



(51) International Patent Classification:

F04D 29/42 (2006.01) F04D 29/22 (2006.01)

F04D 7/02 (2006.01) F04D 29/62 (2006.01)

(21) International Application Number:

PCT/AU2021/050521

(22) International Filing Date:

28 May 2021 (28.05.2021)

(25) Filing Language:

English

(26) Publication Language:

English

(30) Priority Data:

63/032,104 29 May 2020 (29.05.2020) US

2020902178 29 June 2020 (29.06.2020) AU

(71) Applicant (for all designated States except MG): WEIR

SLURRY GROUP, INC. [US/US]; 2701 South Stoughton Road, Madison, Wisconsin 53716 (US).

(71) Applicant (for MG only): WEIR MINERALS AUS-

TRALIA LTD [AU/AU]; 1 Marden Street, Artarmon, New South Wales 2064 (AU).

(72) Inventors: KOSMICKI, Randy James; 1138 Leslie Drive,

Edgerton, Wisconsin 53534 (US). BOURGEOIS, Ronald Joseph; 1296 Dolan Drive, Sun Prairie, Wisconsin 53590 (US).

(74) Agent: DAVIES COLLISON CAVE PTY LTD; 255

Elizabeth Street, Sydney, New South Wales 2000 (AU).

(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM,

AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DJ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, IT, JO, JP, KE, KG, KH, KN, KP, KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, WS, ZA, ZM, ZW.

(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH,

GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Published:

— with international search report (Art. 21(3))

(54) Title: ALIGNMENT PORTIONS ON MAIN LINER FOR A PUMP

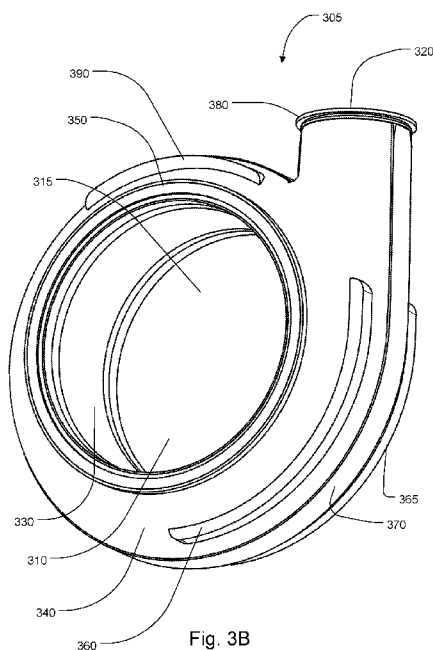


Fig. 3B

(57) Abstract: Disclosed is a main liner for a centrifugal pump having a main pumping chamber, the main liner being located within an outer housing of the centrifugal pump, when in use, and comprising: a main pumping chamber; an inlet opening for the introduction of a liquid into the main pumping chamber; a discharge outlet extending from the main pumping chamber; and an outer surface of the discharge outlet for contact with the outer housing for the liner, the outer surface having at least one alignment portion for engaging with a corresponding alignment portion on the outer housing, the engagement of the alignment portion with the corresponding alignment portion limiting movement of the discharge outlet relative to the outer housing.



ALIGNMENT PORTIONS ON MAIN LINER FOR A PUMP

Technical Field

[001] The present invention generally relates to minerals processing equipment and more particularly to replaceable wear parts for minerals processing equipment.

Background

[002] Many parts of mining equipment suffer abrasion due to the movement of slurry through or over the equipment. The slurry may vary in concentration of solid particles, size of the solid particles, shape of solid particles, and composition of a solution suspending the particles. The parts, exposed to high rates of wear, may be designed for replacement to improve operational lifespans of the mining equipment. Once the part is sufficiently worn, the part is replaced.

[003] The parts may be used in different types of mining equipment, such as a slurry pump which is a type of pump designed for pumping liquid containing solid particles. Variations in design and construction of the pump may occur to account for the various different types of slurry. An example of a slurry pump is a centrifugal pump.

[004] Due to the abrasive nature of the medium being pumped, such pumps experience a very high wear rate on their internal parts, such as the main liner that houses the impeller and the side liners located on either side of the main liner. The side liners include a front side liner that is located on the inlet side of the impeller and a rear side liner that is located on the opposing side of the impeller. In particular, the side liner located on the inlet side of the pump (which is also referred to as a front side liner or a throatbush) and the main liner (which is also referred to as a volute liner) are both subjected to a great deal of wear.

[005] As a result of the wear, many of the internal parts are replaceable wear parts. Typically the main liner and the side liners of a slurry pump may be replaceable. Such wear parts may be made of an elastomer, such as natural rubber, polyurethane or neoprene, or made of wear resistant cast alloys. Due to cost, alloy wear parts are typically used for situations where an elastomer wear part is not suitable, such as when the slurry contains particles with coarse or sharp edges or for high operating temperatures or velocities.

[006] Elastomer wear parts are used where possible, although there is variation of wear resistance between different types of elastomers. For example, natural rubber exhibits better wear resistance than synthetic elastomers such as neoprene or butyl. However, synthetic elastomers may have other desirable properties such as greater chemical resistance than natural rubber.

[007] The wear parts may be attached to a non-wearing part or located within a housing. In the case of an elastomer main liner, the liner is located within an outer housing, also known as a casing. Positioning of the main liner within the outer housing is important during installation and operation of a pump to ensure correct operation of the main liner.

[008] The preferred embodiments of the present invention seek to address one or more of these disadvantages, and/or to at least provide the public with a useful alternative.

[009] The reference in this specification to any prior publication (or information derived from the prior publication), or to any matter which is known, is not, and should not be taken as an acknowledgment or admission or any form of suggestion that the prior publication (or information derived from the prior publication) or known matter forms part of the common general knowledge in the field of endeavour to which this specification relates.

Summary

[010] This Summary is provided to introduce a selection of concepts in a simplified form that are further described below in the Detailed Description. This Summary is not intended to identify essential features of the claimed subject matter, nor is it intended to be used to limit the scope of the claimed subject matter.

[011] In a one embodiment, there is provided by way of example only a main liner for a centrifugal pump having a main pumping chamber, the main liner being located within an outer housing of the centrifugal pump, when in use, and comprising: a main pumping chamber; an inlet opening for the introduction of a liquid into the main pumping chamber; a discharge outlet extending from the main pumping chamber; and an outer surface of the discharge outlet for contact with the outer housing for the liner, the outer surface having at least one alignment portion for engaging with a corresponding alignment portion on the outer housing, the

engagement of the alignment portion with the corresponding alignment portion limiting movement of the discharge outlet relative to the outer housing.

[012] In one embodiment the alignment portion limits movement of the discharge outlet in a direction towards the main pumping chamber of the liner.

[013] In one embodiment the alignment portion limits movement of the main liner in a direction opposite to a flow direction of the liquid as the liquid exits the discharge outlet when in use.

[014] In one embodiment the alignment portion limits movement of the discharge outlet in a direction away from the main pumping chamber of the liner.

[015] In one embodiment the alignment portion limits movement of the liner in either direction axially of the discharge outlet.

[016] In one embodiment the fluid is a slurry.

[017] In one embodiment the alignment portion is formed from a plurality of discontinuous segments.

[018] In one embodiment the alignment portion limits movement of the discharge outlet to maintain sealing of the discharge outlet.

[019] In one embodiment the liner is formed from a first and second part and the alignment portion of the discharge outlet enables alignment of the first and second part within the outer housing.

[020] In one embodiment the alignment portion is located at an end of the discharge outlet.

[021] In one embodiment, there is provided by way of example only a main liner for a centrifugal pump, the liner being located within an outer housing of the centrifugal pump, when in use, and comprising: a main pumping chamber; an inlet opening for the introduction of an liquid into a main pumping chamber; a discharge outlet extending from the main pumping

chamber; and an outer surface of the main pumping chamber for contact with the outer housing for the liner, the outer surface having at least one alignment portion located on a face of the main liner for engaging with a corresponding alignment portion on the outer housing, the engagement of the alignment portion with the corresponding alignment portion limiting movement of the main pumping chamber of the liner relative to the outer housing in a direction parallel to an axis or rotation of an impeller of the centrifugal pump.

[022] In one embodiment the alignment portion protrudes from the outer surface of the main liner.

[023] In one embodiment the alignment portion protrudes from the outer surface of the main liner and is received by a matching recess in the outer housing.

[024] In one embodiment the alignment portion is a central alignment portion.

[025] In one embodiment the alignment portion limits movement in a first lateral direction substantially parallel to an axis or rotation of an impeller of the centrifugal pump.

[026] In one embodiment the alignment portion limits movement in a second lateral direction substantially parallel to an axis or rotation of an impeller of the centrifugal pump.

[027] In one embodiment the alignment portion extends circumferentially around the main liner.

[028] In one embodiment the at least one alignment portion includes a first and a second alignment portion, the first alignment portion limiting movement in a first lateral direction and the second alignment portion limiting movement in a second lateral direction, the first and second lateral directions being substantially parallel to an axis or rotation of an impeller of the centrifugal pump.

[029] In one embodiment the at least one alignment portion further includes a central alignment portion limiting movement in both the first and the second lateral directions.

[030] In one embodiment the at least one alignment portion includes a first alignment portion on an inlet side of the main liner and a second alignment portion on an outlet side of the main liner.

[031] In one embodiment the at least one alignment portion includes an early stage alignment portion and a late stage alignment portion.

[032] In one embodiment the at least one alignment portion is an early stage alignment portion.

[033] In one embodiment the at least one alignment portion is a late stage alignment portion.

[034] In one embodiment the at least one alignment portion is located on a front face of the main liner

[035] In one embodiment the at least one alignment portion is located on a rear face of the main liner.

[036] In one embodiment a first alignment portion of the at least one alignment portion is located on a front face of the main liner and a second alignment portion of the at least one alignment portion is located on a rear face of the main liner.

Brief Description of Figures

[037] Example embodiments are apparent from the following description, which is given by way of example only, of at least one non-limiting embodiment, described in connection with the accompanying figures, in which:

[038] Fig. 1 is a perspective illustration of a conventional main line for a centrifugal pump;

[039] Fig. 2 illustrates a sectional view of the conventional main liner of Fig. 1;

[040] Figs. 3A and 3B are perspective illustrations of a main liner for a centrifugal pump according to a first and second embodiment;

[041] Fig. 4 illustrates a section view of an outlet port of a main liner according to one embodiment;

[042] Fig. 5 illustrates a cross sectional view of a centrifugal pump with the main liner of Fig. 3A;

[043] Fig. 6 illustrates a cross section view of a conventional main liner for a centrifugal pump;

[044] Figs. 7A and 7B are perspective illustrations of the main liner of Fig. 3A and 3B respectively;

[045] Figs. 8A and 8B are perspective illustrations of the main liner of Fig. 3A and 3B respectively;

[046] Figs. 9A and 9B are perspective illustrations of the main liner of Fig. 3A and 3B respectively;

[047] Figs. 10A and 10B are perspective illustrations of the main liner of Fig. 3A and 3B respectively;

[048] Figs. 11A and 11B are perspective illustrations of the main liner of Fig. 3A and 3B respectively; and

[049] Figs. 12A and 12B are perspective illustrations of the main liner of Fig. 3A and 3B respectively.

Detailed Description

[050] The following modes, given by way of example only, are described in order to provide a more precise understanding of one or more embodiments. In the figures, like reference numerals are used to identify like parts throughout the figures.

[051] Figs. 1 and 2 show a main liner 10 for a centrifugal pump. The main liner 10 includes a peripheral wall portion 12 having a pumping chamber 14, also called a collection chamber, therein and opposed sides 15 and 16 (Fig. 2). During use, an impeller is mounted for rotation

within the pumping chamber 14 of the main liner. An inlet opening to the pumping chamber 14 is provided on one side of the casing and a drive shaft to which the impeller is mounted extends through the other side. The pumping chamber 14 in the region of the peripheral wall portion 12 is of a volute shape, offset circular shape or any other suitable shape. A discharge outlet 13 extending from the peripheral wall portion 12, there being a cutwater 19 which in use generally serves to divide the discharge outlet flow from the pumping chamber recirculation flow.

[052] In some forms of centrifugal pumps an outer housing is provided to encase the main liner shown in Figs 1 and 2. The term "main liner" refers to a chamber which surrounds a pump impeller and in which the impeller can rotate in use of a lined pump. The main liner is itself surrounded by an exterior casing structure. In lined pumps, the main liner, also referred to as a volute liner, is a wear part which is exposed to the movement of an abrasive liquid or slurry during use, and which eventually requires replacement, and the exterior casing or shell of the pump remains undamaged.

[053] The main liner may be formed from an elastomeric material, such as rubber. The main liner may mate with side liners mounted at respective sides 15, 16 of the main liner 10. As seen in Fig. 2, the main liner 10 includes a cutwater 19, having transition zones 17 in the form of tapering blend sections extending from the ends of the arch-shaped cutwater between the discharge outlet 13 and the pumping chamber 14, in the region of the peripheral wall portion 12.

[054] Figs. 3A, 7A, 8A, 9A, 10A, 11A and 12A show a main liner 300 for a centrifugal pump according to an embodiment of the present invention. The main liner 300 has a main pumping chamber, with the liner being located within an outer housing (not shown). The main liner 300 has an inlet opening for the introduction of a liquid into the main pumping chamber as well as a discharge outlet extending from the main pumping chamber. The discharge outlet has an outer surface for contact with the outer housing. Located on the outer surface is at least one alignment portion for engaging with a corresponding alignment portion on the outer housing. The alignment portion is engaged with the corresponding alignment portion, limiting movement of the discharge outlet. The main liner 300 also has an outer surface of the main pumping chamber for contact with the outer housing. The outer surface has at least one alignment portion for engaging with a corresponding alignment portion on the outer housing. The alignment portion is engaged with the corresponding alignment portion, limiting lateral movement of the main pumping chamber of the liner.

[055] Located on an inlet side of the main liner 300 is an inlet opening 310 through which a fluid, such as a slurry, may pass into a main pumping chamber 315. On the opposite side, a drive side of the pumping chamber 315, is a drive side opening 312 through which a drive shaft for an impeller passes. The impeller, not shown, operates in the main pumping chamber 315 to pump the fluid out a discharge outlet 320 to allow flow of liquid from the main pumping chamber 315. The main pumping chamber 315 is formed by an inner surface 330 and is sealed using side liners that seal the openings, such as the inlet opening 310 and drive side opening 312, around an opening rim 350.

