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DESCRIPTION

FIELD

[0001] The present invention relates in general to a gearbox assembly for a wind turbine, to a method for lubricating that gearbox and more particularly to a planet carrier of a wind turbine gearbox having an improved lubricant path.

BACKGROUND

[0002] Generally, a wind turbine includes a tower, a nacelle mounted on the tower, and a rotor coupled to the nacelle. The rotor generally includes a rotatable hub and a plurality of rotor blades coupled to and extending outwardly from the hub. Each rotor blade may be spaced about the hub so as to facilitate rotating the rotor to enable kinetic energy to be converted into usable mechanical energy, which may then be transmitted to an electric generator disposed within the nacelle for the production of electrical energy. Typically, a gearbox is used to drive the electric generator in response to rotation of the rotor. For instance, the gearbox may be configured to convert a low speed, high torque input provided by the rotor to a high speed, low torque output that may drive the electric generator.

[0003] The gearbox generally includes a gearbox housing containing a plurality of gears (e.g., planetary, ring and/or sun gears) connected via one or more planetary carriers and bearings for converting the low speed, high torque input of the rotor shaft to a high speed, low torque output for the generator. Lubrication systems are often used within the gearbox to circulate oil therethrough, thereby decreasing the friction between the components of the gearbox as well as providing cooling for such components. In order for lubricant to reach the planetary bearings and/or the gear meshes of the gearbox, the lubricant must be transferred from the stationary gearbox housing to the rotating planetary carrier with minimum leakages.

[0004] For multi-stage gear systems, the first-stage and/or the second-stage planetary carriers can often be critical components for the gearbox. More specifically, conventional designs of the lubrication path of the second-stage planetary carrier can introduce high stress concentrations on the upwind plug region. Such concentrations limit the load capacity of the gearbox and cause a bottle-neck for further upgrades that require increased load needs.

[0005] Accordingly, an improved gearbox lubrication system for a wind turbine that addresses the aforementioned issues would be welcomed in the art.

[0006] US 2010/007151 A1 describes a gearbox including a gear-train including an input and an output and a rotating conduit internally traversing the gear- train is provided. CN 201 448 430 U relates to a utility model of a mechanical lubrication oil circuit system of epicyclic

transmission mechanism. EP 1 717 489 A2 views an epicycloidal-gear multiplier/reducer useable in wind turbines and similar devices. CN 105 202 169 A describes a gear-box used in a kind of wind-power electricity generation, particularly relating to the gear of wind power speed-increasing gearbox that a kind of inside has planetary mechanism device.

BRIEF DESCRIPTION

[0007] Aspects and advantages of the invention will be set forth in part in the following description, or may be obvious from the description, or may be learned through practice of the invention.

[0008] In one aspect, the present invention is directed to a gearbox assembly as defined by the product claim 1.

[0009] In one embodiment, a portion of the lubricant path is defined through a manufactured component that is mounted between the second location and the first location. For example, in particular embodiments, the manufactured component may be formed via casting. In alternative embodiments, the manufactured component may include a pipe assembly having one or more pipes. In certain embodiments, the pipe assembly may include one or more holes configured to supply a lubricant to at least one of the sun gear or the plurality of planet gears.

[0010] According to the invention, the at least one planetary carrier comprises, at least, a first planetary carrier and a second planetary carrier. A first location comprises a downwind end of the second planetary carrier and a second location comprises a downwind end of the first planetary carrier.

[0011] In further embodiments, the plurality of pin shafts may include, at least, a first pin shaft and a second pin shaft. As such, the first pin shaft may be arranged with the first planetary carrier and the second pin shaft may be arranged with the second planetary carrier.

[0012] In several embodiments, the gearbox assembly may include at least one additional oil path defined through at least one of the first pin shaft or the second pin shaft. In such embodiments, the additional oil path(s) may be defined from a downwind end of at least one of the first pin shaft or the second pin shaft to one or more bearings of the gearbox assembly.

[0013] In another aspect, the present invention is directed to a method for lubricating a gearbox assembly as defined in claim 10.

[0014] In one embodiment, the method includes installing a manufactured component between the second location and the first location and defining a portion of the lubricant path through the manufactured component. For example, in such embodiments, the method may include forming the manufactured component via casting. In alternative embodiments, the method may include forming the manufactured component from a pipe assembly having one or more pipes.

In such embodiments, the method may include forming one or more holes in the one or more pipes of the pipe assembly, the one or more holes configured to supply a lubricant to at least one of the sun gear or the plurality of planet gears.

[0015] In another embodiment, the method further includes defining at least one additional oil path through at least one of the first pin shaft or the second pin shaft. More specifically, as mentioned, the additional oil path(s) may be defined from a downwind end of at least one of the first pin shaft or the second pin shaft to one or more bearings of the gearbox assembly. It should also be understood that the method may further include any of the additional features and/or steps described herein.

[0016] These and other features, aspects and advantages of the present invention will become better understood with reference to the following description and appended claims. The accompanying drawings, which are incorporated in and constitute a part of this specification, illustrate embodiments of the invention and, together with the description, serve to explain the principles of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0017] A full and enabling disclosure of the present invention, including the best mode thereof, directed to one of ordinary skill in the art, is set forth in the specification, which makes reference to the appended figures, in which:

FIG. 1 illustrates a perspective view of one embodiment of a wind turbine of conventional construction;

FIG. 2 illustrates a detailed, internal view of one embodiment of a nacelle of a wind turbine according to the present invention;

FIG. 3 illustrates a cross-sectional view of one embodiment of a gearbox assembly of a wind turbine according to conventional construction;

FIG. 4 illustrates a cross-sectional view of one embodiment of a gearbox assembly of a wind turbine according to the present invention;

FIG. 5 illustrates a partial, cross-sectional view of one embodiment of the gearbox assembly of FIG. 4;

FIG. 6 illustrates a partial, cross-sectional view of another embodiment of a gearbox assembly of a wind turbine according to the present invention;

FIG. 7 illustrates a cross-sectional view of one embodiment of a casting feature for providing a lubricant path according to the present invention;

FIG. 8 illustrates a cross-sectional view of one embodiment of a pipe assembly for providing a

lubricant path according to the present invention; and,

FIG. 9 illustrates a flow diagram of one embodiment of a method for lubricating a gearbox assembly of a wind turbine according to the present invention.

