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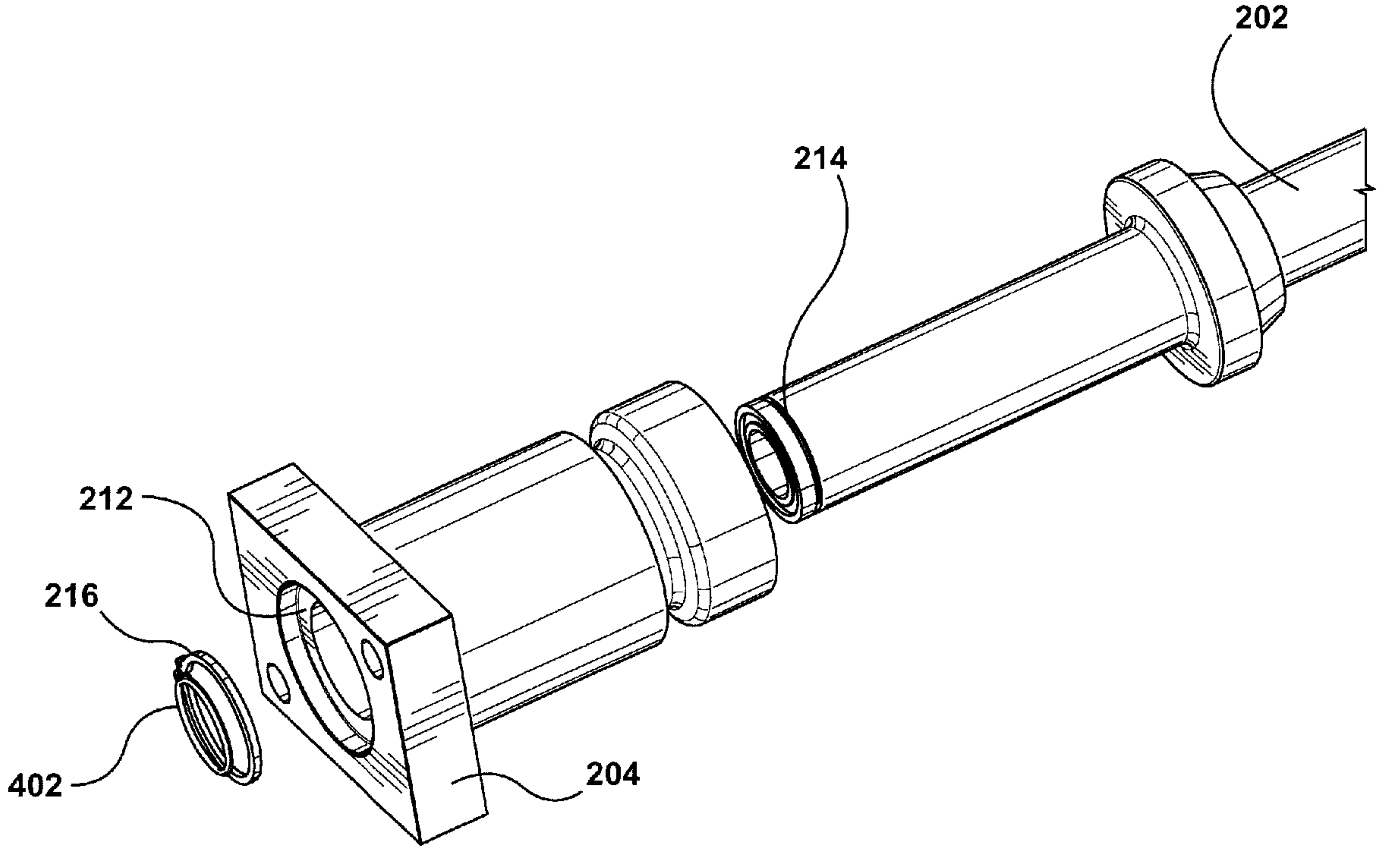


(57) Abrégé/Abstract:
Disclosed are a compensating core for use with a molding system and the molding system incorporating same. A core insert (105, 105a, 105b) for use in a molding system is provided. The core insert (105, 105a, 105b) comprises a core base (202, 202a) for defining, in use, a portion of a molding cavity (120); a core support (204, 204a) for supporting, in use, the core base (202, 202a) relative to a core plate of the molding system; a compensator (206, 206a) associated, at least partially, with the core support (204, 204a) to permit at least a degree of axial movement to the core base (202, 202a).

ABSTRACT OF THE DISCLOSURE

Disclosed are a compensating core for use with a molding system and the molding system incorporating same. A core insert (105, 105a, 105b) for use in a molding system is provided. The core insert (105, 105a, 105b) comprises a core base (202, 202a) for defining, in use, a portion of a molding cavity (120); a core support (204, 204a) for supporting, in use, the core base (202, 202a) relative to a core plate of the molding system; a compensator (206, 206a) associated, at least partially, with the core support (204, 204a) to permit at least a degree of axial movement to the core base (202, 202a).

A COMPENSATING CORE FOR USE WITH A MOLDING SYSTEM AND THE MOLDING SYSTEM INCORPORATING SAME

TECHNICAL FIELD

The present invention generally relates to, but is not limited to, molding systems, and more specifically the present invention relates to, but is not limited to, a compensating core for use with a molding system and the molding system incorporating same.

BACKGROUND OF THE INVENTION

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.

A typical molding system includes an injection unit, a clamp assembly and a mold assembly. The injection unit can be of a reciprocating screw type or of a two-stage type. The clamp assembly includes *inter alia* a frame, a movable platen, a fixed platen and an actuator for moving the movable platen and to apply tonnage to the mold assembly arranged between the platens. The mold assembly includes *inter alia* a cold half and a hot half. The hot half is usually associated with one or more cavities (and, hence, also sometimes referred to by those of skill in the art as a "cavity half"), while the cold half is usually associated with one or more cores (and, hence, also sometimes referred to by those of skill in the art as a "core half"). The one or more cavities together with one or more cores define, in use, one or more molding cavities. The hot half can also be associated with a melt distribution system (also referred to sometimes by those of skill in the art as a "hot runner") for melt distribution. The mold assembly can be associated with a number of additional components, such as neck rings, neck ring slides, ejector structures, wear pads, etc.

As an illustration, injection molding of PET material involves heating the PET material (ex. PET pellets, PEN powder, PLA, etc.) to a homogeneous molten state and injecting, under pressure, the so-melted PET material into the one or more molding cavities defined, at least in part, by the aforementioned one or more cavities and one or more cores mounted respectively on a cavity plate and a core plate of the mold assembly. The cavity plate and the core plate are urged together and are held together by clamp force, the clamp force being sufficient 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 urged apart, the molded article tends to remain associated with the core. Accordingly, by urging the core plate away from the cavity plate, the molded article can be demolded, i.e. ejected from 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.

SUMMARY OF THE INVENTION

According to a first broad aspect of the present invention, there is provided a core insert for use in a molding system. The core insert comprises a core base for defining, in use, a portion of a molding cavity; a core support for supporting, in use, the core base relative to a core plate of the molding system; a compensator associated, at least partially, with the core support to permit at least a degree of axial movement to the core base.

According to a second broad aspect of the present invention, there is provided a sliding interface defined, in use, between: a core base for defining, in use, a portion of a molding cavity; and a core support for supporting the core base relative to a core plate of a molding system; the core base and the core support constituting to a core insert, the sliding interface configured to permit a degree of lateral movement to the core base.

According to a third broad aspect of the present invention, there is provided a compensating portion defined in a core support used for supporting a core base relative to a core plate of a molding system; the compensating portion configured to permit a degree of axial movement the core base.

According to a fourth broad aspect of the present invention, there is provided a compensator comprising one of: (a) a sliding interface defined, in use, between (i) a core base for defining, in use, a portion of a molding cavity; and (ii) a core support for supporting the core base relative to a core plate of a molding system; the core base and the core support constituting to a core insert; and a compensating portion defined in said core support; and (b) a spring connection between said core base and said core support, the compensator for affording, in use, at least a degree of axial movement to the core base.

According to another broad aspect of the present invention, there is provided a mold stack comprising: a compensating core insert complementary to a cavity insert, the compensating core insert and the cavity insert configured to jointly define, in use, at least a portion of a molding cavity, the compensating core insert configured to have a degree of axial and lateral movement relative to at least the cavity insert. There is further provided a molding system incorporating the mold stack.

According to yet another broad aspect of the present invention, there is provided a core insert for use in a molding system. The core insert comprises a core base having a cavity defining portion for defining, in use, a portion of a molding cavity; a core support that is configured to cooperate with a base portion of the core base; a compensator associated, at least partially, with the core support to permit at least a degree of axial movement to the core base.

According to yet another broad aspect of the present invention, there is provided a core support that is configured to cooperate with a base portion of a core base. The core support comprises a compensator to permit a degree of flexibility to the core support whereby to permit at least a degree of axial movement to the core base.

According to yet another broad aspect of the present invention, there is provided a core base. The core base comprises a cavity defining portion configured to define, in use, a portion of a molding cavity; a base portion configured to cooperate, in use, with a core support, a portion of the base portion being configured to define, in use, a portion of a sliding portion between the core base and the core support.

According to another broad aspect of the present invention, there is provided a retaining member for coupling, in use, a core base to a core support, the core base and the core support for use with a molding system. The retaining member comprises a first end and a second end, each of the first end and the second end comprising a respective plurality of fingers; the respective plurality of fingers is actuatable between (i) a retracted position, where the respective plurality of fingers are insertable, respectively, into a first internal bore and a second internal bore associated, respectively, with the core support and the core base; and (b) an expanded position, where the respective plurality of fingers engage, respectively) a first retaining lip and a second retaining lip, associated, respectively, with the first internal bore and the second internal bore.

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

BRIEF DESCRIPTION OF THE DRAWINGS

A better understanding of the embodiments of the present invention (including alternatives and/or variations thereof) may be obtained with reference to the detailed description of the exemplary embodiments along with the following drawings, in which:

Figure 1 is a cross-section view of a portion of a mold stack according to a non-limiting embodiment of the present invention.

Figure 2 is a cross-section view of a core insert of the mold stack of Figure 1, according to a non-limiting embodiment of the present invention.

Figure 3 is a cross-section view of a core insert according to another non-limiting embodiment of the present invention.

Figure 4 is a perspective view of the core insert of Figure 3.

Figure 5 is a perspective view of another embodiment of the core insert of Figure 1.

Figure 6 is a cross-section view of the core insert of Figure 5.

Figure 7 is a cross-section view of a cavity insert, a cavity plate and a gate insert of the mold stack of Figure 1, according to a non-limiting embodiment of the present invention.

Figure 8 is a perspective view of a cavity plate of the mold stack of Figure 1 with a plurality of retaining structures disposed thereupon, according to a non-limiting embodiment of the present invention.

Figure 9 is a perspective view of the retaining structure of Figure 8.

Figure 10 is a perspective view of the cavity insert of Figure 7.

Figure 11 is a cross-section view of a portion of the mold stack of Figure 1, in a mold closed position.

Figure 12 is a cross-section view depicting a portion of the mold stack of Figure 1, with a retaining member implemented according to an alternative non-limiting embodiment of the present invention.

Figure 13 is a cross-section view of a core insert with a compensator implemented according to another non-limiting embodiment of the present invention.

Figure 14 is a schematic view of a manifold and slides of the mold stack of Figure 1, according to a non-limiting embodiment of the present invention.

Figure 15 is a partial section view of a compensating coupling of Figure 14, according to a non-limiting embodiment of the present invention.

Figure 16 is a perspective view of the compensating coupling of Figure 15, according to a non-limiting embodiment of the present invention.

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

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT(S)

Inventors have appreciated that there exists a premature wear problem associated with various components of a known injection molding system. The premature wear problem can be broadly categorized, depending on severity and/or location of the problem, as fretting, galling or hobbing. Inventors believe that the premature wear problem(s) is(are) attributable, at least in part, to some or all of the following issues: (a) excessive clamping force, (b) insufficient clamping force, (c) process parameters of filling the molding cavity with the melt, (d) geometry of the mold stack components, (e) platen parallelism (or lack thereof), (f) number of cavities in a given size of a cavity plate, (g) material used for various mold stack components (ex. tapers, etc.) and (i) relative position of various mating mold stack components (ex. mis-alignment of individual mating mold stack components). Naturally, the premature wear problem can be attributable to other known or to be appreciated issues.

Inventors have further appreciated that in a mold stack of a given size, clamping force is not distributed equally along a cross-section of the mold stack that traverses an operational axis of a molding system. Some areas of the cross-section experience higher clamping force, while other area of the cross-section experience lower clamping force.

With reference to Figure 1, there is depicted a portion of a mold stack 100 according to a non-limiting embodiments of the present invention. The mold stack 100 comprises a stripper plate 102 and a cavity plate 104. Even though not shown in Figure 1, the mold stack 100 further comprises a core plate, which abuts the stripper plate 102 at a rear extremity thereof *vis-à-vis* the cavity plate 104. There is also provided a core insert 105, which is associated with a core plate (not depicted) and is positioned, in use, through aperture(s) in the stripper plate 102. Associated with the cavity plate 104 are a cavity insert 106 and a gate insert 108. Coupled to the stripper plate 102 and disposed intermediate the stripper plate 102 and the cavity plate 104, is a split mold insert assembly 110. The split mold insert assembly 110 can comprise a plurality of slides 112, only two of which are depicted in Figure 1. Coupled to each of the pair of slides 112 is a split mold insert 114, also referred to by those of skill in the art as a "neck ring". Two split mold inserts 114 form a split mold insert pair. The function of the split mold inserts 114 is well known to those of skill in the art and, as such, need not be discussed here at any length. In the specific non-limiting embodiment of Figure 1, the split mold insert 114 is coupled to the slide 112 in a so-called "front-face coupling arrangement", which is more particularly described in a patent application bearing a serial application number 11/740,564 filed with the United States Patent Office on April 26, 2007 and assigned to Assignee of the present patent application. However, in alternative embodiments of the present invention, the split mold insert 114 can be coupled to the slide 112 in other known arrangement, such as, for example, the typical "top-face coupling arrangement".

