



(11)

EP 4 571 121 A1

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
18.06.2025 Bulletin 2025/25

(51) International Patent Classification (IPC):
F04D 29/40 ^(2006.01) **F04D 29/42** ^(2006.01)
F04D 29/62 ^(2006.01) **F04B 53/16** ^(2006.01)

(21) Application number: **24220569.8**

(52) Cooperative Patent Classification (CPC):
F04B 53/16; F04D 29/406; F04D 29/426;
F04D 29/628; F04C 2240/30

(22) Date of filing: **17.12.2024**

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB
GR HR HU IE IS IT LI LT LU LV MC ME MK MT NL
NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA
Designated Validation States:
GE KH MA MD TN

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(30) Priority: **17.12.2023 US 202363611187 P**

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(54) **HIGH PRESSURE PUMP**

(57) A high pressure pump (100) includes a housing (102) having a first part (102A) and a second part (102B), a first bracket (106A), and a second bracket (106B). The first part (102A) has a first flange (104A) positioned on a first circumference and the second part (102B) has a second flange (104B) positioned on a second circumference. The first bracket (106A) is positioned adjacent to the first flange (104A). The second bracket (106B) is positioned adjacent to the second flange (104B). The first bracket (106A) and the second bracket (106B) are coupled to one another to press the first part (102A) of the housing against the second part (102B) of the housing. The first bracket (106A) and the second bracket (106B) are substantially parallel to each other.

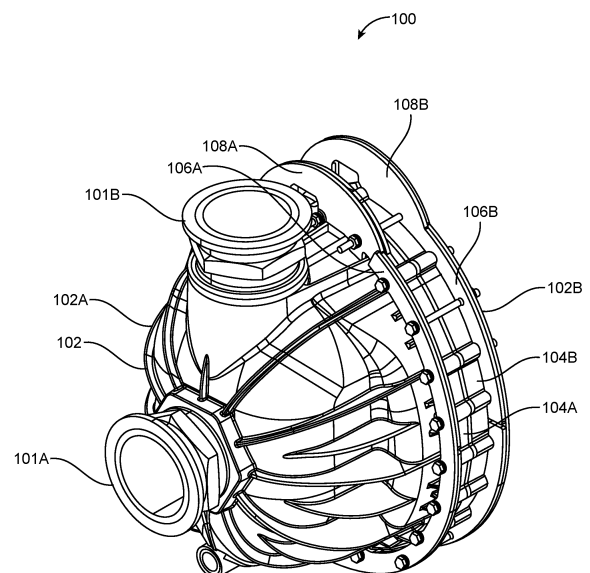


FIG. 1A

Description

RELATED APPLICATIONS

[0001] This application claims priority under 35 U.S.C. §119 to U.S. Provisional Patent Application No. 63/611,187 filed on December 17, 2023, the entire contents of which are incorporated herein by reference.

TECHNICAL FIELD

[0002] The present disclosure generally relates to pumps. More particularly, the exemplary embodiment of the present disclosure relates to a pump that operates at higher pressure/s and a method for manufacturing the same.

BACKGROUND

[0003] Pumps are widely used to transfer fluids (such as water, chemicals, drinks, etc.) in different applications. Depending on the use of a pump in a particular application, pressure builds up inside the pump while operating the pump. For example, the pump may be used for transferring chemicals for agricultural spraying purposes. In some applications, the pump is installed downstream of a high-pressure fluid source (e.g., a secondary pump, fire hydrant, etc.). Further, when a valve connecting the pump to a fluid source is opened or a valve downstream of the pump is closed instantaneously, a water hammer effect can cause a high-pressure surge to the pump. In conventional pumps, high-pressure surges and high-pressure applications can lead to pump deformation or failure. Therefore, the art recognizes a need for an improved pump that can operate under high-pressures.

SUMMARY

[0004] Some embodiments provide a pump including a housing having a first part and a second part, a first bracket, and a second bracket. The first part has a first flange defining a first circumference and the second part has a second flange defining a second circumference. The first bracket is positioned adjacent to the first flange. The second bracket is positioned adjacent to the second flange. The first bracket and the second bracket are coupled to one another to press the first part of the housing against the second part of the housing. The first bracket and the second bracket are substantially parallel to each other.

[0005] In some embodiments, the first flange defines a first flange surface and the second flange defines a second flange surface, the first flange surface being substantially parallel to the second flange surface. The first bracket can define a first bracket surface and the second bracket can define a second bracket surface, the first bracket surface being substantially parallel to the

second bracket surface. In some forms, the first flange surface, the second flange surface, the first bracket surface, and the second bracket surface are all substantially parallel. The first bracket surface can be arranged to abut the first flange surface and the second bracket surface can be arranged to abut the second flange surface. The first flange and the second flange can each include one or more flange through-holes for fastening the first part of the housing to the second part of the housing, and the first bracket and the second bracket can each include one or more bracket through-holes corresponding to the one or more flange through-holes for fastening the first bracket to the first flange and the second bracket to the second flange. The first bracket and the second bracket can each include a protrusion, and a width of the protrusion can be greater than a first width of the first bracket and a second width of the second bracket. One or more of the first bracket and the second bracket can define a notch in the respective protrusion. One or more of the first bracket and the second bracket can be formed of a plurality of arcuate bracket segments. The plurality of arcuate bracket segments can circumferentially abut and overlap one another.

[0006] Some embodiments provide a pump including a first portion and a second portion of a housing and a fastener. The first portion and the second portion are pressed against one another by a first bracket and a second bracket. The fastener is inserted through and secures together the first portion, the second portion, the first bracket, and the second bracket.

[0007] In some embodiments, the first portion includes a body and a plurality of bosses that are spaced circumferentially about the body, and the second portion includes an end plate having a plurality of protrusions that are spaced circumferentially about the end plate. The plurality of bosses can each include a boss surface and the boss surfaces define a first plane, and the plurality of protrusions can each include a protrusion surface and the protrusion surfaces define a second plane, the first plane and the second plane being substantially parallel to one another. A first inward face of the first bracket, a second inward face of the second bracket, the first plane, and the second plane can all be substantially parallel. Each of the plurality of bosses can include a boss through-hole, each of the plurality of protrusions can include a protrusion through-hole, the first bracket can include a plurality of first bracket through-holes and the second bracket can include a plurality of second bracket through-holes. The fastener can be one of a plurality of fasteners inserted through and securing the first portion, the second portion, the first bracket, and the second bracket together. Each of the plurality of fasteners can extend through one of the boss through-holes, one of the protrusion through-holes, one of the first bracket through-holes, and one of the second bracket through-holes. A first subset of the plurality of fasteners can be inserted in a first direction and a second subset of the plurality of fasteners can be inserted in a second direction, and the first direction can be

opposite the second direction.

[0008] Some embodiments provide a method of assembling a pump. The method includes fitting a first portion and a second portion of a housing together, aligning a first through-hole of the first portion with a second through-hole of the second portion, placing a first bracket against the first portion, placing a second bracket against the second portion, aligning a first bracket through-hole of the first bracket with the first through-hole and the second through-hole, aligning a second bracket through-hole of the second bracket with the first through-hole, the second through-hole, and the first bracket through-hole, inserting a fastener through the first bracket through-hole, the first through-hole, the second through-hole, and the second bracket through-hole, and tightening the fastener against the first bracket and the second bracket. In some embodiments, the fastener is tightened against the first bracket and the second bracket, and the first bracket and the second bracket are substantially parallel.

[0009] In another independent aspect, a method for manufacturing a pump includes the steps of manufacturing a first part of a housing of the pump. Further, the first part includes a first flange. The method also includes the steps of manufacturing a second part of the housing of the pump. Further, the second part includes a second flange. The method includes the steps of mounting a first bracket on a first circumference of the first part and mounting a second bracket on a second circumference of the second part. Further, the first bracket is positioned adjacent to a first flange positioned on the first circumference of the first part. Furthermore, the second bracket is positioned adjacent to a second flange positioned on the second circumference of the second part. Moreover, the first bracket and the second bracket are parallel to each other.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010]

FIG. 1A depicts a front left isometric view of a pump according to an embodiment;
 FIG. 1B depicts an exploded view of the pump of FIG. 1A;
 FIG. 2A depicts an exploded view of select components of the pump of FIG. 1A;
 FIG. 2B depicts an isometric view of select components of the pump of FIG. 1A;
 FIG. 2C depicts a front right isometric view of the pump of FIG. 1A;
 FIG. 3 schematically illustrates a flow diagram representing a method for manufacturing the pump of FIG. 1A;
 FIG. 4 depicts an isometric view of a pump according to another embodiment;
 FIG. 5 depicts an exploded view of the pump of FIG. 4;

FIG. 6 depicts a side elevational view of the pump of FIG. 4;

FIG. 7 depicts an isometric view of a pump, according to a further embodiment;

FIG. 8 depicts an exploded view of the pump of FIG. 7; and

FIG. 9 depicts a side elevational view of the pump of FIG. 7.

10 DETAILED DESCRIPTION

[0011] The following discussion is presented to enable a person skilled in the art to make and use embodiments of the invention. Various modifications to the illustrated embodiments will be readily apparent to those skilled in the art, and the generic principles herein can be applied to other embodiments and applications without departing from embodiments of the invention. Thus, embodiments of the invention are not intended to be limited to embodiments shown but are to be accorded the widest scope consistent with the principles and features disclosed herein.

[0012] The following detailed description is to be read with reference to the figures, in which like elements in different figures have like reference numerals. The figures, which are not necessarily to scale, depict selected embodiments and are not intended to limit the scope of embodiments of the invention. Skilled artisans will recognize the examples provided herein have many useful alternatives and fall within the scope of embodiments of the invention. The invention is capable of other embodiments and of being practiced or of being carried out in various ways. Also, it is to be understood that the phraseology and terminology used herein are for the purpose of description and should not be regarded as limiting. For example, the use of "including," "comprising," or "having" and variations thereof herein is meant to encompass the items listed thereafter and equivalents thereof as well as additional items.

[0013] As used herein, unless otherwise specified or limited, the terms "mounted," "connected," "supported," and "coupled" and variations thereof are used broadly and encompass both direct and indirect mountings, connections, supports, and couplings. Further, unless otherwise specified or limited, "connected" and "coupled" are not restricted to physical or mechanical connections or couplings, but can also refer to communicative, electrical, or fluidic couplings.

[0014] As used herein, unless otherwise specified or limited, "at least one of A, B, and C," and similar other phrases, are meant to indicate A, or B, or C, or any combination of A, B, and/or C. As such, this phrase, and similar other phrases can include single or multiple instances of A, B, and/or C, and, in the case that any of A, B, and/or C indicates a category of elements, single or multiple instances of any of the elements of the categories A, B, and/or C.