DETAILED DESCRIPTION

[0018] Reference now will be made in detail to embodiments of the invention, one or more examples of which are illustrated in the drawings. Each example is provided by way of explanation of the invention, not limitation of the invention. In fact, it will be apparent to those skilled in the art that various modifications and variations can be made in the present invention without departing from the scope or spirit of the invention. For instance, features illustrated or described as part of one embodiment can be used with another embodiment to yield a still further embodiment. Thus, it is intended that the present invention covers such modifications and variations as come within the scope of the appended claims and their equivalents.

[0019] Generally, the present invention is directed to a gearbox assembly having an improved lubrication system. The gearbox assembly includes a housing that encloses a planetary gear system, as well as an optional helical gear system, a lubrication system, a cooling system, and/or a bearing system. The planetary gear system includes planet gears, a sun gear, a ring gear, first and second planetary carriers operatively coupled with the planet gears, and a plurality of pin shafts. Each of the planet gears are arranged so as to rotate around one of the pin shafts. Further, the planet gears are engaged with the ring gear and rotate about the sun gear. The gearbox assembly also includes a first lubricant path defined from a first location to a second location through, e.g. the secondary planetary carrier. Moreover, the first lubricant path is located outside of the plurality of pin shafts. As such, the improved lubrication path reduces bottle-necking of the lubricant in the planet carrier. Thus, the planetary carrier of the present invention has an increased margin for both static strength and fatigue life. In addition, the planetary carrier has improved (i.e. less complex) machinability.

[0020] Referring now to the drawings, FIG. 1 illustrates a perspective view of one embodiment of a wind turbine 10 of conventional construction. As shown, the wind turbine 10 includes a tower 12 extending from a support surface 14, a nacelle 16 mounted on the tower 12, and a rotor 18 coupled to the nacelle 16. The rotor 18 includes a rotatable hub 20 and at least one rotor blade 22 coupled to and extending outwardly from the hub 20. For example, in the illustrated embodiment, the rotor 18 includes three rotor blades 22. However, in an alternative embodiment, the rotor 18 may include more or less than three rotor blades 22. Each rotor blade 22 may be spaced about the hub 20 to facilitate rotating the rotor 18 to enable kinetic energy to be transferred from the wind into usable mechanical energy, and subsequently, electrical energy. For instance, the hub 20 may be rotatably coupled to an electric generator 24 (FIG. 2) positioned within the nacelle 16 to permit electrical energy to be produced.

[0021] As shown, the wind turbine 10 may also include a turbine control system or a turbine controller 26 centralized within the nacelle 16. For example, as shown in FIG. 2, the turbine controller 26 is disposed within a control cabinet mounted to a portion of the nacelle 16. However, it should be appreciated that the turbine controller 26 may be disposed at any location on or in the wind turbine 10, at any location on the support surface 14 or generally at any other location. In general, the turbine controller 26 may be configured to transmit and execute wind turbine control signals and/or commands in order to control the various operating modes (e.g., start-up or shut-down sequences) and/or components of the wind turbine 10.

[0022] Referring now to FIG. 2, a simplified, internal view of one embodiment of a nacelle 16 of a wind turbine 10 is illustrated. As shown, a generator 24 may be disposed within the nacelle 16. In general, the generator 24 may be coupled to the rotor 18 of the wind turbine 10 for producing electrical power from the rotational energy generated by the rotor 18. For example, as shown in the illustrated embodiment, the rotor 18 may include a rotor shaft 32 coupled to the hub 20 for rotation therewith. The rotor shaft 32 may, in turn, be rotatably coupled to a generator shaft 34 of the generator 24 through a gearbox assembly 36. As is generally understood, the rotor shaft 32 may provide a low speed, high torque input to the gearbox assembly 36 in response to rotation of the rotor blades 22 and the hub 20. The gearbox assembly 36 may then be configured to convert the low speed, high torque input to a high speed, low torque output to drive the generator shaft 34 and, thus, the generator 24. In alternative embodiments, the rotor shaft 32 may be eliminated and the rotatable hub 20 may be configured to turn the gears of the gearbox assembly 36, rather than requiring a separate rotor shaft 32.

[0023] Referring now to FIG. 3, a cross-sectional view of a gearbox assembly 36 according to conventional construction is illustrated. As shown, the gearbox assembly 36 includes planetary gear system 38 housed within a gearbox housing 37. More specifically, the gear system 38 includes a plurality of gears (e.g., planetary, ring and/or sun gears) and bearings 39 for converting the low speed, high torque input of the rotor shaft 32 to a high speed, low torque output for the generator 24. For example, as shown, the input shaft 32 may provide an input load to the gear system 38 and the system 38 may provide an output load to the generator 24 (FIG. 2) as is generally known in the art. Thus, during operation, input load at an input rotational speed is transmitted through the planetary gear system 38 and provided as output load at output rotational speed to the generator 24.

[0024] Further, the planetary gear system 38 includes a first planetary carrier 40 and a second planetary carrier 42 operatively coupling a plurality of gears. Further, as shown, the planetary gear system 38 includes, at least, a ring gear 41, one or more planet gears 44, a sun gear 46, one or more first pin shafts 43, and one or more second pin shafts 45. For example, in several embodiments, the gear system 38 may include one, two, three, four, five, six, seven, eight, or more planet gears 44. Further, each of the gears 41, 44, 46 includes a plurality of teeth. The teeth are sized and shaped to mesh together such that the various gears 41, 44, 46 engage each other. For example, the ring gear 41 and the sun gear 46 may each engage the planet gears 44. In addition, it should be understood that the gears 41, 44, 46 described herein may

include any suitable type of gears, including but not limited to spur gears, face gears, worm gears, helical gears, double helical gears, or similar.

[0025] In some embodiments, the planetary carriers 40, 42 may be stationary. In these embodiments, the input shaft 32 may be coupled to the ring gear 41, and input loads on the input shaft 32 may be transmitted through the ring gear 41 to the planet gears 44. Thus, the ring gear 41 may drive the gear system 38. In other embodiments, the ring gear 41 may be stationary. In these embodiments, the input shaft 32 may be coupled to the planetary carriers 40, 42, and input loads on the input shaft 32 may be transmitted through the planetary carriers 40, 42 to the planet gears 44. Thus, the planetary carriers 40, 42 may drive the gear system 38. In still further embodiments, any other suitable component, such as the planet gear 44 or the sun gear 46, may drive the gear system 38.

[0026] Still referring to FIG. 3, the sun gear 46 defines a central axis 49, and thus rotates about this central axis 49. The ring gear 41 may at least partially surround the sun gear 46, and be positioned along the central axis 49. Further, the ring gear 41 may (if rotatable) thus rotate about the central axis 49. Each of the planet gears 44 may be disposed between the sun gear 46 and the ring gear 41, and may engage both the sun gear 46 and the ring gear 41. For example, the teeth of the gears may mesh together, as discussed above. Further, each of the planet gears 44 may define a central planet axis 48, as shown. Thus, each planet gear 44 may rotate about its central planet axis 48. Additionally, the planet gears 44 and central planet axes 48 thereof may rotate about the central axis 49.