Also depicted in Figure 1, is a retaining structure 116 coupled to the cavity plate 104. Structure and function of the retaining structure 116 will be explained in greater detail herein below. However, for the time being suffice it to say, that the retaining structure 116 cooperates with a respective one of the pair of slides 112 to position and to retain the respective one of the pair of slides 112 in an operating position.

Further depicted in Figure 1, is a wear plate 118 coupled to the stripper plate 102, intermediate the stripper plate 102 and the pair of slides 112. The purpose of the wear plate 118 is to prevent substantial damage to the pair of slides 112 and/or the stripper plate 102 during lateral movement of the pair of slides 112 relative to each other. Within alternative non-limiting embodiments of the present invention, the wear plate 118 can be omitted from the architecture of the mold stack 100. This is particularly applicable in those embodiments of the present invention, where an actuator that actuates the lateral movement of the pair of slides 112 provides for lifting of the pair of slides 112 relative to the stripper plate 102. An example of such a solution is disclosed in a PCT patent application PCT/CA2007/000392 filed with Canadian Intellectual Property Office as a Receiving Office for PCT on March 8, 2007.

Within the non-limiting illustration of Figure 1, the core insert 105, the cavity insert 106, the gate insert 108 and the two split mold inserts 114 are depicted in a so-called mold closed position. Within the mold closed position, a portion of the core insert 105, a portion of the cavity insert 106, a portion of the gate insert 108 and a portion of each of the two split mold inserts 114 cooperate to define a molding cavity 120. A shape of the molding cavity corresponds to a shape of a molded article 122. Within specific non-limiting embodiment depicted in Figure 1, the molded article 122 comprises a preform that is capable of being subsequently blow-molded into a final-shaped article, such as beverage container. However, it should be expressly understood that the molded article 122 can be of any other shape and/or configuration. Accordingly, it should be clear that teachings of embodiments of present invention apply to a mold stack 100 and a molding system incorporating the mold stack 100 that can be configured to produce different types of molded articles 122, such as, but not limited to, preforms, thin wall containers, closures and the like.

Also provided within Figure 1, is a first interface 124 defined between the split mold inserts 114 and the cavity insert 106. In the specific embodiment illustrated, the first interface 124 comprises a pair of complementary tapers defined on the split mold inserts 114 and the cavity insert 106. There is also provided a second interface 126 defined between the core insert 105 and the split mold inserts 114. In the specific embodiment illustrated, the second interface 126 comprises a pair of complementary tapers defined on the split mold inserts 114 and the core insert 105. It should be understood that in alternative non-limiting embodiments of the present invention, the first interface 124 and/or the second interface 126 can be implemented differently and, as such, do not need to necessarily include tapers. The first interface 124 and/or the second interface 126 can be implemented in any alternative shape, such as a cylindrical shape, spherical shape and the like.

With reference to Figure 2, which depicts in more detail the core insert 105 of the mold stack 100 of Figure 1, structure of the core insert 105 according to a non-limiting embodiment of the present invention will now be described in greater detail. The core inserts 105 implemented according to various embodiments of the present invention can be thought of as a "compensating core insert". The core insert 105 comprises a core base 202 and a core support 204. A portion of the core base 202 (i.e. a "cavity defining portion") defines a portion of the molding cavity 120. Generally speaking, the purpose of the core support 204 is to support the core base 202, in an operating position, where it is affixed to the core plate (not depicted) in a floating arrangement, as will be described in greater detail herein below. To this extent, the core support 204 cooperates with a portion of the core base 202 (i.e. a "base portion").

The core support 204 comprises a compensator 206. Generally speaking, the purpose of the compensator 206 is to compensate for mis-alignment potentially present between various parts of the mold stack 100. For example, the compensator 206 may be configured to compensate for height differences in various parts of the mold stack 100 in a direction depicted in Figure 2 at "F" (or, in other words, axial mis-alignment). Additionally or alternatively, the compensator 206 may be configured to compensate for mis-alignment in a direction depicted in Figure 2 at "S1" (or, in other words, lateral mis-alignment).

More specifically, in the embodiment depicted in Figure 2, the compensator 206 comprises a compensating portion 208 and a sliding interface 210. The compensating portion 208 is defined in the core support 204 and in the example being presented herein comprises a conical spring member, which in the cross section depicted in Figure 2 is generally S-shaped. Generally speaking, the purpose of the compensating portion 208 is to allow a degree of axial flexibility to the core support 204. The degree of axial flexibility allows to compensate for the mis-alignment of the stack components. Accordingly, the dimension of the compensating portion 208 is selected such that to provide the degree of flexibility to the core support 204, while providing operational stability, while in use. For the avoidance of doubt, the term "operational stability" as used herein above and herein below is meant to define an operational state between various components of the mold stack 100 which is suitable for proper operation of the mold stack 100, i.e. injection of melt under pressure of formation of the molded article 122. The sliding interface 210 is a sliding interface defined between the core support 204 and the core base 202. In alternative non-limiting embodiments of the present invention, the compensator 206 can comprise just the compensating portion 208. In yet further non-limiting embodiments of the present invention, the compensator 206 can comprise just the sliding interface 210.

As is best seen in Figure 1, there is provided a core clearance 160 defined between the core base 202 and the core support 204. The core clearance 160 is configured to provide a degree of float to the core base 202 relative to the core support 204. Accordingly, the dimension of the core clearance 160 is selected such that to provide the degree of float to the core base 202, while providing operational stability, while in use. It can be said that a combination of the core clearance 160, the sliding interface 210 and the compensating portion 208 permits the core base 202 to move relative to the core support 204 in a direction depicted in Figure 2 at "S2" (i.e. axial move) and in a direction depicted in Figure 2 as "S1" (i.e. lateral move). More specifically, the core clearance 160 and/or the sliding interface 210 allows for the lateral move and the compensating portion 208 allows for the axial move.

In the embodiment depicted in Figure 2, the core base 202 further comprises a connecting portion 218. The connecting portion 218 can comprise a spigot that cooperates, in use, with a complementary spigot connection associated with the core plate (not depicted). As can be clearly seen in Figure 2, the connecting portion 218 protrudes beyond a rear extremity of the core support 204. However, in an alternative non-limiting embodiment of the present invention, the connecting portion 218 can be substantially flush with the rear extremity of the core support 204. This is illustrated in Figure 3, which illustrates another non-limiting embodiment of the core insert 105a. The core insert 105a can be substantially similar to the core insert 105 and, as such, like elements are depicted with like numerals. However, in the embodiment of Figure 3, the core insert 105a comprises a connecting portion 218a which is substantially flush with the rear extremity of the core support 204. An additional technical effect of this embodiment of the present invention is the additional ability for the core base 202 to shift relative to the core support 204 (and, therefore, relative to the core plate, which is not depicted) in a direction depicted in Figure 3 at "CS".

A coupling between the core base 202 and the core support 204 will now be explained in greater detail. With reference to Figure 4, which depicts a perspective view of the core insert 105a of Figure 3, there is provided a retaining member 216. In the specific non-limiting embodiment being presented herein, the retaining member 216 comprises a snap ring. A non-limiting example of a snap ring that can be adapted to implement embodiments of the present invention comprises a Seeger circlip ring E 1570 available from Meusburger (http://www.meusburger.com/). However, it should be understood that any other suitable type of a releasable fastener can be used.

The core support 204 comprises a retaining step 212 and the core base 202 comprises an undercut 214. The retaining step 212, the undercut 214 and the retaining member 216 cooperate to maintain the core base 202 affixed to the core support 204. More specifically, the core base 202 is installed within the core support 204. The retaining member 216 is then stretched (for example, using a tool or the like) to an open position and pulled over a rear extremity of the core base 202. Once the so-stretched retaining member 216 is positioned substantially close over the undercut 214, the retaining member 216 is allowed to return to a closed position where it is positioned partially within the undercut 214. An outer portion of the retaining member 216 protrudes radially and cooperates with the retaining step 212 to maintain the core based 202 and the core support 204 in this operational configuration.

As is best seen in Figure 4, there is also provided is a sealing member 402, such as an O-ring and the like, to seal against coolant leaks.

Figure 5 and Figure 6 depict another non-limiting embodiment of how a coupling between a core base 202a and a core support 204a can be implemented. Within the embodiment of Figure 5 and Figure 6, there is provided a retaining member 502. As us best seen in Figure 6, the retaining member 502 is implemented as a retaining clip. The retaining member 502 comprises a first end 504 and a second end 506. The first end 504 comprises a plurality of fingers 508 and the second end 506 comprises a plurality of fingers 510. The core support 204a comprises a first internal bore 511 and the core base 202a comprises a second internal bore 513. The first internal bore 511 comprises a first retaining lip 512 and the second internal bore comprises a second retaining lip 514. The plurality of fingers 508 and the plurality of fingers 510 are actuatable between (i) a retracted position, where the plurality of fingers 508 and the plurality of fingers 510 can be inserted, respectively, into the first internal bore 511 and the second internal bore 513; and (b) an expanded position, where the plurality of fingers 508 engage the first retaining lip 512 and the plurality of fingers 510 engage the second retaining lip 514. As is best seen in Figure 6, there is provided the sliding interface 210 and an internal clearance 620, which allow for a degree of movement of the core base 202a relative to the core support 204a.

It should be understood that Figures 2-6 depict just a few possible implementations for the core base 202, 202a and the core support 204, 204a. It should be further understood that numerous alternative implementations are possible. For example, a shape of the compensating portion 208 is not particularly limited. Even though Figures 2 - 6 depict the compensating portion 208 as having a "S-shaped" configuration in the cross-section of Figures 2-6, in alternative embodiments of the present invention, the compensating portion 208 can have other shapes, such as, for example, "Z-shape" and the like. Generally speaking, the compensating portion 208 can be implemented in any suitable form factor that allows a degree of resiliency.
It should also be understood that the precise location of the compensating portion 208 along a length of the core support 204 is not particularly limited. For example, as can be seen by comparing the core support 204a of Figure 5 with the core support 204 of Figure 2 or Figure 3, the position of a compensating portion 208a is much closer to a rear extremity of the core support 204a than the position of the compensating portion 208 of the core support 204. Other alternatives are, of course, possible.

In yet further non-limiting embodiments of the present invention, the compensator 206 can be implemented differently. For example, the compensator 206 can be implemented as a spring connection between the core base 202 and the core support 204. A non-limiting example of such an implementation is depicted in Figure 13. Figure 13 depicts a core insert 105b implemented according to an alternative non-limiting embodiment of the present invention. More specifically, the core insert 105b comprises a compensator 206a, which in this embodiment is implemented as a spring connection. An example of structure that can be used to implement these embodiments comprises a disk spring and the like. It should be noted that the placement and/or the structure of the spring connection can be implemented differently.

With reference to Figure 7, a portion the cavity plate 104, the cavity insert 106 and the gate insert 108 of Figure 1, according to a non-limiting embodiment of the present invention, are depicted. The cavity insert 106 implemented according to embodiments of the present invention can be thought of as a "compensating cavity insert". Similarly, the gate insert 108 implemented according to embodiments of the present invention can be thought of as a "compensating gate insert".

To this extent, there is provided a cavity clearance 702 defined between the cavity insert 106 and the cavity plate 104. The cavity clearance 702 provides for a degree of movement of the cavity insert 106 within the cavity plate 104. Accordingly, the dimension of the cavity clearance 702 is selected such that to provide the degree of movement to the cavity insert 106, while providing operational stability, while in use. In the non-limiting embodiment of Figure 7, the cavity insert 106 is coupled to the cavity plate 104 by means of first flexible fasteners 704. Generally speaking, the first flexible fasteners 704 can be implemented by any suitable means that secures the cavity insert 106 to the cavity plate 104, while allowing a degree of movement to the cavity insert 106 *vis-à-vis* the cavity plate 104. An example of the structure suitable for implementing the first flexible fasteners 704 is a two-piece shoulder screw. An example of such two-piece shoulder screw can be implemented as a socket head shoulder screw available from SPS Technologies, Unbrako Engineered Fasteners (http://www.unbrako.com.au/). However, in alternative non-limiting embodiments other types of fasteners can be used, such as, for example, standard shoulder screws and the like.

With brief reference to Figure 10, which depicts a perspective view of the cavity insert 106, the cavity insert 106 comprises a plurality of cooling channels 1200. The function of the plurality of cooling channels 1200 is generally known and can be broadly categorized as supplying coolant (such as water or another suitable coolant medium) to provide for cooling of the cavity insert 106 during specific portions of a molding cycle. In the specific non-limiting embodiment depicted in Figure 10, the cooling channels 1200 comprise a plurality of elongated grooves extending substantially along an outer periphery of the cavity insert 106 in a direction of the operational axis of the mold stack 100. In some embodiments of the present invention, the plurality of cooling channels 1200 can be produced by using a rolling machine. However, a plethora of alternative tools can be used for producing the cooling channels 1200, such as, but not limited to, milling tools, machining tools, as well as various erosion techniques. In alternative non-limiting embodiments of the present invention, other configurations of the cooling channels 1200 can be used, such as, but not limited to a spiral configuration and the like. Also depicted in Figure 10 is a plurality of coupling interfaces 1202 configured to accept, in use, the aforementioned first flexible fasteners 704.

