



(51) International Patent Classification:

F16D 51/20 (2006.01) *F16D 65/09* (2006.01)
B60G 9/00 (2006.01)

(21) International Application Number:

PCT/US2017/035112

(22) International Filing Date:

31 May 2017 (31.05.2017)

(25) Filing Language:

English

(26) Publication Language:

English

(30) Priority Data:

PCT/US2016/035024

31 May 2016 (31.05.2016)

US

(71) Applicant: **COMPAGNIE GENERALE DES
ETABLISSEMENTS MICHELIN** [FR/FR]; 12 Cours
Sablon, 63000 Clermont-Ferrand (FR).

(72) Inventor; and

(71) Applicant (for US only): **MERRILL, Zachary, Alexan-
der** [US/US]; c/o Michelin North America, Inc./, Intellectual
Property Dept, 515 Michelin Road, Greenville, SC 29605
(US).

(74) Agent: **PIEROTTI, Neal, P.**; Michelin North Ameri-
ca, Inc., Intellectual Property Dept., 515 Michelin Road,
Greenville, SC 29605 (US).

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

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

(54) Title: BRAKE ANCHOR PIN ANTI-ROTATION ELEMENT

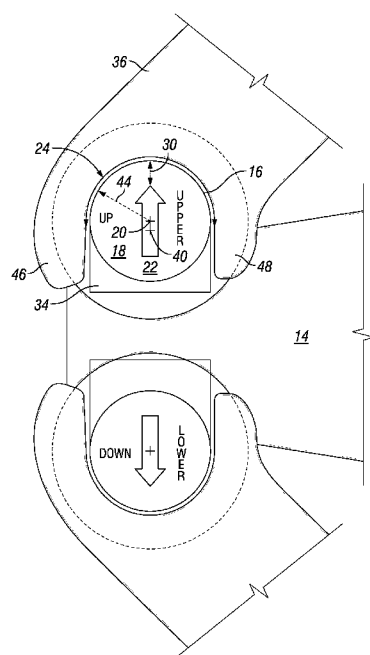


FIG. 11

(57) Abstract: An apparatus for a vehicle is provided that includes an axle (12) and a brake mounting plate (14) that has a brake anchor pin aperture (16) in which a brake anchor pin (18) is disposed. The brake anchor pin (18) has a central axis (20) and first and second ends (22, 26) with first and second mounting surfaces (24, 28). The first and second mounting surfaces (24, 28) are located at different distances from the brake anchor pin central axis (20). The brake anchor pin (18) has an anti-rotation element (34). A brake frictional component carrying member (36) is present and engages the brake anchor pin (18). The anti-rotation element (34) engages the brake frictional component carrying member (36) to limit rotation of the brake anchor pin (18) relative to the brake mounting plate (14).

Declarations under Rule 4.17:

— *of inventorship (Rule 4.17(iv))*

Published:

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

BRAKE ANCHOR PIN ANTI-ROTATION ELEMENT

FIELD OF THE INVENTION

[0001] The subject matter of the present invention relates to an anti-rotation element for a brake anchor pin to prevent it from moving relative to a spider plate and brake shoes. More particularly, the present application involves a brake anchor pin anti-rotation element for use with brake shoes and a drum that are angled relative to the axle onto which they are mounted.

BACKGROUND OF THE INVENTION

[0002] The alignment of a vehicle's wheel plane relative to the path traveled by the vehicle affects not only the handling of the vehicle but also affects the wear on the tires. As used herein, alignment refers to camber, toe, and thrust. Camber is the angle between the vertical axis of the wheel and the vertical axis of the vehicle. Positive camber refers to an angle where the top of the wheel is farther away from the center of vehicle than the bottom of the wheel. Negative camber refers to an angle where the bottom of the wheel is farther away from center of the vehicle than the top. Generally speaking, camber changes of even a tenth of one degree can impact tire wear. Abnormal tire wear has been observed in certain applications with even smaller camber angles changes. Toe is the angle each wheel makes with the longitudinal axis of the vehicle. Positive toe, also referred to as toe in, is a condition where the front of the wheel is pointing in or towards the center line of the vehicle. Negative toe, also referred to as toe out, is a condition where the front of the wheel points out or away from the center line of the vehicle. Generally speaking, toe changes of even one-twentieth of a degree can have an impact on tire wear. Thrust is the resulting direction of travel of an axle as opposed to the direction that might be expected from the orientation of the tires on the axle.

[0003] The typical trailer axle is made by welding a pair of spindle forgings onto a piece of axle tubing then machining the precision surfaces of both spindles simultaneously in a lathe process. The resulting axle is near perfectly straight; i.e., each spindle axis possesses zero camber and zero toe. When a typical axle is installed under a vehicle (used herein to refer to both motorized vehicles as well as trailers) and placed into normal operation under typical loading conditions, the camber does not remain at zero. The axle under load, although quite rigid, does flex. The flexing of the axle occurs because the

suspension is attached to the axle at load transfer points which are significantly inboard of the ends of the axle, but the tires support the weight of the vehicle by means of attachment points which are relatively near the outboard ends of the axle. As a result of this geometry, the weight of the vehicle imposes a bending moment on the axle which in turn causes upward deflection of the ends of the axle resulting in the tires presenting a slight negative camber. As the load increases, the more negative the camber becomes. At the typical maximum legal tandem axle load in the US, it would not be unusual for the wheel camber angle to reach approximately 0.5 degrees. The contribution of tire alignment to tire wear can be particularly problematic with vehicles used for transporting heavy loads.

[0004] Once the weight is removed, the axle may recover and again affect the alignment of the wheels. Because of factors such as the additional costs and amount of material that would be required, increasing the stiffness of the axle to resolve camber issues may not be practical.

[0005] Even with the same amount of camber on each axle spindle, axle camber affects the tires differently depending on their individual wheel end position on the vehicle because most road surfaces are not flat transversely across the road. The road surface is either crowned or sloped (by about 1.5% on average) so that water will evacuate from the road surface. Trucks, in most of the world, generally operate in the right most lane, and the right most lane is usually sloped very slightly to the right. This means that all the while the vehicle is traveling on the road way, there is a gravitational pull on the rig that is pulling the vehicle to the right. This pull is resisted through the tire contact patch and the tire transmits this force to the axle by transmitting the required force opposite of the direction of pull through its interface with its wheel. The result is that as the tire rolls down the highway, the contact patch shifts leftward with respect to the wheel center. At full load and at normal pressure on a typical NGWBS tire, this shift has an effect on tire shoulder wear that is roughly the equivalent of a 0.5 degree shift in wheel camber. This means that, although the left and the right wheel may each measure approximately -0.5 degree of camber, when the shift effect is considered, the effective camber angle on the left side tires is approximately -0.7 degree, and the effective camber angle on the right side tires is approximately -0.3 degree. As a consequence of this phenomenon, the left hand tires usually experience worse inboard shoulder wear than the right hand tires.

[0006] When a typical tandem axle vehicle (tractor or trailer) turns, the dynamics of the vehicle favor lateral grip by the forward axle tires. As a result the pivot point of the vehicle shifts toward the forward axle tires and the rear axle tires will tend to have greater

slip laterally as the vehicle negotiates a turn maneuver. For this reason, the rear tires on a tandem axle pair receive more scrub and have a faster wear rate than the tires on the forward axle. Scrub tends to arrest the development of irregular wear and thus the rear tires usually are less affected by the camber issue than are the tires on the forward axle.

[0007] So as a consequence, the tire irregular wear issue is usually worst on the inboard surface of the left front tire. Next worst is the left rear tire. The right front tire comes next but is sometimes similar in severity to the left rear. The most even wear usually is found on the rear right tire depending upon the particular application, load, and routes normally traveled. It should be obvious that in countries such as Australia, where drivers drive on the left side of the road instead of the right side, the above would be reversed.

[0008] One mechanism of adjusting axial alignment involves a system that includes a spindle sleeve that has an outer surface about a first axis of revolution and an inner surface about a second axis of revolution at an angle to the first axis. The predetermined angle may be in a vertical direction to induce a change in camber, in a horizontal direction to induce a change in toe, or a combination thereof. The wheel can thus be set at an angle to the spindle, but doing so requires a means by which the contact surface orientation of the brake friction material can be properly matched to the friction surface of the drum. The angle of the brake shoes can be adjusted by providing the brake anchor pins with eccentric forward and backward ends that are at different heights to one another. The brake shoes resting on the forward and backward ends will then be at an angle when resting on the brake anchor pins so that the brake friction surface of the shoes aligns with the drum.

