US 20250257759A1

(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2025/0257759 A1**

JASUD et al. (43) **Pub. Date: Aug. 14, 2025**

(54) **SYSTEMS FOR A DRIVE AXLE**

(71) Applicant: **DANA ITALIA S.R.L.**, Arco (IT)

(72) Inventors: **Pradip JASUD**, Pune (IN); **Sushil PATIL**, Pune (IN); **Shailesh DALVI**, Pune (IN)

(21) Appl. No.: **18/441,320**

(22) Filed: **Feb. 14, 2024**

Publication Classification

(51) **Int. Cl.**

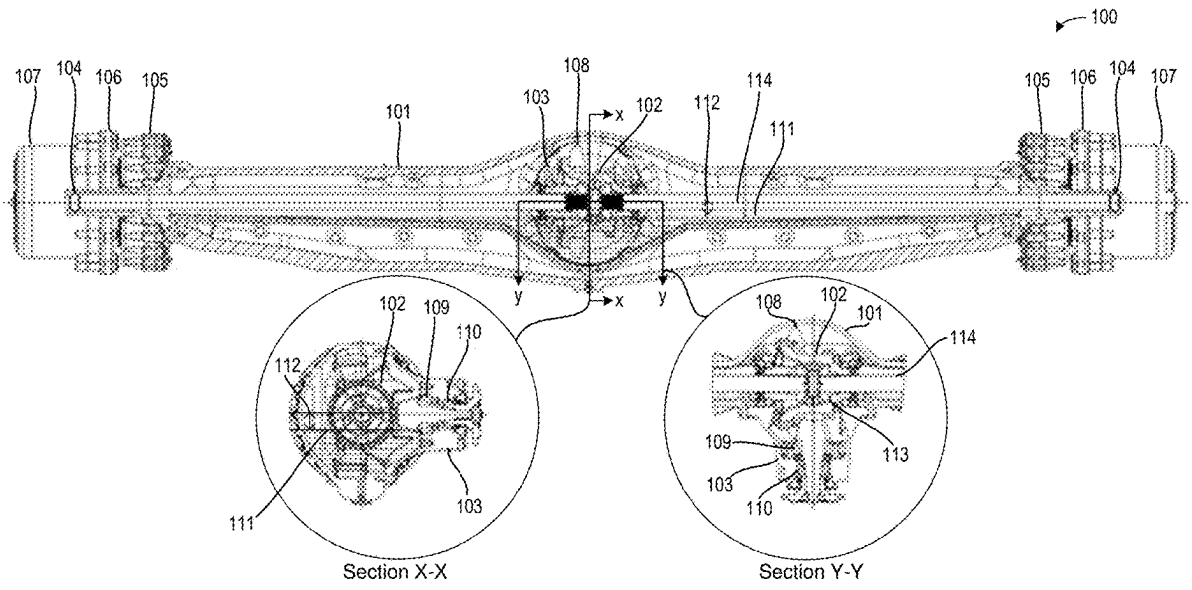
F16C 3/02	(2006.01)
F16H 57/04	(2010.01)

(52) **U.S. Cl.**

CPC ***F16C 3/02*** (2013.01); ***F16H 57/0423*** (2013.01); ***F16H 57/0454*** (2013.01); ***F16H 57/0483*** (2013.01)

(57) **ABSTRACT**

Methods and systems for a drive axle. The drive axle includes a central portion including a differential assembly, the differential assembly including axle shaft side gears with a plurality of fins in contact with lubricant of an axle housing, and an arm portion including axle shafts, the arm portion including an inner inclined surface to guide oil toward the central portion and a plurality of holes distributed axially.



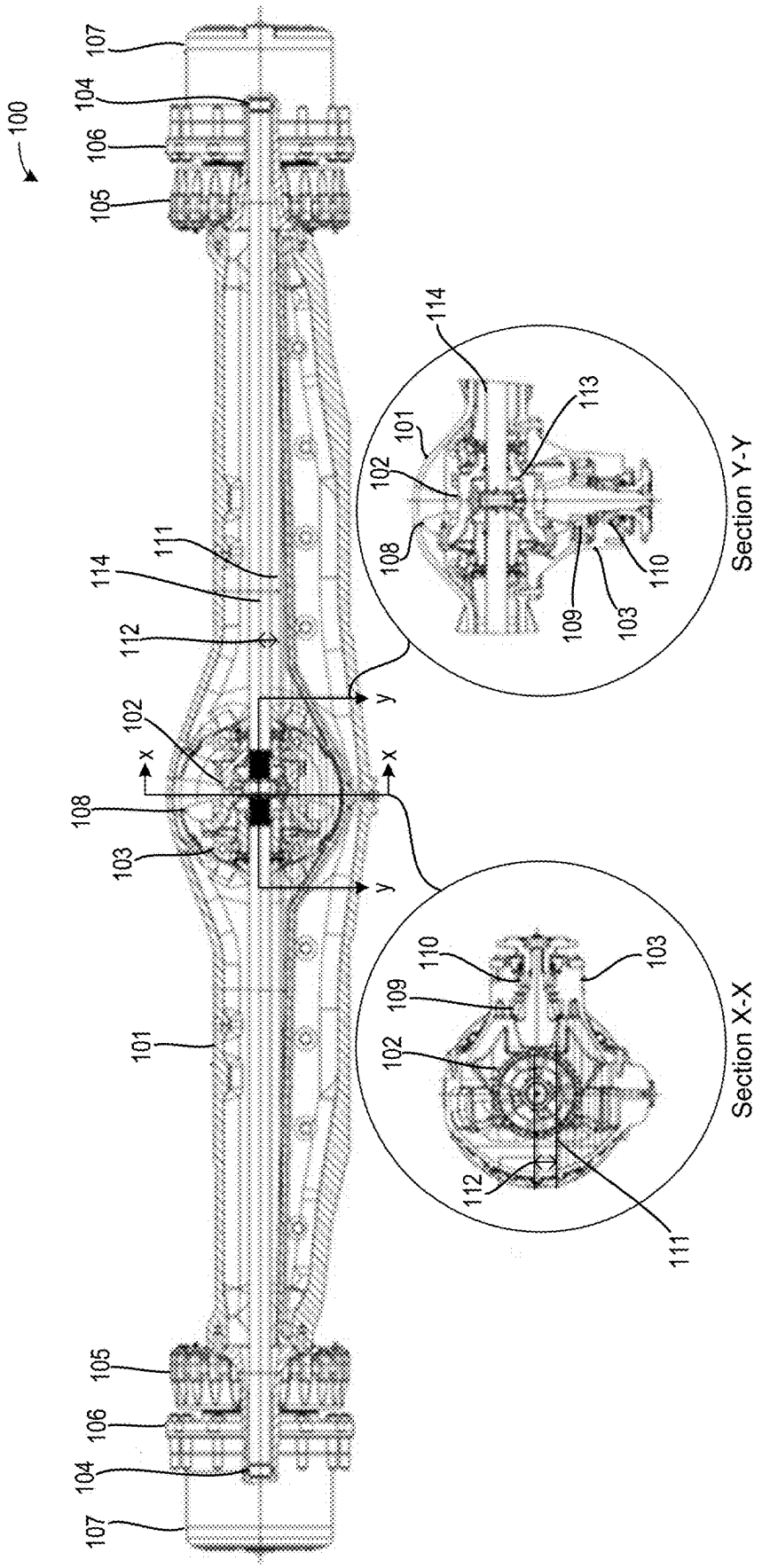
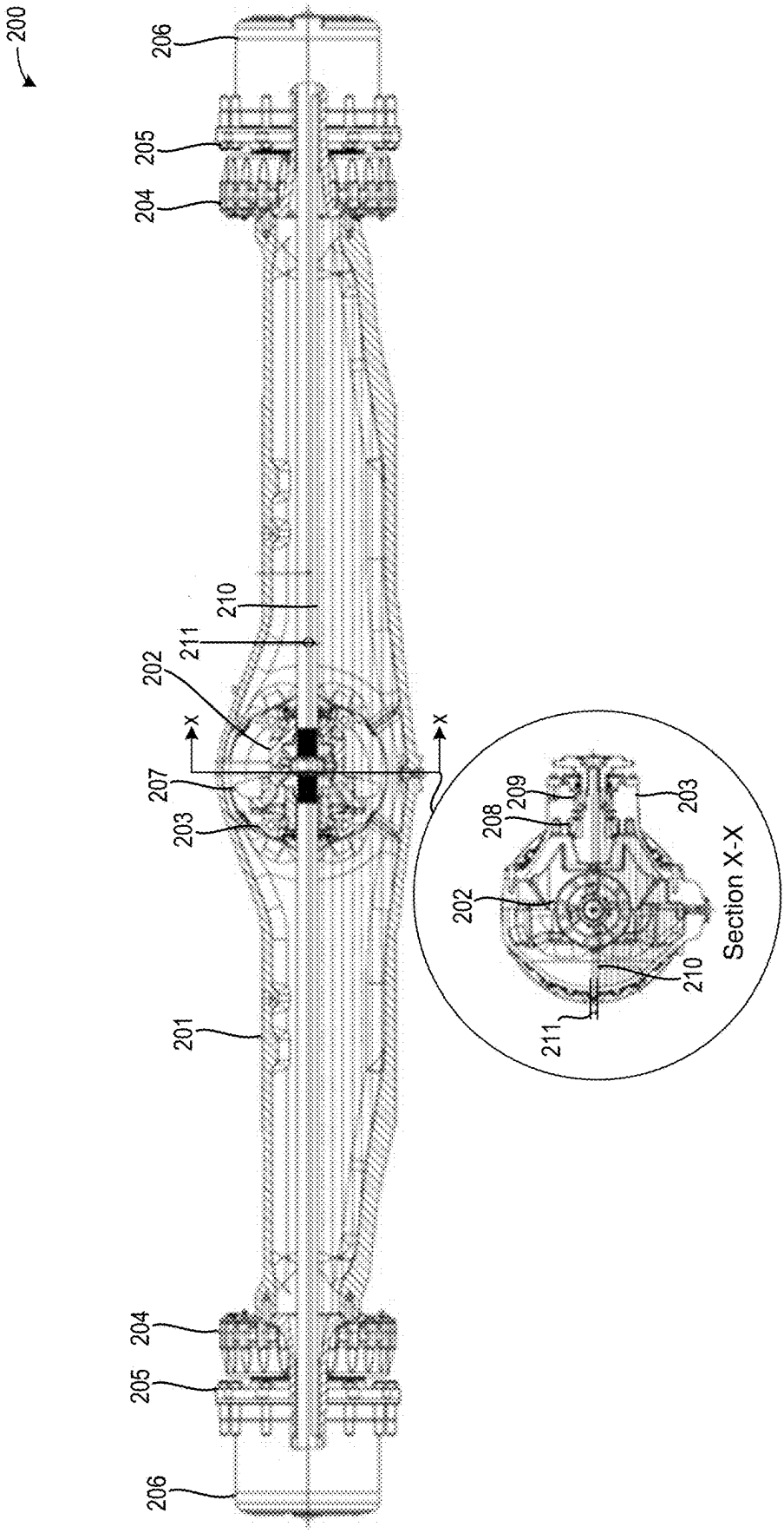