With continued reference to Figure 7, the cavity insert 106 comprises a step 720. The step 720 is configured to accept, in use a lip 722 of the gate insert 108. Accordingly, it can be said that an interface 724 defined between the cavity insert 106 and the gate insert 108 comprises a first contact surface 726 and a second contact surface 728, the first contact surface 726 and the second contact surface 728 being disposed in different planes and separated by a traversing third contact surface 730. However, in alternative non-limiting embodiments of the present invention, the interface 724 can be implemented differently, for an example, as a single contact surface (not depicted) known to those of skill in the art.

There is also provided a gate insert clearance 706 defined between the gate insert 108 and the cavity plate 104. The gate insert clearance 706 provides for a degree of movement of the gate insert 108 within the cavity plate 104. Accordingly, the dimension of the gate insert 108 is selected such that to provide the degree of movement, while providing operational stability, while in use. In the non-limiting embodiment of Figure 7, the gate insert 108 is coupled to the cavity plate 104 by means of second flexible fasteners 708. Generally speaking, the second flexible fasteners 708 can be implemented by any suitable means that secures the gate insert 108 to the cavity plate 104, while allowing a degree of movement to the gate insert 108 *vis-à-vis* the cavity plate 104. An example of the structure suitable for implementing the second flexible fasteners 708 is a two-piece shoulder screw. An example of such two-piece shoulder screw can be implemented as a socket head shoulder screw available from SPS Technologies, Unbrako Engineered Fasteners (http://www.unbrako.com.au/). However, in alternative non-limiting embodiments other types of fasteners can be used, such as, for example, standard shoulder screws and the like.

Also depicted in Figure 7 is a first sealing member 710 and a second sealing member 712. The first sealing member 710 is positioned in an annular groove 714 defined between a front face of a shoulder 716 of the core insert 105 and a rear extremity face of the cavity plate 104. The second sealing member 712 is positioned in an annular groove 717 defined between a front face of a shoulder 718 of the gate insert 108 and a front extremity of the cavity plate 104. An additional technical effect of this placement of the first sealing member 710 and the second sealing member 712 includes ability to provide an effective seal even with larger dimensions of the cavity clearance 702 and/or the gate insert clearance 706. Another technical effect of these embodiments of the present invention may include prevention of a "bounce-back effect" of the cavity insert 106 after being aligned to or, in other words, after movement to a desired position. For the avoidance of doubt, term "bounce-back effect" is meant to denote an effect whereby the cavity insert 106 experiences an urge to move to (or, in other words, "bounce back") to a position within the cavity plate 104 that it was in prior to be aligned to the desired position. In the specific embodiment of Figure 7, there is also provided a third sealing member 750 provided between the lip 722 and the step 720.

However, in alternative non-limiting embodiments of the present invention, the first sealing member 710 and/or the second sealing member 712 can be positioned along an outer circumference of the cavity insert 106, as is known in the art.

It is worthwhile noting that Figure 7 depicts one embodiments of how the compensating cavity insert 106 and the compensating gate insert 108 can be implemented. It should be appreciated that other alternative implementations are possible. One example of alternative implementation is disclosed in a US patent application bearing a serial application number 11/741,761 filed on April 29, 2007 and assigned to the Assignee of the present patent application, content of which is incorporated by reference herein in its entirety.

With reference to Figure 8, a perspective view of the cavity plate 104 according to a non-limiting embodiment of the present invention is depicted. The cavity plate is associated with a retaining structure 116a. Within specific embodiment of the present invention depicted in Figure 8, the cavity plate 104 is associated with a plurality of retaining structures 116a. With continued reference to Figure 8 and with reference to Figure 9, a non-limiting embodiment of one such retaining structure 116a is depicted. The retaining structure 116a comprises a body 902. Defined in the body 902 is a relief element 904. Generally speaking, the purpose of the relief element 904 is to provide a degree of flexibility to the body 902 of the retaining structure 116a. Accordingly, the dimension of the relief element 904 is selected such that to provide the degree of flexibility to the retaining structure 116a, while providing operational stability, while in use.

Within the specific non-limiting embodiment of Figure 9, the relief element 904 comprises a groove defined along a length of the body 902. However, in alternative non-limiting embodiments of the present invention, the relief element 904 can be implemented as a groove (or another shape) defined along at least a portion of the length of the body 902.

As will be recalled from the description of Figure 1, the purpose of the retaining structure 116a is to position and to retain the respective one of the pair of slides 112 in an operating position. Traditionally, structures similar to the retaining structure 116a have been manufactured to tight tolerances using various precise-machining techniques. A technical effect of embodiments of the present invention may include decreased or no requirement to precise-machine the retaining structure 116a, as the relief element 904 can compensate for imprecision(s) in the dimensions of the body 902.

In the embodiment being described herein, the body 902 comprises a coupling interface 906. The coupling interface 906 can comprise two bores for accepting a pair of suitable fasteners (such as bolts, etc.) therethrough for coupling to the cavity plate 104. It should be appreciated that the number of bores/fasteners used is not particularly limited. Similarly, other structures to implement the coupling interface 906 can be used and are known to those of skill in the art. The body 902 further comprises a first positioning interface 908. The first positioning interface 908 cooperates with a second positioning interface 808 defined on a face of the cavity plate 104, as is best seen in Figure 8. In the specific non-limiting embodiment depicted herein, the first positioning interface 908 comprises a protruding leg and the second positioning interface 808 comprises a groove, the shape of the groove being complementary to the shape of the protruding leg. The first positioning interface 908 and the second positioning interface 808 are dimensioned in this complementary relationship such that to precisely position the retaining structure 116a *vis-à-vis* the cavity plate 104 and, more specifically, *vis-à-vis* a respective pair of slides 112 when the mold stack 100 is in the operating position.

Accordingly, the retaining structure 116a implemented according to embodiments of the present invention can be thought of as a "compensating retaining structure". As is shown in Figure 8, there are also provided a plurality of non-compensating retaining structures 810. The plurality of non-compensating retaining structures 810 are located at a periphery of the cavity plate 104 and, more specifically, on opposing ends of the cavity plate 104 relative to the operating axis of the mold stack 100. In alternative non-limiting embodiments, compensating retaining structures similar to the retaining structure 116a can be used instead of the non-compensating retaining structure 810.

It should be noted that the non-limiting embodiment of the relief element 904 depicted in Figure 8 and Figure 9 is just one example of possible implementation thereof. Numerous alternative implementations are possible. For example, with reference to Figure 1, another non-limiting embodiment of the retaining structure 116 is depicted. Within the embodiment of Figure 1, the retaining structure 116 comprises a body 1002. The body 1002 comprises a relief element 1004. In the specific non-limiting embodiment of Figure 1, the relief element 1004 comprises three undercuts defined in the body 1002. The body 1002 further comprises a first positioning interface 1008. The cavity plate 104 also comprises a second positioning interface 1010. Similar to the first positioning interface 908 and the second positioning interface 808, the first positioning interface 1008 and the second positioning interface 1010 are dimensioned in a complementary relationship such that to precisely position the retaining structure 116 *vis-à-vis* the cavity plate 104 and, more specifically, *vis-à-vis* a respective pair of slides 112 when the mold stack 100 is in the operating position.

It should be noted that the number of, the shape of or location of the undercuts that constitute to the relief element 1004 is not particularly limited. An example of an alternative non-limiting implementation for the relief element 1004 is depicted in Figure 12. A retaining member 116b of Figure 12 comprises a relief element 1004a. The relief element 1004a comprises three undercuts, however, the positioning of the three undercuts is different from that of Figure 1. More specifically, two of the three undercuts of Figure 12 are positioned at a different angle *vis-à-vis* a perimeter of the retaining member 116b compared to the three undercuts of the relief element 1004 of Figure 1. Naturally, other alternative implementations are also possible.

In yet further embodiments of the present invention, the retaining structure 116a of Figure 8 can be implemented as a rail extending along the length of the cavity plate 104. For example, the retaining structures 116a depicted in Figure 8 as a retaining structure 116a`, a retaining structure 116a``, a retaining structure 116a``` and a retaining structure 116a```` can be implemented in a single rail (not depicted). Other alternatives are, of course, also possible.

With reference to Figure 14, there is depicted a non-limiting embodiment of a compensating coupling 1400 between a water manifold 1402 and the plurality of slides 112. The manifold 1402 comprises an inlet 1404 for operatively coupling to a coolant supply 1408. The manifold 1402 further comprises an internal manifold distribution network 1406 coupled to the inlet 1404 and to a plurality of outlets 1407, each of the plurality of outlets 1407 being associated with a given one of the plurality of slides 112. Each of the plurality of slides 112 comprises an internal slide distribution network 1410. The combination of the internal manifold distribution network 1406 and the internal slide distribution network 1410 allows for supply of coolant (such as water and the like) to the plurality of slides 112 and, accordingly, to the plurality of split mold inserts 114. In the embodiment depicted in Figure 14, there is also provided the compensating coupling 1400 between each of the plurality of outlets 1407 and each internal slide distribution network 1410.

With further reference to Figure 15 and Figure 16, structure of the compensating coupling 1400 will now be described in greater detail. More specifically, the manifold 1402 comprises a receptacle 1502 for receiving the compensating coupling 1400 therethrough. Dimension of the compensating coupling 1400 is selected relative to the receptacle 1502 such that to permit a degree of movement to the compensating coupling 1400 *vis-à-vis* the receptacle 1502. This, in turn, permits a degree of movement to the plurality of slides 112 *vis-à-vis* the manifold 1402. The compensating coupling 1400 comprises a coupling inlet 1602 and a coupling outlet 1604, communicatively coupled by an internal channel (not separately numbered).

Even though within the specific non-limiting embodiment of Figure 14, the compensating coupling 1400 is implemented as a compensator of the mold stack 100, this need not be so in every embodiment of the present invention, As such, in alternative non-limiting embodiments of the present invention, a coupling between the manifold 1402 and the plurality of slides 112 can be implemented in any other known manner.

As has been described herein above, the mold stack 100 comprises one or more compensator(s). For example, the mold stack 100 can implement one or more of the following compensators: (a) the compensating core insert 105, (b) the compensating cavity insert 106, (c) the compensating gate insert 108; (d) the compensating retaining structure 116 and (e) the compensating coupling 1400. Accordingly, it can be said that the mold stack 100 that implements one or more of these compensators can be thought of as a "compensating mold stack". In some embodiments of the present invention, the compensating mold stack 100 can include one or more of these compensators or variations thereof. In other embodiments of the present invention, the compensating mold stack 100 can include two or more of these compensators of variations thereof. In yet further embodiments, the compensating mold stack 100 can include all of these compensators or equivalents thereof. Naturally, the compensating mold stack 100 may have a number of additional compensators.

Given the architecture of the mold stack 100 described above, a process of alignment of various components of the mold stack 100 will now be described in greater detail. In some non-limiting embodiments of the present invention, the split mold inserts 114 are used as a master for alignment of various components of the mold stack 100. In a specific example, when the mold stack 100 is urged into the operating position (i.e. the mold closed position), the pair of slides 112 cooperates with the pair of retaining structures 116, 116a to position the split mold inserts 114. It will be recalled that the retaining structures 116, 116a include a relief element 904, 1004, 1004a. Even though the relief element 904, 1004, 1004a provides for some degree of flexing, the retaining structure 116, 116a is rigid enough to provide for positioning of the split mold inserts 114.

Once the split mold inserts 114 have been positioned, the core insert 105 is positioned *vis-à-vis* the split mold inserts 114. Recalling that (i) there exists the second interface 126 between the core insert 105 and the split mold inserts 114; and (ii) that the core insert 105 can be implemented as a compensating core insert; the core insert 105 aligns its position with the position of the split mold inserts 114. Similarly, the cavity insert 106 is positioned *vis-à-vis* the split mold inserts 114. Recalling that (i) there exists the first interface 124 between the cavity insert 106 and the split mold inserts 114; and (ii) that the cavity insert 106 can be implemented as a compensating cavity insert; the cavity insert 106 aligns its position with the position of the split mold inserts 114. Naturally, the precise timing of the positioning of the core insert 105 and positioning of the cavity insert 106 can occur substantially simultaneously or one after another with certain overlap or without certain overlap therebetween.

Recalling that the gate insert 108 can be implemented as a compensating gate insert, the gate insert 108 is also aligned with a positioning of a hot runner nozzle (not depicted). Inventors believe that alignment of the gate insert 108 *vis-à-vis* the hot runner nozzle will allow for positioning of an orifice (not depicted) of the hot runner nozzle and sufficient seal therebetween.

With reference to Figure 11, a portion of the mold stack 100 of Figure 1 is depicted according to a non-limiting embodiment of the present invention. More specifically, the mold stack 100 of Figure 11 is depicted in the mold-closed position. Figure 11 is meant to depict one of the technical effects of the mold stack 100 having one or more compensating components. Within this particular illustration, the mold stack 100 is depicted as having the compensating core insert 105 (i.e. the core base 202 and the core support 204). It can be clearly seen in Figure 11 that in the mold closed position, the core base 202 has shifted *vis-à-vis* the core support 204 (and, accordingly, *vis-à-vis* the core plate, which is not depicted). More specifically, the lateral shift of the core base 202 has resulted in a core clearance 160a being greater than a core clearance 160b. It has also results in a lateral shift 210a associated with the sliding interface 210.

A technical effect of embodiments of the present invention, amongst others, can include decrease premature wear of various components of the mold stack 100. Alternatively or additionally, the premature wear may be re-distributed to less expensive components of the mold stack 100. Another technical effect of embodiments of the present invention can include improved tolerance to force distribution imperfections. Another technical effect of embodiments of the present invention may include decreased costs associated with producing various components of the mold stack 100. It should be expressly understood that various technical effects mentioned herein above need not be realized in their entirety in each and every embodiment of the present invention.

