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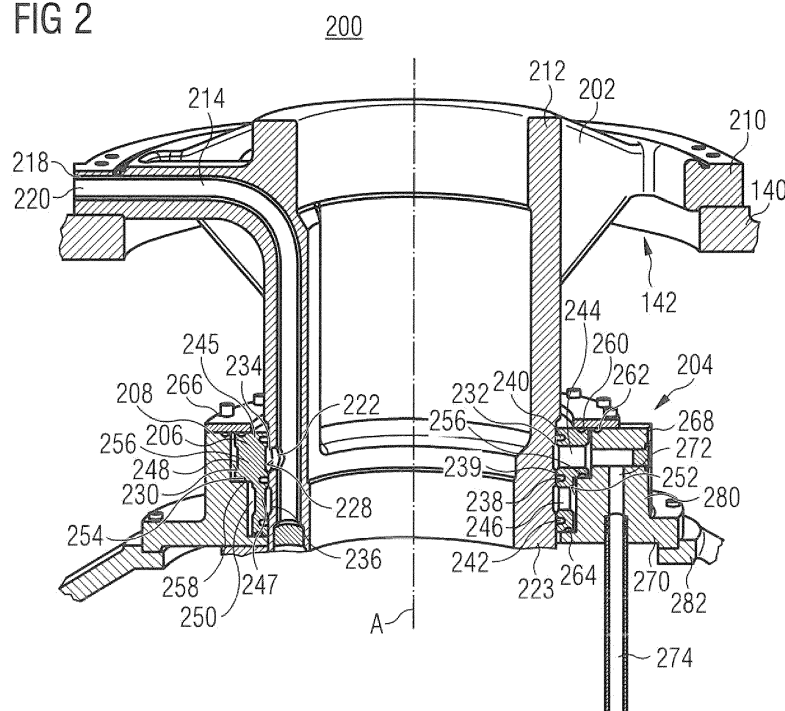
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(54) FLUID GUIDING DEVICE FOR AZIMUTH THRUSTER

(57) A fluid guiding device (200) for an azimuth thruster (100) is disclosed. The fluid guiding device (200) comprises an inner ring member (206) extending circumferentially about a longitudinal axis (A), and including a first inner ring member channel (244). The fluid guiding device (200) further comprises an outer ring member (208) arranged coaxial around the inner ring member (206), and including a first outer ring member channel

(272) fluidly connected to the first inner ring member channel (244). The inner ring member (206) and the outer ring member (208) are movable with respect to each other in a radial direction of the longitudinal axis (A). Said configuration may allow to accommodate a radial movement resulting from a thrust force of the propeller which may slightly bend and/or displace the drive shaft.

FIG 2



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Description

Technical Field

[0001] The present disclosure relates to an azimuth thruster. Particularly, the present disclosure relates to a fluid guiding device for an azimuth thruster, and an azimuth thruster including the fluid guiding device.

Background

[0002] Azimuth thrusters are commonly used as propulsion devices for marine vessels. Azimuth thrusters are at least partly arranged beneath a hull of a marine vessel and typically comprise an upper gear unit, an azimuth unit and a lower gear unit. The upper gear unit is connected to a horizontal drive shaft via an upper gear crown wheel and configured to mechanically drive a vertical input shaft of the azimuth thruster. The azimuth unit is connected to the upper gear unit via a slewing bearing. The azimuth unit has an outer azimuth stem and an inner azimuth stem. The slewing bearing allows a relative rotation between the outer azimuth stem and the inner azimuth stem so that the azimuth thruster can be slewed for maneuvering the vessel. The lower gear unit includes one or more propellers connected to the vertical input shaft for providing thrust to the marine vessel.

[0003] The propeller may be a variable pitch propeller which allows to vary a pitch of the propeller blades. For example, the pitch may be varied by a piston moving under the influence of a pressure of a hydraulic fluid selectively supplied to the propeller.

[0004] The present disclosure is directed, at least in part, to improving or overcoming one or more aspects of prior systems.

Summary of the Disclosure

[0005] In one aspect, the present disclosure relates to a fluid guiding device for an azimuth thruster. The fluid guiding device comprises an inner ring member extending circumferentially about a longitudinal axis, and including a first inner ring member channel. The fluid guiding device further comprises an outer ring member arranged coaxial around the inner ring member, and including a first outer ring member channel fluidly connected to the first inner ring member channel. The inner ring member and the outer ring member are movable with respect to each other in a radial direction of the longitudinal axis.

[0006] In another aspect, an azimuth thruster is disclosed. The azimuth thruster comprises a variable pitch propeller, and a fluid guiding device according to the above aspect or any embodiment as disclosed herein. The first inner ring member channel and the first outer ring member channel are fluidly connected to the variable pitch propeller for varying a pitch.

[0007] In another aspect, an azimuth thruster is disclosed. The azimuth thruster comprises an upper gear

housing accommodating an upper gear unit, and rotatable inner azimuth stem for slewing the azimuth thruster. The azimuth thruster further comprises a fluid guiding device according to the above aspect or any embodiment as disclosed herein, wherein a shaft housing is connected to the upper gear housing, and the outer ring member is connected to the inner stem so that the outer ring member rotates relative to the shaft housing when the inner stem is rotated about the longitudinal axis.

[0008] In another aspect, a fluid guiding device for an azimuth thruster with a drive shaft is disclosed. The fluid guiding device comprises a shaft housing extending along a longitudinal axis and configured to support the drive shaft of the azimuth thruster. The shaft housing includes a first shaft housing channel. The fluid guiding device comprises an outer ring member arranged coaxial around the shaft housing and including a first outer ring member channel. The fluid guiding device comprises an inner ring member arranged coaxial around the shaft housing between the shaft housing and the outer ring member. The inner ring member includes a first inner ring member channel fluidly interconnected between the first shaft housing channel and the outer ring member channel. The inner ring member and the outer ring member are movable with respect to each other in a radial direction of the longitudinal axis.