100
107
104
106
105
114
111
112
102
108
103
101
x
y
Section Y-Y
113
109
110
Section X-X

FIG. 1



(prior art)

FIG. 2

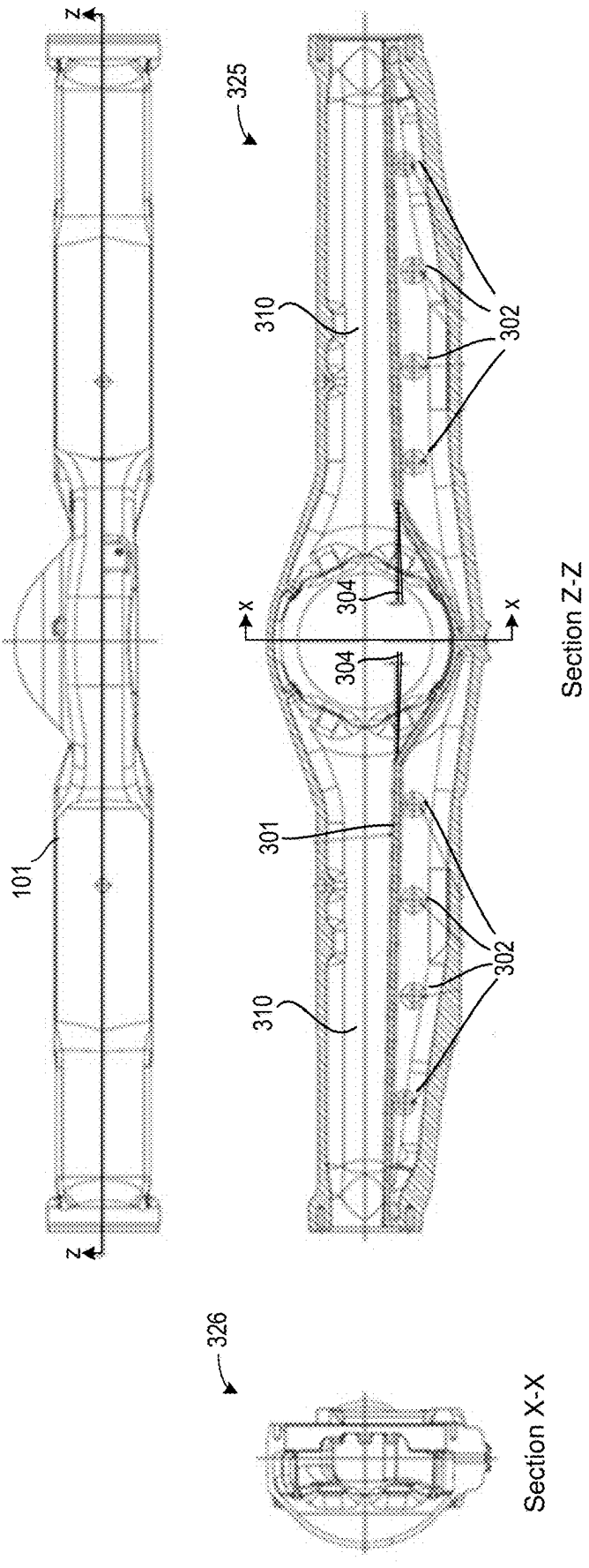

300
100
101
Z
Z
325
310
302
304
304
X
X
301
310
302
Section Z-Z
326
Section X-X

FIG. 3A

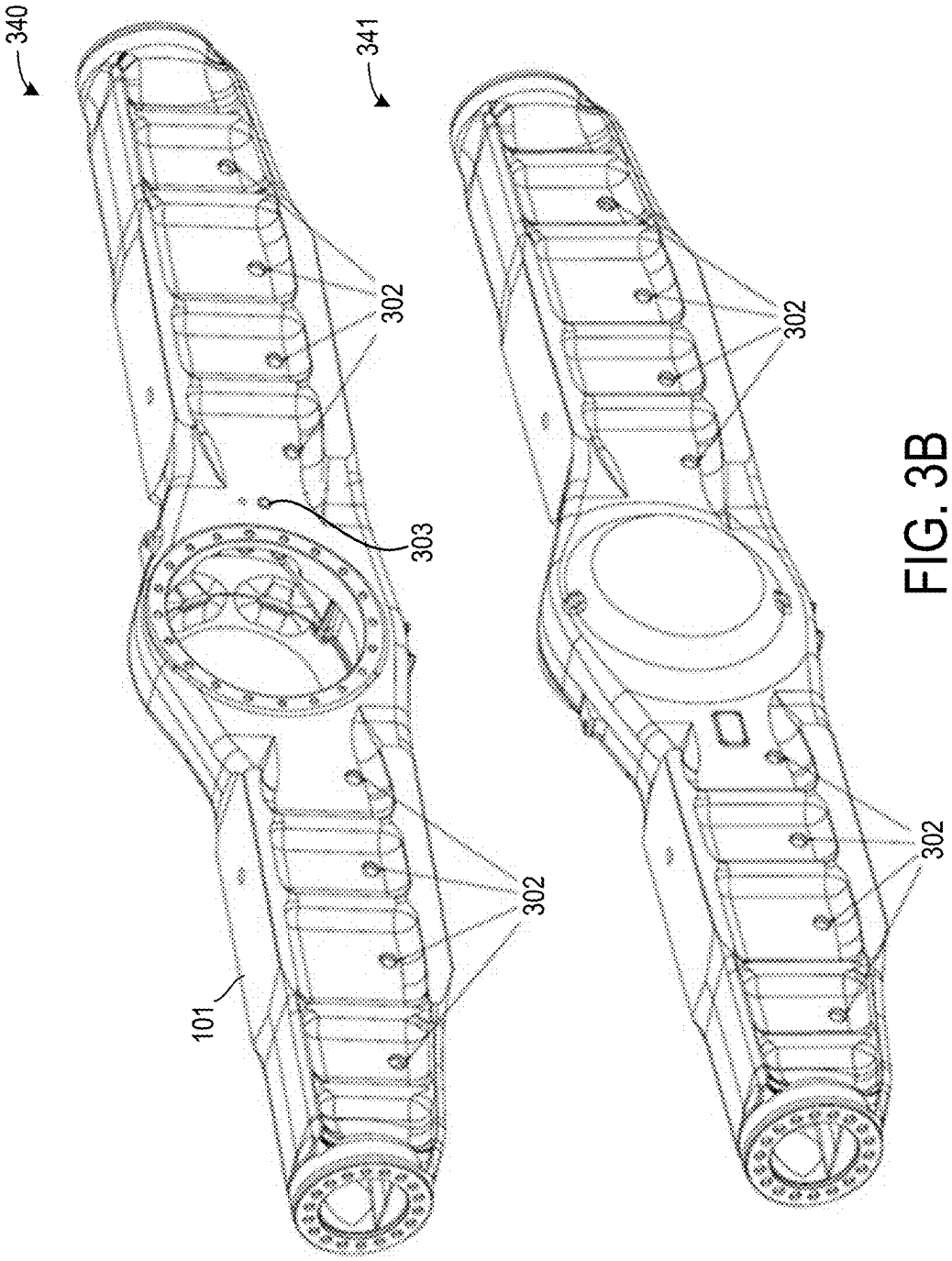


FIG. 3B

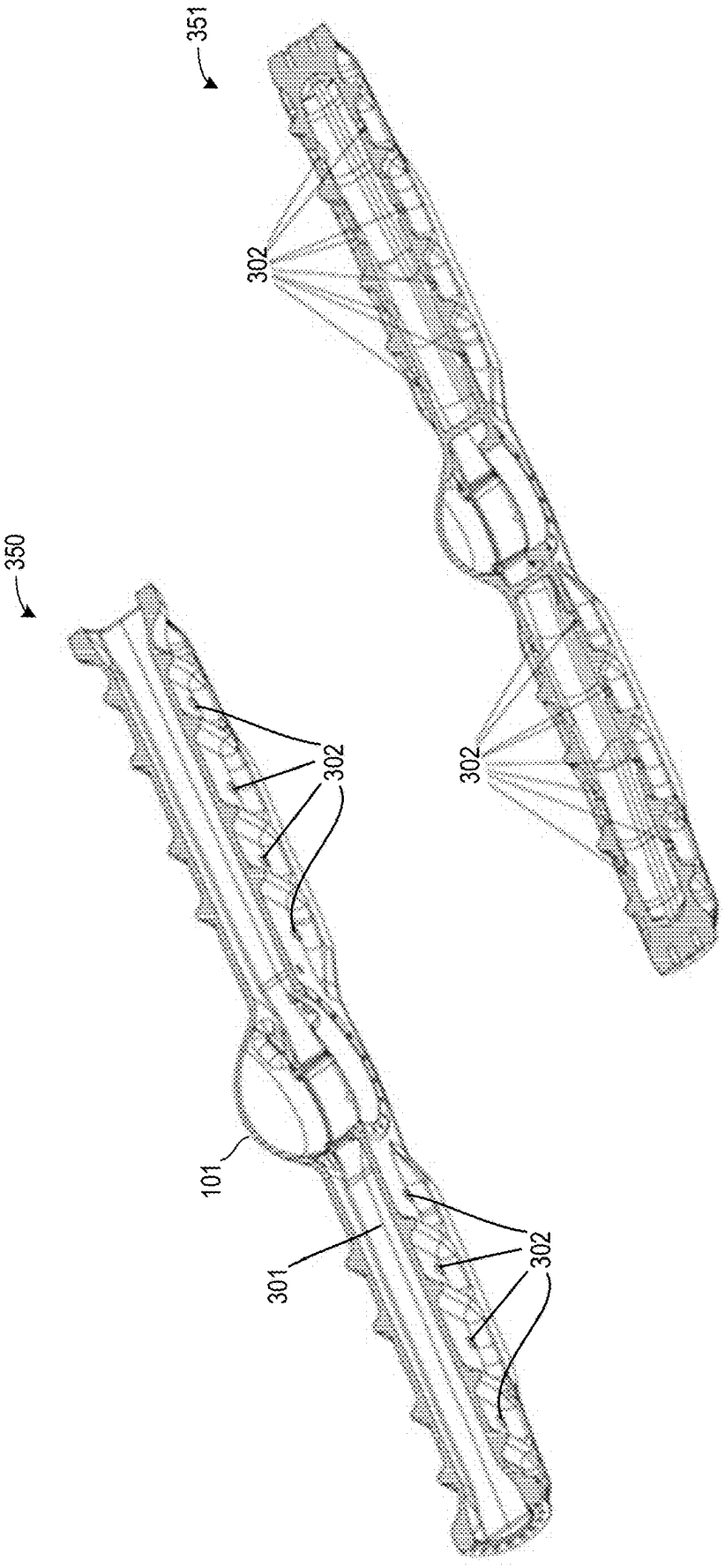


FIG. 3C

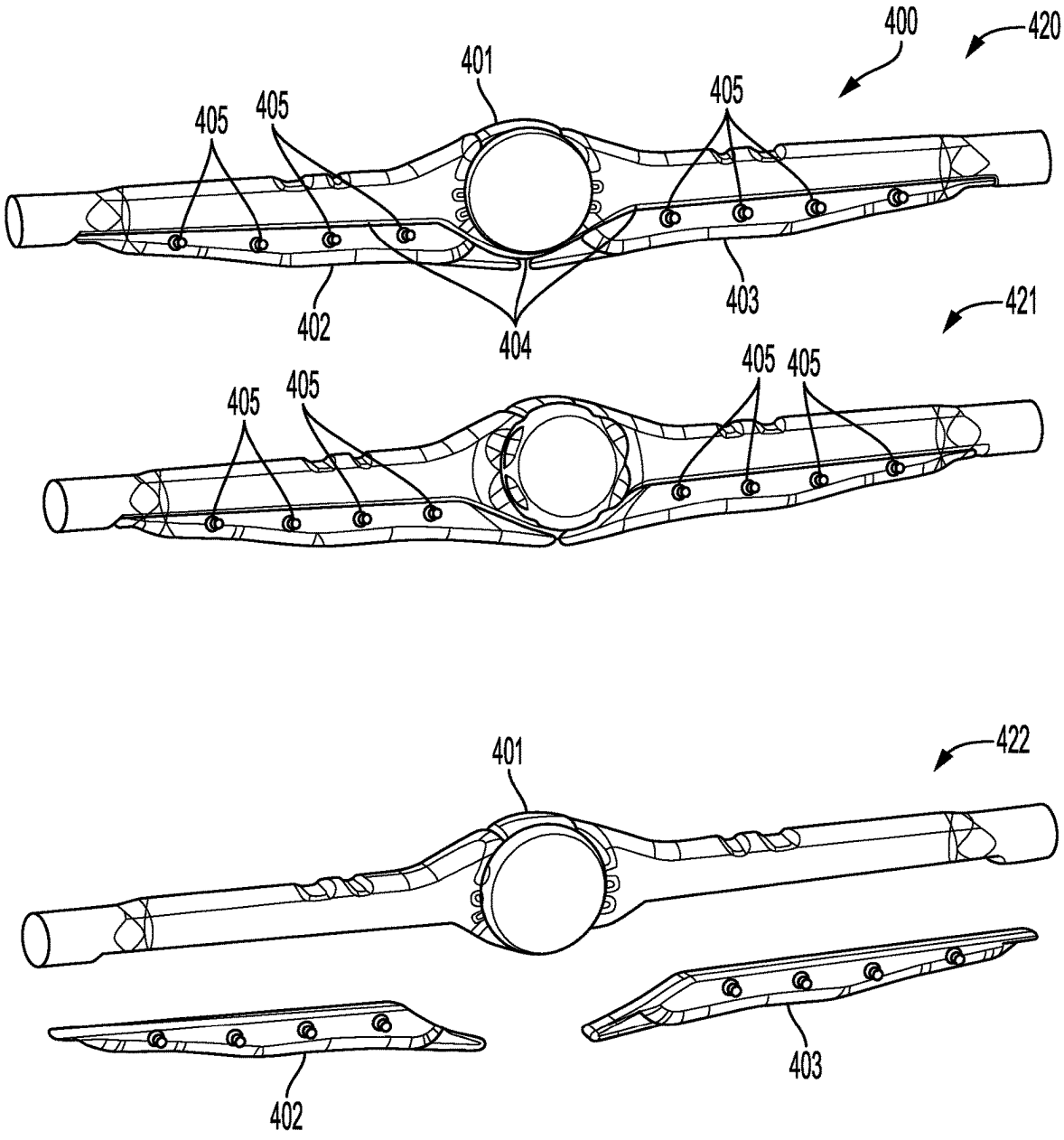

400
420
401
405
405
405
402
404
403
421
405
405
405
405
401
422
402
403

FIG. 4A

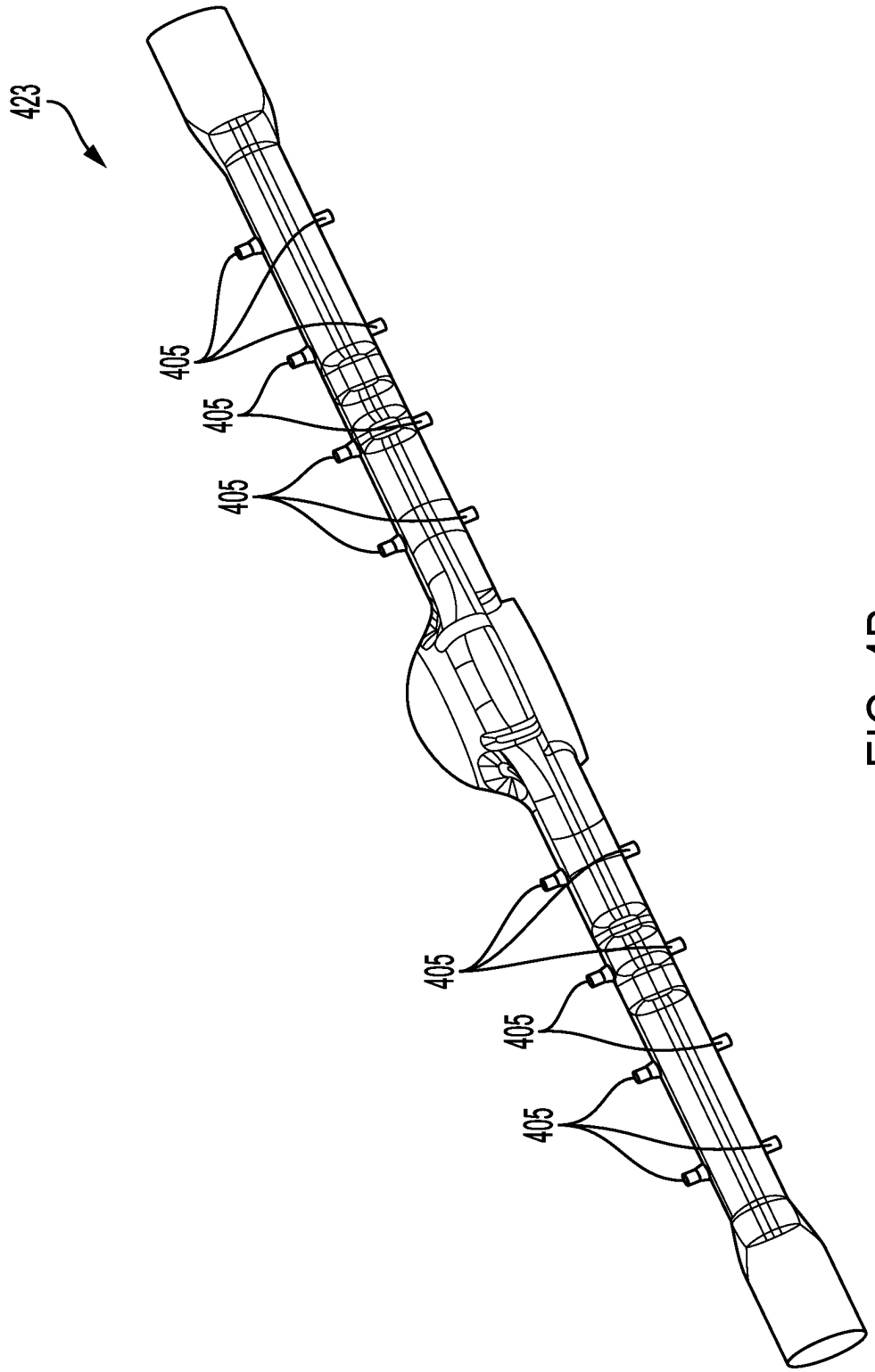


FIG. 4B

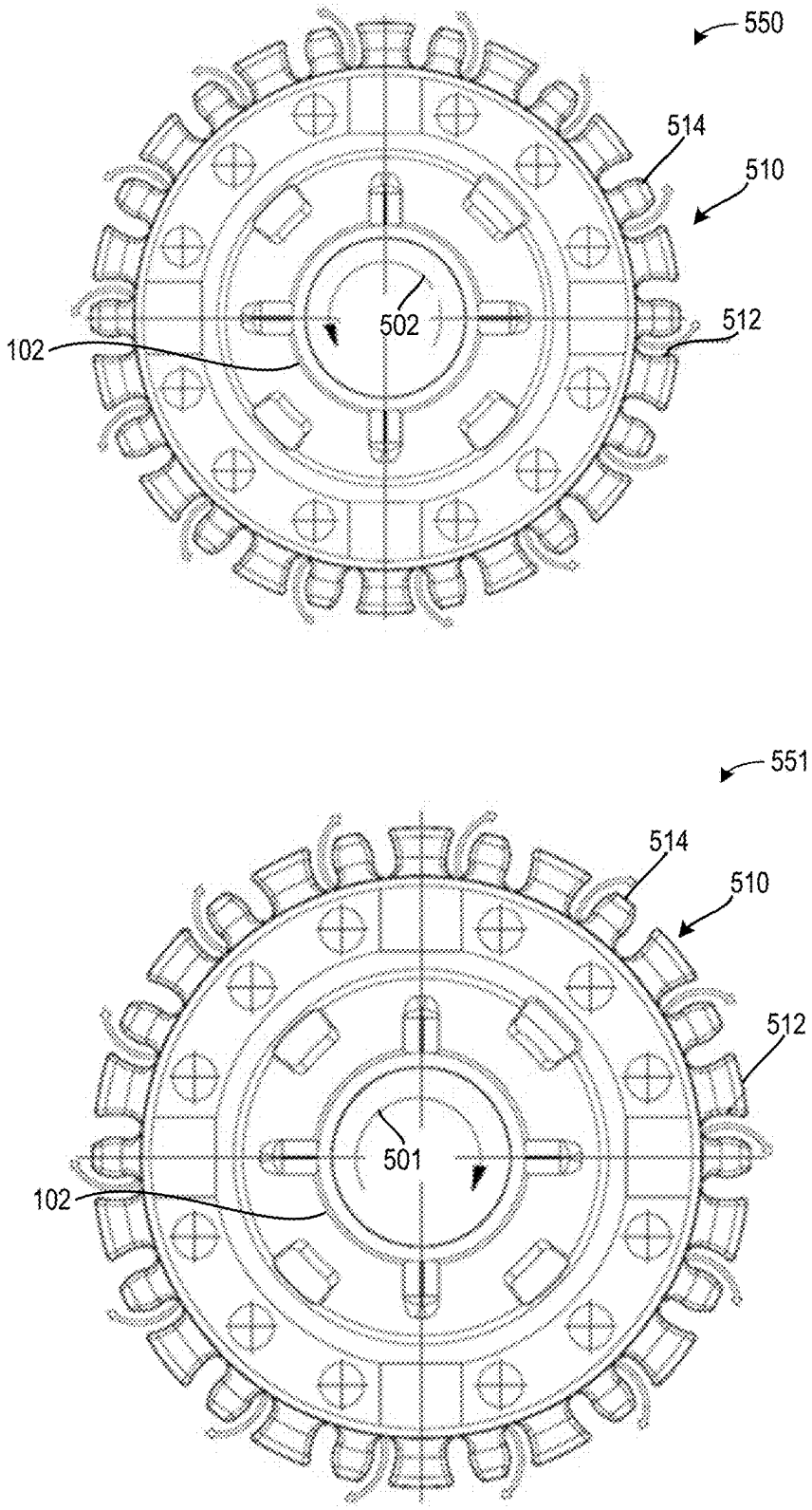


FIG. 5A

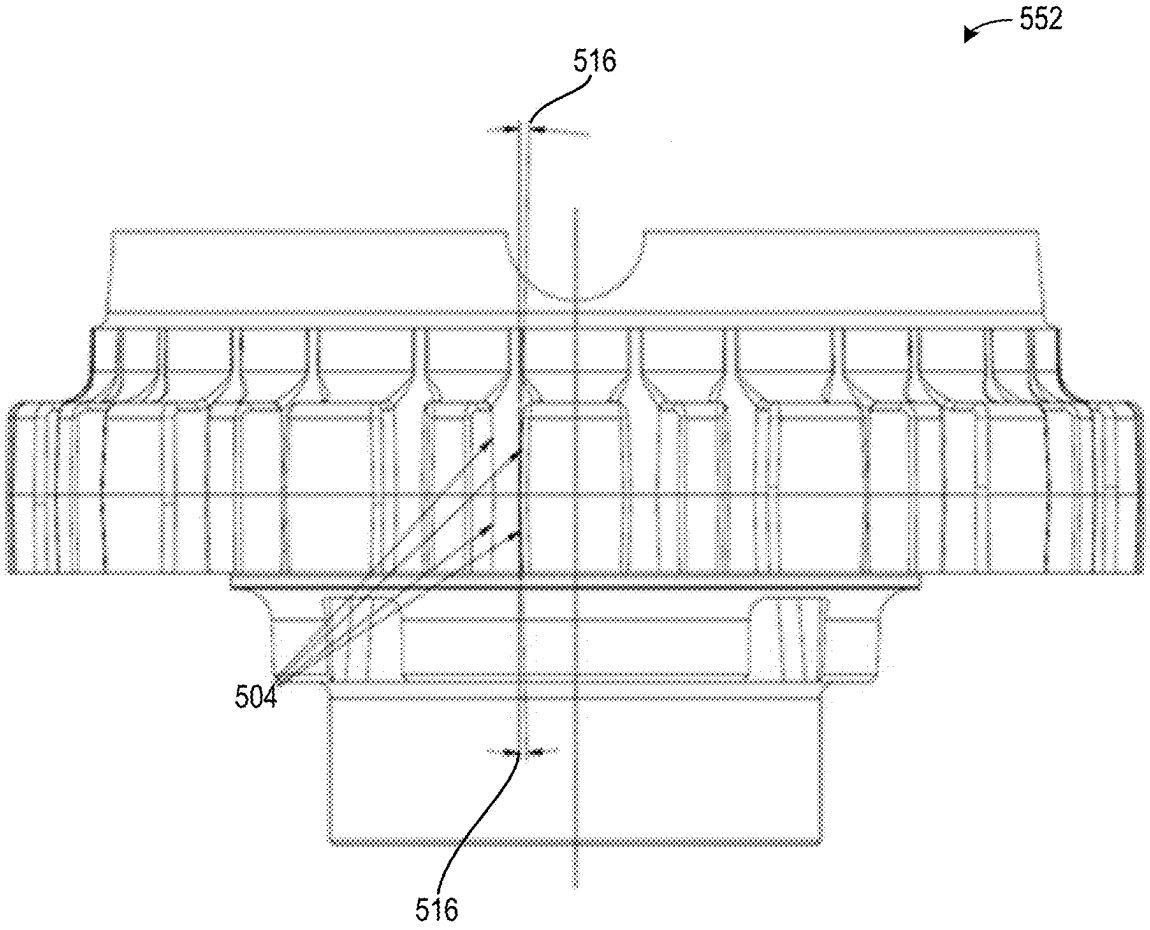


FIG. 5B

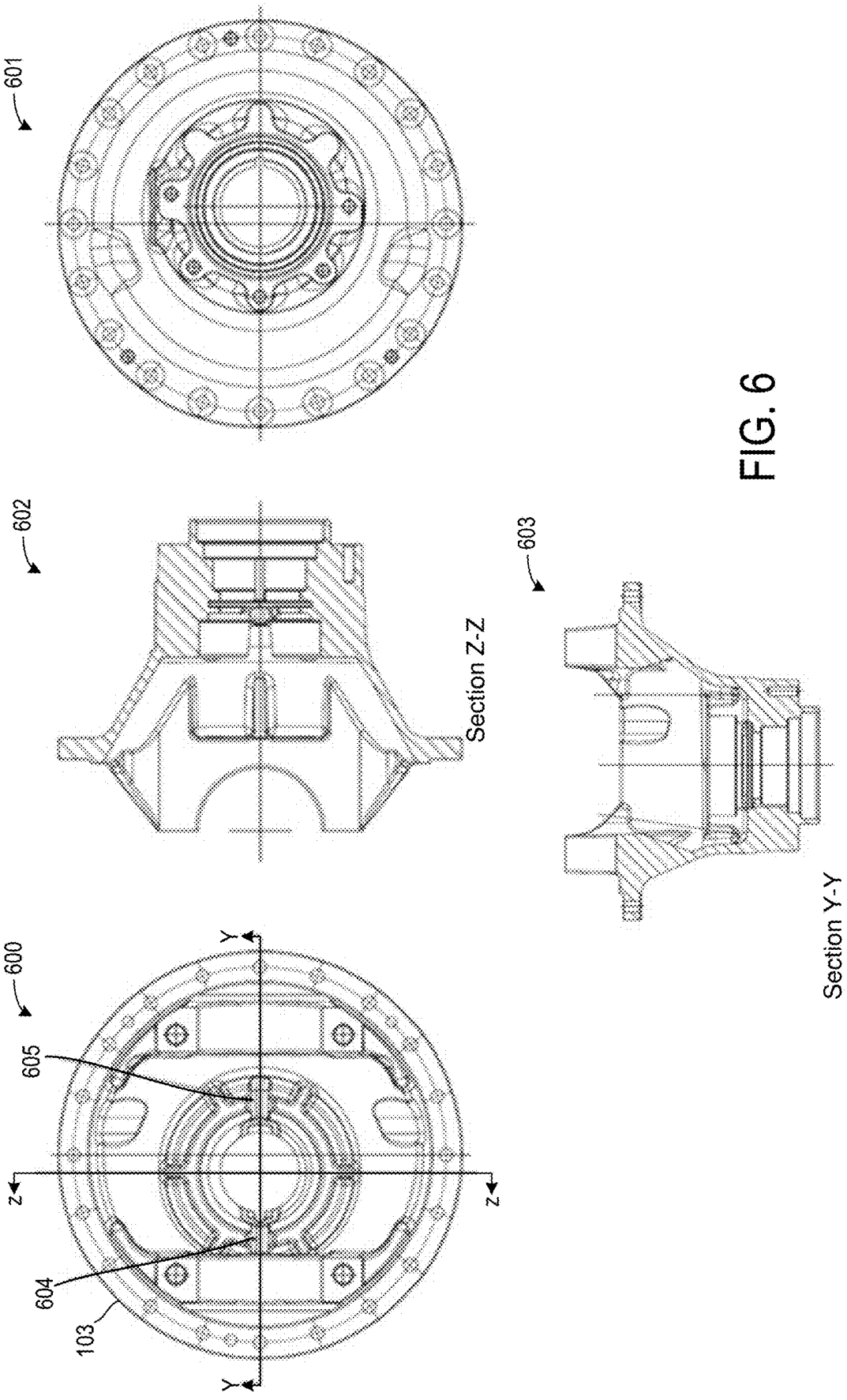


FIG. 6

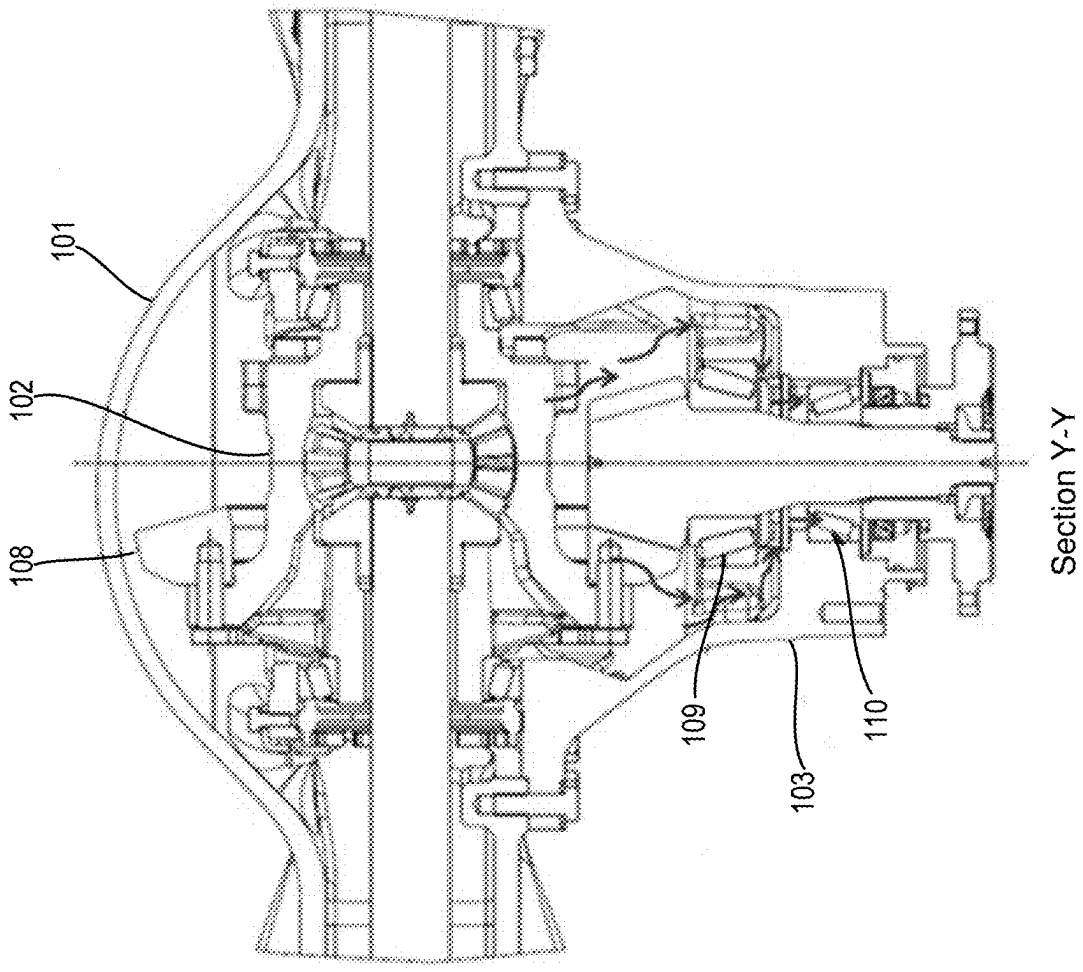


FIG. 7

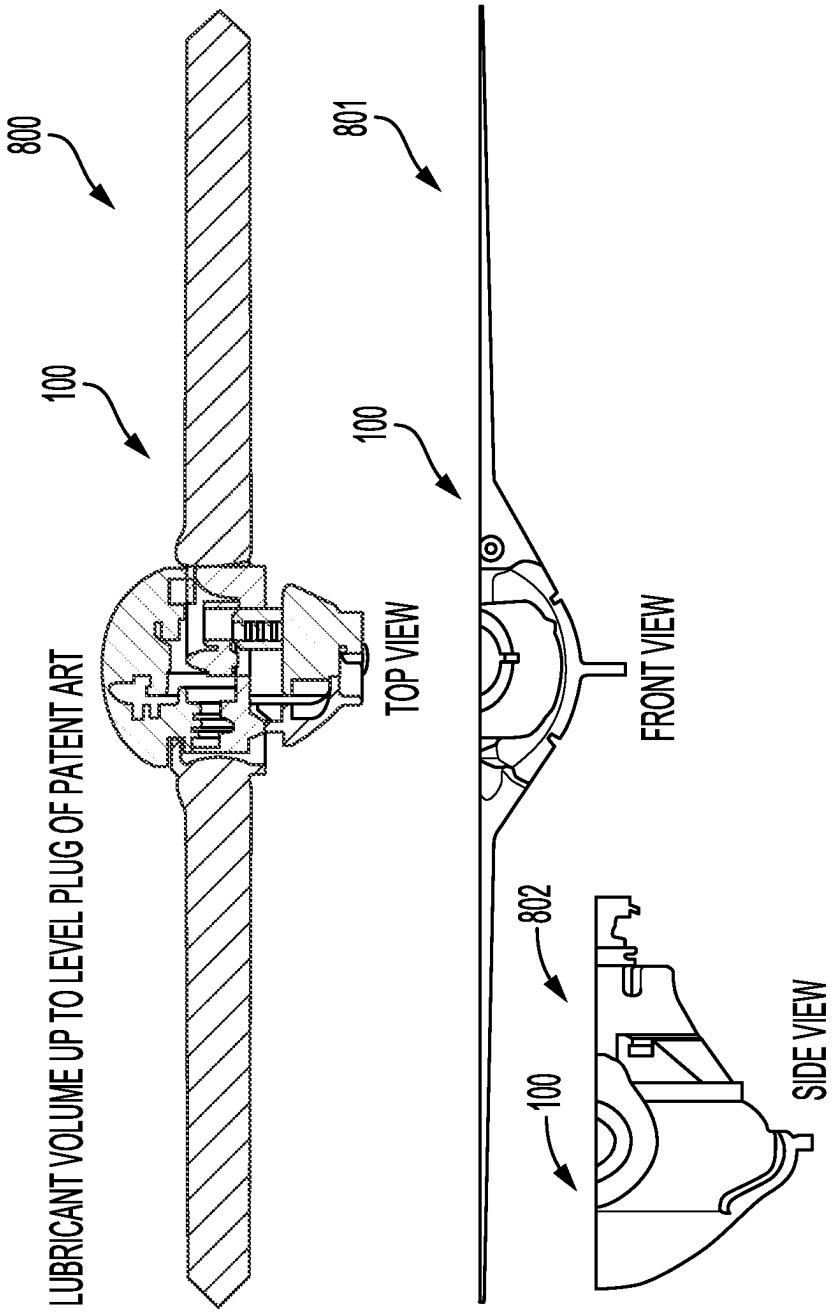

800
100
LUBRICANT VOLUME UP TO LEVEL PLUG OF PATENT ART
TOP VIEW
801
100
FRONT VIEW
802
100
SIDE VIEW

FIG. 8

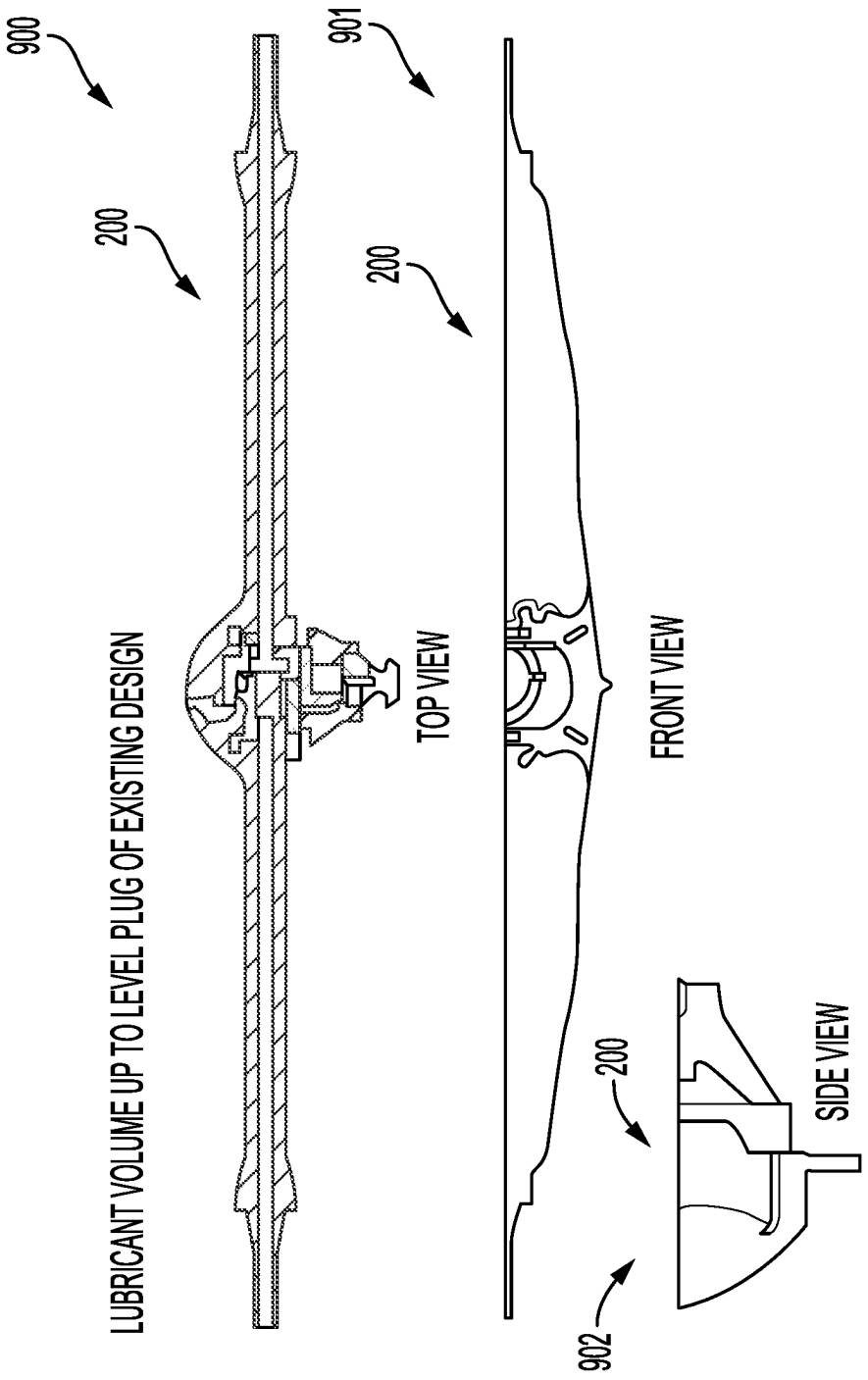


FIG. 9
(Prior art)

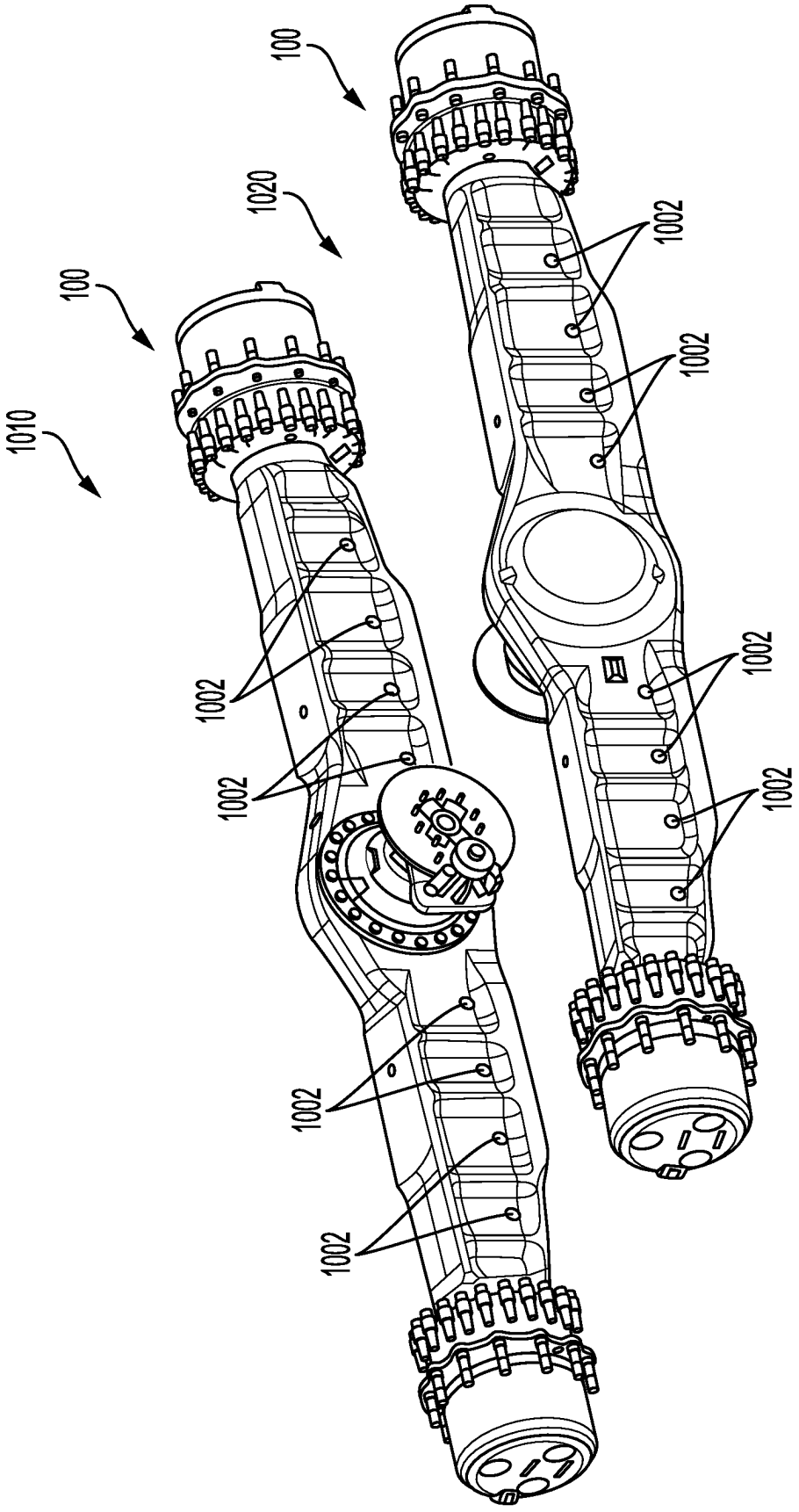

100
1020
100
1010
1002
1002
1002
1002
1002
1002
1002
1002
1002

FIG. 10

SYSTEMS FOR A DRIVE AXLE

TECHNICAL FIELD The present disclosure relates generally to a drive axle.

BACKGROUND AND SUMMARY