[0009] Although the ends of the brake anchor pins afford a mechanism of angling the brake shoes relative to the drum, the brake anchor pins must themselves be in a set orientation with respect to the spider plate into which they are contained. As the cam of the brake assembly is actuated to move the brake shoes, forces imparted by braking may cause the brake anchor pins to rotate relative to the spider plate. If the brake anchor pins are not properly oriented with respect to the spider plate, the desired orientation and elevation of the brake shoes will not be achieved. The brake shoes may themselves be at an undesired “camber” angle and even an undesired “toe” angle with respect to the drum to which they should be aligned. As such, a need exists for providing a way of preventing the brake anchor pins from rotating relative to the spider plate so that the brake friction material is properly aligned with the corresponding friction surface of the brake drum.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] A full and enabling disclosure of the present invention, including the best mode thereof, directed to one of ordinary skill in the art, is set forth in the specification, which makes reference to the appended figures, in which:

[0011] Fig. 1 is an exploded perspective view of the rear outboard side of the assembly of axle, spindle, spindle sleeve, brake mounting plate, spindle sleeve washer and spindle nut.

[0012] Fig. 2 is a cross-sectional view of the spindle sleeve taken along line 2-2 in Fig. 1.

[0013] Fig. 3 is cross-sectional view showing misalignment of the brake drum and the brake frictional material upon adjustment of the hub.

[0014] Fig. 4 is a side view of the brake anchor pin

[0015] Fig. 5 is a front view of the brake anchor pin of Fig. 4.

[0016] Fig. 6 is a back view of the brake anchor pin of Fig. 4.

[0017] Fig. 7 is a front view of the brake mounting plate with a brake frictional component carrying member mounted thereon.

[0018] Fig. 8 is a cross-sectional view showing alignment of the brake drum and the brake frictional material upon adjustment of the hub and adjustment through the use of the brake anchor pin.

[0019] Fig. 9 is a side view of the brake anchor pin with the anti-rotation element.

[0020] Fig. 10 is a front view of the brake anchor pin of Fig. 9.

[0021] Fig. 11 is a side view of the brake mounting plate with the brake frictional component carrying member mounted thereon through the use of brake anchor pins.

[0022] Fig. 12 is a top view the anti-rotation element before attachment to the brake anchor pin.

[0023] Fig. 13 is a side view of the anti-rotation element of Fig. 12.

[0024] Fig. 14 is a front view of the anti-rotation element of Fig. 12.

[0025] Fig. 15 is a side view of the brake anchor pin in which the anti-rotation element is a pair of pins.

[0026] Fig. 16 is a side view of the brake anchor pin in which the anti-rotation element is a recess in the brake anchor pin.

[0027] The use of identical or similar reference numerals in different figures denotes identical or similar features.

DETAILED DESCRIPTION OF THE INVENTION

[0028] Reference will now be made in detail to embodiments of the invention, one or more examples of which are illustrated in the drawings. Each example is provided by way of explanation of the invention, and not meant as a limitation of the invention. For example, features illustrated or described as part of one embodiment can be used with another embodiment to yield still a third embodiment. It is intended that the present invention include these and other modifications and variations.

[0029] It is to be understood that the ranges mentioned herein include all ranges located within the prescribed range. As such, all ranges mentioned herein include all sub-ranges included in the mentioned ranges. For instance, a range from 100-200 also includes ranges from 110-150, 170-190, and 153-162. Further, all limits mentioned herein include all other limits included in the mentioned limits. For instance, a limit of up to 7 also includes a limit of up to 5, up to 3, and up to 4.5.

[0030] The following terms are defined as follows for this disclosure:

[0031] “Axial direction” refers to a direction parallel to the axis of rotation of for example, the hub or the wheel as it travels along a road surface.

[0032] “Radial direction” refers to a direction that is orthogonal to the axial direction and extends in the same direction as any radius that extends orthogonally from the axial direction.

[0033] “Toe” means the angle of the equatorial plane of the tire with respect to the longitudinal axis of the vehicle.

[0034] “Camber” means the angle of the equatorial plane of the tire with respect to the vertical axis of the vehicle.

[0035] “Vehicle” includes motorized vehicles and non-motorized vehicles including trailers.

[0036] Fig. 1 provides an embodiment of an apparatus for adjusting the alignment of the axis of rotation of a hub 76 relative to a spindle 66 attached at the end of an axle 12. The hub 76 is retained on the axle 12 usually by way of an axle nut, also referred to as a spindle nut 82, which engages a threaded end of the spindle 66. In this particular embodiment, the spindle 66 and hub 76 are typical to what may be observed on a heavy vehicle such as a truck trailer, but it should be understood that the invention disclosed could be used with other vehicle types.

[0037] The spindle 66 has an outer surface of revolution centered upon an axis 62 of the axle 12. The spindle 66 can be mounted to the axle 12 in a variety of manners in

accordance with various exemplary embodiments. A spindle sleeve 68, shown in cross-section in Fig. 2, possessing a spindle sleeve inner surface 90 is machined to a diameter so as to fit over the outer surface of the spindle 66. The spindle sleeve inner surface 90 is a generally cylindrical surface of revolution about a spindle sleeve inner surface axis 92. When the spindle sleeve 68 is mated with the spindle 66, the spindle axis which is the same as the axis 62 of the axle 12 and the spindle sleeve inner surface axis 92 are positionally and angularly aligned to one another such that the axes 62, 92 are geometrically the same and are coaxial.

[0038] The spindle sleeve 68 possesses a spindle sleeve outer surface 70 with an outer surface of revolution about a spindle sleeve outer surface axis 88 which is oriented at a predetermined angle and position relative to the spindle sleeve inner surface axis 92. In this regard, the spindle sleeve outer surface axis 88 and the spindle sleeve inner surface axis 92 are oriented at an angle 94 to one another. This predetermined angle 94 may be in a vertical direction (inducing a positive or negative change in camber) or horizontal direction (inducing a positive or negative change in toe) or a combination thereof (inducing a positive or negative change in camber and inducing a positive or negative change in toe). It should be appreciated that the value of the difference in angle between the spindle sleeve outer surface axis 88 and the spindle sleeve inner surface axis 92 may be nonzero when viewed in a particular direction. For example the difference in angle may be zero in the horizontal where no change in toe is occurring while having a positive or negative change in angle in the vertical direction where a change in camber is occurring. The angle between the spindle sleeve inner surface axis 92 and the spindle sleeve outer surface axis 88 is chosen depending upon the desired adjustment of the camber, toe and thrust angle of the hub 76 (and attached wheel).

[0039] The vertical and horizontal placement and the angular alignment of the spindle sleeve outer surface axis 88 relative to the spindle sleeve inner surface axis 92 is limited to the thickness of the spindle sleeve 68 walls. The walls must be sufficiently thick so as not to deform during handling of the spindle sleeve 68, installation of the spindle sleeve 68 upon the spindle 66, or operation of the vehicle as the loads are transmitted from the vehicle through the spindle 66, spindle sleeve 68, wheel bearings, hub 76 and to the road surface.

[0040] With reference back to Fig. 1, the hub 76 is rotationally mounted onto the exterior surface of the spindle sleeve 68. This rotational mounting may be accomplished by the use of one or more bearings between the hub 76 and the spindle sleeve 68 in the

radial direction. The bearing arrangement can include inner races 74 and 80 on the spindle sleeve outer surface 70 and spaced from one another a distance in the axial direction of the spindle sleeve inner surface axis 92 by a bearing spacer 78. A washer 86 can be located outboard of and can engage the inner race 80. A seal 72 may be pressed on the inboard portion of the spindle sleeve 68 and inboard portion of the hub 76. The seal 72 illustrated is a unitized type seal, but other seal types are possible such as non-unitized positive contact lip seals. Other components can be included in the bearing arrangement, and the hub 76 can be placed into rotating engagement with the spindle sleeve 68 in a variety of manners in accordance with other exemplary embodiments.

[0041] The spindle 66 may be welded to an end of an axle tube of the axle 12 and when the suspension system is unloaded, the axes of the spindles 66 on each side are aligned and have zero degrees of camber and zero degrees of toe. As discussed above, the vehicle dynamics and loads placed upon the axle 12 by the vehicle weight and cargo deflect the axle 12 causing the spindles 66 to take on a small amount of camber. The spindle sleeve 68 allows adjustment of the wheel camber, toe and thrust angles by a desired amount.

[0042] A keyway may be positioned on the rear end of the axle 12 and may extend into a spindle wall portion and may extend in length in the direction of the axis 62. The keyway allows a spindle nut lock ring 84 to prevent the spindle nut 82 from rotating relative to the spindle 66.

[0043] The spindle nut 82 shown here is a locking spindle nut having a spindle nut lock ring 84. Other spindle nuts 82 may be used, including a castle nut, a nut and retaining washer, or dual nut and a lock plate. It should also be understood that such spindle nuts may work in conjunction with a locating pin inserted through an aperture on the spindle 66 instead of a keyway as described.