[0009] In yet another aspect, a rotatable inner ring member for a fluid guiding device of an azimuth thruster is disclosed. The inner ring member includes at least one inner ring member channel. The inner ring member includes a stepped outer circumferential face.

[0010] The inner ring member may include at least one first annular sealing face extending in a radial direction of a longitudinal axis of the inner ring member and including at least one first annular groove accommodating at least one first seal ring. Additionally or alternatively, the inner ring member may include a second annular sealing face extending parallel to the longitudinal axis, the second sealing face including at least one second annular accommodating at least one second seal ring.

[0011] Other features and aspects of this disclosure will be apparent from the following description and the accompanying drawings.

Brief Description of the Drawings

[0012] The accompanying drawings, which are incorporated herein and constitute a part of the specification, illustrate exemplary embodiments of the disclosure and, together with the description, serve to explain the principles of the disclosure. In the drawings:

Fig. 1 shows a schematic cut view of an exemplary azimuth thruster for a marine vessel (ship, oil rig, etc.) according to the present disclosure;
Fig. 2 shows a schematic cut view of a fluid guiding device according to the present disclosure; and
Fig. 3 shows another schematic cut view of the fluid

guiding device.

Detailed Description

[0013] The following is a detailed description of exemplary embodiments of the present disclosure. The exemplary embodiments described therein and illustrated in the drawings are intended to teach the principles of the present disclosure, enabling those of ordinary skill in the art to implement and use the present disclosure in many different environments and for many different applications. Therefore, the exemplary embodiments are not intended to be, and should not be considered as, a limiting description of the scope of patent protection. Rather, the scope of patent protection shall be defined by the appended claims.

[0014] The present disclosure is based in part on the realization that a swivel assembly may be integrated into an azimuth thruster for guiding a hydraulic fluid from a stationary component to a lower gear unit and a propeller, which are rotatable relative to the stationary component about a longitudinal axis of a vertical drive shaft of the azimuth thruster.

[0015] The present disclosure is further based in part on the realization that the swivel assembly may include a rotatable inner ring member and a rotatable outer ring member, wherein the ring members are arranged and configured to allow a movement between both ring members in a radial direction of the longitudinal axis. Said configuration allows to accommodate a radial movement resulting from a thrust force of the propeller which may slightly bend and/or displace the drive shaft.

[0016] Referring now to the drawings. It should be noted that throughout the drawings, like elements are referred to with the same reference signs.

[0017] Fig. 1 shows a schematic drawing of an exemplary azimuth thruster 100 for a marine vessel. The azimuth thruster 100 includes an upper gear unit 102, an azimuth unit 104 and a lower gear unit 106.

[0018] The upper gear unit 102 includes a substantially horizontal drive shaft 108 for connecting to a drive source. The drive shaft 108 terminates to an upper gear pinion wheel 110. The upper gear pinion wheel 110 includes an upper gear pinion wheel extension 112 configured to rotatably support the horizontal drive shaft 108 within an upper gear housing 114. The upper gear pinion wheel 110 is configured to transmit power from the horizontal drive shaft 108 to an upper gear crown wheel 116.

[0019] The upper gear crown wheel 116 is mounted on top of a substantially vertical drive shaft 118. The vertical drive shaft 118 includes an upper crown wheel shaft 120, an intermediate shaft 122, and a lower pinion shaft 124. The upper crown wheel shaft 120 is drivably connected to the intermediate shaft 122 via a first connection 126. The lower pinion shaft 124 is drivably connected to the intermediate shaft 122 via a second connection 128. The first and second connections 126, 128 may be splined connections, flexible shaft couplings and/or float-

ing shaft couplings.

[0020] The vertical input shaft 118 terminates to a lower gear pinion wheel 130 formed on the lower pinion shaft 124. The lower gear pinion wheel 130 extends into the lower gear unit 106 and transmits the power to a lower gear crown wheel 132. The lower gear crown wheel 132 is connected to a propeller shaft 134. The propeller shaft 134 extends substantially horizontal and is provided with a propeller 136 for providing thrust to the azimuth thruster 100. The propeller 136 may be any type of propeller known to a person skilled in the art, for example a variable or fixed pitch propeller.

[0021] The propeller 136 is surrounded by a nozzle 138. The nozzle 138 is fixedly connected to the lower gear unit 106 and may be any type of nozzle known to a person skilled in the art. The nozzle 138 is configured to increase a thrust of the propeller 136 and to protect the propeller 136 against, for example, debris. In some embodiments, the azimuth thruster 100 may not include the nozzle 138.

[0022] For maneuvering the marine vessel, the lower gear unit 106 including the propeller 136 and the nozzle 138 need to be rotated (slewed) around the vertical input shaft 118. This means that the upper gear unit 102 needs to be stationary, e.g. non-rotatable, whereas the lower gear unit 106 needs to be rotatable. To rotate the lower gear unit 106 relative to the upper gear unit 102 and thus about the vertical input shaft 118, the azimuth thruster 100 includes the azimuth unit 104.

[0023] The azimuth unit 104 is connected to the upper gear unit 102 via a separation plate 140. The separation plate 140 includes an opening 142 configured to at least partially accommodate the upper crown wheel shaft 120. Thus, the separation plate 140 at least partially separates the azimuth unit 104 from the upper gear unit 102. An upper crown wheel shaft housing (not shown in Fig. 1) may be connected to the separation plate 140 and may protrude through the opening 142 for rotatably supporting the upper crown wheel shaft 120 via suitable bearings.

[0024] The azimuth unit 104 further includes an azimuth stem 144 with an inner azimuth stem 146 and an outer azimuth stem 148. The outer azimuth stem 148 is connected to the separation plate 140 via a ring body 152. The ring body 152 is fixedly connected to an annular flange 150 of the outer azimuth stem 148. The annular flange 150 is fixedly connected to a hull structure (foundation) of the marine vessel. Thus, the outer azimuth stem 148 including the separation plate 140 and the upper gear unit 102 are stationary, e.g. non-rotatable, with respect to the marine vessel.