[0001] A drive axle in a vehicle or other type of machinery may include relatively high lubricant demands for desired operation. Drive axles used in heavy machinery and/or industrial equipment may be relatively large and demand a large volume of lubricant. However, large volumes of lubricant may lead to churning losses and additional costs associated with manufacture and maintenance. Thus, a drive axle assembly with a design configured to decrease a lubricant volume while still meeting lubricant demands may be desired.

[0002] In one example, the issues described above may be at least partially addressed by an axle housing including a central portion including a differential assembly, the differential assembly including axle shaft side gears with radially extending fins contact lubricant of the axle housing, and an arm portion including axle shafts, the arm portion including an inner inclined surface to guide oil toward the central portion and a plurality of holes distributed axially.

[0003] It should be understood that the summary above is provided to introduce in simplified form a selection of concepts that are further described in the detailed description. It is not meant to identify key or essential features of the claimed subject matter, the scope of which is defined uniquely by the claims that follow the detailed description. Furthermore, the claimed subject matter is not limited to implementations that solve any disadvantages noted above or in any part of this disclosure.

BRIEF DESCRIPTION OF THE DRAWINGS

[0004] Various aspects of this disclosure may be better understood upon reading the following detailed description and upon reference to the drawings, in which:

[0005] FIG. **1** shows a drive axle according to an embodiment of the present disclosure;

[0006] FIG. **2** shows a prior art example of a drive axle;

[0007] FIG. **3**A shows an embodiment of a lubricant partition of the drive axle according to an embodiment of the present disclosure;

[0008] FIG. **3**B shows an isometric view of an axle housing of the drive axle according to an embodiment of the present disclosure;

[0009] FIG. **3**C shows an isometric section view of the lubricant partition according to an embodiment of the present disclosure;

[0010] FIG. **4**A shows a front and a rear view of the axle housing interior core area according to an embodiment of the present disclosure;

[0011] FIG. **4**B shows a top view of the axle housing interior core area according to an embodiment of the present disclosure;