Description of the embodiments of the present inventions provides examples of the present invention, and these examples do not limit the scope of the present invention. It is to be expressly understood that the scope of the present invention is limited by the claims. The concepts described above may be adapted for specific conditions and/or functions, and may be further extended to a variety of other applications that are within the scope of the present invention. Having thus described the embodiments of the present invention, it will be apparent that modifications and enhancements are possible without departing from the concepts as described. Therefore, what is to be protected by way of letters patent are limited only by the scope of the following claims:

WHAT IS CLAIMED IS:

1. A core insert (105, 105a, 105b) for use in a molding system, the core insert (105, 105a, 105b) comprising:

a core base (202, 202a) for defining, in use, a portion of a molding cavity (120);

a core support (204, 204a) for supporting, in use, said core base (202, 202a) relative to a core plate of the molding system;

a compensator (206, 206a) defined, at least partially, within said core support (204, 204a), the compensator (206, 206a) configured to permit at least a degree of axial movement to said core base (202, 202a).

2. The core insert (105, 105a, 105b) of claim **1**, wherein said compensator (206, 206a) further permits a degree of lateral movement.

3. The core insert (105, 105a, 105b) of claim **1**, further comprising a core clearance (160) defined between the core base (202, 202a) and the core support (204, 204a).

4. The core insert (105, 105a) of claim **1**, wherein said compensator (206) comprises:

a compensating portion (208) defined within said core support (204, 204a); and

a sliding interface (210) defined, in use, between said core base (202, 202a) and said core support (204, 204a).

5. The core insert (105, 105a, 105b) of claim **4**, further comprising a core clearance (160) defined between the core base (202, 202a) and the core support (204, 204a).

6. The core insert (105, 105a) of claim **4**, wherein said compensating portion (208) is implemented as a resilient portion defined within a body of said core support (204, 204a).

7. The core insert (105, 105a) of claim **6**, wherein said compensating portion (208) comprises a substantially “S-shaped” portion of said core support (204, 204a).

8. The core insert (105, 105a) of claim **6**, wherein said compensating portion (208) comprises a substantially “Z-shaped” portion of said core support (204, 204a).

9. The core insert (105, 105a, 105b) of claim **4**, wherein said compensating portion (208) permits a degree of axial movement to said core base (202, 202a).

10. The core insert (105, 105a, 105b) of claim **4**, wherein said sliding interface (210) permits a degree of lateral movement to said core base (202, 202a).

11. The core insert (105, 105a) of claim **1**, further comprising a retaining member (216, 502) for coupling said core base (202, 202a) and said core support (204, 204a).

12. The core insert (105, 105a) of claim **11**, wherein said retaining member (216) comprises a releasable fastener.

13. The core insert (105, 105a) of claim **12**, wherein

said core support (204) comprises a retaining step (212), and

said core base (202) comprises an undercut (214); and wherein

said retaining step (212), said undercut (214) and said releasable fastener cooperates, in use, to retain said core base (202) and said core support (204) in an operating position.

14. The core insert (105, 105a) of claim **11**, wherein said retaining member (502) comprises a retaining clip.

15. The core insert (105, 105a) of claim **14**, wherein

said retaining clip comprises a first end (504) and a second end (506), each of said first end (504) and said second end (506) comprising a respective plurality of fingers (508, 510); and

said core support (204a) comprises a first internal bore (511) defining a first retaining lip (512) and wherein said core base (202a) comprises a second internal bore (513) defining a second retaining lip (514); and wherein

said respective plurality of fingers (508, 510) is actuatable between (i) a retracted position, where said respective plurality of fingers (508, 510) are insertable, respectively, into said first internal bore (511) and said second internal bore (513); and (b) an expanded position, where said respective plurality of fingers (508, 510) engage, respectively) said first retaining lip (512) and said second retaining lip (514).

16. The core insert (105, 105a, 105b) of claim **1**, further comprising a connecting portion (218, 218a).

17. The core insert (105, 105b) of claim **16**, wherein said connecting portion (218) protrudes, in use, beyond a rear extremity of said core support (204, 204a).

18. The core insert (105a) of claim **16**, wherein said connecting portion (218a) is substantially flush, in use, with a rear extremity of said core support (204, 204a).

19. A sliding interface (210) defined, in use, between:

a core base (202, 202a) for defining, in use, a portion of a molding cavity (120); and

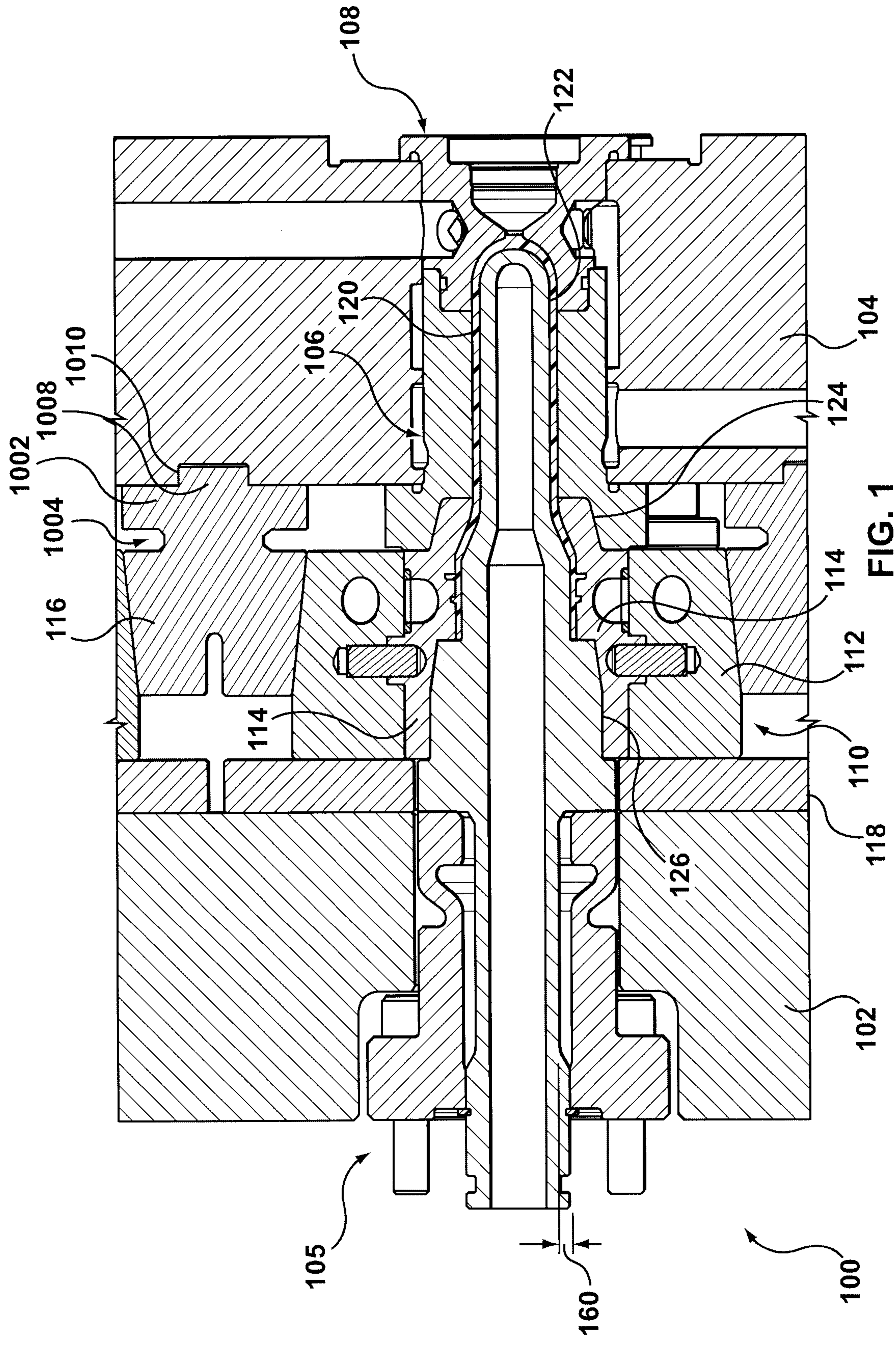
a core support (204, 204a) for supporting said core base (202, 202a) relative to a core plate of a molding system;

said core base (202, 202a) and said core support (204, 204a) constituting to a core insert (105, 105a, 105b), said sliding interface (210) configured to permit a degree of lateral movement to said core base (202, 202a).

20. A compensating portion (208) defined within a core support (204, 204a) used for supporting a core base (202, 202a) relative to a core plate of a molding system; the compensating portion (208) configured to permit a degree of axial movement said core base (202, 202a).

21. A core support (204, 204a) that is configured to cooperate with a base portion of a core base (202, 202a), the core support (204, 204a) comprising:

a compensator (206, 206a) defined within a body of the core support (204, 204a) to permit a degree of flexibility to said core support (204, 204a) whereby to permit at least a degree of axial movement to the core base (202, 202a).


108
122
120
106
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1008
1002
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104
124
114
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118
126
102
105
160
100