[0025] A ring-shaped gearwheel 154 is rotatable relative to the outer ring body 152 via a bearing 153. The ring-shaped gearwheel 154 is fixedly connected to the inner azimuth stem 146. The outer ring body 152 and the ring-shaped gearwheel 154 together form a slewing bearing 156. Specifically, the outer ring body 152 forms an outer race of the slewing bearing 156, and the ring-shaped gearwheel 154 forms an inner race of the slewing

bearing 156. The slewing bearing 156 is configured to allow a rotation of the inner azimuth stem 146 relative to the outer azimuth stem 148 (relative rotation between the ring-shaped gearwheel 154 and the outer ring body 152).

[0026] The ring-shaped gearwheel 154 includes teeth on an inner circumferential face. A slewing drive including at least one drive gearwheel (both not shown) is arranged to rotate the ring-shaped gearwheel 154. Specifically, teeth on an outer circumferential face of the at least one drive gearwheel engage with the teeth on the inner circumferential face of the ring-shaped gearwheel 154. Thus, the slewing drive rotates the at least one drive gearwheel which in turn rotates the ring-shaped gearwheel 154 relative to the outer ring body 152.

[0027] The inner azimuth stem 146 is connected at its lower part to a vertical shaft housing 158. The vertical shaft housing 158 surrounds the vertical input shaft 118 and connects the inner azimuth stem 146 with the lower gear unit 106. The vertical shaft housing 158 is fixedly connected to a lower gear housing 159. The lower gear housing 159 surrounds the lower gear transmission of the lower gear unit 106.

[0028] As the outer azimuth stem 148 is non-rotatably connected to the hull structure of the marine vessel, and as the inner azimuth stem 146 is rotatably connected to the outer azimuth stem 148 via the slewing bearing 156, the lower gear unit 106 is rotatable relative to the upper gear unit 102 via the slewing bearing 156.

[0029] Inside the azimuth unit 104 a lubricant compartment 160 is disposed to accommodate lubricant for bath lubricating the slewing bearing 156. Lubricant may be any type of lubricant known to a person skilled in the art. For example, the lubricant may be oil.

[0030] The lubricant compartment 160 is formed by an annular space surrounding the vertical input shaft 118. The lubricant compartment 160 is filled with lubricant such that the slewing bearing 156 is immersed in lubricant for arranging a full bath lubrication of the slewing bearing 156. For keeping the lubricant within the azimuth stem 144, a radial shaft seal 157 is arranged between a lower end of the outer azimuth stem 148 and a lower end of inner azimuth stem 146. Typically, the lubricant compartment 160 accommodates a volume of lubricant in a range between about 0.5 m³ and about 3 m³, depending on the type and size of the azimuth thruster 100 and the inner azimuth stem 146.

[0031] As noted above, the drive shaft 118 is supported by a shaft housing (not shown in Fig. 1), which surrounds the upper crown wheel shaft 120. In Figs. 2 to 5, said shaft housing is depicted together with further components constituting a fluid guiding device for guiding a fluid from an upper region of the azimuth thruster 100 to the propeller 136.

[0032] Figs. 2 and 3 show vertical cross-sections of the fluid guiding device 200 at different circumferential positions. Figs. 4 and 5 show vertical cross section of a lower region of the fluid guiding device 200 at different

circumferential positions.

[0033] As can be seen in Figs. 2 and 3, the fluid guiding device 200 comprises a shaft housing 202, and a swivel assembly 204 including an inner ring member 206 and an outer ring member 208.

[0034] The shaft housing 202 is configured to rotatably support the drive shaft 118 (see Fig. 1) at an upper region thereof via suitable bearings not shown in further detail here. The shaft housing 202 extends along a longitudinal axis A, which coincides with a longitudinal axis of the drive shaft 118.

[0035] The shaft housing 202 includes an annular mounting portion 210 at an upper end. The mounting portion 210 is fastened to the separation plate 140, for example an inner circumferential edge portion of the separation plate 140, which defines the opening 142 (see Fig. 1). Alternatively, for example, the mounting portion 210 may be fastened to the upper gear housing 114.

[0036] The shaft housing 202 further includes a substantially hollow cylindrical portion 212, through which the drive shaft 118 (see Fig. 1) extends in an assembled state.

[0037] A first shaft housing channel 214 (see Fig. 2) and a second shaft housing channel 216 (see Fig. 3) extend through the shaft housing 202. The first and second shaft housing channels 214 and 216 extend through the shaft housing 202 at different circumferential positions of the shaft housing 202 with respect to the longitudinal axis A. The first and second shaft housing channels 214 and 216 include an arcuate (curved) shape along their extension.

[0038] Specifically, the first shaft housing channel 214 (see Fig. 2) extends between an opening 220 in a circumferential outer face 218 of the mounting portion 210, and an opening 222 in a bottom region of the substantially hollow cylindrical portion 212. For machining the first shaft housing channel 214, the same may extend until an opening in an annular end face 223 of the substantially hollow cylindrical portion 212, which is sealed (for example, by a plug) after machining so that fluid can be guided in the first shaft housing channel 214 between the openings 220 and 222.

[0039] Similarly, the second shaft housing channel 216 (see Fig. 3) extends between an opening 224 in a circumferential outer face 218 of the mounting portion 210, and an opening 226 in a bottom region of the substantially hollow cylindrical portion 212. Similar to the first shaft housing channel 214, the second shaft housing channel 216 may extend until an opening in the annular end face 223, which is sealed after machining so that fluid can be guided in the second shaft housing channel 216 between the openings 224 and 226.

