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(71) **Applicant** (*for all designated States except US*): **INSTINCT (2008) LIMITED** [NZ/NZ]; 8 Richardson Street, Whakatane, 3120 (NZ).

(72) **Inventor:** COLLINS, Peter Roger; 20 Omega Place, Coastlands, Whakatane, 3120 (NZ).

(72) Inventor; and

(75) **Inventor/Applicant (for US only):** COLLINS, Peter Roger [NZ/NZ]; 20 Omega Place, Coastlands, Whakatane, 3120 (NZ).

(74) **Agents:** O'CALLAHAN, Logan, P et al.; A J Park, PO Box 949, Wellington, 6140 (NZ).

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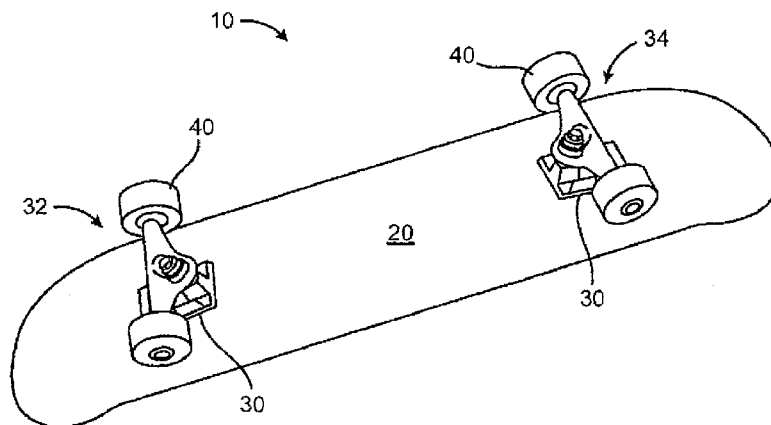


FIGURE 1

(S7) Abstract: A skateboard truck includes a base, a hanger and a pivot connection between the base and the hanger, retaining the hanger to the base. A kingpin is secured to the base through an opening in the hanger. A pivot connection between the hanger and the kingpin excludes translation movement except along the axis of the kingpin. A resilient spacer is compressed between the base and the hanger. The spacer size determines an angular orientation of the kingpin's axis, a location of the hanger pivot connection to the kingpin, and a pivot axis of the hanger relative to the base, a pivot axis of the hanger relative to the base is defined by a line between the first and second pivot connections, and contact between a surface of the hanger's opening and the kingpin defines end limits for tilting of the hanger about axes transverse to the axis of the kingpin.

A TRUCK FOR A RIDEABLE BOARD

FIELD OF THE INVENTION

The invention relates to skateboards and similar rideable boards, and more particularly to trucks for rideable boards.

BACKGROUND OF THE ART

The first commercially available skateboards were produced and sold in California during the early 1960s. Early skateboard design and development was heavily influenced by surfing. Skateboard development climaxed in the late 1970s and skateboards incorporating many of the features encountered today were publicly available.

The majority of modern skateboards can be classified as either longboards or shortboards. The distinction between these categories can be concluded from a number of characteristic features that have evolved to accommodate specific applications.

Longboards are commonly used for cruising, downhill racing or as transport. As the name suggests, longboards generally comprise a longer skateboard deck, often measuring between 90 and 150cm. Generally the trucks and wheels used in conjunction with a longboard will also be larger than the shortboard equivalents. The greater size and weight of a longboard makes them less suitable for many common skateboard tricks, but results in a fluid riding motion through greater momentum.

The specific configuration of a longboard (including deck, truck and wheel selection) is often adapted to the intended application of the longboard. Downhill longboards are generally configured for high speed stability and often have stiff deck and truck configurations with a lower centre of gravity. Conversely, cruising longboards generally have flexible decks to increase comfort and soft truck settings to promote responsiveness.

The other common category of skateboard, the shortboard, is configured predominately for performing skateboard tricks. Accordingly, shortboard components are generally smaller and lighter than the longboard equivalents. Shortboard decks are generally between 70 and 84cm in length and commonly vary between 18 and 27cm in width.

Modern shortboard decks have a raised lip (known as a kick tail or kick) located at either end that provides leverage for performing tricks. Shortboard trucks and wheels are generally smaller and lighter than the longboard equivalents to better accommodate execution of the tricks.

Skateboard Trucks

The trucks of a skateboard facilitate turning and provide mounting locations for the wheels. Conventional skateboards have a pair of trucks mounted to the underside of the deck. The trucks are generally spaced apart to support the user.

5 A traditional skateboard truck comprises a hanger and a base. The hanger includes an axle which the skateboard wheels are mounted to, while the base is configured to mount to the skateboard deck. The hanger and base are movably coupled to enable the skateboard to turn. The physical geometry of the base and hanger, combined with the properties of the coupling between these components, determines turning characteristics of the skateboard.

10 The hanger and base of traditional skateboard trucks are coupled by a kingpin and complementary pivot head and cup arrangement. The kingpin retains the hanger and base in relative position and provides a first pivot point to restrain relative movement of these components. A second pivot point is provided at the pivot head and cup interface. The relative positions of these pivot points with respect to the deck, often referred to as the truck geometry,
15 determines the truck turning angle.

The turning angle of the truck represents the amount the axle will turn for a given angle of deck pitch. The turning angle of conventional trucks is commonly selected by choosing the angle of the kingpin relative to the deck. Generally, the truck turning angle increases with more acute kingpin angles (the angle the kingpin form with the deck). The greater the kingpin angle
20 the more stable the truck is and a greater force is required to make the skateboard turn.

Shortboard trucks generally have greater kingpin angles than the longboard equivalents. However, downhill longboards, commonly configured for high speed applications, will often incorporate trucks with increased kingpin angles to promote stability. In some instances (particularly boards configured for slalom applications) a skateboard may incorporate two trucks
25 with different configurations to promote preferable characteristics (such as greater responsiveness and traction). Generally longboard trucks have kingpin angles between 30° and 55°.

Conventional trucks incorporate two resilient bushings located between the base and the hanger end of the kingpin. The bushings are commonly made from flexible polyurethane and
30 facilitate relative movement of the hanger and base by suitably deforming. When deformed, the bushings provide a resilient returning force that acts toward a neutral undeformed configuration.

The first bushing is located between the base and the hanger. The second bushing is positioned between the hanger and the end of the kingpin located remote of the base. Each bushing has a corresponding cup washer, which are positioned adjacent the base and end of the kingpin located remote of base respectively. The cup washers retain the bushing in position and regulate their deformation.

The stiffness of the bushings contributes to the overall responsiveness of the skateboard by altering the turning resistance.

SUMMARY OF THE INVENTION

In one aspect, the present invention may broadly be said to consist in a skateboard truck comprising a base, a hanger, a pivot connection between the base and the hanger which retains the hanger to the base, a king pin secured through an opening in the hanger and secured to the base, and a pivot connection between the hanger and the kingpin which excludes translation movement except along the axis of the kingpin, and a resilient spacer located about the kingpin and compressed between the base and the hanger; wherein the size of the spacer determines an angular orientation of the axis of the kingpin, a location of the hanger pivot connection to the kingpin, and a pivot axis of the hanger relative to the base; a pivot axis of the hanger relative to the base is defined by a line between the first and second pivot connections, and contact between a surface of the opening of the hanger and the kingpin defines end limits for tilting of the hanger about axes transverse to the axis of the kingpin.

According to a further aspect, the pivot connection between the base and the hanger includes a shaft extending from the hanger, secured in a spherical bearing retained to the base, such that the shaft pivots about the pivot centre of the spherical bearing.

According to a further aspect, the base includes a socket open toward the hanger, the spherical bearing is secured to the socket, and an opening extends through the base to the bottom of the socket, and a retainer that is visible through the opening secures the hanger shaft to the spherical basing.

According to a further aspect, one end of the kingpin is retained in a socket in the base, the socket opening away from the hanger, and an aperture extends through the base to the bottom of the socket, the kingpin passing through the aperture, the aperture shaped to provide for angular movement of the kingpin in a fore and aft direction, but not in a side to side direction.

In another aspect, the present invention may broadly be said to consist in a skateboard truck comprising a base, a hanger, a pivot engagement between the base and the hanger, a king

pin secured through the hanger and secured to the base, and a pivot connection between the hanger and the kingpin.

According to a further aspect, the pivot engagement between the base and the hanger comprises, a pivot connection between the base and the hanger, and wherein each of the pivot connections retains the hanger to the base independently of the other pivot connection, and a pivot axis of the hanger relative to the base is defined by a line between the first and second pivot connections.

According to a further aspect, the pivot connection between the base and the hanger includes a shaft extending from the hanger, secured in a spherical bearing retained to the base, such that the shaft pivots about the pivot centre of the spherical bearing.

According to a further aspect, the base includes a socket open toward the hanger, the spherical bearing is secured to the socket, and an opening extends through the base to the bottom of the socket, and a retainer that is visible through the opening secures the hanger shaft to the spherical basing.

According to a further aspect, the pivot connection of the hanger on the kingpin allows tilting of the hanger about axes transverse to the kingpin, but excludes translation movement except along the axis of the kingpin.

According to a further aspect, the skateboard truck includes a resilient spacer located about the kingpin, compressed between the base and the hanger.

According to a further aspect, the skateboard truck includes a resilient spacer located about the kingpin compressed between the base and the hanger, the size of the spacer determining an angular orientation of the axis of the kingpin, a location of the hanger pivot connection to the kingpin, and a pivot axis of the hanger relative to the base.

According to a further aspect, one end of the kingpin is retained in a socket in the base, the socket opening away from the hanger, and an aperture extends through the base to the bottom of the socket, the kingpin passing through the aperture, the aperture shaped to provide for angular movement of the kingpin in a fore and aft direction, but not in a side to side direction.

According to a further aspect, the base includes a bearing surface surrounding the aperture, facing toward the hanger and oriented approximately normal to the kingpin axis, and a cup washer is located between the spacer and the bearing surface, the kingpin passing through an aperture in the cup washer.

According to a further aspect, the kingpin extends through an opening in the hanger and is secured at one end portion to the base, the pivot connection of the hanger on the kingpin excludes translation movement except along the axis of the kingpin, and contact between a

surface of the opening of the hanger and the kingpin defines end limits for tilting of the hanger about axes transverse to the axis of the kingpin.

According to a further aspect, the opening is an aperture having a sidewall that extends along the axis of the kingpin beyond the extent of the pivot connection, and the contact occurs
5 between the sidewall and the kingpin.