[0015] Referring to FIGS. 1A and 1B, an isometric view

of an pump 100 according to an embodiment is shown. The pump 100 includes a housing 102. The housing 102 of the pump 100 encloses the internal components of the pump 100. The pump 100 includes a suction port 101A and a discharge port 101B. The suction port 101A acts as an inlet for receiving fluid (such as water, chemicals, etc.) from a source (such as a storage tank, etc.). The discharge port 101B acts as an outlet for moving the fluid from the pump 100 to a container, a sprayer, a nozzle, etc. depending on the application. In some embodiments, the pump 100 is provided in the form of a centrifugal pump, a positive displacement pump, or another known pump type. In some exemplary embodiments, the housing 102 is made up of a polymer material known in the art.

[0016] The pump 100 may be used to transfer the fluid (such as water, chemicals, etc.) from a tank to a sprayer. The pump 100 may also be used to draw liquid from a hopper and mix the liquid into a jetted stream of water that is pushed to the sprayer. In addition, the pump 100 may also be used for liquid transferring operations such as transferring water, liquid fertilizers, and other chemicals compatible with pump materials. Moreover, the pump 100 is also capable of performing other farming operations such as filling nurse tanks, watering seedbeds, and transferring liquids and/or de-watering applications. For performing such operations, the pump 100 generates a pressure of around 10 pounds per square inch ("psi") to around 50 psi. However, at times, while performing such operations, the pressure inside the pump can range between around 50 psi to around 300 psi. To operate the pump 100 under high-pressure conditions, limit stresses on the housing 102, and hold the pump 100 together to prevent deformation or failure of the pump 100 or the pump housing 102, a first bracket 106A and a second bracket 106B can be mounted to the pump 100 as explained below.

[0017] The housing 102 has a first part 102A including a first flange 104A and a second part 102B including a second flange 104B. Further, the first part 102A has a first circumference C1, and the second part 102B has a second circumference C2 (as shown in FIG. 1B). The first circumference C1 is defined by a circumferential edge of the first flange 104A, and the second circumference C2 is defined by a circumferential edge of the second flange 104B. Further, the first circumference C1 and the second circumference C2 are defined at the location where the first part 102A and the second part 102B are designed to abut one another. The first flange 104A and the second flange 104B aide in fastening the first part 102A of the housing 102 to the second part 102B of the housing 102. The first bracket 106A is positioned adjacent to the first flange 104A. Similarly, the second bracket 106B is positioned adjacent to the second flange 104B. The fastening mechanism between the first bracket 106A, the first flange 104A, the second flange 104B, and the second bracket 106B is explained further below with respect to FIG. 2A and FIG. 2B.

[0018] In some embodiments, each of the first bracket

106A and the second bracket 106B comprise a metallic material such as steel, titanium, nickel, bronze, alloys thereof, or other known materials. In some exemplary embodiments, each of the first bracket 106A and the second bracket 106B can be provided in the form of an oval, irregular oval, ellipse, irregular ellipse, obround, circle, among other shapes or segments thereof. In some forms, one or both of the first bracket 106A or the second bracket 106B can be provided in the form of a plurality of bracket segments. In some forms, the bracket segments overlap one another and are axially fastened together.

[0019] Referring to FIG. 2A, an exploded view of select components of the pump 100 is shown. In FIG. 2A, the first flange 104A and the second flange 104B are shown, but the remainder of the housing 102 is rendered transparently to help illustrate how the flanges 104A, 104B, and the brackets 106A, 106B of the pump 100 are aligned and fastened together. The first flange 104A has a first side 104AS1 and a second side 104AS2, the first side 104AS1 facing outward and the second side 104AS2 facing inward. The first side 104AS1 defines a first outer flange surface, which is flat in some instances. The second side 104AS2 can also define a first inner flange surface, which is flat in some instances. In the same way, the second flange 104B has a first side 104BS1 and a second side 104BS2, the first side 104BS1 facing inward and the second side 104BS2 facing outward. Further, the first side 104BS1 defines a second inner flange surface, which is flat in some instances. Also, the second side 104BS2 can define a second outer flange surface, which is flat in some instances.

[0020] As depicted, the first flange 104A includes a plurality of flange through-holes such as at least a first flange through-hole 114A and a second flange through-hole 120A, which extend from the first side 104AS1 to the second side 104AS2. As depicted, the second flange 104B also includes a plurality of flange through-holes such as at least a first flange through-hole 114B and a second flange through-hole 120B, which extend from the first side 104BS1 to the second side 104BS2.

[0021] The through-holes of the first flange 104A can correspond and/or align with the through-holes of the second flange 104B. For example, the first flange through-hole 114B of the second flange 104B corresponds to the first flange through-hole 114A of the first flange 104A. Similarly, the second flange through-hole 120B of the second flange 104B corresponds to the second flange through-hole 120A of the first flange 104A. In some forms, every flange through-hole of the first flange 104A corresponds with a flange through-hole of the second flange 104B.

[0022] Referring further to FIG. 2A, the first bracket 106A has a first side 106AS1 and a second side 106AS2, the first side 106AS1 facing outward and the second side 106AS2 facing inward. The first side 106AS1 defines a first outer bracket surface, which is flat in some instances. The second side 106AS2 defines a first inner bracket surface, which is flat in some instances. The first bracket

106A also includes a plurality of bracket through-holes such as at least a first bracket through-hole 116A and a second bracket through-hole 122A extending from the first side 106AS1 to the second side 106AS2.

[0023] In the same way, the second bracket 106B has a first side 106BS1 and a second side 106BS2, the first side 106BS1 facing inward and the second side 106BS2 facing outward. The first side 106BS1 defines a second inner bracket surface, which is flat in some instances. The second side 106BS2 defines a second outer bracket surface, which is flat in some instances. The second bracket 106B also includes a plurality of through-holes such as at least a first bracket through-hole 116B and a second bracket through-hole 122B extending from the first side 106BS1 to the second side 106BS2.

[0024] The first bracket through-hole 116B of the second bracket 106B corresponds to the first flange through-hole 114B of the second flange 104B. The second bracket through-hole 122B of the second bracket 106B corresponds to the second flange through-hole 120B of the second flange 104B. Similarly, the first bracket through-hole 116A of the first bracket 106A corresponds to the first flange through-hole 114A of the first flange 104A. The second bracket through-hole 122A of the first bracket 106A corresponds to the second flange through-hole 120A of the first flange 104A.

[0025] The arrangement and fastening of the flanges 104A, 104B and the brackets 106A, 106B requires aligning the various through-holes. For example, to fasten the flanges 104A, 104B and the brackets 106A, 106B of the pump 100, the flange through-holes 114A, 120A of the first flange 104A will first be aligned with the corresponding flange through-holes 114B, 120B of the second flange 104B thus bringing the first part 102A and the second part 102B of the housing 102 together. Next, the bracket through-holes 116A, 122A of the first bracket 106A are aligned with the corresponding flange through-holes 114A, 120A of the first flange 104A. Then, the bracket through-holes 116B, 122B of the second bracket 106B are aligned with the corresponding flange through-holes 114B, 120B of the second flange 104B.

[0026] By mapping the flange through-holes with their corresponding bracket through-holes, the first side 104AS1 of the first flange 104A is positioned adjacent to the second side 106AS2 of the first bracket 106A. Further, the second side 104AS2 of the first flange 104A is positioned adjacent to the first side 104BS1 of the second flange 104B. Furthermore, the second side 104BS2 of the second flange 104B is positioned adjacent to the first side 106BS1 of the second bracket 106B.

[0027] With the flanges 104A, 104B and the brackets 106A, 106B aligned and in proper position (and/or fastened together), various elements will be substantially parallel to one another to ensure an even distribution of tensile and compression forces. For example, the first inner bracket surface on side 106AS2 of the first bracket 106A can be adjacent to and/or abut the first outer flange surface on side 104AS1 of the first flange 104A. Further,

the second inner bracket surface on side 106BS1 of the second bracket 106B can be adjacent to and/or abut the second outer flange surface on side 104BS2 of the second flange 104B. When the first flange 104A and the second flange 104B are properly aligned, or are fastened together, the first outer flange surface can be substantially parallel to the second outer flange surface. Similarly, when the first bracket 106A and the second bracket 106B are properly aligned, or are fastened together, the first inner bracket surface can be substantially parallel to the second inner bracket surface. Additionally, when the flanges 104A, 104B and the brackets 106A, 106B are all properly aligned, or are fastened together, the first outer flange surface, the second outer flange, the first inner bracket surface, and the second inner bracket surface can all be substantially parallel with one another.

[0028] After aligning the flange through-holes of the flanges 104A, 104B and the bracket through-holes of the brackets 106A, 106B, one or more fasteners (such as nuts and bolts) are utilized to fasten together the flanges 104A, 104B and the brackets 106A, 106B. As depicted, a plurality of bolts 118A fasten the first bracket 106A, the first part 102A, the second part 102B, and the second bracket 106B together. When assembled, the first part 102A and the second part 102B contact one another and are pressed together by the first bracket 106A and the second bracket 106B. For example, the bolt 118A can be inserted through the first bracket through-hole 116A of the first bracket 106A, the corresponding first flange through-hole 114A of the first flange 104A, the corresponding first flange through-hole 114B of the second flange 104B, and the corresponding first bracket through-hole 116B of the second bracket 106B. Then, a first nut 118B threadably engages and is tightened along the first bolt 118A to secure the first bracket 106A, first part 102A, the second part 102B, and the second bracket 106B together. This process can be repeated with respect to the other bracket through-holes and flange through-holes, which are distributed circumferentially around the first bracket 106A, the second bracket 106B, the first flange 104A, and the second flange 104B. In some instances, the first nuts 118B are respectively tightened on the first bolts 118A according to a star pattern, e.g., tighten over a first through-hole, then tighten over a through-hole opposite the first, then tighten over a second through-hole adjacent to the first through-hole, then tighten over a through-hole opposite the second through-hole.

[0029] During assembly, some of the bolts 118A may be inserted into the through-holes in different directions. As shown best in FIG. 1B, a first subset 128A of the bolts 118A can be inserted through the first bracket 106A, the first part 102A, the second part 102B, and the second bracket 106B in first direction 130A, and a second subset 128B of the bolts 118A can be inserted through the second bracket 106B, the second part 102B, the first part 102A, and the first bracket 106A in a second direction 130B that is opposite the first direction 130A.

In some instances, the first subset 128A is larger and/or positioned lower than the second subset 128B. Thus, heads 132 of bolts 118A of the first subset 128A contact the first side 106AS1 of the first bracket 106A, and nuts 118B are threadably engaged with the first subset 128A and in contact the second side 106BS2 of the second bracket 106B. Conversely, heads 132 of bolts 118A of the second subset 128B contact the second side 106BS2 of the second bracket 106B and nuts 118B are threadably engaged with the second subset 128B and in contact the first side 106AS1 of the first bracket 106A. In some instances, the second subset 128B is installed after the first subset 128A.

