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Patrick et al.

(10) **Patent No.: US 12,138,960 B1**
(45) **Date of Patent: Nov. 12, 2024**

(54) **CASTER ASSEMBLY HAVING SINUSOIDAL WHEELS**

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(72) Inventors: **David Michael Patrick**, Ladera Ranch, CA (US); **Robert S. Patrick**, Plano, TX (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

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(22) Filed: **Nov. 13, 2023**

(51) **Int. Cl.**
B60B 33/00 (2006.01)

(52) **U.S. Cl.**
CPC ***B60B 33/0042*** (2013.01); ***B60B 33/0021*** (2013.01); ***B60B 33/0068*** (2013.01); ***B60B 33/0081*** (2013.01)

(58) **Field of Classification Search**
CPC B60B 33/0039; B60B 33/0018; B60B 33/0042; B60B 33/0021; B60B 33/006; B60B 33/0065; B60B 33/0068; B60B 33/0076; B60B 33/0081
See application file for complete search history.

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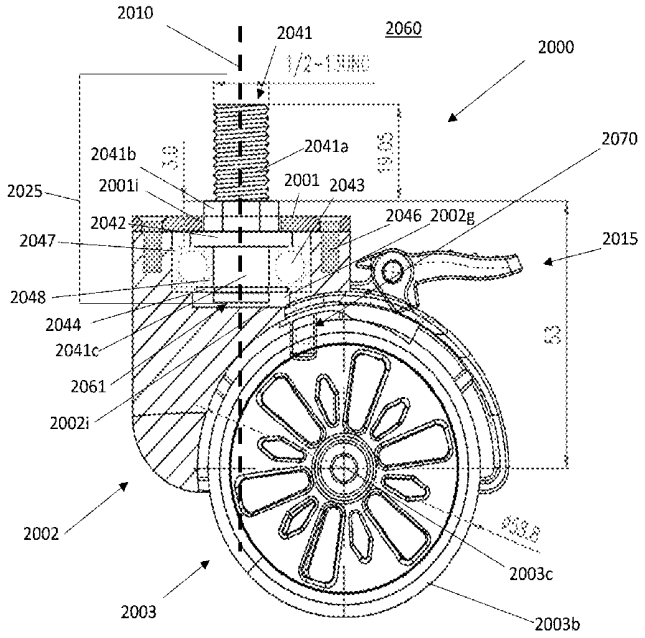
(57) **ABSTRACT**

A caster assembly having a top cap configured to engage with a structure, a caster leg configured to pivotally engage with the top cap, such that the caster leg selectively pivots about a pivot axis, and a pair of sinusoidal wheels configured to be rotationally engaged with the caster leg, the sinusoidal wheels being configured to rotate about a wheel rotational axis and swivel with the caster leg as a required when the structure is moved. An angled member of the caster leg may be configured to engage with the sinusoidal wheels such that the wheel rotational axis is not intersected by the pivot axis. An offset angle formed between the angled member and a vertical member of the caster leg, when used in conjunction with the disclosed sinusoidal wheels, is configured to ease structure movement by minimizing resistances exerted on the sinusoidal wheels during rolling and caster leg pivoting.

7 Claims, 17 Drawing Sheets



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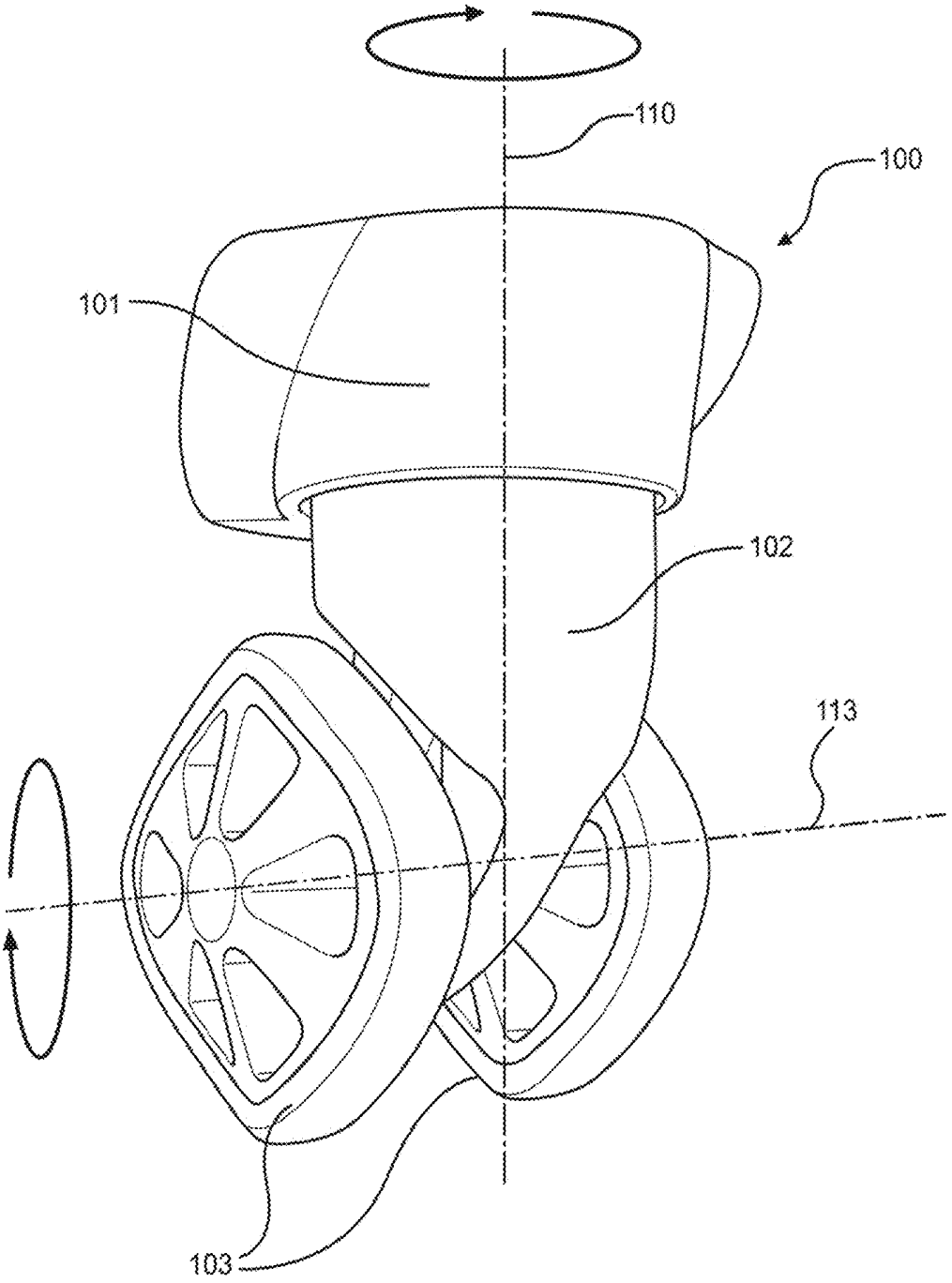


FIG. 1

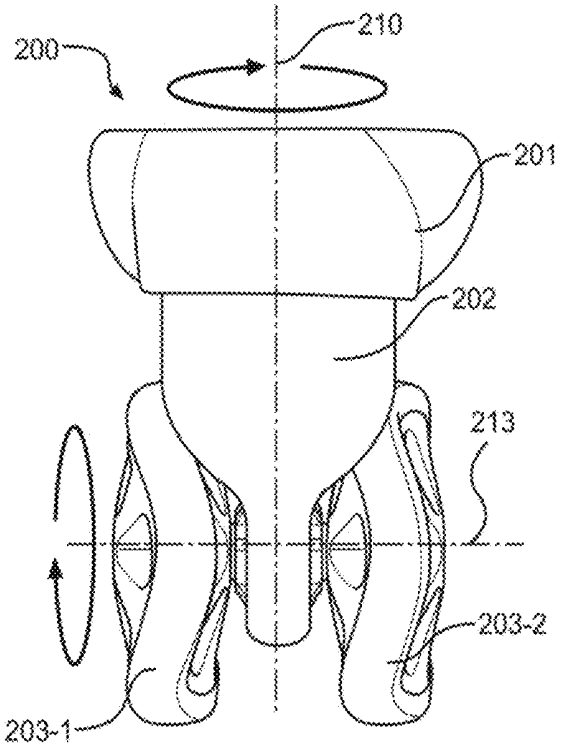


FIG. 2A

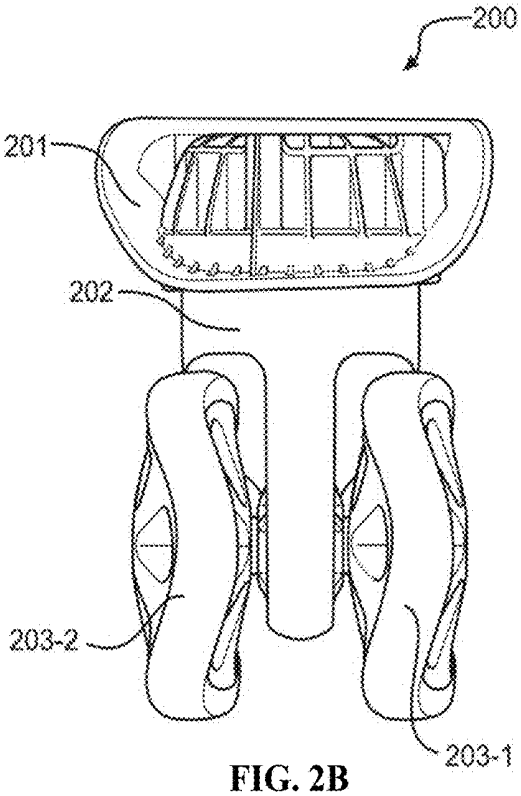


FIG. 2B

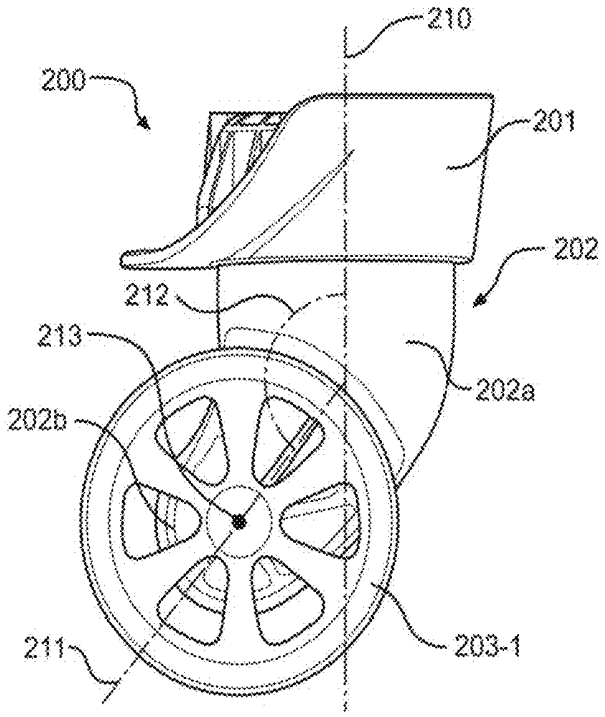
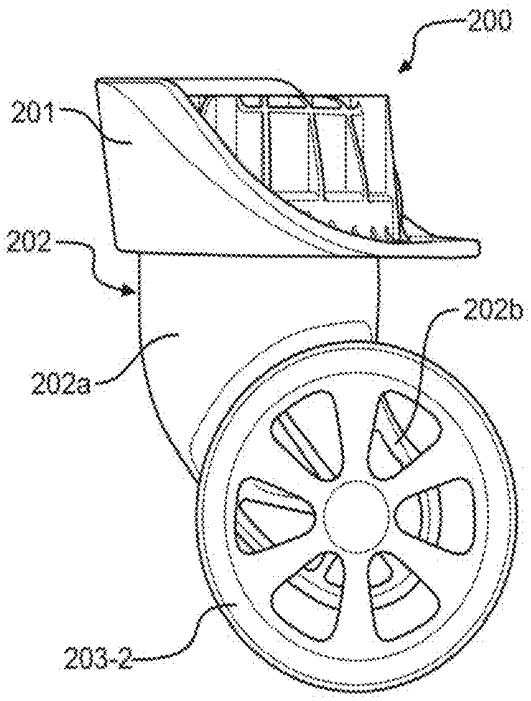


FIG. 2C



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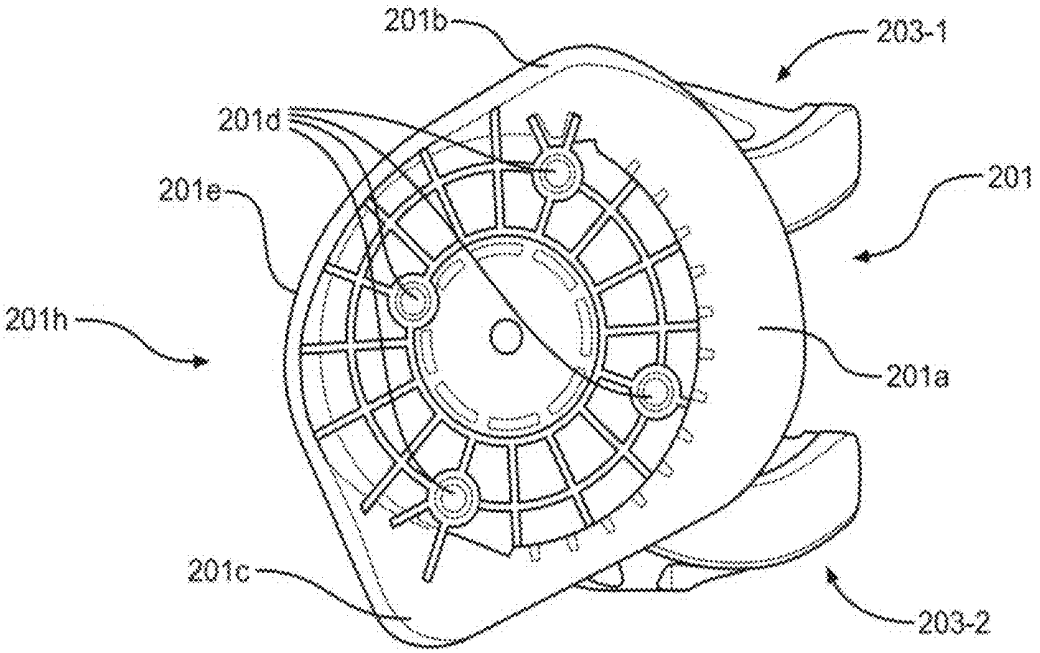
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201c
203-2

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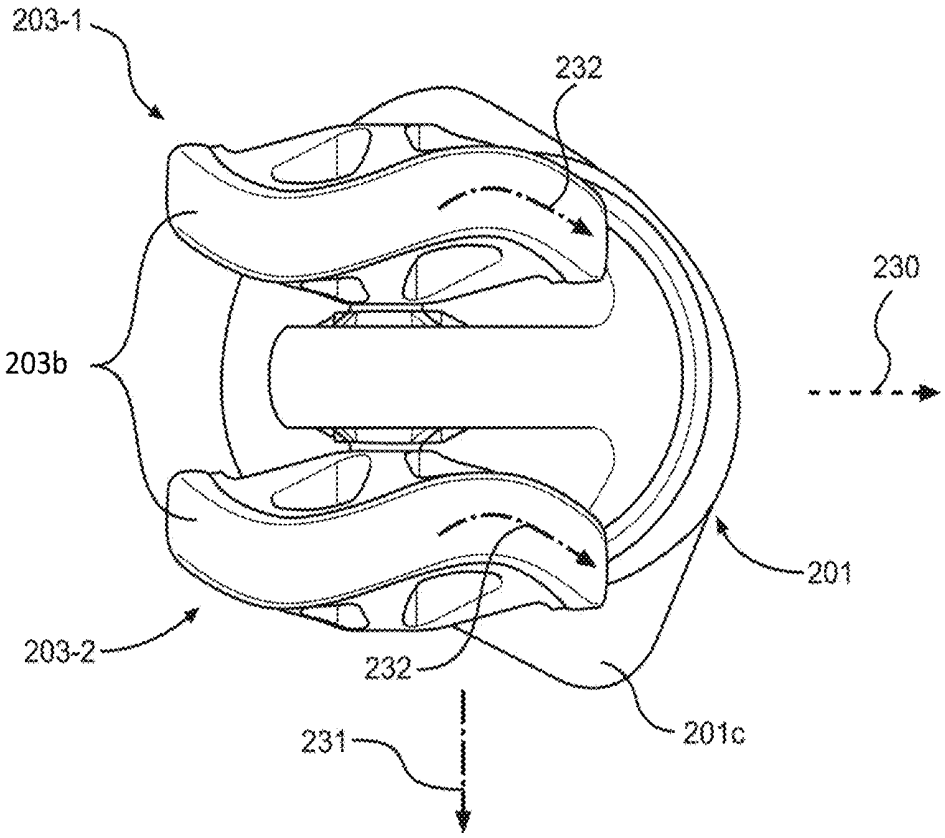
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203b
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203-2
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201c
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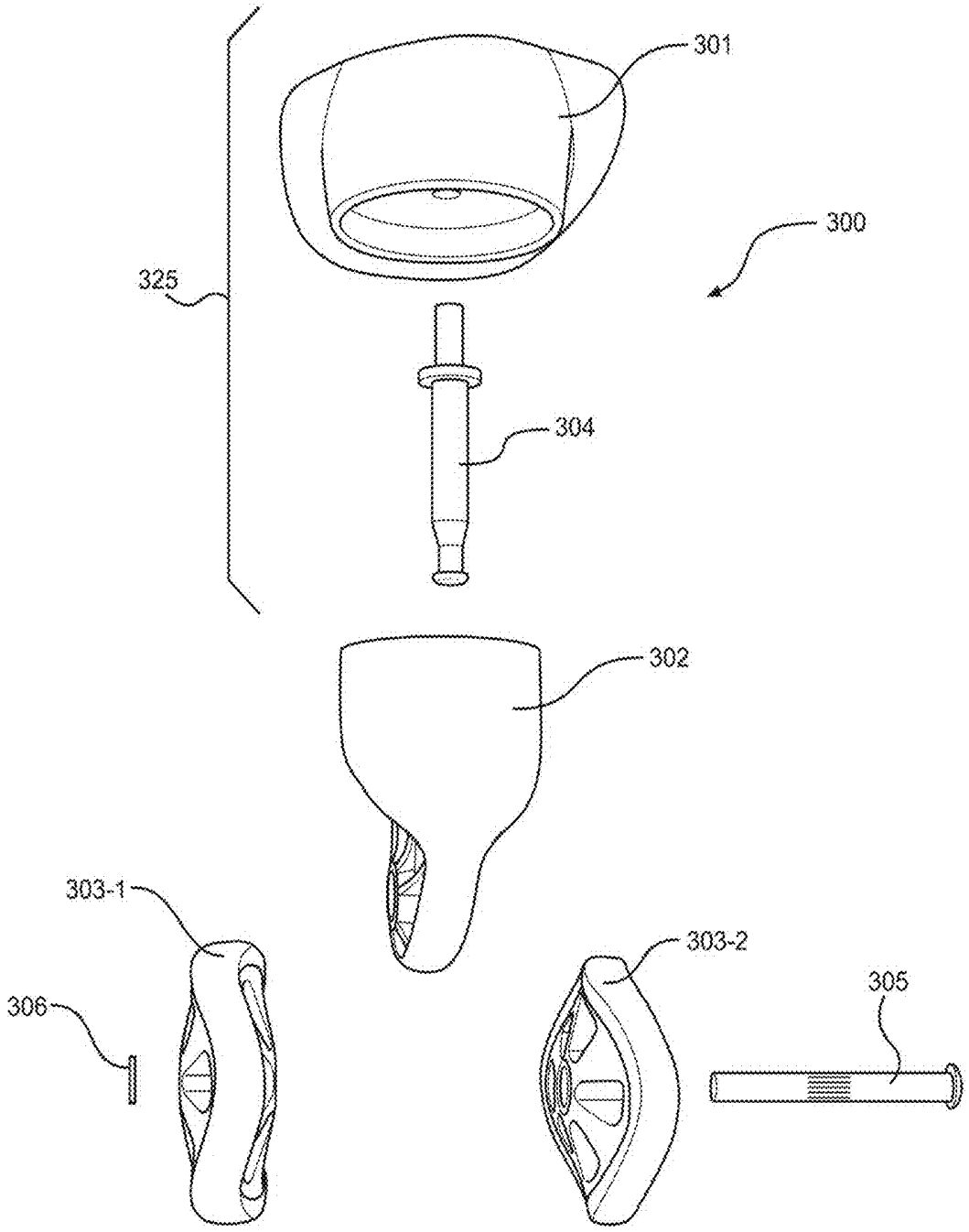