[0044] When the angle of the camber and toe is changed, the angle that the brake components attached to the axle 12, such as the brake frictional component carrying member 36, change with respect to the brake components attached to the hub 76, such as the brake drum 56. Fig. 3 shows the hub 76 after mounting onto the spindle sleeve 68 so that an axis 77 of the hub 76 is aligned with the spindle sleeve outer surface axis 88 and so that these two axes 77, 88 are at an angle to the axis 62 of the axle 12. The spindle sleeve 68 is not shown in the figure for clarity. The brake drum 56 rotates about the same axis as the hub axis 77 and the spindle sleeve outer surface axis 88, and the brake drum 56 has friction material 60 included thereon. The brake frictional component carrying member 36

is not attached to the spindle sleeve outer surface 70 and does not rotate about the spindle sleeve outer surface axis 88 or the hub axis 77. The friction material 58 of the brake frictional component carrying member 36 is thus misaligned with the friction material 60 when the hub 76 is adjusted for camber, or in some cases when toe alignment is also modified. The brake anchor pin 18 illustrated extends straight through a brake anchor pin aperture 16 of the brake mounting plate 14 and has a brake anchor pin central axis 20 that is parallel to axis 62. The friction materials 58 and 60 are not in alignment with one another and may exhibit accelerated wearing and decreased braking. The brake anchor pin aperture 16 may extend completely through the brake mounting plate 14 so that it is open on opposite ends but closed in the radial direction 44 of the brake anchor pin aperture 16. In other arrangements, the brake anchor pin aperture 16 is open as well at one or more locations in the radial direction 44.

[0045] In order to adjust the angle of the friction material 58 so that it lays against friction material 60 when braking is applied, the angle of the brake frictional component carrying member 36 should be adjusted so that it lays along the axes 77 and 88. Fig. 4 illustrates a brake anchor pin 18 that can be used in order to effect this adjustment of the brake frictional component carrying member 36. The brake anchor pin 18 has a cylindrical central body 38 with a brake anchor pin central axis 20 located at its center in the radial direction. The brake anchor pin 18 includes a first end 22 and an oppositely disposed second end 26 that are sized differently than the central body 38. The first end 22 may likewise be sized differently than the second end 26. The first and second ends 22 and 26 extend from the central body 38 in directions generally opposite to one another.

[0046] The first end 22 is shown in Fig. 5 and is cylindrical in shape. The first end 22 has a first end axis 40 that is not coaxial with the brake anchor pin central axis 20. The first end 22 has a first mounting surface 24 that is convex in shape and that extends around a portion of the circumference of the first end 22. In some instances, the first mounting surface 24 may extend 360 degrees about the first end 22. The first end 22 and the central body 38 form eccentric circles when viewed end on in the end view of Fig. 5. The first mounting surface 24 is located at a distance 30 from the brake anchor pin central axis 20. The distance 30 changes in magnitude about the first mounting surface 24 due to the fact that the first end 22 is essentially offset from the central body 38 in an eccentric fashion. The diameter of the first end 22 is less than the diameter of the central body 38, but in other embodiments the first end 22 may be the same as or larger in diameter.

[0047] The second end 26 is shown in Fig. 6 in end view and is similar to the first end 22 in that it is cylindrical in shape and has a second end axis 42 offset from and not coaxial with the brake anchor pin central axis 20. The second end 26 has a convex outer surface, and a second mounting surface 28 that may extend 360 degrees around the second end axis 42. The second end 26 and the central body 38 form an eccentric in that they both have circular cross sections with axes 20 and 42 that are not coaxial. The second mounting surface 28 is located at a distance 32 from the brake anchor pin central axis 20. The distance 32 changes about the second mounting surface 28 due to the eccentric orientation between the central body 38 and the second end 26. The diameter of the second end 26 is smaller than the diameter of the central body 38, but it could be the same as or larger in other embodiments. The first and second mounting surfaces 24 and 28 are portions of the brake anchor pin 18 that engage the brake frictional component carrying member 36, and the surfaces 24 and 28 may extend from 90-120 degrees, from 120-150 degrees, from 150-180 degrees, from 180-210 degrees, from 210-250 degrees, from 250-300 degrees, from 300-320 degrees, or up to 360 degrees about the first end axis 40 and the second end axis 42.

[0048] The first end 22 and the second end 26 are not arranged in the same manner as one another. In this regard, at least one of the shape, size, or placement relative to the central body 38 is different between the first end 22 and the second end 26. In some instances, two or even all three of these factors are different between the first end 22 and the second end 26. In the embodiment shown, the diameter of the first end 22 is larger than the diameter of the second end 26, but both the first end 22 and the second end 26 are shaped in the same manner. The placement of the first end axis 40 relative to the brake anchor pin central axis 20 is different than the placement of the second end axis 42 relative to the brake anchor pin central axis 20. In this regard, the axes 20 and 40 are closer to one another than the axes 20 and 42. The distances 30 and 32 are likewise different from one another at various points along the first and second mounting surfaces 24, 28, although as previously described the distances 30 and 32 may in fact be the same at certain points on the first and second mounting surfaces 24, 28.

[0049] The brake anchor pin 18 is shown assembled with the brake mounting plate 14 and the brake frictional component carrying member 36 in Fig. 7. The brake mounting plate 14 has a central aperture through which the axis 62 of the axle 12 is disposed. The brake mounting plate 14 does not move relative to the axle 12. The brake mounting plate 14 has a brake anchor pin aperture 16 into which the brake anchor pin 18 is disposed. The

brake anchor pin 18 may extend all the way through the brake anchor pin aperture 16 so that the central body 38 is contained within the brake anchor pin aperture 16 and so that the first end 22 and the second end 26 are outside of the brake anchor pin aperture 16. The brake frictional component carrying member 36 rests onto the first mounting surface 24 and the second mounting surface 28 of the first end 22 and second end 26. The brake frictional component carrying member 36 may be free from engagement with the central body 38. A second brake anchor pin (unlabeled) is shown below the brake anchor pin 18 and is likewise disposed through an aperture of the brake mounting plate 14. This second brake anchor pin can be arranged in a similar manner to that of the first brake anchor pin 18 as previously discussed and a repeat of this information is not necessary. A second section of the brake frictional component carrying member 36 may engage the second brake anchor pin in a manner similar to that of the brake anchor pin 18. A pair of springs 96, 98 engage the two sections of the brake frictional component carrying member 36 and pull them towards one another and against the brake anchor pins 18. The arrangement also has a cam 64 that can be rotated in order to actuate the brake. Rotation of the cam 64 causes the sections of the brake frictional component carrying member 36 against the cam 64 to pivot outwards away from one another. These sections of the brake frictional component carrying member 36 will pivot about the brake anchor pins 18 to which they are engaged to cause the brake to assume a braked orientation such that the friction material 60 carried by the brake frictional component carrying member 36 engages the friction material 58 to stop the hub 76 from rotating. Forces imparted by the cam 64 and transferred through the brake frictional component carrying member 36 may be imparted upon the brake anchor pins 18 and may cause the brake anchor pins 18 to rotate relative to the brake mounting plate 14 and the brake anchor pin apertures 16.

[0050] A side and partial cross-sectional view of the brake is shown in Fig. 8. The brake anchor pin 18 of Figs. 4-7 is included and the first end 22 is arranged differently than the second end 26. In this regard, the first mounting surface 24 is located higher than the second mounting surface 28, or put another way may be located farther from the axes 62 and 92 than the second mounting surface 28. As the first and second ends 22, 26 are not identical, the brake frictional component carrying member 36 will not lay straight across the brake anchor pin 18, but will instead seat at an angle to the brake anchor pin 18. With reference to Fig. 8, the brake frictional component carrying member 36 is angled so as to be aligned with the hub axis 77 and the spindle sleeve outer surface axis 88. This alignment causes the brake frictional component carrying member 36 to be aligned with the

hub 76, and the friction material 58 to be aligned with the friction material 60 so that the brake wears evenly and appropriately upon application. The lower brake anchor pin (not numbered) can be provided in a similar manner and can be appropriately oriented with respect to the brake mounting plate 14 so that the brake frictional component carrying member 36 is aligned as desired with the hub axis 77.

[0051] Rotation of one or both of the brake anchor pins 18 will cause the first and second mounting surfaces 24 and 28 to be rotated out of their desired positions. This will in turn change the camber angle, and possibly the toe angle, of the brake frictional component carrying member 36. The friction materials 58 and 60 will be out of alignment and will not function or wear in an optimal manner. In order to prevent the brake anchor pin 18 from rotating within the brake anchor pin aperture 16, the brake anchor pin 18 can be provided with an anti-rotation element 34. With reference to Figs. 9 and 10, the anti-rotation element 34 is located at the first end 22 but not at the second end 26. In other arrangements, the anti-rotation element 34 is located at the second end 26 but not at the first end 22, and in yet other embodiments the anti-rotation element 34 is present both at the first and second ends 22, 26. The anti-rotation element 34 extends outward from the first end 22 in the radial direction so as to extend radially outward from the first end axis 40. The anti-rotation element 34 can extend from the first end 22 to a location that is farther from the brake anchor pin central axis 20 than the central body 38 or any other portion of the brake anchor pin 18. The shape of the anti-rotation element 34 is generally rectangular and is not cylindrical in shape and may lack any concave or convex surfaces. The first mounting surface 24 may extend about the first end 22 from the anti-rotation element 34 on one side to the anti-rotation element 34 on the opposite side. The first mounting surface 24 may be the entire longitudinal surface of the first end 22 that is not the anti-rotation element 34. The anti-rotation element 34 may be shaped and sized differently in accordance with other embodiments of the apparatus 10.