[0027] The gearbox assembly 36 may also include a lubrication system or other means for circulating oil throughout the gearbox components. For example, as shown in FIG. 3, the gearbox assembly 36 may include a plurality of oil passages 47 that are configured to transfer oil therethrough. As is generally understood, the oil may be used to reduce friction between the moving components of the gearbox assembly 36 and may also be utilized to provide cooling for such components, thereby decreasing component wear and other losses within the gearbox assembly 36 and increasing the lifespan thereof. In addition, the oil may contain properties that prevent corrosion of the internal gearbox components.

[0028] More specifically, as shown, the second-stage planetary carrier 42 includes an oil path 50 defined by a substantially axial oil passage 47 and a plurality of substantially radial passages 47 extending from the axial oil passage 47 to an outer surface of the second planetary carrier 42. In addition, as shown, one or more plugs 50 may be used to prevent leakage of the lubricant from the passages 47. This conventional oil path, however, introduces high stress concentrations at the upwind plug region (i.e. the drilled holes on the planetary carrier 42 where the plugs 50 are assembled), which limits the load capacity of the gearbox assembly 36.

[0029] As such, FIG. 4 illustrates a cross-sectional view of a gearbox assembly 136 according to the present invention. As shown, the gearbox assembly 136 includes planetary gear system 138 housed within a gearbox housing 137. More specifically, the gear system 138 includes a

plurality of gears (e.g., planetary, ring and/or sun gears) and bearings 139 for converting the low speed, high torque input of the rotor shaft 132 to a high speed, low torque output for the generator 24. For example, as shown, the input shaft 132 may provide an input load to the gear system 138 and the system 138 may provide an output load to the generator 24 (FIG. 2) via output shaft 134. Thus, during operation, input load at an input rotational speed is transmitted through the planetary gear system 138 and provided as output load at output rotational speed to the generator 24.

[0030] Further, as shown, the planetary gear system 138 includes a first planetary carrier 140 and a second planetary carrier 142 operatively coupling a plurality of gears. Further, as shown, the planetary gear system 138 includes, at least, a ring gear 141, one or more planet gears 144, a sun gear 146, one or more first pin shafts 143, and one or more second pin shafts 145. For example, in several embodiments, the gear system 138 may include one, two, three, four, five, six, seven, eight, or more planet gears 144. Further, each of the gears 141, 144, 146 includes a plurality of teeth. The teeth are sized and shaped to mesh together such that the various gears 141, 144, 146 engage each other. For example, the ring gear 141 and the sun gear 146 may each engage the planet gears 144. In addition, as mentioned, it should be understood that the gears 141, 144, 146 described herein may include any suitable type of gears, including but not limited to spur gears, face gears, worm gears, helical gears, double helical gears, or similar.

[0031] In some embodiments, the planetary carriers 140, 142 may be stationary. In these embodiments, the input shaft 132 may be coupled to the ring gear 141, and input loads on the input shaft 132 may be transmitted through the ring gear 141 to the planet gears 144. Thus, the ring gear 141 may drive the gear system 138. In other embodiments, the ring gear 141 may be stationary. In these embodiments, the input shaft 132 may be coupled to the planetary carriers 140, 142, and input loads on the input shaft 132 may be transmitted through the planetary carriers 140, 142 to the planet gears 144.

[0032] Still referring to FIG. 4, the sun gear 146 defines a central axis 149, and thus rotates about this central axis 149. The ring gear 141 may at least partially surround the sun gear 146, and be positioned along the central axis 149. For example, the ring gear 141 may be aligned with the sun gear 146 along the central axis 149, or may be offset from the sun gear 46 along the axis 149. The ring gear 141 may (if rotatable) thus rotate about the central axis 149. Each of the planet gears 144 may be disposed between the sun gear 146 and the ring gear 141, and may engage both the sun gear 146 and the ring gear 141. Further, each of the planet gears 144 may define a central planet axis 148, as shown. Thus, each planet gear 144 may rotate about its central planet axis 148. Additionally, the planet gears 144 and central planet axes 148 thereof may rotate about the central axis 149.

[0033] Referring now to FIGS. 4-6, the gearbox assembly 136 may also include a lubrication system or other means for circulating oil throughout the gearbox components. For example, as shown, the gearbox assembly 136 may include a plurality of oil passages 147 that are configured to transfer oil therethrough. As is generally understood, the oil may be used to

reduce friction between the moving components of the gearbox assembly 136 and may also be utilized to provide cooling for such components, thereby decreasing component wear and other losses within the gearbox assembly 136 and increasing the lifespan thereof. In addition, the oil may contain properties that prevent corrosion of the internal gearbox components.

[0034] More specifically, as shown in FIGS. 5 and 6, the second-stage planetary carrier 142 includes a first lubricant path 150 defined from a first location to a second location through at least one of the planetary carriers 140, 142, i.e. outside of and not through the plurality of pin shafts 143, 145. As such, the lubricant path 150 of the present invention avoids having to drill holes on the load path of the second planetary carrier 142. In addition, as shown, the plug 50 is also eliminated. For example, as shown, the first lubricant path 150 is defined from a first location 154 to a second location 152 through the secondary planetary carriers 142. In such embodiment, according to the invention, the first location (154) comprises a downwind end of the second planetary carrier (142) and a second location (152) comprises a downwind end of the first planetary carrier (140).

[0035] In addition, as shown, a portion of the lubricant path 150 may be defined through a manufactured component 156 that is mounted between the second location 152 and the first location 154. For example, as shown in FIG. 5, the manufactured component 156 may be a casting feature 158 formed via casting. With the addition of the casting features 158, the lubricant path 150 is simplified to require only a single drilled hole through the secondary planetary carrier 142 away from the high-stress area and/or load path. In alternative embodiments, as shown in FIG. 6, the manufactured component 156 may include a pipe assembly 160 having one or more pipes.

[0036] In further embodiments, as shown in FIGS. 7 and 8, the manufactured component 156 may further include one or more holes 164 configured to supply a lubricant for the meshing sun gear 146 and/or planet gears 144. As such, the holes 164 may be configured to spray lubricant to any neighboring components in the gearbox assembly 136.