[0030] In some forms, each of the first bracket 106A and the second bracket 106B can also have one or more bracket through-holes that do not have any corresponding flange through-hole on either the first flange 104A or the second flange 104B. For example, the first bracket 106A has an extra bracket through-hole 126A and the second bracket 106B has an extra bracket through-hole 126B. The extra through-hole 126A corresponds with the extra through-hole 126B on the second protrusion 108B. These two extra through-holes 126A, 126B are fastened together with the fasteners to provide additional compression of the first part 102A against the second part 102B of the pump 100 via the brackets 106A, 106B.

[0031] Referring to FIG. 2B, in some forms, the first bracket 106A has a first protrusion 108A and the second bracket 106B has a second protrusion 108B. As can be seen, a width PW1 of the first protrusion 108A is greater than a first width BW1 of the first bracket 106A that is measured on a non-protrusion portion of the first bracket 106A. Moreover, a width PW2 of the second protrusion 108B is greater than a second width BW2 of the second bracket 106B that is measured on a non-protrusion portion of the second bracket 106B.

[0032] In some embodiments, the first width BW1 of the first bracket 106A and the second width BW2 of the second bracket 106B range from 10 millimeters to 50 millimeters. In some embodiments, the width PW1 of the first protrusion 108A and the width PW2 of the second protrusion 108B range from 30 millimeters to 80 millimeters. In some embodiments, a first thickness PT1 of the first bracket 106A and a second thickness PT2 of the second bracket 106B range from 1 millimeter to 20 millimeters. Further, in some instances, the pump 100 includes a relatively large number bolts 118A and respective nuts 118B (e.g., greater than 20). In some instances, a maximum distance Dmax is defined between the bolts 118A to ensure that the first part 102A and the second part 102B of the pump 100 sufficiently distribute the forces caused by high-pressure applications.

[0033] With reference to FIG. 2C, the first part 102A of the housing 102 defines a fill port 140 and a drain port 142. A fill plug 144 sealably and/or threadably fits into the fill port 140. Similarly, a drain plug 146 sealably and/or threadably fits into the drain port 142. The protrusions 108A, 108B respectively define first and second notches

148A, 148B, which are shaped and/or sized to accommodate the fill port 140 and/or the fill plug 144. Additionally, a tool (e.g., a hook, rope, a clip, etc.) may be inserted through the first and/or second notches 148A, B to transport the pump 100.

[0034] FIG. 3 depicts a flow diagram of a method 300 for manufacturing a pump 100. The method starts at step 302. At step 304, the first part 102A of the housing 102 of the pump 100 is manufactured. Further, the first part 102A includes the first flange 104A. In some exemplary embodiments, the first part 102A of the housing 102, including the first flange 104A, is manufactured through a polymer-molding process known in the art. Although the present disclosure mentions only the polymer-molding process herein, it is understood that any other known manufacturing process for the first part 102A is also within the scope of the present disclosure.

[0035] At step 306, the second part 102B of the housing 102 of the pump 100 is manufactured. Further, the second part 102B includes the second flange 104B. In some exemplary embodiments, the second part 102B of the housing 102, including the second flange 104B, is also manufactured through the polymer-molding process that is obvious to a person skilled in the art. Although the present disclosure mentions only the polymer-molding process herein, it is understood that any other known manufacturing process for the second part 102B is also within the scope of the present disclosure.

[0036] At step 308, the first bracket 106A is manufactured and mounted on the first circumference C1 of the first part 102A. The procedure for mounting the first bracket 106A adjacent to the first flange 104A of the first part 102A is explained above in conjunction with FIG. 2A. Further, the first bracket 106A is manufactured using a machining process, metal cutting process (e.g., laser cutting, water jet, etc.), sheet metal process (including blanking, bending, drawing, stamping), or any other processes known in the art.

[0037] At step 310, the second bracket 106B is manufactured and mounted on the second circumference C2 of the second part 102B. The procedure for mounting the second bracket 106B adjacent to the second flange 104B of the second part 102B is explained above in conjunction with FIG. 2A. Further, the second bracket 106B is manufactured using a machining process, metal cutting process (e.g., laser cutting, water jet, etc.), sheet metal process (including blanking, bending, drawing, stamping), or any other processes known in the art.

[0038] Furthermore, the first bracket 106A is positioned adjacent to the first flange 104A positioned on the first circumference C1 of the first part 102A. The second bracket 106B is positioned adjacent to the second flange 104B positioned on the second circumference C2 of the second part 102B. The first bracket 106A and the second bracket 106B are parallel to each other. The method 300 ends at step 312.

[0039] Turning to FIGS. 4-6, a pump 400 according to an embodiment is illustrated. The pump 400 includes an

impeller 402 (see FIG. 5) disposed in a housing 404 and operatively connected to a motor 406. In the illustrated example of FIG. 4, the pump 400 is depicted as a centrifugal pump. The impeller 402 defines a rotation axis R.

[0040] The housing 404 includes a first portion 410 and a second portion 412 that are sealably engaged with one another and pressed together by a first bracket assembly 414 and a second bracket assembly 416. Threaded fasteners 418 extend through and secure together the first bracket assembly 414, the first portion 410, the second portion 412, and the second bracket assembly 416. As discussed above, in some instances, the threaded fasteners 418 each include a bolt 420 and a nut 422. In some instances, during assembly, the threaded fasteners 418 are tightened according to a star pattern, which is described above.

[0041] The first portion 410 includes inlet port 430 extending axially outward from a body 432 of the first portion 410. The inlet port 430 is generally cylindrical and thus extends circumferentially about an inlet axis I. In some instances, the inlet axis I is colinear with the rotational axis R. An outlet port 434 extends tangentially from and is transitionally connected to the body 432. The outlet port 434 is also generally cylindrical and thus extends circumferentially about an outlet axis O, which, in some instances, is substantially orthogonal to the inlet axis I and/or the rotational axis R. The inlet port 430 and the outlet port 434 respectively define an inlet opening 436 and an outlet opening 438, which are in fluid communication with one another via the body 432. Bosses 440 are spaced circumferentially about the inlet axis I and/or the rotation axis R around the outer circumference of the body 432. The bosses 440 also extend axially and radially outward from the body 432 and engage the first bracket assembly 414.

[0042] The second portion 412 includes a motor mount 450 and a pedestal 452 extending axially from an end plate 454. Protrusions 456 are spaced circumferentially about the rotation axis R, extend radially from the end plate 454, and engage the second bracket assembly 416. Each boss 440 corresponds to and/or is paired with one of the protrusions 456. The motor 406 is mounted to and extends axially from the motor mount 450.

[0043] The first bracket assembly 414 is formed of a plurality of arcuate first bracket segments 460 that axially abut and overlappingly layer with one another. Similarly, the second bracket assembly 416 is formed of a plurality of arcuate second bracket segments 462 that axially abut and overlappingly layer with one another. In some instances, the first bracket assembly 414 and the second bracket assembly 416 are formed of a metallic material such as steel, titanium, nickel, bronze, alloys thereof, or other known materials. In some instances, the first bracket assembly 414 and the second bracket assembly 416 are not formed of a plurality of bracket segments but are instead integrally formed.

[0044] Turning to FIG. 5, each of the bosses 440 defines a boss through-hole 470 and has a substantially flat,

outwardly facing boss surface 472. The boss surfaces 472 are coplanar with one another and define a first plane. Similarly, each of the protrusions 456 defines a protrusion through-hole 474 and has a substantially flat, outwardly facing protrusion surface 476. The protrusion surfaces 476 are coplanar with one another and define a second plane. Further, the first bracket assembly 414 defines first bracket through-holes 478 and has a first outward face 480a and a first inward face 480b, which are both substantially flat. In some forms, the first outward face 480a and the first inward face 480b are parallel. Similarly, the second bracket assembly 416 defines second bracket through-holes 482 and has a second outward face 484a and a second inward face 484b, which are both substantially flat. In some forms, the second outward face 484a and the second inward face 484b are parallel. When the pump 400 is properly assembled, the first plane and the second plane are substantially parallel. Further, in some forms, the first plane, the second plane, the first inward face 480b, and the second inward face 484b are substantially parallel.

[0045] The first bracket assembly 414 is annular and forms a closed ring. The second bracket assembly 416 is also annular, but defines a notch 490 and thus forms a split ring. Each of the boss through-holes 470, the protrusion through-holes 474, the first bracket through-holes 478, and the second bracket through-holes 482 respectively correspond to and align with one another. Thus, the bolts 420 may be respectively inserted and extend through the second bracket through-holes 482, the protrusion through-holes 474, the boss-through holes 470, and the first bracket through-holes 478 to threadably mate with the nuts 422.

[0046] Additionally, an O-ring 500 is mounted to the second portion 412 to sealably engage with the first portion 410. The impeller 402 is rotatably supported by the second portion 412 and drivably engaged with the motor 406.

[0047] Referring to FIG. 6, the first portion 410 and the second portion 412 mateably and/or sealably fit together and are pressed together between the first bracket assembly 414 and the second bracket assembly 416, which are collectively secured by the threaded fasteners 418. More specifically, the nut 422 contacts and engages the first outward face 480a. The first inward face 480b contacts and engages the boss surface 472. The second inward face 484b contacts and engages the protrusion surface 476. Further, a head 510 of the bolt 420 contacts and engages the second outward face 484a.

[0048] Additionally, the pedestal 452 includes a foot 520 and a stem 522 extending axially from the end plate 454. More specifically, the foot 520 extends from a perimeter 524 (e.g., a circumference) of the end plate 454. Further, the stem 522 extends radially between the foot 520 and the motor mount 450. The notch 490 (shown in FIG. 5) accommodates the stem 522.

[0049] In operation, internal pressurization of the housing 404 places outward axial and radial forces on the first

portion 410 and the second portion 412. The first bracket assembly 414 and the second bracket assembly 416 provide radial tensile and/or compressive reaction forces via the bosses 440 and the protrusions 456. Thus, the first bracket assembly 414 and the second bracket assembly 416 provide structural support to the housing 404, particularly under load.

[0050] With reference to FIGS. 7-9, a pump 700 according to an embodiment is illustrated. The pump 700 includes a housing 704 that rotatably supports a shaft 706, which is configured to driveably connect to a motor (not shown) via keyway 708. In the illustrated example of FIG. 7, the pump 700 is depicted as a roller pump. The shaft 706 defines a rotational axis R.

[0051] The housing 704 includes a first portion 710 and a second portion 712 that are sealably engaged with one another and pressed together between a first bracket assembly 714a and a second bracket assembly 714b. Threaded fasteners 418 extend through and secure together the first bracket assembly 714a, the first portion 710, the second portion 712, and the second bracket assembly 714b. As discussed above, in some instances, the threaded fasteners 418 each include the bolt 420 and the nut 422. In some instances, during assembly, the threaded fasteners 418 are tightened according to a star pattern, which is described above.