[0052] Referring now to Fig. 11, the brake anchor pin 18 includes the anti-rotation element 34 on the first end 22, and the anti-rotation element 34 is configured as previously discussed with respect to Figs. 9 and 10. The brake frictional component carrying member 36 has a pair of fingers 46, 48 between which the first end 22 is disposed and that engage the first end 22. The brake anchor pin 18 can be marked with identifying indicia so that the proper position and orientation of the brake anchor pin 18 relative to the brake mounting plate 14 can be achieved. The anti-rotation element 34 extends beyond the fingers 46 and 48. In use, actuation of the brake cause the brake frictional component carrying member

36 to move off of the first end and/or pivot relative to the first end 22. Enough clearance with the anti-rotation element 34 may exist to allow this pivoting. The anti-rotation element 34 will function to prevent rotation of the brake anchor pin 18 about the brake anchor pin aperture 16. Forces imparted onto the brake anchor pin 18 causing it to rotate will cause the anti-rotation element 34 to engage either the finger 46 in one direction of rotation, or finger 48 in the opposite direction of rotation. This engagement will prevent rotation of the brake anchor pin 18 and keep the brake anchor pin 18 properly oriented with respect to the brake mounting plate 14 to cause the brake anchor pin 18 to apply the correct angular orientation of the friction material 36 as presented to the frictional material 60.

[0053] Although not numbered, the lower brake anchor pin illustrated in Fig. 11 is likewise provided with an anti-rotation element 34 to prevent it from rotating out of its desired position relative to the brake mounting plate 14. The two anti-rotation elements 34 may face one another and may be separated from one another a sufficient distance so that they do not interfere with one another during operation of the brake.

[0054] Figs. 12-14 illustrate one embodiment of the anti-rotation element 34 that can be constructed and subsequently attached to the first end 22. The anti-rotation element 34 has a concave upper surface that is complimentary to and matches the convex outer surface of the first end 22. A through aperture extends through the center of the concave upper surface. The rest of the anti-rotation element 34 is rectangular in shape, and the entire anti-rotation element 34 can be made of metal, such as steel, and may be the same material as the brake anchor pin 18. The through aperture can be present to form a plug weld for attachment of the anti-rotation element 34 to the first end 22. Additionally, the marks shown in Fig. 13 can be locations of additional welds that can be formed to cause the anti-rotation element 34 to be attached to the first end 22.

[0055] The anti-rotation element 34 can be provided in a variety of manners in order to eliminate or reduce rotation of the brake anchor pin 18 within the brake anchor pin aperture 16. Fig. 15 shows an alternate embodiment in which the anti-rotation element 34 is a pair of pins 50 and 52 that extend from the first end 22. The pins 50, 52 are at different arc length positions about the first end 22 and are separated from one another so that a space is present between the pins 50, 52. The first mounting surface 24 may extend from one of the pins 50 to the other pin 52 about the surface of the first end 22. The pins 50, 52 may be cylindrical in shape, or they can be square, rectangular, or triangular in shape in other arrangements. In some embodiments the pins 50, 52 are roll pins. The pins 50, 52 may be inserted into the brake anchor pin 18 or threaded onto the brake anchor pin 18 or

welded onto the brake anchor pin 18. The pins 50, 52 may extend beyond the fingers 46, 48 or may be short so that they do not extend beyond the fingers 46, 48 of the brake frictional component carrying member 36. Rotation of the first end 22 about the brake anchor pin aperture 16 will be prevented upon engagement of the pin 50 to the finger 46. Should the first end 22 want to rotate in the counter-clockwise direction, the pin 52 will engage the finger 48 thus preventing rotation of the first end 22 in this direction. The pins 50, 52 may be formed integrally with or attached to the brake anchor pin 18.

[0056] Another arrangement of the anti-rotation element 34 is disclosed in Fig. 16 in which the anti-rotation element 34 is a pair of recesses 54 located in the first end 22. The fingers 46 and 48 wrap around the first end 22 and portions thereof may be disposed within the recesses 54. Rotation of the first end 22 about the brake anchor pin aperture 16 can be prevented when the portion of the first end 22 that is between the recesses 54 engages the finger 46 in one direction or the finger 48 in the opposite direction of rotation.

[0057] The brake frictional component carrying member 36 is shown as a set of brake shoes. Although shown as being used with a brake that includes shoes and a brake drum 56, the anti-rotation element 34 can be incorporated into an assembly 10 with a different type of brake such as a disc or caliper brake in other embodiments. The anti-rotation element 34 could be machined into the brake anchor pin 18 or welded to the brake anchor pin 18.

[0058] Aside from functioning as an anti-rotation feature, the anti-rotation element 34 may also function as a locating device in that upon assembly of the brake, the anti-rotation element 34 will be placed between the fingers 46, 48 so that the brake anchor pin 18 is properly oriented within the brake anchor pin aperture 16. The anti-rotation element 34 may be arranged to completely limit rotation of the brake anchor pin 18 relative to the brake mounting plate 14 or so that the brake anchor pin 18 is only capable of rotating a particular degree relative to the brake mounting plate 14. For instance, the anti-rotation element 34 may limit rotation of the brake anchor pin 18 to less than 1 degree, less than 3 degrees, less than 5 degrees, less than 7 degrees, less than 9 degrees, or less than 10 degrees relative to the brake mounting plate 14.

[0059] While the present subject matter has been described in detail with respect to specific embodiments and methods thereof, it will be appreciated that those skilled in the art, upon attaining an understanding of the foregoing may readily produce alterations to, variations of, and equivalents to such embodiments. Accordingly, the scope of the present disclosure is by way of example rather than by way of limitation, and the subject disclosure

does not preclude inclusion of such modifications, variations and/or additions to the present subject matter as would be readily apparent to one of ordinary skill in the art.

WHAT IS CLAIMED IS:

1. An apparatus for a vehicle, comprising:
 - an axle, wherein the axle has an axis;
 - a spindle sleeve with a spindle sleeve inner surface axis that is coaxial with an axis of the axle, wherein the spindle sleeve has a spindle sleeve outer surface axis that is not coaxial with the axis of the axle;
 - a brake mounting plate carried by the axle, wherein the brake mounting plate has a brake anchor pin aperture;
 - a brake anchor pin disposed in the brake anchor pin aperture, wherein the brake anchor pin has a brake anchor pin central axis, wherein the brake anchor pin has a first end with a first mounting surface, wherein the brake anchor pin has a second end with a second mounting surface, wherein the first mounting surface and the second mounting surface are located at different distances from the brake anchor pin central axis, wherein the brake anchor pin has an anti-rotation element; and
 - a brake frictional component carrying member that engages the brake anchor pin, wherein the anti-rotation element engages the brake frictional component carrying member to limit rotation of the brake anchor pin relative to the brake mounting plate.
2. The apparatus as set forth in claim 1, wherein the brake anchor pin has a central body and the brake anchor pin central axis extends through the center of the central body, wherein the first end is cylindrically shaped and has a first end axis that is not coaxial with the brake anchor pin central axis, wherein the second end is cylindrically shaped and has a second end axis that is not coaxial with the brake anchor pin central axis.
3. The apparatus as set forth in claim 2, wherein the brake frictional component carrying member engages the first end and the second end of the brake anchor pin.
4. The apparatus as set forth in claim 3, wherein the brake frictional component carrying member is free from engagement with the central body of the brake anchor pin, wherein the brake mounting plate engages the central body of the brake anchor pin, and wherein the brake mounting plate is free from engagement with the first end and the second end of the brake anchor pin.

5. The apparatus as set forth in any one of claims 1-4, wherein the first mounting surface extends 360 degrees about the first end axis, and wherein the second mounting surface extends 360 degrees about the second end axis.
6. The apparatus as set forth in any one of claims 1-5, wherein the brake anchor pin aperture is circular in shape, wherein the brake anchor pin aperture is closed in a radial direction of the brake anchor pin aperture.
7. The apparatus as set forth in any one of claims 1-6, wherein the brake frictional component carrying member has a pair of fingers between which the first mounting surface of the first end is disposed, wherein the anti-rotation element engages one of the pair of fingers to limit rotation of the brake anchor pin relative to the brake mounting plate.
8. The apparatus as set forth in any one of claims 1-7, wherein the brake frictional component carrying member is a brake shoe.
9. The apparatus as set forth in any one of claims 1-8, wherein the anti-rotation element is located at the first end of the brake anchor pin, wherein the anti-rotation element extends farther from the first end axis than the first mounting surface extends from the first end axis.
10. The apparatus as set forth in any one of the preceding claims, wherein the anti-rotation element is a pair of pins that extend from the first end of the brake anchor pin, wherein the pair of pins are separated from one another and define the first mounting surface about a portion of the circumference of the first end of the brake anchor pin.
11. The apparatus as set forth in any one of claims 1-8, wherein the anti-rotation element is a recess in the first end, wherein the brake frictional component carrying member is disposed within the recess.
12. The apparatus as set forth in any one of the preceding claims, wherein the anti-rotation element is not located at the second end.