[0037] In several embodiments, the gearbox assembly 136 may include at least one additional oil path 151 defined through one of first or second pin shafts 143, 145. In such embodiments, as shown, the additional oil path(s) 151 may be defined from a downwind end of the first or second pin shafts 143, 145 to one or more bearings 162 of the gearbox assembly 136.

[0038] Referring now to FIG. 9, a flow diagram of one embodiment of a method 100 for lubricating the gearbox assembly 136 of the wind turbine 10 is illustrated. As shown at 102, the method 100 includes defining the first lubricant path 150 from the first location 154 to the second location 152 through at least one planetary carrier 140, 142 of the gearbox assembly 136. Further, as mentioned, the first lubricant path is located outside of the plurality of pin shafts 143, 145. As shown at 104, the method 100 includes providing a lubricant through the first lubricant path 150.

[0039] In one embodiment, the method 100 includes installing a manufactured component 156

between the second location 152 and the first location 154 and defining a portion of the lubricant path 150 through the manufactured component 156. For example, in such embodiments, the method 100 may include forming the manufactured component 156 via casting. In alternative embodiments, the method 100 may include forming the manufactured component 156 from a pipe assembly 160 having one or more pipes.

[0040] In another embodiment, the method 100 further includes defining at least one additional oil path 151 through one or both of the first or second pin shafts 143, 145. In such embodiments, the additional oil path(s) 151 may be defined from the downwind end 154 of one of the first or second pin shafts 143, 145 to one or more bearings 162 of the gearbox assembly 136.

Reference Character	Component
10	Wind Turbine
12	Tower
14	Foundation
16	Nacelle
18	Rotor
20	Hub
22	Rotor Blades
24	Generator
26	Controller
30	Yaw Axis
32	Main Shaft
34	Generator Shaft
36	Gearbox Assembly
37	Gearbox Housing
38	Planetary Gear System
39	Bearings
40	First Planetary Carrier
41	Ring Gear
42	Second Planetary Carrier
43	First Pin Shaft
44	Planet Gears
45	Second Pin Shaft
46	Sun Gear
47	Oil Passages
48	Central Planet Axis
49	Central Axis

Reference Character	Component
50	Plug
100	Method
102	Method Step
104	Method Step
132	Main Shaft
134	Generator Shaft
136	Gearbox Assembly
137	Gearbox Housing
138	Planetary Gear System
139	Bearings
140	First Planetary Carrier
141	Ring Gear
142	Second Planetary Carrier
143	First Pin Shaft
144	Planet Gears
145	Second Pin Shaft
146	Sun Gear
147	Oil Passages
148	Central Planet Axis
149	Central Axis
150	Lubricant Path
152	Second Location
154	First Location
156	Manufactured Component
158	Casting Feature
160	Pipe Assembly
162	Bearings
164	Holes

REFERENCES CITED IN THE DESCRIPTION

Cited references

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- [CN201448430U \[0006\]](#)
- [EP1717489A2 \[0006\]](#)
- [CN105202169A \[0006\]](#)

KRAV

1. Gearkassesamling (136) til en vindmølle, som omfatter:

et gearkassehus (137);

- 5 et planetgearsystem (138), der er indrettet inden i gearkassehuset (137),
hvor planetgearsystemet (138) omfatter en flerhed af planetgear (144),
mindst ét solgear (146), mindst ét ringhjul (141), mindst én planetbærer
(140, 142), som er operativt koblet med flerheden af planetgear (144), og
en flerhed af stiftaksler (143, 145), hver af flerheden af planetgear (144)
10 er arrangeret til at rotere omkring én af flerheden af stiftaksler (143, 145),
hvor flerheden af planetgear (144) er i indgreb med det mindst ene ringhjul
(141) og indrettet til at dreje omkring det mindst ene solgear (146);

hvor den mindst ene planetbærer (140, 142) omfatter i det mindste en
første planetbærer (140) og en anden planetbærer (142);

- 15 hvor en første placering (154) omfatter en nedvind ende af den anden
planetbærer (142), og en anden placering (152) omfatter en nedvind ende
af den første planetbærer (140), **kendetegnet ved at**

- en første smøremiddelvej (150) er defineret fra den første placering (154)
til den anden placering (152) gennem den anden planetbærer (142), hvor
20 den første smøremiddelvej (150) er anbragt uden for flerheden af
stiftaksler (143, 145).

- 2.** Gearkassesamling (136) ifølge krav 1, hvor en del af smøremiddelvejen (150)
er defineret gennem en fremstillet komponent (156), som er monteret mellem
25 den anden placering (152) og den første placering (154).

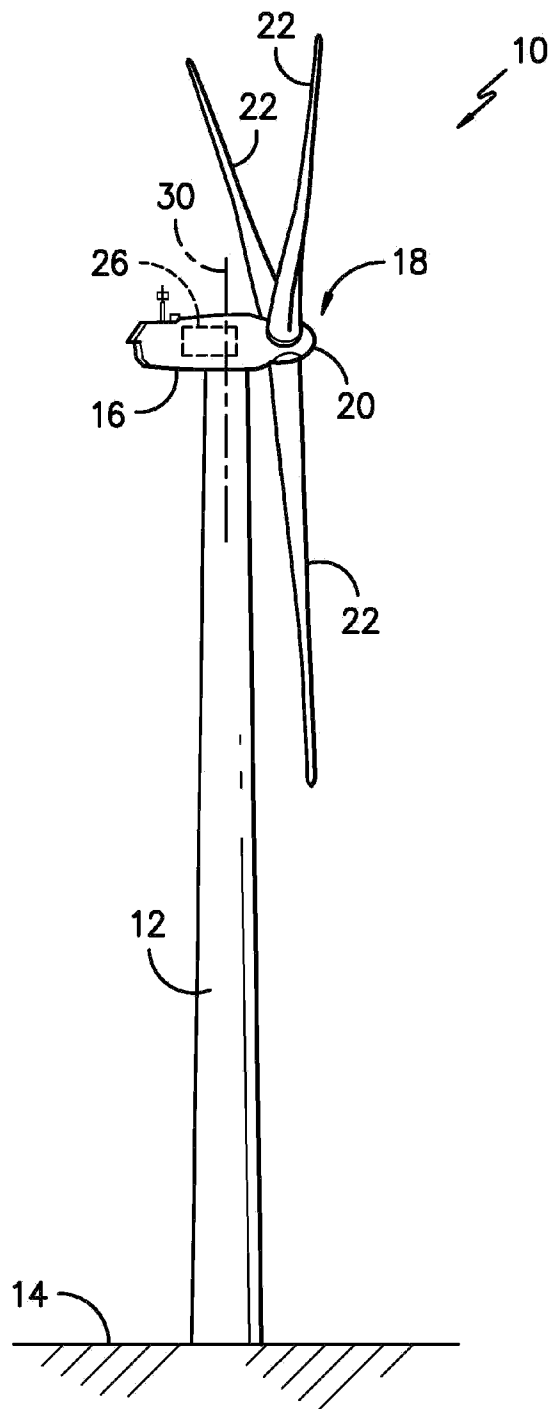
3. Gearkassesamling (136) ifølge krav 2, hvor den fremstillede komponent (156)
er dannet ved hjælp af støbning.