FIG. 1

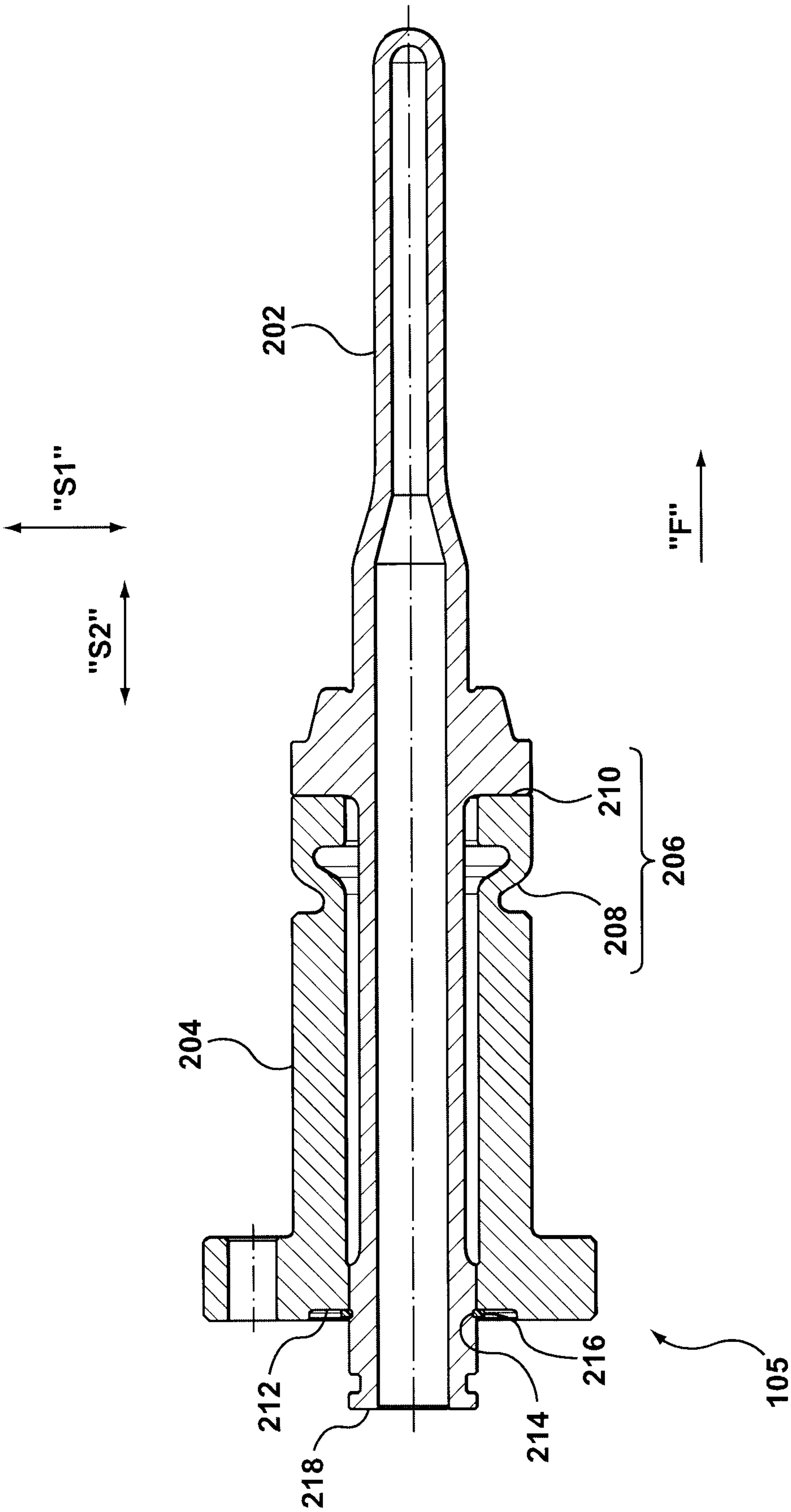


FIG. 2

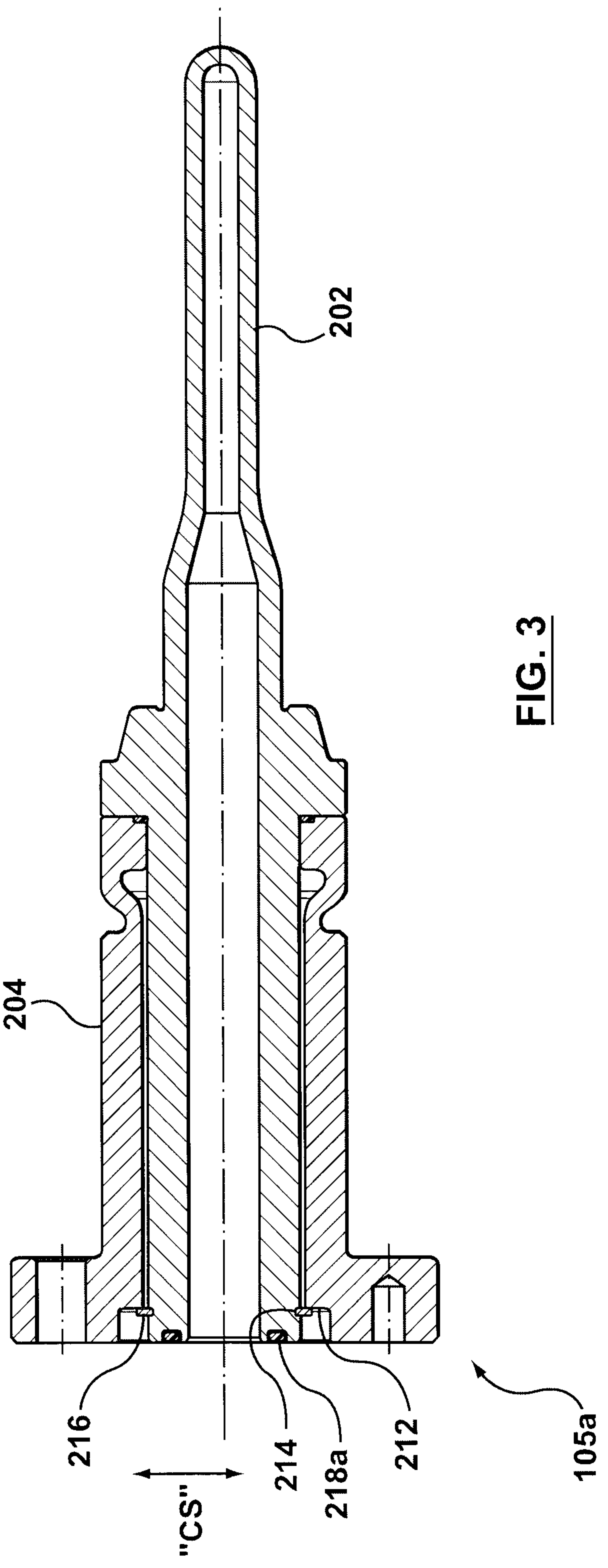


FIG. 3

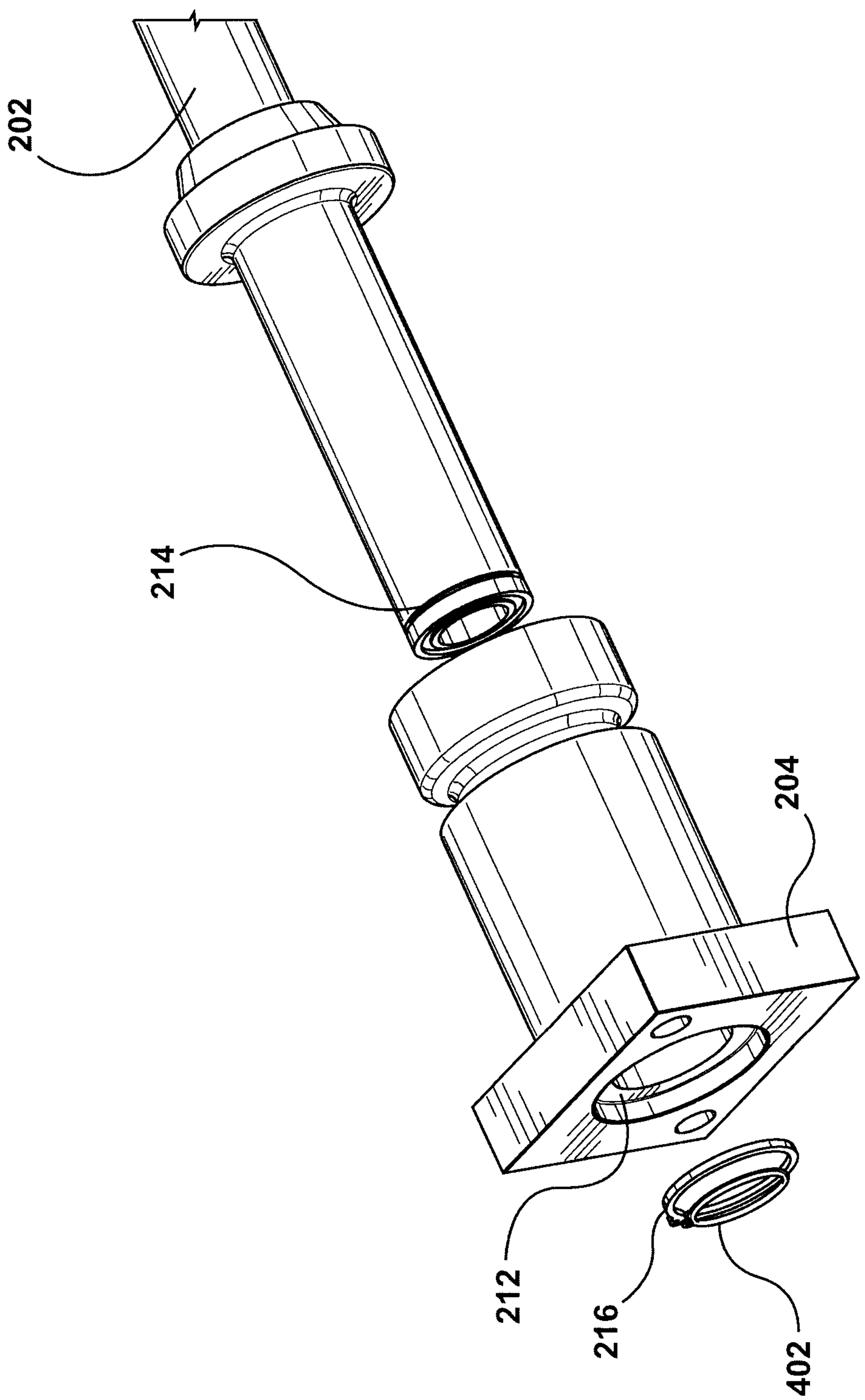


FIG. 4

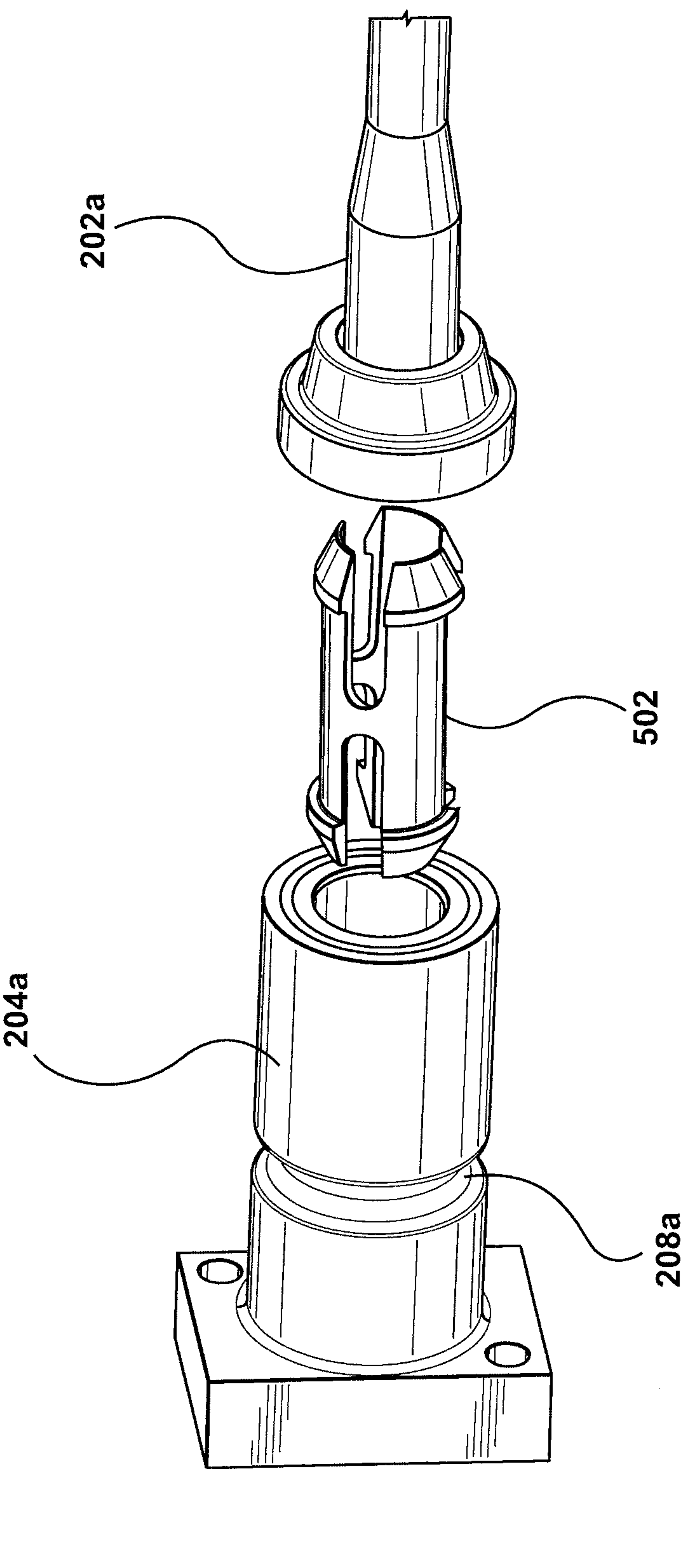


FIG. 5

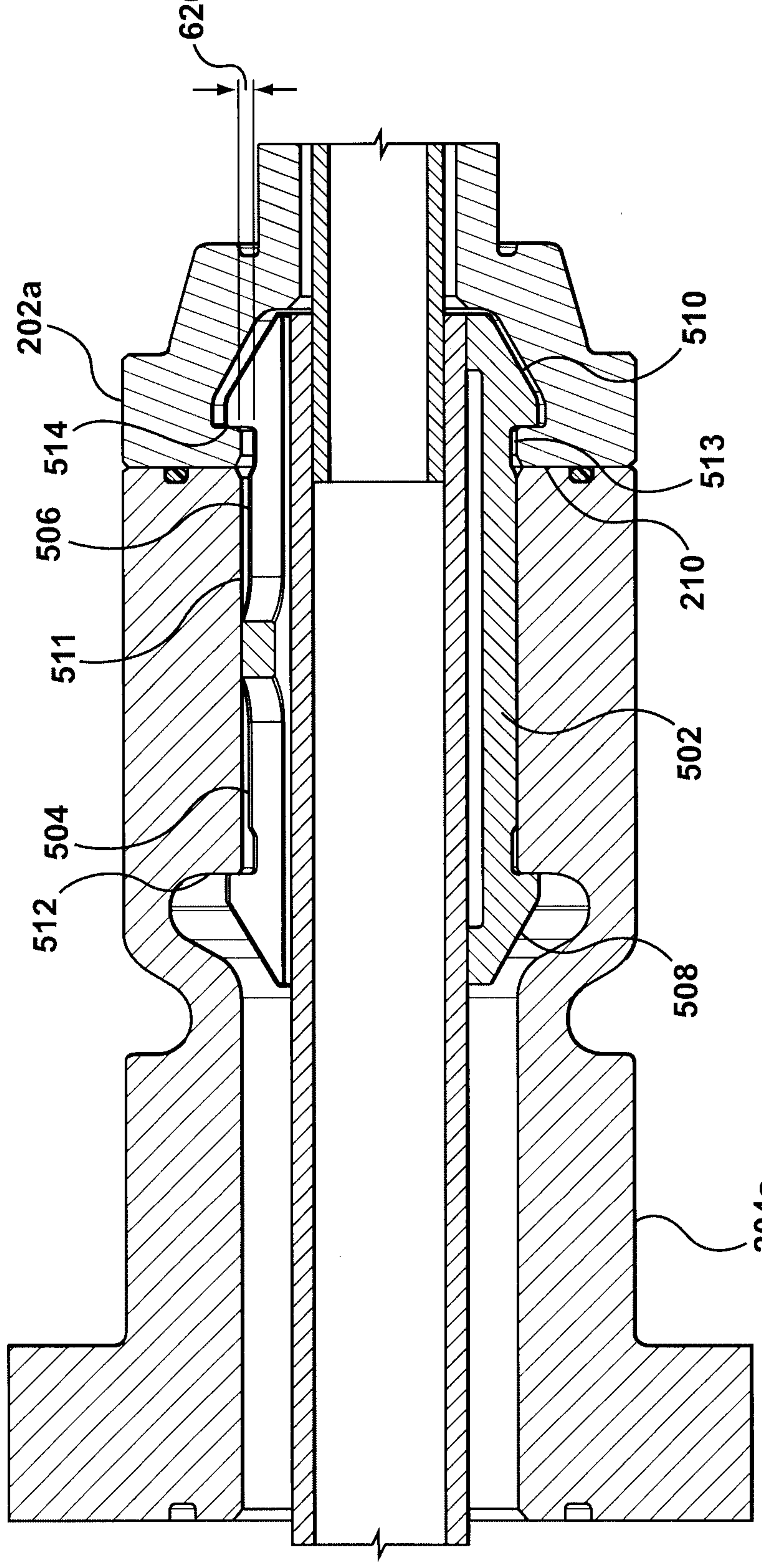


FIG. 6

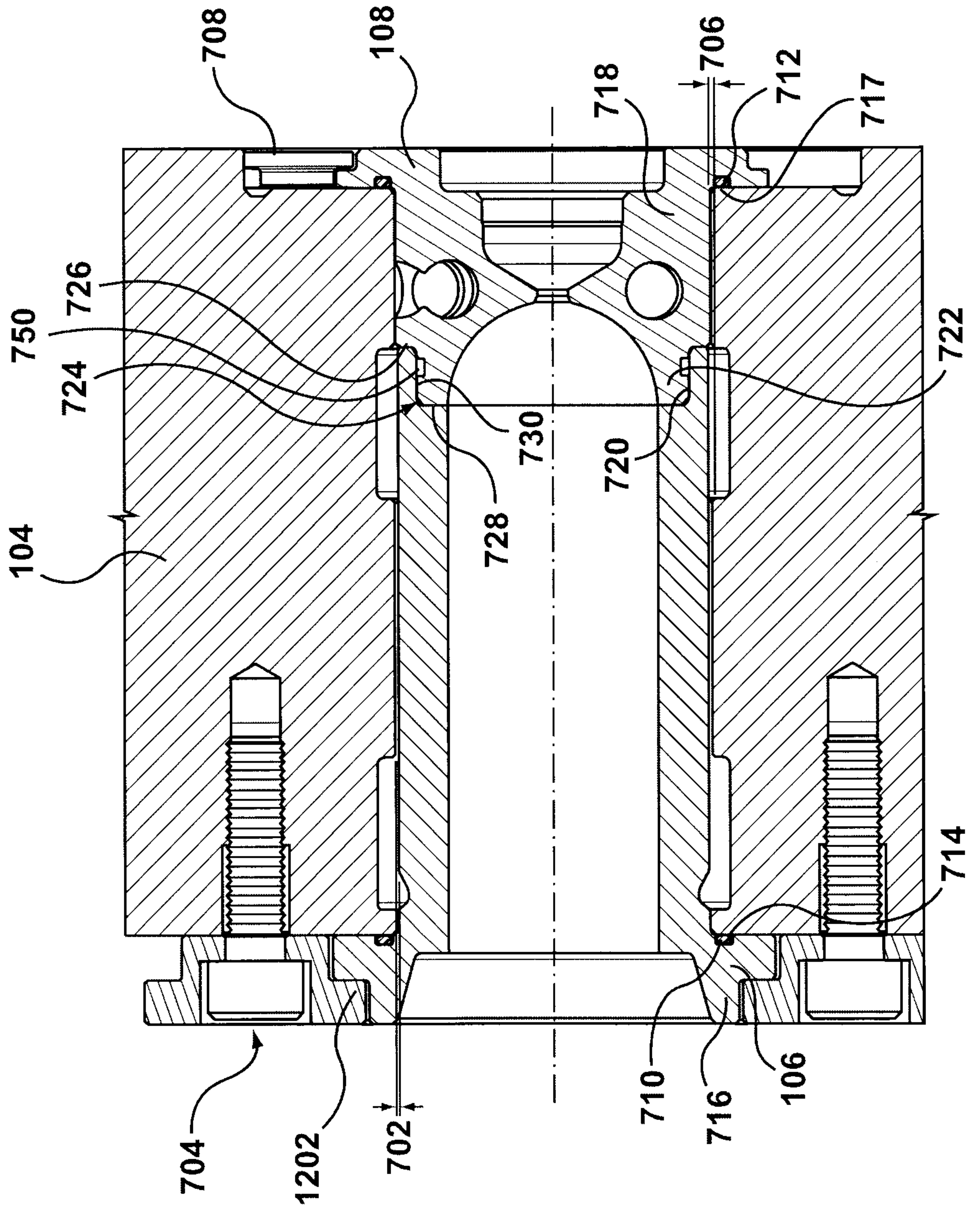

708
108
718
706
712
717
726
750
724
730
728
720
722
104
714
710
716
106
704
1202
702