According to a further aspect, the contacting sidewall portion of the hanger aperture is located between the pivot connection and the base.

In another aspect, the present invention may broadly be said to consist in a skateboard including a deck and at least a truck secured to the deck, the truck comprising a base, a hanger, a
10 pivot engagement between the base and the hanger, a king pin secured through the hanger and secured to the base, and a pivot connection between the hanger and the kingpin.

According to a further aspect, the pivot engagement between the base and the hanger comprises, a pivot connection between the base and the hanger, and wherein each of the pivot connections retains the hanger to the base independently of the other pivot connection, and a
15 pivot axis of the hanger relative to the base is defined by a line between the first and second pivot connections.

According to a further aspect, a flange on the kingpin retains the hanger and a shank of the kingpin engages a nut retained in the base in such a fashion that the nut can orient to the axis of the kingpin but cannot turn, and a resilient spacer is located about the kingpin compressed
20 between the base and the hanger, the size of the spacer determining an angular orientation of the axis of the kingpin, a location of the hanger pivot connection to the kingpin, and a pivot axis of the hanger relative to the base.

According to a further aspect, the kingpin extends through an opening in the hanger and is secured at one end portion to the base, the pivot connection of the hanger on the kingpin
25 excludes translation movement except along the axis of the kingpin, and contact between a surface of the opening of the hanger and the kingpin defines end limits for tilting of the hanger about axes transverse to the axis of the kingpin.

The term “comprising” as used in this specification (and claims - where present -
30 delete if it is a NZ prov) means “consisting at least in part of”. When interpreting each statement in this specification (and claims-again delete if not needed) that includes the term “comprising”, features other than that or those prefaced by the term may also be present. Related terms such as “comprise” and “comprises” are to be interpreted in the same manner.

This invention may also be said broadly to consist in the parts, elements and features referred to or indicated in the specification of the application, individually or collectively, and any or all combinations of any two or more said parts, elements or features, and where specific integers are mentioned herein which have known equivalents in the art to which this invention relates, such known equivalents are deemed to be incorporated herein as if individually set forth. (Keep in Prov but remove in Complete spec)

The invention consists in the foregoing and also envisages constructions of which the following gives examples only.

10 BRIEF DESCRIPTION OF THE DRAWINGS

Preferred embodiments of the invention will be described by way of example only and with reference to the drawings, in which:

Figure 1 is a perspective lower side view of a skateboard incorporating a pair of conventional skateboard trucks

15 **Figure 2** is an exploded perspective view of a conventional skateboard truck including a base, hanger, kingpin, bushings and cup washers.

Figure 3a is an exploded side view of a truck according to an embodiment of the present invention including a base, hanger, kingpin, bushing, kingpin sleeve, retaining fastener and washer arrangement. The truck has four mounting protrusions that project from the base into the skateboard deck and a single centrally located fastener to support the truck.

Figure 3b is an exploded side view of a truck according to an embodiment of the present invention including a base, hanger, kingpin, bushing, kingpin sleeve, retaining fastener and washer arrangement. The truck has two mounting protrusions that project from the base into the skateboard deck and a single centrally located fastener to support the truck.

25 **Figure 3c** is an exploded side view of a truck according to an embodiment of the present invention including a base, hanger, kingpin, bushing, kingpin sleeve, retaining fastener and washer arrangement. The truck has a single mounting protrusion that projects from the base into the skateboard deck and a single fastener to support the truck.

Figure 3d is an exploded side view of a truck according to an embodiment of the present invention including a base, hanger, kingpin, bushing, kingpin sleeve, retaining fastener and washer arrangement. The truck has four fastener apertures that each receive complimentary

fasteners to support the truck, the fasteners are secured within the truck base and do not require separate fastening nuts.

Figure 4b is an assembled side view of the truck of Figure 3a illustrating the potential for skateboard height reduction.

5 **Figure 4b** is an assembled side view of the truck of Figure 3b illustrating the potential for skateboard height reduction.

Figure 4c is an assembled side view of the truck of Figure 3c illustrating the potential for skateboard height reduction.

10 **Figure 4d** is an assembled side view of the truck of Figure 3d illustrating the potential for skateboard height reduction.

Figure 5 is a perspective view of the truck pictured in Figure 4 assembled and installed in a skateboard deck. The truck illustrated from an inner location of the skateboard deck and shows the kingpin coupling and bushing arrangement that retains the hanger relative to the base.

15 **Figure 6** is an exploded front view of an embodiment of hanger incorporating a braking mechanism actuated by the users weight distribution. The braking mechanism comprises a washer, spring and brake collar illustrated axially exploded with a conventional skateboard truck wheel, bearings and dome nut.

Figure 7 is an assembled close up front view of one side of the hanger pictured in Figure 6 illustrating the braking mechanism installed and unengaged.

20 **Figure 8** is an assembled close up front view of one side of the hanger pictured in Figure 7 illustrating the braking mechanism engaged and the braking protrusion abutting with the skateboard wheel.

25 **Figure 9** is an assembled close up front view of one side of the hanger pictured in Figure 8 illustrating the braking mechanism disabled by a collar inserted about the truck axle underneath the spring between the hanger a skateboard wheel.

Figure 10 is an exploded front view of an embodiment of hanger incorporating a braking mechanism actuated by the users' weight distribution. The braking mechanism is the same as the mechanism illustrated in Figure 6 except the braking protrusions are provided as separate replaceable components.

30 **Figure 11** is a perspective view of the skateboard wheel illustrated in Figure 10.

Figure 12 is a perspective view of the braking side of the detachable brake protrusion illustrated in Figure 10.

Figure 13 is a perspective view of the backing plate side of the detachable brake protrusion illustrated in Figure 10.

5 **Figure 14** is a perspective view of the truck and braking mechanism of Figure 10 assembled.

Figure 15 is a cross-section view from one side of a truck with a locked pivot coupling and a centralised kingpin coupling.

Figure 16 is a perspective view of the truck of Figure 15.

10 **Figure 17** is a side view of the truck of Figure 15.

Figure 18 is a side view of a “reverse kingpin” truck with a locked pivot coupling and a centralised kingpin coupling.

Figure 19 is a side perspective view of the truck of Figure 18 with bush removed and kingpin partially withdrawn.

15 **Figure 20** is a rear view of a truck of the type illustrated in Figure 15, with partial cut away at the coupling of the kingpin to hanger.

Figure 21 is a similar view to Figure 20, but excluding the bushing to improve visibility of the kingpin, with the hanger tilted to one side, to show how the centralized kingpin coupling and shape of the aperture together limit tilting movement of the truck.

20 **Figure 22** is a bottom view of the truck of Figure 21.

Figure 23 is a cross-section of the truck of Figure 15, with diagram illustrating adjustability of hanger angle.

Figure 24 is a cross-section of an alternative variation, with diagram illustrating adjustability of hanger angle.

25 **Figures 25a and 25b** are views of alternative variations on a cross-section through line AA in Figure 24 (limited to the area immediately surrounding the base aperture).

Figures 26A to 26D illustrate a range of resilient bushes to suite different hanger pivot angles for the truck of Figure 24.

30 **Figure 27** is a side view of a truck of the type of Figure 18, with the mounting arrangement of Figure 3b.

Figure 28 is a side view of a truck of the type of Figure 15 with a mounting arrangement of the type of Figure 3b.

Figure 29 illustrates a skateboard including a deck and a pair of trucks of the type of Figure 18 or 27.

Figure 30 illustrates a skateboard including a deck and a pair of trucks of the type of Figure 15 or 28.

5

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

Figure 1 illustrates a conventional skateboard comprising a shortboard deck 20 with two conventional skateboard trucks 30 mounted to the underside. Each truck 30 is mounted with the kingpin coupling facing inwardly of the deck 20 and the pivot head and cup facing the respective
10 kicktails. A pair of skateboard wheels 40 are mounted either side of each truck 30.

The trucks 30 are illustrated in greater detail in Figure 2. Each truck comprises a base 52 that is configured to mount to the underside of a skateboard deck. The base 52 incorporates six mounting holes that accommodate the bolts (not pictured) used to connect the base 52 to the skateboard deck 20. Generally four bolts are used to mount the base 52, with the additional holes
15 compensating for alternate hole placements in the deck.

The hanger 68 incorporates an axle 66 that extends transverse to a skateboard deck when the truck is mounted. The axle 66 supports the wheels of the skateboard (not shown in Figure 2). The wheels 40 mount to the axle 66 on either side of the hanger 68 and are retained on the axle 66 by a pair of wheel nuts 64. A bearing is commonly press fit inside the wheels 40. The bearing
20 allows the wheel 40 to rotate.

The hanger 68 and base 52 are coupled by a kingpin 50. The kingpin 50 is a threaded fastener that extends through respective apertures in both the hanger 68 and the base 52. The illustrated kingpin is arranged in a 'conventional' orientation (as opposed to 'inverted' or 'reverse'), where the kingpin head (in this case a hexagonal bolt head) is positioned within the
25 base 52 and a retainer (usually a suitable threaded nut) is threaded onto the kingpin adjacent the hanger 68. The kingpin 50 may be inserted through the hanger 68 and into the base 52, with the retainer disposed within or adjacent the base 52 and the kingpin head accessible from the underside of the skateboard deck 20 (referred to as an 'inverted' or 'reversed' kingpin).

The hanger 68 is retained in position by the fastening tension of the kingpin 50. The
30 kingpin 50 compresses a pair of resilient bushings 58, 70 that bear against the hanger 58 to secure it in place relative to the base 52. The hanger bushing 58 is supported by a hanger cup washer 60 that is positioned against the end of the kingpin 50 away the base 52. The base bushing 70 is supported by a base cup washer 72 that is positioned against the base 52. The cup

washers 60, 72 locate the respective bushings 58, 70 and control the shape of their deformation. The bushing 58, 70 are compressed and deform asymmetrically when an off-centre force is applied to the hanger 68, causing the hanger to swivel and allowing the skateboard to turn.

The hanger 68 and the base 52 also interface at the junction of the pivot head 56 and the pivot cup 54. The pivot head 56 and cup 54 provide a pivot connection between the hanger 68 and the base 52. The pivot head 56 is retained in the pivot cup 54 by the securing force of the kingpin 50. The pivot cup 54 is generally fabricated from (or alternatively lined with) a hard wearing low friction material, such as a nylon, rubber, PTFE, glass composite plastic or a suitable polymer, to accommodate the bearing force of the pivot head 56.