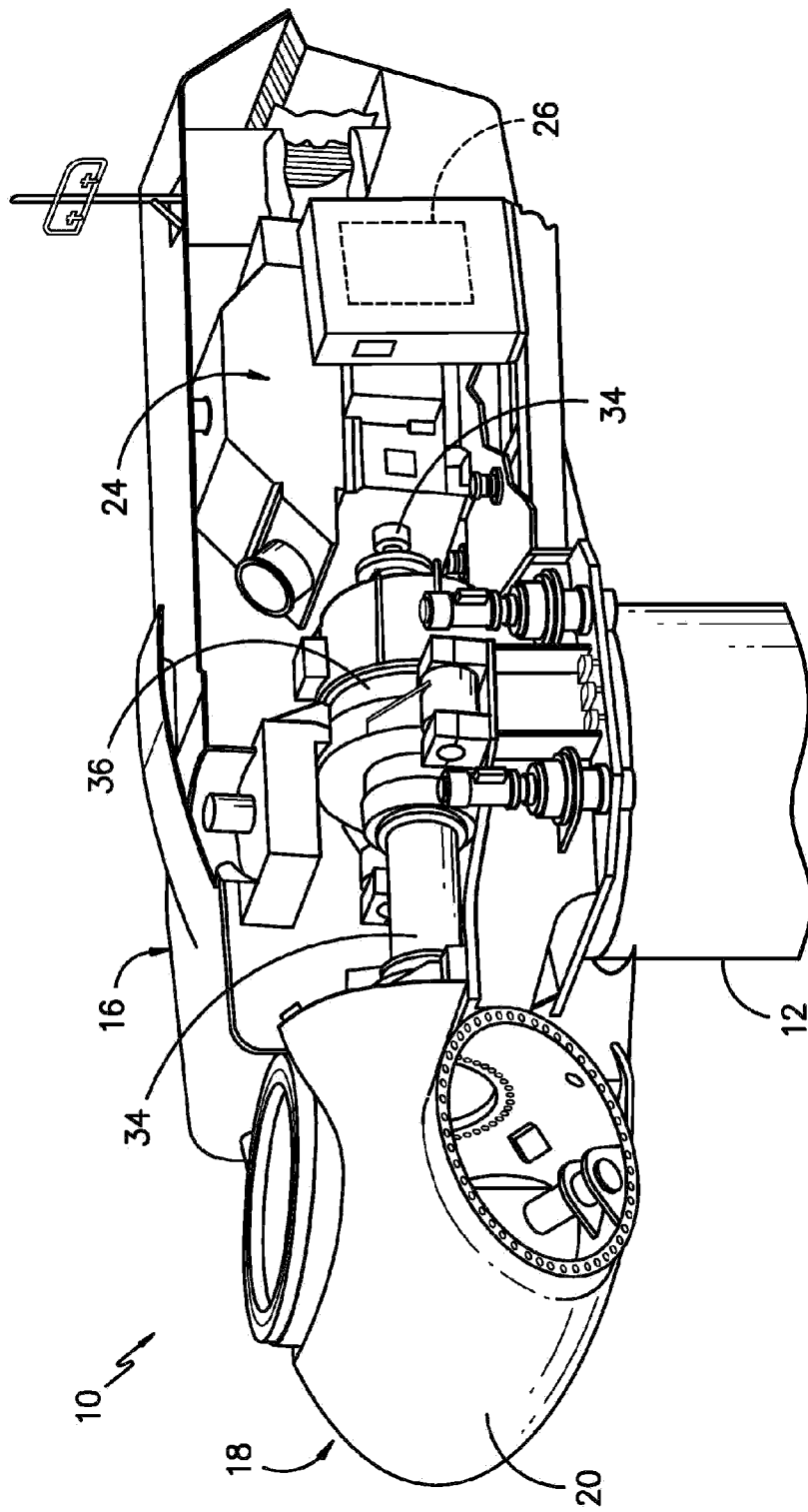
- 30 **4.** Gearkassesamling (136) ifølge krav 2, hvor den fremstillede komponent (156)
omfatter en rørkonstruktion (160), hvor rørkonstruktionen (160) omfatter ét eller

flere rør.

- 5.** Gearkassesamling (136) ifølge krav 4, hvor rørkonstruktionen (160) omfatter ét eller flere huller (164), der er indrettet til at forsyne et smøremiddel til mindst 5 ét af solgearene (146) eller flerheden af planetgear (144).
- 6.** Gearkassesamling (136) ifølge et hvilket som helst af de foregående krav, hvor flerheden af stiftaksler (143, 145) omfatter i det mindste en første stiftaksel (143) og en anden stiftaksel (145), hvor den første stiftaksel (145) 143) anbragt med 10 den første planetbærer (140), hvor den anden stiftaksel (145) anbragt med den anden planetbærer (142).
- 7.** Gearkassesamling (136) ifølge et hvilket som helst af de foregående krav, yderligere omfattende mindst én yderligere olievej (147), der er defineret gennem 15 mindst én af den første stiftaksel (143) eller den anden stiftaksel (145).
- 8.** Gearkassesamling (136) ifølge krav 7, hvor den mindst ene yderligere olievej er defineret fra en nedvind ende af mindst én af den første stiftaksel (143) eller den anden stiftaksel (145) til ét eller flere lejer af gearkassesamlingen (136). 20
- 9.** Vindmølle med en gearkassesamling (136) ifølge et af de foregående krav.
- 10.** Fremgangsmåde (100) til smøring af en gearkassesamling (136) ifølge krav 1, hvor fremgangsmåden (100) omfatter at: 25 tilvejebringe et smøremiddel gennem den første smøremiddelvej (150).