[0040] In the shown embodiment, the opening 220 of the first shaft housing channel 214 and the opening 224 of the second shaft housing channel 216 are arranged to overlap with respect to a longitudinal position (height position) along the longitudinal axis A. The opening 220 and the opening 224 are arranged to be spaced apart

with respect to a circumferential position about the longitudinal axis A. Furthermore, the opening 222 of the first shaft housing channel 214 and the opening 226 of the second shaft housing channel 216 are arranged to be spaced apart with respect to a longitudinal position along the longitudinal axis A. The opening 222 and the opening 226 of the second shaft housing channel 216 are arranged to be spaced apart with respect to a circumferential position about the longitudinal axis A. In other embodiments, for example, the openings 220-226 may be arranged in any other fashion allowing to fluidly isolate the first shaft housing channel 214 and the second shaft housing channel 216.

[0041] A hydraulic fluid system not shown in further detail may be connected to the openings 220 and 224 for supplying and drawing hydraulic fluid as desired. The hydraulic fluid system may be configured to control a pitch of the variable pitch propeller 136 (Fig. 1) as described in greater detail later on. In other embodiments, a lubrication oil system not shown in further detail may be connected to the openings 220 and/or 224.

[0042] The inner ring member 206 is arranged coaxial around the shaft housing 202 to surround a bottom region of the substantially hollow cylindrical portion 212. The inner ring member 206 may be made of a low-friction material such as bronze. The inner ring member 206 includes an inner circumferential face 228 and a stepped outer circumferential face 230. The inner circumferential face 228 of the inner ring member 206 and an outer circumferential face 232 define a first inner annular channel 234 and a second inner annular channel 236. The first inner annular channel 234 and the second inner annular channel 236 are fluidly isolated to each other by an inner intermediate seal ring 238. The first and second inner annular channels 234, 236 extend coaxial between the inner ring member 206 and the shaft housing 202. The inner annular channels 234, 236 are arranged spaced apart with respect to a longitudinal position along the longitudinal axis A.

[0043] The first shaft housing channel 214 is fluidly connected to the first inner annular channel 234 via the opening 222. The second shaft housing channel 216 is fluidly connected to the second inner annular channel 236 via the opening 226.

[0044] The inner ring member 206 and the shaft housing 202 are rotatable with respect to each other. Additionally, the inner ring member 206 is connected to the shaft housing 202 to follow a radial movement of the shaft housing 202 with respect to the longitudinal axis A. Said radial movement may result from a thrust force of the propeller 136 which may slightly bend and/or displace the drive shaft 118 supported by the shaft housing 202 in a radial direction of the longitudinal axis A. Said radial movement is oppositely directed to the water jet generated by the propeller 136.

[0045] The inner ring member 206 is sealingly engaged with the shaft housing 202 via an inner upper seal ring 240, the inner intermediate seal ring 238, and an inner

lower seal ring 242. The inner upper seal ring 240 seals between the first inner annular channel 234 and an exterior of the swivel assembly 204. The inner intermediate seal ring 238 seals between the first inner annular channel 234 and the second inner annular channel 236. The inner lower seal ring 242 seals between the second inner annular channel 236 and an exterior of the swivel assembly 204.

[0046] The seal rings 238-242 are accommodated in corresponding grooves extending in the inner circumferential face 228 of the inner ring member 206. Alternatively, the seal rings 238-242 may be accommodated in corresponding grooves extending in the outer circumferential face 232 of the shaft housing 202.

[0047] In some embodiments, the seal rings 238-242 may be formed by flexible outer ring bodies connected (glued etc.) to low-friction inner ring bodies, for example, made up of Teflon. The flexible outer ring bodies may press the low-friction inner ring bodies against the outer circumferential face 232 of the shaft housing 202 for obtaining a sealing effect while allowing a rotational movement between the inner ring member 206 and the shaft housing 202.

[0048] The at least one first inner ring member channel 244 extends through a first portion 245 of the inner ring member 206, and the at least one second inner ring member channel 246 extends through a second portion 247 of the inner ring member 206. The first portion 245 has a greater thickness than the second portion 247 in a radial direction of the longitudinal axis A.

[0049] The at least one first inner ring member channel 244 and the at least one second inner ring member channel 246 are arranged spaced apart with respect to a longitudinal position along the longitudinal axis A. In other words, the at least one first inner ring member channel 244 is arranged above the at least one second inner ring member channel 246 in a vertical direction.

[0050] The inner ring member 206 includes at least one first inner ring member channel 244 and at least one second inner ring member channel 246. The at least one first inner ring member channel 244 extends between the first inner annular channel 234 and a first outer annular channel 248. The at least one second inner ring member channel 246 extends between the second inner annular channel 236 and a second outer annular channel 250. The at least one first inner ring member channel 244 and the at least one second inner ring member channel 246 extend in a radial direction with respect to the longitudinal axis A.

[0051] The first and second outer annular channels 248, 250 are defined by the outer circumferential face 230 of the inner ring member 206 and a stepped inner circumferential face 252 of the outer ring member 208. The first and second outer annular channels 248, 250 extend coaxial between the inner ring member 206 and the outer ring member 208. The first and second outer annular channels 248, 250 are fluidly isolated from each other by an outer intermediate seal ring 254. The outer

intermediate seal ring 254 is accommodated in an annular groove 256 of a sealing face 258 of the inner ring member 206. The sealing face 258 extends in a radial direction of the longitudinal axis A so that a sealing effect is obtained by the outer intermediate seal ring 254 even if a slight radial movement between the inner ring member 206 and outer ring member 208 occurs. Alternatively, for example, the outer intermediate seal ring 254 may be accommodated in an annular groove of a radially extending sealing face of the outer ring member 208.

[0052] The inner ring member 206 is sealingly engaged with the outer ring member 208 via first and second outer upper seal rings 260, 262, the outer intermediate seal ring 254, and an outer lower seal ring 264. The first and second outer upper seal rings 240 seal between the first outer annular channel 248 and an annular plate 266 mounted on top of the outer ring member 208. The inner intermediate seal ring 254 seals between the first outer annular channel 248 and the second outer annular channel 250. The outer lower seal ring 264 seals the second outer annular channel 250.