The positions of the pivot head 56 and cup 54 relative to the kingpin head determine the turning characteristics of the truck (commonly referred to as the truck geometry). Generally, alterations to the truck geometry involve modifying the angle the kingpin 50 makes with the skateboard deck (reflected in the angle the hanger 68 makes with the base 52).

The pivot junction (the junction between the pivot head and pivot cup) and the kingpin are spaced along a line of symmetry (or centreline) of the truck, and are conventionally aligned with the longitudinal axis of the skateboard deck (as illustrated in Figure 1).

Kingpin coupling

Various truck arrangements are illustrated in Figures 3a to 4d. Each truck comprises similar fundamental features. Common or similar features of the truck are denoted with the same base reference numerals (such as kingpin 150) and a prefix that reflects a particular embodiment (the kingpin is denoted with reference numeral 2150 in Figure 3c). The base reference numeral may be used to identify characteristics that are common to each embodiment.

The kingpin 150 illustrated in Figures 3a to 3d is arranged in an inverted configuration most commonly encountered in longboard trucks. However, the coupling is equally applicable to non-inverted or conventional kingpin arrangements, where the kingpin head is retained within the base and the threaded section of the kingpin extends through the hanger coupling remote of the base (as illustrated in Figures 1 and 2).

The tension of the kingpin 150 provides a compressive coupling to retain the hanger 168 and base 152 together. Relative movement of the hanger 168 and base 152 is facilitated by a single resilient bushing 170 located about the kingpin 150 between the base 152 and hanger 168. The bushing 170 is configured to deform to permit relative movement of the hanger 168 and base 152. Deformation of the bushing 170 allows the axle to turn in response to changes in weight distribution on the skateboard deck.

In the embodiment pictured in Figures 3 to 5 there is no upper bushing between the hanger 168 and the end 157 of the kingpin located remote of the base (such as is present in conventional truck couplings). Instead there are two washers 181, 182 positioned between the hanger 168 and kingpin end 157.

5 The truck 100 can be adjusted, similarly to a conventional truck, by to altering the kingpin 150 tension to modify the turning characteristics. Tightening the kingpin 150 compresses the bushing 170, resulting in a stiffer less responsive coupling that is more stabile. Conversely, loosening the kingpin 150 reduces compression on the bushing 170, resulting in greater responsiveness.

10 Although not essential, the washers 181, 182 reduce wearing of the hanger 168 and the kingpin 150 by facilitating low friction sliding. The kingpin end washer 181 is preferably fabricated from a harder material than the hanger end washer 182 to withstand the forces exerted by the kingpin end 157. In the most preferred embodiment, the kingpin end 157 washer 181 is metallic (most preferably steel) and the hanger 168 washer 182 is fabricated from a suitable
15 polymer (such as nylon). Alternatively, the kingpin end washer 181 may also be fabricated from an appropriate polymer, preferably of greater hardness than the hanger end washer 182.

 The forces generated by the kingpin end 157 are sequentially distributed to the kingpin end washer 181, the hanger end washer 182 and the hanger 168. Preferably the surface area of each component increases from the kingpin end 157 toward the hanger to effectively distribute
20 the generated force. To this extent it is preferable that the kingpin end washer 181 has a greater outer diameter than the kingpin end 157, but a smaller outer diameter than the hanger end washer 182 (as illustrated in Figure 3a to 3d).

 The sequential increase in surface area from the kingpin end 157 to the hanger washer 182 distributes the kingpin forces over a greater surface area of the hanger 168, which reduces
25 material stress. Furthermore, the ability of the kingpin end 157 and kingpin end washer 181 to slide relative to the hanger 168 distributes the forces exerted on the hanger 168 away from the kingpin hole 186, which can be vulnerable to fatigue and fracture from increased stress intensity (arising from the proximity of the kingpin hole 186) and reduced material thickness.

 The low friction interface and relative size between the washers 181, 182 prevents the
30 kingpin end washer 181 from pitching under the influence of the kingpin end 157 during a turn. The kingpin end 157 is inclined with respect to the hanger recess 185 during a turn as the hanger 168 pitches with respect to the kingpin 150 enabling turning. By retaining the kingpin end washer 157 true with respect to the hanger recess 185 and hanger end washer 182 during a turn the force transmission surface area is maintained, preventing excessive stress on the hanger as

can occur when the washer 181 pitches on edge or the kingpin end 157 acts directly on the hanger 168.

Another advantage of the sequential washer sizing arrangement is that the kingpin end washer 181 is gradually rotated over extended use of the truck 100. Rotating the kingpin end washer 181 distributes the dynamic forces across the washer 181 evenly, promoting balanced wearing and work hardening (if a metallic washer is employed) of the washer 181.

Preferably the hanger end washer 182 is accommodated in a complementary rebate in the hanger 168, illustrated in Figure 9. The rebate 185 is arranged about the hanger kingpin hole 186 and is responsible for locating the washer and preventing significant movement. The circumferential lip of the rebate 185 may be configured to extend past the hanger end washer 182, so that the depth of the rebate exceeds the hanger end washer 182 thickness. This provides a displacement limit for the kingpin end washer 181. Preferably the outer diameter of the hanger washer 182 is marginally larger than the rebate 185 circumference, requiring the washer 182 to be compacted on insertion and ensuring the washer 182 is firmly retained in position.

The coupling illustrated in Figures 3 to 8 facilitates all practical movement between the hanger 168 and the base 152 through deformation of the resilient bushing 170. One significant advantage of this configuration is that all movement of the truck axle 166 relative to the skateboard deck is restricted to movement occurring between the hanger 168 and the base 152.

The truck coupling illustrated in Figures 3 to 8 exhibits greater stability (compared to conventional trucks) when the skateboard is travelling in a straight line over substantially even terrain. In this circumstance the truck is in a neutral state with the axle substantially parallel with the skateboard deck. To transition from a neutral truck state in order to execute a turn, the user must exert a greater force than generally required with conventional skateboard trucks having similar configurations (bushing stiffness and kingpin angle). This is predominantly attributable to the increased stiffness of the upper coupling (between the hanger 168 and kingpin end 157) resulting from the absence of an upper bushing. As a result, the skateboard has a returning force that the user must overcome before executing a turn. This stabilising force and associated stable region promotes user confidence (particularly at high speeds) and is largely attributable to the lack of deformation between the kingpin end 157 and hanger 168.

The single bush coupling allows the kingpin 150 angle with the base 152 to be reduced as the kingpin end 157 does not project past the axle. The kingpin 150 is also shielded from objects under the skateboard deck as it is partially concealed by the hanger 168.

To accommodate the permissible reductions in kingpin angle the pivot head 156 is preferably shifted forward over the pivot cup 154. Shifting the pivot head 156 forward reduces

preloading of the bushing 170 by transferring a greater portion of the compressive forces (such as the static and impactive weight force of the user) to the pivot head and cup engagement. By reducing preloading on the bushing 170, the truck 100 turning angle is increased as the bushing 170 is capable of greater deformation during execution of a turn (as there is less static deformation). The pivot head 156 position can be varied up to a 90° coupling (directly over the pivot cup) depending on the intended application of the truck.

Preferably the pivot cup 154 is formed in an open configuration to reduce restrictions on pivot head 156 movement, further increasing the turning angle of the truck. In the most preferred embodiment the pivot head 156 is not supported by the side of the pivot cup 154 (as commonly encountered in conventional rubber pivot cup arrangements), but rests on the pivot cup 154 base independently of the sides when the truck is not excessively loaded. The pivot head 156 may abut with the pivot cup 154 sides at the limit of the trucks turning capacity, but in general the pivot head 156 and cup 154 engagement does not restrict movement of the hanger 168 relative to the base 152 in the most preferred embodiment.

The single bushing configuration is cable of adaptation to retain the truck geometry as the pivot cup 154 wears. Wearing in the pivot cup 154 moves the pivot head 156 interface inwardly toward the truck base 152, which consequently moves the hanger 168 forward toward the pivot head and cup engagement. To facilitate forward movement of the hanger 168, the kingpin 150 and kingpin end washer 181 move backward in the hanger recess 185 (away from the pivot head and cup engagement). The pivot cup 154 can be replaced when wearing becomes excessive and the characteristics of the truck become detrimentally affected. Replacing the pivot cup 154 will return the kingpin 150 and kingpin end washer 181 to a forward position toward the pivot head and cup engagement. Similarly, both the kingpin end washer 181 and hanger end washer 182 can be replaced to maintain the trucks performance.

Kingpin sleeve

Tightening the kingpin 150 compresses the bushing 170, resulting in a stiffer less responsive coupling that is more stabile. Conversely, loosening the kingpin 150 reduces compression on the bushing 170, resulting in greater responsiveness. However, tensioning the kingpin to modify the responsiveness of the truck 100 also effects the truck geometry by altering the relative positions of the hanger 168 and base 152 and can create uneven compression in the bushing 170.

An optional sleeve 172 may be inserted within the bushing 170 and about the kingpin 151 to provide a limit stop when adjusting the kingpin 151. The length of the sleeve 172 is

preferably selected for a particular truck to provide an optimal geometry (tradeoff between turning angle and stability) when the kingpin 157 is set to the limit stop.

The depth of the bushing 170 is also preferably selected to reflect the optimal geometry for a particular truck. Generally, the sleeve 172 and bushing 170 are of commensurate depth so that the bushing 170 is evenly compressed at the limit stop to provide uniform resistance to deformation. The opposed faces of the bushing 170 (oriented toward the base 152 and hanger 158) are generally parallel when the kingpin 157 is adjusted to the limit stop set by the sleeve 172 in this situation. As the bushing 170 cannot be compressed beyond the limit set by the sleeve 172, the stiffness of the truck can only be adjusted by altering the bushing 170 properties (requiring the bushing to be exchanged).

The sleeve 172 also stabilises the truck by removing unwanted play between the kingpin 157 and the base 152 and increases tension in the kingpin 157 when it is adjusted to the limit stop, effectively locking the kingpin 157 in place. The increased stiffness of the kingpin 157 eliminates vibrations.

Locked pivot junction

Conventional pivot junctions (as illustrated in Figures 1 and 2), may dislocate during use, as the pivot head is not directly restrained within the pivot cup. Displacement of the pivot head from the pivot cup can be caused by shock or impact loading the truck and may be exacerbated if the truck is in a compromised condition. Some factors that may also contribute to dislocation of the pivot junction include excessively worn truck components, loose kingpin setups, extreme loading and over extension of the pivot junction.