DRAWINGS

*FIG. -1-*



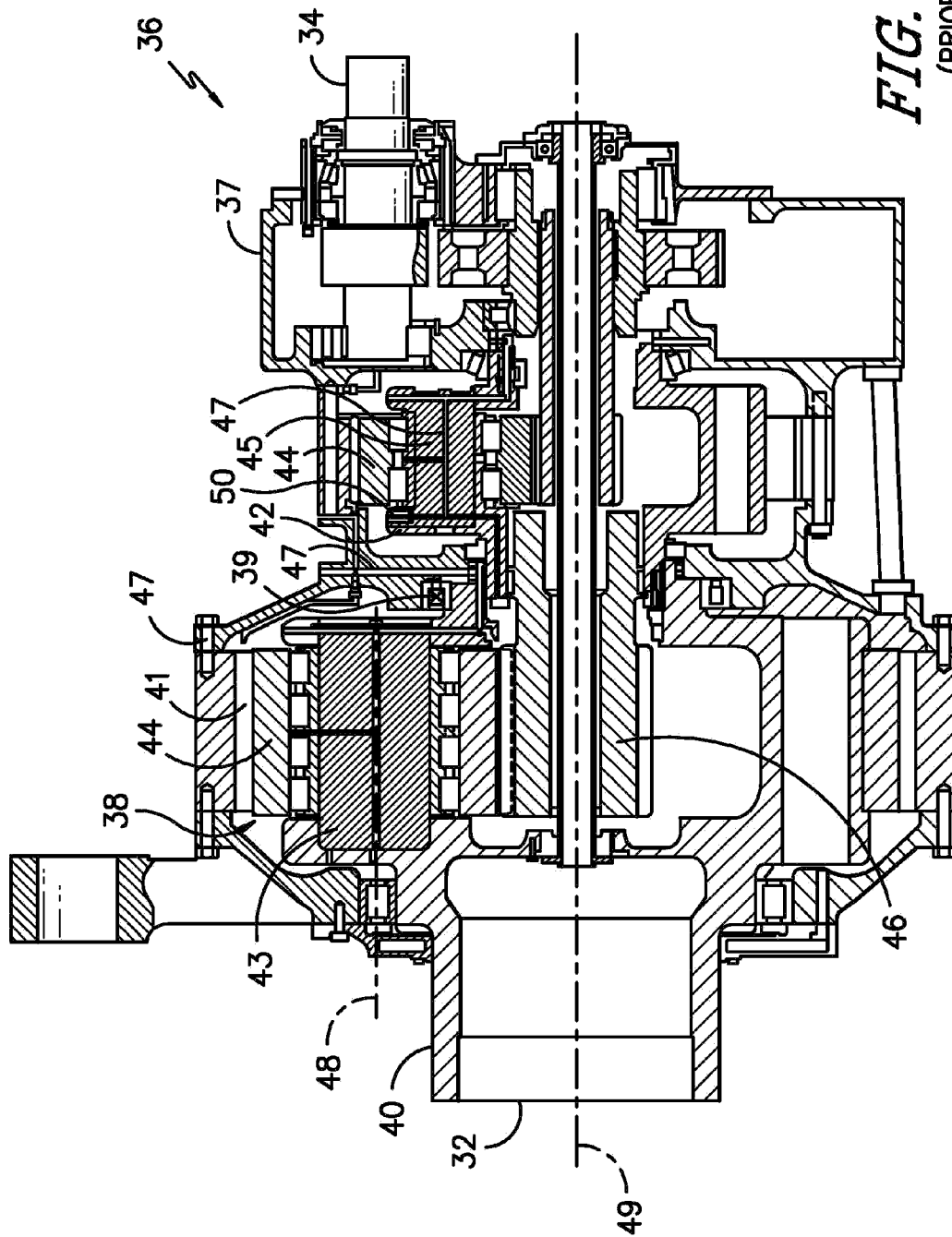


FIG. -3-
(PRIOR ART)