[0052] The first portion 710 includes an inlet port 730 extending radially outward from a body 732 of the first portion 710. The inlet port 730 is generally cylindrical and extends circumferentially about an inlet axis I. In some instances, the inlet axis I is orthogonal with the rotational axis R. An outlet port 734 extends radially outwardly from the body 732. The outlet port 734 is also generally cylindrical and extends circumferentially about an outlet axis O, which, in some instances, is substantially colinear with the inlet axis I and/or orthogonal with the rotational axis R. The inlet port 730 and the outlet port 734 respectively define an inlet opening 736 and an outlet opening 738, which are in fluid communication with one another via the body 732. Bosses 740 are spaced circumferentially about the rotation axis R around the outer circumference of the body 732. The bosses 740 also extend axially along the body 732 and engage the first bracket assembly 714a.

[0053] The second portion 712 includes a bearing collar 750 and support ribs 752 extending axially from an end plate 754. The support ribs 752 extend radially from the bearing collar 750 and are circumferentially spaced about the rotation axis R. Protrusions 756 are spaced circumferentially about the rotation axis R, extend radially from the end plate 754, and engage the second bracket assembly 714b. Each boss 740 corresponds to and/or is paired with one of the protrusions 756. The bearing collar 750 is generally cylindrical and extends circumferentially about the rotation axis R. A bearing 758 is sealably mounted in the bearing collar 750.

[0054] The first bracket assembly 714a and the second bracket assembly 714b are formed of a plurality of arc-

uate first bracket segments 760 that axially abut and overlappingly layer with one another. In some instances, the first bracket assembly 714a and the second bracket assembly 714b are not formed of a plurality of bracket segments but are instead integrally formed.

[0055] Turning to FIG. 8, each of the bosses 740 defines a boss through-hole 770 and has a substantially flat, outwardly facing boss surface 772. The boss surfaces 772 are coplanar with one another and define a first plane. Similarly, each of the protrusions 756 defines a protrusion through-hole 774 and has a substantially flat, outwardly facing protrusion surface 776. The protrusion surfaces 776 are coplanar with one another and define a second plane. Further, the first bracket assembly 714a and the second bracket assembly 714b define bracket through-holes 778 and each have an outward face 780a and an inward face 780b, which are also substantially flat. In some forms, the outward faces 780a and the inward faces 780b are parallel. When the pump 700 is properly assembled, the first plane and the second plane are substantially parallel. Further, in some forms, the first plane, the second plane, the outward faces 780a and the inward faces 780b are substantially parallel.

[0056] The first bracket assembly 714a and the second bracket assembly 714b are rounded (e.g., provided in the form of an oval, irregular oval, ellipse, irregular ellipse, obround, circle, etc.) and form a closed ring. Each of the boss through-holes 770, the protrusion through-holes 774, and the bracket through-holes 778 respectively correspond and align with one another. Thus, the bolts 420 may be respectively inserted and extend through the bracket through-holes 778, the second protrusion through-holes 774, and the boss through-holes 770 to threadably mate with the nuts 422.

[0057] Additionally, a roller carrier 800 is rotatably connected to the second portion 712 via the bearing 758 and driveably connected to the shaft 706. A plurality of rollers 802 are rollably and slidably captured by the roller carrier 800 and the second portion 712.

[0058] Referring to FIG. 9, the first portion 710 and the second portion 712 mateably and/or sealably fit together and are pressed together between the first bracket assembly 714a and the second bracket assembly 714b, which are collectively secured by the threaded fasteners 418. More specifically, the nut 422 contacts and engages the outward face 780a of the first bracket assembly 714a. The inward face 780b of the first bracket assembly 714a contacts and engages the boss surface 772. The protrusion surface 776 contacts and engages the inward face 780b of the second bracket assembly 714b. Further, the head 510 of the bolt 420 contacts and engages the outward face 780a of the second bracket assembly 714b.

[0059] Additionally, the first portion 710 includes a shaft collar 820 and support ribs 822 extending axially from the body 732. The support ribs 822 extend radially from the shaft collar 820 and are circumferentially spaced about the rotation axis R. The shaft collar 820 is generally cylindrical and thus extends circumferentially about the

rotation axis R.

[0060] In operation, internal pressurization of the housing 704 places outward axial and radial forces on the first portion 710 and the second portion 712. The first bracket assembly 714a and the second bracket assembly 714b provide radial tensile and/or compressive reaction forces via the bosses 740 and the protrusion 756. Thus, the first bracket assembly 714a and the second bracket assembly 714b provide structural support to the housing 704, particularly under load.

[0061] Referring to FIGS. 4-9, it should be understood that one or more of the first and second bracket assemblies 414, 416, 714a, 714b and similarly configured brackets may be adapted to additional types of pumps beyond the depicted example pumps 400, 700. Further, one or more of the first and second bracket assemblies 414, 416, 714a, 714b and similarly configured brackets may be retrofitted onto existing pumps.

[0062] The present disclosure offers the following technical advantages over the existing pumps: a) provides brackets on respective circumferences of the first part and the second part of the pump housing to sustain the high-pressure surge, b) avoids/prevents pump deformation or failure at high pressures due to the brackets on the respective circumferences of the first part and the second part, c) allows the pump to achieve higher internal pressure before rupturing through the use of brackets.

[0063] It will be appreciated by those skilled in the art that while the disclosure has been described above in connection with particular embodiments and examples, the disclosure is not necessarily so limited, and that numerous other embodiments, examples, uses, modifications and departures from the embodiments, examples, and uses are intended to be encompassed by the claims attached hereto. The entire disclosure of each patent and publication cited herein is incorporated by reference, as if each such patent or publication were individually incorporated by reference herein. Various features and advantages of the disclosure are set forth in the following claims.

Claims

1. A pump, comprising:

a housing having a first part and a second part, the first part having a first flange defining a first circumference and the second part having a second flange defining a second circumference; a first bracket positioned adjacent to the first flange; and a second bracket positioned adjacent to the second flange, the first bracket and the second bracket are coupled to one another to press the first part of the housing against the second part of the housing, and

the first bracket and the second bracket are substantially parallel to each other.

2. The pump of claim 1, wherein the first flange defines a first flange surface and the second flange defines a second flange surface, the first flange surface being substantially parallel to the second flange surface.
3. The pump of claim 1 or 2, wherein the first bracket defines a first bracket surface and the second bracket defines a second bracket surface, the first bracket surface being substantially parallel to the second bracket surface.
4. The pump of claim 1, wherein the first flange defines a first flange surface, the second flange defines a second flange surface, the first bracket defines a first bracket surface, and the second bracket defines a second bracket surface, and the first flange surface, the second flange surface, the first bracket surface, and the second bracket surface are all substantially parallel.
5. The pump of claim 3 or 4, wherein the first bracket surface is arranged to abut the first flange surface and the second bracket surface is arranged to abut the second flange surface.
6. The pump of any one of claims 1 to 5, wherein the first flange and the second flange each include one or more flange through-holes for fastening the first part of the housing to the second part of the housing, and the first bracket and the second bracket each include one or more bracket through-holes corresponding to the one or more flange through-holes for fastening the first bracket to the first flange and the second bracket to the second flange.
7. The pump of any one of claims 1 to 6, wherein the first bracket and the second bracket each include a protrusion, and a width of the protrusion is greater than a first width of the first bracket and a second width of the second bracket.
8. The pump of claim 7, wherein one or more of the first bracket and the second bracket define a notch in the respective protrusion.
9. The pump of any one of claims 1 to 8, wherein one or more of the first bracket and the second bracket are formed of a plurality of arcuate bracket segments.
10. The pump of claim 9, wherein the plurality of arcuate bracket segments circumferentially abut and overlap one another.
11. The pump of any one of claims 1 to 10, wherein the first part includes a body and a plurality of bosses that

are spaced circumferentially about the body, and the second part includes an end plate having a plurality of protrusions that are spaced circumferentially about the end plate.

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- 12.** The pump of claim 11, wherein the plurality of bosses each include a boss surface and the boss surfaces define a first plane, and the plurality of protrusions each include a protrusion surface and the protrusion surfaces define a second plane, the first plane and the second plane being substantially parallel to one another. 10
- 13.** The pump of claim 12, wherein a first inward face of the first bracket, a second inward face of the second bracket, the first plane, and the second plane are all substantially parallel. 15
- 14.** The pump of claim 11 or 12, wherein each of the plurality of bosses includes a boss through-hole, each of the plurality of protrusions includes a protrusion through-hole, the first bracket includes a plurality of first bracket through-holes and the second bracket includes a plurality of second bracket through-holes. 20 25
- 15.** The pump of claim 14, wherein each of a plurality of fasteners extends through one of the boss through-holes, one of the protrusion through-holes, one of the first bracket through-holes, and one of the second bracket through-holes. 30

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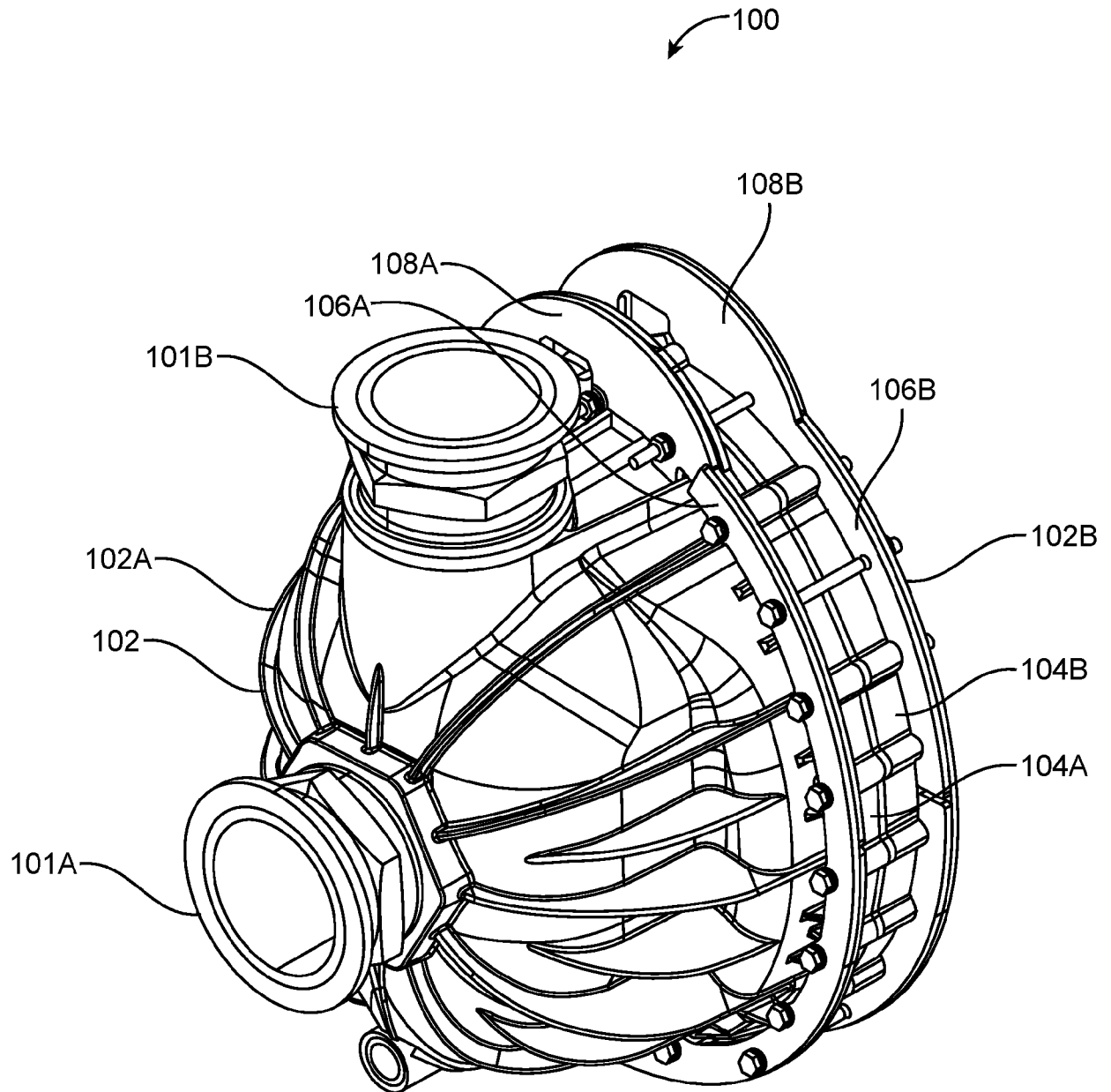