Skateboard trucks 5000 with a locked pivot coupling 5055 formed at the pivot junction between the base 5052 and the hanger 5068 are illustrated in Figures 15 to 25. The pivot head 5056 is secured to the base 5052 through the pivot coupling 5055, which virtually eliminates dislocation of the pivot junction in normal circumstances.

In the skateboard trucks illustrated in Figures 15 to 25 the illustrated hanger 5068 and base 5052 are independently secured through both the kingpin 5050 and the pivot coupling 5055. As the pivot head 5056 is locked directly to the pivot cup 5054, the kingpin 5050 tension can be adjusted over a greater range without compromises the integrity of the pivot junction (risking dislocation). The tension of the kingpin 5050 influences the handling of the truck 5000 by dictating the pre-compression of the resilient bushing 5070 which affect the stability and responsiveness of the truck 5000.

The bushing is chosen from a range of bushings of different stiffness. The bushing is slightly compressed between the hanger and the base. The slight compression results in initial

centering of the truck. Further asymmetric compression occurs during turning, with one side of the bushing being squeezed between surfaces of the hanger and base.

In some embodiments the rubber or plastic bushing may be replaced by an alternative mechanically resilient bushing, such as a stiff metal spring.

5 The truck 5000 retains similar manoeuvrability and performance characteristics to a conventional truck with traditional pivot head and cup (as illustrated in Figures 1 and 2). Locking the pivot junction as illustrated in Figures 15 to 25 effectively creates a fixed pivot joint between the base 5052 and the hanger 5068, preventing the pivot head 5056 from slipping within the pivot cup 5054 and unsettling the truck 5000.

10 A spherical bearing 5071 forms the foundation of the illustrated pivot coupling 5055 (other locked couplings may also be used, such as a ball and socket joint or similar pivoting arrangements). An outer ring 5072 of the spherical bearing 5071 is press fit into an aperture 5002 in the base 5052 in Figures 15 to 18. The outer ring 5072 may alternatively be threaded into the base 5052, secured with adhesive or a clip, or otherwise retained. In some
15 embodiments the outer ring 5072 seats against a shoulder 5004 that faces the hanger 5068.

A fastener 5075 engages with the pivot head 5056 to lock the pivot coupling 5055. The head of the fastener 5075 bears against a face of the bearing inner ring 5073 to secure the pivot head 5056 in position. The pivot head 5056 may bear against the other face of inner ring 5073 (on the hanger side of the bearing 5071) or extend through the bearing 5056 entirely.

20 The head of the fastener 5075 may be tapered to sit partially within the bearing inner ring 5073 so that the fastener head does not abut with the bearing outer ring 5072 and limit movement of the pivot coupling 5055.

The head of the fastener is preferably accessible through part of the aperture 5002 opening away from the hanger. In some board embodiments the head of the fastener may be
25 visible to the board rider in use. The board rider can see the head of the fastener moving in the aperture as the board tilts during turns.

Alternatively, the pivot head may be formed to directly incorporate the spherical convex surface of the pivot coupling, either integrally, or as a component part, and be locked into an outer ring on assembly to the base. For example, the outer ring may be split at one location to
30 expand over the spherical end prior to assembly into the base. This would suite a material of higher stiffness such as stainless steel. Alternatively the outer ring may be made from a material of lower stiffness, such as a suitable plastic. Suitable plastics might include Nylon or PTFE.

The preferred pivot coupling or connection is a spherical bearing (or ball joint) and is pivotal about multiple axes. This allows the coupling to accommodate changes in hanger angle that may result from using an adjustable kingpin coupling.

However, in a truck with a fixed hanger pivot axis, the hanger to base pivot coupling
5 could be a coupling that pivots about only one axis (the hanger pivot axis). For example the coupling could be a hinge.

Centralised kingpin pivot

The trucks 5000 illustrated Figure 15 to 25 have a centralised pivot coupling 5060 formed between the hanger 5068 and the kingpin 5050. The hanger 5068 is secured to the kingpin 5050
10 through the pivot coupling 5060. The trucks 5000 illustrated in Figures 15 to 25 have an inverted kingpin arrangement the kingpin head 5006 adjacent the hanger 5068 and the kingpin having a threaded connection to the base.

In some embodiments the threaded connection to the base is through a hole or aperture, with the end of the kingpin secured in a nut 5036. In some embodiments the nut 5036 is housed
15 in a socket 5038. The socket may be shaped so that the nut 5036 cannot rotate, but can align axially with the kingpin rotation axis. The nut may pull against a shoulder 5040 which faces away from the hanger.

The truck could alternatively utilise a standard kingpin arrangement, with the head located in the base and a nut adjacent the hanger. However, in that arrangement, the protruding
20 nut has a higher profile and may inhibit pivoting of the bearing by impacting the sidewall of the hanger aperture, or may protrude from the hanger aperture, becoming vulnerable to contact with obstacles in use.

The kingpin pivot coupling 5060 is centred relative to the kingpin 5050. The illustrated coupling 5060 utilises a spherical bearing 5080 (similar to the locked pivot joint). Other
25 centralised couplings may also be used. For example to coupling to include a ball and socket joint (with the ball or socket provided on the end of the kingpin). Or, in the case of a fixed pivot axis, the connection could comprise a hinge having only one axis of pivoting (aligned with the hanger pivot axis).

The coupling 5060 differs from conventional truck kingpin arrangements (as illustrated in
30 Figures 1 and 2) and the single bushing arrangement best illustrated in Figures 3 to 5 by defining a single centralised pivot position about the kingpin 5050. The pivot position is centralised with respect to the longitudinal axis of rotation of the kingpin 5050.

By contrast, the kingpin coupling illustrated best in Figures 3 to 5 defines a decentralised pivot position. The pivot position moves about the kingpin end 5057 when the hanger 5068

pivots about the base 5052. The pivot position depends on the way the hanger 5068 pivots, the amount the hanger 5068 pivots and the diameter of the kingpin end 157 or washer 182 (pivot is generally formed at the outermost stationary point relative to the kingpin 150).

The pivot position defined by conventional kingpin couplings (as illustrated in Figures 1 and 2) is further complicated by deformation of the upper bushing 58 and the relative deformation of the upper 58 and lower 70 bushings when the hanger 68 pivots about the base 52.

The kingpin coupling 5060 illustrated in Figures 15 to 25 is centralised relative to the kingpin axis. The coupling 5060 is centralised by a defined pivot joint incorporated into the hanger 5068. The pivot joint illustrated in Figures 15 to 25 is a spherical bearing 5080. The spherical bearing 5080 may be located in an opening or aperture 5010 through the hanger.

Where the truck 5000 is setup with an inverted kingpin arrangement (as illustrated in Figures 15 to 25), the kingpin head bears against the inner ring 5083 of the bearing. Similarly to the pivot coupling 5055, the head of the kingpin may be tapered to sit partially within the bearing inner ring 5083 so that the kingpin head does not abut with the bearing outer ring 5082 and limit movement of the kingpin coupling 5060. The outer ring 5082 may be seated against a shoulder 5012 in the opening 5010. The shoulder may face away from the base.

In some embodiments the kingpin may not be completely secured to the spherical bearing 5080, the hanger 5068 may move axially along the kingpin 5050 a small amount as can be appreciated from the diagram in Figure 23. This axial movement reduces shock loading of the kingpin coupling 5060 (which can happen when the skater lands an aerial trick) and reduces the possibility that the pivot joint may be dislodged from the hanger 5068. As will be described in more detail below with reference to Figure 23, the extent of the sliding movement available along the kingpin depends on the truck geometry and the amount of play in the assembly.

In some embodiments the kingpin may have a plain shank portion adjacent the head that is the same or a larger diameter than the outermost extent of a threaded portion adjacent the free end. This plain shank provides a smoother bearing surface for the inner ring of the spherical bearing. In other embodiments the plain shank may provide a smoother bearing surface for other purposes such as abutting with the lower edge of the kingpin aperture in the hanger or the outer edge or collar of the kingpin aperture of the base.

Two defined pivot couplings

The combination of two defined pivots (pivot coupling 5055 and kingpin coupling 5060) illustrated in Figures 15 to 25 defines an essentially fixed pivot axis about which the hanger 5068 can pivot relative to the base 5052. The pivot axis 5085 is illustrated by line 5085 in Figure 23, and by line 5012 in Figure 18.

Tilt limiting

Another invention herein, illustrated with respect to Figures 20 to 22, takes advantage of this defined axis to establish fixed limits for lateral pivoting of the hanger 5068 about the base 5052.

5 The shape of the hanger kingpin hole 5010 and the diameter of the kingpin 5050 define a pivot limit for the movement of the hanger 5068 about the base 5052. As the kingpin pivot position 5014 does not move relative to the kingpin axis, abutment of a lateral surface 5016 of the kingpin 5050 against the inner surface 5018 of hole 5010 of the hanger 5068 defines a limit to the pivot motion of the hanger 5068. This is illustrated clearly in Figure 21, where the surface
10 5018 at one side of the hole contacts the surface 5016 of the kingpin, at location 5020.

These limits may be set and modified by using an insert (similar to a washer) that is press fit or otherwise retained in the hanger opening 5010 to define a suitable kingpin hole width at the lower edge of the hole. Alternatively, these limits may be set and modified by an insert that is fitted to surround the kingpin thereby increasing the effective kingpin control surface external
15 diameter to narrow the limit of the pivot motion of the hanger 5068. In this way the truck 5000 may be adapted simply and cheaply to various boards designs, wheel sizes and hanger pivot angles, to prevent wheel grab (also known as wheel bite).

The inner edge of the hole or insert may be chamfered or otherwise shaped to increase the load bearing surface. As discussed above, a portion of the kingpin in this region may have a
20 plain shank. The contact surface of the hole may be faced with a hard material, such as stainless steel, or with a hard wearing plastic material, such as nylon or PTFE.

Figure 22 illustrates the degree of turn allowed by the truck when tilted to the tilt limit illustrated in Figure 21.

According to some embodiments the kingpin may have a plain shank portion adjacent the
25 head. The plain shank portion may be sized to fit closely within the spherical bearing. The threaded shank portion, or an extended plain shank portion may extend from the bearing toward the base. In some embodiments, this portion, which is to bear against the inner surface of the aperture to limit tilt, is of a reduced diameter compared to the part of the shank adjacent the head.

30 Where this tilt limiting arrangement is implemented in conjunction with a retained hanger to base pivot connection, the tilt limit can be easily tested without the bush in place, allowing the user to see the point of contact, and therefore the movement limit of the axle and any connected wheel.