[056] The main liner 300 has an outer surface 340 that is in contact with an outer housing of the centrifugal pump. While the main liner 300 is typically made of an elastomer, the outer housing is typically made of metal and designed to allow replacement of the main liner 300 as required, for example due to wear. When placed inside the outer housing chamber, liner chamber alignment portions 360 and 365 may correctly position the main liner 300 within the outer housing. The alignment portions 360 and 365 are positioned on the outer surface 340 and protrude to engage with and be received by corresponding, or matching, alignment portions on the outer housing. The alignment portion 360 is located on a face of the main liner 300, being a front face on the inlet side of the main liner 300, with the alignment portion 365 located on the face of the main liner 300, being a rear face on the drive side. The alignment portions 360 and 365 may also be considered to be located on a shoulder region of the main liner 300. When engaged with the corresponding alignment portions, the alignment portions 360 and 365 position the main liner 300 relative to the outer housing and limit lateral movement, the lateral movement being substantially parallel to an axis or rotation of an impeller of the centrifugal pump. Each of the alignment portions may limit movement in at least one lateral direction. The alignment portion 360 may limit movement in a first lateral direction and the alignment portion 365 may limit movement in a second lateral direction. Combined, the alignment portions may limit movement in both lateral directions. In one alternative, the main liner 300 may have only one of the alignment portions 360 and 365. For example, alignment portion 360 may be present while alignment portion 365 is not included on the main liner 300. In another example, alignment portion 360 may not be included on the main liner 300 while alignment portion 365 is present.

[057] The alignment portions 360 and 365 are shown extending partially around the outer surface 340. The alignment portions 360 and 365 may be longer or shorter than shown in Figs. 3A, 7A, 8A, 9A, 10A, 11A and 12A. For example, the alignment portions 360 and 365 may

extend all around the outer surface 340. Alternatively, one, or both of the alignment portions 360 and 365 may be formed from two or more discontinuous arcs, formed from two or more alignment portions. A shape of the portions 360 and 365 will be discussed below in relation to Fig. 5.

[058] A central alignment portion 370, is also shown on the outer surface 340. The central alignment portion 370 may operate in a similar manner to the alignment portions 360 and 365 by engaging with a corresponding, or matching, central alignment portion on the outer housing. When engaged, the central alignment portion 370 aligns the main liner 300 with the outer housing and may limit lateral movement of the outer surface 340 relative to the outer housing in two directions, the lateral direction being substantially parallel to an axis or rotation of an impeller of the centrifugal pump. The central alignment portion 370 protrudes from and extends around the external circumference of the main liner 300, starting near a flange 380 of the discharge outlet 320. As with the alignment portions 360 and 365, the central alignment portion 370 may be shorter or formed from two or more discontinuous segments. A shape of the central alignment portion 370 will be discussed in more detail below in relation to Fig. 5. The central alignment portion 370 is located at a central portion of the main liner 300.

[059] Figs. 3B, 7B, 8B, 9B, 10B, 11B and 12B show a main liner 305. The main liner is similar to the main liner 300, incorporating the features of the main liner 300 described above in Figs. 3A, 7A, 8A, 9A, 10A, 11A and 12A. However, the main liner 305 has two additional alignment portions located on the outer surface 340 of the main liner 305. An alignment portion 390 is located on the inlet side of the main liner 305, with an alignment portion 395 located on the drive side.

[060] The main pumping chamber 315 has a recirculation flow that is sent to the discharge outlet 320. The flow of the fluid in the pumping chamber 315 may be considered a flow path of circulation for the liquid with the discharge outlet being the last part of the flow path. The flow path will travel in a circular direction within the pumping chamber 315, based on the direction of spin of the impeller. For Fig. 3B the direction of the flow will be counter clockwise, while for Fig. 8B the direction of flow will be clockwise as the main liner 305 is viewed from the drive side in Fig. 8B. The alignment portions 390 and 395 are located on the outer surface 340 at an earlier stage of the flow path, compared to the alignment portions 360 and 365 which are located at a later stage of the flow path. The alignment portions may be termed early stage alignment

portions 390 and 395 and late stage alignment portions 360 and 365. Alternatively, the alignment portions 390 and 395 may be considered to be positioned at, or near, a start of the flow path, while the alignment portions 360 and 365 may be considered to be at or near an end of the flow path. The alignment portions may be termed start of flow alignment portions 390 and 395 and end of flow alignment portions 360 and 365. Alternatively, the alignment portions 390 and 395 may be considered to be located wholly outside the main pumping chamber 315 while the alignment portions 360 and 365 may be considered to extend on to an outer surface of the discharge outlet. The alignment portions may be termed pumping chamber alignment portions 390 and 395 and partial discharge outlet alignment portions 360 and 365. A combination of such terms may also be used. Alternatively, the alignment portions 390 and 395 may be considered to extend perpendicular to the axis of the discharge outlet 320 and the alignment portions 360 and 362 may be considered to extend parallel to the axis of the discharge outlet 320. As such, the alignment portions may be termed the perpendicular alignment portions 390 and 395 and the parallel alignment portions 360 and 365.

[061] When placed inside the outer housing chamber, early stage alignment portions 390 and 395 may correctly position the main liner 305 within the outer housing. The early stage alignment portions 390 and 395 are positioned on the outer surface 340 and protrude to engage with and be received by corresponding, or matching, alignment portions on the outer housing. The early stage alignment portion 390 is located on the face of the main liner 300, being a front face on the inlet side of the main liner 305, with the alignment portion 395 located on the face of the main liner 300, being a rear face on the drive side. The alignment portions 390 and 395 may also be considered to be located on the shoulder region of the main liner 300. When engaged with the corresponding alignment portions, the early stage alignment portions 390 and 395 position the main liner 305 relative to the outer housing and limit lateral movement substantially parallel to an axis or rotation of an impeller of the centrifugal pump. Each of the alignment portions may limit movement in at least one lateral direction. The early stage alignment portion 390 may limit movement in a first lateral direction and the alignment portion 395 may limit movement in a second lateral direction. Combined, the alignment portions may limit movement in both lateral directions. In one alternative, the main liner 300 may have only one of the alignment portions 390 and 395. For example, alignment portion 390 may be present while alignment portion 395 is not included on the main liner 300. In another example, alignment portion 390 may not be included on the main liner 300 while alignment portion 395 is present.

[062] The early stage alignment portions 390 and 395 are shown extending partially around the outer surface 340. The early stage alignment portions 390 and 395 may be longer or shorter than shown in Figs. 3B, 7B, 8B, 9B, 10B, 11B and 12B. For example, the early stage alignment portions 390 and 395 may extend further around the outer surface 340, in the flow direction, towards the late stage alignment portions 360 and 365. Alternatively, one, or both of the early stage alignment portions 390 and 395 may be formed from two or more discontinuous arcs, formed from two or more alignment portions. A shape of the early stage alignment portions 390 and 395 may be the same or similar to the late stage portions 360 and 365 which are discussed below in relation to Fig. 5.

[063] The early stage alignment portions 390 and 395 may be used to locate the main liner 305 relative to the outer housing when installing the main liner 305. Additional alignment portions may also be added to the main liner 305. For example, a mid stage alignment portion may be located between the early stage alignment portions 390 and 395 and the late stage alignment portions 360 and 365. The mid stage alignment portions may assist in locating the main liner relative to the outer housing. The alignment portions 390, 395, 360 and 365 may be located on the outer surface 340 wherever positioning of the main liner 305 in the outer housing is important or for areas where misalignment tolerances are lower. An example is the location of the early stage alignment portions 390 and 395 being close to the discharge outlet 320 as the position allows the discharge outlet to be more accurately positioned relative to the outer housing.

[064] A configuration of the discharge outlet 320 will now be described in relation to a liner 400 of Fig. 4. The flange 380 extends about the discharge outlet 320 and is a continuous, circumferential, outwardly projecting flange having a radially extending lip. Two alignment portions for the outer housing are shown. The first is housing outlet alignment portion 410 of the outer housing which is positioned in contact with the flange 380 and acts to position the discharge outlet 320. The first housing alignment portion 410 limits movement of the flange 380, and the discharge outlet 320, in a single axial direction of the discharge outlet 320 towards the main pumping chamber 315. That is, the first alignment portion 410 limits movement of the discharge outlet 320 in a direction opposite to a flow direction of the liquid as the liquid exits the discharge outlet 320. In addition to limiting axial movement, the first alignment portion 410 may also limit radial movement and distortion of the discharge outlet 320.

[065] A second housing outlet alignment portion 430 of the outer housing is also shown in Fig. 4 engaging with a liner outlet alignment portion 420. The liner outlet alignment portion 420 is shown as a continuous, circumferential, outwardly projecting flange having a radially extending lip that engages with a recess of the second housing alignment portion 430. As a result of the engagement between the two alignment portions, movement of the main liner 300 is reduced or even limited in either direction axially of the discharge outlet 320. In contrast to the first housing alignment portion 410, the second housing alignment portion 430 provides an additional limitation to axial movement. While the first alignment portion 410 limits movement of the discharge outlet 320 towards the main pumping chamber 315, the second housing alignment portion 430 limits movement away from the pumping chamber 315 in addition to limiting movement towards the main pumping chamber 315. That is, the second housing alignment portion 430 limits movement of the discharge outlet 320 in a direction of the flow, as well as a direction opposite to the flow of the liquid as the liquid exits the discharge outlet 320. This may be beneficial to assist in ensuring proper orientation of the liner as support is provided for the outer housing and seal at the discharge outlet 320. This may also be beneficial when pumping forces attempt to rotate the main liner 300 that results in axial movement along the discharge outlet 320. Limiting the movement of the discharge outlet 320 may also assist in maintaining a seal of the discharge outlet 320 with attached piping.

[066] While Fig. 4 shows the second housing alignment portion 430 with a recess for receiving the liner outlet alignment portion 420 protrusion, alternative arrangements may also be used. For example, the second housing alignment portion 430 may be a protrusion that is received and/or engaged by a recess in the liner outlet alignment portion 420. In an alternative embodiment, the use of first and second alignment portions may be replaced by the use of either the first or the second alignment portions alone. In such an arrangement the first alignment portion 410, the second alignment portion 430 and/or the liner outlet alignment portion 420 may extend around all of the discharge outlet 320 or a portion of the discharge outlet 320. Alternatively, the alignment portions may be located around the discharge outlet 320 in two or more discontinuous sections.

[067] Fig. 5 illustrates a cross section of centrifugal pump 500 with a main liner 510 having alignment portions engaging with corresponding alignment portions of an outer housing. The outer housing of Fig. 5 has a left side outer housing 520 and a right side outer housing 530. The two sides of the outer housing are connected together by fasteners such as connection bolt 540.

Typically the two sides of the outer housing may be separated to allow access to, and replacement of, the main liner 510.

[068] Located on the main liner 510 are a left liner alignment portion 550 and a right liner alignment portion 555. The two alignment portions of the main liner 510 protrude to engage with corresponding, recessed, alignment portions on the outer housing, being the left housing alignment portion receiver 560 and the right housing alignment portion receiver 565. Also shown in Fig. 5 is a protruding central liner alignment portion 570 and a corresponding central housing alignment portion receiver 580. The central alignment portion receiver 580 is formed from recesses in the left and right side of the outer housing 520 and 530.

[069] The liner alignment portions, located on the liner 510, are shown as protrusions from an outer surface of the main liner 510 engaging with the corresponding alignment portions recessed in the outer housing. In an alternative embodiment, one or more of the alignment portions located on the main liner 510 may be formed from recesses and engage with corresponding alignment portions formed from protrusions located on the outer housing. However, one consideration that should be factored into determining a shape and location of the alignment portions is how the main liner 510 is placed inside the outer housing. For example, if the central liner alignment portion 570 was recessed, instead of protruding as seen in Fig. 5, then the central housing alignment portion 580 will protrude to allow for engagement. When the left side outer housing 520 and the right side outer housing 530 are separated the central housing alignment portion 580 will be separated. When closing the sides of the outer housing, it may be difficult for the recessed central liner alignment portion 570 to fully engage with the protruding central housing alignment portion until the two sides of the housing are closed together. However it may not be easy, or even possible, to ensure the engagement of the central alignment portions has occurred once the outer housing is closed. Such a problem may be reduced by offsetting the protruding central alignment portion so the portion sits on only one half of the outer housing. Alternatively, the housing may be tapered.

[070] In addition to allowing engagement, a shape of the alignment portions may also determine directional resistance to forces on the main liner 510. For example, the left liner alignment portion 550 is shaped to limit movement of the main liner 510 to the left and downwards, as shown in Fig. 5. Force applied to the main liner 510 to move left is counteracted by surface 551. In a similar manner, the surface 552 may limit movement of the liner downwards (in the direction of the surface 552). Combined, the two surfaces 551 and 552 may limit

movement of the main liner 510 in directions with a component left or down. In an alternative embodiment, the slope of the surfaces 551 and 552 may be modified to provide better resistance to forces. For example, the surface 551 may be sloped to provide resistance to a force having an upwards component. In another alternative, the surface 551 and 552 may be curved or additional surface, or facets, added.

[071] The right alignment portion 555 and alignment portion receiver 565 will work in a similar manner to limit movement to the right, downwards or for some combination of the two directions. As with the left alignment portion 550 and alignment portion receiver 560, the shape of the alignment portions may be varied.

[072] The central alignment portion 570 and central alignment portion receiver 580 may limit movement to the left, right, downwards or some combination of those directions. While the central liner alignment portion 570 forms only a small protrusion, a larger protrusion may be used when larger lateral forces may act on the main liner 510. The protrusion shape may also be changed. In one embodiment, the central alignment portion 570 and central alignment portion receiver 580 may be formed in a dovetail shape. Such a shape may limit the main liner 510 pulling away from the outer housing.

[073] A conventional main liner will now be described in relation to the centrifugal pump 600 of Fig. 6. The main liner is formed from two parts, a left side main liner 612 and a right side main liner 614 with an outer surface 616 which is in contact with a two part outer housing formed from a left side outer housing 620 and a right side outer housing 630. The two parts of the outer housing are joined together by fasteners, such as the connection bolt 640.

[074] The main liner has a single alignment portion to engage with the outer housing. Located on both sides of the main liner is a protruding alignment portion 670 and a corresponding central housing alignment portion 680. Unlike the central housing alignment portion 570 of Fig. 5, the central housing alignment portion 680 is formed from a recess in only the left side outer housing 620 and may reduce manufacturing complexity by limiting the recess to one part. However, such an arrangements may not provide sufficient alignments of the main liner with the outer housing before sealing the outer housing parts together. For example, the right side outer housing 630 and the right side main liner 614 may not correctly align using only the liner alignment portion 670. The liner alignment portion 670 may be clamped between the left and right outer housing 620 and 630. The clamping assists to maintain a position of the main liner as well as to assist in

maintaining a seal between the left and right sides of the main liner. When clamped, the housing alignment portion 670 may limit movement of the liner in any direction.

[075] Returning to the liner 500 of Fig. 5. The liner 500 may also be formed from two or more parts in a manner similar to the left side main liner 612 and the right side main liner 614. An example would be if the liner 500 is formed from two parts, a left and a right part. The central alignment portion of the liner 600 may be used instead of the central alignment portion of the liner 500.

[076] While the alignment portions have been described as limiting or reducing movement of the main liner, in respect to the outer housing, such movement may occur in a localised manner. For example, the movement may not be for the entire main liner. Instead the alignment portions may limit or prevent local deformation, assist the main liner to maintain an intended shape, maintain a location relative to the outer housing or a combination of the above. Prevention of deformation may allow the main liner to operate more efficiently as deformation of the main liner may reduce the efficient movement of the liquid over the inner surface of the main liner as a shape of the main liner no longer matches an intended operational shape.

