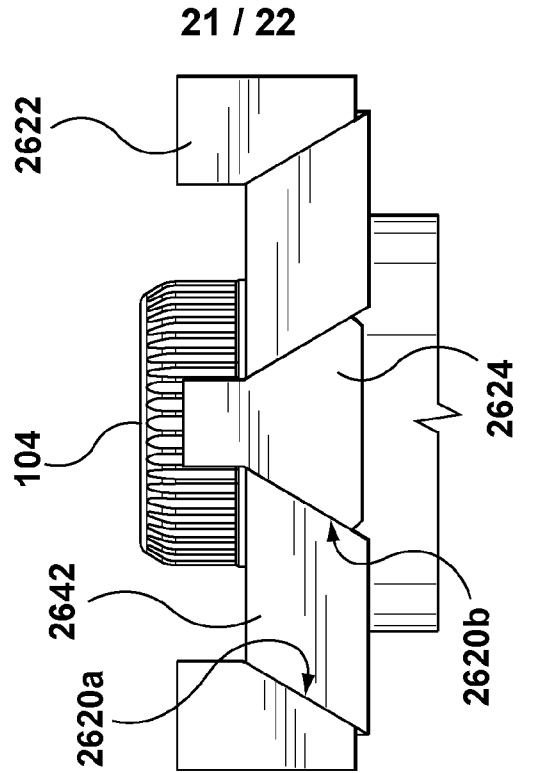


FIG. 27

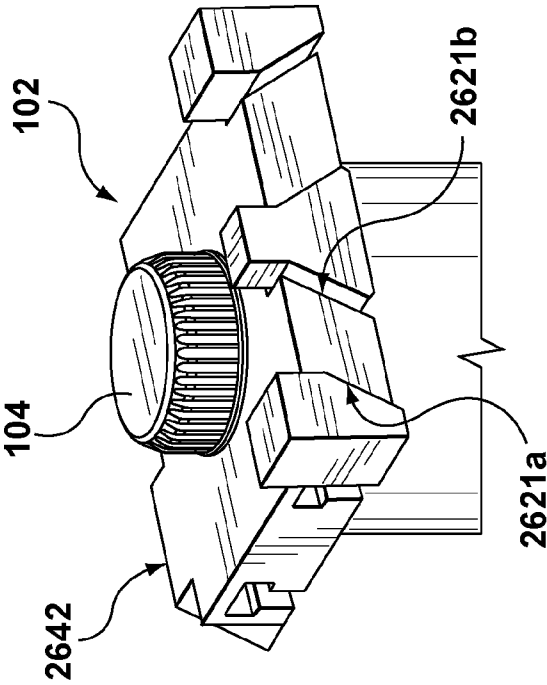


FIG. 26

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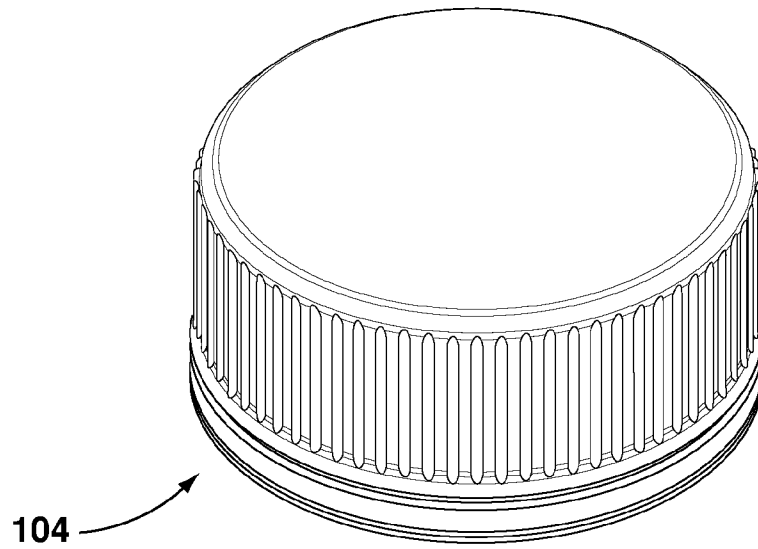


FIG. 28

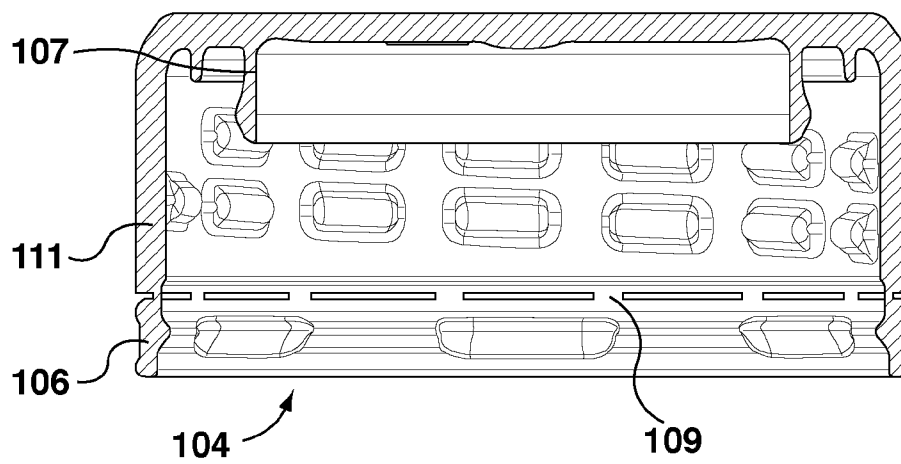


FIG. 29

INTERNATIONAL SEARCH REPORT

International application No.

PCT/CA2015/051125

A. CLASSIFICATION OF SUBJECT MATTER
 IPC: **B29C 45/17** (2006.01), **B29C 45/76** (2006.01)

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
 IPC: **B29C 45/*** (2006.01)

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 (Fampat) with key words, such as: mold, mould, cavity, core, cam, slide, link, linkage, member, lid, cap, closure, undercut, thread*, split insert, collaps* core, article, part, product, transfer* and remov*.

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X, P	CN 104708773 A (MIAO, J. et al.) 17 June 2015 (17-06-2015) *figs. 1-5; pages 3/4-4/4*	1-24 and 31-43
X	CN 102601930 A (SHEN, D. L.) 25 July 2012 (25-07-2012) *whole document*	1-24 and 31-43
A	CN 202156009 U (GONG, W. P. et al.) 7 March 2012 (07-03-2012) *whole document*	1-50

☐ Further documents are listed in the continuation of Box C.	☒ See patent family annex.
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* Special categories of cited documents: "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier application or patent but published on or after the international filing date "L" 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) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" 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 "Y" 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 "&" document member of the same patent family
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Date of the actual completion of the international search 19 January 2016 (19-01-2016)	Date of mailing of the international search report 19 January 2016 (19-01-2016)
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Name and mailing address of the ISA/CA Canadian Intellectual Property Office Place du Portage I, C114 - 1st Floor, Box PCT 50 Victoria Street Gatineau, Quebec K1A 0C9 Facsimile No.: 001-819-953-2476	Authorized officer Pengfei Zhang (819) 639-7928
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Information on patent family members

PCT/CA2015/051125

Patent Document Cited in Search Report	Publication Date	Patent Family Member(s)	Publication Date
CN 104708773 A	17 June 2015 (17-06-2015)	NONE	
CN 102601930 A	25 July 2012 (25-07-2012)	NONE	
CN 202156009 U	7 March 2012 (07-03-2012)	NONE	