Adjustable hanger pivot axis

According to another invention herein, the hanger angle, and the hanger pivot axis, can be adjusted by choosing a preferred bushing 5070, from a selection of bushings.

Figure 23 illustrates a range of pivot angle that may be available through tolerance
5 between the kingpin and the spherical bearing and (with greater effect) between the kingpin and the aperture through the base. This tolerance provides a small amount of play, particularly by slight angular shifts of the kingpin in the aperture 5026 through base 5052. This play allows a degree of movement of the spherical bearing along the kingpin axis. The amount of movement, illustrated by the angle between lines 5028 and 5030, depends on the total play and on the angle
10 formed between the kingpin axis and the hanger pivot axis.

Where this angle, between the kingpin axis and the hanger pivot axis, is close to perpendicular, the amount of potential adjustment is increased for any given amount of play. This is due to the kingpin axis being tangential to the locus of movement 5032 of the pivot coupling centre 5034. An example truck having this angle close to perpendicular is the reverse
15 kingpin truck of Figures 18 and 19. In this truck, the kingpin passes between the axle and the base. The hanger pivot axis and the kingpin axis are illustrated by lines 5085 and 5022 respectively in Figure 18.

Further truck variations with improved degree of adjustability are illustrated in Figures 24 and 25. The truck variations illustrated in these figures provide for adjustment of the kingpin
20 angle in the fore and aft direction of the truck. This adjustment is illustrated by the three kingpin centre lines 2402, 2404, 2406 in Figure 24.

Kingpin centreline 2404 represents a centralised position of the kingpin. In this kingpin position, the hanger pivot axis is as illustrated by radius 2410.

Kingpin centreline 2402 represents a foreward (for a front truck) or backward (for a back
25 truck) limit angle of the kingpin – where the kingpin is stopped by edge 2412 of the base aperture. This results in a hanger pivot axis indicated by radius 2414.

Kingpin centreline 2406 represents the other limit of angular travel of the kingpin, where it meets the other end 2416 of the base aperture. This results in a hanger pivot axis illustrated by radius 2418.

30 The available adjustment is therefore between radius lines 241 and 2418.

Between these positions, the angle may be set by selecting a bushing of the correct height, from a range of bushings of different height. Bushing in the range may also have a wedge shape formed by an angle between the upper and lower faces that compliments the orientation of the opposed bearing faces of the hanger and base. An example range of

replacement bushings is illustrated in Figures 26A to 26D, with the hanger pivot angle progressively decreasing from Figure 26A to Figure 26D.

The kingpin 5050 may move in the fore and aft direction, but is restrained from moving in a side to side direction.

5 In some embodiments this range of movement may be provided by forming the aperture through the base 5052 as a wedge shaped slot. For example the wider part of the wedge would open toward the hanger and the narrower portion of the wedge open toward the nut 5036. Parallel sides of the slot would be aligned in the fore and aft direction and be separated by slightly greater than the diameter of the kingpin. These side surfaces would laterally support the
10 kingpin, while the wedge shape would allow angular adjustment of the kingpin in a fore and aft plane.

In other embodiments the lateral support and angular movement of the kingpin may be provided by supporting the kingpin at two locations. At a first location closer to the hanger the kingpin is supported to allow fore and aft movement of the location, but not lateral movement.
15 At a second location, further away from the hanger, the kingpin is allowed to pivot, but the kingpin location is constrained from moving fore and aft or laterally.

Two examples of this are illustrated in the Figures. Figure 24 broadly applies to both variations detailed with reference to Figures 25A and 25B.

In Figure 25A the insert 5021 with a rectangular or oval hole, sits in a rectangular recess
20 5023 in the face 5025 of the base. A slotted hole 5027 extends from the bottom of the recess 5023. A smaller, and short, hole 5029, just larger than the kingpin diameter, extends from the bottom of hole 5027, through the base and opens into the socket. The kingpin is supported at one location by the edges of the hole 5029 and at the other location by the inwardly facing surfaces of insert 5021. The insert may be made from any suitable material. In some embodiments the
25 insert may be made of a hard material such as stainless steel.

In Figure 25B the insert 5021 is a circular insert with a rectangular or oval hole, and sits in a circular recess 5023 in the face 5025 of the base. A hole 5027 with a smaller diameter than the recess extends from the bottom of the recess 5023. The insert sits against a shoulder thus formed at the junction of the recess 2023 and hole 5027. A smaller, and short, hole 5029, just
30 larger than the kingpin diameter, extends from the bottom of hole 5027, through the base and opens into the socket. The kingpin is supported at one location by the edges of the hole 5029 and at the other location by the inwardly facing surfaces of insert 5021. The insert may be made from any suitable material. In some embodiments the insert may be made of a hard material such as stainless steel.

The turning characteristic of the truck are largely defined by the hanger pivot axis relative to the deck of the board. Conventional trucks are specifically designed for a particular pivot axis. The pivot axis angle of conventional trucks cannot be changed more than a few degrees. Often skaters will buy and interchange trucks to achieve desired handling characteristics. At the same time, conventional trucks do not fully constrain the hanger pivot axis relative to the base, so that the turning characteristics of the board are imprecise.

The kingpin angle of the truck 5000 illustrated in Figure 24 can be adjusted over a wide range by simply altering the depth of the bushing 5070.

Furthermore, the shape of the bushing may be modified to reflect desired handling characteristics. The illustrated frustoconical bushing 5070 is particularly desirable as it allows a wide bearing surface 5022 under the kingpin hole 5010, but is sufficiently narrow over some of its height to allow a high degree of compression during turning.

Adjustment of the hanger pivot axis relative to the base (and therefore the deck of the board) is useful to adjust the balance between sharpness of turn and stability. Increasing the fore and aft angle of the pivot axis relative to the plane of the deck will increase the angle of turn for a given amount of tilt. However this will also reduce stability, with the board tending to prefer the tilted positions to the centred position.

Some truck geometries are inherently more stable than others and so suited to particular types of board and use. For example the style of truck illustrated in Figures 18 and 19 (which is commonly used on long boards) is more stable than the style of truck illustrated in Figures 15 to 17.

Base Mounting Configuration

Four alternate truck base mounting arrangements are illustrated in Figures 3a to 4d. Each truck comprises similar fundamental features. Similar features are denoted with similar reference numerals (the reference numeral prefix is altered in each instance to identify the specific embodiment to which they relate) to assist interpretation of the alternate embodiments.

Each of the base mounting arrangements illustrated in Figures 3a to 4d conceal the mounting components when the truck is installed and viewed from the underside of the deck, as illustrated in Figure 5. It is preferable that the truck base illustrated in each embodiment incorporates a suitable engagement configured to receive and secure a complimentary fastener so that separate securements (such as fastening nuts) are not required on the underside of the deck. In the illustrated embodiments, the respective truck bases include one or more threaded apertures configured to receive a complimentary arrangement of threaded fasteners mounted through the

top of the skateboard deck. Neither the fastener nor the aperture are visible from the underside of the deck when the truck is mounted.

Four Locating Protrusions

An embodiment of skateboard truck according to the present invention is illustrated in
5 Figures 3a and 4a. The skateboard truck 100 includes a base 152 configured to mount the truck to a skateboard deck. The base 152 includes four locating protrusions 171. The locating 171 protrusions are concealed from sight when the truck is mounted. A single retaining fastener 174 affixes the base 152 with the skateboard deck. The retention fastener 174 is preferably fastened into the truck base 152 from the top side of the skateboard deck, meaning that no fastening is
10 visible from the underside of the deck (as illustrated in Figure 5). The protrusions 171 are preferably integral with the truck base 152, but may be otherwise suitable affixed within the base 152 (such as by a threaded engagement concealed within the base 152).

The locating protrusions 171 project upwardly from a common surface of the base 152. The common base surface provides a substantially flat mounting interface to which the underside
15 of the skateboard deck abuts. The mounting interface portion is configured to transmit compressive forces between the base 152 and the skateboard deck and is at least partially responsible for supporting the weight of a user. Abutment of the mounting interface portion and skateboard deck underside provides a limit to the extent which the locating protrusions 171 extend into the skateboard deck.

20 In the pictured embodiments the locating protrusions 171 are generally cylindrical elongate extensions that may taper slightly with displacement from the base 152. The protrusions 171 are configured to replace the threaded bolts commonly employed to secure a conventional skateboard truck to a skateboard deck. The protrusions 171 are preferably commensurate in circumference and spaced to coincide with the mounting apertures in a conventional skateboard
25 deck so that the truck 100 may be substituted with a conventional skateboard truck with minimal additional modifications required for installation. The illustrated protrusions 171 are configured to fit within the skateboard deck and preferably do not extend past the end of the mounting apertures.

The locating protrusions 171 transmit shear forces (including fore, aft, lateral and
30 twisting forces) between the base 152 and skateboard deck. This is in contrast to conventional truck mounting arrangements where shear forces are transmitted through the fixings, not directly through the truck body.

The threaded bolts employed to mount conventional skateboard trucks cause wearing about the complimentary deck mounting holes, resulting in elongation with extended use. Wearing is caused by the shear forces acting between the base and the skateboard deck (particularly twist) and is accelerated by the sharp thread commonly encountered on the mounting bolts. The persistent wearing eventually results in the holes becoming elliptical, which introduces play between the truck base and deck and often leads to premature replacement of the deck.

In contrast, the mounting arrangement illustrated in Figures 3 to 5 reduces wearing by transmitting shear forces (particularly twisting) through the unthreaded protrusion 171. The locating protrusions 171 eliminate play that can occur between the mounting bolts and base in conventional mounting arrangements and provide greater rigidity.

The base 152 is coupled to the skateboard deck by a retaining fastener 174. The retaining fastener 174 prevents the truck from being dislodged from the skateboard deck when subjected to a separating force (such as the weight force acting on the truck when the skateboard is lifted from the ground). The skateboard truck pictured in Figures 3 to 5 incorporates a single retaining fastener 174.

Although multiple retaining fasteners are envisaged (and do not significantly alter the functionality of the mounting arrangement), it is preferable that the truck is restrained with a single centrally located retaining fastener (as illustrated in Figures 3 to 5). Multiple retaining fasteners increase the potential for skateboard deck wearing about the fastener hole, as invariably a portion of the twisting forces generated between the truck and deck is transmitted through off centre fasteners.