[0053] The outer ring member 208 of the swivel assembly 204 is arranged coaxial around the shaft housing 202 and the inner ring member 206. The inner ring member 206 and the outer ring member 208 are movable with respect to each other in a radial direction of the longitudinal axis A while maintaining a sealing engagement of the seal rings 254, 260-264, which seal against radially extending sealing faces. The inner ring member 206 is rotatable with respect to the shaft housing 202 and the outer ring member 208.

[0054] The outer ring member 208 includes a first portion 268 and a second portion 270. The first portion 268 has a smaller thickness than the second portion 270 in a radial direction of the longitudinal axis A. The first portion 268 and the second portion 270 are connected to one another. The first portion 268 of the outer ring member 208 is positioned to substantially overlap the first portion 245 of the inner ring member 206 viewed in a radial direction of the longitudinal axis A. The second portion 270 of the outer ring member 208 is positioned to substantially overlap the second portion 247 of the inner ring member 206 viewed in a radial direction of the longitudinal axis A.

[0055] A first outer ring member channel 272 extends through the first and second portions 268 and 270 to fluidly interconnect the first outer annular channel 248 and a first hydraulic fluid tube 274 connected to a variable pitch mechanism of the propeller 136. A second outer ring member channel 276 (see Fig. 3) extends through the second portion 270 to fluidly interconnect the second outer annular channel 250 and a second hydraulic fluid tube 278 connected to the variable pitch mechanism. For machining the outer ring member channels 272, 276, the same may extend until an opening in an outer circumferential face 280 of outer ring member 208, which are sealed after machining (for example, by inserting a plug) so that fluid can be guided in the first and second outer

ring member channels 272 and 276 between first and second outer annular channels 248 and 250, and the first and second hydraulic fluid tubes 274 and 278, respectively.

[0056] The first and second outer ring member channels 272 and 276 are spaced apart from each other with respect to a circumferential position around the longitudinal axis A.

[0057] The outer ring member 208 is fastened to the inner azimuth stem 146 (see Fig. 1) via a plurality of radially extending supports 282 so that the outer ring member 208 rotates together with the inner azimuth stem 146 (and the lower gear unit 106) when rotating the azimuth thruster 100 is rotated about the longitudinal axis A.

[0058] As described in detail above, the first shaft housing channel 214, the first inner annular channel 234, the first inner ring member channel 244, the first outer annular channel 248, and the first outer ring member channel 272 together define a first fluid passage for guiding a hydraulic fluid. Similarly, the second shaft housing channel 216, the second inner annular channel 236, the second inner ring member channel 246, the second outer annular channel 250, and the second outer ring member channel 276 together define a second fluid passage. The first fluid passage and the second fluid passage are fluidly isolated from each other.

[0059] The first fluid passage and the second fluid passage as noted above may be used to supply a hydraulic fluid to a variable pitch mechanism of the propeller 136. Particularly, for varying the pitch in a first direction, hydraulic fluid may be supplied via the first fluid passage to a first chamber to displace a piston of the variable pitch mechanism for varying the pitch. While increasing a volume of the first chamber, the piston pushes hydraulic fluid out of a second chamber and into the second fluid passage. Similarly, for varying the pitch in a second direction opposite the first direction, hydraulic fluid may be supplied via the second fluid passage to the second chamber to displace the piston to vary the pitch, and simultaneously pushing hydraulic fluid from the first chamber into the first fluid passage. In other embodiments, one of the first and the second fluid passages may be sufficient for varying the pitch depending on the specific variable pitch mechanism.

[0060] In some embodiments, the first fluid passage and/or the second fluid passage may be used to supply any other fluid to the lower gear unit 106. For example, the first fluid passage and/or the second fluid passage may be used to supply a lubricant to the lower gear unit 106 and/or the propeller 136 for providing a point lubrication. In those embodiments, one of the first fluid passage and the second fluid passage may be omitted.

[0061] Furthermore, as described in detail above, the inner ring member 206 is arranged in a floating manner between the outer ring member 208 and the shaft housing 202. That is, the inner ring member 206 is arranged to follow the radial movement of the shaft housing 202 to radially move relative to the outer ring member 208. The

inner and outer ring members 206 and 208 may be dimensioned so that a radial movement greater than 0 mm between the inner and outer ring members 206 and 208 can be accommodated. For example, a clearance gap between the inner and outer ring members 206 and 208 may be within a range between about 0,5 mm and 10 mm, or even greater.

[0062] It should be noted that, in the shown embodiment, the stepped configuration of the inner ring member 206 (outer circumferential face 230) and the outer ring member 208 (inner circumferential face 252) together with the seal rings 254, and 260 to 264, which are disposed in sealing faces extending in a radial direction of the longitudinal axis A, allows a relative radial movement between the inner ring member 206 and outer ring member 208 while maintaining a sealing engagement.

[0063] In case the inner stem 146 is rotated during operation, the outer ring member 208 rotates together with the inner stem 146. The inner ring member 206 typically tends to at least partially rotate together with the outer ring member 208 due to the higher friction caused by the outer seal rings 254, 262 and 264 relative to the low-friction inner seal rings 238-242. As a result, the inner ring member 206 rotates relative to the shaft housing 202.

Industrial Applicability

[0064] The fluid guiding device as disclosed herein is applicable for integration in an azimuth thruster for providing thrust to a marine vessel. The fluid guiding device allows to guide a fluid in fluidly isolated channels from a fixed shaft housing for a drive shaft of the azimuth thruster and a rotatable swivel assembly, which is rotatable together with the inner azimuth stem, the lower gear unit, and the propeller about a longitudinal axis of the drive shaft.

[0065] Terms such as "about", "around", "approximately", or "substantially" as used herein when referring to a measurable value such as a parameter, an amount, a temporal duration, and the like, is meant to encompass variations of $\pm 10\%$ or less, preferably $\pm 5\%$ or less, more preferably $\pm 1\%$ or less, and still more preferably $\pm 0.1\%$ or less of and from the specified value, insofar as such variations are appropriate to perform in the disclosed invention. It is to be understood that the value to which the modifier "about" refers is itself also specifically, and preferably, disclosed. The recitation of numerical ranges by endpoints includes all numbers and fractions subsumed within the respective ranges, as well as the recited endpoints.