FIG. 1A

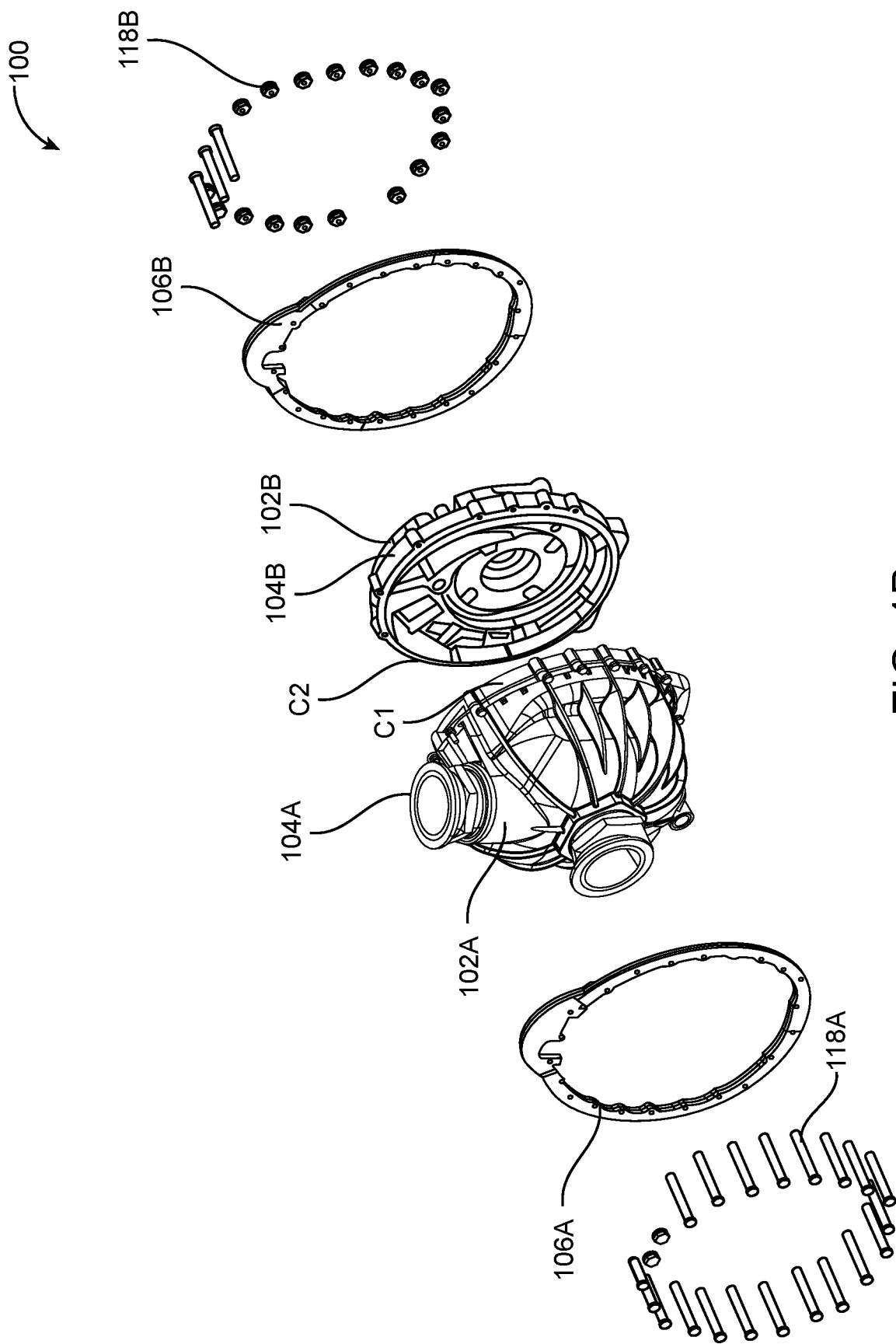


FIG. 1B

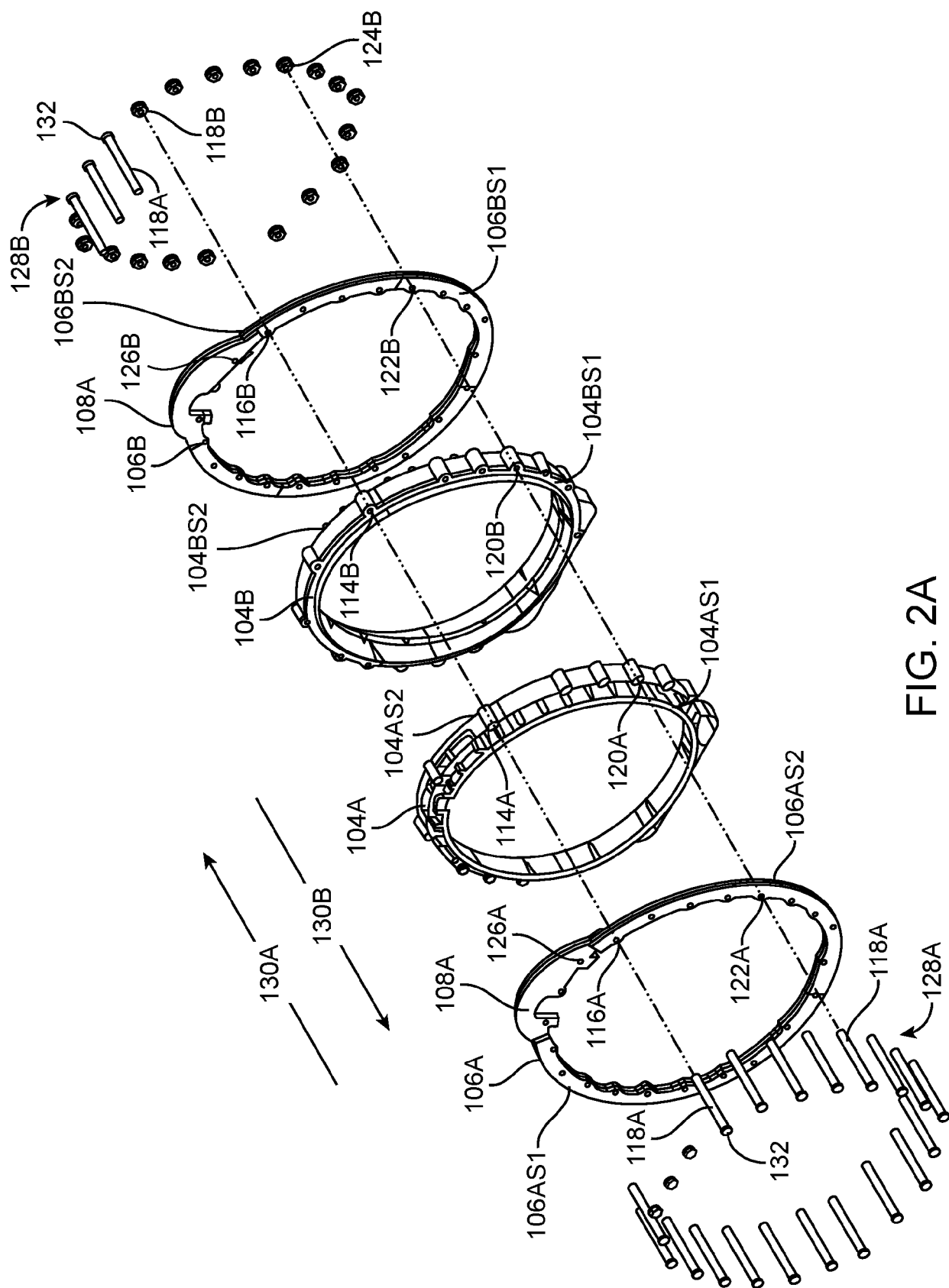


FIG. 2A

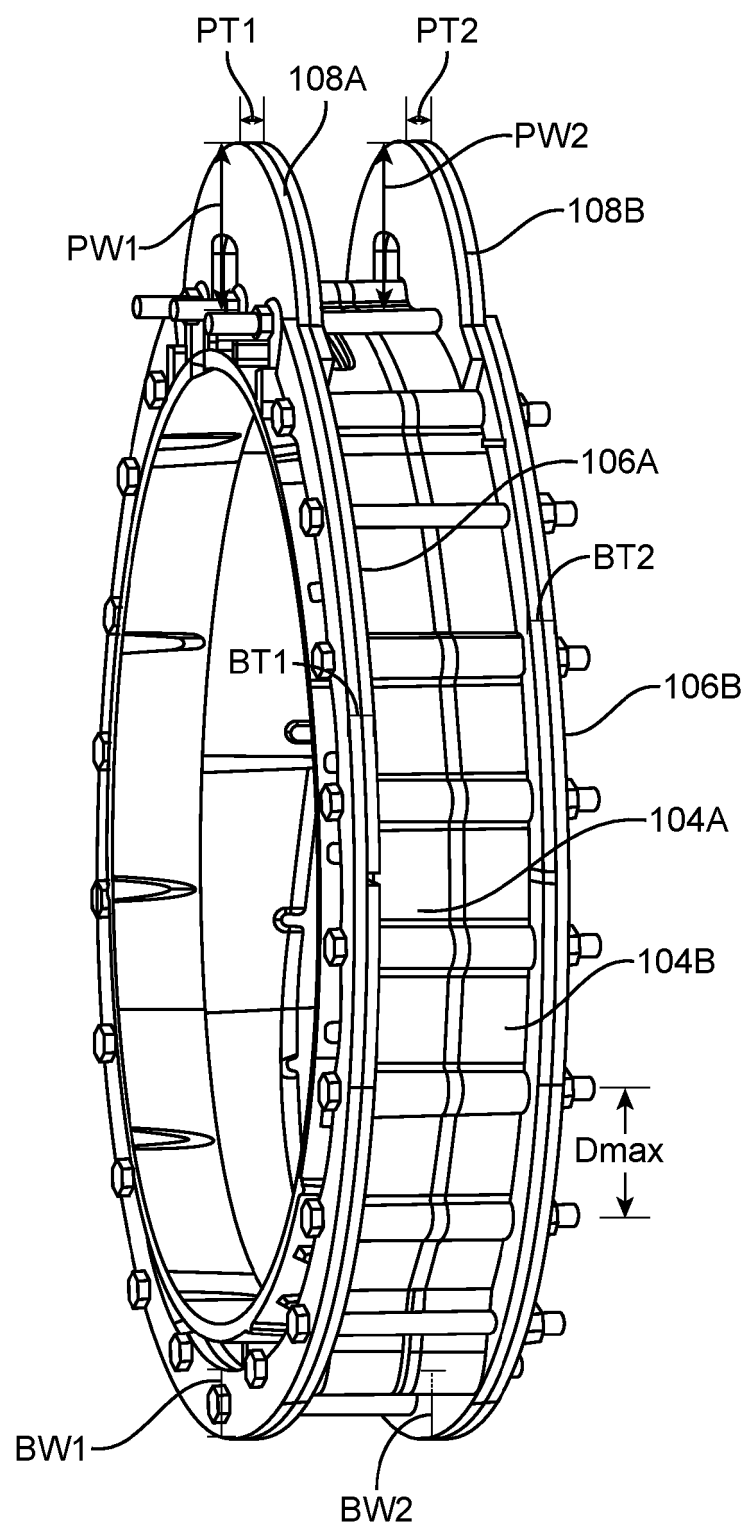


FIG. 2B

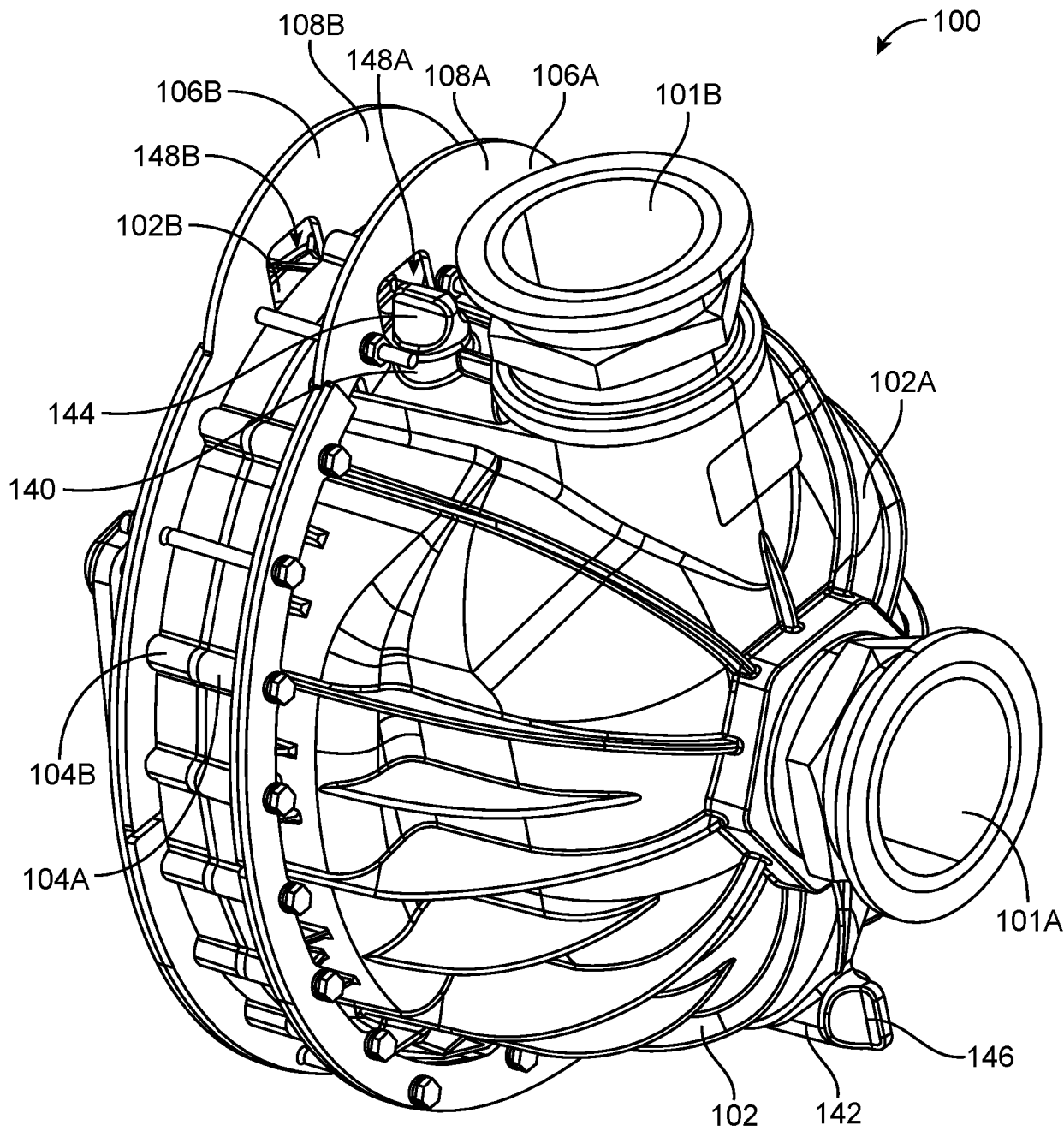