[0012] FIG. **5**A shows a case differential cap according to an embodiment of the present disclosure;

[0013] FIG. **5**B shows a fin angle according to an embodiment of the present disclosure;

[0014] FIG. **6** shows the case differential carrier including a lubricant gallery according to an embodiment of the present disclosure;

[0015] FIG. **7** shows an example lubricant flow from the case differential cap to a differential ring gear according to an embodiment of the present disclosure;

[0016] FIG. **8** shows an example lubricant fill level of the axle housing according to an embodiment of the present disclosure;

[0017] FIG. **9** shows an example lubricant fill level of the prior art axle housing; and

[0018] FIG. **10** shows a fully assembled view of the drive axle according to an embodiment of the present disclosure.

DETAILED DESCRIPTION

[0019] The disclosure provides support for systems including a drive axle. FIG. **1** shows a drive axle according to an embodiment of the present disclosure. FIG. **2** shows a prior art example of a drive axle. FIG. **3**A shows an embodiment of a lubricant partition of the drive axle according to an embodiment of the present disclosure. FIG. **3**B shows an isometric view of an axle housing of the drive axle according to an embodiment of the present disclosure. FIG. **3**C shows an isometric section view of the lubricant partition according to an embodiment of the present disclosure. FIG. **4**A shows a front and a rear view of the axle housing interior core area according to an embodiment of the present disclosure. FIG. **4**B shows a top view of the axle housing interior core area according to an embodiment of the present disclosure;

[0020] FIG. **5**A shows a case differential cap according to an embodiment of the present disclosure. FIG. **5**B shows a fin angle according to an embodiment of the present disclosure. FIG. **6** shows the case differential carrier including a lubricant gallery according to an embodiment of the present disclosure. FIG. **7** shows an example lubricant flow from the case differential cap to a differential ring gear according to an embodiment of the present disclosure. FIG. **8** shows an example lubricant fill level of the axle housing according to an embodiment of the present disclosure. FIG. **9** shows an example lubricant fill level of the prior art axle housing. FIG. **10** shows a fully assembled view of the drive axle according to an embodiment of the present disclosure.