13. The apparatus as set forth in any one of the preceding claims, wherein the anti-rotation element engages the brake frictional component carrying member to limit rotation of the brake anchor pin relative to the brake mounting plate such that the brake anchor pin does not rotate at all relative to the brake mounting plate.

14. The apparatus as set forth in any one of claims 1-12, wherein the anti-rotation element engages the brake frictional component carrying member to limit rotation of the brake anchor pin relative to the brake mounting plate such that the brake anchor pin rotates less than 10 degrees relative to the brake mounting plate.

1/8

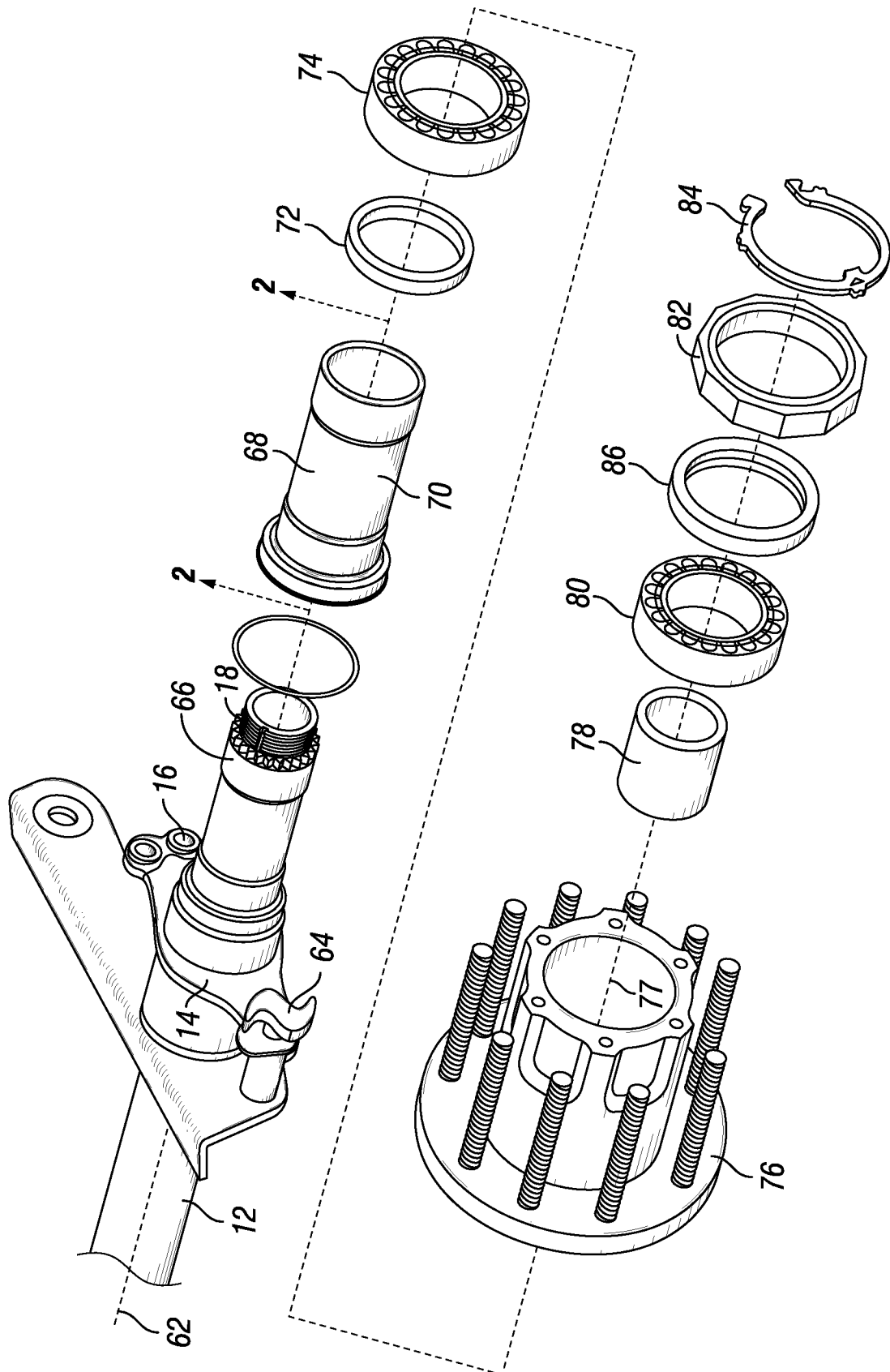
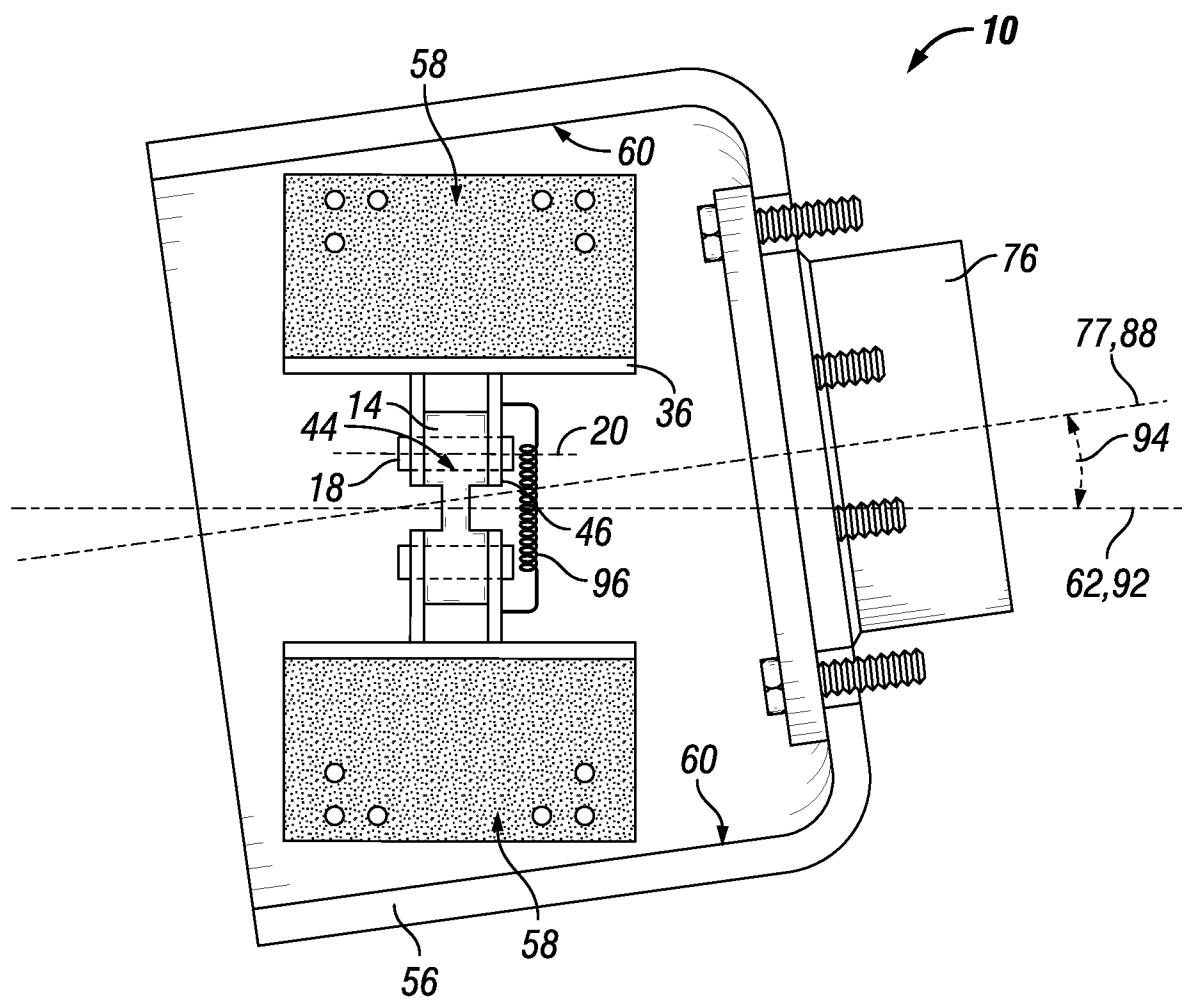
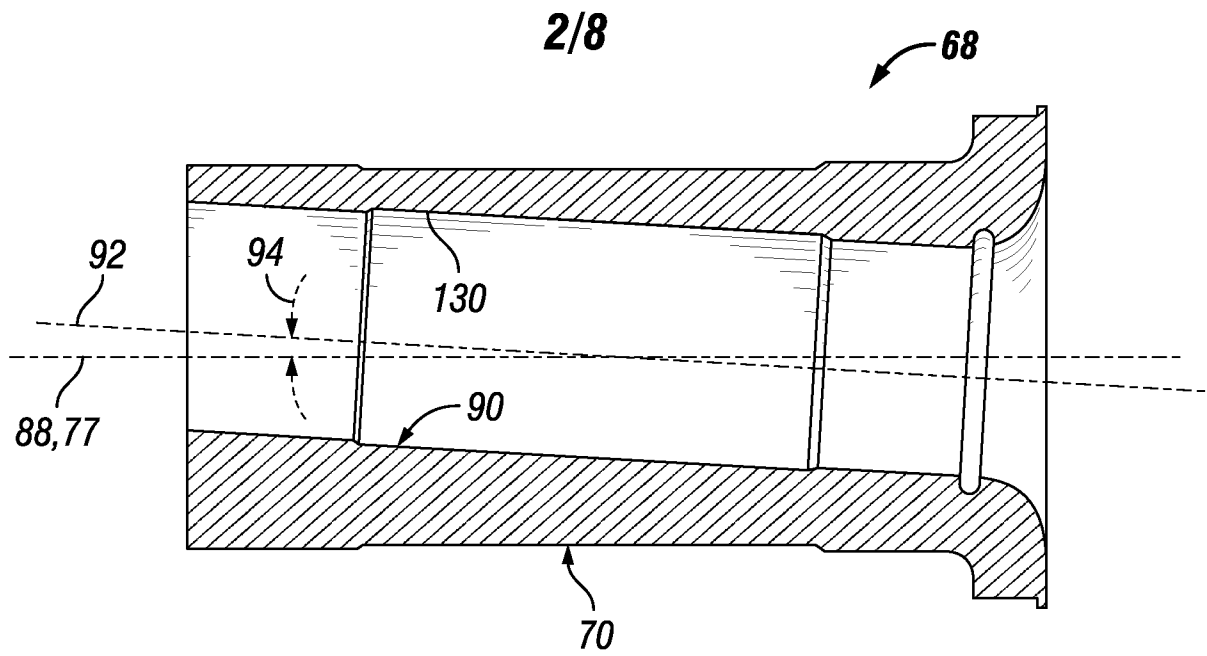
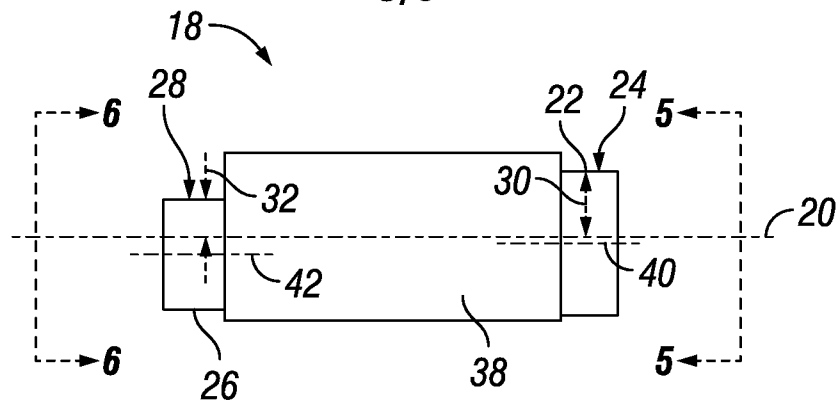
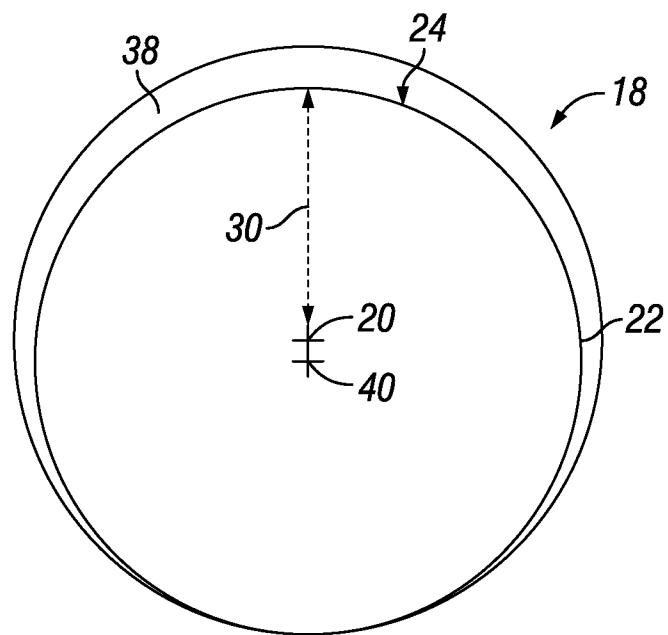
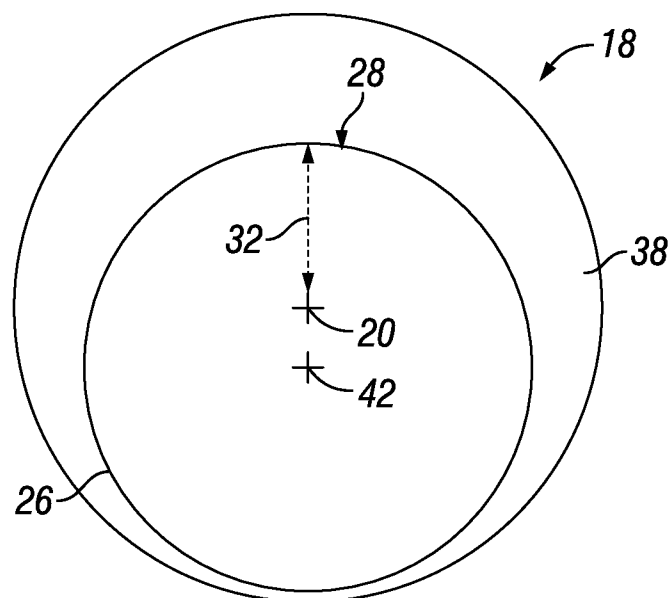