FIG. 2C

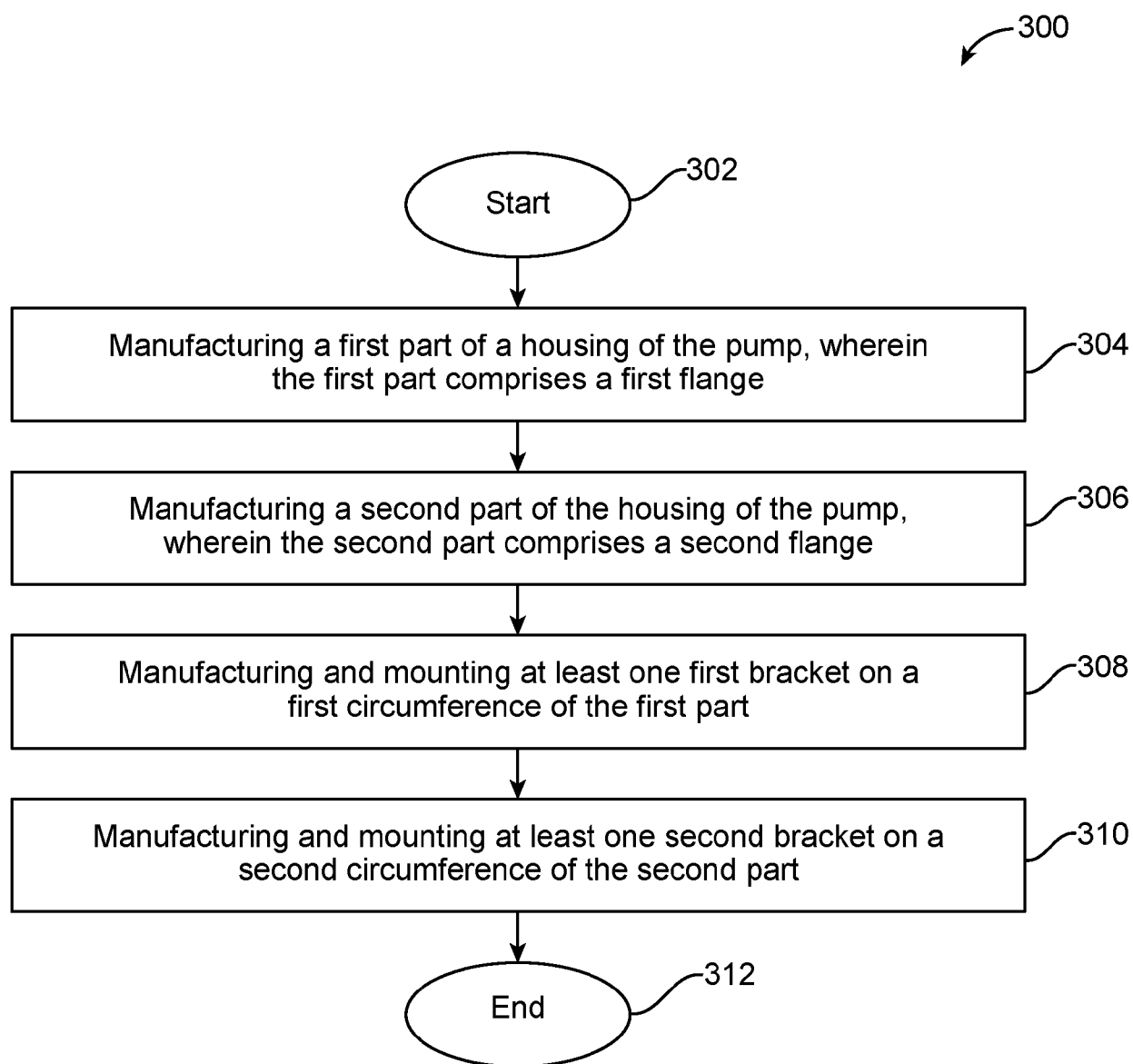


FIG. 3

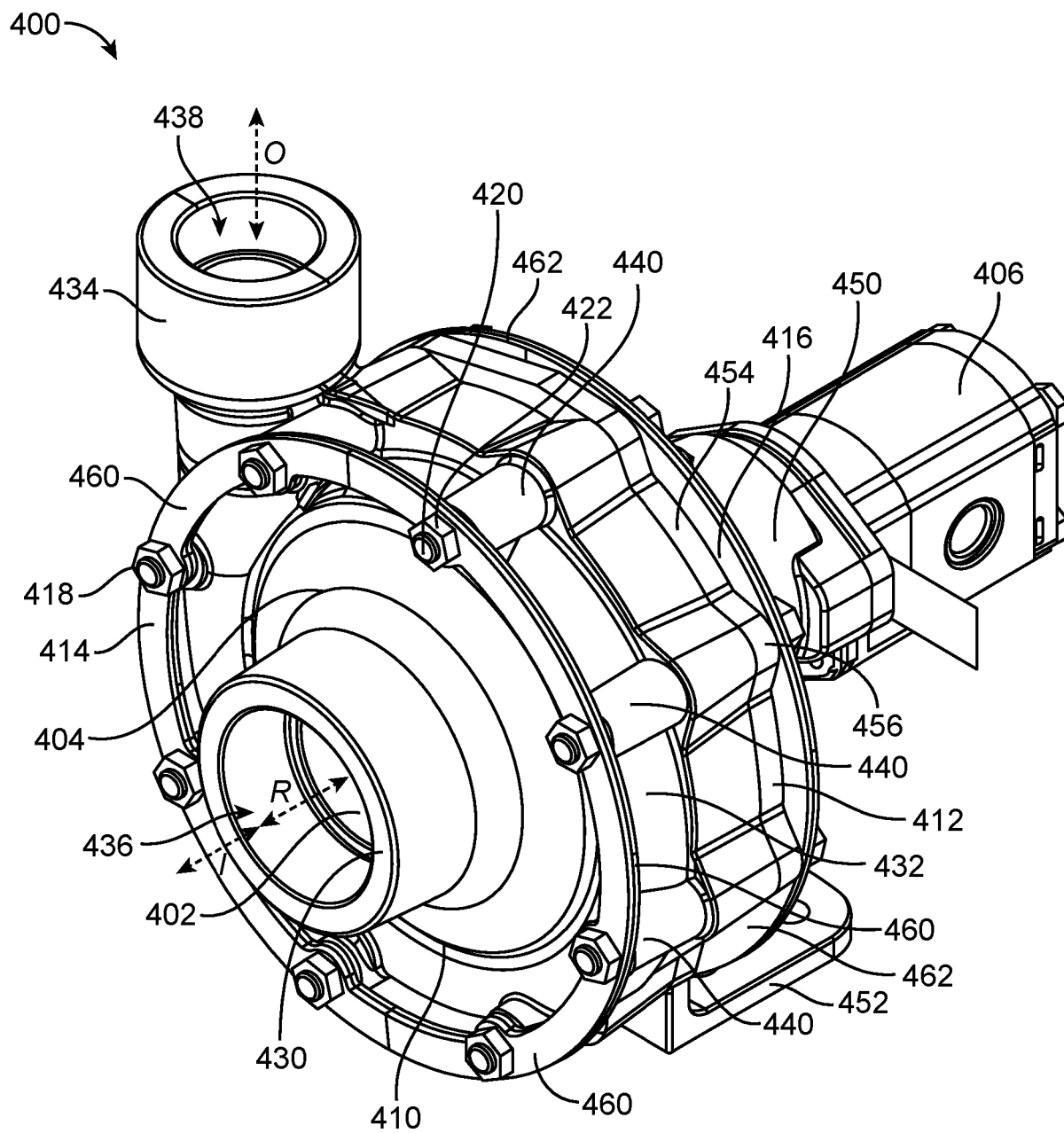


FIG. 4

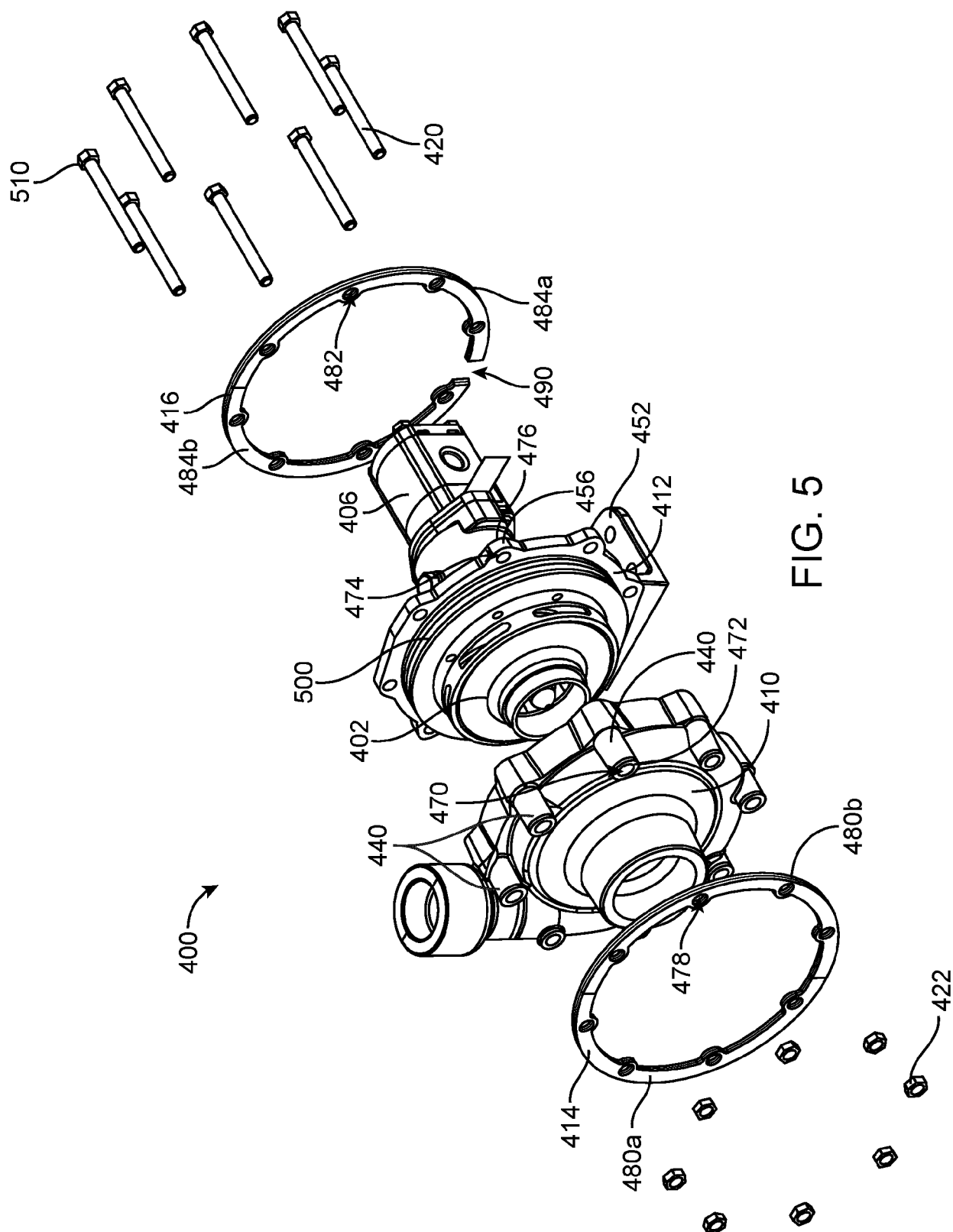


FIG. 5