[0021] Turning now to FIG. **1**, it shows a drive axle **100** with higher mechanical efficiency. The drive axle **100** comprises an axle housing **101** with lubricant partition. The drive axle **100** further includes a case differential cap half **102** including lubricant circulators, such as fins. The drive axle **100** further includes a differential carrier **103** with lubricant galleries. There are two galleries in differential carrier **103**, first the case differential cap half side gallery **604** and second differential ring gear side gallery **605** (shown in FIG. **6**). The lubricant partition may include a plurality of oil seals **104** may be included to maintain a lubricant quantity and to separate lubricant in the central portion of the drive axle **100** from the wheel end. The drive axle **100** may further include a plurality of side gears **113**, axle shafts **114**, a plurality of brakes **105** coupled to a plurality of hubs **106**. The plurality of hubs **106** may be coupled to a plurality of planet carries **107**.

[0022] The drive axle **100** may include a differential ring gear **108** in the case differential. Cross-sections X-X and Y-Y show a differential head bearing **109**, differential tail bearing **110**, and lubricant level **111** from axle shaft center.

[0023] A mechanical efficiency of the drive axle **100** is increased due to less lubricant used in the drive axle **100** relative to prior art drive axle **200** of FIG. **2**. This drive axle

concept can be used for off-highway applications where the axle housing size is large. In one example, the lubricant level **111** may be higher than a prior art lubricant level **210** of FIG. **2**.

[0024] FIG. **2** shows a prior art example of a drive axle **200**. The drive axle **200** includes an axle housing **201** without a lubricant partition. As such, lubricant in the central portion of the drive axle **200** may not be separated from wheel ends of the drive axle **200**. The drive axle **200** may include a case differential cap **202** without lubricant circulators, a differential carrier **203** without additional oil galleries, two brakes **204**, two wheel hubs **205**, and two planet carriers **206**. The drive axle **200** may further include a differential ring gear **207**, a differential head bearing **208**, a differential tail bearing **209**, and a lubricant level **210** from an axle shaft center. The drive axle **200** may be powered by a transmission or a motor through differential. The prior art drive axle **200** requires more lubricant than the drive axle **100** because there is no partition separating lubricant in the central portion of the drive axle **200** from the wheel ends. This results in a greater amount of lubricant and a relatively higher lubricant level **210** relative to the lubricant level **111**. A distance **211** illustrates a distance between the axle shaft center and the lubricant level **210**. As illustrated, the distance **211** is less than a distance **112**, which shows a distance between the axle shaft center of the drive axle **100** and the lubricant level **111**. In one example, the distance **211** is five times less than the distance **112**. The increased amount of lubricant in the drive axle **200** may increase a drive axle overall weight as well as resistance to rotating parts. This may result in increased churning losses and heat. The mechanical efficiency of prior art drive axle **200** is lower as compared to the drive axle **100** of the present disclosure.

[0025] In one example, the lubricant level is defined from an axle shaft center line, which is shown by distances **112** of FIG. **1** and **211** of FIG. **2**. As the distances increase, the lubricant quantity decreases.

[0026] Turning now to FIG. **3**A, it shows a detailed view **300** of the axle housing **101**. Cross-section **325** taken along the cutting plane Z-Z illustrates a lubricant partition **301** on which an angle **304** is maintained to keep lubricant in center section. In one example, the angle **304** is sloped toward the case differential and away from the wheel ends. The angle **304** may be less than 5°, less than 3°, and/or less than 2°. In one example, the angle **304** is equal to 1.5°.

[0027] An axle housing arm lubricant partition casting wall **301**, arranged between a top and a bottom wall and connecting casting side walls **310**, may function as a rib to provide increased strength to the drive axle **100**. The axle housing arm lubricant partition casting wall **301** may help to reduce weight of a rest area of sections due to increased strength of the axle housing **101**. Below the lubricant partition **301**, a plurality of core holes **302** are arranged. The plurality of core holes **302** may be used to support the core of the drive axle **100** during manufacturing. The plurality of core holes **302** may be further used to flush the core sand. The plurality of core holes **302** may be plugged with core plugs when the drive axle **100** is arranged in a vehicle. The plurality of core holes **302** are provided to support the sand core in the casting mold. Supports may arrange the large size core rigidly and more accurately inside a mold during manufacture. The plurality of core holes **302** of axle housing may reduce the final weight of casting by reducing wall thickness variation and the manufacturing cost as well. The plurality of core holes **302** may also remove the gases evolved within the core of such a large housing. The venting process may mitigate the casting defects such as blowhole, shrinkage, etc. Ultimately this will increase strength of large axle housing casting by reducing defects, which may increase the strength and longevity of the axle housing **101**. Cross-section **326** shows an additional view of the case differential along cutting plane X-X.

[0028] Turning now to FIG. **3**B, it shows a front isometric view **340** and a rear isometric view **341** of the axle housing **101**. The plurality of core holes **302** are inline from front to rear side of the axle housing. The front isometric view **340** shows a level plug hole **303** which may maintain a lubricant volume up to the lubricant level **111** of FIG. **1**.

[0029] Turning now to FIG. **3**C, it shows an isometric sectional view of axle housing **101**. FIG. **3**C includes an isometric sectional view through an axle shaft center **350** and an isometric sectional view through axle core holes **351**. The isometric sectional view through axle shaft center **350** shows the lubricant partition (**301**) geometry and the isometric sectional view through axle core holes **351** shows eight of the plurality of core holes **302**.

[0030] Turning now to FIG. **4**A, it shows a front view **420** and a rear view **421** of a core **400** used for manufacturing of the axle housing **101**. The core **400** includes of a top core **401**, a first bottom core **402**, and a second bottom core **403**, which is shown in view **422**. A lubricant partition gap **404** is maintained between the top core **401**, the first bottom core **402**, and the second bottom core **403** to create the lubricant partition (e.g., lubricant partition **301** of FIG. **3**A). Core supports **405** may support the cores and create core holes in axle housing **101**. View **422** shows the top core **401**, the first bottom core **402**, and the second bottom core **403** separated from one another.

[0031] Turning now to FIG. **4**B, it shows a top view **423** of a core used for manufacturing of axle housing **101**. There are eight core supports **405** which are inline from front to rear side of the axle housing core, similar to the plurality of core holes.

[0032] Turning now to FIG. **5**A, it shows views **550** and **551** of the differential cap half **102** with lubricant circulators. The case differential includes of a plurality of fins **510**, which circulates the lubricant in clockwise direction **501** or in a counterclockwise direction **502**. The plurality of fins **510** may include a plurality of first fins **512** and a plurality of second fins **514**. The plurality of first fins **512** may include a square shape with concave surfaces. The plurality of second fins **514** may include a thimble shape with convex walls. In one example, the plurality of first fins **512** may alternate with the plurality of second fins **514** such that neighboring of the plurality of first fins **512** are separated by one of the plurality of second fins **514**. A number of the plurality of first fins **512** may be equal to a number of the plurality of second fins **514**. In one example, the number of first fins is equal to 14 and the number of second fins is equal to 14. Each of the plurality of fins **510** includes an angle **516** as shown in FIG. **5**B. The angle **516** may spread lubricant in either direction (e.g., clockwise or counterclockwise), which may circulate and direct lubricant towards the differential carrier **103**, as shown in FIG. **7**.

[0033] In embodiment **552** of FIG. **5**B, the angle **516** of surfaces **504** of the plurality of first fins **512** and the plurality of second fins **514** is identical. The angle **516** may be less than 5°, less than 3°, and/or less than 2°. In one example, the

angle **516** is equal to exactly 1.5°. which is provided to spread lubricant in either direction.

[0034] Turning now to FIG. **6**, it shows the differential carrier **103** with the lubricant galleries. The differential carrier includes lubricant galleries including a differential cap half side gallery **604** and the differential ring gear side gallery **605**. Rotation of the differential cap half **102** and the differential ring gear **108** splashes lubricant towards gallery **604** & **605**, which further transfers to the differential head bearing **109** and the differential tail bearing **110**, as shown in FIG. **7**. In this way the center section may be lubricated with less lubricant compared to the prior art drive axle **200**.

[0035] FIG. **6** shows a rear view **600** of the differential carrier **103**, a front view **601** of the differential carrier, a cross-sectional view **602** taken along a Z-Z cutting plane, and a cross-sectional view **603** taken along a Y-Y cutting plane.

[0036] FIG. **7** shows the lubricant flowing, via arrows from the differential cap half **102** and the differential ring gear **108** to the differential head bearing **109** and the differential tail bearing **110**, via lubricant galleries shaped in the differential carrier.

[0037] The differential carrier has lubricant galleries, the differential cap half side gallery **604** and differential ring gear side gallery **605**. These both galleries are opened on head bearing outer diameter & continue to tail outer bearing diameter (shown in FIG. **7**). FIG. **8** shows the lubricant total lubricant quantity used for the drive axle **100**. FIG. **8** includes a top view **800**, a front view **801**, and a side view **802**, each taken along a cutting plane parallel to the lubricant level **111** of FIG. **1**. The lubricant level may be maintained by filling lubricant up to level plug hole **303** (shown in FIG. **3**B). Lubricant quantity may be approximately 12 liters, which is 76% less than the lubricant quantity used in the prior art drive axle **200**. The approximate weight of 12 liters of lubricant is 11 Kg, which is 77.5% less than prior art drive axle **200**.