FIG. 1



3/8

**FIG. 4****FIG. 5****FIG. 6**

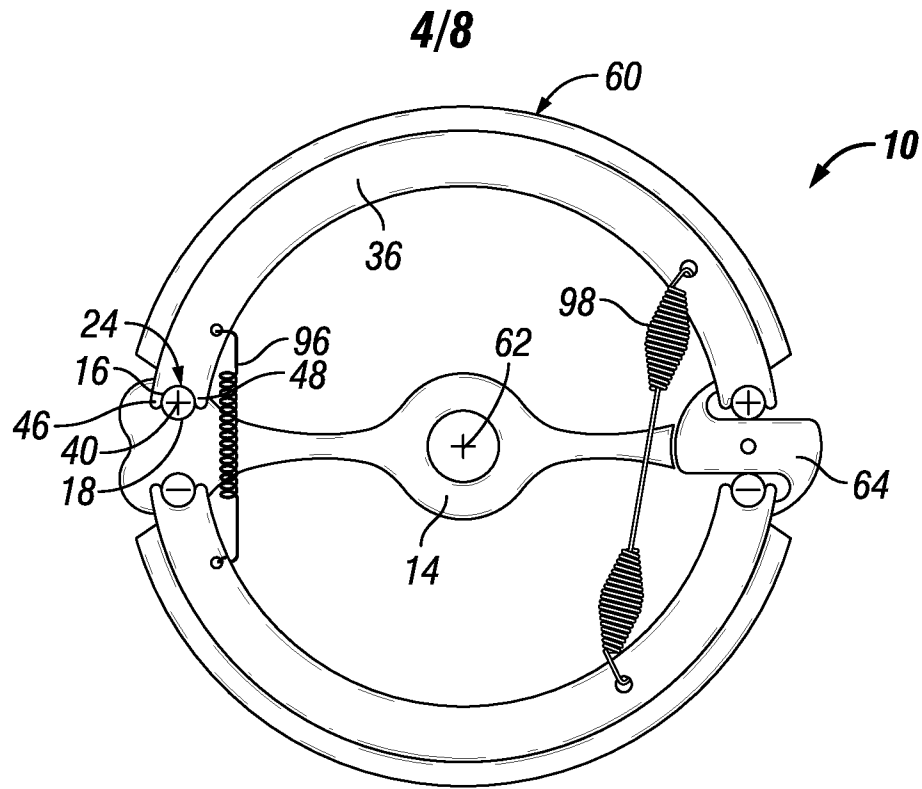


FIG. 7

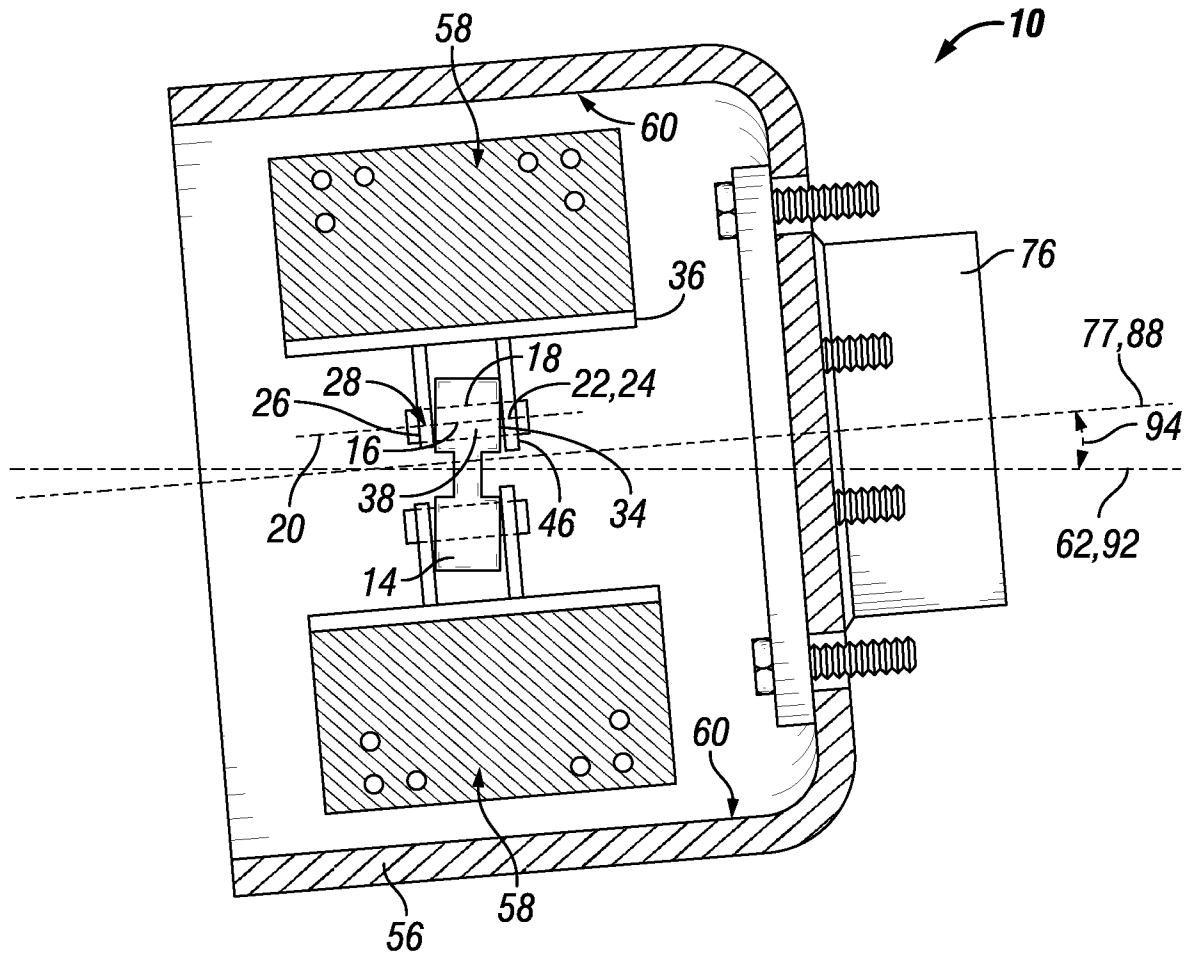


FIG. 8

5/8

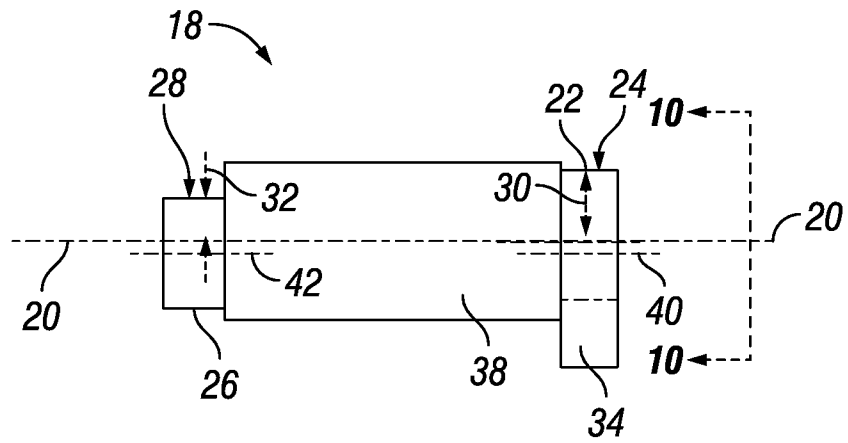


FIG. 9

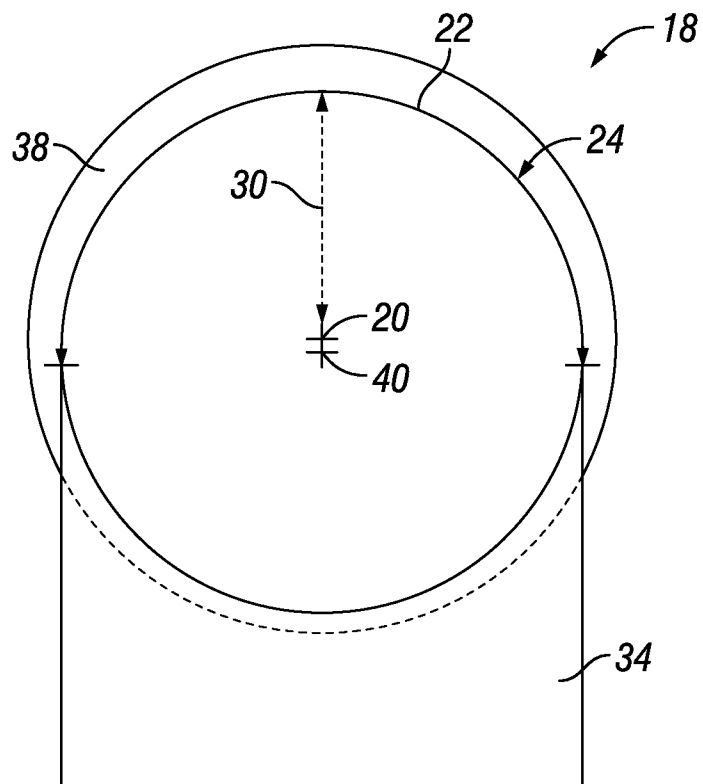


FIG. 10

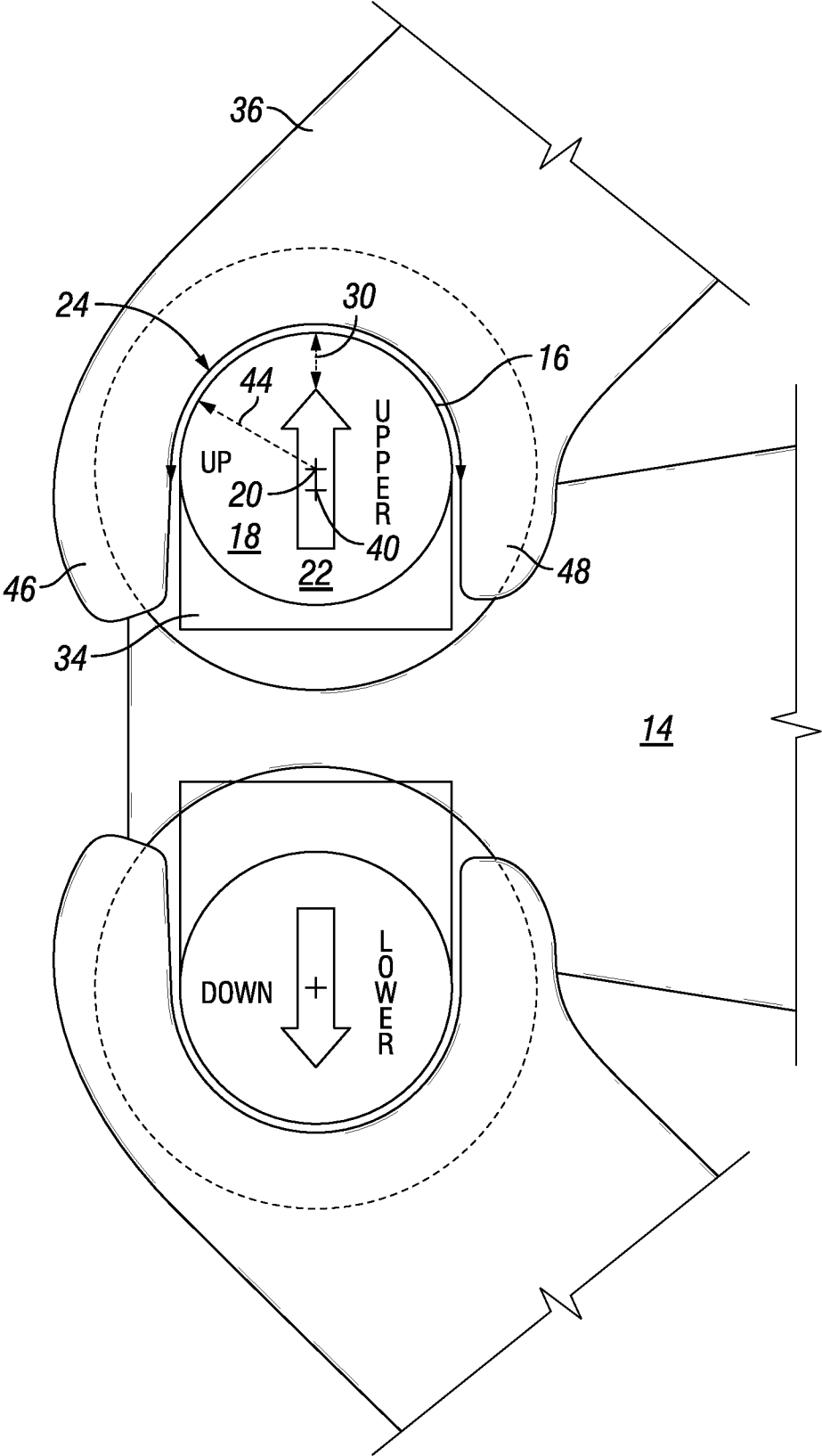


FIG. 11

7/8

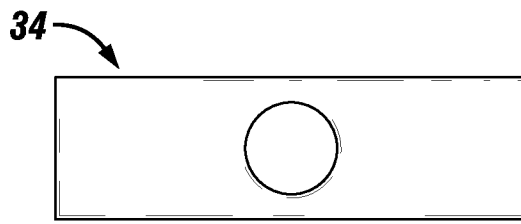


FIG. 12

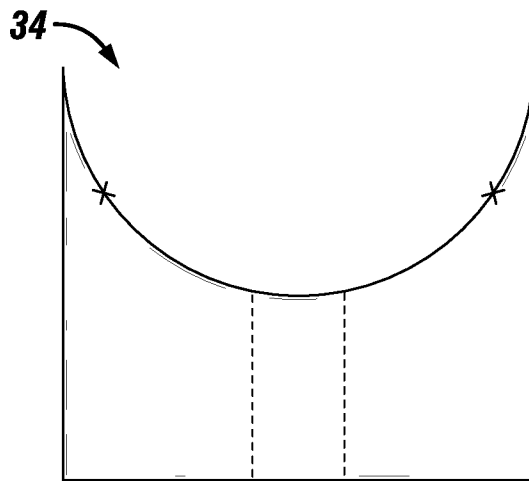


FIG. 13

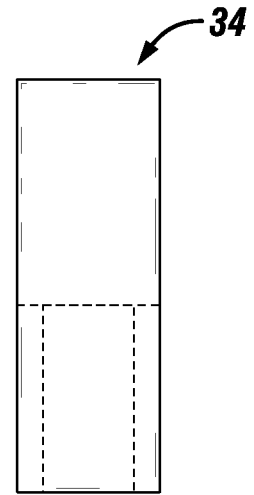


FIG. 14

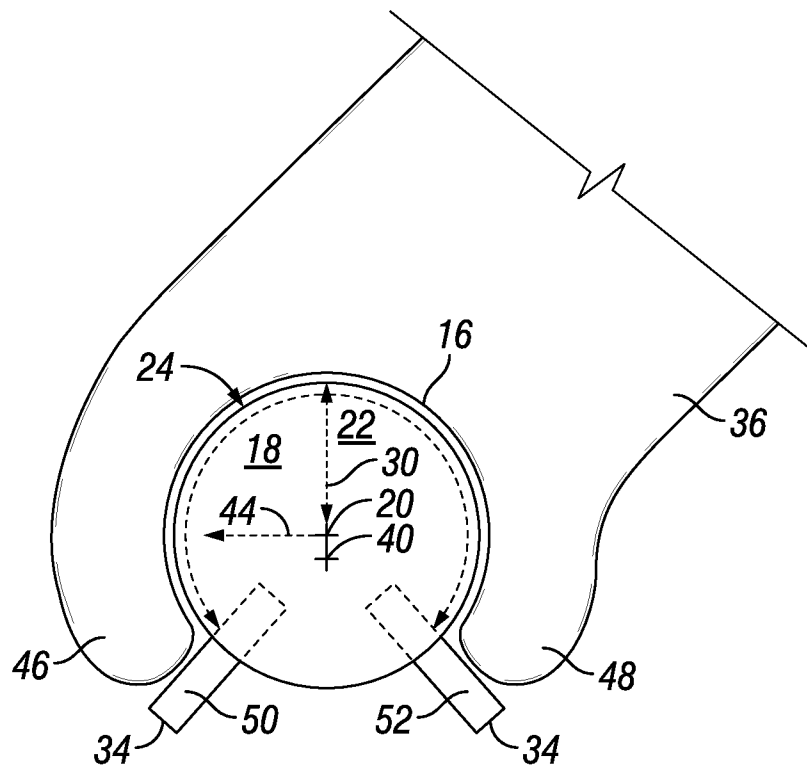


FIG. 15

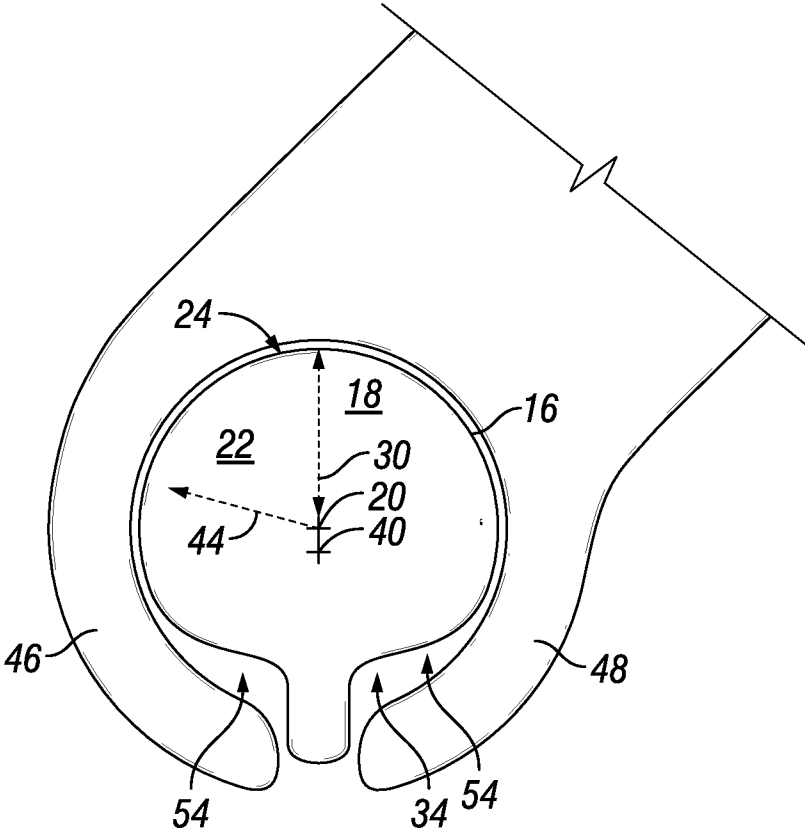


FIG. 16

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2017/035112

A. CLASSIFICATION OF SUBJECT MATTER
INV. F16D51/20 B60G9/00 F16D65/09
ADD.

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
F16D B60G

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

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

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 2016/080966 A1 (MICHELIN & CIE [FR]; MICHELIN RECH TECH [CH]; MERRILL ZACHARY ALEXANDE) 26 May 2016 (2016-05-26) the whole document -----	1-14
A	US 4 157 747 A (GETZ JOHN E [US] ET AL) 12 June 1979 (1979-06-12) column 3, lines 5-13; figure 4 -----	1-14