Advantages

[077] The embodiments described above provide a novel main liner for a centrifugal pump. The main liner uses one or more alignment portions on a surface of the main liner that may assist in positioning the main liner as well as keeping the main liner in position relative to an outer housing. The alignment portions may also assist in keeping the main liner in position, relative to the outer housing, during operation of the centrifugal pump as well as assist in maintaining a suitable shape of the main liner.

[078] The alignment portions located on the discharge outlet of the main liner may also assist in maintaining a seal between the main liner and a pipe attached to the discharge outlet. The discharge outlet may be held in position by the alignment portions and maintain the seal during pumping operations.

[079] In the foregoing description of preferred embodiments, specific terminology has been resorted to for the sake of clarity. However, the invention is not intended to be limited to the specific terms so selected, and it is to be understood that each specific term includes all technical equivalents which operate in a similar manner to accomplish a similar technical purpose. Terms

such as "front" and "rear", "above" and "below" and the like are used as words of convenience to provide reference points and are not to be construed as limiting terms.

[080] Optional embodiments may also be said to broadly include the parts, elements, steps and/or features referred to or indicated herein, individually or in any combination of two or more of the parts, elements, steps and/or features, and wherein specific integers are mentioned which have known equivalents in the art to which the invention relates, such known equivalents are deemed to be incorporated herein as if individually set forth.

[081] Although a preferred embodiment has been described in detail, it should be understood that modifications, changes, substitutions or alterations will be apparent to those skilled in the art without departing from the scope of the present invention.

[082] Throughout this specification and the claims which follow, unless the context requires otherwise, the word "comprise", and variations such as "comprised", "comprises" or "comprising", will be understood to imply the inclusion of a stated integer or step or group of integers or steps but not the exclusion of any other integer or step or group of integers or steps.

[083] As used herein, a, an, the, at least one, and one or more are used interchangeably, and refer to one or to more than one (i.e. at least one) of the grammatical object. By way of example, "an element" means one element, at least one element, or one or more elements.

[084] In the context of this specification, the term "about" is understood to refer to a range of numbers that a person of skill in the art would consider equivalent to the recited value in the context of achieving the same function or result.

The claims defining the invention are as follows:

1. A main liner for a centrifugal pump having a main pumping chamber, the main liner being located within an outer housing of the centrifugal pump, when in use, and comprising:
 - a main pumping chamber;
 - an inlet opening for the introduction of a liquid into the main pumping chamber;
 - a discharge outlet extending from the main pumping chamber; and
 - an outer surface of the discharge outlet for contact with the outer housing for the liner, the outer surface having at least one alignment portion for engaging with a corresponding alignment portion on the outer housing, the engagement of the alignment portion with the corresponding alignment portion limiting movement of the discharge outlet relative to the outer housing.
2. The main liner according to claim 1, wherein the alignment portion limits movement of the discharge outlet in a direction towards the main pumping chamber of the liner.
3. The main liner according to any one of claim 1 or 2, wherein the alignment portion limits movement of the main liner in a direction opposite to a flow direction of the liquid as the liquid exits the discharge outlet when in use.
4. The main liner according to claim 2, wherein the alignment portion limits movement of the discharge outlet in a direction away from the main pumping chamber of the liner.
5. The main liner according to claim 1, wherein the alignment portion limits movement of the liner in either direction axially of the discharge outlet.
6. The main liner according to any one of claims 1 to 5, wherein the fluid is a slurry.
7. The main liner according to any one of claims 1 to 6, wherein the alignment portion is formed from a plurality of discontinuous segments.

8. The main liner according to any one of claims 1 to 7, wherein the alignment portion limits movement of the discharge outlet to maintain sealing of the discharge outlet.
9. The main liner according to any one of claims 1 to 8, wherein the liner is formed from a first and second part and the alignment portion of the discharge outlet enables alignment of the first and second part within the outer housing.
10. The main liner according to any one of claims 1 to 9, wherein the alignment portion is located at an end of the discharge outlet.
11. A main liner for a centrifugal pump, the liner being located within an outer housing of the centrifugal pump, when in use, and comprising:
 - a main pumping chamber;
 - an inlet opening for the introduction of an liquid into a main pumping chamber;
 - a discharge outlet extending from the main pumping chamber; and
 - an outer surface of the main pumping chamber for contact with the outer housing for the liner, the outer surface having at least one alignment portion located on a face of the main liner for engaging with a corresponding alignment portion on the outer housing, the engagement of the alignment portion with the corresponding alignment portion limiting movement of the main pumping chamber of the liner in a direction parallel to an axis or rotation of an impeller of the centrifugal pump.
12. The main liner according to claim 11, wherein the alignment portion protrudes from the outer surface of the main liner.
13. The main liner according to claim 12, wherein the alignment portion protrudes from the outer surface of the main liner and is received by a matching recess in the outer housing.
14. The main liner according to any one of claims 11 to 13, wherein the alignment portion is a central alignment portion.
15. The main liner according to any one of claims 11 to 14, wherein the alignment portion limits movement in a first lateral direction substantially parallel to an axis or rotation of an impeller of the centrifugal pump.

16. The main liner according to claim 15, wherein the alignment portion limits movement in a second lateral direction substantially parallel to an axis or rotation of an impeller of the centrifugal pump.

17. The main liner according to any one of claims 11 to 16, wherein the alignment portion extends circumferentially around the main liner.

18. The main liner according to claim 11, wherein the at least one alignment portion includes a first and a second alignment portion, the first alignment portion limiting movement in a first lateral direction and the second alignment portion limiting movement in a second lateral direction, the first and second lateral directions being substantially parallel to an axis or rotation of an impeller of the centrifugal pump.

19. The main liner according to claim 18, wherein the at least one alignment portion further includes a central alignment portion limiting movement in both the first and the second lateral directions.

20. The main liner according to any one of claims 11 to 19, wherein the at least one alignment portion includes a first alignment portion on an inlet side of the main liner and a second alignment portion on an outlet side of the main liner.

21. The main liner according to any one of claim 11 to 20, wherein the at least one alignment portion includes an early stage alignment portion and a late stage alignment portion.

22. The main liner according to any one of claims 11 to 20, wherein the at least one alignment portion is an early stage alignment portion.

23. The main liner according to any one of claims 11 to 20, where the at least one alignment portion is a late stage alignment portion.

24. The main liner according to any one of claims 11 to 23, wherein the at least one alignment portion is located on a front face of the main liner

25. The main liner according to any one of claims 11 to 23, wherein the at least one alignment portion is located on a rear face of the main liner.

26. The main liner according to any one of claims 11 to 23, wherein a first alignment portion of the at least one alignment portion is located on a front face of the main liner and a second alignment portion of the at least one alignment portion is located on a rear face of the main liner.

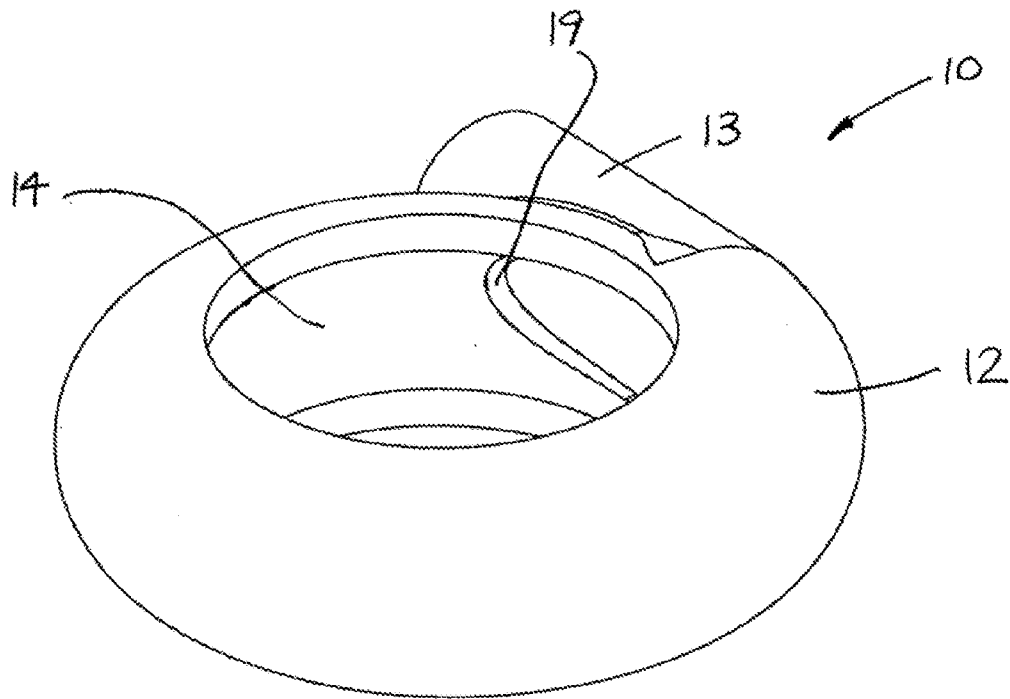


Fig. 1
(Prior Art)

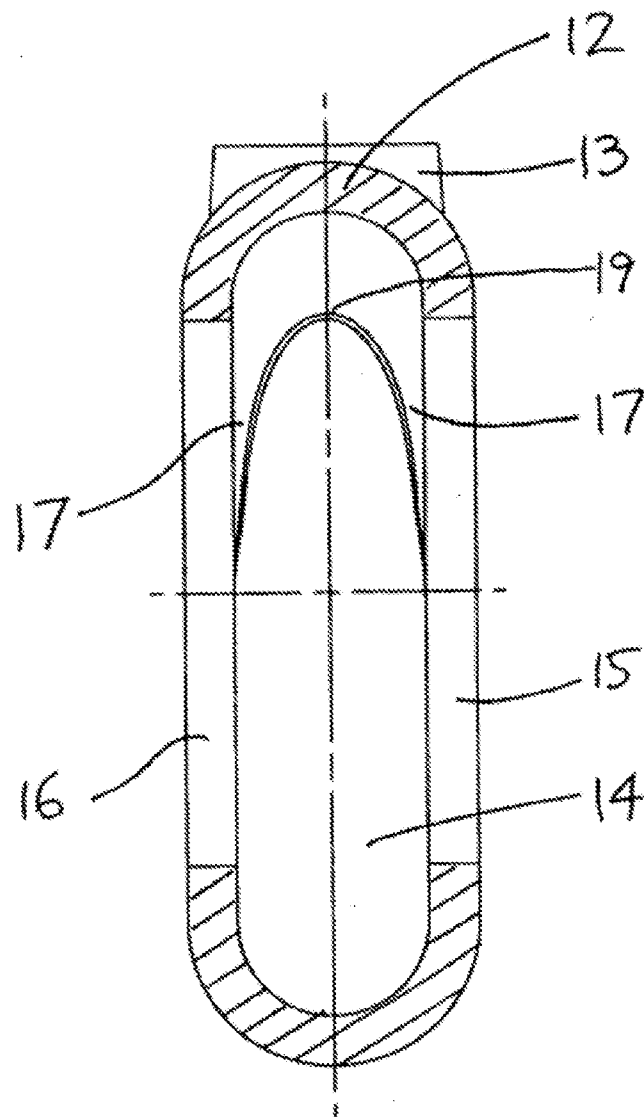
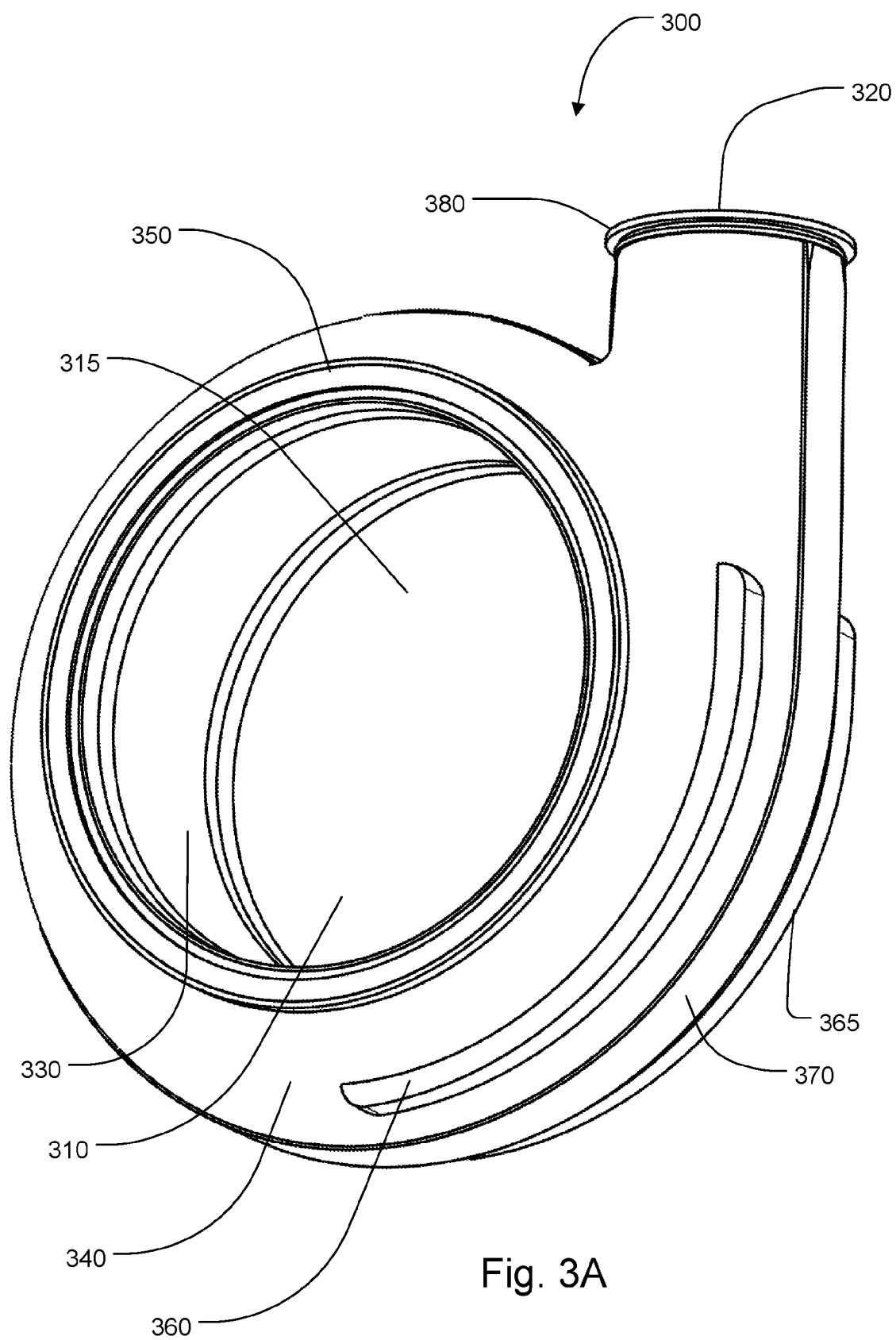
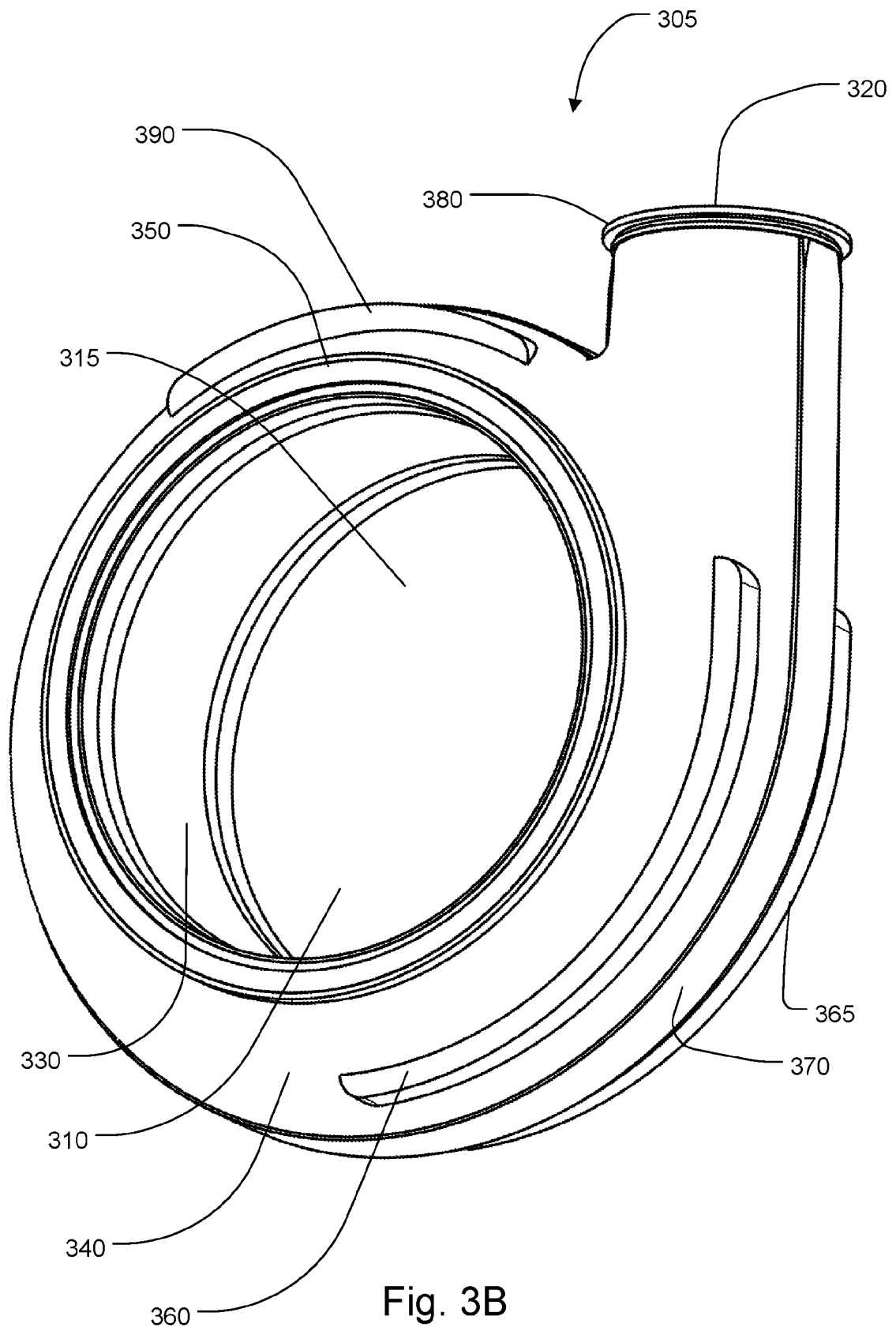