FIG. 7

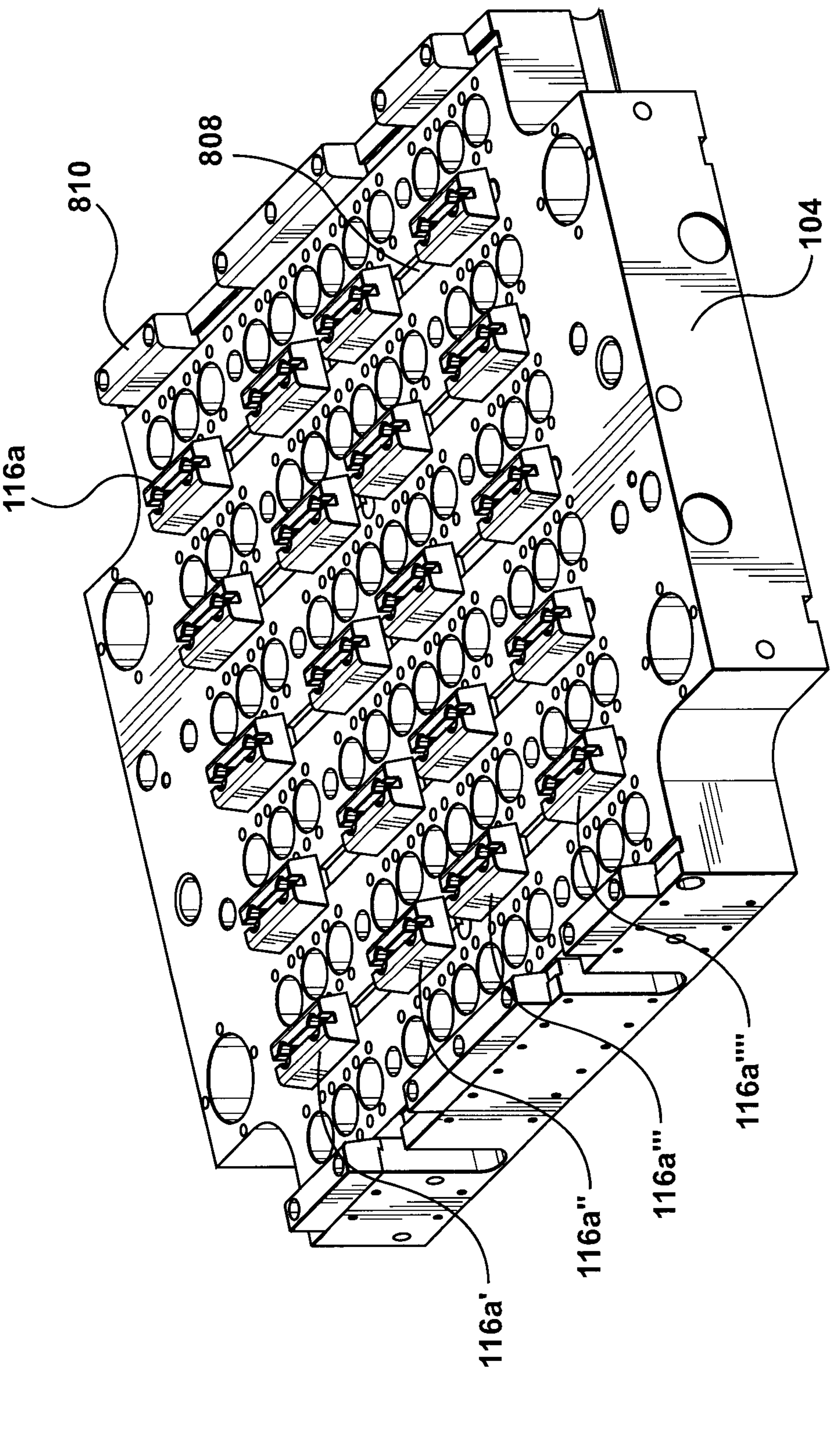


FIG. 8

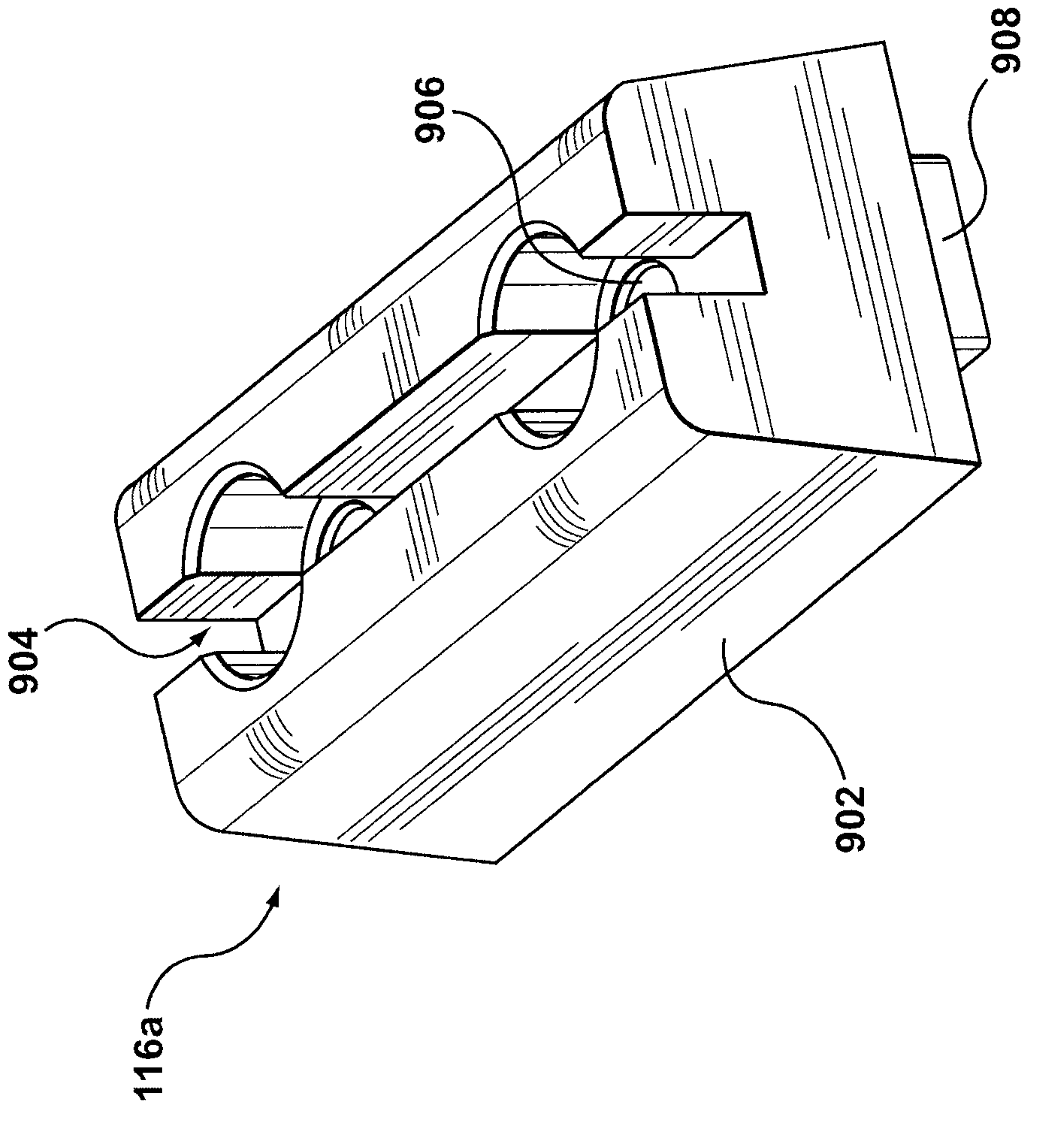


FIG. 9

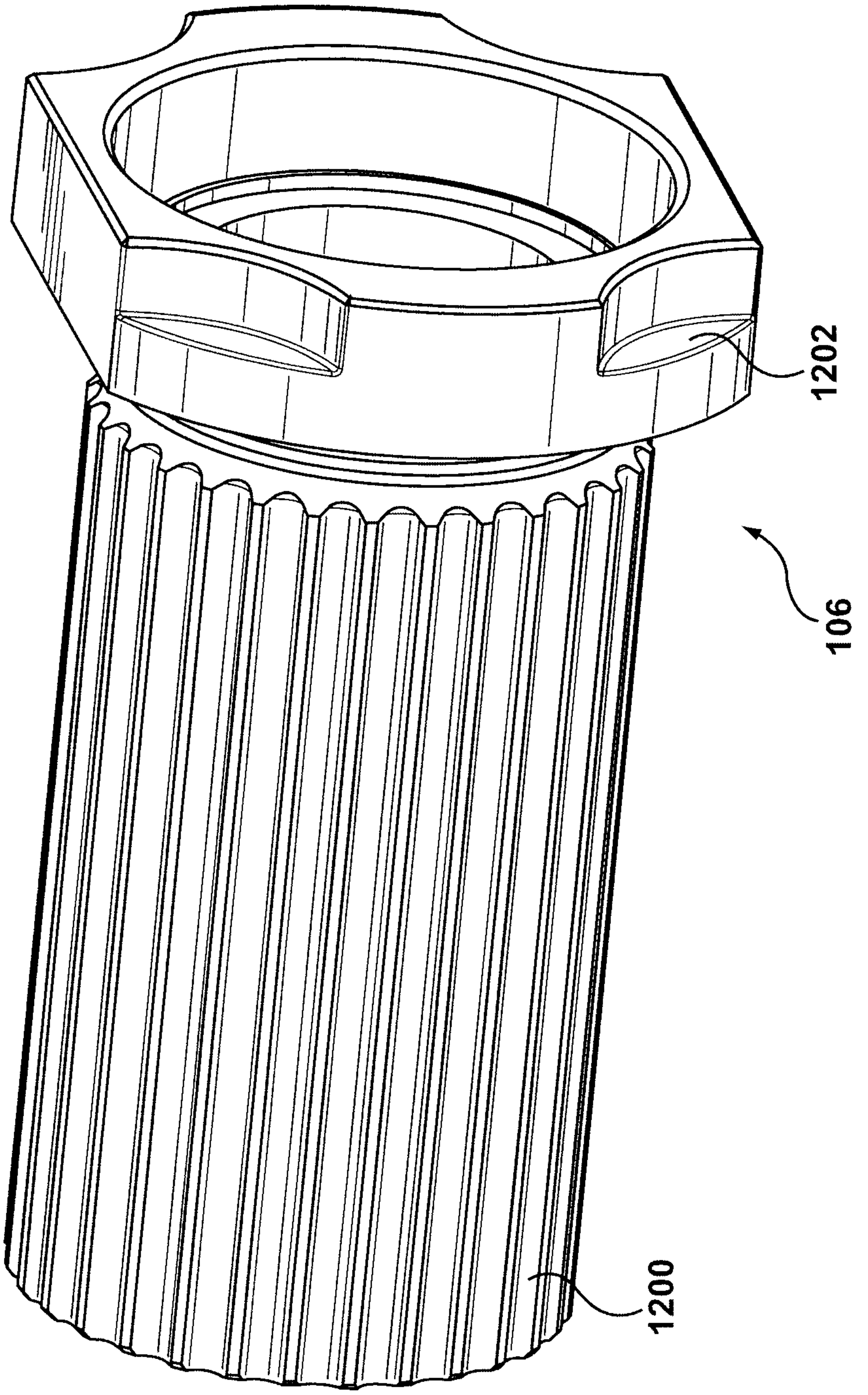


FIG. 10