To prevent unnecessary lateral loading of the skateboard deck about the retention fastener 174, it is preferable that the retention fastener 174 (and associated base aperture 175) is located as close as practical to the centre of twist of the skateboard truck. A consequence of this configuration is that twisting moments generated between the truck and the deck act around the retention fastener 174 and are transmitted to the skateboard deck by the locating protrusions 171 reducing wearing on the deck.

The centre of twist of the truck is generally an empirical determination for a particular truck configuration and is not necessarily situated equidistant between the locating protrusions. The position of the centre of twist depends on the forces acting through the kingpin and pivot head and cup interface. In this respect, the centre of twist is highly dependent on the truck geometry and requires determination for different kingpin angles.

Two Locating Protrusions

Another embodiment of skateboard truck according to the present invention is illustrated in Figures 3b and 4b. The skateboard truck 1100 includes a base 1152 configured to mount the truck to a skateboard deck. The base 1152 includes two locating protrusions 1171. The locating
5 1171 protrusions are concealed from sight when the truck is mounted. A single retaining fastener 1174 affixes the base 1152 with the skateboard deck. The retention fastener 1174 is preferably fastened into the truck base 1152 from the top side of the skateboard deck, meaning that no fastening is visible from the underside of the deck (as illustrated in Figure 5). The protrusions 1171 are preferably integral with the truck base 1152, but may be otherwise suitable affixed
10 within the base 1152 (such as by a threaded engagement concealed within the base 1152).

The locating protrusions 1171 project upwardly from a common surface of the base 1152. The common base surface provides a substantially flat mounting interface to which the underside of the skateboard deck abuts. The mounting interface portion is configured to transmit compressive forces between the base 1152 and the skateboard deck and is at least partially
15 responsible for supporting the weight of a user. Abutment of the mounting interface portion and skateboard deck underside provides a limit to the extent which the locating protrusions 1171 extend into the skateboard deck.

Compressive forces acting between the base 1152 and skateboard deck may also be transmitted through the side wall of the locating protrusions 1171. This is particularly relevant
20 where the bearing surface of the shoulder portion is reduced (particularly about the protrusions 1171) or the shoulder is raised from the deck surface. The grade of taper on the locating protrusions 1171 may be modified to enable a greater portion of compressive forces between the base 1152 and deck to be transmitted through the side wall. Reducing the protrusion 1171 taper grade presents a greater surface area for the deck to bear against and transfer the user's weight
25 force. The compressive forces are preferentially transmitted through the protrusion 1171 side wall rather than the top of the protrusion as the skateboard deck directly above the protrusion is weakened by the reduction in deck thickness necessary to receive the protrusions 1171.

In the pictured embodiments the locating protrusions 1171 are generally cylindrical extensions that may taper slightly with displacement from the base 1152. The illustrated
30 protrusions 1171 are configured to fit within the skateboard deck and preferably do not extend past the top surface of the deck. The protrusions may have a frustoconical or truncated cone profile. Other configurations of locating protrusion could also be used and may include tapered and non-tapered rectangular sections.

The locating protrusions 1171 transmit shear forces (including fore, aft, lateral and twisting forces) between the base 1152 and skateboard deck. This is in contrast to conventional truck mounting arrangements where shear forces are transmitted through the fixings, not directly through the truck body.

5 The shear forces are transmitted substantially in the plain of the skateboard deck through an interface between the locating protrusions 1171 and the complimentary recesses in the skateboard deck. Preferably the interface contact surface area of each protrusion (the area of the protrusion transverse to the deck) is between 150mm² and 500mm².

10 The threaded bolts employed to mount conventional skateboard trucks cause wearing about the complimentary deck mounting holes, resulting in elongation with extended use. Wearing is caused by the shear forces acting between the base and the skateboard deck (particularly twist) and is accelerated by the sharp thread commonly encountered on the mounting bolts. The persistent wearing eventually results in the holes becoming elliptical, which introduces play between the truck base and deck and often leads to premature replacement of the
15 deck.

In contrast, the mounting arrangement illustrated in Figures 3b and 4b reduces wearing by transmitting shear forces (particularly twisting) through the unthreaded protrusion 1171. The locating protrusions 1171 eliminate play that can occur between the mounting bolts and base in conventional mounting arrangements and provide greater rigidity.

20 In contrast, the truck mounting arrangement illustrated in Figures 3b and 4b has a significantly increased transmission interface (the surface area between the locating protrusions 1171 and complimentary skateboard deck recesses) for distributing shear forces. Accordingly, the skateboard deck is exposed to a lower mechanical stress for the same shear loading. Additionally, the locating protrusions 1171 do not require threading to retain the truck relative to
25 the deck, further reducing wearing at the transmission interface.

The base 1152 is coupled to the skateboard deck by a retaining fastener 1174. The retaining fastener 1174 prevents the truck from being dislodged from the skateboard deck when subjected to a separating force (such as the weight force acting on the truck when the skateboard is lifted from the ground). The skateboard truck pictured in Figures 3b and 4b incorporates a
30 single retaining fastener 1174.

Although multiple retaining fasteners are envisaged (and do not significantly alter the functionality of the mounting arrangement), it is preferable that the truck is restrained with a single centrally located retaining fastener (as illustrated in Figures 3b and 4b). Multiple retaining

fasteners increase the potential for skateboard deck wearing about the fastener hole, as invariably a portion of the twisting forces generated between the truck and deck is transmitted through off centre fasteners.

To prevent unnecessary lateral loading of the skateboard deck about the retention fastener 1174, it is preferable that the retention fastener 1174 (and associated base aperture 1175) is located as close as practical to the centre of twist of the skateboard truck. A consequence of this configuration is that twisting moments generated between the truck and the deck act around the retention fastener 1174 and are transmitted to the skateboard deck by the locating protrusions 1171 reducing wearing on the deck.

The centre of twist of the truck is generally an empirical determination for a particular truck configuration and is not necessarily situated equidistant between the locating protrusions. The position of the centre of twist depends on the forces acting through the kingpin and pivot head and cup interface. In this respect, the centre of twist is highly dependent on the truck geometry and requires determination for different kingpin angles.

This mounting arrangement can be applied to trucks of different types. For example, Figure 27 illustrates a truck of the type of Figure 18, with the mounting arrangement of Figure 3b. Figure 28 illustrates a truck of the type of Figure 15 with a mounting arrangement of the type of Figure 3b.

Single Locating Protrusion

Another embodiment of skateboard truck according to the present invention is illustrated in Figures 3c and 4c. The skateboard truck 2100 includes a base 2152 configured to mount the truck to a skateboard deck. The base 2152 includes a single locating protrusion 2171. The locating protrusion 2171 is concealed from sight when the truck is mounted. A single retaining fastener 2174 affixes the base 2152 with the skateboard deck. The retention fastener 2174 is preferably fastened into the truck base 2152 from the top side of the skateboard deck, meaning that no fastening is visible from the underside of the deck (as illustrated in Figure 5). The protrusion 2171 is preferably integral with the truck base 2152, but may be otherwise suitable affixed within the base 2152 (such as by a threaded engagement concealed within the base 2152).

The locating protrusion 2171 projects upwardly from an upper surface of the base 2152. The base upper surface provides a substantially flat mounting interface to which the underside of the skateboard deck abuts. The mounting interface portion is configured to transmit compressive forces between the base 2152 and the skateboard deck and is at least partially responsible for

supporting the weight of a user. Abutment of the mounting interface portion and skateboard deck underside provides a limit to the extent which the locating protrusion 2171 extends into the skateboard deck.

Compressive forces acting between the base 2152 and skateboard deck may also be transmitted through the side wall of the locating protrusion 2171. This is particularly relevant where the bearing surface of the shoulder portion is reduced (particularly about the protrusion 2171) or the shoulder is raised from the deck surface. The grade of taper on the locating protrusion 2171 may be modified to enable a greater portion of compressive forces between the base 2152 and deck to be transmitted through the side wall. Reducing the grade of taper on the protrusion 2171 presents a greater surface area for the deck to bear against and transfer the user's weight force. The compressive forces are preferentially transmitted through the protrusion 2171 side wall rather than the top of the protrusion as the skateboard deck directly above the protrusion is weakened by the reduction in deck thickness necessary to receive the protrusion 2171.

In the pictured embodiments the locating protrusion 2171 is a generally cylindrical extension that may taper slightly with displacement from the base 2152. The illustrated protrusion 2171 is configured to fit within the skateboard deck and preferably do not extend past the top surface of the deck. The protrusion may have a frustoconical or truncated cone profile. Other configurations of locating protrusion could also be used and may include tapered and non-tapered rectangular sections.

The base 2152 is coupled to the skateboard deck by a retaining fastener 2174. The retaining fastener 2174 prevents the truck from being dislodged from the skateboard deck when subjected to a separating force (such as the weight force acting on the truck when the skateboard is lifted from the ground). The skateboard truck pictured in Figures 3c and 4c incorporates a single retaining fastener 2174.

The locating protrusion 2171 and fastener 2174 transmit shear forces (including fore, aft, lateral and twisting forces) between the base 2152 and skateboard deck. The shear forces are transmitted substantially in the plane of the skateboard deck through an interface between the locating protrusion 2171 and fastener 2174 and the complementary recesses in the skateboard deck. Preferably the interface contact surface area of the protrusion (the area of the protrusion transverse to the deck) is between 150mm² and 500mm².

Multiple retaining fasteners may also be employed. It is preferably that fasteners are received and secured within the base to prevent

Threaded Fasteners Secured to the Truck Base

Another embodiment of skateboard truck according to the present invention is illustrated in Figures 3d and 4d. The skateboard truck 3100 includes a base 3152 configured to mount the truck to a skateboard deck. The truck base 3152 includes four threaded apertures configured to receive and secure four complimentary threaded fasteners 3171. The fasteners 3171 affix the
5 base 3152 with the skateboard deck. The fasteners 3174 are preferably fastened into the truck base 2152 from the top side of the skateboard deck, meaning that no fastening is visible from the underside of the deck (as illustrated in Figure 5).

The fastener apertures extend into the truck base 3152 from an upper surface. The base upper surface provides a substantially flat mounting interface to which the underside of the
10 skateboard deck abuts. The mounting interface portion is configured to transmit compressive forces between the base 3152 and the skateboard deck and is at least partially responsible for supporting the weight of a user.