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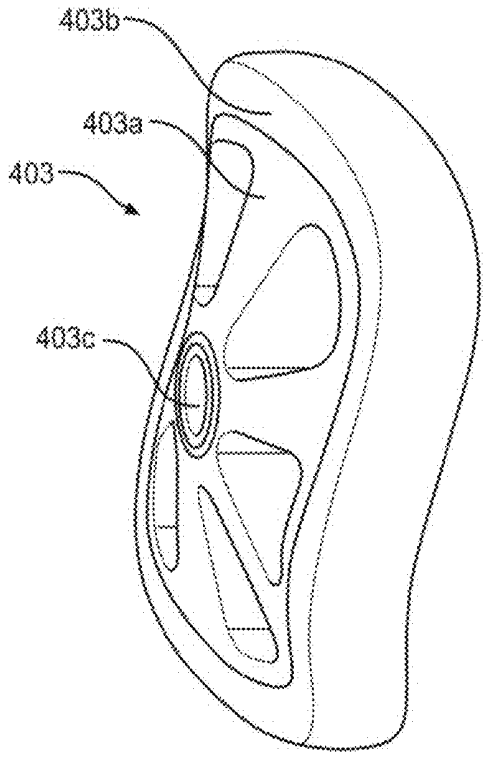

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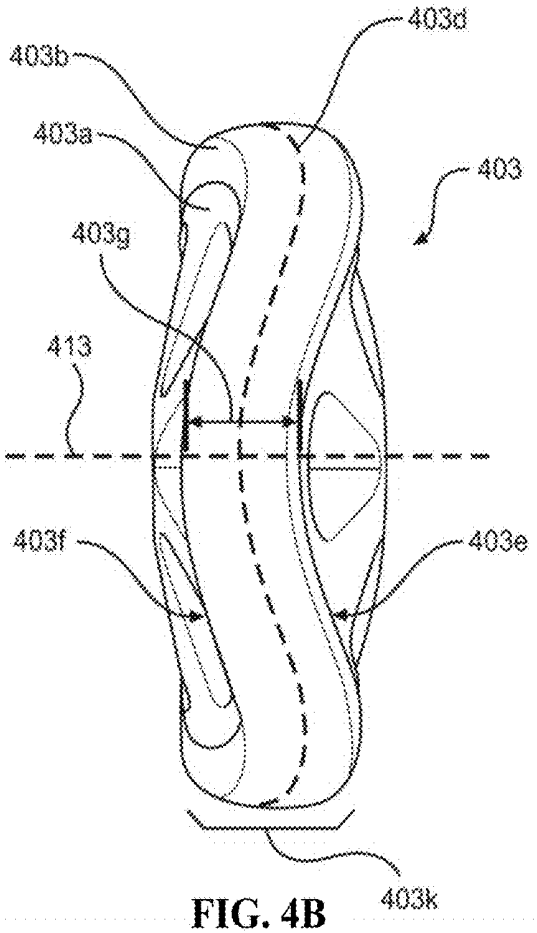


FIG. 4B

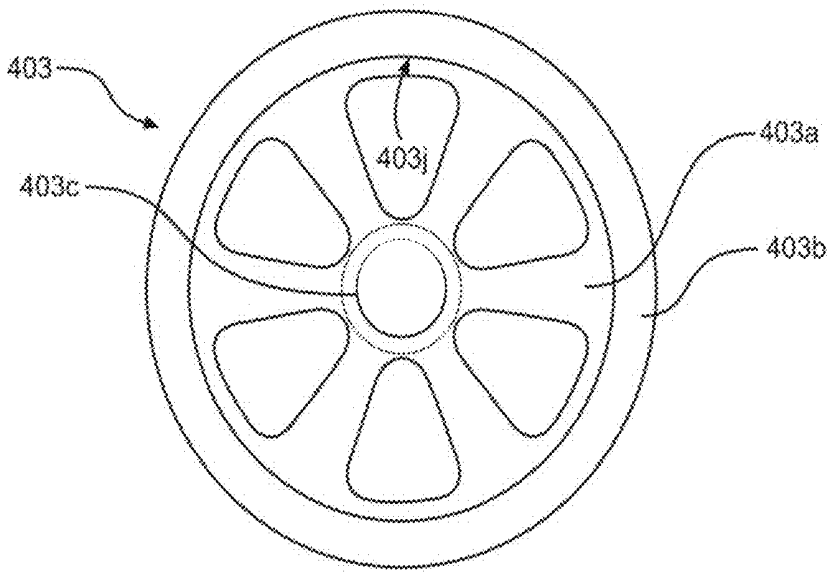


FIG. 4C

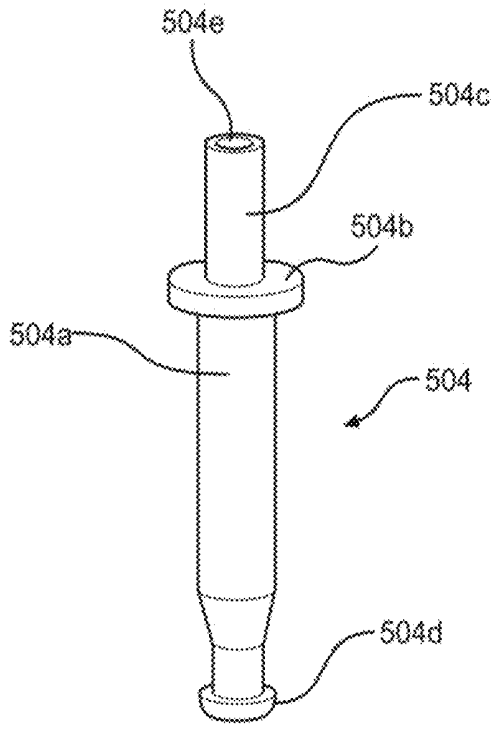
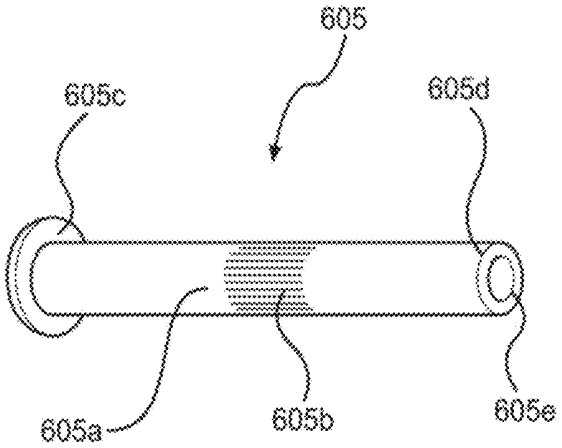


FIG. 5



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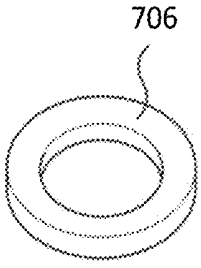

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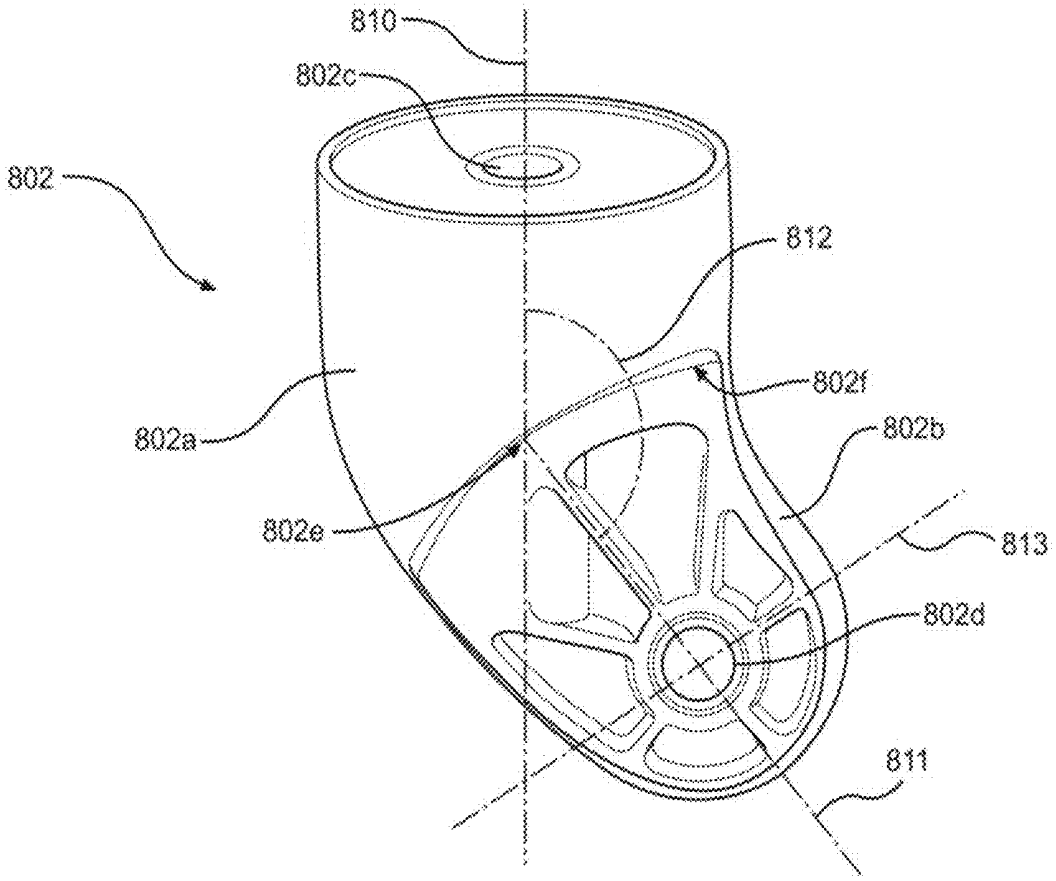
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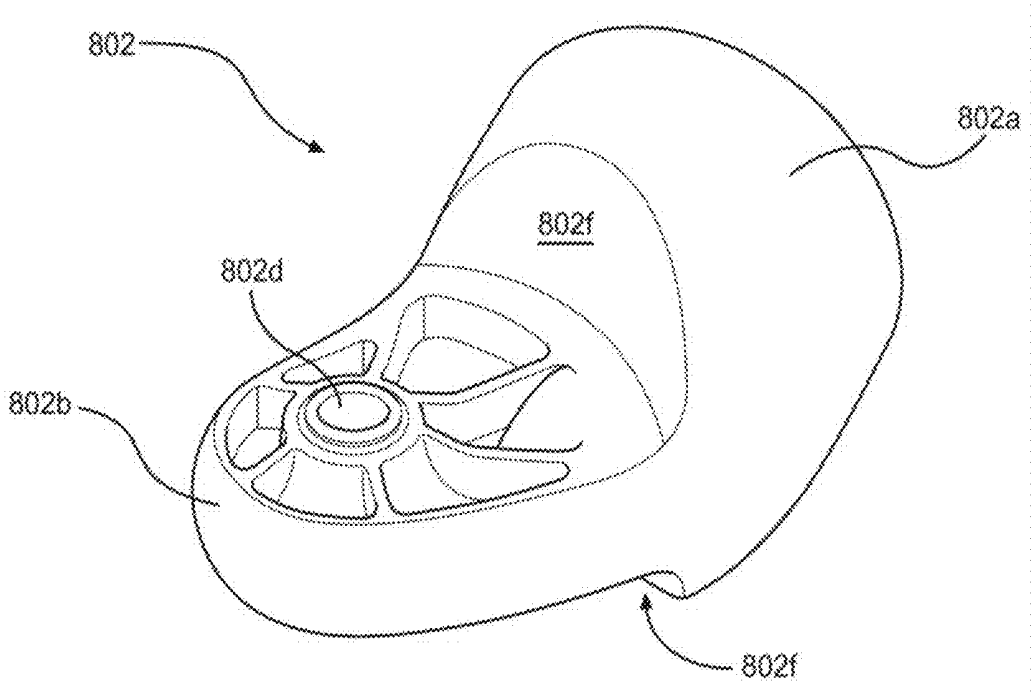
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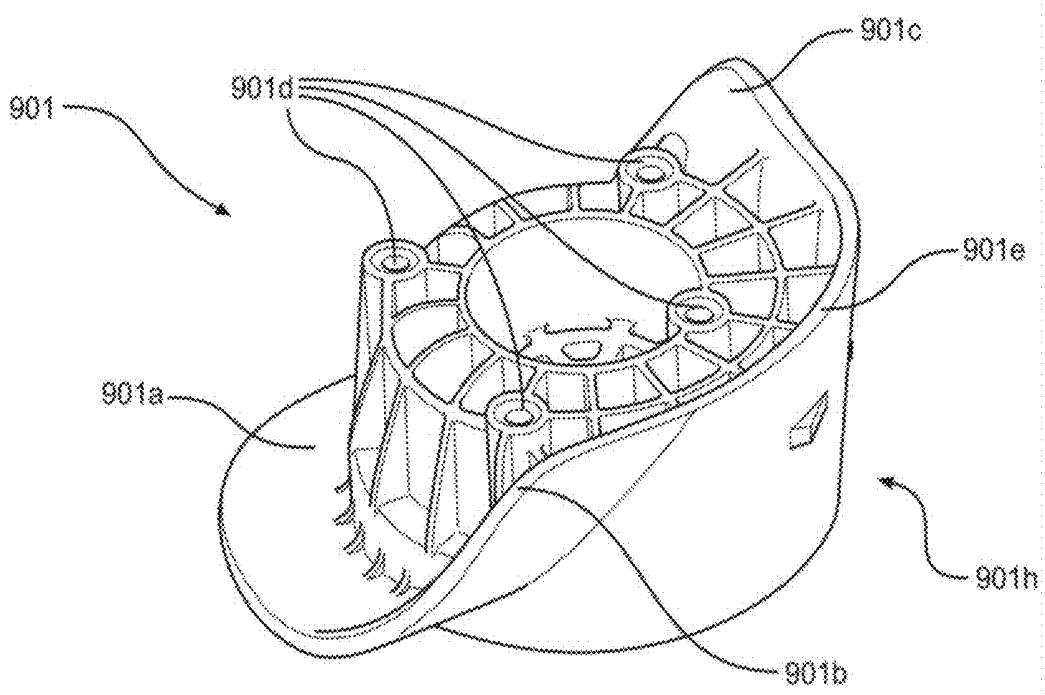

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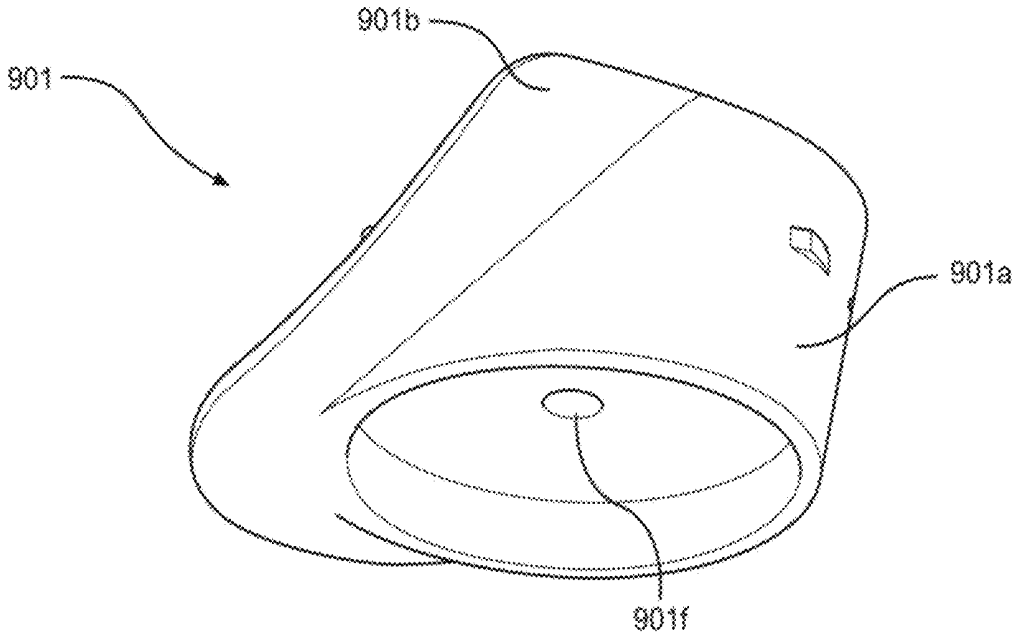