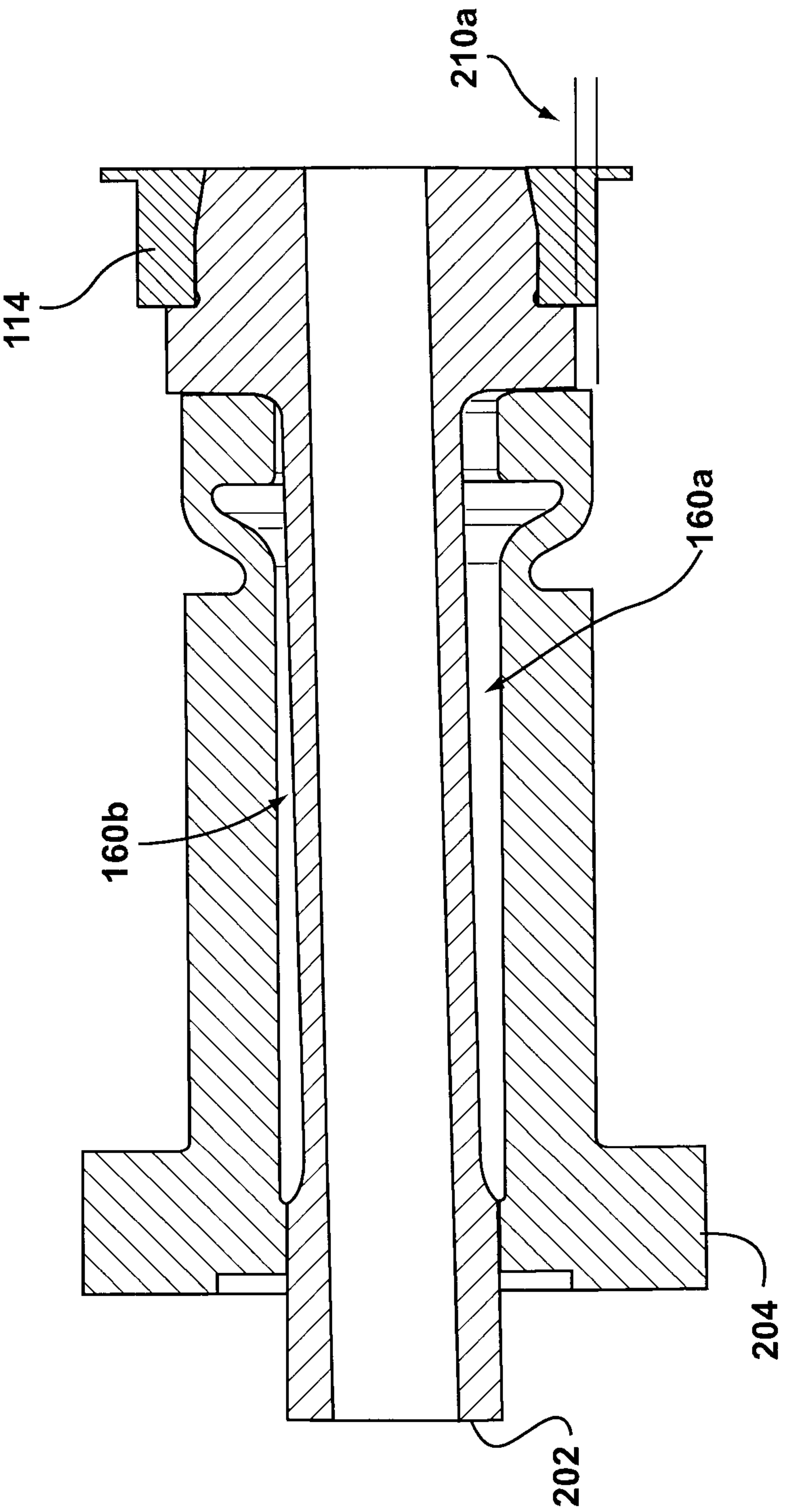


FIG. 11

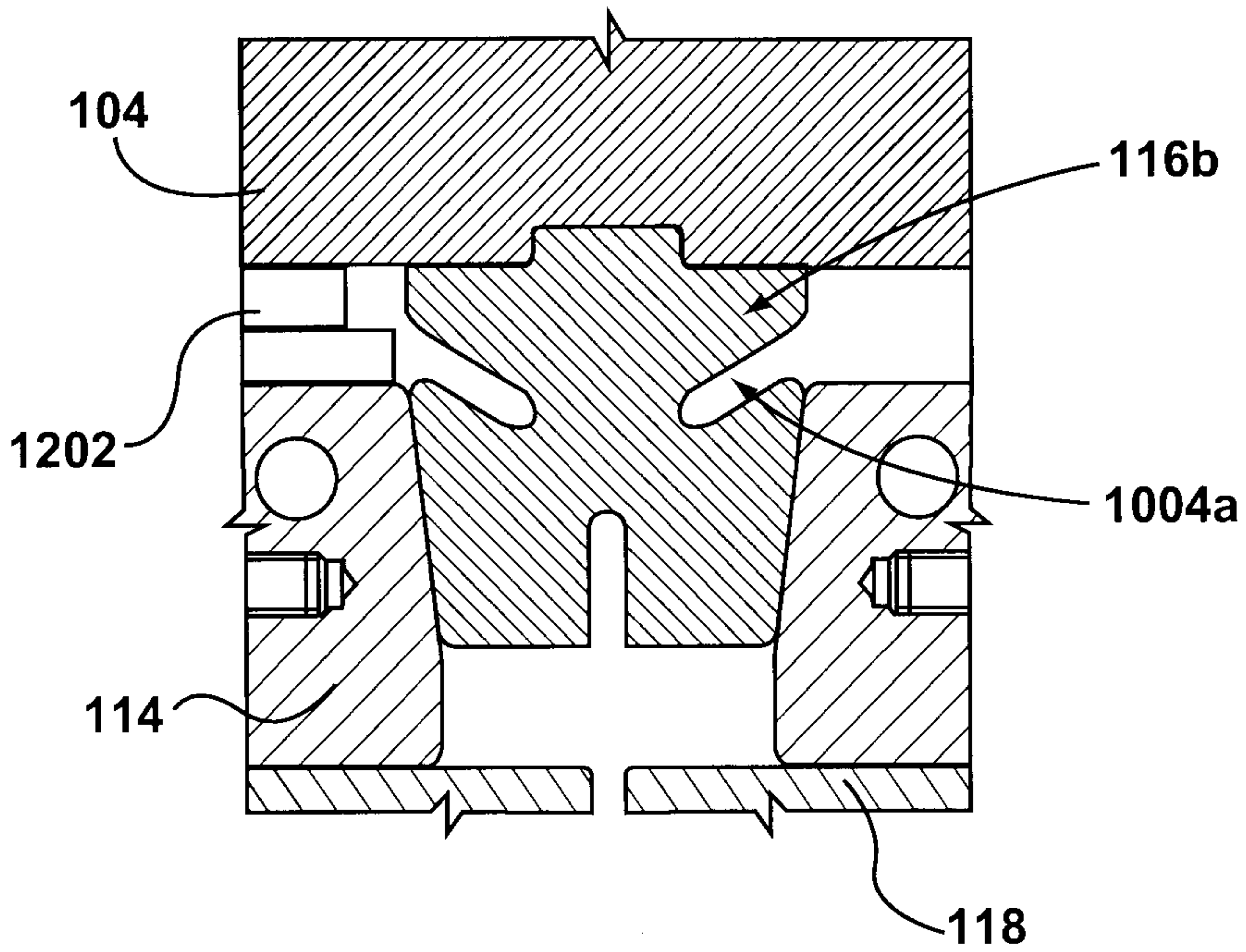


FIG. 12

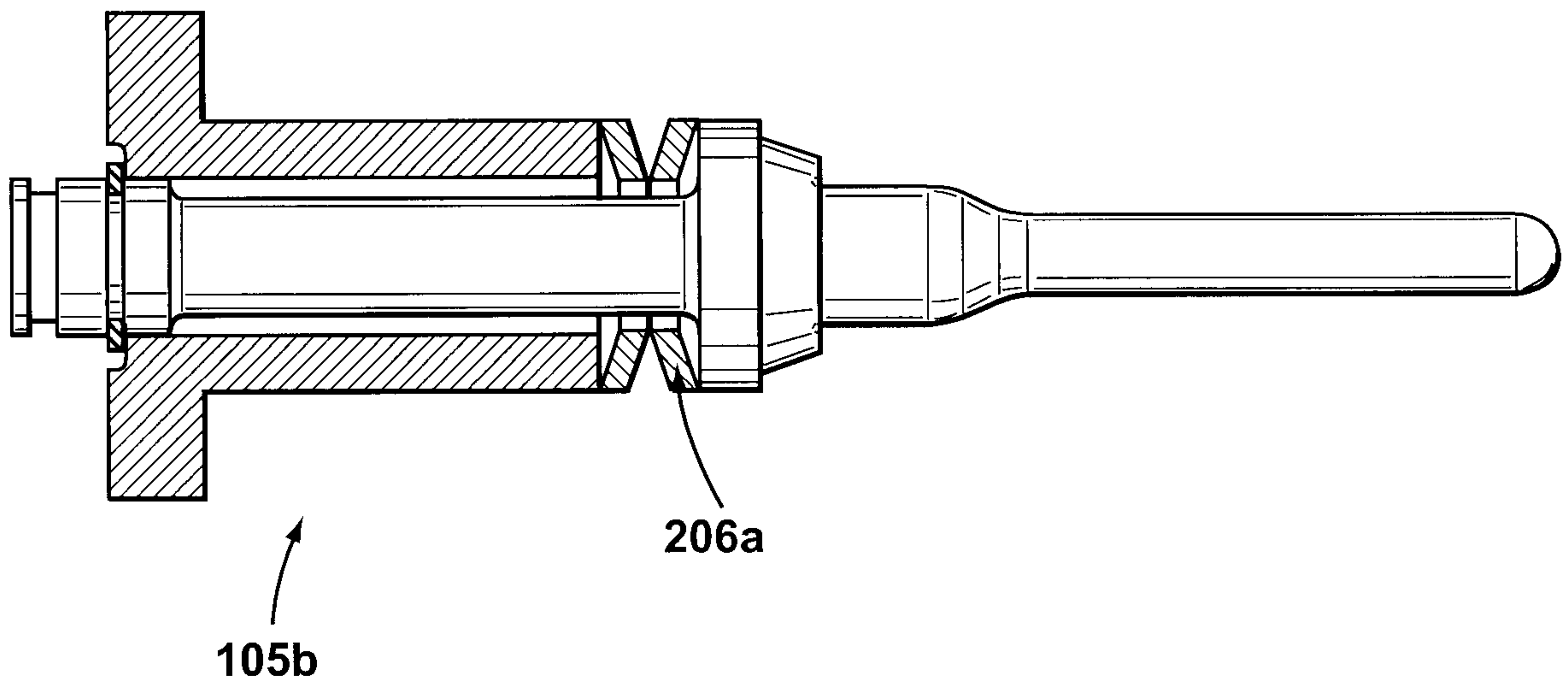


FIG. 13

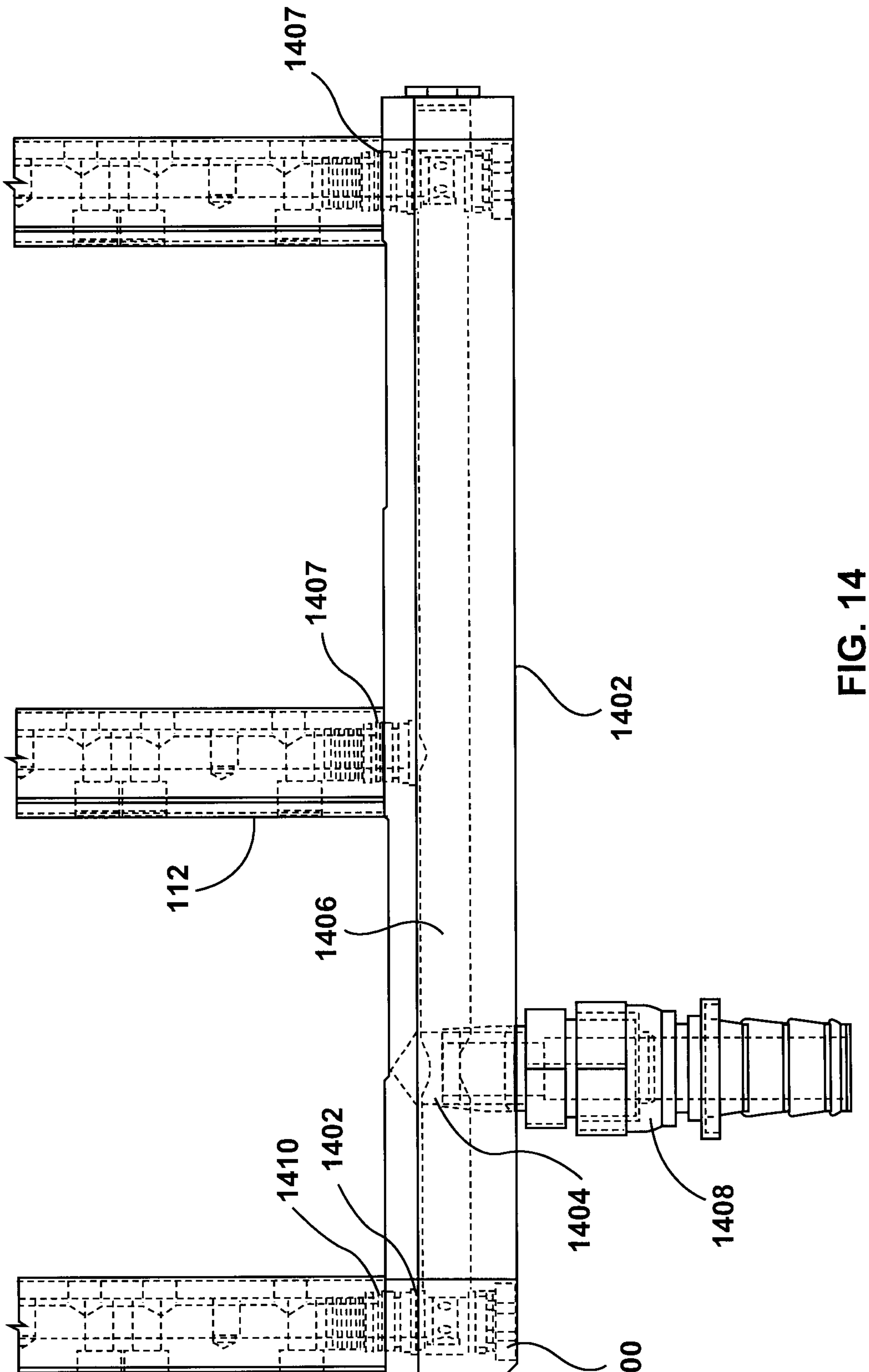