In the pictured embodiments, the fasteners 3171 are generally cylindrical elongate extensions. The illustrated truck base 3152 is configured to receive fasteners 3171 that depend
15 from the skateboard deck (similarly to conventional truck mounting armaments). The fastener apertures in the truck base 3152 are configured with a complimentary engagement to the fasteners 3171 (a threaded engagement is illustrated in Figures 3d and 4d) so that the base 3152 receive and secures the fasteners 3171 without a separate fastener securement (such as a fastener nut) and the fasteners do not project through the base 3152. Preferably the fastener apertures do
20 not extend through the base 3152 (as illustrated) so that none of the fastening arrangement is visible from the underside of the skateboard deck when assembled.

The fasteners 3171 prevent the truck from being dislodged from the skateboard deck when subjected to a separating force (such as the weight force acting on the truck when the skateboard is lifted from the ground).

25 The fasteners 3171 transmit shear forces (including fore, aft, lateral and twisting forces) between the base 3152 and skateboard deck. The shear forces are transmitted substantially in the plain of the skateboard deck through an interface between the fasteners 2171 and the complimentary apertures in the skateboard deck.

Alternate fastener configurations may also be employed, such as double or triple fastener
30 arrangements (substituted for the locating protrusions of previous embodiments) or addition of a central fastener to the present embodiment. It is preferably that fasteners are received and secured within the base to preserve the minimalist appearance of the skateboard underside.

The truck mounting configuration described above and illustrated in the figures provides an aesthetically pleasing and functionally superior alternative to conventional truck mountings. The integrated mounting arrangement provides a sleek and streamline appearance with minimal components and unnecessary bulk.

5 **Truck Braking Mechanism**

A mechanism for reducing the speed of the skateboard is illustrated in Figures 6 to 14. The mechanism is implemented around the skateboard truck axle and provides the user with a natural and intuitive actuation method.

The truck hanger 468 illustrated in Figure 6 incorporates two braking protrusions 404, 405 extending outwardly from the hanger 468 and offset from the axle 466. The braking protrusions 404, 405 are configured to bear against or abut with the respective skateboard wheels 420, 421 or wheel bearings 426 to reduce the speed of the skateboard.

In the pictured embodiment, the braking protrusions 404, 405 are extensions of and integrally formed with the hanger 468 housing. However, the protrusions 404, 405 could be alternately arranged without significantly altering the function of the braking mechanism.

The illustrated skateboard wheels 420, 421 incorporate a centrally located aperture configured to receive one or more bearings 425, 426. The bearings 425, 426 are configured to mount the wheel 420, 421 to the truck axle 466 and facilitate rotation.

Conventional truck configurations restrain the wheel to prevent translation along the axle. The wheel is restrained by a wheel nut that bears against the outside bearing 425 (or associated washer) to retain the inside bearing 426 against the hanger housing. A loose wheel nut or worn components can cause the skateboard wheel to rattle, generally attributable to repetitious axial translation of the wheel and bearings along the truck axle.

The truck illustrated in Figure 6 incorporates an elastic member 410, 411 and distribution washer 413, 414 positioned about the axle 466 between the hanger housing 468 and respective wheels 420, 421. The elastic members 410, 411 in the illustrated embodiment are compression springs. The wheels 420, 421 are retained on the axle 466 by a wheel nut 464 (not pictured for wheel 420) positioned at either end of the axle.

When the truck is assembled (as illustrated in Figures 7 to 9'), the elastic members 410, 411 act between the hanger 468 housing and the wheel 420, 421 to retain the outer wheel bearing 425 against the wheel nut 464 when the truck is in an equilibrium or neutral state. An equilibrium state generally represents insignificant lateral loading of the skateboard wheels so

that they are substantially evenly spaced about the hanger 468, most commonly encountered when the skateboard is moving in a substantially straight line along even terrain.

The amount of braking, and accordingly the rate of deceleration of the skateboard, is related to the frictional force between the braking protrusion 404, 405 and associated wheel 420, 421. The frictional force is intrinsically related to the force with which the wheel 420, 421 bears against the corresponding braking protrusion 404, 405 and is therefore influenced by inertial forces acting on the skateboard. Consequently, the braking force generated by the braking mechanism reflects the speed at which the skateboard is moving and the severity of turn being executed.

The amount of braking for a given inertial force (commonly referred to as the centrifugal force) is regulated by the resilient returning force of the elastic member 410, 411. In this regard the compression springs 410, 411 can be exchanged to modulate the amount of braking to reflect a user's ability and confidence level.

The inherent friction between the ground and skateboard wheels 420,421 that produces a rolling resistance to movement of the skateboard also provides a lateral component that resists the inertial forces generated during a turn. The lateral component of the friction force opposes the skateboard wheels 420,421 sliding and enables the inertial force to be transferred to the elastic member 410,411. Actuation of the braking mechanism is therefore dependant on the presence of this friction force, and the braking mechanism is disengaged if the lateral loading is momentarily removed (such as the wheel being lifted from the ground). Removing the braking force in the absence of lateral loading, which commonly occurs concurrently with momentary removal of the rolling resistance, prevents the wheel from locking and creating a flat spot when the rolling resistance is restored. This is a distinct advantage over direct user actuation (such as handheld or pedal mechanisms).

Another embodiment of the truck braking mechanism is illustrated in Figures 10 to 14. The illustrated truck hanger 568 incorporates two detachable braking protrusions 504, 505. When the hanger is assembled (illustrated in Figure 14) the braking protrusions 504, 505 extend outwardly from a central hanger portion 569 and are offset about the axle 566. The braking protrusions 504, 505 are configured to bear against or abut the respective skateboard wheels 520, 521 to reduce the speed of the skateboard. The braking protrusions may be configured to bear against the respective wheel bearing (or a washer disposed intermediate of the braking protrusion in wheel bearing) or a surface of wheel to effect braking.

The illustrated braking protrusions 504, 505 comprise a backing plate 550 and a braking interface 551. The backing plate 550 is generally circular disc that abuts with the central portion of the hanger 568 when the hanger is assembled. The backing plate may include a cylindrical lip extending from the same face as the braking interface 551 to align the two components.

5 A keyed interface 552 is provided in the backing plate 550. A complimentary keyed interface is provided on the central portion of the hanger 569 so that the hanger components are rotationally locked when the hanger 568 is assembled.

10 The braking interface 551 extends from an outer face of the backing plate away from the central hanger portion 569. The braking interface 551 comprises a thick walled cylindrical body that is disposed generally coaxial with the truck axle 566 in the assembled hanger 568. The outer face 553 of the braking interface provides a friction surface that is positioned adjacent the skateboard wheel 520 when the truck is assembled. It is the friction surface that bears against the skateboard wheel 521 when the braking mechanism is actuated.

15 The selection of materials for the braking protrusion components may be influenced by the intended application of the truck, fabrication budget, desired appearance or other criteria. It is desirable that the backing plate 550 provide a generally ridged support for the braking protrusions 405, 505 and the braking interface 551 provide a high friction surface for effecting braking and exhibit good wear characteristics.

20 The braking interface 551 is preferably fabricated from a soft rubber compound with a suitable dynamic friction co-efficient to provide adequate braking characteristics and reduce wear on the skateboard wheel 521. The braking protrusion 504 may be replaced when excessive wear on the braking interface 551 affects braking performance. The backing plate 550 is preferably metallic and of sufficient thickness to provide adequate support in bending when the braking mechanism is engaged. It may also be desirable to polish the inner face 554 of the backing plate 551 to present an attractive finish.

30 The illustrated skateboard wheels 520, 521 comprise a generally cylindrical body with a pair of opposed side walls 561. A centrally located bearing aperture extends from one of the side walls 561. The bearing aperture is substantially coaxial with the cylindrical body 570. The bearing aperture is configured to receive one or more bearings 525, 526 that mount the wheel 520, 521 to the truck axle 566 to facilitate rotation.

The illustrated skateboard wheels 520, 521 include a cylindrical recess 560 arranged generally coaxial with the bearing aperture and cylindrical body 571. The recess 560 extends from the other side wall 561 of the wheel opposite the bearing aperture. The recess 560 adjoins

the bearing aperture intermediate the side walls 560. The circumference of the recess 560 is greater than the circumference of the bearing aperture, providing a torodial surface 562. The circumference of the cylindrical recess 560 is substantially commensurate with the outer cylindrical surface of the braking interface 551 so that a portion of the braking protrusion 504 may be received within the recess 560.

Preferably the recess 160 is commensurate in depth with the corresponding braking protrusion so that the backing plate 550 is arranged flush with a corresponding side wall 561 of the wheel 520, as illustrated in Figure 14. The torodial surface 562 provides a surface for the friction surface 553 of the braking protrusion 504 to bear against when the braking mechanism is actuated. The braking surface 562 and the braking protrusion friction surface 553 are complimentarily configured with generally parallel engaging faces and suitable material properties. The braking interface 562 may be tapered at the entrance of the bearings aperture to facilitate alignment at insertion of the bearing 526.

A cone shaped coil spring 510, 511 is provided about the truck axle 566 between the braking protrusion 504, 505 and respective wheel 520, 521. A distribution washer 513, 514 may be positioned between the respective coil springs 510, 511 and wheel 520, 521 to distribute the retention force provided by the spring. Wheel nuts 564 are threaded to either end of the axle 566 to secure the wheels 520, 521 to the truck.

The coil springs 510, 511 act between the hanger 568 and the respective wheels 520, 521 to retain the outer wheel bearing 525 against the wheel nut 564 when the truck is assembled and in an equilibrium state. The coil springs 510, 511 may be exchanged to moderate the braking affect by providing a different retention force (related to the spring constant). The coil spring is cone shaped to increase compression capabilities and facilitate a greater range of movement to accommodate wearing of the braking interface 551.

The braking mechanism illustrated in Figures 10 to 13 provides the user with adaptable braking that is intuitively actuated provides a braking force in proportion to the speed at which the skateboard is travelling. There are three distinct configurations in which the truck can be set to accommodate different user requirements. This functionality permits the truck to be adapted to specific applications and skill levels by the user.

User Actuated Braking

In a user actuated braking configuration the truck braking mechanism is activated by the user executing a turn, similar to how a snow boarder reduces their speed of decent down a mountain. In this respect, the illustrated skateboard braking mechanism is more intuitive than

other braking systems that involve direct user actuation (such as braking pedals or hand grips). One particular application where this braking configuration may be desirable is for steep narrow descents where there is limited carving space available to the rider.

To configure the truck for user actuated braking the respective wheel nuts are applied to the axel to retain the wheel on the axle without abutting the respective braking protrusions. Accordingly, there is a gap between the wheels and respective braking protrusions when the truck is in equilibrium. For this configuration dome nuts are preferable as they incorporate an intrinsic fastening stop.