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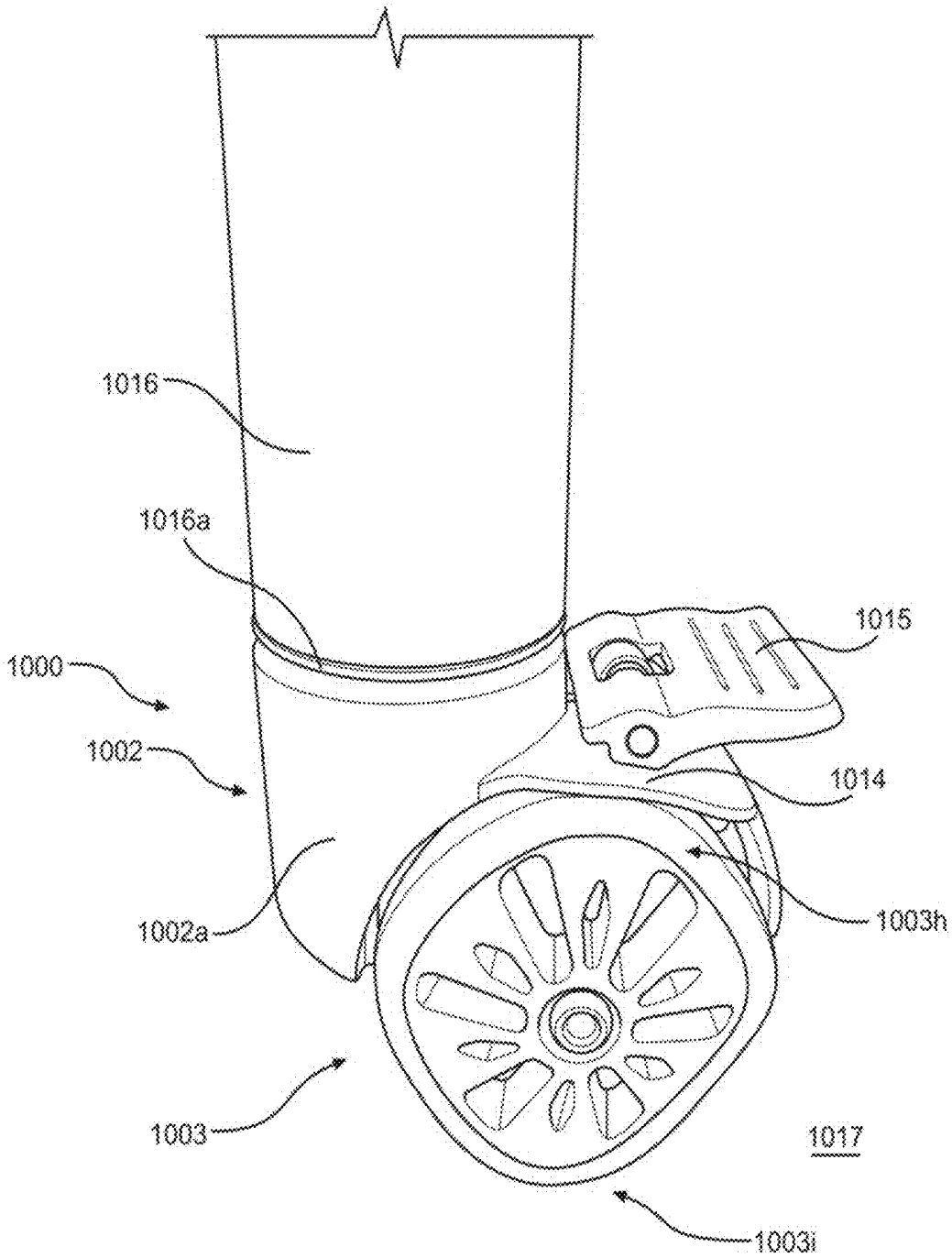

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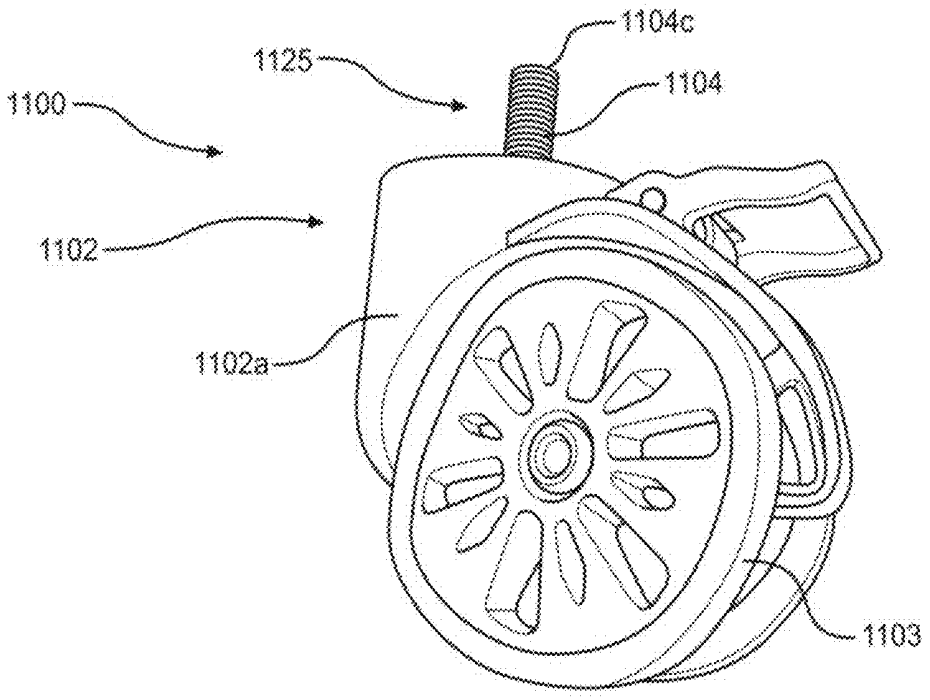
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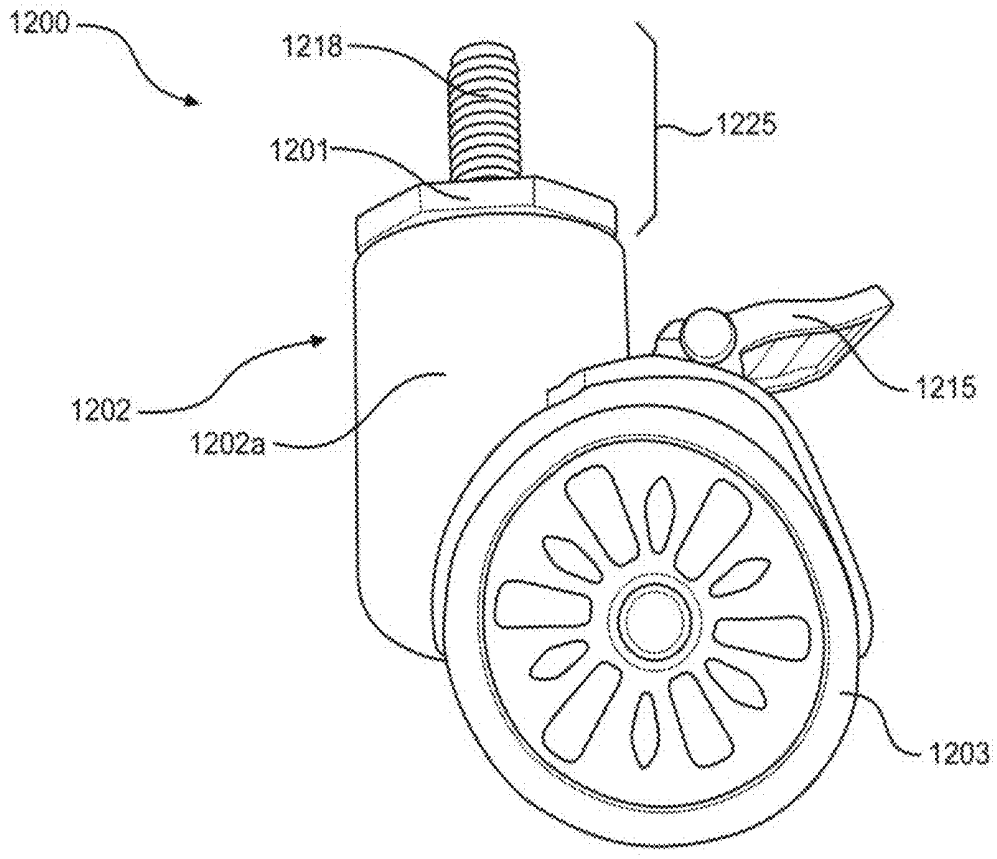
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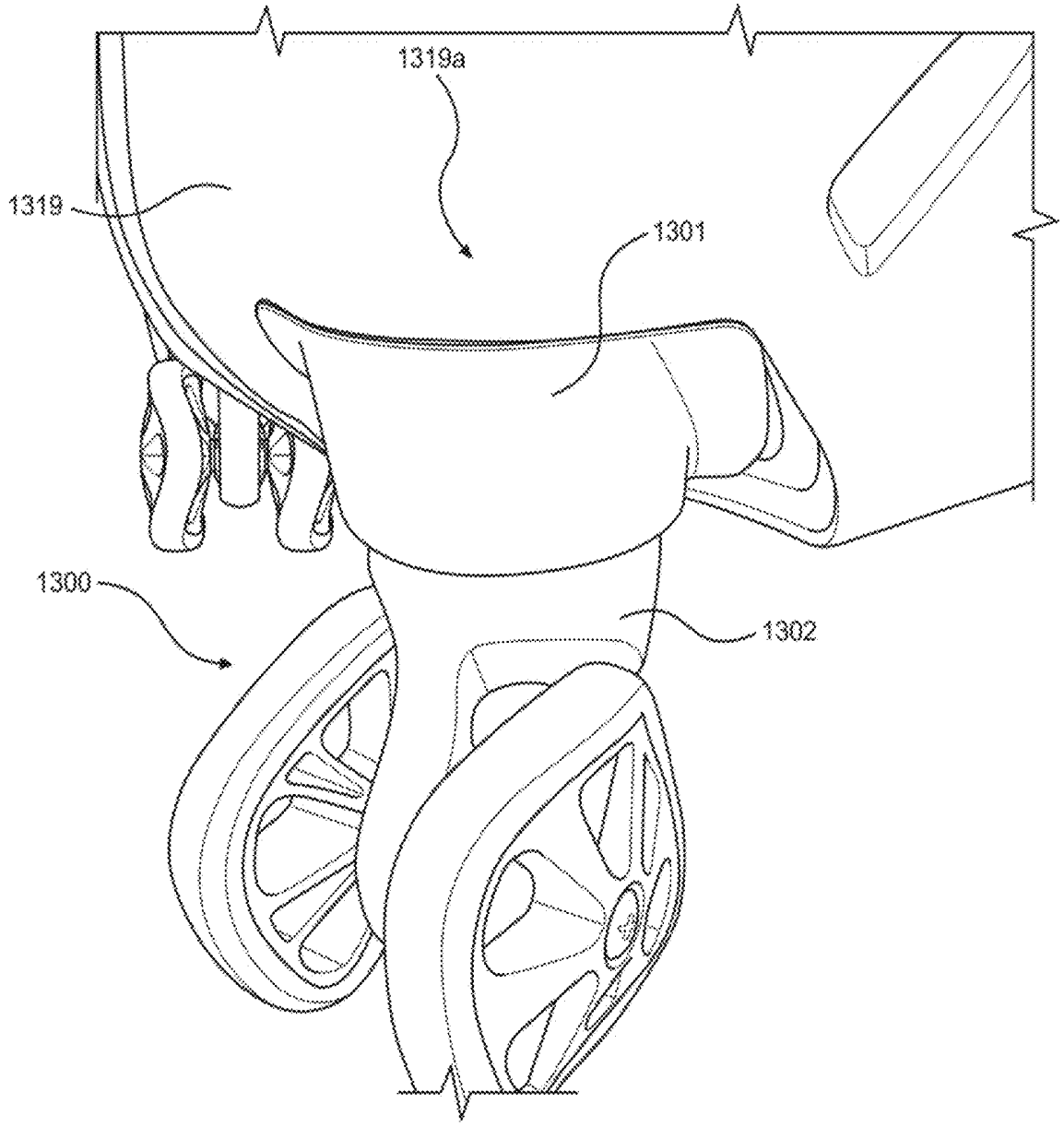

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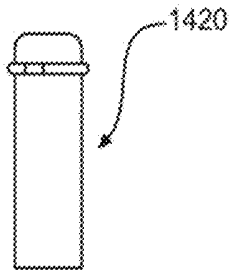

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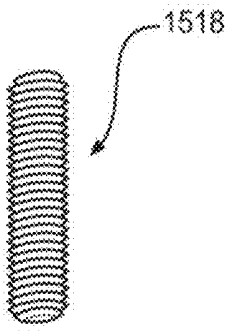


FIG. 15

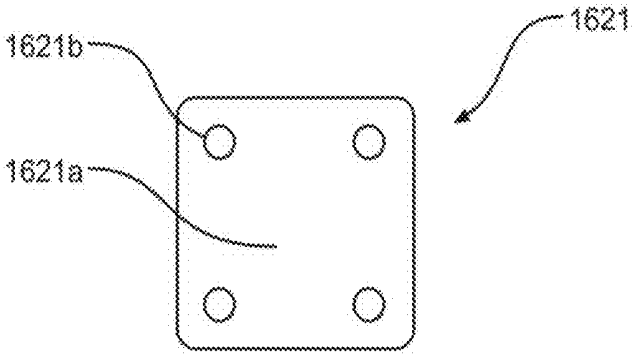


FIG. 16

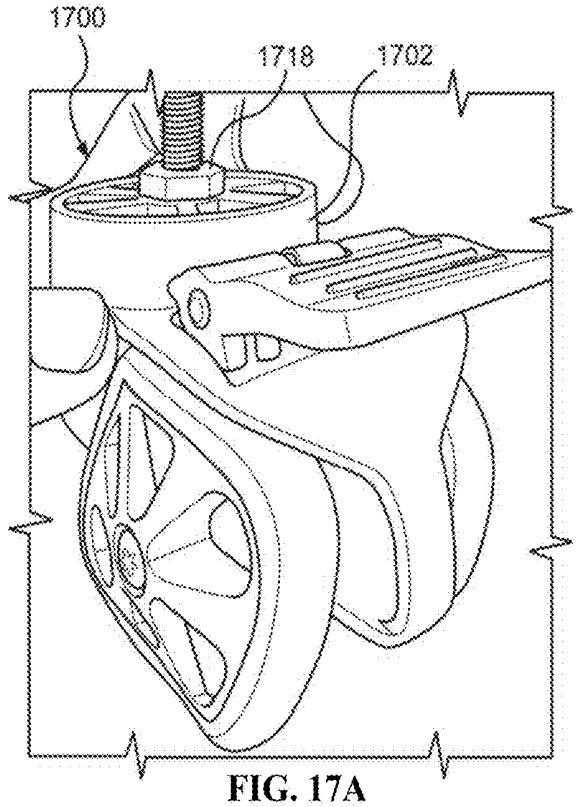


FIG. 17A

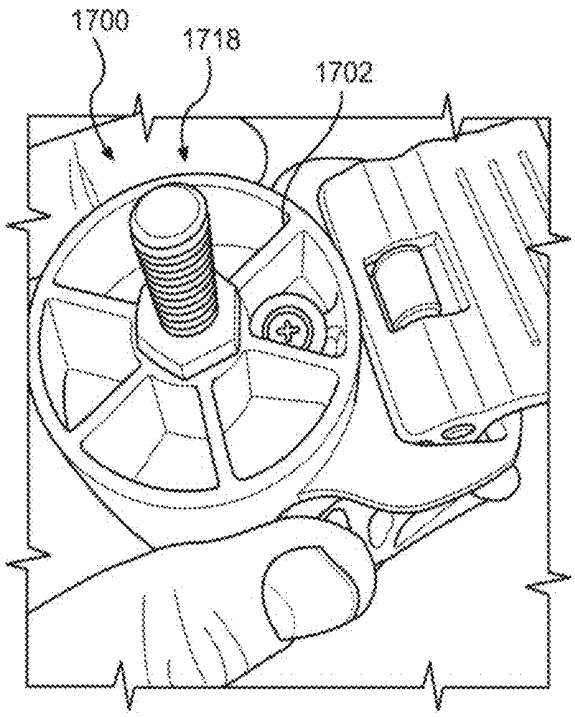
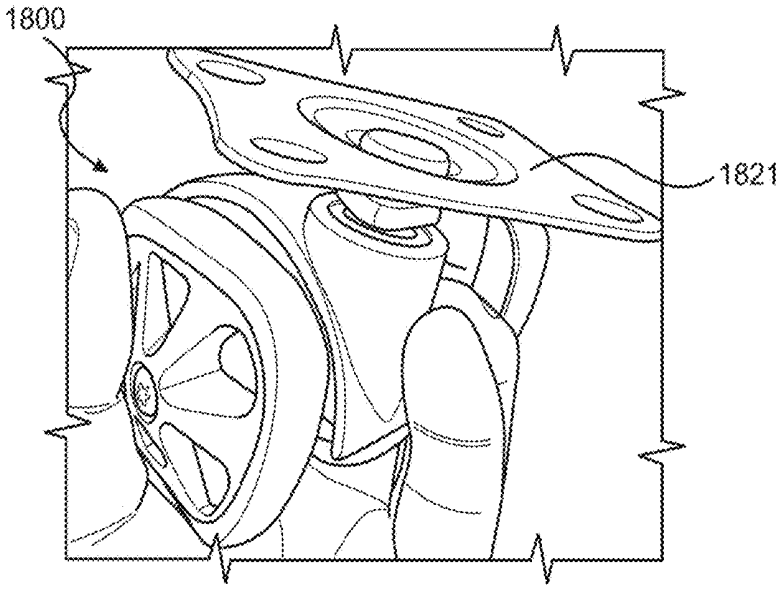