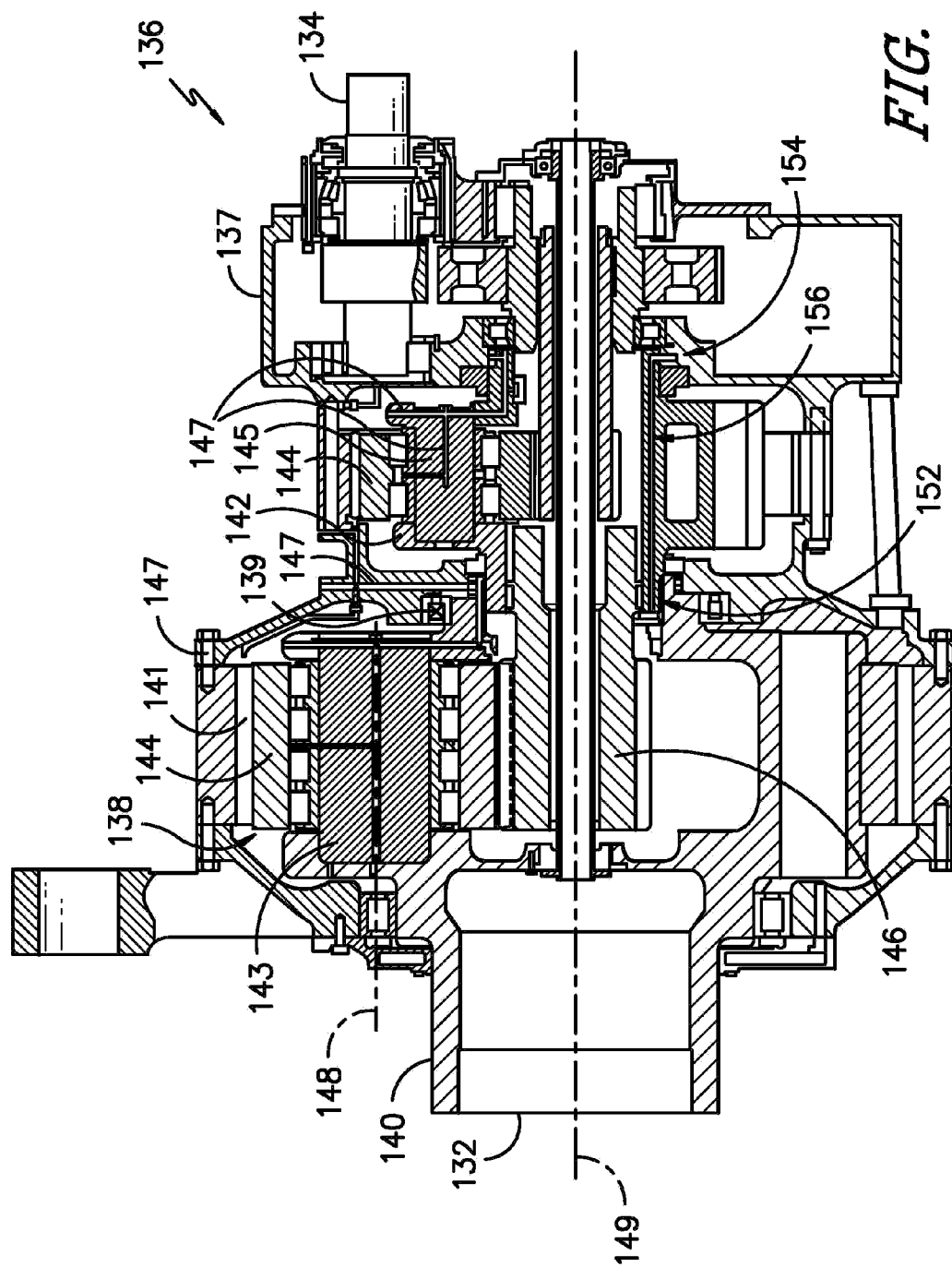


FIG. -4-

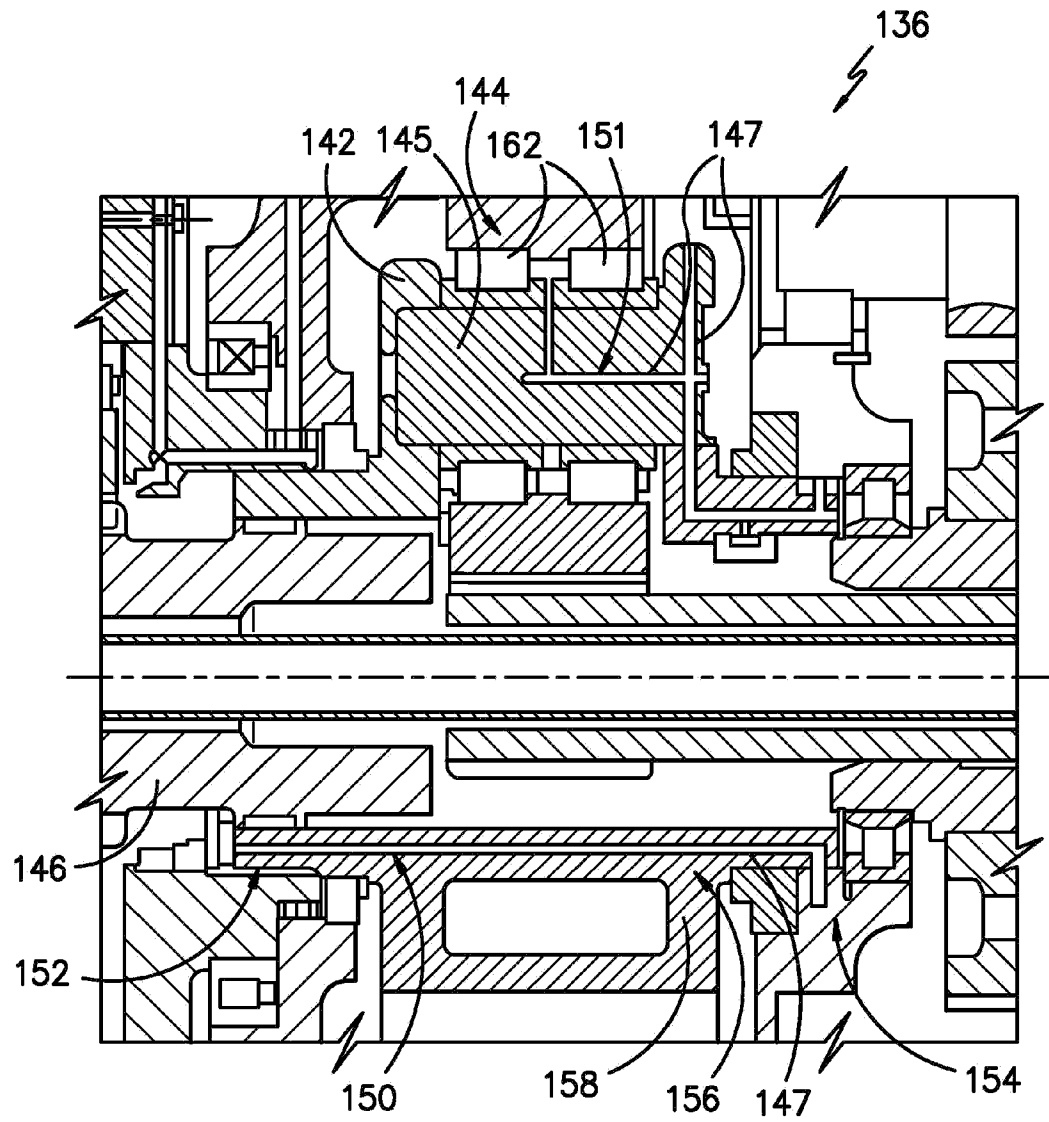


FIG. -5-

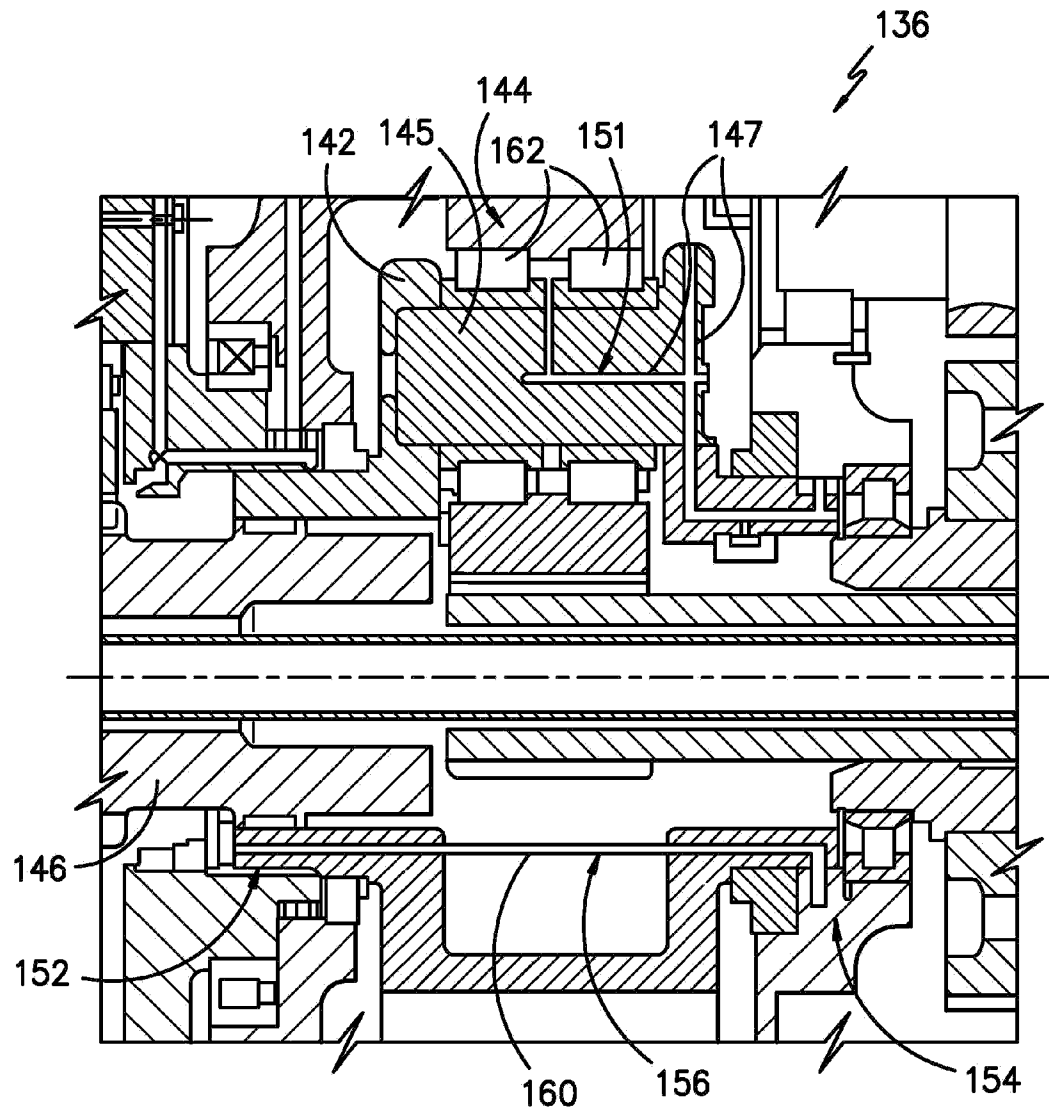


FIG. -6-