[0066] It is explicitly stated that all features disclosed in the description and/or the claims are intended to be disclosed separately and independently from each other for the purpose of original disclosure as well as for the purpose of restricting the claimed invention independent of the composition of the features in the embodiments and/or the claims. It is explicitly stated that all value ranges or indications of groups of entities disclose every pos-

sible intermediate value or intermediate entity for the purpose of original disclosure as well as for the purpose of restricting the claimed invention, in particular as limits of value ranges.

[0067] Although the preferred embodiments of this invention have been described herein, improvements and modifications may be incorporated without departing from the scope of the following claims.

Claims

1. A fluid guiding device (200) for an azimuth thruster (100), comprising:

an inner ring member (206) extending circumferentially about a longitudinal axis (A), and including a first inner ring member channel (244); and

an outer ring member (208) arranged coaxial around the inner ring member (206), and including a first outer ring member channel (272) fluidly connected to the first inner ring member channel (244), wherein the inner ring member (206) and the outer ring member (208) are movable with respect to each other in a radial direction of the longitudinal axis (A).

2. The fluid guiding device (200) of claim 1, further comprising:

a shaft housing (202) extending along the longitudinal axis (A) and configured to support a drive shaft (118) of the azimuth thruster (100), the shaft housing (202) including a first shaft housing channel (214) fluidly connected to the first inner ring member channel (244).

3. The fluid guiding device (200) of claim 2, wherein the inner ring member (206) is connected to the shaft housing (202) to follow a radial movement of the shaft housing (202) with respect to the longitudinal axis (A).

4. The fluid guiding device (200) of any one of the preceding claims, wherein:

the inner ring member (206) is sealingly engaged with the outer ring member (208); and/or the inner ring member (206) is rotatable with respect to the outer ring member (208).

5. The fluid guiding device (200) of any one of claims 2 to 4, wherein:

the inner ring member (206) is sealingly engaged with the shaft housing (202); and/or the inner ring member (206) is rotatable with re-

spect to the shaft housing (202).

6. The fluid guiding device (200) of any one of the preceding claims, wherein an outer circumferential face (230) of the inner ring member (206) and an inner circumferential face (252) of the outer ring member (208) are configured to define a first outer annular channel (248) fluidly interconnecting the first inner ring member channel (244) and the first outer ring member channel (272).

7. The fluid guiding device (200) of any one of claims 2 to 6, wherein an inner circumferential face (228) of the inner ring member (206) and an outer circumferential face (232) of the shaft housing (202) are configured to define a first inner annular channel (234) fluidly interconnecting the first shaft housing channel (214) and the first inner ring member channel (244).

8. The fluid guiding device (200) of any one of claims 2 to 7, wherein:

the shaft housing (202) includes a second shaft housing channel (216);
the outer ring member (208) includes a second outer ring member channel (276); and
the inner ring member (206) includes a second inner ring member channel (246) fluidly interconnected between the second shaft housing channel (216) and the second outer ring member channel (276).

9. The fluid guiding device (200) of claim 8, wherein:

an inner circumferential face (228) of the inner ring member (206) and an outer circumferential face (232) of the shaft housing (202) are configured to define a second inner annular channel (236) fluidly interconnecting the second shaft housing channel (216) and the second inner ring member channel (246), and/or
an outer circumferential face (230) of the inner ring member (206) and an inner circumferential face (252) of the outer ring member (208) are configured to define a second outer annular channel (250) fluidly interconnecting the second inner ring member channel (246) and the second outer ring member channel (276).

10. The fluid guiding device (200) of claim 9, wherein the first shaft housing channel (214), the first inner annular channel (234), the first inner ring member channel (244), the first outer annular channel (248), and the first outer ring member channel (272) together define a first fluid passage;
the second shaft housing channel (216), the second inner annular channel (236), the second inner ring

member channel (246), the second outer annular channel (250), and the second outer ring member channel (276) together define a second fluid passage; and

the first fluid passage and the second fluid passage are fluidly isolated from each other.

11. The fluid guiding device (200) of any one of the preceding claims, wherein at least one of the inner ring member (206) and the outer ring member (208) includes at least one first annular sealing face (258) extending in a radial direction of the longitudinal axis (A) and including at least one first annular groove (256) accommodating at least one first seal ring (254) sealing between the inner ring member (206) and outer ring member (208).

12. The fluid guiding device (200) of any one of claims 2 to 11, wherein at least one of the inner ring member (206) and the shaft housing (202) includes a second annular sealing face (228) extending parallel to the longitudinal axis (A), the second sealing face (228) including at least one second annular groove (239) accommodating at least one second seal ring (238) sealing between the inner ring member (206) and the shaft housing (202).

13. The fluid guiding device (200) of any one of the preceding claims, wherein the inner ring member (206) is made of bronze.

14. An azimuth thruster (100), comprising a variable pitch propeller (136); and a fluid guiding device (200) according to any one of claims 1 to 13, wherein the first inner ring member channel (244) and the first outer ring member channel (272) are fluidly connected to the variable pitch propeller (136) for varying a pitch.

15. An azimuth thruster (100), comprising an upper gear housing (114) accommodating an upper gear unit (102); a rotatable inner azimuth stem (146) for slewing the azimuth thruster (100); and a fluid guiding device (200) according to any one of claims 2 to 13, wherein the shaft housing (202) is connected to the upper gear housing (114), and the outer ring member (208) is connected to the inner stem (146) so that the outer ring member (208) rotates relative to the shaft housing (202) when the inner stem (146) is rotated about the longitudinal axis (A).