FIG. 17B



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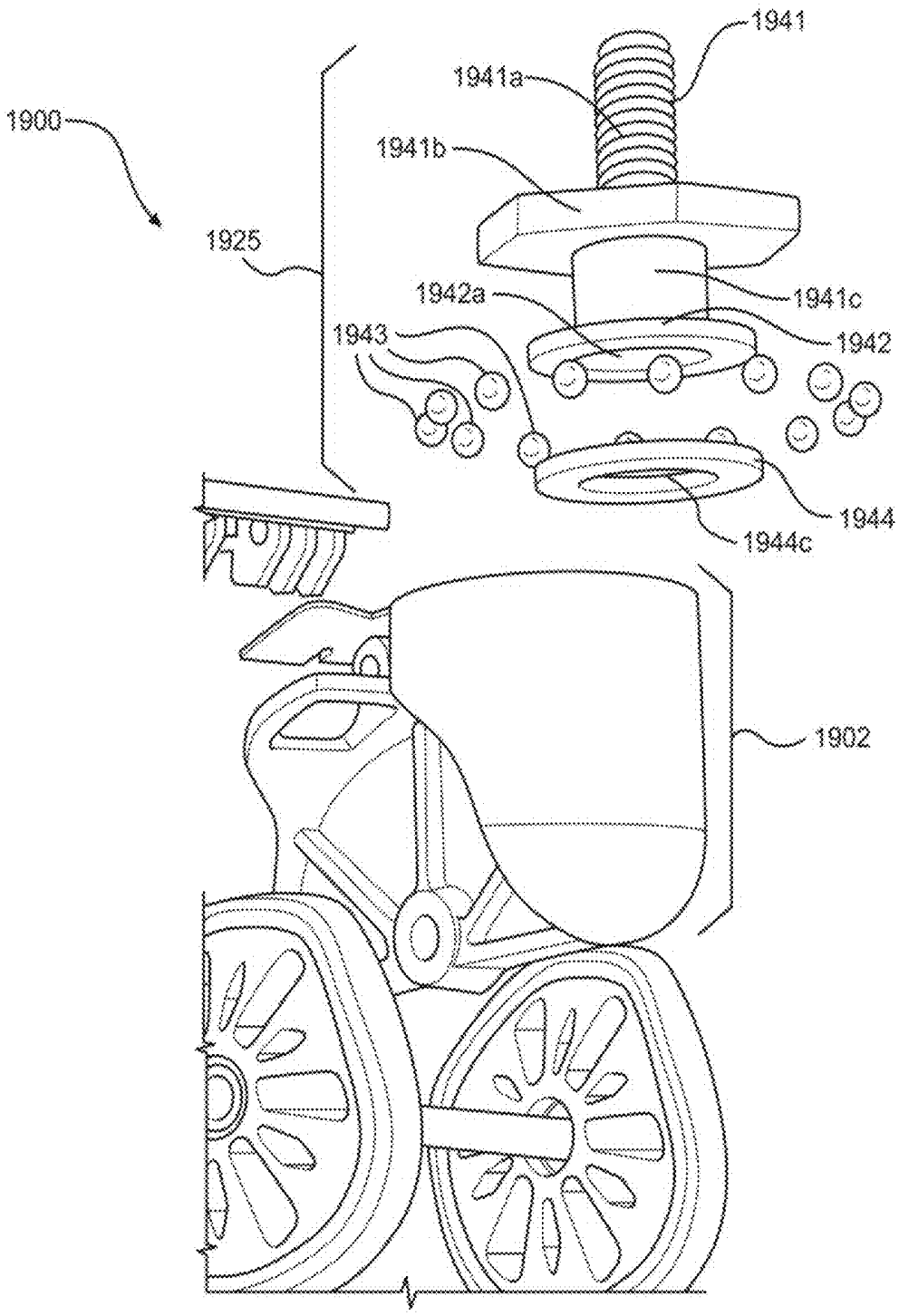
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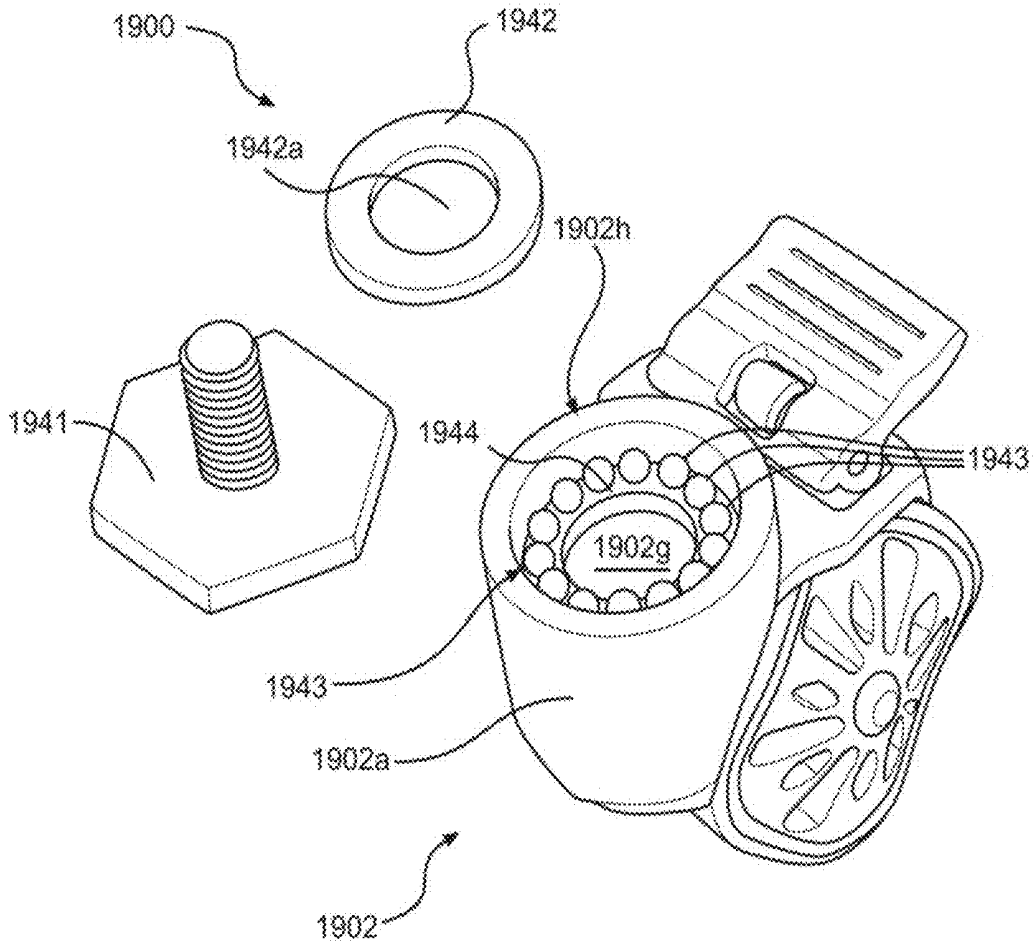
FIG. 19A



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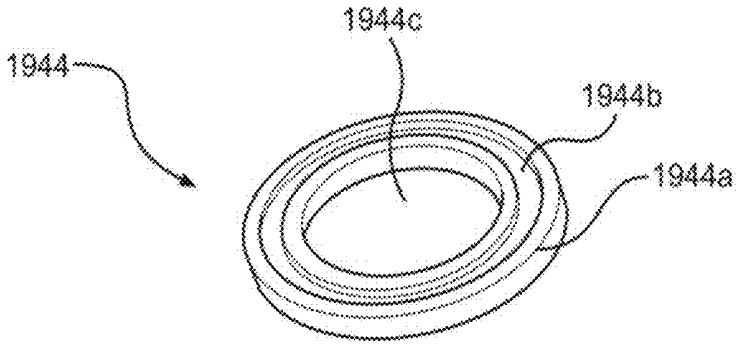

FIG. 19C

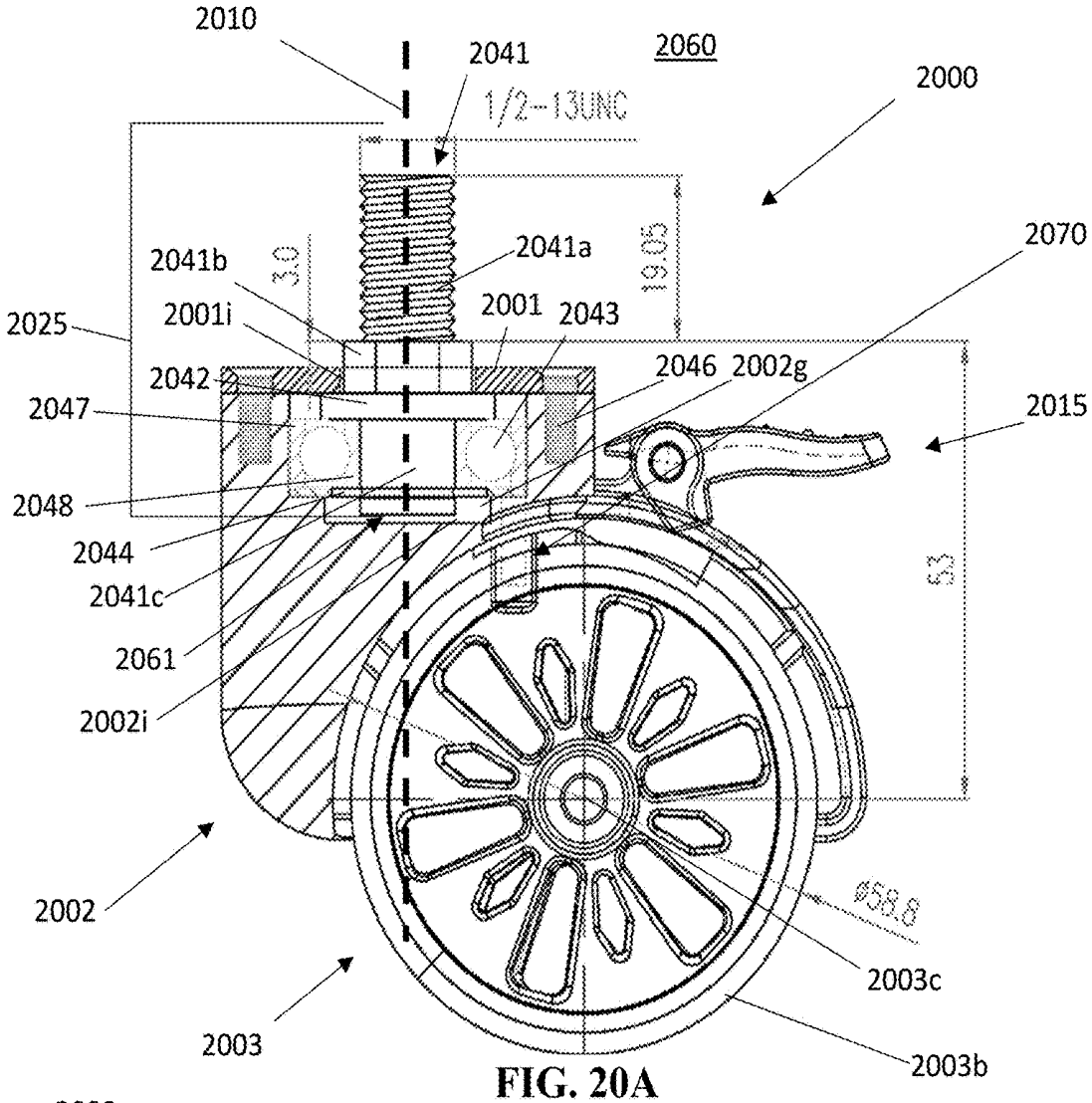

FIG. 20A

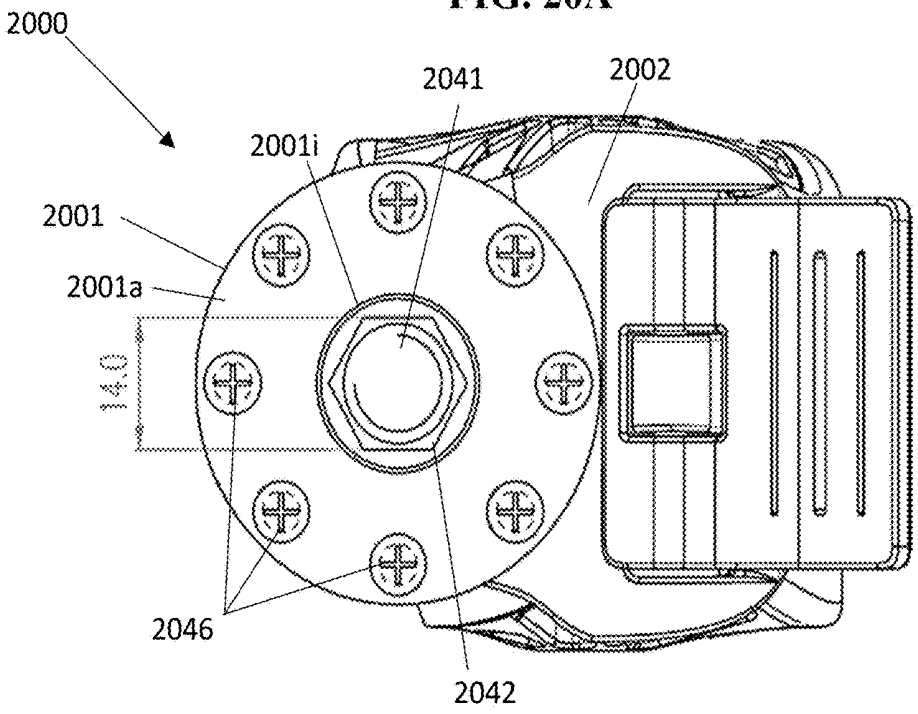

FIG. 20B

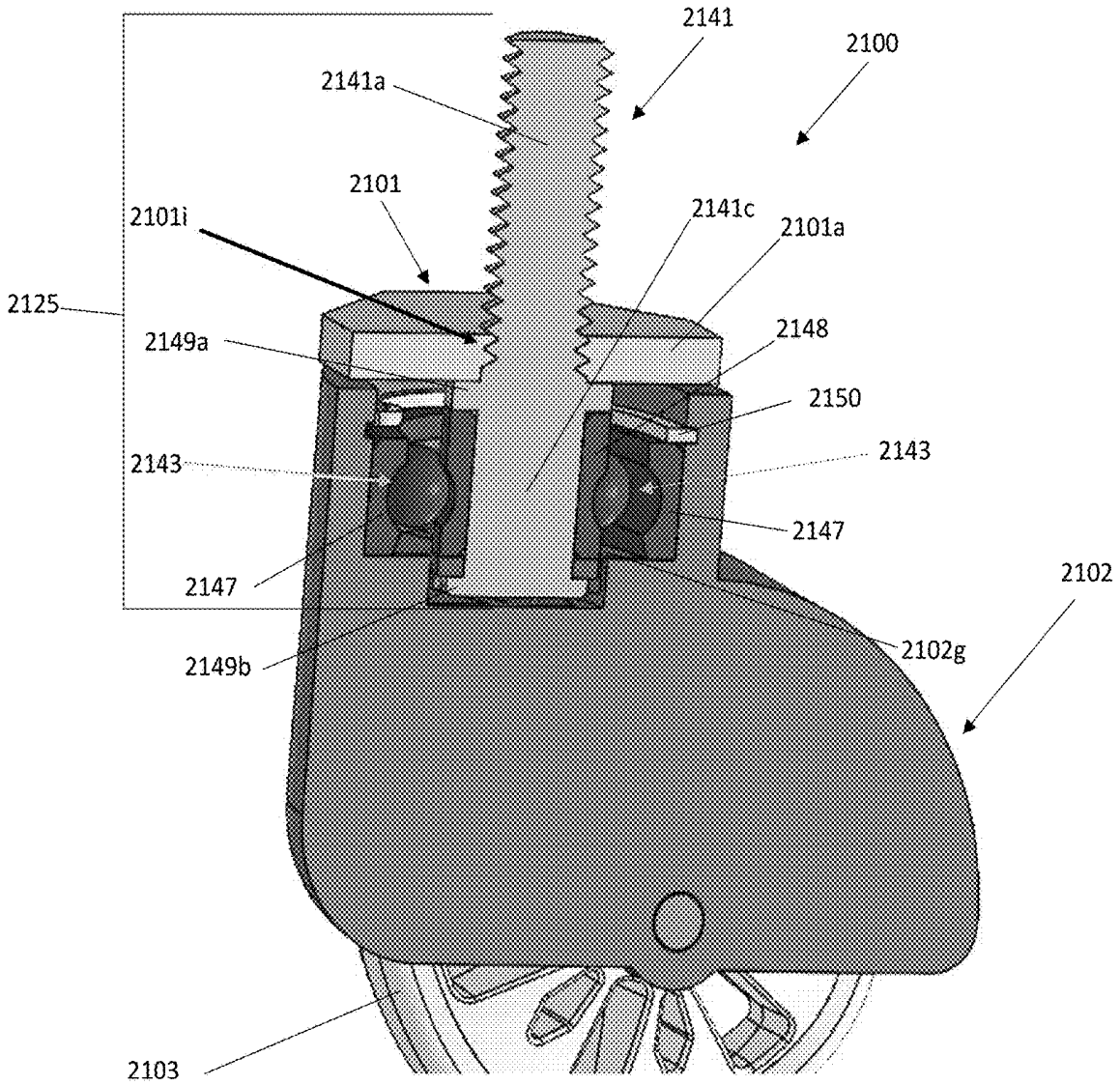
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FIG. 21

CASTER ASSEMBLY HAVING SINUSOIDAL WHEELS

BACKGROUND OF INVENTION

1. Field of the Invention

The invention relates generally to casters and specifically to caster assemblies having sinusoidal wheels.

2. Description of the Related Art

Casters and similar wheel based technologies are often placed on the bottoms of supported structures, such as tables, workbenches, etc. in order to allow a user to selectively move the supported structures around via rolling, while reducing the amount of strain and effort required to do so. Conventional casters may utilize common cylindrical wheels to facilitate the rolling of said supported structure, however, such technologies may have several notable limitations. For example, standard, cylindrical wheels may exhibit a notable resistance to being rolled, particularly if a significant amount of weight is being applied on them by the supported structure. Additionally, the flat profile of a standard cylindrical wheel may result in a significant amount of frictional resistance being exerted on said wheel while being swiveled, thus increasing wheel wear and the force required to swivel the caster to change the travel direction of the supported structure.

Therefore, there is a need to solve the problems described above by proving a device and method for a caster assembly configured to reduce the amount of resistance experienced while rolling and swiveling its wheels through the utilization of sinusoidally shaped wheels disposed at an offset angle.

The aspects or the problems and the associated solutions presented in this section could be or could have been pursued; they are not necessarily approaches that have been previously conceived or pursued. Therefore, unless otherwise indicated, it should not be assumed that any of the approaches presented in this section qualify as prior art merely by virtue of their presence in this section of the application.

BRIEF INVENTION SUMMARY

This Summary is provided to introduce a selection of concepts in a simplified form that are further described below in the Detailed Description. This Summary is not intended to identify key aspects or essential aspects of the claimed subject matter. Moreover, this Summary is not intended for use as an aid in determining the scope of the claimed subject matter.

In an aspect, a caster assembly is provided, the caster assembly comprising: a pivot hub configured to be engaged with a supported structure, the pivot hub comprising: a pivot shaft configured to be engaged with the supported structure; and a plurality of ball bearings configured to be engaged with the pivot shaft; a caster leg configured to be engaged with the pivot hub, such that the caster leg is pivotally engaged with the supported structure and configured to pivot about a pivot axis, the caster leg having: a vertical member configured to be coaxially aligned with the pivot axis; a caster leg cavity nested within the vertical member, wherein each ball bearing of the plurality of ball bearings is configured to be nested within the caster leg cavity; and an angled member associated with the vertical member, the angled member being coaxially aligned with an offset axis, wherein the angled member engages with the vertical member such that an offset angle is formed between the pivot axis and the offset axis; a top cap associated with the caster leg, wherein the top cap is configured to cover the caster leg cavity; a pair of sinusoidal wheels configured to be rotationally engaged with the angled member of the caster leg, such that each sinusoidal wheel of the pair of sinusoidal wheels is configured to rotate independently about a wheel rotational axis, each sinusoidal wheel of the pair of sinusoidal wheels having: a wheel hub configured to be rotationally engaged with the angled member of the caster leg; and a rim configured to surround and be engaged with the wheel hub, the rim having: a pair of lateral edges; and a rim center engaged with and equidistantly disposed between the pair of lateral edges, wherein the rim center of each sinusoidal wheel of the pair of sinusoidal wheels follows a sinusoidal pattern around a circumference of the sinusoidal wheel, the sinusoidal pattern having a sinusoidal amplitude and sinusoidal frequency, wherein the rim center of each sinusoidal wheel of the pair of sinusoidal wheels is configured to be coaxially aligned with the wheel rotational axis. Thus, an advantage is that the amount of resistance experienced when rolling the sinusoidal wheels of the caster assembly is reduced, compared to the amount of resistance experienced when rolling a comparable caster assembly having standard, cylindrical wheels. Another advantage is that the resistance experienced while swiveling the caster assembly having sinusoidal wheels is less than when the resistance experienced while swiveling the caster having standard, cylindrical wheels, for wheels with rims having equivalent surface area. Another advantage is that each sinusoidal wheel of the pair of sinusoidal wheels may be configured to rotate independently of the other sinusoidal wheel, such that the caster assembly may be configured to perform tight pivots within a small area, thus aiding the maneuverability of the supported object. Another advantage is that the caster assembly may be configured to utilize a heavy load pivot hub to allow the caster leg to remain easily pivotable about the supported structure, even for heavier supported structures.