Fig. 2
(Prior Art)





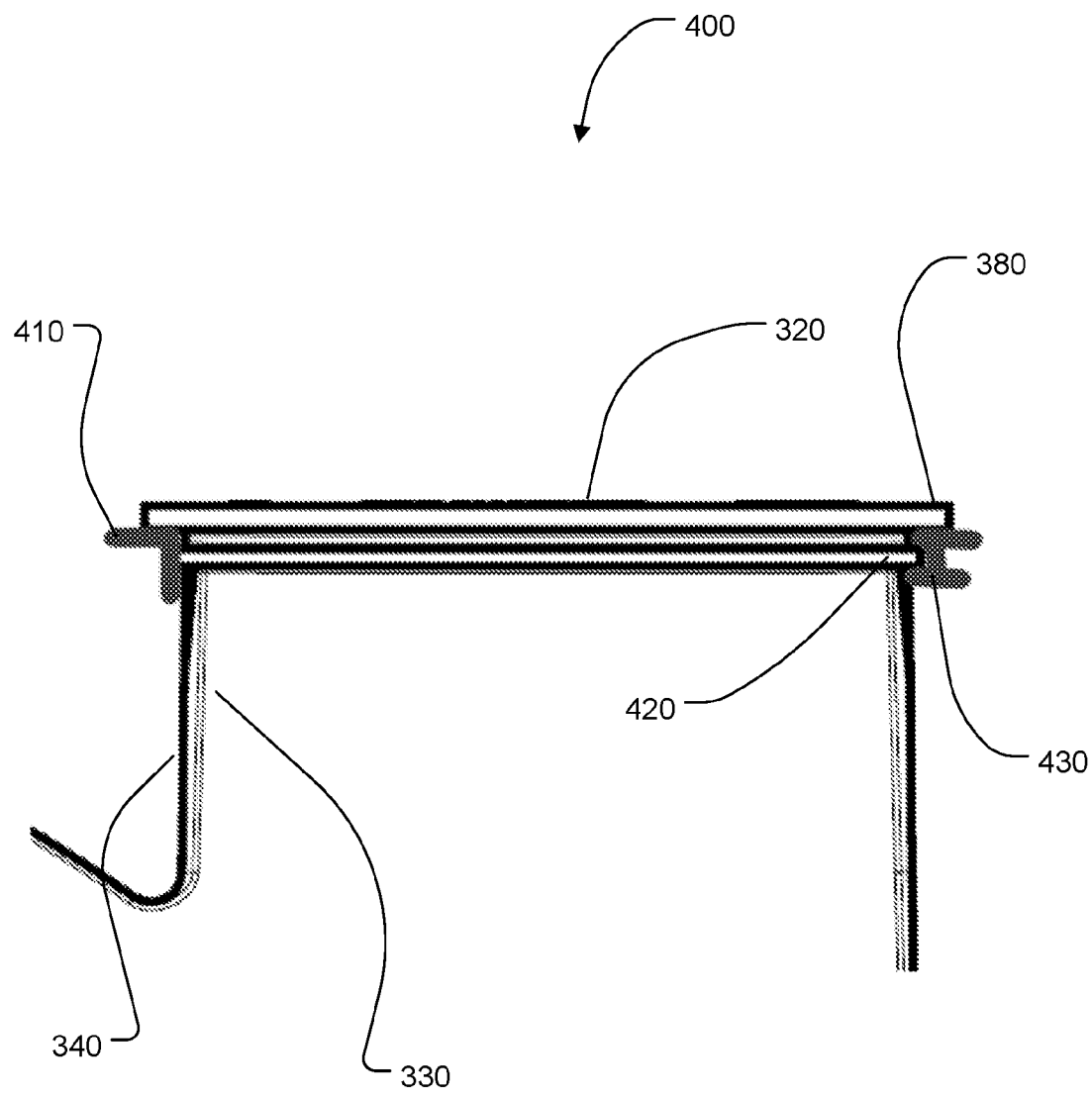


Fig. 4

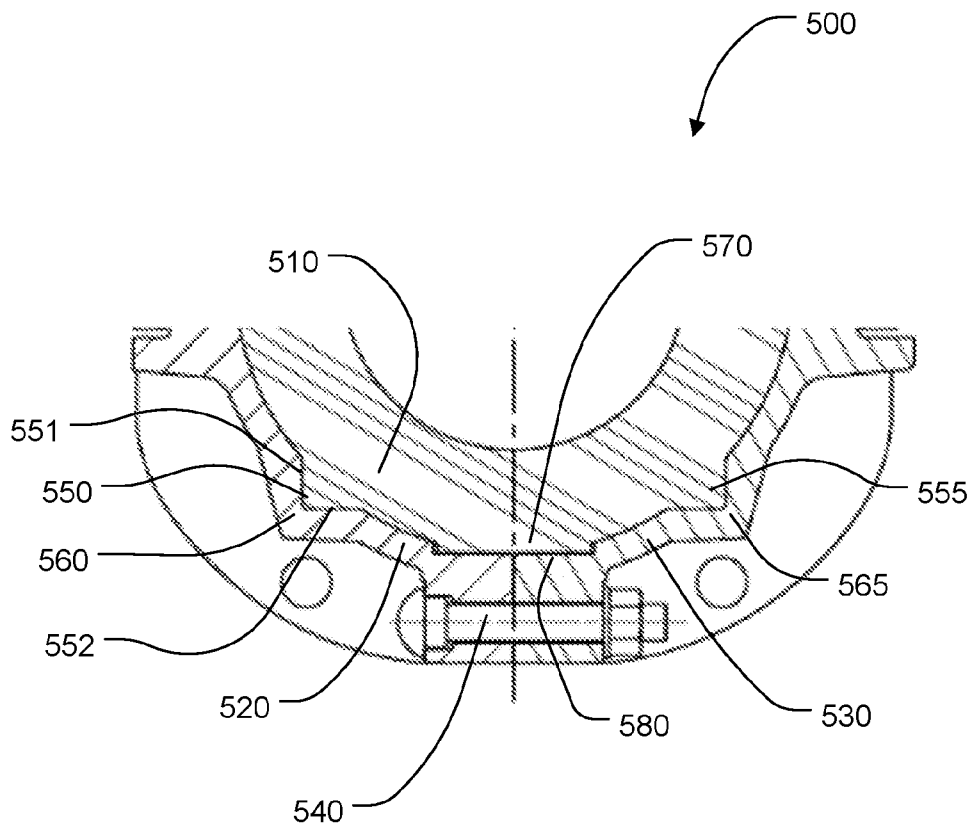


Fig. 5

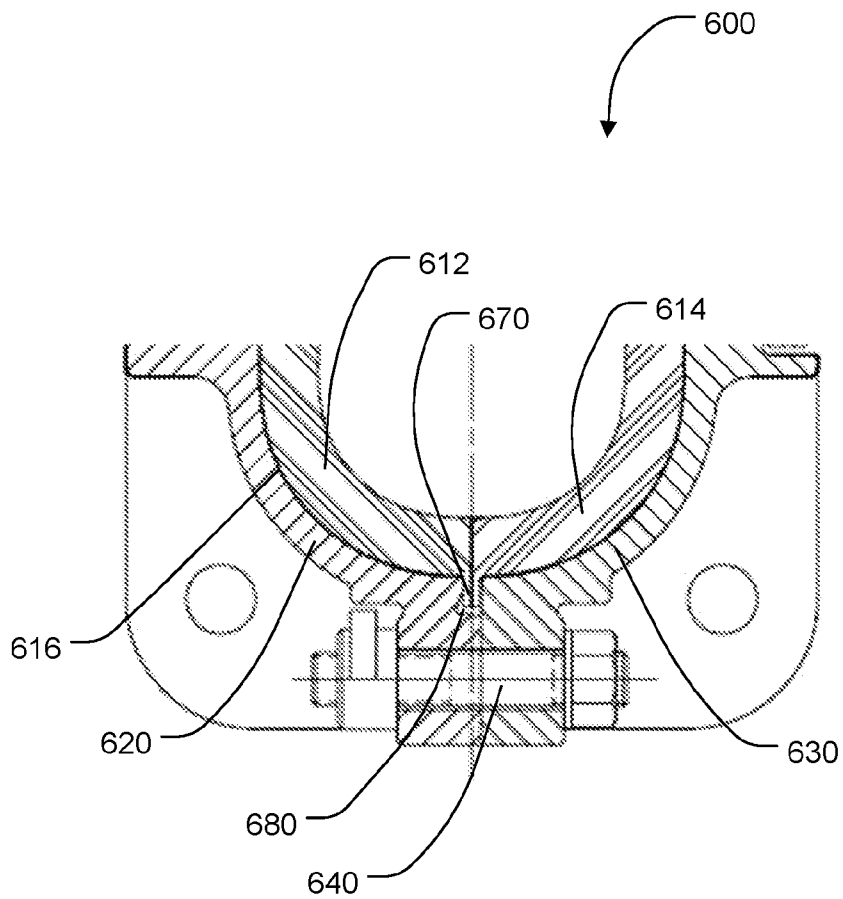
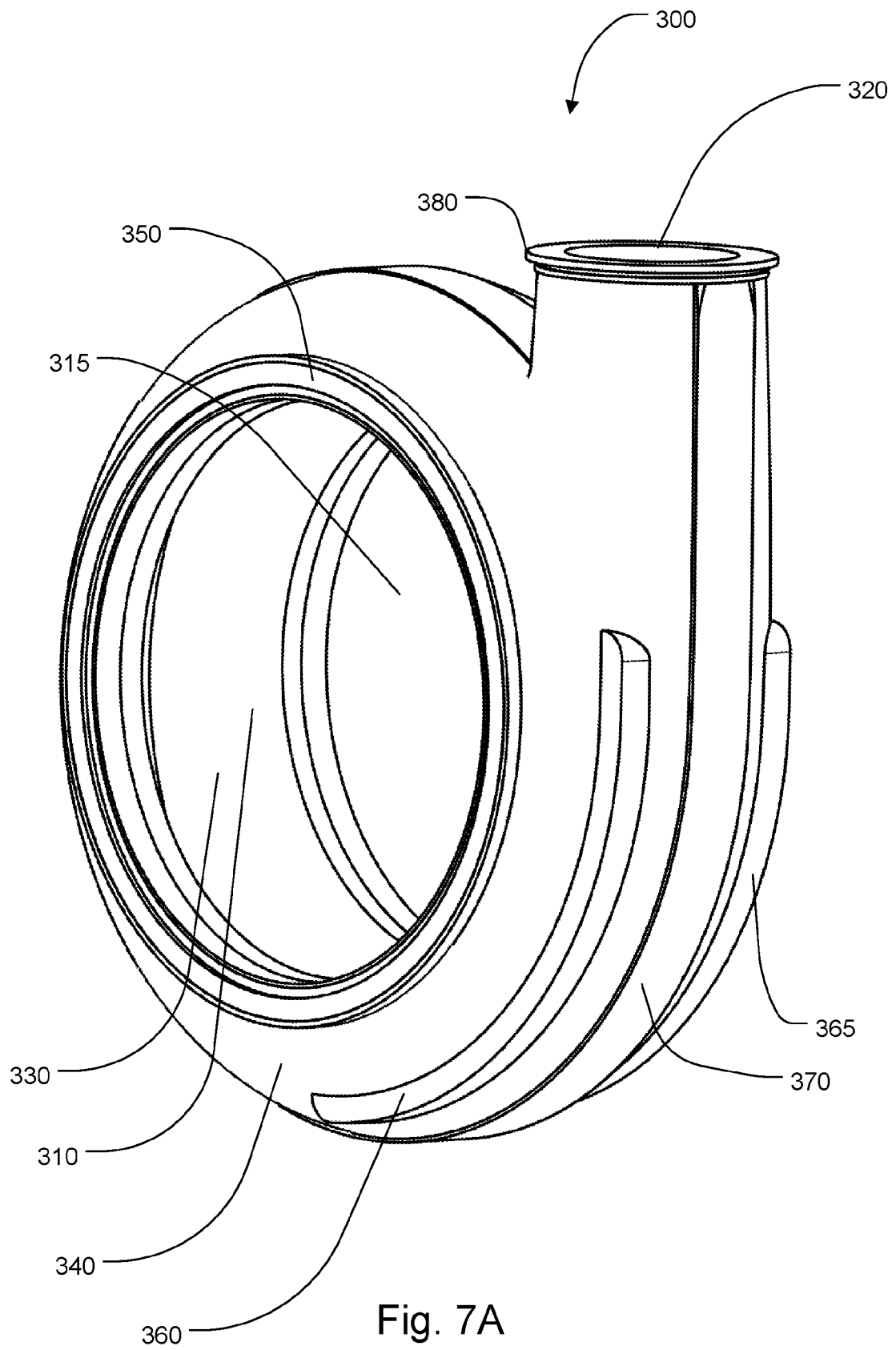