FIG. 14

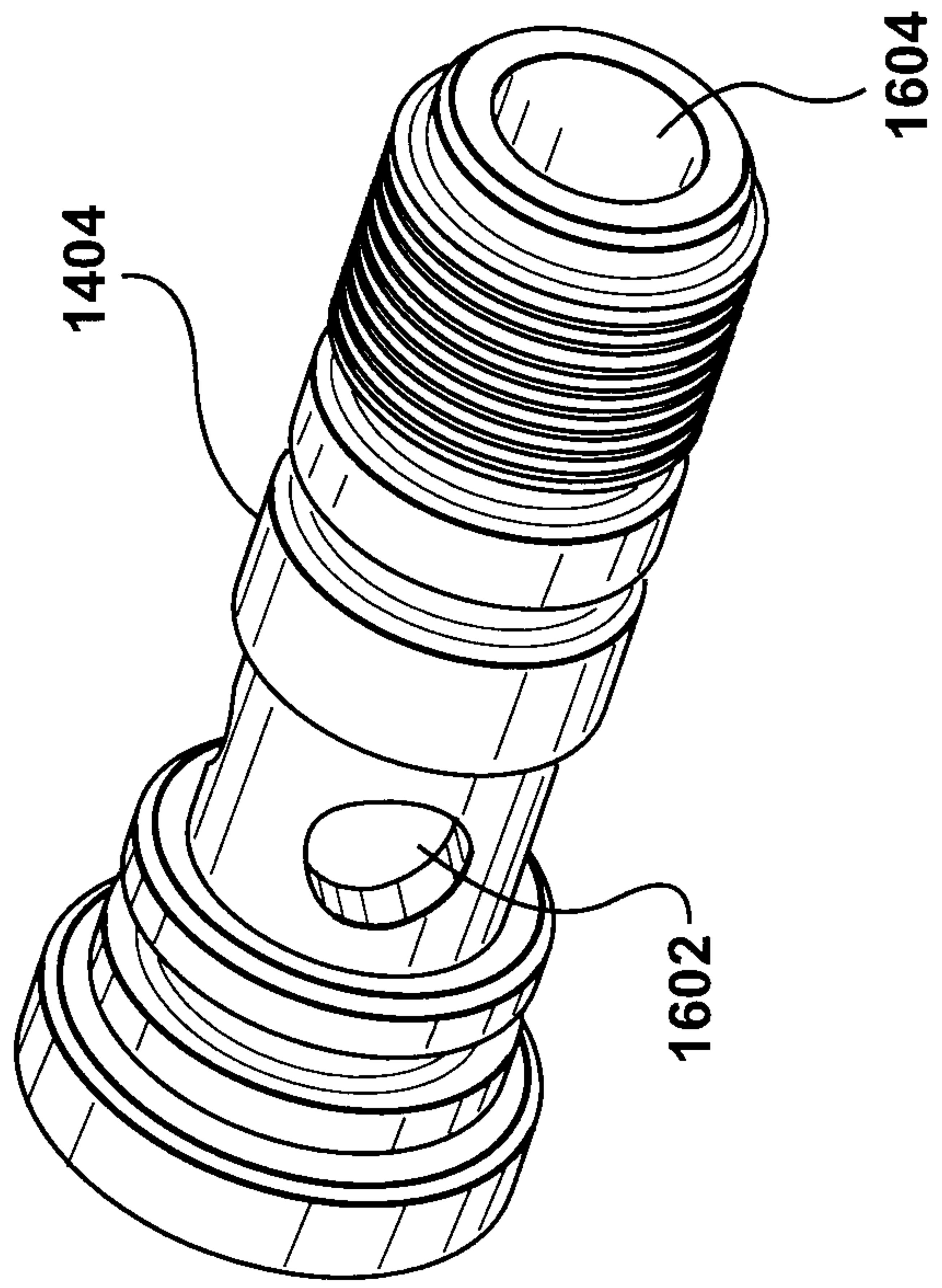


FIG. 16

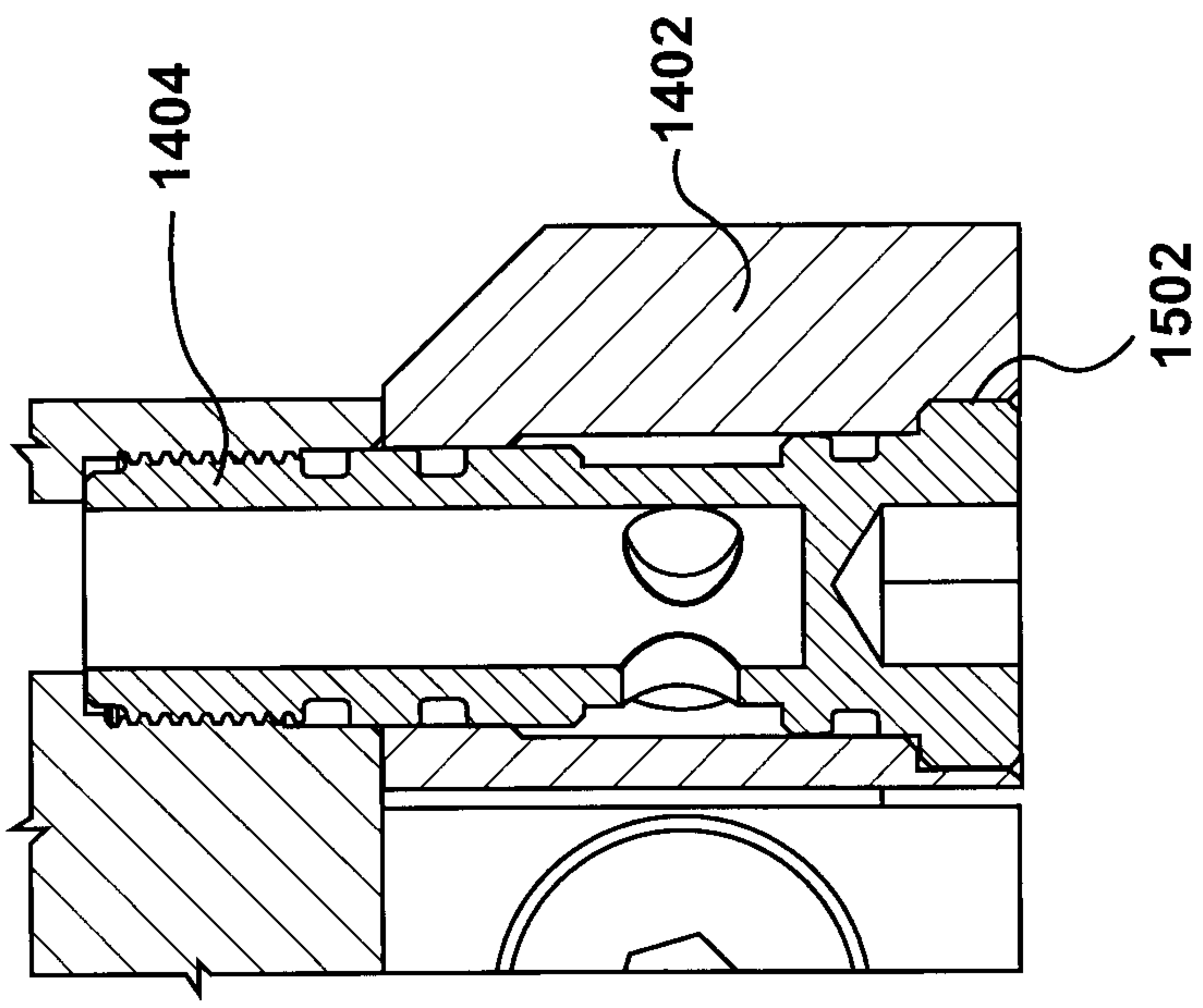
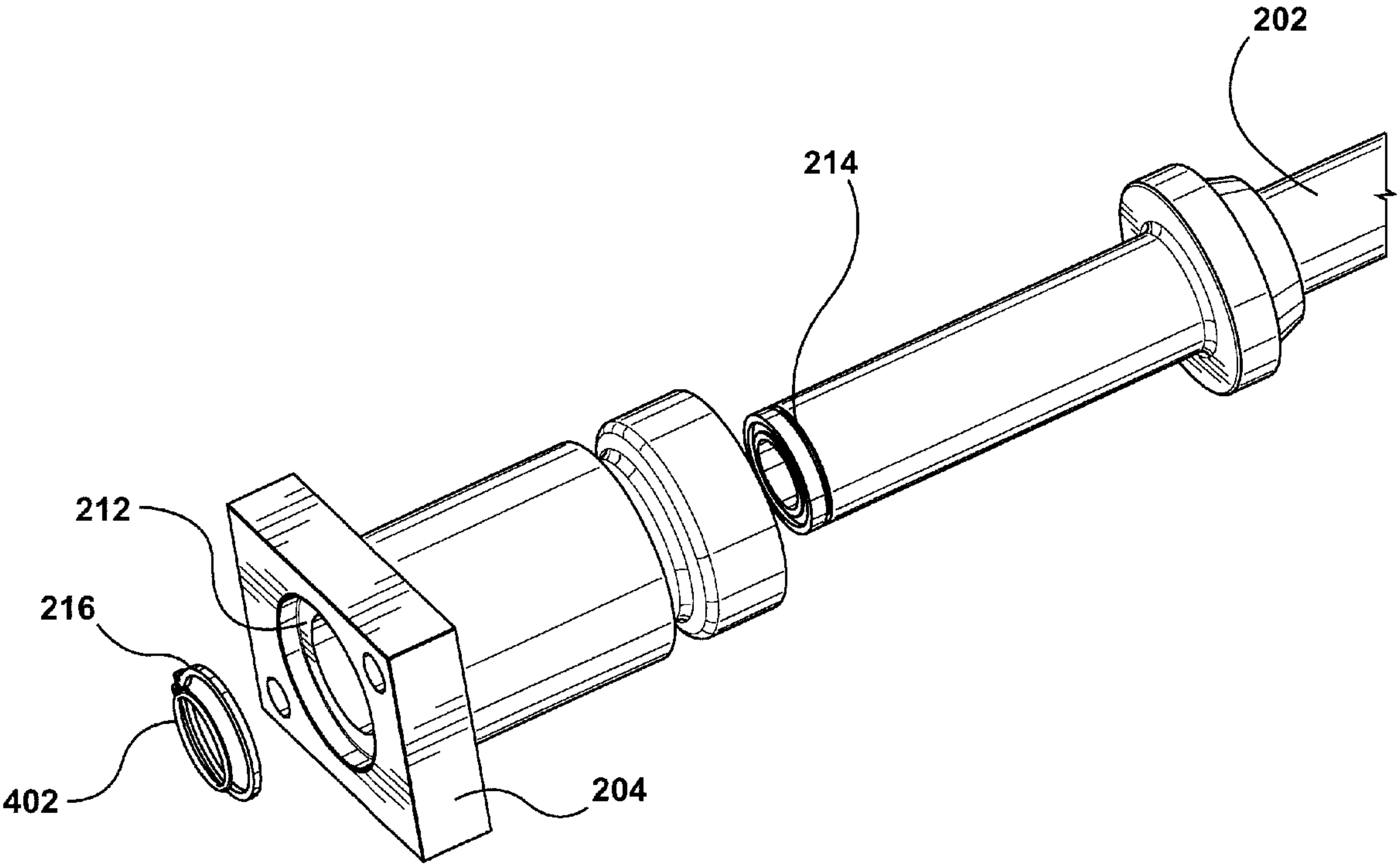


FIG. 15


202
214
212
216
402
204