In another aspect a caster assembly is provided, the caster assembly comprising: a pivot hub configured to be engaged with a supported structure; a caster leg configured to be engaged with the pivot hub, such that the caster leg is pivotally engaged with the supported structure and configured to pivot about a pivot axis, the caster leg having: a vertical member configured to be coaxially aligned with the pivot axis; and an angled member associated with the vertical member, the angled member being coaxially aligned with an offset axis, wherein the angled member engages with the vertical member such that an offset angle is formed between the pivot axis and the offset axis; a pair of sinusoidal wheels configured to be rotationally engaged with the angled member of the caster leg, such that each sinusoidal wheel of the pair of sinusoidal wheels is configured to rotate about a wheel rotational axis, each sinusoidal wheel of the pair of sinusoidal wheels having: a rim configured to be pivotally engaged with the angled member of the caster leg, the rim having: a pair of lateral edges; and a rim center engaged with and equidistantly disposed between the pair of lateral edges, wherein the rim center of each sinusoidal wheel of the pair of sinusoidal wheels follows a sinusoidal pattern around a circumference of the sinusoidal wheel, the sinusoidal pattern having a sinusoidal amplitude and sinusoidal frequency, wherein the rim center of each sinusoidal wheel of the pair of sinusoidal wheels is configured to be coaxially aligned with the wheel rotational axis. Again, an

advantage is that the amount of resistance experienced when rolling the sinusoidal wheels of the caster assembly is reduced, compared to the amount of resistance experienced when rolling a comparable caster assembly having standard, cylindrical wheels. Another advantage is that the resistance experienced while swiveling the caster assembly having sinusoidal wheels is less than when the resistance experienced while swiveling the caster having standard, cylindrical wheels, for wheels with rims having equivalent surface area. Another advantage is that each sinusoidal wheel of the pair of sinusoidal wheels may be configured to rotate independently of the other sinusoidal wheel, such that the caster assembly may be configured to perform tight pivots within a small area, thus aiding the maneuverability of the supported object. Another advantage is that the caster assembly may be configured to utilize a heavy load pivot hub to allow the caster leg to remain easily pivotable about the supported structure, even for heavier supported structures.

In another aspect, a caster assembly is provided, the caster assembly comprising: a caster leg configured to be pivotally engaged with a supported structure, wherein the caster leg is configured to pivot about a pivot axis, the caster leg having: a vertical member configured to be coaxially aligned with the pivot axis; and an angled member associated with the vertical member, the angled member being coaxially aligned with an offset axis, wherein the angled member engages with the vertical member such that an offset angle is formed between the pivot axis and the offset axis; at least one sinusoidal wheel configured to be rotationally engaged with the angled member of the caster leg, such that the at least one sinusoidal wheel is configured to rotate about a wheel rotational axis, wherein a rim of the at least on sinusoidal wheel follows a sinusoidal pattern around a circumference of the sinusoidal wheel, the sinusoidal pattern having a sinusoidal amplitude and sinusoidal frequency. Again, an advantage is that the amount of resistance experienced when rolling the sinusoidal wheels of the caster assembly is reduced, compared to the amount of resistance experienced when rolling a comparable caster assembly having standard, cylindrical wheels. Another advantage is that the resistance experienced while swiveling the caster assembly having sinusoidal wheels is less than when the resistance experienced while swiveling the caster having standard, cylindrical wheels, for wheels with rims having equivalent surface area. Another advantage is that each sinusoidal wheel of the pair of sinusoidal wheels may be configured to rotate independently of the other sinusoidal wheel, such that the caster assembly may be configured to perform tight pivots within a small area, thus aiding the maneuverability of the supported object. Another advantage is that the caster assembly may be configured to utilize a heavy load pivot hub to allow the caster leg to remain easily pivotable about the supported structure, even for heavier supported structures.

The above aspects or examples and advantages, as well as other aspects or examples and advantages, will become apparent from the ensuing description and accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

For exemplification purposes, and not for limitation purposes, aspects, embodiments or examples of the invention are illustrated in the figures of the accompanying drawings, in which:

FIG. **1** illustrates the front perspective view of a caster assembly having sinusoidal wheels, according to an aspect.

FIGS. **2**A-**2**F illustrate the front elevation, rear elevation, left side elevation, right side elevation, top plan and bottom plan views, respectively, of a caster assembly having sinusoidal wheels, according to an aspect.

FIG. **3** illustrates the exploded, front perspective view of a caster assembly having sinusoidal wheels, according to an aspect.

FIGS. **4**A-**4**C illustrate the front perspective, front elevation and side elevation views, respectively of a sinusoidal wheel, according to an aspect.

FIG. **5** illustrates the front perspective view of a pivot pin, according to an aspect.

FIG. **6** illustrates the front perspective view of a wheel axle, according to an aspect.

FIG. **7** illustrates the front perspective view of an axle washer, according to an aspect.

FIGS. **8**A-**8**B illustrate the front perspective and bottom perspective views, respectively, of the caster leg, according to an aspect.

FIGS. **9**A-**9**B illustrate the top perspective and the bottom perspective views, respectively, of a top cap, according to an aspect.

FIG. **10** illustrates the side perspective view of an alternative embodiment of the disclosed caster assembly secured to the leg of a structure, according to an aspect.

FIG. **11** illustrates the side perspective view of an alternative embodiment of the caster assembly without the top cap, according to an aspect.

FIG. **12** illustrates the side perspective view of an alternative embodiment of the caster assembly having an octagonal top cap, according to an aspect.

FIG. **13** illustrates the front perspective view of a caster assembly engaged with a suitcase, according to an aspect.

FIG. **14** illustrates a front elevation view of grip ring stem embodiment of the pivot pin, according to an aspect.

FIG. **15** illustrates a front elevation view of a threaded stem embodiment of the pivot pin, according to an aspect.

FIG. **16** illustrates the top plan view of a flat plate embodiment of the top cap, according to an aspect.

FIG. **17**A-**17**B illustrate the rear perspective and top perspective views, respectively, of a caster assembly having a threaded stem, according to an aspect.

FIG. **18** illustrates the rear perspective view of a caster assembly having a flat plate, according to an aspect.

FIG. **19**A illustrates an exploded side perspective view of a caster assembly having enhanced load bearing capabilities, according to an aspect.

FIG. **19**B illustrates an exploded top perspective view of a caster assembly having enhanced load bearing capabilities, according to an aspect.

FIG. **19**C illustrates a top perspective view of a retainer ring, according to an aspect.

FIG. **20**A illustrates the side elevation cross-sectional view of an alternative caster assembly having enhanced load bearing capabilities, according to an aspect.

FIG. **20**B illustrates the top plan view of an alternative caster assembly having enhanced load bearing capabilities, according to an aspect.

FIG. **21** illustrates a side perspective cross-sectional view of an alternative caster assembly having enhanced load bearing capabilities, according to an aspect.

DETAILED DESCRIPTION

What follows is a description of various aspects, embodiments and/or examples in which the invention may be

practiced. Reference will be made to the attached drawings, and the information included in the drawings is part of this detailed description. The aspects, embodiments and/or examples described herein are presented for exemplification purposes, and not for limitation purposes. It should be understood that structural and/or logical modifications could be made by someone of ordinary skills in the art without departing from the scope of the invention. Therefore, the scope of the invention is defined by the accompanying claims and their equivalents.

It should be understood that, for clarity of the drawings and of the specification, some or all details about some structural components or steps that are known in the art are not shown or described if they are not necessary for the invention to be understood by one of ordinary skills in the art.

For the following description, it can be assumed that most correspondingly labeled elements across the figures (e.g., **102** and **202**, etc.) possess the same characteristics and are subject to the same structure and function. If there is a difference between correspondingly labeled elements that is not pointed out, and this difference results in a non-corresponding structure or function of an element for a particular embodiment, example or aspect, then the conflicting description given for that particular embodiment, example or aspect shall govern.

FIG. **1** illustrates the front perspective view of a caster assembly ("caster") **100** having sinusoidal wheels **103**, according to an aspect. The herein disclosed caster assembly **100** of FIG. **1** may be configured to utilize a pair of sinusoidal wheels **103** in conjunction with specially arranged caster elements in order to facilitate easy rolling of a supported structure and selective swiveling of each caster assembly **100** as the structure travels in different directions. The caster assembly **100** may comprise a top cap **101**, a caster leg **102**, a pivot pin, such as pivot pin **304** of FIG. **3**, configured to pivotally engage the top cap **101** with the caster leg **102**, a pair of sinusoidal wheels **103**, a wheel axle, such as wheel axle **305** of FIG. **3**, configured to rotationally engage the pair of sinusoidal wheels **103** with the caster leg **102** and an axle washer, such as axle washer **306** of FIG. **3**, configured to engage with the wheel axle. The engagements between each element of the caster assembly **100** will be discussed in greater detail hereinbelow.

In an embodiment, the caster leg **102** may be configured to pivotally engage with the top cap **101**, such that the caster leg **102** may pivot freely about a pivot axis **110** while the top cap **101** may be irrotationally secured to a supported structure, such as a workbench or cart. Furthermore, in said embodiment, the sinusoidal wheels **103** may be configured rotate about a wheel rotational axis **113**, wherein the wheel rotational axis **113** may be perpendicular to the pivot axis **110**. While pivot axis **110** and the wheel rotational axis **113** may be perpendicular to each other, they may not occupy the same plane nor intersect each other, due to an offset angle of the caster leg **102**, such as offset angle **212** of FIG. **2**C, which will be discussed hereinbelow. This particular configuration of the caster assembly **100** having a pair of sinusoidal wheels **103** disposed at an offset angle from the pivot axis **110** may experience reduced resistance when rolling of the sinusoidal wheels **103**, when compared to a caster assembly lacking the offset angle and using standard cylindrical, thus allowing for structures or objects placed on top of these caster assemblies **100** to be rolled without requiring as much force to move it as a caster assembly lacking the sinusoidal wheels and the offset wheel rotational axis **113**. In an embodiment, the herein disclosed caster assembly **100** may experience 57% less rolling resistance when compared to a conventional caster assembly utilizing wheels having a right circular cylinder shape and lacking an offset angle, wherein said conventional caster assembly otherwise has the equivalent specifications (same contact patch surface area for the wheels, same material, etc. As a result of the shape of the sinusoidal wheels, said sinusoidal wheels **103** may be able to, in certain situations, begin rolling after pivoting/rotating fewer degrees, when compared to conventional right circular cylindrical wheels, thus reducing the force required to pivot said sinusoidal wheels to a rollable orientation, as will be disclosed in greater detail hereinbelow.

In an embodiment, a table (not shown) having four legs may have one of the herein disclosed caster assemblies **100** attached to the bottom of each leg, for a total of four caster assemblies **100**. As the table is selectively pushed in a direction by a user, each caster assembly **100** may quickly pivot accordingly such that the sinusoidal wheels roll smoothly as the table is moved. If the user changes the movement direction of the table (e.g., changing a movement direction from left to right, for example), the caster leg **102** of each caster assembly **100** may selectively pivot about the pivot axis **110** accordingly, in order to orient the sinusoidal wheels **103** such that their wheel rotational axis **113** is perpendicular to the direction of travel, wherein said orientation allows the sinusoidal wheels **103** to roll with the least amount of resistance. Furthermore, an offset angle, such as offset angle **212** of FIG. **2**C, may be formed between the portion of the caster leg **102** attached to the sinusoidal wheels **103** and the portion of the caster leg **102** pivotally engaged with the top cap **101** on the pivot axis **110**. Said offset angle, as well as the utilization of sinusoidal shaped wheels **103**, may ensure optimized caster performance (e.g. minimized resistance to rolling the sinusoidal wheels **103**, minimized resistance to pivoting the caster leg **102** and the attached sinusoidal wheels **103**) while moving a supported structure.

FIGS. **2**A-**2**F illustrate the front elevation, rear elevation, left side elevation, right side elevation, top plan and bottom plan views, respectively, of a caster assembly **200** having sinusoidal wheels **203-1**, **203-2**, according to an aspect. As disclosed hereinabove, the top cap **201** of a caster assembly **200** may be configured to engage directly with a portion of a supported structure (not shown), while also being pivotally engaged with the caster leg **202**, such that the attached sinusoidal wheels **203-1**, **203-2** are pivotally engaged with the supported structure. From the front elevation view of FIG. **2**A, the pivot axis **210** and wheel rotational axis **213** may be shown as being perpendicular to each other (e.g., forming a 90 degree angle between each other, from the viewed perspective), but not intersecting (not occupying a shared plane). As can be seen in FIG. **2**C, while a vertical member **202***a* of the caster leg **202** may be coaxially aligned with the pivot axis **210**, an angled member **202***b* of the caster leg **202** may be bent at an offset angle **212** to the pivot axis **210**, such that the angled member **202***b* of the caster leg **202** is coaxially aligned with an offset axis **211**. As such, an offset angle **212** may be formed between pivot axis **210** and the offset axis **211**. This offset angle **212** may help to maintain the pivoting function of the caster leg **202** and rotating function of the sinusoidal wheels **203-1**, **203-2**, even when supporting greater weights.

The top cap **201** may include several features that allow it to facilitate a secure engagement between the supported structure and the caster leg **202**, wherein the caster leg **202** is pivotally engaged with the supported structure. The top

cap **201** may comprise a cap body **201***a* having a first raised edge **201***b* and a second raised edge **201***c*, wherein the first raised edge **201***b* and a second raised edge **201***c* form a continuous raised rim **201***e* around a front end **201***h* of the cap body **201***a*. In an embodiment, the top cap **201** may be symmetrical, while in an alternative embodiment, the top cap **201** may be asymmetrical. The disclosed caster assembly embodiment **200** of FIG. **2**A-**2**F may be configured to engage with a suitcase, such as suitcase **1319** of FIG. **13**, wherein the top cap **201** is configured to securely engage with the bottom corner of a suitcase to enable enhanced maneuverability of said suitcase. The top cap **201** may have any suitable shape, as long as said top cap **201** facilitates secure, pivotal engagement between the supported structure and the caster leg **202**. In an embodiment, a plurality of fastening pockets **201***d* may be nested within the cap body **201***a*, wherein each fastening pocket **201***d* may be configured to aid engagement of the caster assembly **200** with the supported structure, such as the suitcase **1319** of FIG. **13**. It should be understood that the shape and structure of the top cap **201** may be configured to facilitate secure engagement between the top cap **201** and a supported structure.

The disclosed caster assembly **200** embodiment of FIGS. **2**A-**2**F may utilize two sinusoidally shaped wheels **203-1**, **203-2** to facilitate rolling of the caster; a first sinusoidal wheel **203-1** and a second sinusoidal wheel **203-2**. It should be understood that other quantities of wheels may also be utilized within the disclosed caster assembly while remaining within the scope of the application. As will be discussed in greater detail hereinbelow, the "sinusoidal" aspect of the sinusoidally shaped wheels **203-1**, **203-2** may relate to the shape of their rims, such as rim **403***b*, of FIG. **4**B.

As can be seen in FIG. **2**F, the particular shape of the sinusoidal wheels **203-1**, **203-2** may be configured to allow for easy directional changes of the caster leg **202**, and thus directional changes of the supported object, under certain conditions. In an embodiment, a caster leg **202** is facing in a current travel direction **230**. In said embodiment, the user wishes to move the supported object in an intended travel direction **231**. As a result of the sinusoidal wheels **203-1**, **203-2** having a sinusoidally shaped rim **203***b*, the rim **203***b* of each sinusoidal wheel **203-1**, **203-2** may "wave" or "reciprocate" back and forth around the circumference/outer perimeter of the corresponding sinusoidal wheel **203-1**, **203-2**, thus resulting in the rim **203***b* of each sinusoidal wheel "bending" **232** toward or away from the intended travel direction **231**.

If the sinusoidal wheels **203-1**, **203-2** are both "bending" **232** toward an intended travel direction **231**, while the user is attempting to move the supported object in said intended travel direction **231**, then the amount of scrubbing (e.g. frictional resistance) that the sinusoidal wheels **203-1**, **203-2** will experience before being able to roll in the intended travel direction **231** may be reduced, in comparison to the same scenario using conventional, right circular cylindrical wheels. In contrast, in embodiments wherein the sinusoidal wheels **203-1**, **203-2** are not already "bending" **232** in the intended travel direction **231**, scrubbing of the sinusoidal wheels **203-1**, **203-2** may still occur, but the amount of force required to scrub/pivot the sinusoidal wheels **203-1**, **203-2** until they may roll in an intended travel direction **231** may be no greater than what would be required to do the same for standard cylindrical wheels.

FIG. **3** illustrates the exploded, front perspective view of a caster assembly **300** having sinusoidal wheels **303-1**, **303-2**, according to an aspect. As disclosed hereinabove, the caster assembly **300** may comprise a top cap **301**, a caster leg **302**, a pivot pin **304** configured to pivotally engage the top cap **301** with the caster leg **302**, a first sinusoidal wheel **303-1**, a second sinusoidal wheel **303-2**, a wheel axle **305** configured to rotationally engage the first sinusoidal wheel **303-1** and the second sinusoidal wheel **303-2** with the caster leg **302**, and an axle washer **306** configured to engage with the wheel axle **305** to maintain the rotational engagement between first and second sinusoidal wheels **303-1**, **303-2** and the caster leg **302**. Each component of the caster assembly **300** and their various sub-components will be described in greater detail hereinbelow. While not visible in FIG. **3**, it should be understood that each sinusoidal wheel **303-1**, **303-2** and the caster leg **302** may each have a corresponding port, such as wheel axle port **403***c* of FIG. **4**C, for the wheel axle **305** to be nested within them (e.g. slotted through) to facilitate the rotational engagement/interconnection between said elements, and thus the rotation of the sinusoidal wheels **303-1**, **303-2** relative to the caster leg **302** and resultant rolling of the caster assembly **300**. It should be understood that the term "pivotal" may be used in describing the pivoting of caster leg **302** about the pivot axis, such as pivot axis **110** of FIG. **1**, whereas the term "rotational" may be used in describing the rotating of the sinusoidal wheels **303-1**, **303-2** about the wheel rotational axis, such as wheel rotational axis **113** of FIG. **1**.