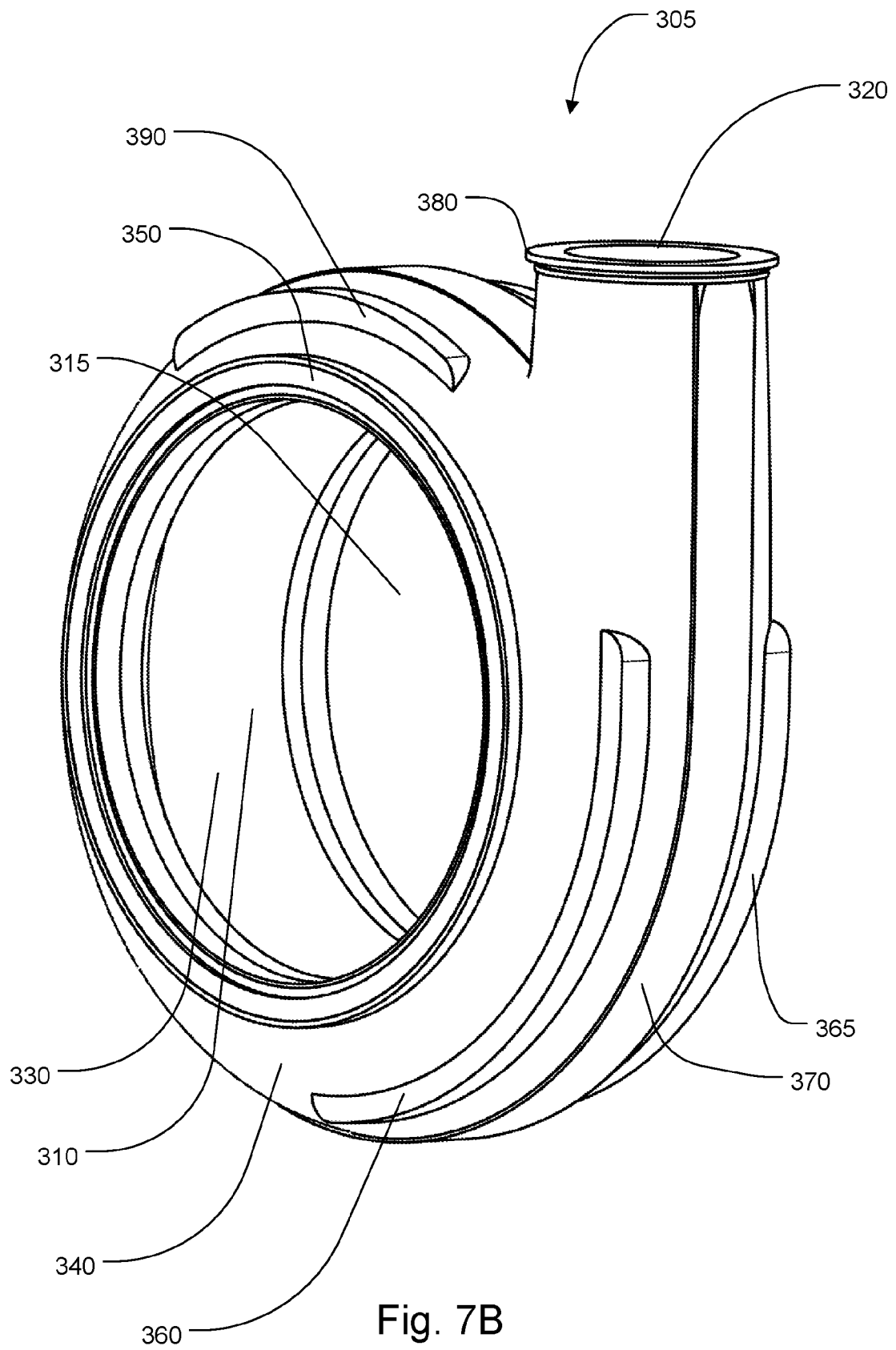


Fig. 6
(Prior Art)





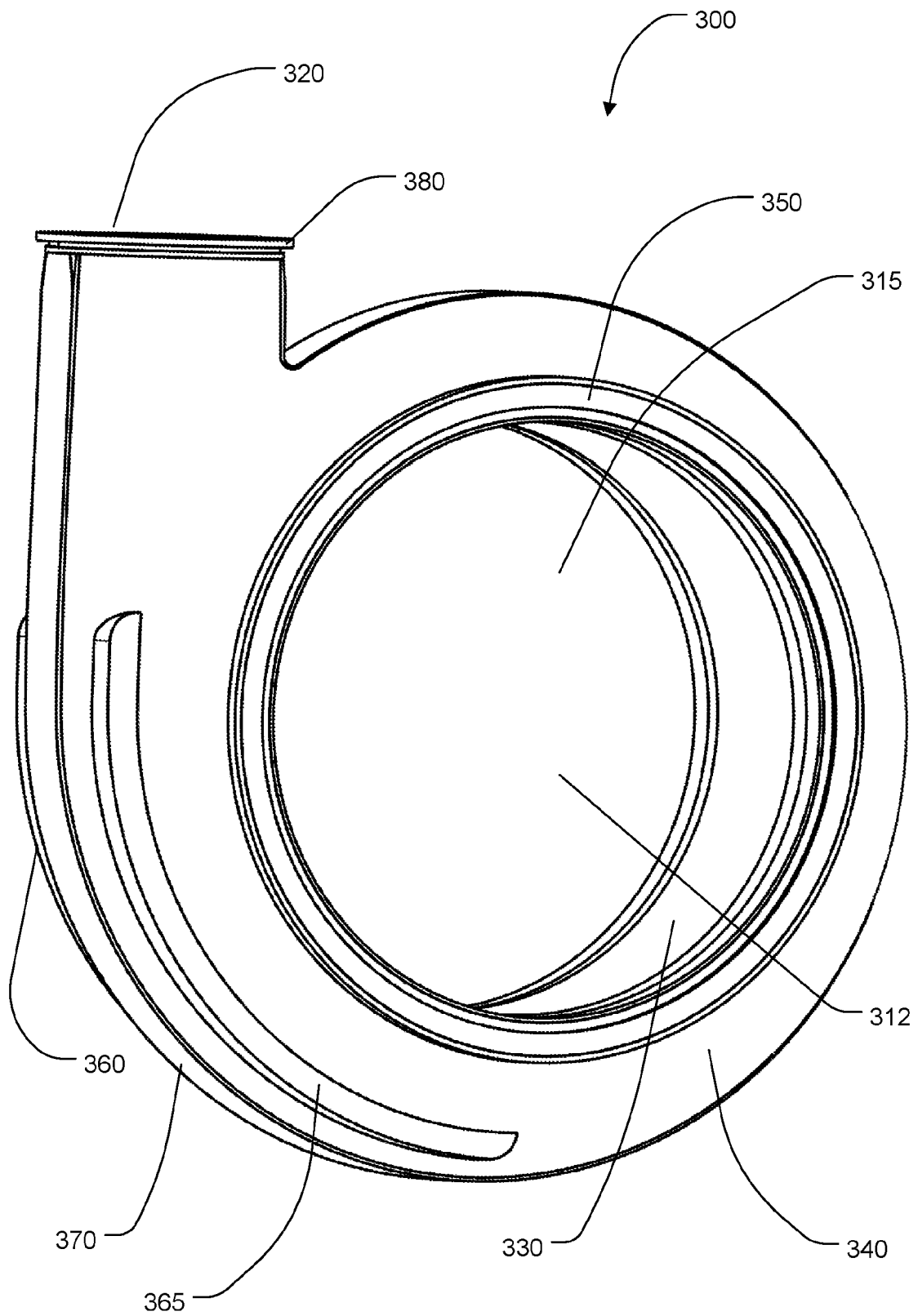


Fig. 8A

11/19

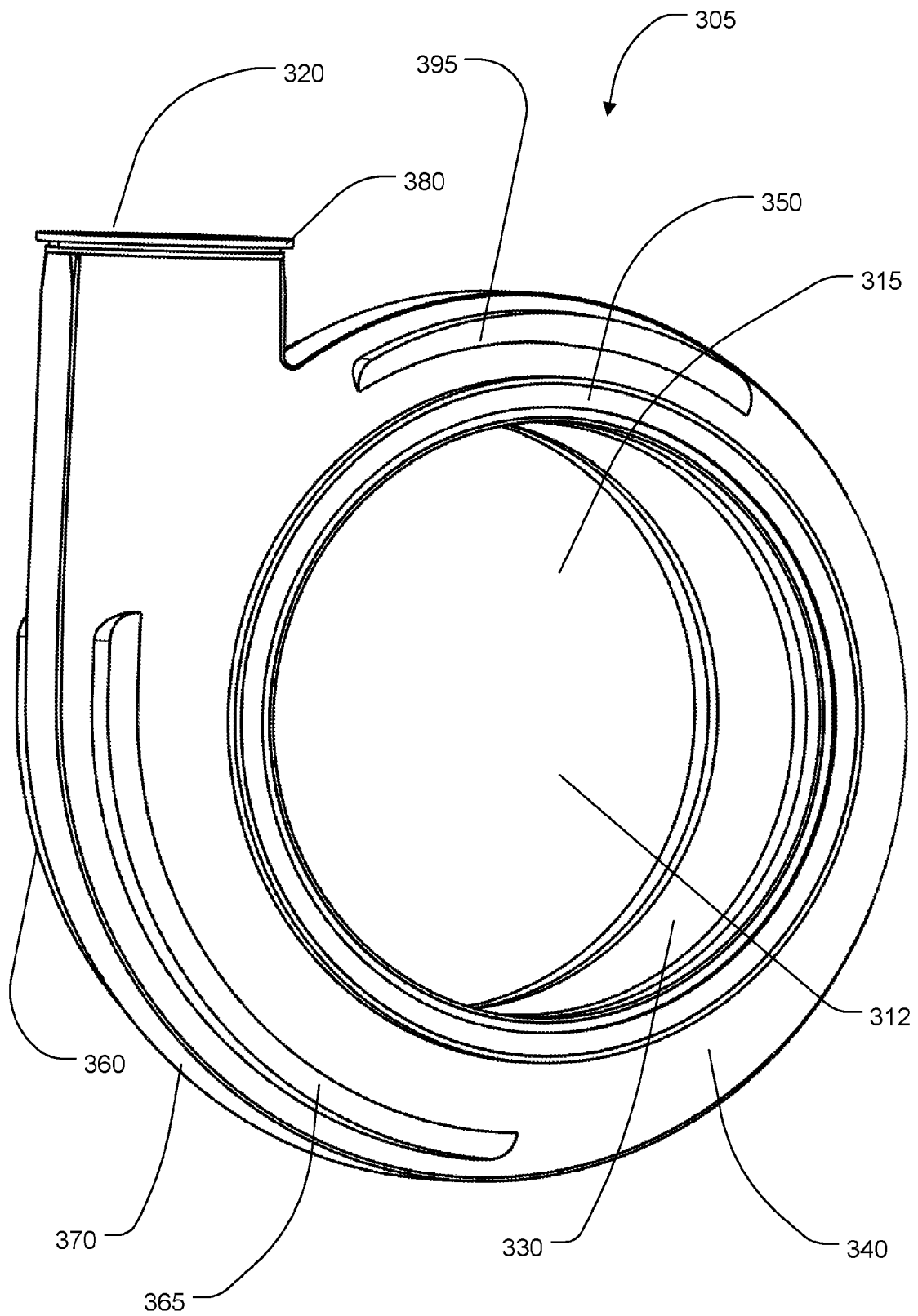
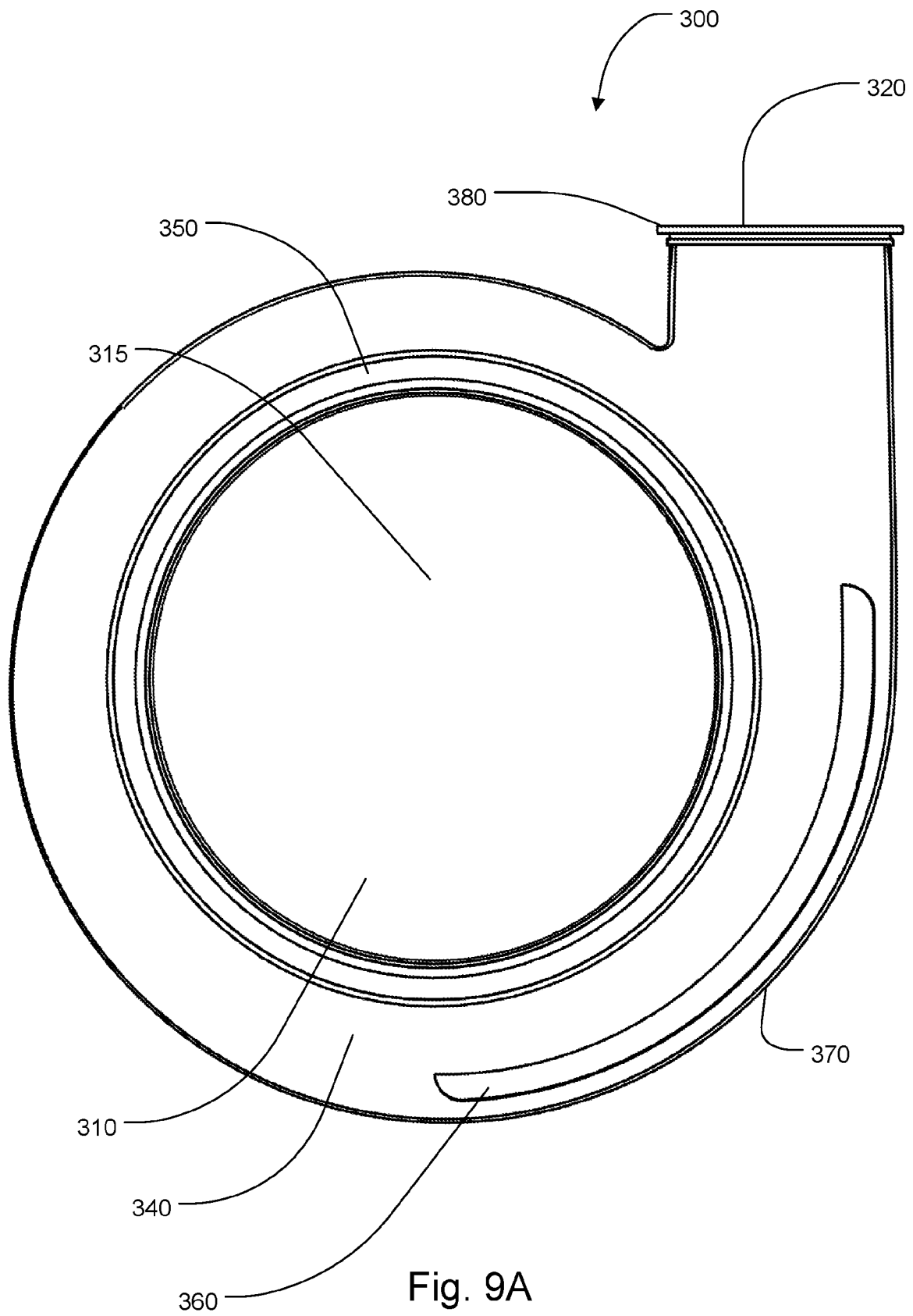
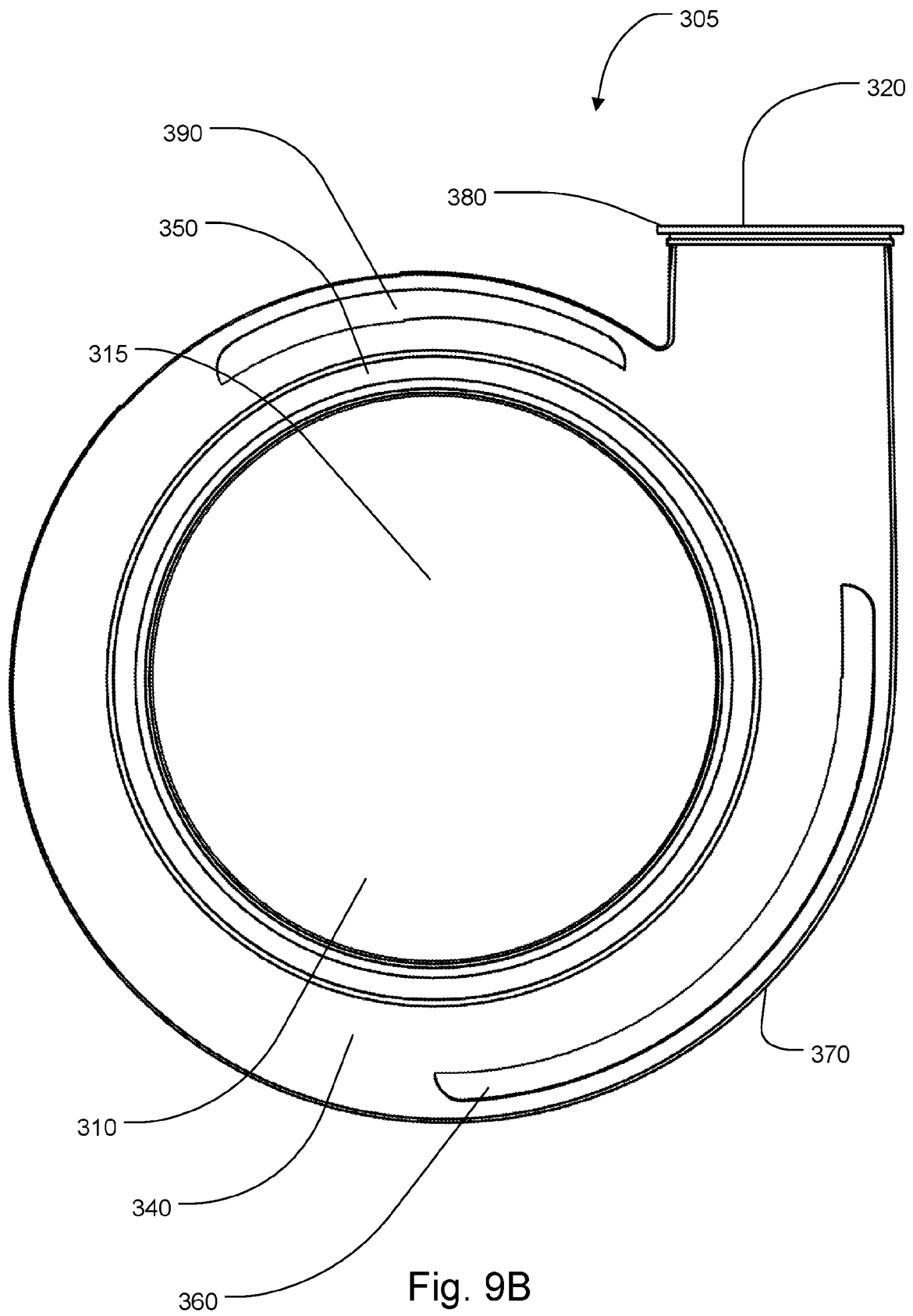