[0038] FIG. **9** shows the lubricant total lubricant quantity required for the prior art drive axle **200**. FIG. **9** shows a top view **900**, a front view **901**, and a side view **902** of the drive axle **200** cut along the lubricant level **210**. Lubricant quantity will be approximately **51** liters which is 76% higher than the drive axle **100**. The approximate weight of 51 liters of lubricant is 49 Kg which is 77.5% higher than drive axle **100**.

[0039] FIG. **10** shows the drive axle **100** including a plurality of core plugs **1002**. The plurality of core plugs **1002** are inserted into the plurality of core holes **302** on a front side of the drive axle **100**, as shown in view **1010**, and on a rear side of the drive axle **100**, as shown in view **1020**.

[0040] While various embodiments have been described above, it should be understood that they have been presented by way of example, and not limitation. It will be apparent to persons skilled in the relevant arts that the disclosed subject matter may be embodied in other specific forms without departing from the spirit of the subject matter. The embodiments described above are therefore to be considered in all respects as illustrative, not restrictive.

[0041] The disclosure provides support for a drive axle including a central portion comprising a differential assembly, the differential assembly comprising axle shaft side gears with a plurality of fins in contact with lubricant of an axle housing, and an arm portion comprising axle shafts, the arm portion comprising an inner inclined surface to guide oil toward the central portion and a plurality of holes distributed axially. A first example of the drive axle further includes where the arm portion comprises a seal between the central portion and a wheel portion. A second example of the drive axle, optionally including the first example, further includes where the seal is configured to block lubricant from flowing from the central portion to the wheel portion. A third example of the drive axle, optionally including one or more of the previous examples, further includes where the inner inclined surface is sloped toward the central portion. A fourth example of the drive axle, optionally including one or more of the previous examples, further includes where the inner inclined surface is configured to return lubricant toward the central portion and away from a wheel portion arranged at an end of the arm portion. A fifth example of the drive axle, optionally including one or more of the previous examples, further includes where the plurality of fins comprises a plurality of first fins and a plurality of second fins different than the plurality of first fins. A sixth example of the drive axle, optionally including one or more of the previous examples, further includes where a second fin of the plurality of second fins is arranged between neighboring first fins of the plurality of first fins. A seventh example of the drive axle, optionally including one or more of the previous examples, further includes where surfaces of the plurality of fins are angled.

[0042] The disclosure provides additional support for a drive axle assembly including a case differential comprising a plurality of fins along a central portion of a drive axle and a plurality of seals arranged between the central portion of the drive axle and wheel ends arranged at opposite extreme ends of the drive axle. A first example of the drive axle assembly further includes where the plurality of fins comprises angled surfaces configured to direct lubricant in a clockwise direction or a counterclockwise direction. A second example of the drive axle assembly, optionally including the first example, further includes where an arm portion of the drive axle extends from the central portion to the wheel ends, the arm portion sloped toward the central portion. A third example of the drive axle assembly, optionally including one or more of the previous examples, further includes where the plurality of fins comprises a plurality of first fins and a plurality of second fins different than the plurality of first fins. A fourth example of the drive axle assembly, optionally including one or more of the previous examples, further includes where the plurality of fins extends radially outward from the axle shaft side gears. A fifth example of the drive axle assembly, optionally including one or more of the previous examples, further includes lubricant galleries extending from a differential cap half and a differential ring gear to a differential head bearing and a differential tail bearing. A sixth example of the drive axle assembly, optionally including one or more of the previous examples, further includes where seals of the plurality of seals are arranged at the wheel ends.

[0043] The disclosure provides further support for a system including a drive axle assembly comprising an axle extending between wheel ends and a differential cap centrally arranged between the wheel ends, wherein a plurality of lubricant galleries extend from a differential cap half and a differential ring gear to a differential head bearing and a differential tail bearing. A first example of the system further includes where a plurality of fins is arranged on a differential side gear, wherein the plurality of fins comprises convex and

concave surfaces configured to direct lubricant in clockwise and counterclockwise directions. A second example of the system, optionally including a first example, further includes where a plurality of seals is arranged between the differential cap and the wheel ends. A third example of the system, optionally including one or more of the previous examples, further includes where the axle comprises sloped surfaces that decline from the wheel ends toward the differential cap. A fourth example of the system, optionally including one or more of the previous examples, further includes a plurality of core holes arranged in the axles plugged with a plurality of core plugs.

[0044] It will be appreciated that the configurations and routines disclosed herein are exemplary in nature, and that these specific embodiments are not to be considered in a limiting sense, because numerous variations are possible. As used herein, an element or step recited in the singular and proceeded with the word "a" or "an" should be understood as not excluding plural of said elements or steps, unless such exclusion is explicitly stated. Furthermore, references to "one embodiment" of the present invention are not intended to be interpreted as excluding the existence of additional embodiments that also incorporate the recited features. Moreover, unless explicitly stated to the contrary, embodiments "comprising," "including," or "having" an element or a plurality of elements having a particular property may include additional such elements not having that property. The terms "including" and "in which" are used as the plain-language equivalents of the respective terms "comprising" and "wherein." Moreover, the terms "first," "second," and "third," etc. are used merely as labels, and are not intended to impose numerical requirements or a particular positional order on their objects.

[0045] FIGS. **1-10** show example configurations with relative positioning of various components. If shown directly contacting each other, or directly coupled, then such elements may be referred to as directly contacting or directly coupled, respectively, at least in one example. Similarly, elements shown contiguous or adjacent to one another may be contiguous or adjacent to each other, respectively, at least in one example. As an example, components laying in face-sharing contact with each other may be referred to as in face-sharing contact. As another example, elements positioned apart from each other with only a space therebetween and no other components may be referred to as such, in at least one example. As yet another example, elements shown above/below one another, at opposite sides to one another, or to the left/right of one another may be referred to as such, relative to one another. Further, as shown in the figures, a topmost element or point of element may be referred to as a "top" of the component and a bottommost element or point of the element may be referred to as a "bottom" of the component, in at least one example. As used herein, top/bottom, upper/lower, above/below, may be relative to a vertical axis of the figures and used to describe positioning of elements of the figures relative to one another. As such, elements shown above other elements are positioned vertically above the other elements, in one example. As yet another example, shapes of the elements depicted within the figures may be referred to as having those shapes (e.g., such as being circular, straight, planar, curved, rounded, chamfered, angled, or the like). Further, elements shown intersecting one another may be referred to as intersecting elements or intersecting one another, in at least one example. Further still, an element shown within another element or shown outside of another element may be referred as such, in one example. FIGS. **1-10** are shown approximately to scale. However, other dimensions may be used if desired.

[0046] This written description uses examples to disclose the invention, including the best mode, and also to enable a person of ordinary skill in the relevant art to practice the invention, including making and using any devices or systems and performing any incorporated methods. The patentable scope of the invention is defined by the claims, and may include other examples that occur to those of ordinary skill in the art. Such other examples are intended to be within the scope of the claims if they have structural elements that do not differ from the literal language of the claims, or if they include equivalent structural elements with insubstantial differences from the literal languages of the claims.

1. A drive axle, comprising:

a central portion comprising a differential assembly, the differential assembly comprising axle shaft side gears with a plurality of fins in contact with lubricant of an axle housing, and an arm portion comprising axle shafts, the arm portion comprising an inner inclined surface to guide oil toward the central portion and a plurality of holes distributed axially.

2. The drive axle of claim **1**, wherein the arm portion comprises a seal between the central portion and a wheel portion.

3. The drive axle of claim **2**, wherein the seal is configured to block lubricant from flowing from the central portion to the wheel portion.

4. The drive axle of claim **1**, wherein the inner inclined surface is sloped toward the central portion.

5. The drive axle of claim **4**, wherein the inner inclined surface is configured to return lubricant toward the central portion and away from a wheel portion arranged at an end of the arm portion.

6. The drive axle of claim **1**, wherein the plurality of fins comprises a plurality of first fins and a plurality of second fins different than the plurality of first fins.

7. The drive axle of claim **6**, wherein a second fin of the plurality of second fins is arranged between neighboring first fins of the plurality of first fins.

8. The drive axle of claim **1**, wherein surfaces of the plurality of fins are angled.

9. A drive axle assembly, comprising:

a case differential comprising a plurality of fins along a central portion of a drive axle; and

a plurality of seals arranged between the central portion of the drive axle and wheel ends arranged at opposite extreme ends of the drive axle.

10. The drive axle assembly of claim **9**, wherein the plurality of fins comprises angled surfaces configured to direct lubricant in a clockwise direction or a counterclockwise direction.

11. The drive axle assembly of claim **9**, wherein an arm portion of the drive axle extends from the central portion to the wheel ends, the arm portion sloped toward the central portion.

12. The drive axle assembly of claim **9**, wherein the plurality of fins comprises a plurality of first fins and a plurality of second fins different than the plurality of first fins.

13. The drive axle assembly of claim **9**, wherein the plurality of fins extends radially outward from the axle shaft side gears.

14. The drive axle assembly of claim **9**, further comprising lubricant galleries extending from a differential cap half and a differential ring gear to a differential head bearing and a differential tail bearing.

15. The drive axle assembly of claim **9**, wherein seals of the plurality of seals are arranged at the wheel ends.

16. A system, comprising:

a drive axle assembly comprising an axle extending between wheel ends; and

a differential cap centrally arranged between the wheel ends, wherein a plurality of lubricant galleries extend from a differential cap half and a differential ring gear to a differential head bearing and a differential tail bearing.

17. The system of claim **16**, wherein a plurality of fins is arranged on a differential side gear, wherein the plurality of fins comprises convex and concave surfaces configured to direct lubricant in clockwise and counterclockwise directions.

18. The system of claim **16**, wherein a plurality of seals is arranged between the differential cap and the wheel ends.

19. The system of claim **16**, wherein the axle comprises sloped surfaces that decline from the wheel ends toward the differential cap.

20. The system of claim **16**, further comprising a plurality of core holes arranged in the axles plugged with a plurality of core plugs.

* * * * *