It should be noted that the sinusoidal wheels **303-1**, **303-2** may be configured to rotate independently of each other. In an example, a first sinusoidal wheel **303-1** may be rotated clockwise, while the second sinusoidal **303-2** wheel may be rotated counterclockwise. In said example, the independent rotation of each sinusoidal wheel **303-1**, **303-2** in an opposite direction may be configured to pivot the attached caster assembly **300** in a tight radius, thus allowing the caster assembly to change directions rapidly within a small area.

While the caster leg **302** may be configured to be pivoted about its engagement with a supported structure, it should be understood that various different arrangements may be utilized in order to facilitate this pivoting of the caster leg **302** about a supported object. As seen in FIG. **3**, the caster leg **302** may be pivotally engaged with the top cap **301** by the pivot pin **304**, wherein the top cap **301** may be irrotationally engaged with a supported structure. In contrast, alternative embodiments of the caster assembly, such as caster assembly **1000** of FIG. **10**, may omit the top cap entirely, wherein the caster assembly may be pivotally engaged with the supported structure by a corresponding pivot pin. It should be understood that any suitable element(s) may be disposed between the caster leg **302** and the supported structure to facilitate pivoting of the caster leg **302** and thus the attached sinusoidal wheels **303-1**, **303-2**. As such, the element or collection of elements configured to engage with the supported structure with the caster leg **302** to facilitate pivoting of the caster leg **302** about the pivot axis, such as pivot axis **210** of FIG. **2**A, may be referred to as a pivot hub **325**. In the caster assembly **300** embodiment of FIG. **3**, the pivot hub **325** comprises a top cap and a pivot pin **304**.

FIGS. **4**A-**4**C illustrate the front perspective, front elevation and side elevation views, respectively of a sinusoidal wheel **403**, according to an aspect. The sinusoidal wheel **403** described herein should be understood to correspond to the first sinusoidal wheel **303-1** or second sinusoidal wheel **303-2** of FIG. **3**, wherein both sinusoidal wheels have the same structure. The sinusoidal wheel **403** may comprise a rim **403***b* and a wheel hub **403***a* engaged with and surrounded by the rim **403***b*, as seen in FIG. **4**A-**4**C. It should be understood that a corresponding wheel axle port **403***c* may be nested within the center of the wheel hub **403***a* to

facilitate rotational engagement of the sinusoidal wheel **403** with the aforementioned wheel axle, such as wheel axle **305** of FIG. **3**.

As seen in FIG. **4**B, the rim **403***b* may have a consistent width **403***g* around the perimeter **403***j* of the wheel hub **403***a*. The rim **403***b* may be configured to contact the ground directly as the sinusoidal wheel **403** rotates, wherein the rim **403***b* has a rim center **403***d* disposed between and engaged with a pair of lateral edges ("edges") **403***e*, **403***f*. The rim center **403***d* may remain equally offset between the first lateral edge **403***e* and the second lateral edge **403***f*, such that the axial distance between the rim center **403***d* and the first lateral edge **403***e* and the axial distance between the rim center **403***d* and the second lateral edge **403***f* are equivalent around the perimeter of the rim (e.g., for any corresponding angle of the sinusoidal wheel **403**). Furthermore, the outer diameter of the wheel rim **403***b* (as measured from the rotational axis **413**) may decrease as it approaches each lateral edge **403***e*, **403***f* of the rim **403***b* from the rim center **403***d*, thus resulting in the rims **403***b* (and thus the sinusoidal wheels **403**) having a rounded profile, and thus a smaller contact surface **403***k* that touches the ground, as seen in FIG. **4**B, making the sinusoidal wheel **403** easier to pivot. In contrast, a sinusoidal wheel having a flat profile, and thus a larger contact surface **403***k*, would have a wheel rim with a uniform outer diameter.

It should be understood that the "profile" of the sinusoidal wheel **403** is referring to the general shape of the wheel rim surface that contacts (or is otherwise adjacent to) the ground, as viewed from in front of or behind the wheel **403**, as seen in FIG. **4**B, wherein the profile of the wheel influences the width (and thus the area) of the contact surface ("contact patch") **403***k* that directly contacts the ground while rolling. In an embodiment, a sinusoidal rim **403***b*/sinusoidal wheel **403** with a more rounded profile may have a contact surface **403***k* with a smaller area, as will be discussed hereinbelow.

It should be understood that the profile of a sinusoidal wheel **403** may be adjusted, depending on the desired properties of the sinusoidal wheel **403**. In an embodiment, the profile of the sinusoidal wheel **403** may be more rounded, such that the wheel rim **403***b* has a smaller area contact surface **403***k* that directly touches the ground. In said rounded profile embodiment, the lesser area of the contact surface **403***k* may result in a greater PSI (pounds per square inch) being exerted upon the ground, but easier swiveling due to the reduced frictional resistance. In an alternative embodiment, a profile of a sinusoidal wheel **403** may be flatter, such that the wheel rim **403***b* has a larger contact surface **403***k* that directly touches the ground. In said flat profile embodiment, the greater area of the contact surface **403***k* may result in a lesser PSI being exerted upon the ground, but more difficult swiveling, due to the increased frictional resistance between the wheel rim **403***b* and the floor. As such, in an embodiment, a caster assembly configured to minimize rolling resistance may utilize sinusoidal wheels with a more rounded profile.

It should be understood that the "axial distances" described herein refer to the distance between corresponding elements as measured in the direction of/along the wheel rotational axis **413**, as seen by the width **403***g* of the rim **403***b*. In an embodiment, the lateral edges **403***e*, **403***f* of the rim **403***b* may be mutually laterally offset to maintain the consistent width **403***g* of the rim **403***b*. In other words, a separation distance between the pair of lateral edges **403***e*, **403***f* of each rim may be configured to be consistent around a circumference of the corresponding rim **403***b*.

In an embodiment, each sinusoidal wheel **403** may be identified as "sinusoidal" as a result of their rim center **403***d* reciprocating back and forth on the wheel rotational axis **413** around the wheel rim **403***b*, as shown in FIG. **4**B. In other words, the wheel rim **403***b* may execute/follow, or otherwise form, a continuous, sinusoidal curve/pattern around the perimeter **403***j* of the wheel hub **403***a*, wherein said continuous, sinusoidal curve has a sinusoidal frequency (thus executing a set amount of sinusoidal periods around the wheel hub **403***a*) and a sinusoidal amplitude. In essence, the rim center **403***d* may follow a sine curve having an amplitude (e.g., axial distance or displacement along wheel rotational axis **413**), said amplitude having a maximum intensity/displacement and a minimum intensity/displacement that it smoothly transitions between as it continuously wraps around the circumference/outer perimeter **403***j* of the wheel hub **403***a*. The quantity of sinusoidal periods executed by the rim center **403***d*, and thus the wheel rim **403***b* may be any suitable whole number, such as 2 periods, such that the sinusoidal pattern is continuous and uninterrupted as it travels around the perimeter **403***j* of the rim **403***b*. As a result of each lateral edge **403***e*, **403***f* being equally offset from the rim center **403***d*, each lateral edge **403***e*, **403***f* may also follow a corresponding sinusoidal curve. It should be understood that sinusoidal curves of the lateral edges **403***e*, **403***f* may be "in phase" with the sinusoidal curve of the rim center **403***d*, such that the peaks (maximums) and troughs (minimums) of each sinusoidal curve are disposed on the same radial position on the sinusoidal wheel **403**. Furthermore, the sinusoidal curves of the lateral edges **403***e*, **403***f* and rim center **403***d* of the rim **403** may be coaxially aligned on the wheel rotational axis, as seen in FIG. **4**B.

The sinusoidal wheels **403** may provide several benefits when implemented within the herein disclosed caster assembly. The sinusoidal wheels **403** may experience less resistance to being rolled when compared to standard cylindrical wheels (e.g., wheels that do not have a rim center that executes/follows a sinusoidal pattern), which may be very helpful for maintaining the ability to roll the sinusoidal wheels **403** to move a supported structure, particularly for heavier supported structures that may require significantly more force to move. Additionally, the disclosed sinusoidal wheels **403** may be configured to pivot/change their travel direction more easily, as a result of the sinusoidally wheels **403** potentially "bending" in an intended travel direction, as described hereinabove. The shape of the sinusoidal wheel **403**, and thus the resultant shape of the sinusoidal wheel rim **403***b*, may result in each sinusoidal wheel **403** experiencing less "scrubbing" or frictional resistance as each sinusoidal wheel **403** is pivoted, when compared to the shape of a traditional right circular cylindrical wheel having flat, planar rim edges. The utilization of sinusoidal wheels **403** within each herein disclosed caster assembly may also allow a user to change the direction a supported structure is moving by pivoting each caster with less force than would be required if standard cylindrical wheels were utilized for the caster assembly.

FIG. **5** illustrates the front perspective view of a pivot pin **504**, according to an aspect. As disclosed hereinabove, the pivot pin **504** may be configured to facilitate pivotal engagement between the top cap and the caster leg, such as top cap **101** and caster leg **102** of FIG. **1**. The pivot pin **504** may comprise a pin body **504***a*, a support ring **504***b* disposed above and associated with the pin body **504***a*, a pin top **504***c* disposed above and associated with the support ring **504***b* and a rivet head **504***d* disposed below and associated with the pin body **504***a*. In an embodiment, the rivet head **504***d*

and pin body **504***a* may be configured to nest within caster leg, whereas the pin top **504***c* may be configured to nest within the top cap, such that the top cap rests upon support ring **504***b*.

As can be seen in FIG. **5**, the rivet head **504***d* and the support ring **504***b* may have a greater thickness (e.g. diameter) than the pin body **504***a* to facilitate secure engagement with the caster leg and supporting of the top cap, respectively. The thickness of the pin body **504***a* may narrow slightly as it approaches the rivet head **504***d*, in order to make it easier to nest the rivet head **504***d* within the corresponding port of the caster leg. The pin top **504***c* may have the same outer diameter as the pin body **504***a*, thus allowing said pin top **504***c* to be nested within the corresponding port of the top cap, as will be described in greater detail hereinbelow. In an embodiment, a pin slot **504***e* may be nested within the pin top **504***c* to improve engagement between the top cap and the pivot pin **504**.

FIG. **6** illustrates the front perspective view of a wheel axle **605**, according to an aspect. As disclosed hereinabove, the wheel axle **605** may be configured to engage with the caster leg and rotationally engage with the sinusoidal wheels, such as caster leg **302** and sinusoidal wheels **303-1**, **303-2** of FIG. **3**. In order to facilitate this described rotation of the sinusoidal wheels, the wheel axle **605** may be configured to be nested within the wheel axle port of each sinusoidal wheel, such as wheel axle port **403***c* of FIG. **4**C, as well as nested within the leg axle port of the caster leg, such as leg axle port **802***d* of caster leg **802** of FIG. **8**B. It should be understood that wheel axle **605** may be configured such that upon being nested within each wheel axle port and nested within the leg axle port that each wheel axle port and the leg axle port may be coaxially aligned on the wheel rotational axis.

The wheel axle **605** may comprise an axle body **605***a*, a textured surface **605***b* disposed on the axle body **605***a*, an end cap **605***c* disposed on a first end of the axle body **605***a* and a leading end **605***d* disposed on a second end of the axle body **605***a*. In an embodiment, the wheel axle **605** may have a hollow center portion **605***e* nested within the axle body **605***a* to reduce its weight and use less material. The leading end **605***d* may be configured to slide through each of the corresponding wheel axle ports and the leg axle port to facilitate engagement of the wheel axle **605** with each sinusoidal wheel and the caster leg. The end cap **605***c* may have a diameter greater than that of the wheel axle ports and the leg axle port such that the end cap **605***c* itself is not configured to nest within any wheel or leg axle ports. Instead, the end cap **605***c* may be configured to prevent one of the sinusoidal wheels from sliding off of the wheel axle **605** upon being rotationally engaged with the caster leg, by virtue of the corresponding sinusoidal wheel being disposed between the caster leg and the end cap **605***c*. The other wheel may be secured to the wheel axle **605** through the utilization of an axle washer, such as axle washer **706** of FIG. **7**, or another suitable axle capping structure, as will be described hereinbelow. As such, the leading end **605***d* may be disposed on the opposite side of the wheel axle **605** as the end cap **605***c*, thus preventing either wheel from disengaging with the wheel axle **605**.

In an embodiment, the textured surface **605***b* of the wheel axle **605** may be disposed on a central portion of the axle body **605***a*, such that upon construction of the caster assembly via insertion of the wheel axle **605** through the corresponding axle ports, that the textured surface **605***b* is engaged directly with the leg axle port of the caster leg, such as leg axle port **802***d* of caster leg **802** of FIG. **8**B. By securing the textured surface **605***b* of the wheel axle **605** to the caster leg, the wheel axle **605** itself may not rotate about its engagement with the caster leg, but the attached sinusoidal wheels may still be configured to rotate about their rotational engagement with the wheel axle **605**, as intended. As such, the textured surface **605***b* of the axle **605** may itself function as a stopper, thus preventing the axle **605** from sliding out of the leg axle port, thus ensuring the sinusoidal wheels remain rotationally affixed to the axle **605**. The axle body **605***a* may have a smooth, low friction finish, as well as a slightly lesser diameter than the wheel axle ports of each sinusoidal wheel, thus allowing each sinusoidal wheel to rotate freely about its engagement with the wheel axle **605** with minimal resistance, thus facilitating the smooth rolling of the sinusoidal wheels of the associated caster assembly.

In an embodiment, in order to maintain a more affordable price for the caster assembly, said wheel axle **605** may engage directly with the caster leg without the utilization of a corresponding wheel axle bearing (not shown). However, in alternative embodiments in which caster performance is to be optimized, it may be desirable to implement a wheel axle bearing within the structure of the caster assembly to enable smoother, lower friction rolling of the wheels. In an embodiment, a wheel axle bearing may be nested within the leg axle port of the caster leg, such as leg axle port **802***d* of FIGS. **8**A-**8**B, wherein the wheel axle **605** would thusly be suitably engaged with said wheel axle bearing. Maintenance of the independent rolling of each sinusoidal wheel may be desirable to facilitate easy pivoting of the caster assembly, and thus each sinusoidal wheel may be configured to maintain rotational independence from the wheel axle **605**, as well as the other sinusoidal wheel.

FIG. **7** illustrates the front perspective view of an axle washer **706**, according to an aspect. In an embodiment, the axle washer **706** may have a shape roughly equivalent to that of a cylindrical ring. The axle washer **706** may be configured to engage with the traveling end of the wheel axle, such as leading end **605***d* of FIG. **6**, such that one of the two sinusoidal wheels is confined between the axle washer **706** and the caster leg, upon engagement of each wheel with the wheel axle. It should be understood that the axle washer **706** may be nested between an axle cap (not shown) and the corresponding sinusoidal wheel, wherein said axle cap may be configured to engage with the traveling end of the wheel axle upon installation of the corresponding wheel, to help prevent corresponding sinusoidal wheel from falling off of the wheel axle and further prevent the wheel axle from sliding off of the caster assembly. In this way, the axle cap may function similarly to the end cap, such as the end cap **605***c* of FIG. **6**, but for the opposite sinusoidal wheel of the pair.

In an embodiment, upon engagement of the wheel axle with the caster leg, the first sinusoidal wheel and the second sinusoidal wheel, such as wheel axle **305**, caster leg **302**, first sinusoidal wheel **303-1** and second sinusoidal wheel **303-2** of FIG. **3**, the axle washer **706** may be configured to engage with a traveling end of the wheel axle, such as leading end **605***d* of FIG. **6**. In such an embodiment, the first sinusoidal wheel may thusly be confined between the axle washer **706** and the caster leg, while being configured to rotate freely about the wheel rotational axis, whereas the second sinusoidal wheel may thusly be confined between the end cap of the wheel axle, such as end cap **605***c* of FIG. **6**, and the caster leg while also being configured to rotate freely about the wheel rotational axis. The axle washer **706** may be

configured to engage with the wheel axle through conventional engagement mechanisms, such as nesting around the wheel axle.

FIGS. **8**A-**8**B illustrate the front perspective and bottom perspective views, respectively, of the caster leg **802**, according to an aspect. The caster leg **802** may be configured to be pivotally engaged with the top cap and/or the supported structure through the utilization of a pivot pin, to facilitate pivoting of the attached sinusoidal wheels about their engagement to the supported structure, as disclosed hereinabove. The caster leg **802** may comprise a vertical member **802***a*, an angled member **802***b* attached to the vertical member **802***a*, a leg pin port **802***c* nested within the vertical member **802***a*, and a leg axle port **802***d* nested within the angled member **802***b*. As disclosed hereinabove, the leg pin port **802***c* may be configured to engage with the rivet head portion of a pivot pin, such as rivet head **504***d* of FIG. **5**, whereas the leg axle port **802***d* may be configured to have a wheel axle, such as wheel axle **305** of FIG. **3**, nested within it, wherein the wheel axle is coaxially aligned with the wheel rotational axis **813**.

The vertical member **802***a* and the angled member **802***b* may be configured to adjoin at an engagement surface **802***e*, wherein the angled member **802***b* branches off from the vertical member **802***a* at an offset angle **812** defined between the pivot axis **810** of the caster leg **802** and the offset axis **811** of the angled member **802***b*. In an embodiment, the offset axis **811** may be defined by a straight line traveling between the engagement surface **802***e* and the leg axle port **802***d*, as seen in FIG. **8**A. In an embodiment, a pair of wheel pockets **802***f* may be nested within the caster leg **802** to allow the sinusoidal wheels to be positioned beneath the vertical member **802***a*, without extending laterally away from the **810** pivot axis along the wheel rotational axis **813**. In said embodiment, the pair of wheel pockets **802***f* may be utilized to define the engagement surface **802***e* between the vertical member **802***a* and the angled member **802***b*, wherein the engagement surface **802***e* is disposed between the wheel pockets **802***f* and the vertical member **802***a*. It should be understood that the wheel pockets **802***f* themselves may be nested within the angled member **802***b*, and thus may reduce the "thickness" of the angled member **802***b* (e.g., how far the angled member **802***b* extends along the wheel rotational axis **813**.

It should be noted that while the offset angle **812** between the vertical member **802***a* and the angled member **802***b* (or more specifically, between the pivot axis **810** and the offset axis **811**) may be adjusted based on the application of the associated caster assembly, such that the caster assembly may provide better performance (e.g., less frictional resistance to rolling and pivoting) when the offset angle **812** is maintained between a certain range of suitable offset angles **812**. In an embodiment, the offset angle **812** may be an obtuse angle between 90 degrees and 180 degrees. In a preferred embodiment, the offset angle **812** may be between about 145 degrees and about 150 degrees. In a preferred embodiment, the offset angle **812** may be greater than 135 degrees but less than 180 degrees in order to ensure proper function of the caster assembly.