FIG 1

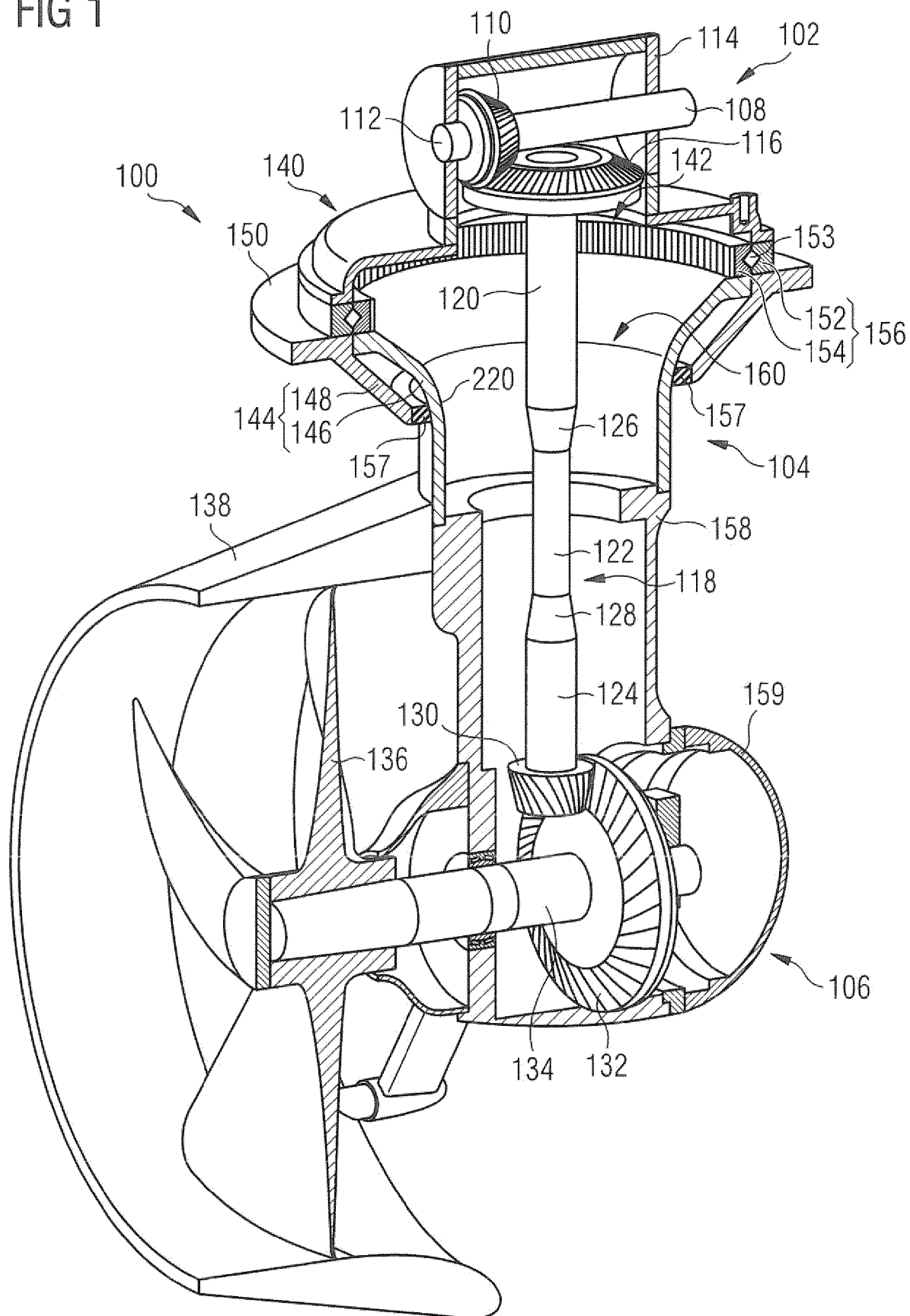


FIG 2

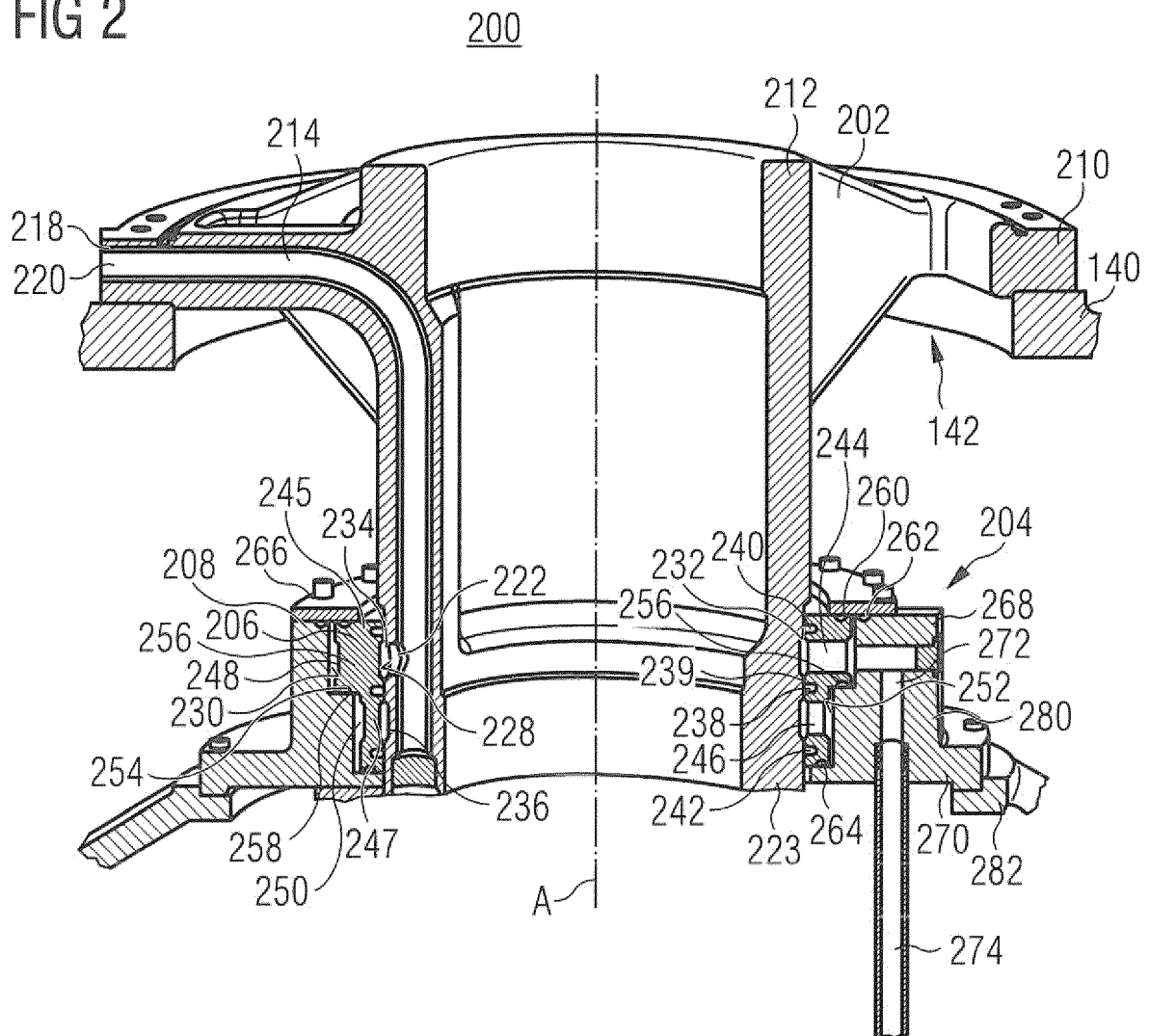
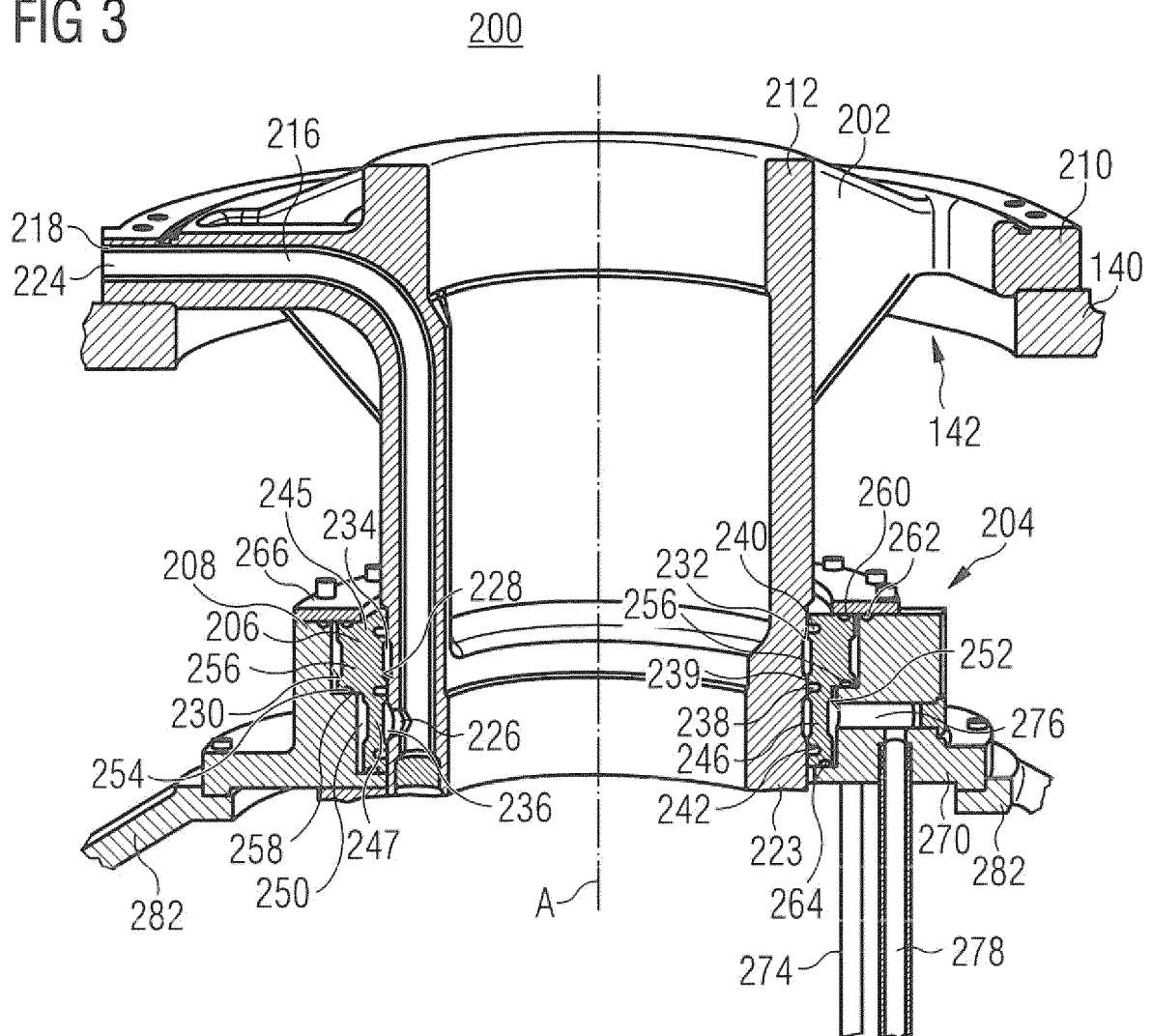


FIG 3





EUROPEAN SEARCH REPORT

Application Number
EP 16 19 6916

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The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 22 March 2017	Examiner Knoflachner, Nikolaus
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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**ANNEX TO THE EUROPEAN SEARCH REPORT
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5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
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