Fig. 8B





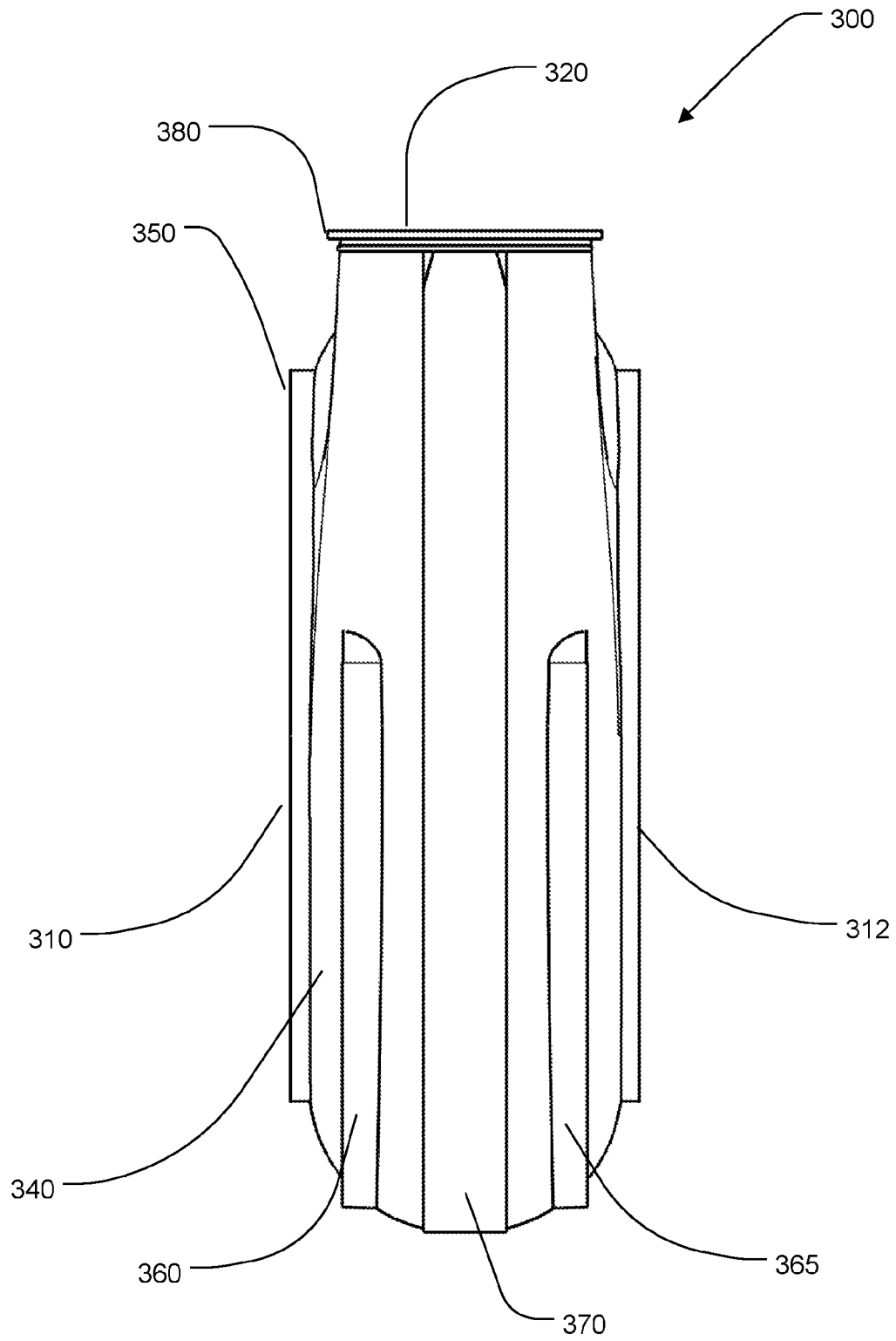


Fig. 10A

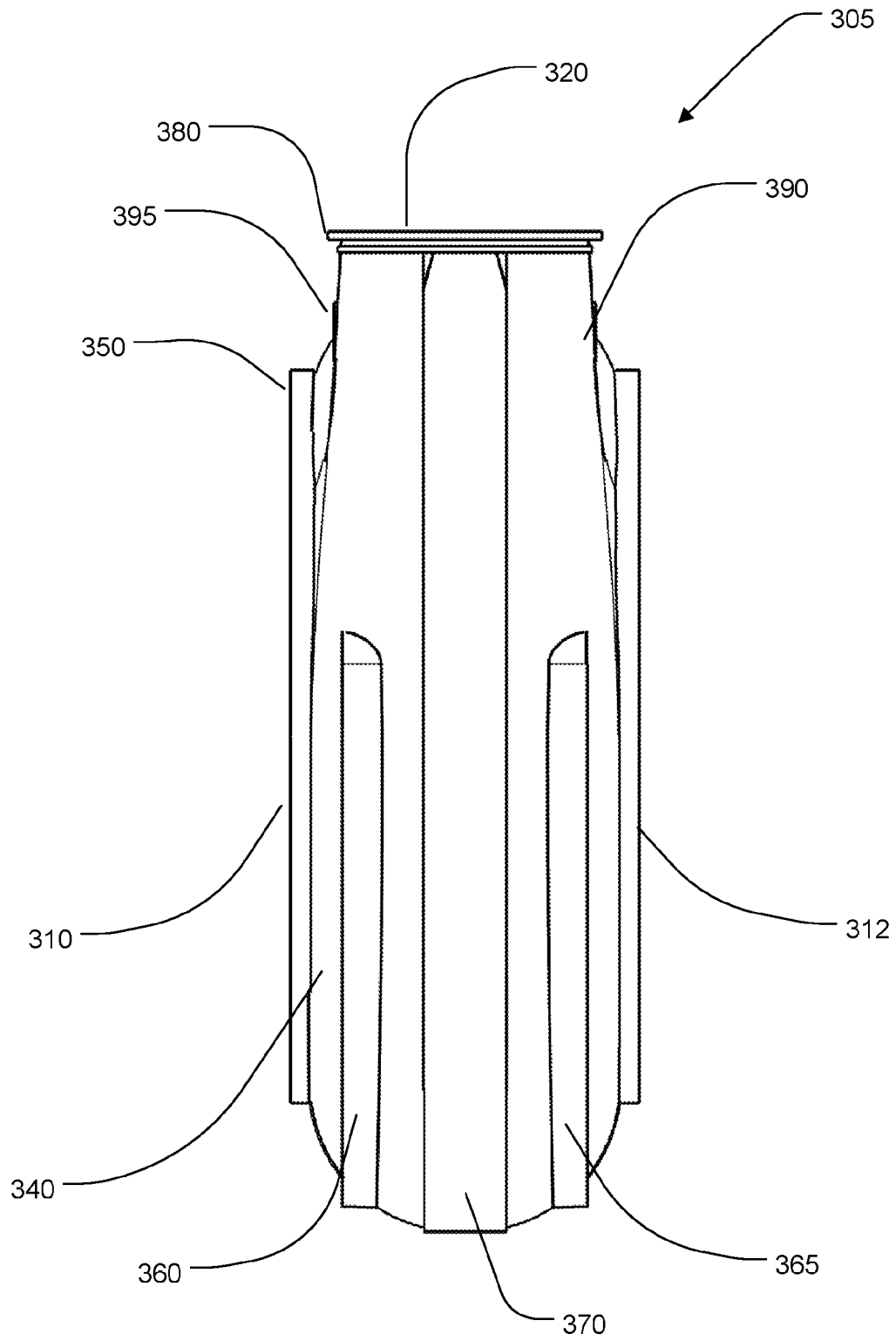


Fig. 10B

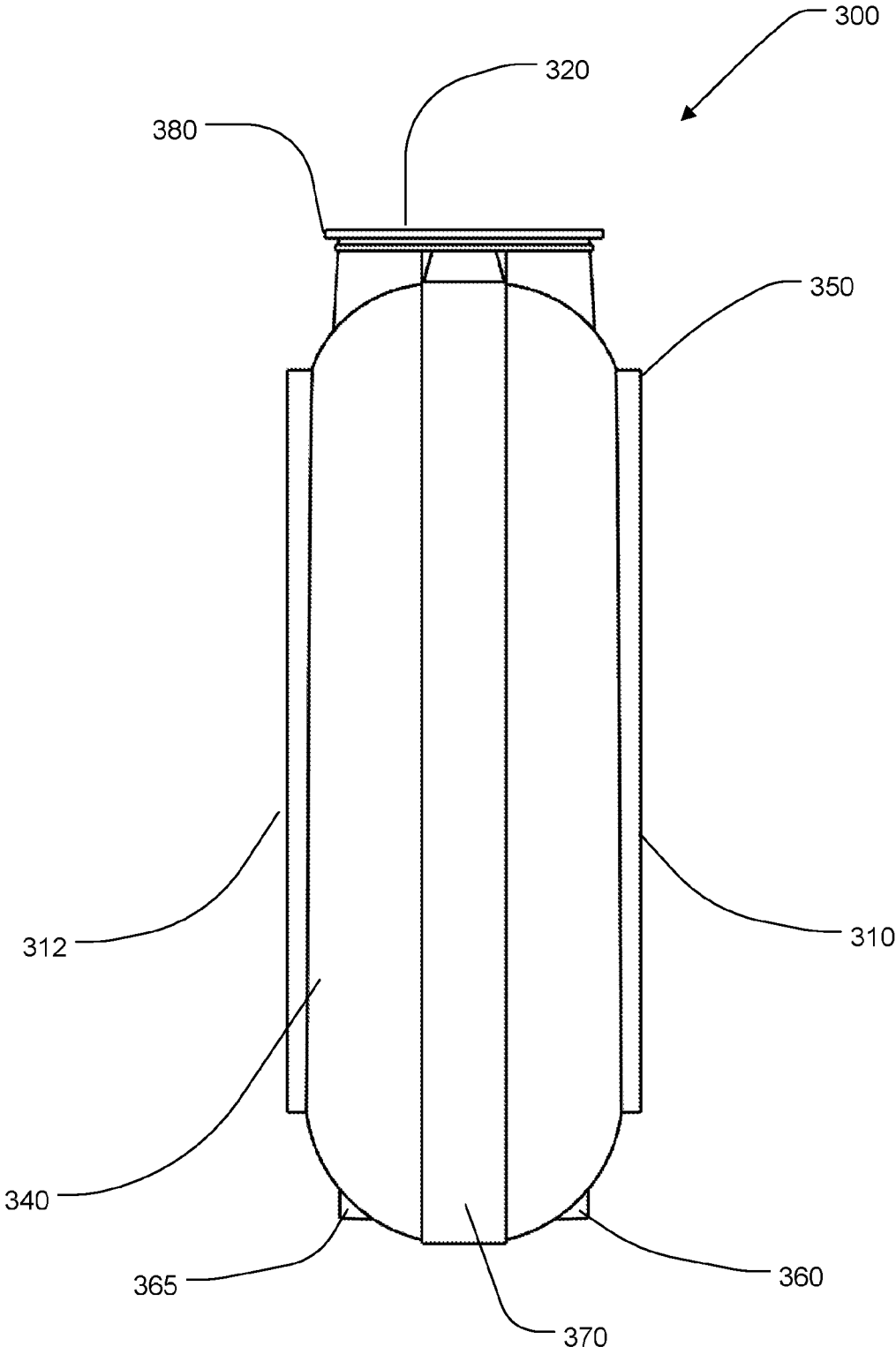


Fig. 11A

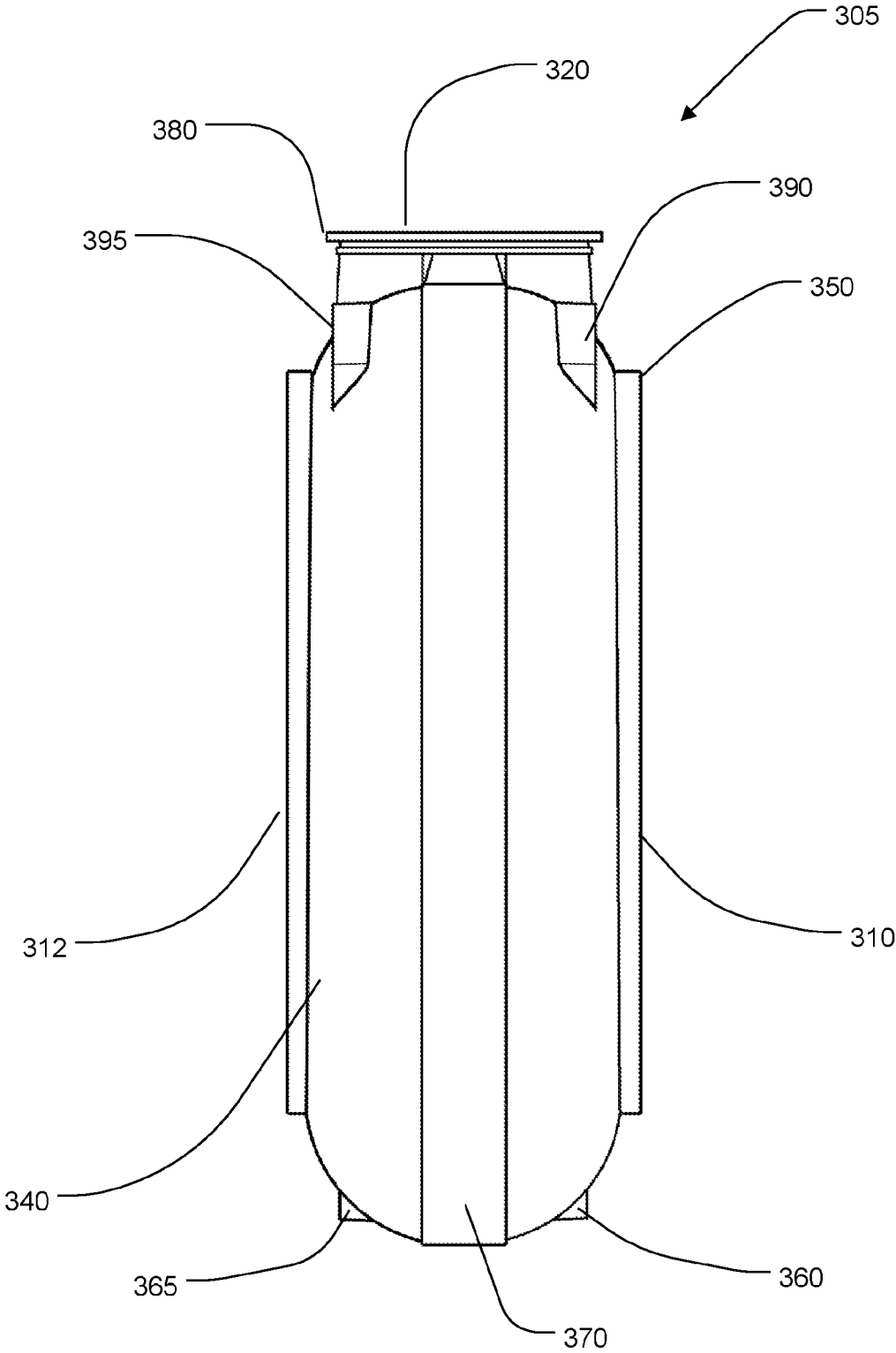


Fig. 11B

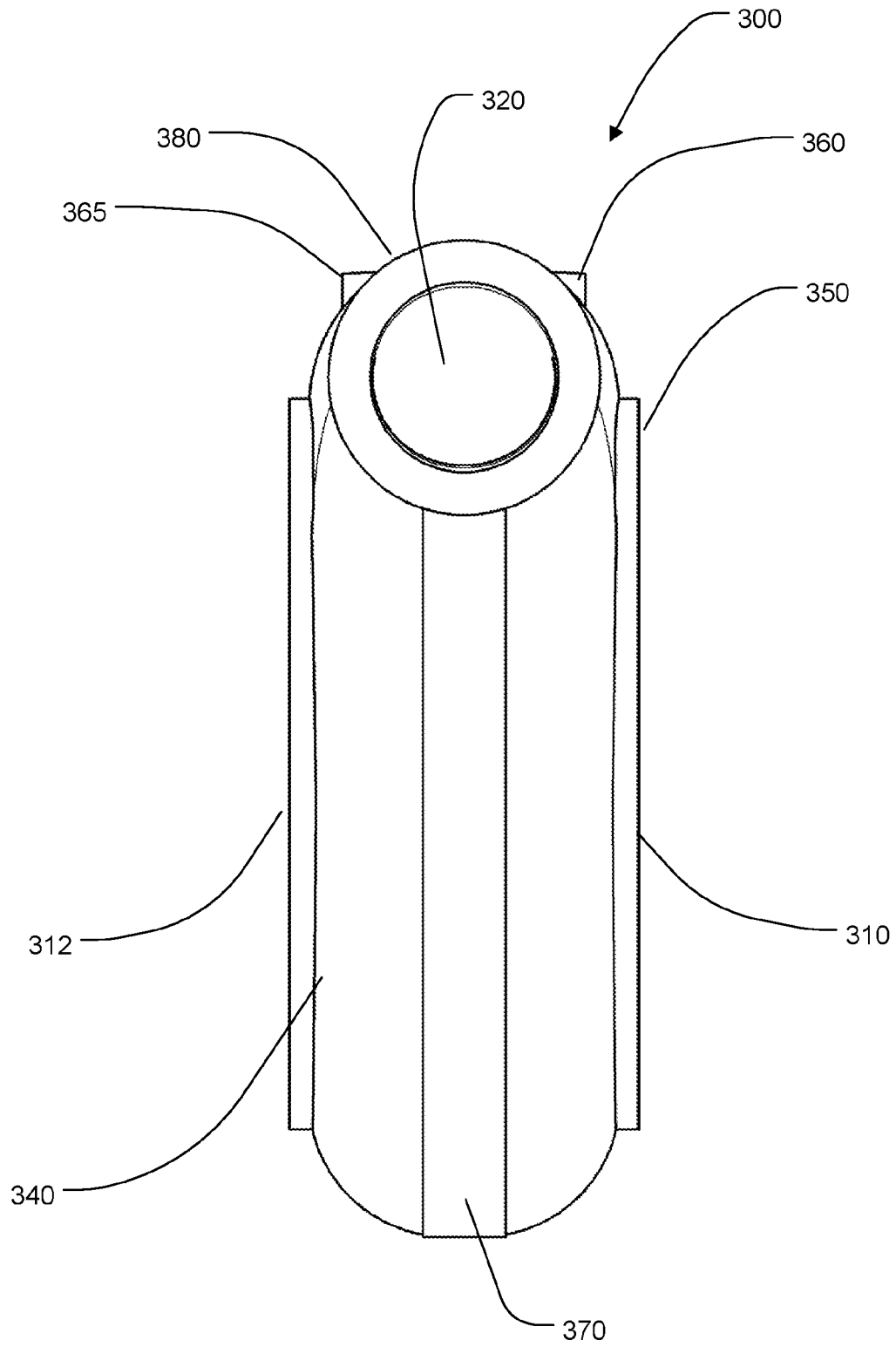


Fig. 12A

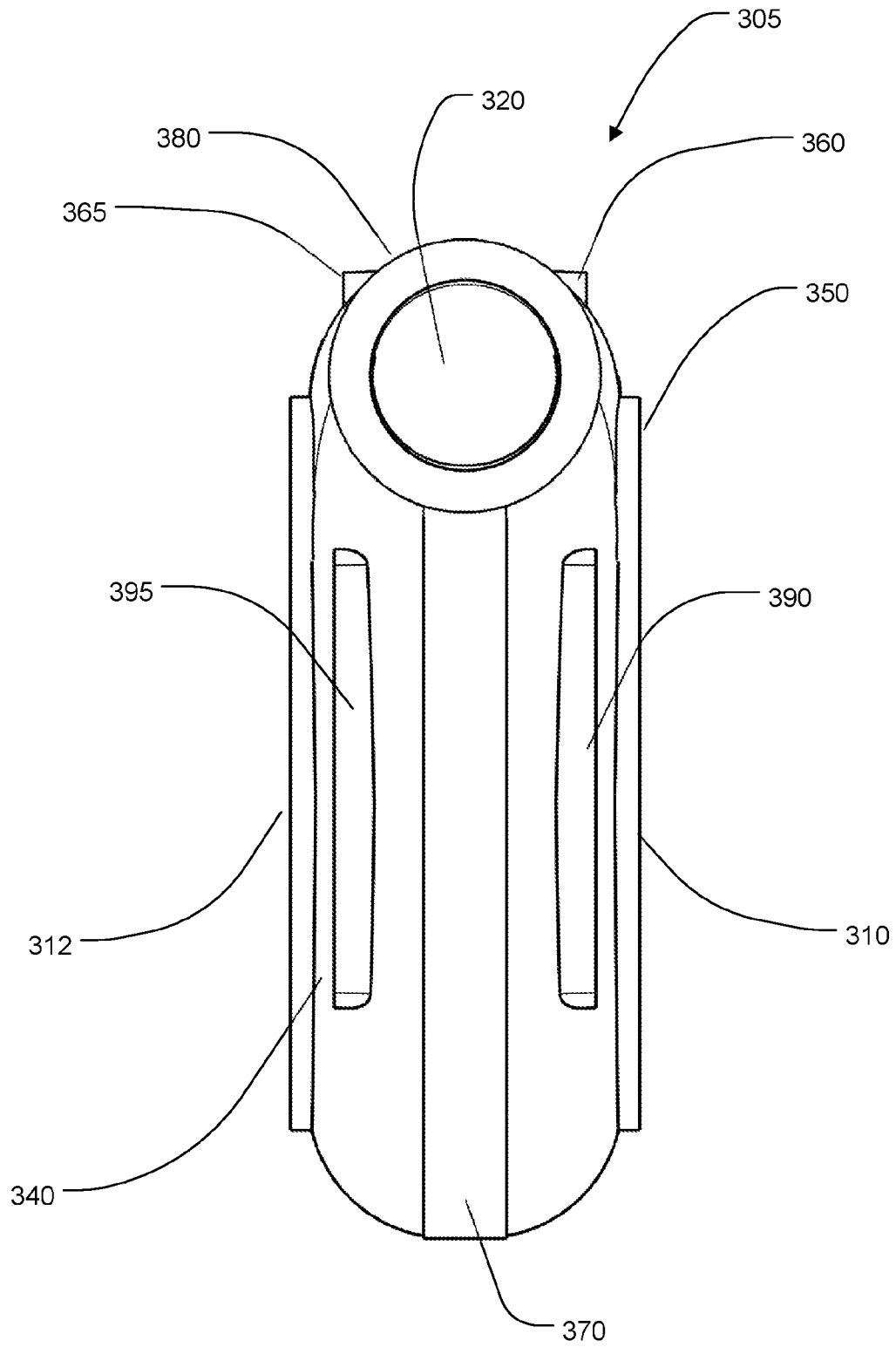


Fig. 12B

INTERNATIONAL SEARCH REPORT

International application No.

PCT/AU2021/050521

A. CLASSIFICATION OF SUBJECT MATTER

F04D 29/42 (2006.01) F04D 7/02 (2006.01) F04D 29/22 (2006.01) F04D 29/62 (2006.01)

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

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

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

PATENW using CPC/IPC: F04D29/4286, F04D7/02, F04D29/22, F04D29/42, F04D29/62, and lower. Keywords: liner, lining, align, locate, dowel, retain, engage, couple, fix, casing, case, volute, projection, protrusion, seat, and like terms. GOOGLE PATENTS, ESPACENET using CPC: F04D29/4286, and keywords: centrifugal, pump, liner, lining, alignment, locate, retain, seating, and like terms. Applicant/Inventor names searched in internal databases provided by IP Australia, Espacenet and AusPat.