A	US 2014/262643 A1 (DETTLOFF DAVID J [US] ET AL) 18 September 2014 (2014-09-18) paragraph [0019]; figures 2,6,7 -----	1-14



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

4 August 2017

Date of mailing of the international search report

23/08/2017

Name and mailing address of the ISA/

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040,
Fax: (+31-70) 340-3016

Authorized officer

Hernandez-Gallegos

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/US2017/035112

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 2016080966	A1	26-05-2016	AU 2015349936 A1 15-06-2017
		CA 2963685 A1 26-05-2016	
		WO 2016080966 A1 26-05-2016	
		WO 2016081625 A1 26-05-2016	

US 4157747	A	12-06-1979	AR 216979 A1 15-02-1980
		AU 546738 B2 19-09-1985	
		BR 7902249 A 04-12-1979	
		CA 1078753 A 03-06-1980	
		DE 2927162 A1 08-01-1981	
		ES 479567 A1 01-01-1980	
		FR 2432116 A1 22-02-1980	
		GB 2018919 A 24-10-1979	
		JP S6329132 B2 13-06-1988	
		JP S54137571 A 25-10-1979	
		US 4157747 A 12-06-1979	

US 2014262643	A1	18-09-2014	BR 102014005936 A2 08-12-2015
		CN 104047977 A 17-09-2014	
		US 2014262643 A1 18-09-2014	
		US 2015122603 A1 07-05-2015	