In an embodiment, having an offset angle **812** of less than 135 degrees may cause the attached sinusoidal wheels to tilt too far away from the pivot axis **810**. This may negatively influence the smoothness of the ride for the caster assembly (e.g. the ease with which the sinusoidal wheels roll), as a result of how the force of the supported structure is exerted upon the sinusoidal wheels. It should be understood that the offset angle **812** may be selected based upon optimizing caster performance, including ease of rolling and ease of pivoting, with the disclosed sinusoidal wheels.

FIGS. **9**A-**9**B illustrate the top perspective and bottom perspective views, respectively, of a top cap **901**, according to an aspect. As disclosed hereinabove, the top cap **901** of the caster assembly may be configured to engage with a supported structure while being pivotally engaged with the caster leg through the utilization of a pivot pin, as shown in FIG. **3**. The top cap **901** may comprise a cap body **901***a* having a first raised edge **901***b* and a second raised edge **901***c*. A raised rim **901***e* may be formed by the first and second raised edges **901***b*, **901***c* on the front end **901***h* of the top cap **901**. A plurality of fastening pocket **901***d* may be nested within the cap body **901***a* to facilitate engagement between the supported structure and the top cap **901**, as disclosed hereinabove. In an embodiment, the top cap **901** may be suitably shaped to securely engage with the supported structure, while maintaining a uniform appearance, as shown by suitcase **1319** of FIG. **13** engaging with the corresponding top cap.

In order to facilitate engagement with the pivot pin, such as pivot pin **504** of FIG. **5**, a cap pin port **901***f* may be nested within or otherwise associated with the cap body **901***a*. As disclosed hereinabove, the top cap **901** be configured to engage with the pivot pin such that the pin top of the pivot pin, such as pin top **504***c* of FIG. **5**, may be configured to nest within the cap pin port **901***f*, whereas the cap body **901***a* may be configured to rest on top of the supporting ring of the pivot pin, such as supporting ring **504***b* of FIG. **5**. It should be understood that the friction between the supporting ring and the cap body **901***a* may be minimized through the selection of suitable element materials, to ensure smooth and easy pivoting of the caster leg about its engagement with the top cap **901**, as applicable.

With regards to the materials utilized for the herein disclosed caster assembly, it should be understood that strong, lightweight, durable materials, such as plastics and metals, may be utilized for the various components of the caster assembly, unless otherwise noted. In an embodiment, each element of the caster assembly may be made out of a high-strength metal, such as steel or aluminum, in order to provide the necessary structural integrity to the caster assemblies to allow them to support a heavy supported structure, such as a tool case, while allowing said supported structures to be rolled and the caster assemblies pivoted with ease. In an embodiment, the wheel rims, such as wheel rim **403***b* of FIGS. **4**A-**4**B, may be made of a higher friction material, such as rubber, to allow the wheels to grip the floor more easily, to ensure the supported object does not slide unintentionally. In an alternative embodiment, the wheel rims **403***b* may be made of a lower friction material, such as a hard plastic to allow the wheels to pivot with less friction.

It should be understood that the wheel axle and pivot pin, such as wheel axle **305** and pivot pin **304** of FIG. **3**, may be made out of a strong, lightweight material that is configured to allow for the pivotal/rotational engagement between adjoined elements, as outlined above, with minimal friction between them, such as a metal material having a smooth external texture. In an embodiment, element materials may be selected to minimize the friction between the wheel axle and sinusoidal wheels, to ensure that the sinusoidal wheels may easily roll in a direction to move a supported object across a floor. In an embodiment, element materials may be selected to minimize the friction between the pivot pin and the top cap and caster leg, such that the caster leg may pivot freely about its pivotal engagement with the top cap/sup-

ported structure, to facilitate smooth, easy pivoting of each caster assembly when a supported structure is pushed in changing directions.

FIG. **10** illustrates the side perspective view of an alternative embodiment of the disclosed caster assembly **1000** secured to the leg **1016** of a structure, according to an aspect. As disclosed hereinabove, in order to facilitate the easy movement of a supported structure, one of the disclosed caster assemblies **1000** may be secured to a bottom portion **1016***a* of each of the supported structure's legs **1016**. By providing a caster assembly **1000** between each leg **1016** and the ground **1017**, the supported structure may be selectively moved with significantly less force than trying to drag or push the structure across the ground without caster assemblies **1000** beneath the legs **1016**.

It should be understood that, in certain embodiments, the caster assembly **1000** may omit the top cap structure, such as top cap **101** of FIG. **1**, while still pivotally engaging the caster leg **1002** with the supported structure using a corresponding pivot pin or pivot hub embodiment. In an embodiment, the caster leg **1002** may be configured to engage with the circular tubing/leg **1016** of the supported structure through the usage of a grip ring stem embodiment of the pivot pin, such as grip ring stem **1420** of FIG. **14**, or a threaded stem embodiment of the pivot pin, such as threaded stem embodiment **1518** of FIG. **15**. Regardless of the type of pivot pin or pivot hub utilized, as long as the caster leg **1002** is suitably configured to pivot about a direct or indirect engagement with the supported structure, any suitable pivot pin/pivot hub embodiment may be utilized.

The disclosed alternative embodiment of the caster assembly **1000** may also differ somewhat from the caster assembly embodiments disclosed hereinabove in FIG. **1-9**B as a result of additional features. Two additional features, including the wheel cover **1014** and a wheel lock **1015** may be implemented into the alternative caster assembly **1000** of FIG. **10**. It should be understood that elements of the prior disclosed caster assembly embodiments of FIG. **1-9**B and the hereinbelow disclosed alternative caster assembly embodiments of FIG. **10-12** may be utilized together, such that the resultant caster assembly may achieve the desired combination of functional capabilities. For example, the hereinbelow described wheel cover **1014** may be implemented within the structure of caster assembly **100** of FIG. **1**, if the corresponding functionality of said wheel cover **1014** (e.g., protecting the wheels) is desirable for an application or use-case.

In an embodiment, the caster leg **1002** of the caster assembly **1000** may further comprise a wheel cover **1014** associated with the vertical member **1002***a* of the caster leg **1002**, wherein the wheel cover **1014** is configured to surround and protect a top portion **1003***h* of each sinusoidal wheel **1003**. It should be understood that the top portion **1003***h* of each sinusoidal wheel **1003** may change as each sinusoidal wheel **1003** rolls, based on the current orientation of the sinusoidal wheel **1003**. The bottom portion **1003***i* of each sinusoidal wheel **1003** may still be configured to contact the ground **1017**, despite the presence of the wheel cover **1014**.

In addition, the alternative caster assembly of FIG. **10** may further comprise a wheel lock **1015** associated with the caster leg **1002**, or more specifically the wheel cover **1014**, wherein the wheel lock **1015** is configured to selectively engage with the sinusoidal wheels **1003** of the caster assembly **1000** to prevent them from rolling. This wheel lock **1015** may facilitate the selective prevention of sinusoidal wheel **1003** rotation by directly contacting the sinusoidal wheels **1003** when actuated. A portion of the wheel lock **1015** configured to selectively contact the sinusoidal wheels **1003** may have a high coefficient of friction, such that said portion's selective contact with said sinusoidal wheels **1003** significantly increases the amount of force required to roll the sinusoidal wheels. As such, a user may choose to disengage the wheel lock **1015** on each caster assembly **1000** before moving a corresponding supported structure, and reengage the wheel lock **1015** of each caster assembly **1000** after moving the supported structure into the desired position, thus locking said supported structure in place.

FIG. **11** illustrates the side perspective view of an alternative embodiment of the caster assembly **1100** without the top cap, according to an aspect. It should be understood that multiple variations of each element of the caster assembly **1100** may be implemented as needed for a particular application of the caster assembly **1100**. In an embodiment, the alternative caster assembly **1100** may utilize a threaded embodiment of the pivot pin **1104** having a pin top **1104***c*, wherein said pivot pin is configured to engage the caster leg **1102** directly with the supported structure. It should be understood that threads, or other known interconnection structures, may be utilized to interconnect the caster assembly elements to the supported structure as necessary, as long as the presence of said interconnection structures does not negatively impact caster functionality or performance. It should be understood that the pivotal engagement between the threaded pivot pin **1104** and the vertical member **1102***a* of the caster leg **1102** may be maintained to facilitate the necessary pivoting/swiveling action of the caster assembly **1100**. It should also be understood that the alternative embodiments of the caster assembly **1100** may utilize sinusoidal wheels **1103** as well.

As disclosed hereinabove, the element of a caster assembly **1100** configured to facilitate the pivotal engagement of the caster leg **1102** with a supported structure may be a pivot pin **1104**. As such, for the caster assembly **1100** embodiment of FIG. **11**, the pivot hub **1125** may be just a pivot pin **1104**, as the pivot pin **1104** is the structure responsible for pivotally engaging the caster leg **1102** with the supported structure.

FIG. **12** illustrates the side perspective view of an alternative embodiment of the caster assembly **1200** having an octagonal top cap **1201**, according to an aspect. In an embodiment, the shape and characteristics of the top cap **1201** may be modified as necessary in order to achieve the necessary functional capabilities and appearance. As seen in FIG. **12**, the top cap **1201** is configured to pivotally engage with the caster leg **1202** may have an octagonal shape (e.g. an octagonal cross section). This octagonally shaped top cap **1201** may be further engaged with a threaded stem **1218** embodiment of the pivot pin, wherein said threaded stem **1218** is configured to be engaged directly with the supported structure, such as leg **1016** of FIG. **10**, such that the octagonal top cap **1201** is configured to be pivotally engaged with the supported structure, along with the attached caster leg **1202**, and thus the attached sinusoidal wheels **1203**, which are also configured to pivot about the pivotal engagement between the octagonal top cap **1201** and the supported structure.

The sizing of each element, such as the length, width, height, diameter, etc. of each element, may be modified as necessary depending on the desired wheel size, offset angle, weight of the supported structure, etc. In an embodiment, the length of the vertical member **1202***a* of FIG. **12** may be longer than the length of vertical member **1102***a* of FIG. **11**. The height of the vertical member **1202***a* of a caster leg **1200** may be adjusted depending on a variety of factors, including

the desired height of the supported structure. It may be preferable to have each caster assembly **1200** configured to attach to a specific supported structure having the same specifications to ensure that supported structure remains level and rolls evenly as it is pushed. In certain embodiments, it may be desirable to attach caster assemblies having different specifications or elements to different legs of a supported structure. For example, a structure having four legs may only need two out of the four caster assemblies to include wheel locks **1215**, as the selective immobilization of the wheels **1203** two of the caster assemblies **1200** out of the four total caster assemblies may be sufficient to render a supported structure stationary as needed.

As disclosed hereinabove, the octagonal top cap **1201** may be configured to be fitted to tube-like elements such as the legs of furniture, tables, etc. In an embodiment, this fitting of the octagonal top cap **1201** to the tube-like element of the supported structure may increase the structural stability to the caster **1200**. Furthermore, having the cross-sectional shapes of directly adjoining elements be similar allows the caster assembly **1200** to pivot as described without having an overly noticeable overhang between the differing geometries of the top cap **1201**, the caster leg **1202** and the tube like element of the supported structure. For example, if an object having a square cross-section were rotated on top another object having a square cross-section, then there would be a noticeable overhang when the corner of one object was rotated to align with the middle of an edge for the other object. In contrast, for an object with an octagonal cross section, such as the octagonal top cap **1201**, rotating on top of (or beneath) an object with a circular cross section, such as the vertical member **1202***a* of the caster leg **1202** or the leg of a supported structure, the overhang between these elements will not be nearly as noticeable, thus providing a more unified, clean appearance. For the disclosed caster assembly **1200** of FIG. **12**, the pivot hub **1225** may comprise a threaded stem **1218** and an octagonal top cap **1201**, wherein the octagonal top cap **1201** is configured to engage with the caster leg **1202** and the threaded stem **1218** and the threaded stem **1218** is configured to be pivotally engaged with the supported structure.

FIG. **13** illustrates the front perspective view of a caster assembly **1300** engaged with a suitcase **1319**, according to an aspect. It should be understood that in order to facilitate secure engagement of the caster assembly **1300** with a supported structure or object, the top cap **1301** of the caster assembly **1300** may need to have a shape that is complementary to or otherwise compatible with the surface of the supported structure or object it is configured to engage with. In an embodiment, a caster assembly **1300** having a top cap **1301** equivalent to those seen in FIG. **1-9**B may be configured to engage with a suitcase **1319**, while conforming to the shape of the corner **1319***a* of said suitcase **1319**. Other casters assemblies may also have top caps configured to have a shape that is complementary to the supported structure or object that they are being engaged with, or for certain embodiments, the top cap may be omitted, and the pivot pin or equivalent pivot hub may be configured to engage directly with the supported structure, while allowing the caster leg **1302** to be pivotally engaged with the supported structure.

FIG. **14** illustrates a front elevation view of grip ring stem **1420** embodiment of the pivot pin, according to an aspect. FIG. **15** illustrates a front elevation view of a threaded stem embodiment **1518** of the pivot pin, according to an aspect. As mentioned hereinabove, various embodiments of the pivot pin may be utilized in order to facilitate the pivotal engagement of a caster assembly component with a supported structure. In embodiments lacking a top cap, an appropriate embodiment of the pivot pin, such as the grip stem **1420** of FIG. **14** or the threaded stem embodiment **1518** of FIG. **15**, may be utilized to pivotally engage the caster leg of the caster assembly to the supported structure. In said embodiments, the pivot pin embodiment may be engaged with the caster leg and the supported structure, wherein the pivot pin is pivotally engaged with caster leg and/or the supported structure to facilitate the pivoting of the caster leg about the supported structure.

In embodiments having a top cap, such as caster assembly **300** of FIG. **3** and caster assembly **1200** of FIG. **12**, the engagements made with the pivot pin embodiment may differ somewhat. As can be seen in FIG. **3**, the pivot pin **304** may be configured to engage directly with the top cap **301** and the caster leg **302**, wherein the top cap **301** was configured to be irrotationally engaged with the supported structure, such as suitcase **1319** of FIG. **13** and the pivot pin **304** is configured to be pivotally engaged with top cap **301** and/or the caster leg **302** to facilitate rotation of the caster leg **302** about the top cap **301**. In contrast, as seen in FIG. **12**, the threaded stem **1218** embodiment of the pivot pin may be engaged with the top cap and be configured to pivotally engage with the supported structures, such that the top cap **1201** rotates with the caster leg **1202** as the caster assembly **1200** is pivoted.

FIG. **16** illustrates the top plan view of a flat plate **1621** embodiment of the top cap, according to an aspect. The flat plate **1621** embodiment of the top cap may be desirable for supported structures having a flat bottom surface. The flat plate **1621** may comprise a plate body portion **1621***a* and a plurality of plate ports **1621***b* nested within the plate body portion **1621***a*. The flat plate **1621** may be configured to engage with a corresponding supported structure through the utilization of plurality of screws or other applicable fasteners, wherein said fasteners are configured to be nested within the plate ports **1621***b* and corresponding structures on the supported object, thus securing the flat plate **1621** to the supported structure. It should be understood that the flat plate **1621** may also be pivotally engaged with the caster leg through the utilization of a corresponding pivot pin, wherein the pivot pin is configured to engage with the flat plate **1621** and to pivotally engage with the caster leg, as seen in FIG. **18**.

FIG. **17**A-**17**B illustrate the rear perspective and top perspective views, respectively, of a caster assembly **1700** having a threaded stem **1718**, according to an aspect. As disclosed hereinabove, in the absence of a top cap, a caster assembly **1700** may be configured to pivotally engage with a supported structure through the use of a pivot pin, such as a threaded stem **1718**, acting as the entirety of the pivot hub. This pivot pin may be configured to pivotally engage the caster leg **1702** with a corresponding part of the supported structure that has a circular cross section, such that a unified appearance is established between the caster assembly **1700** and the supported structure.

FIG. **18** illustrates the rear perspective view of a caster assembly having a flat plate **1821**, according to an aspect. A caster assembly **1800** having a flat plate **1821** embodiment of the top cap may be configured to engage with a portion of the supported structure that has a similar cross-sectional shape. In an embodiment, for a leg of a supported structure having a square cross-sectional shape, the flat plate **1821** configured to engage with the leg of the supported structure may also have a square cross-sectional shape, as seen in FIG. **18**.

It should be understood that the particular cross-sectional shape of the caster assembly element configured to engage and coaxially align with the supported structure may be adapted to be the same (or sufficiently similar to) to the portion of the supported structure that it is configured to engage with. As seen in FIG. **10**, a top cap assembly may be omitted from the corresponding caster assembly, such that the circular cross section of the vertical member **1002***a* of the caster assembly **1000** may coaxially align with a circular cross section leg **1016** of the support structure. For support structures having legs with a square cross section (not shown), the disclosed caster assembly **1800** of FIG. **18** may be desirable, wherein its square flat plate **1821** may be suitably sized and proportioned to coaxially align with the leg of the supported structure. Alternatively, a caster assembly having an octagonal cross section top cap, such as octagonal top cap **1201** of FIG. **12**, may be configured to engage with support structure legs have octagonal, square or circular cross sectional-shapes, as said octagonally shaped top cap may be sufficiently close in shape to both square and circle cross section structures to still provide the desired appearance and performance.

FIG. **19**A illustrates an exploded side perspective view of a caster assembly having enhanced load bearing capabilities, according to an aspect. FIG. **19**B illustrates an exploded top perspective view of a caster assembly having enhanced load bearing capabilities, according to an aspect. FIG. **19**C illustrates a top perspective view of a retainer ring **1944**, according to an aspect. In order to enable the disclosed caster assembly **1900** to support a supported structure or object having a greater weight, a pivot hub **1925** configured to maintain the rotational capabilities of the caster assembly under said greater weight may be incorporated into the structure of the prior disclosed caster assemblies, such as caster assembly **1200** of FIG. **12**. It should be understood that a caster assembly **1900** having this alternative pivot hub **1925** may be described as a "heavy load caster assembly" **1900**, wherein the pivot hub **1925** itself may be described as a "heavy load pivot hub" **1925**. In addition to utilizing alternative structures, caster assemblies may also be constructed of different materials to influence load capacity. In an embodiment, versions of the caster assembly **1900** having caster assembly components (e.g., wheel hubs, caster legs, etc.) made of plastic may be configured/rated to safely support 150 lbs per caster assembly, whereas versions of the caster assembly **1900** having caster assembly components made of aluminum may be configured/rated to safely support 250 lbs per caster assembly.

As can be seen in FIG. **19**A-**19**C, the pivot hub **1925** may comprise a retainer ring **1944** configured to be nested within a caster leg cavity **1902***g*, wherein the caster leg cavity is nested or otherwise disposed within a top part **1902***h* of the vertical member **1902***a* of the caster leg **1902**, the retainer ring **1944** having a retainer ring body **1944***a* and a bearing channel **1944***b* nested within retainer ring body **1944***a*, a plurality of ball bearings **1943** configured to be seated in the bearing channel **1944***b* of the retainer ring **1944**, a pivot ring **1942** configured to be seated on top of, or otherwise engaged with, the plurality ball bearings **1943** and a pivot shaft ("pivot topper") **1941** configured to engage with a supported structure and rest upon pivot ring **1942**. The pivot hub **1925** of FIG. **19** may be configured such that the caster leg **1902** may rotate freely about its indirect engagement with the pivot shaft **1941**, by virtue of the pivot shaft **1941** being seated on top of, or otherwise engaged or associated with, a plurality of ball bearings **1943**, wherein each ball bearing of the plurality of ball bearings **1943** is configured to roll freely within the bearing channel **1944***b*.