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
	Documents are listed in the continuation of Box C	



Further documents are listed in the continuation of Box C



See patent family annex

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

Date of the actual completion of the international search
2 August 2021

Date of mailing of the international search report
02 August 2021

Name and mailing address of the ISA/AU

AUSTRALIAN PATENT OFFICE
PO BOX 200, WODEN ACT 2606, AUSTRALIA
Email address: pct@ipaustalia.gov.au

Authorised officer

Ashok Krishnan
AUSTRALIAN PATENT OFFICE
(ISO 9001 Quality Certified Service)
Telephone No. +61262832190

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

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

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:
the subject matter listed in Rule 39 on which, under Article 17(2)(a)(i), an international search is not required to be carried out, including
2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a)

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

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

See Supplemental Box for Details

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

Remark on Protest

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

INTERNATIONAL SEARCH REPORT		International application No.
C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		PCT/AU2021/050521
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 20150240837 A1 (WEIR MINERALS AUSTRALIA LTD.) 27 August 2015 figure 2-4, 16, 35, 38, 41-44, 49-52, 55, 56; paragraphs [0005], [0006], [0129], [0160]	1-26
X	US 1967182 A (ALLEN) 17 July 1934 figures 2, 7-9; column 3, lines 82-93	1-26
X	US 1591939 A (HUMPHREY) 06 July 1926 figures 1-2	1-26
X	US 2110079 A (BUTLER) 01 March 1938 figures 1-4, 7	1-26
X	US 20070014662 A1 (BURGESS) 18 January 2007 figures 5-8; 12-13, 15-18, 20-21	11-26

Supplemental Box**Continuation of: Box III**

This International Application does not comply with the requirements of unity of invention because it does not relate to one invention or to a group of inventions so linked as to form a single general inventive concept.

This Authority has found that there are different inventions based on the following features that separate the claims into distinct groups:

- Claims 1-10 are directed to a main liner for a centrifugal pump. The feature of alignment portions on the discharge outlet is specific to this group of claims. This corresponds to, for example, figure 4: alignment portion 410 on the discharge outlet, and solve the problem of stabilising the discharge outlet.
- Claims 11-26 are directed to a main liner for a centrifugal pump. The feature of alignment portions on the main pumping chamber is specific to this group of claims. This corresponds to, for example, figure 3: alignment portions 390, 395, 360, 365 on the main pumping chamber, and solves the problem of stabilising the main pumping chamber. Please note that claim 20 recites the feature of the alignment portion on the outlet side of the main liner, which belongs to the second group, and also recites an alignment portion on the inlet side, which belongs to the first group. However, this claim is grouped here for ease of reporting.

PCT Rule 13.2, first sentence, states that unity of invention is only fulfilled when there is a technical relationship among the claimed inventions involving one or more of the same or corresponding special technical features. PCT Rule 13.2, second sentence, defines a special technical feature as a feature which makes a contribution over the prior art.

When there is no special technical feature common to all the claimed inventions there is no unity of invention.

In the above groups of claims, the identified features may have the potential to make a contribution over the prior art but are not common to all the claimed inventions and therefore cannot provide the required technical relationship. The only feature common to all of the claimed inventions and which provides a technical relationship among them is

"Alignment portions on a main liner of a centrifugal pump".

However it is considered that this feature is generic in this particular art. See

D1: US 2015/0240837 A1: paragraph [0100].

Therefore in this light this common feature cannot be a special technical feature. Hence there is no special technical feature common to all the claimed inventions and the requirements for unity of invention are consequently not satisfied *a posteriori*.

INTERNATIONAL SEARCH REPORT		International application No.	
Information on patent family members		PCT/AU2021/050521	
This Annex lists known patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.			
Patent Document/s Cited in Search Report		Patent Family Member/s	
Publication Number	Publication Date	Publication Number	Publication Date
US 20150240837 A1	27 August 2015	US 2015240837 A1	27 Aug 2015
		US 10047761 B2	14 Aug 2018
		AP 3711 A	31 May 2016
		AP 3742 A	30 Jun 2016
		AR 072131 A1	04 Aug 2010
		AR 072132 A1	04 Aug 2010
		AR 072137 A1	11 Aug 2010
		AR 072138 A1	11 Aug 2010
		AR 072364 A1	25 Aug 2010
		AR 105361 A2	27 Sep 2017
		AR 105362 A2	27 Sep 2017
		AR 105823 A2	15 Nov 2017
		AR 105824 A2	15 Nov 2017
		AU 2009257192 A1	17 Dec 2009
		AU 2009257192 B2	08 May 2014
		AU 2009257193 A1	17 Dec 2009
		AU 2009257193 B2	05 Sep 2013
		AU 2009257194 A1	17 Dec 2009
		AU 2009257194 B2	19 Jun 2014
		AU 2009257195 A1	17 Dec 2009
		AU 2009257195 B2	30 Jan 2014
		AU 2009257196 A1	17 Dec 2009
		AU 2009257196 B2	14 Mar 2013
		AU 2013202744 A1	02 May 2013
		AU 2013202744 B2	28 Jan 2016
		AU 2013202757 A1	02 May 2013
		AU 2013202757 B2	15 May 2014
		AU 2013202758 A1	02 May 2013
		AU 2013202758 B2	19 Jun 2014
		AU 2013202761 A1	02 May 2013
		AU 2013202761 B2	19 Feb 2015
		AU 2015202357 A1	21 May 2015
		AU 2015202357 B2	02 Feb 2017
		BR PI0909863 B1	12 May 2020
BR PI0909877 B1	27 Oct 2020		
BR PI0909983 A2	19 Apr 2016		
Due to data integration issues this family listing may not include 10 digit Australian applications filed since May 2001.			

INTERNATIONAL SEARCH REPORT		International application No.	
Information on patent family members		PCT/AU2021/050521	
This Annex lists known patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.			
Patent Document/s Cited in Search Report		Patent Family Member/s	
Publication Number	Publication Date	Publication Number	Publication Date
		BR PI0909983 B1	29 Oct 2019
		BR PI0910008 A2	26 Jan 2016
		BR PI0910008 B1	01 Oct 2019
		CA 2726846 A1	17 Dec 2009
		CA 2726849 A1	17 Dec 2009
		CA 2727534 A1	17 Dec 2009
		CA 2727536 A1	17 Dec 2009
		CA 2727554 A1	17 Dec 2009
		CA 2895960 A1	17 Dec 2009
		CA 2899851 A1	17 Dec 2009
		CA 2946284 A1	17 Dec 2009
		CA 2949502 A1	17 Dec 2009
		CA 3076345 A1	17 Dec 2009
		CL 2010001390 A1	08 Apr 2011
		CL 2010001391 A1	08 Apr 2011
		CL 2010001392 A1	08 Apr 2011
		CL 2010001393 A1	08 Apr 2011
		CL 2010001394 A1	08 Apr 2011
		CL 2013000590 A1	12 Jul 2013
		CL 2016002272 A1	23 Dec 2016
		CL 2018003272 A1	15 Mar 2019
		CN 102066764 A	18 May 2011
		CN 102066764 B	13 Aug 2014
		CN 102066765 A	18 May 2011
		CN 102066765 B	04 Jun 2014
		CN 102066769 A	18 May 2011
		CN 102066769 B	22 Jan 2014
		CN 102066770 A	18 May 2011
		CN 102066770 B	18 Feb 2015
		CN 102105700 A	22 Jun 2011
		CN 102105700 B	13 Nov 2013
		CN 103362871 A	23 Oct 2013
		CN 103362871 B	29 Mar 2017
		CN 103867490 A	18 Jun 2014
		CN 103867490 B	29 Mar 2017
		EA 201170012 A1	30 Aug 2011
Due to data integration issues this family listing may not include 10 digit Australian applications filed since May 2001.			

INTERNATIONAL SEARCH REPORT		International application No.	
Information on patent family members		PCT/AU2021/050521	
This Annex lists known patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.			
Patent Document/s Cited in Search Report		Patent Family Member/s	
Publication Number	Publication Date	Publication Number	Publication Date
		EA 019128 B1	30 Jan 2014
		EA 201170011 A1	30 Aug 2011
		EA 019907 B1	30 Jul 2014
		EA 201170010 A1	30 Aug 2011
		EA 019991 B1	30 Jul 2014
		EA 201170008 A1	30 Aug 2011
		EA 021288 B1	29 May 2015
		EA 201170009 A1	30 Aug 2011
		EA 023108 B1	29 Apr 2016
		EA 201401052 A1	30 Dec 2014
		EA 025659 B1	30 Jan 2017
		EA 201300579 A1	30 Sep 2013
		EA 027313 B1	31 Jul 2017
		EA 201790230 A1	31 Jan 2018
		EA 036109 B1	29 Sep 2020
		EP 2315947 A1	04 May 2011
		EP 2315947 B1	13 Apr 2016
		EP 2315948 A1	04 May 2011
		EP 2315948 B1	25 Feb 2015
		EP 2315949 A1	04 May 2011
		EP 2315949 B1	29 Apr 2015
		EP 2324248 A1	25 May 2011
		EP 2324248 B1	14 Oct 2015
		EP 2324250 A1	25 May 2011
		EP 2324250 B1	22 Oct 2014
		EP 2894352 A1	15 Jul 2015
		EP 2894352 B1	07 Nov 2018
		EP 2902640 A1	05 Aug 2015
		EP 3056743 A1	17 Aug 2016
		EP 3056743 B1	28 Aug 2019
		EP 3447308 A1	27 Feb 2019
		IL 209686 A	31 Jul 2014
		IL 209687 A	30 Jun 2016
		IL 209688 A	28 Feb 2017
		IL 228497 A	21 Apr 2016
		IL 228498 A	31 Mar 2016
Due to data integration issues this family listing may not include 10 digit Australian applications filed since May 2001.			

INTERNATIONAL SEARCH REPORT		International application No.	
Information on patent family members		PCT/AU2021/050521	
This Annex lists known patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.			
Patent Document/s Cited in Search Report		Patent Family Member/s	
Publication Number	Publication Date	Publication Number	Publication Date
		IL 228499 A	29 Sep 2016
		MX 344889 B	11 Jan 2017
		MX 346808 B	31 Mar 2017
		MX 346810 B	31 Mar 2017
		MX 350021 B	18 Aug 2017
		MX 2010013765 A	25 May 2011
		MX 2010013767 A	25 May 2011
		MX 2010013769 A	24 May 2011
		PE 20110030 A1	09 Feb 2011
		PE 20110031 A1	09 Feb 2011
		PE 20110032 A1	11 Feb 2011
		PE 20110158 A1	04 Mar 2011
		PE 20110657 A1	16 Sep 2011
		PE 20142007 A1	19 Dec 2014
		PE 20150514 A1	07 May 2015
		PE 20150788 A1	02 Jun 2015
		PH 12018501008 A1	11 Feb 2019
		PH 12018501008 B1	11 Feb 2019
		US 2012001444 A1	05 Jan 2012
		US 8662551 B2	04 Mar 2014
		US 2011142599 A1	16 Jun 2011
		US 8790077 B2	29 Jul 2014
		US 2011164841 A1	07 Jul 2011
		US 8967874 B2	03 Mar 2015
		US 2011158800 A1	30 Jun 2011
		US 8967953 B2	03 Mar 2015
		US 2011164973 A1	07 Jul 2011
		US 9593692 B2	14 Mar 2017
		US 2015240831 A1	27 Aug 2015
		US 9618006 B2	11 Apr 2017
		US 2014341705 A1	20 Nov 2014
		US 9759224 B2	12 Sep 2017
		US 2014167364 A1	19 Jun 2014
		WO 2009149511 A1	17 Dec 2009
		WO 2009149512 A1	17 Dec 2009
		WO 2009149513 A1	17 Dec 2009
Due to data integration issues this family listing may not include 10 digit Australian applications filed since May 2001.			
Form PCT/ISA/210 (Family Annex)(July 2019)			

INTERNATIONAL SEARCH REPORT Information on patent family members		International application No. PCT/AU2021/050521	
This Annex lists known patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.			
Patent Document/s Cited in Search Report		Patent Family Member/s	
Publication Number	Publication Date	Publication Number	Publication Date
		WO 2009149514 A1	17 Dec 2009
		WO 2009149515 A1	17 Dec 2009
		ZA 201008602 B	31 Jul 2019
		ZA 201008604 B	28 Nov 2018
Due to data integration issues this family listing may not include 10 digit Australian applications filed since May 2001. Form PCT/ISA/210 (Family Annex)(July 2019)			

INTERNATIONAL SEARCH REPORT		International application No.	
Information on patent family members		PCT/AU2021/050521	
This Annex lists known patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.			
Patent Document/s Cited in Search Report		Patent Family Member/s	
Publication Number	Publication Date	Publication Number	Publication Date
US 1967182 A	17 July 1934	US 1967182 A	17 Jul 1934
US 1591939 A	06 July 1926	US 1591939 A	06 Jul 1926
US 2110079 A	01 March 1938	US 2110079 A	01 Mar 1938
US 20070014662 A1	18 January 2007	US 2007014662 A1	18 Jan 2007
		US 7416383 B2	26 Aug 2008
		AP 1863 A	07 Jul 2008
		AR 045583 A1	02 Nov 2005
		AR 089582 A2	03 Sep 2014
		AU 2004270753 A1	17 Mar 2005
		AU 2004270753 A2	17 Apr 2008
		AU 2004270753 B2	05 Nov 2009
		BR PI0414138 A	31 Oct 2006
		BR PI0414138 B1	11 Apr 2017
		CA 2533615 A1	17 Mar 2005
		CN 1842658 A	04 Oct 2006
		CN 101303028 A	12 Nov 2008
		CN 101303028 B	27 Mar 2013
		EA 200600532 A1	25 Aug 2006
		EA 007512 B1	27 Oct 2006
		EC SP066478 A	10 Oct 2006
		EP 1660778 A1	31 May 2006
		EP 1660778 B1	12 Nov 2008
		EP 2012018 A2	07 Jan 2009
		HK 1085526 A1	25 Aug 2006
		IL 173353 A	28 Nov 2013
		JO 2487 B1	05 Oct 2009
		JP 2010265904 A	25 Nov 2010
		JP 5296018 B2	25 Sep 2013
		JP 2011169328 A	01 Sep 2011
		JP 5394434 B2	22 Jan 2014
		JP 2007533886 A	22 Nov 2007
		KR 20110074796 A	01 Jul 2011
		KR 101143901 B1	11 May 2012
Due to data integration issues this family listing may not include 10 digit Australian applications filed since May 2001.			

INTERNATIONAL SEARCH REPORT Information on patent family members		International application No. PCT/AU2021/050521	
This Annex lists known patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.			
Patent Document/s Cited in Search Report		Patent Family Member/s	
Publication Number	Publication Date	Publication Number	Publication Date
		KR 20060061358 A	07 Jun 2006
		KR 101178581 B1	30 Aug 2012
		MX PA06002539 A	20 Jun 2006
		MY 142716 A	31 Dec 2010
		NZ 545072 A	31 Jul 2009
		PE 20050270 A1	07 Jun 2005
		TW 200510640 A	16 Mar 2005
		TW I350887 B	21 Oct 2011
		US 2009068002 A1	12 Mar 2009
		US 7806654 B2	05 Oct 2010
		WO 2005024243 A1	17 Mar 2005
		ZA 200601284 B	30 May 2007
End of Annex			
Due to data integration issues this family listing may not include 10 digit Australian applications filed since May 2001. Form PCT/ISA/210 (Family Annex)(July 2019)			