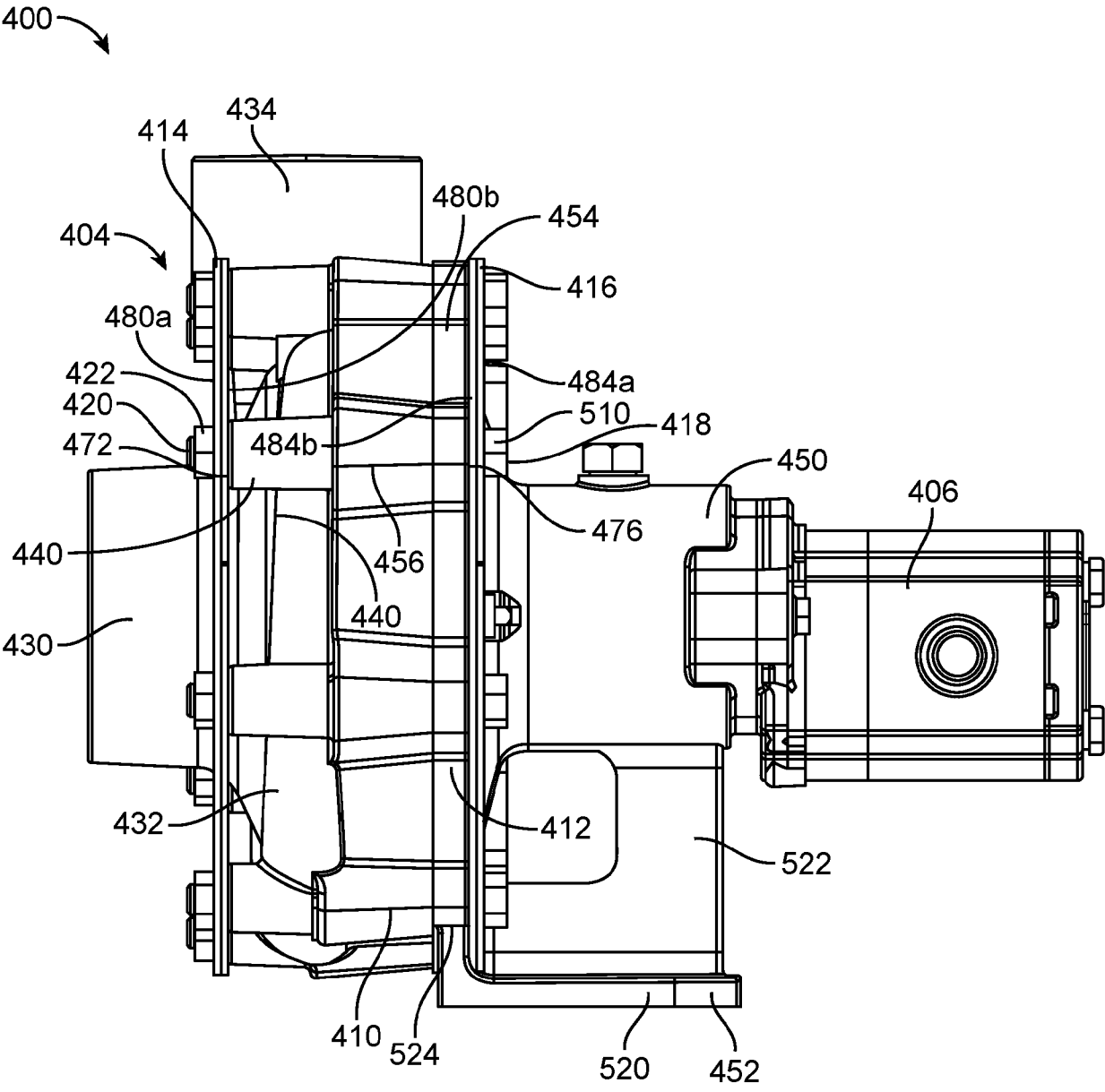


FIG. 6

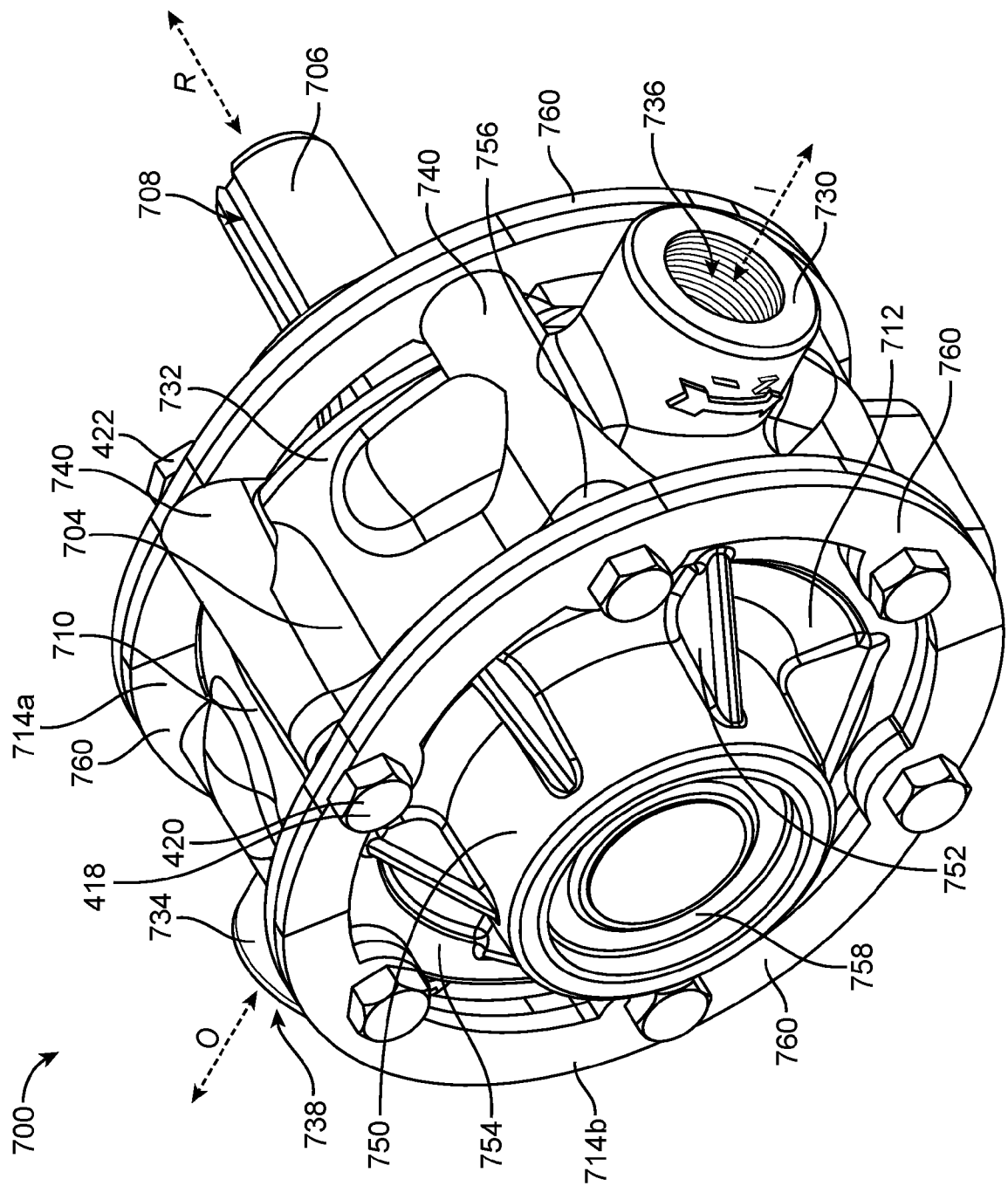


FIG. 7

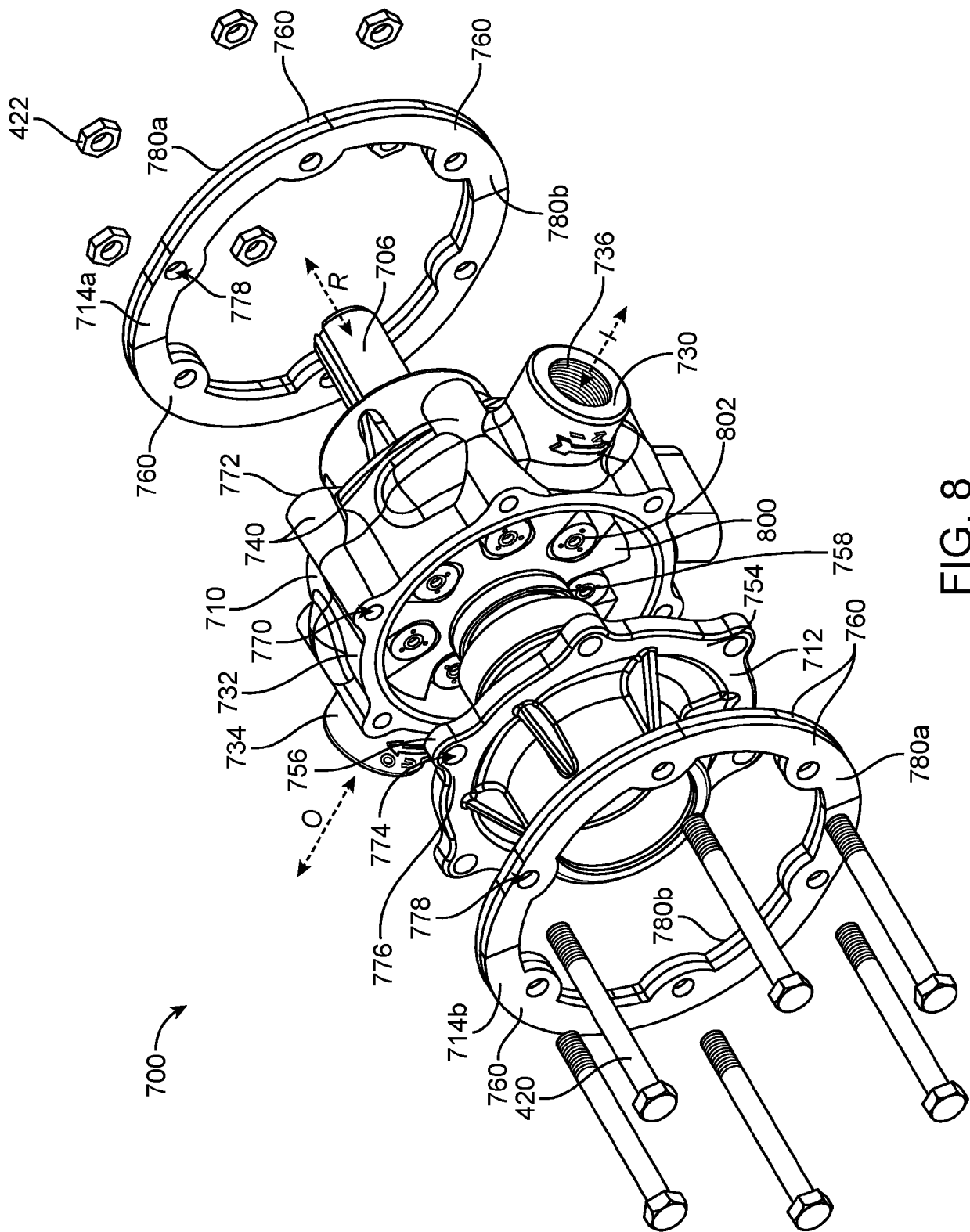


FIG. 8

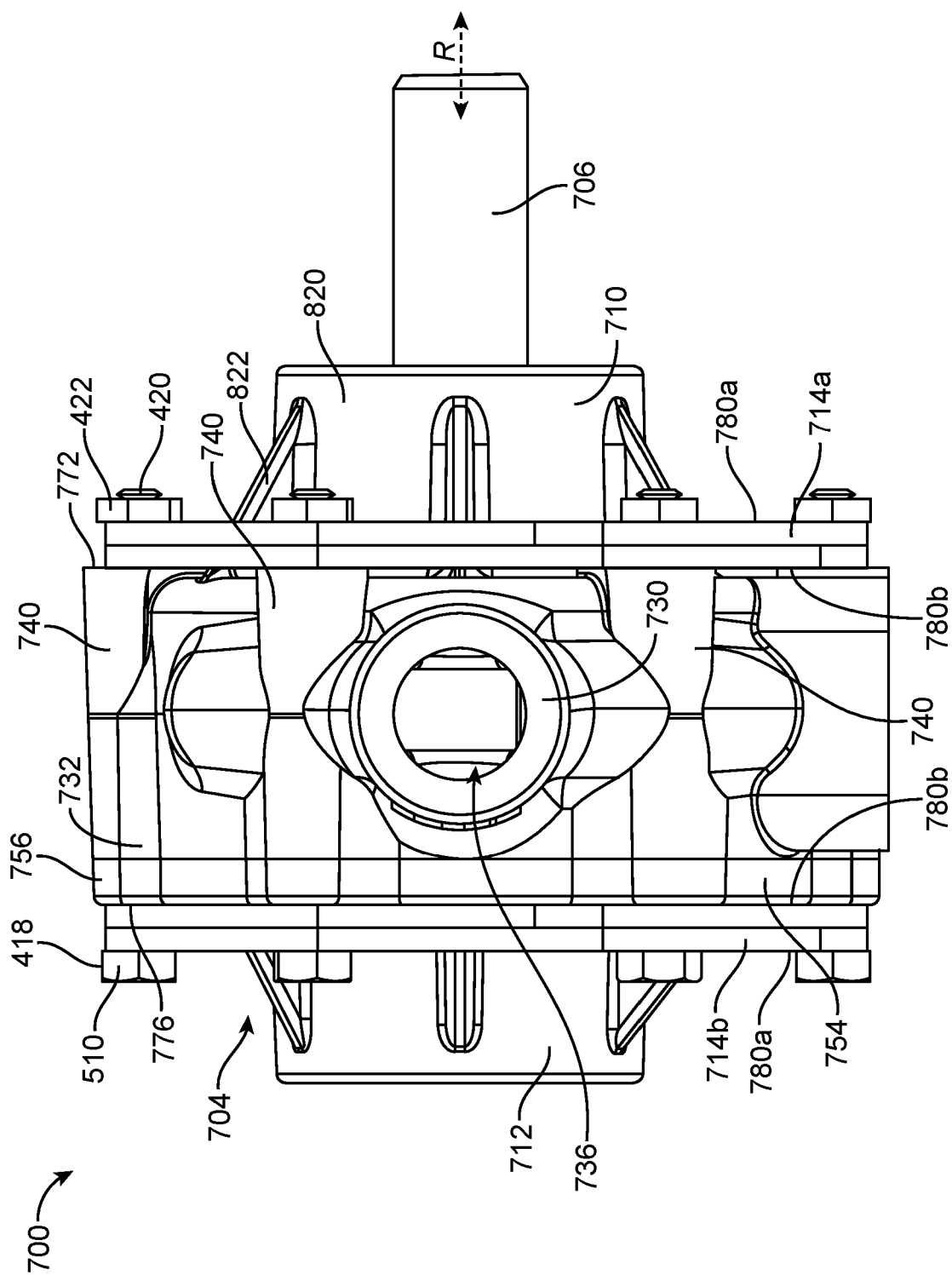


FIG. 9



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The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 30 January 2025	Examiner Olona Laglera, C
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