As can be seen in the embodiment of FIG. **19**A, the pivot shaft **1941** may further comprise a plurality of elements combined into a monolithic structure. In an embodiment, the pivot shaft **1941** may further comprise a threaded rod **1941***a*, a pivot shaft nut **1941***b* engaged with and disposed below the threaded rod **1941***a*, and a pivot shaft base **1941***c* engaged with and disposed below the pivot shaft nut **1941***b*. In an embodiment, the threaded rod **1941***a* may be configured to be engaged with the supported structure, whereas the pivot shaft nut **1941***b* may be configured to be seated on or otherwise engaged with the pivot ring **1942**, such that the supported structure is configured to be pivotally engaged with the caster leg **1902**. In said embodiment, such as the caster assembly **1900** embodiment of FIG. **19**D, the pivot ring **1942** and retainer ring **1944** may both be configured to surround the pivot shaft base **1941***c*, such that the pivot shaft base **1941***c* is nested within or otherwise surrounded by an empty central opening **1942***a* of the pivot ring **1942** and an empty central opening **1944***c* of the retainer ring **1944**. The capability for the plurality of ball bearing **1943** to move within the bearing channel **1944***b* allows the pivot ring **1942**, and thus the pivot shaft **1941** resting upon the pivot ring **1942**, to be pivotally engaged with the caster leg **1902**, such that the caster leg **1902** may pivot about the supported structure.

In an embodiment, the pivot shaft nut **1941***b* may have an octagonal shape/cross-section, similarly to the top cap **1201** of FIG. **12**. In said embodiment, the pivot shaft nut **1941***b* may be sufficiently sized to cover the caster leg cavity **1902***g* disposed beneath it, such that debris and other materials may be kept out of the caster leg cavity **1902***g* to ensure proper pivotal engagement between the caster leg **1902** and the supported structure. This octagonal shape/cross-sectional shape of the pivot shaft nut **1941***b* may be configured to provide a uniform appearance for the caster leg as it pivots about the corresponding element of the supported structure, as disclosed hereinabove.

The particular configuration of the heavy load caster assembly **1900** of FIG. **19**A-**19**B is such that the weight of the supported structure is exerted evenly across the plurality of ball bearings, thus ensuring that the heavy load caster assembly may evenly support greater weights **1900** without being damaged. In the disclosed caster assembly **1900**, the weight of the supported load may be distributed over a greater surface area than if the pivot hub **1925** was engaged with the caster leg **1902** via a single rod or thread. In an embodiment, the caster leg **1902** may be irrotationally engaged with the retainer ring **1944** and the pivot shaft **1941** may be irrotationally engaged with the supported structure. As a result of the ball bearings **1943** being able to travel freely within the bearing channel **1944***b*, the pivot ring **1942** seated on top of the plurality of ball bearings **1943** may be configured to pivot about the pivot axis, such as pivot axis **2010** of FIG. **20**, thus facilitating a pivotal engagement between the pivot shaft **1941** and retainer ring **1944**. This in turn results in the pivotal engagement between the caster leg **1902** and the supported structure.

FIG. **20**A illustrates the side elevation cross-sectional view of an alternative caster assembly **2000** having enhanced load bearing capabilities, according to an aspect. FIG. **20**B illustrates the top plan view of an alternative caster assembly **2000** having enhanced load bearing capabilities, according to an aspect. As can be seen in FIG. **20**A-**20**B, the structure of this alternative caster assembly **2000** may differ somewhat from the previously described heavy load caster

assembly **1900** of FIG. **19**A-**19**B. This being said, the alternative caster assembly **2000** of FIG. **20**A-**20**B may utilize a similar heavy load pivot hub **2025**, and thus may be classified as another type of heavy load caster assembly **2000**.

The exact mechanism through which the plurality of ball bearings **2043** enable pivotal engagement between the caster leg **2002** and a supported structure may differ somewhat from the engagement mechanism described hereinabove in FIGS. **19**A-**19**B. As can be seen in FIG. **20**A, the pivot hub **2025** may further comprise of an inner gasket **2048** engaged with and surrounding the pivot shaft base **2041***c* of the pivot shaft **2041** and an outer gasket **2047** may be engaged with the caster leg **2002** and nested within the caster leg cavity **2002***g*. In an embodiment, the inner gasket **2048** may be disposed between the retainer ring **2044** and the pivot ring **2042**. In contrast to the caster assembly **1900** embodiment of FIGS. **19**A-**19**B, the plurality of ball bearings **2043** may be sandwiched/compressed or otherwise disposed between the inner gasket **2048** and the outer gasket **2047** to enable pivotal engagement between the pivot shaft **2041** (and thus the supported structure) and the caster leg **2002**. In said embodiment of FIG. **20**A, the retainer ring **2044** may not be utilized to directly seat the plurality of ball bearings **2043**, but may instead be utilized to suitably seat the inner gasket **2048** engaged with the pivot shaft **2041** such that the inner gasket **2048** may be both coaxially aligned with, and the same elevation as, the outer gasket **2047** nested within the caster leg cavity **2002***g*.

Additional structures may also be utilized within the heavy load caster assembly **2000** of FIG. **20**A-**20**B to ensure the desired look and performance for said caster assembly **2000**. Atop cap **2001** may be engaged with the caster leg **2002** by a plurality of screws **2046** to provide a covering for the caster leg cavity **2002***g*. This top cap **2001** embodiment may have a cap body **2001***a* and a cap port **2001***i* nested within the cap body **2001***a*, wherein the cap port **2001***i* is configured to allow the pivot shaft **2041** to travel between the caster leg cavity **2002***g* and the external environment **2060**, to facilitate pivotal engagement between the caster leg **2002** and the supported structure through said pivot shaft **2041**. In an embodiment, the pivot shaft **2041** (including its threaded rod **2041***a*, pivot shaft nut **2041***b* and pivot shaft base **2041***c*), top cap **2001** (including its cap port **2001***i*), pivot ring **2042**, retainer ring **2044**, inner gasket **2048**, outer gasket **2047** and caster leg cavity **2002***g* may be coaxially aligned on the pivot axis **2010**. The plurality of ball bearings **2043** may be arranged into a circular pattern, as seen by ball bearings **1943** of FIG. **19**B, in accordance with the circular ring shapes of the corresponding elements that engaged with them. In an embodiment, the top cap **2001** may be identified as a component of the pivot hub **2025**.

In the embodiment of FIG. **19**A-**19**B, the circular arrangement of the plurality of ball bearings **1943** is the result of the circular bearing channel **1944***b*. In the caster assembly **2000** of FIG. **20**A-**20**B, the circular arrangement of the plurality of ball bearings **1943** is the result of the circular shape of the inner gasket **2048** (as a result of the inner gasket **2048** wrapping around the circular cross section of the pivot shaft base **2041***c*) and the circular shape of the outer gasket (as a result of the circular cross section of the caster leg cavity **2002***g*). Because of the circular shapes of the inner gasket **2048** and the outer gasket **2047**, as well as their coaxial alignment and same elevation, the circular pattern formed by the plurality of ball bearings **2043** disposed between the inner and outer gaskets **2048**, **2047** may be circular as well. As is understood, the circular shapes utilized for each corresponding structure of the pivot hub **2025** may allow for smooth pivoting of the caster leg **2002** about its engagement with a supported structure, even when the weight of the supported structure is significant. In an embodiment, the pivot shaft **2041** may not come into direct contact with the caster leg cavity (as seen by a small gap **2061** seen between the bottom of the pivot shaft base **2041***c* and the base **2002***i* of the caster leg cavity **2002***g*.)

It should be noted that the sizing specifications included herein are purely provided to illustrate a potential embodiment, rather than to limit the potential sizing specifications that may be utilized in alternative embodiments of the invention. In an embodiment, the outer diameter of the rim **2003***b* of each wheel **2003** may be about 58.8 mm. In said embodiment, the distance between the center of the wheel axle port **2003***c* and the top of the pivot shaft nut **2041***b* may be about 53 mm, wherein the top of the pivot shaft nut **2041***b* is about 3.0 mm tall, has a hexagonal shape, and an about 14.0 mm separation between the center of each hexagonal face and the corresponding opposing hexagonal face, as seen in FIG. **20**B. The threaded rod **2041***a* may have height that extends the top of the pivot shaft nut **2041***b* by about 19.05 mm, wherein the threaded rod **2041***a* may have a ½"-13 UNC thread size. In an embodiment, a lock pin **2070** may be configured to engage with the wheel lock **2015** and the caster leg **2002** to secure the wheel lock **2015** to the caster leg **2002**.

FIG. **21** illustrates a side perspective cross-sectional view of an alternative caster assembly **2100** having enhanced load bearing capabilities, according to an aspect. As seen in FIG. **21**, this alternative caster assembly **2100** embodiment may have several differences from the hereinabove described alternative caster assembly **2000** of FIG. **20**A-**20**B. In the alternative caster assembly **2100** embodiment of FIG. **21**, the pivot ring **2149***a* and base ring **2149***b* may be incorporated into the structure of the pivot shaft **2141**, such that the threaded rod **2141***a*, pivot ring **2149***a* and base ring **2149***b* form a monolithic structure. Similarly to the caster assembly embodiment **2000** of FIG. **20**A-**20**B, the inner gasket **2148** may be configured to surround the pivot shaft base **2141***c* and be nested between the pivot ring **2149***a* and base ring **2149***b*. In an embodiment, unlike the caster assembly embodiment **2000** of FIG. **20**A-**20**B, the top cap **2101** may be directly engaged to the threaded rod **2141***a*, such that the top cap **2101** does not pivot with the caster leg **2102**, but instead remains irrotationally affixed to the supported structure as the caster leg **2102** rotates around said top cap **2101** and the supported structure.

As can be seen in FIG. **21**, the top cap **2101** may comprise a cap body **2101***a* and a threaded cap port **2101***i* nested within the cap body **2101***a*. The threaded rod **2141***a* of the pivot toper **2141** may be configured to engage with the threaded cap port **2101***i* such that the threaded rod **2141***a* is partially nested within the threaded cap port **2101***i* and extends above the top cap **2101**, whereas the pivot shaft base **2141***c* is disposed below the top cap **2101**. Aside from the disclosed difference regarding the engagement between the top cap **2101** and the pivot shaft **2141**, the disclosed alternative caster assembly **2100** of FIG. **21** may be largely the same as the alternative caster assembly **2000** of FIGS. **20**A-**20**B. The disclosed plurality of ball bearings **2143** may be configured to be compressed between the inner gasket **2148** and the outer gasket **2147** to facilitate the rotation of the caster leg **2102** about the pivot shaft **2141**. In an embodiment, the inner gasket **2148** may be secured to the pivot shaft **2141** and the outer gasket may be secured to the caster leg **2002** in order to facilitate this pivotal engagement.

The plurality of ball bearings **2143** disposed between the inner gasket **2148** and the outer gasket **2147** may for a circular arrangement, wherein said circular arrangement is configured to be coaxially aligned with the inner gasket **2148**, the outer gasket **2147** and the pivot shaft **2141**.

In an embodiment, an outer gasket retaining ring **2150** may be configured to be nested within the caster leg cavity **2102***g*, as shown in FIG. **21**. In said embodiment, the outer gasket retaining ring **2150** may be configured to further enable the smooth rotation of the caster leg **2102** about a supported structure by securely holding the outer gasket **2147** in place. By holding the outer gasket in place **2147**, the plurality of ball bearing **2143** may also be held in place, as a result of being compressed between the secured outer gasket **2147** and the inner gasket **2148**.

As disclosed hereinabove, the pivot hub **2125** may be configured to enable the pivotal engagement between the caster leg **2102** and a supported structure. While the exact rotational behavior of each element of the pivot hub **2125** may vary, each embodiment may allow the caster leg **2102** to swivel accordingly as the supported structure is moved. As is understood, the disclosed heavy load embodiments of the caster assembly **2100** may utilize the sinusoidal wheels **2103** described herein, such that the said caster assembly **2100** may be provided the corresponding advantages disclosed hereinabove.

It may be advantageous to set forth definitions of certain words and phrases used in this patent document. The term "couple" and its derivatives refer to any direct or indirect communication between two or more elements, whether or not those elements are in physical contact with one another. The term "or" is inclusive, meaning and/or. The phrases "associated with" and "associated therewith," as well as derivatives thereof, may mean to include, be included within, interconnect with, contain, be contained within, connect to or with, couple to or with, be communicable with, cooperate with, interleave, juxtapose, be proximate to, be bound to or with, have, have a property of, or the like.

Further, as used in this application, "plurality" means two or more. A "set" of items may include one or more of such items. Whether in the written description or the claims, the terms "comprising," "including," "carrying," "having," "containing," "involving," and the like are to be understood to be open-ended, i.e., to mean including but not limited to. Only the transitional phrases "consisting of" and "consisting essentially of," respectively, are closed or semi-closed transitional phrases with respect to claims.

If present, use of ordinal terms such as "first," "second," "third," etc., in the claims to modify a claim element does not by itself connote any priority, precedence or order of one claim element over another or the temporal order in which acts of a method are performed. These terms are used merely as labels to distinguish one claim element having a certain name from another element having a same name (but for use of the ordinal term) to distinguish the claim elements. As used in this application, "and/or" means that the listed items are alternatives, but the alternatives also include any combination of the listed items.

Throughout this description, the aspects, embodiments or examples shown should be considered as exemplars, rather than limitations on the apparatus or procedures disclosed or claimed. Although some of the examples may involve specific combinations of method acts or system elements, it should be understood that those acts and those elements may be combined in other ways to accomplish the same objectives.

Acts, elements and features discussed only in connection with one aspect, embodiment or example are not intended to be excluded from a similar role(s) in other aspects, embodiments or examples.

Aspects, embodiments or examples of the invention may be described as processes, which are usually depicted using a flowchart, a flow diagram, a structure diagram, or a block diagram. Although a flowchart may depict the operations as a sequential process, many of the operations can be performed in parallel or concurrently. In addition, the order of the operations may be re-arranged. With regard to flowcharts, it should be understood that additional and fewer steps may be taken, and the steps as shown may be combined or further refined to achieve the described methods.

If means-plus-function limitations are recited in the claims, the means are not intended to be limited to the means disclosed in this application for performing the recited function, but are intended to cover in scope any equivalent means, known now or later developed, for performing the recited function.

Claim limitations should be construed as means-plus-function limitations only if the claim recites the term "means" in association with a recited function.

If any presented, the claims directed to a method and/or process should not be limited to the performance of their steps in the order written, and one skilled in the art can readily appreciate that the sequences may be varied and still remain within the spirit and scope of the present invention.

Although aspects, embodiments and/or examples have been illustrated and described herein, someone of ordinary skills in the art will easily detect alternate of the same and/or equivalent variations, which may be capable of achieving the same results, and which may be substituted for the aspects, embodiments and/or examples illustrated and described herein, without departing from the scope of the invention. Therefore, the scope of this application is intended to cover such alternate aspects, embodiments and/or examples. Hence, the scope of the invention is defined by the accompanying claims and their equivalents. Further, each and every claim is incorporated as further disclosure into the specification.

What is claimed is:

1. A caster assembly comprising:

a pivot hub configured to be engaged with a supported structure, the pivot hub comprising:

a pivot shaft configured to be engaged with the supported structure, the pivot shaft comprising:

a threaded rod configured to be engaged with the supported structure:

a pivot shaft nut disposed below and engaged with the threaded rod; and

a pivot shaft base disposed below and engaged with the pivot shaft nut; and

a plurality of ball bearings configured to be engaged with the pivot shaft;

a caster leg configured to be engaged with the pivot hub, such that the caster leg is pivotally engaged with the supported structure and configured to pivot about a pivot axis, the caster leg having:

a vertical member configured to be coaxially aligned with the pivot axis;

a caster leg cavity nested within the vertical member, wherein each ball bearing of the plurality of ball bearings is configured to be nested within the caster leg cavity; and

an angled member associated with the vertical member, the angled member being coaxially aligned with an

offset axis, wherein the angled member engages with the vertical member such that an offset angle is formed between the pivot axis and the offset axis;

a top cap associated with the caster leg, wherein the top cap is configured to cover the caster leg cavity;

a pair of sinusoidal wheels configured to be rotationally engaged with the angled member of the caster leg, such that each sinusoidal wheel of the pair of sinusoidal wheels is configured to rotate independently about a wheel rotational axis, each sinusoidal wheel of the pair of sinusoidal wheels having:

a wheel hub configured to be rotationally engaged with the angled member of the caster leg; and

a rim configured to surround and be engaged with the wheel hub, the rim having:

a pair of lateral edges; and

a rim center engaged with and equidistantly disposed between the pair of lateral edges;

wherein the rim center of each sinusoidal wheel of the pair of sinusoidal wheels follows a sinusoidal pattern around a circumference of the sinusoidal wheel, the sinusoidal pattern having a sinusoidal amplitude and sinusoidal frequency, wherein the rim center of each sinusoidal wheel of the pair of sinusoidal wheels is configured to be coaxially aligned with the wheel rotational axis and the pivot shaft is configured to be engaged with the plurality of ball bearings such that each ball bearing of the plurality of ball bearings is configured to roll in order to facilitate pivotal engagement between the caster leg and the pivot shaft.

2. The pivot shaft of claim **1** further comprising an inner gasket configured to be engaged with the pivot shaft and an outer gasket configured to be engaged with the caster leg, wherein each ball bearing of the plurality of ball bearings is disposed between the inner gasket and the outer gasket.

3. The caster assembly of claim **1** further comprising a wheel axle, wherein each sinusoidal wheel of the pair of sinusoidal wheels is configured to be rotationally engaged with the angled member of the caster leg by the wheel axle, the wheel axle being configured to be nested within the wheel hub of each sinusoidal wheel and the angled member, such that the wheel axle and each sinusoidal wheel of the pair of sinusoidal wheels are coaxially aligned on the wheel rotational axis.

4. The caster assembly of claim **1**, wherein the offset angle is between about 145 degrees and about 150 degrees.

5. The caster assembly of claim **1**, wherein the offset angle is configured such that the pivot axis does not intersect the wheel rotational axis.

6. The caster assembly of claim **1**, wherein a separation distance between the pair of lateral edges of each rim is constant around the circumference of the corresponding rim.

7. The caster assembly of claim **1**, further comprising a wheel lock configured to be engaged with the caster leg, wherein the wheel lock is further configured to be selectively engaged with the pair of sinusoidal wheels to prevent rotation of the pair of sinusoidal wheels about the wheel rotational axis.

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