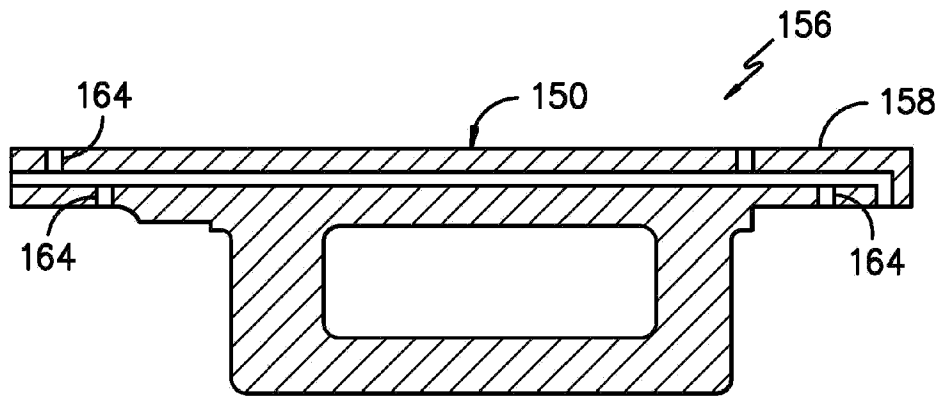


FIG. -7-

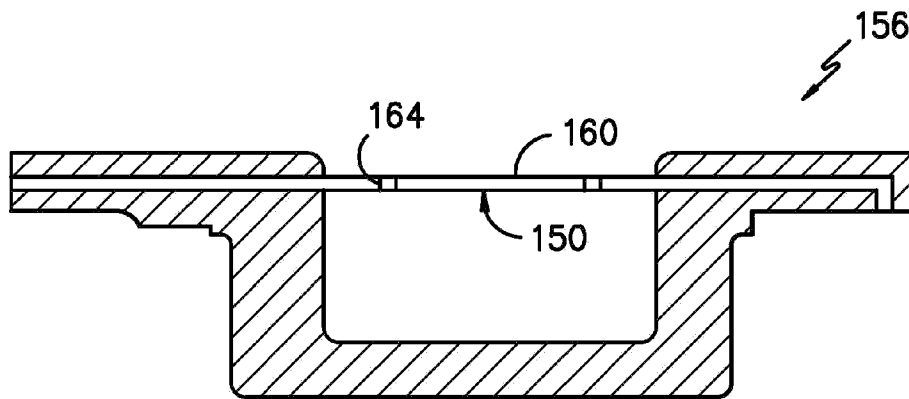


FIG. -8-

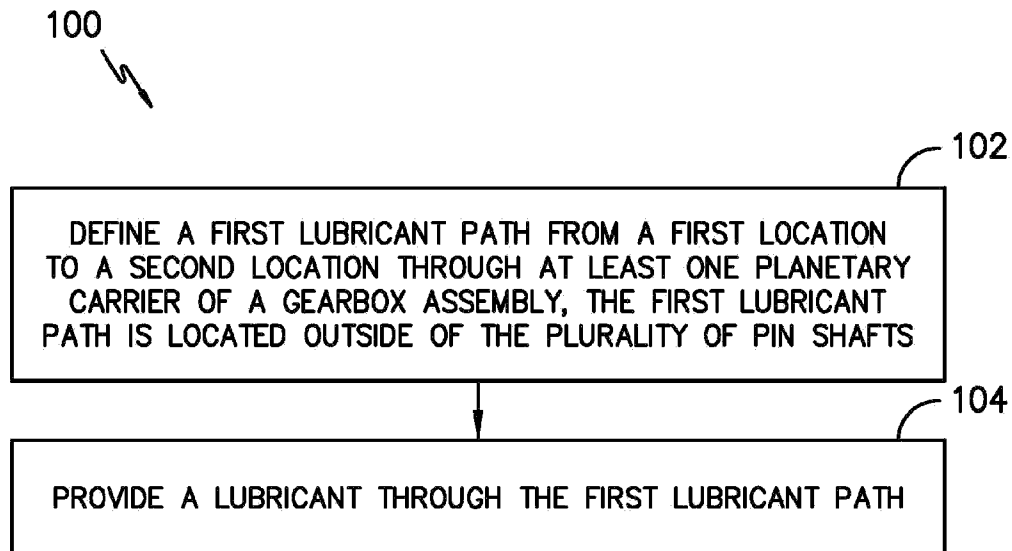


FIG. -9-