When the user executes a turn an inertial (centrifugal) force acts on the user and skateboard, causing a compressive force on the corresponding elastic member (depending on the direction of turn). When the centrifugal or inertial force overcomes any preload of the corresponding elastic member, the outside wheel and associated bearings (with respect to the turning arc of the skateboard) begin to translate along the axle toward the hanger housing, causing the respective elastic member to further compress. Braking is affected when the centrifugal force is sufficient to compress the spring enough to bring the braking protrusion and wheel into contact.

Abutment of the wheel with the respective braking protrusion reduces the rotational speed of the wheel, slowing the skateboard accordingly. During operation of the braking mechanism in this configuration, the inside wheel remains displaced from the respective braking protrusion, so that braking occurs at the outside wheel only. Although the centrifugal force also acts on the inside wheel, the wheel bears against the wheel nut which prevents any translation along the axle away from the hanger.

Training Configuration

The truck may be configured with inherent braking independent of external forces. In this configuration the wheel nuts are fastened on to the axle to the extent that the wheels abut with the respective braking protrusions, preferably in equilibrium. The abutment of the wheels and braking protrusions provides a frictional force that opposes movement of the skateboard when the wheels are rotating.

As the truck provides a minimum braking force that opposes all rotation of the wheels this configuration is particularly applicable for people learning to ride a skateboard. The amount of braking provided by the braking mechanism increases during execution of a turn as discussed in relation to the user actuated braking configuration. Accordingly, the braking mechanism training configuration not only enables new users to attempt descents that would otherwise be

too advanced, but also promotes good carving technique and enables the user to progress intuitively to the user actuated braking configuration.

The amount of braking provided in the training configuration depends on the force of abutment between the wheels and braking protrusions, which in turn reflects the degree to which the wheel nuts are fastened on the axle. It may be preferable to use regular wheel nuts to permit greater flexibility when adjusting the wheel nuts to regulate the amount of braking (as there is no intrinsic limit stop with regular wheel nuts).

Braking Inactivation

If the user wants to disable the braking mechanism a collar 415, 515 can be inserted about the axle between the hanger housing and wheel. The collar 415, 515 bears against the respective washers to restrain the wheel and prevent translation along the axle. In the pictured embodiment, the collar is configured to fit under the compression spring and provide rigid opposition to the centrifugal force. However, the brake collar 415, 515 could be arranged in alternate configurations (in place of or over top of the compression spring 410, 411) without altering the desired function.

For the embodiment of the braking mechanism illustrated in Figures 10 to 14, braking may also be inactivated by reversing the orientation of the detachable braking protrusions 504, 505 so the braking interface 551 projects toward the hanger central portion 569. The backing plate 520 still bears against the hanger central portion 569, which inactivates braking by preventing abutment of the braking protrusion 504, 505 with the wheel 520.

The braking mechanism provides consistent and predictable deceleration with intuitive actuation and reliable execution, promoting good technique and confidence in new users. Because of the intuitive way braking is actuated, established or returning skaters do not need to adjust their style to accommodate the mechanism if they want the added functionality.

Trucks incorporating this braking mechanism can be fitted to either the front or rear of a skateboard deck or both. It may also be beneficial for a user to configure their skateboard with a set of braking enabled trucks that actuate at different cornering velocities so that braking is greater at either the front or rear of the skateboard. Alternatively, the front and rear trucks could be setup in different user configurations (such as disabling the braking mechanism on the front while retaining braking on the rear).

The braking interface may alternatively be formed between a suitably adapted braking protrusion and wheel bearing or a bearing washer positioned between the bearing and braking

protrusion. Relocating the rotating contact interface adjacent the bearing enables the braking protrusion to be partially or completely concealed within a conventional skateboard wheel.

Concealment of the braking protrusions is particularly desirable on shortboard trucks, primarily for aesthetic reasons, as the braking protrusion can appear out of place on the smaller size truck hanger. However, the reduced braking moment provided by this embodiment of the mechanism (resulting from the reduced offset of the braking protrusion from the centre of rotation) and potential for heat generation may be better suited to the lower speed applications shortboards are commonly subjected to.

Embodiments of the braking mechanism involving direct abutment of the braking protrusion with the bearing may require the bearing, braking protrusion or both be fabricated from or incorporate a surface coating of high heat tolerance material, such as a suitable ceramic, plastic or Kevlar. It may also be necessary to isolate the internal components of the bearing from the heat generated by the braking friction (produced by abutment with the braking protrusion) to prevent undue stress or accelerated fatigue of the bearing. Similar heat resistant materials can be incorporated into the bearing to reduce heat penetration. Alternatively, the bearing abutting surface may be spaced from the bearing housing to insulate the internal components (similar to a washer coupled to and spaced from the bearing inner surface). These considerations are particularly relevant to embodiments where the braking contact interface is removed from the air flow path around the skateboard, as the convective cooling capacity of the mechanism will be reduced.

The braking mechanism may be applied to any of the truck variations described previously. For example the braking mechanism may be applied to the types of truck illustrated in Figure 2, Figure 15 or Figure 18, or to the conventional trucks illustrated in Figure 1.

Skateboard

Embodiments of truck according to the variations disclosed herein are intended to be incorporated in skateboards. The skateboards typically comprise a deck and a pair of trucks, with one truck fixed adjacent each end of the board. A long board incorporating trucks according to Figure 18 or 27 is illustrated in Figure 29. A short board incorporating trucks according to Figure 15 or 28 is illustrated in Figure 30.

The foregoing description of the invention includes preferred forms thereof. Modifications may be made thereto without departing from the scope of the invention (as defined by the accompanying claims – if a complete spec).

CLAIMS:

1. A skateboard truck comprising:
 - a base,
 - 5 a hanger,
 - a pivot connection between the base and the hanger which retains the hanger to the base,
 - a king pin secured through an opening in the hanger and secured to the base, and
 - a pivot connection between the hanger and the kingpin which excludes translation
 - 10 movement except along the axis of the kingpin, and
 - a resilient spacer located about the kingpin and compressed between the base and the
 - hanger; wherein
 - the size of the spacer determines an angular orientation of the axis of the kingpin, a
 - location of the hanger pivot connection to the kingpin, and a pivot axis of the hanger relative to
 - the base;
 - 15 a pivot axis of the hanger relative to the base is defined by a line between the first and
 - second pivot connections, and
 - contact between a surface of the opening of the hanger and the kingpin defines end limits
 - for tilting of the hanger about axes transverse to the axis of the kingpin.
- 20 2. A skateboard truck as claimed in claim 1 wherein the pivot connection between the base
- and the hanger includes a shaft extending from the hanger, secured in a spherical bearing
- retained to the base, such that the shaft pivots about the pivot centre of the spherical bearing.
3. A skateboard truck as claimed in claim 1 or claim 2 wherein the base includes a socket
- 25 open toward the hanger, the spherical bearing is secured to the socket, and an opening extends
- through the base to the bottom of the socket, and a retainer that is visible through the opening
- secures the hanger shaft to the spherical basing.
4. A skateboard truck as claimed in any one of claims 1 to 3 wherein one end of the kingpin
- 30 is retained in a socket in the base, the socket opening away from the hanger, and an aperture
- extends through the base to the bottom of the socket, the kingpin passing through the aperture,
- the aperture shaped to provide for angular movement of the kingpin in a fore and aft direction,
- but not in a side to side direction.

5. A skateboard truck comprising:

a base,

a hanger,

a pivot engagement between the base and the hanger,

5 a king pin secured through the hanger and secured to the base, and

a pivot connection between the hanger and the kingpin.

6. A skateboard truck as claimed in claim 5 wherein the pivot engagement between the base and the hanger comprises, a pivot connection between the base and the hanger, and wherein

10 each of the pivot connections retains the hanger to the base independently of the other pivot connection, and a pivot axis of the hanger relative to the base is defined by a line between the first and second pivot connections.

7. A skateboard truck as claimed in claim 6 wherein the pivot connection between the base

15 and the hanger includes a shaft extending from the hanger, secured in a spherical bearing retained to the base, such that the shaft pivots about the pivot centre of the spherical bearing.

8. A skateboard truck as claimed in claim 7 wherein the base includes a socket open toward the hanger, the spherical bearing is secured to the socket, and an opening extends through the

20 base to the bottom of the socket, and a retainer that is visible through the opening secures the hanger shaft to the spherical basing.

9. A skateboard truck as claimed in any one of claims 6 to 8 wherein the pivot connection of the hanger on the kingpin allows tilting of the hanger about axes transverse to the kingpin, but

25 excludes translation movement except along the axis of the kingpin.

10. A skateboard truck as claimed in any one of claims 1 to 9 including a resilient spacer located about the kingpin, compressed between the base and the hanger.

30 11. A skateboard truck as claimed in claim 5 including a resilient spacer located about the kingpin compressed between the base and the hanger,

the size of the spacer determining an angular orientation of the axis of the kingpin, a location of the hanger pivot connection to the kingpin, and a pivot axis of the hanger relative to the base.

12. A skateboard truck as claimed in claim 11 wherein one end of the kingpin is retained in a socket in the base, the socket opening away from the hanger, and an aperture extends through the base to the bottom of the socket, the kingpin passing through the aperture, the aperture shaped to provide for angular movement of the kingpin in a fore and aft direction, but not in a side to side direction.

13. A skateboard truck as claimed in either claim 11 or claim 12 wherein the base includes a bearing surface surrounding the aperture, facing toward the hanger and oriented approximately normal to the kingpin axis, and a cup washer is located between the spacer and the bearing surface, the kingpin passing through an aperture in the cup washer.

14. A skateboard truck as claimed in claim 5 wherein the kingpin extends through an opening in the hanger and is secured at one end portion to the base,

the pivot connection of the hanger on the kingpin excludes translation movement except along the axis of the kingpin, and

contact between a surface of the opening of the hanger and the kingpin defines end limits for tilting of the hanger about axes transverse to the axis of the kingpin.

15. A skateboard truck as claimed in claim 14 wherein the opening is an aperture having a sidewall that extends along the axis of the kingpin beyond the extent of the pivot connection, and the contact occurs between the sidewall and the kingpin.

16. A skateboard truck as claimed in claim 15 wherein the contacting sidewall portion of the hanger aperture is located between the pivot connection and the base.

17. A skateboard including a deck and at least a truck secured to the deck, the truck comprising:

a base,

a hanger,

a pivot engagement between the base and the hanger,

a king pin secured through the hanger and secured to the base, and

a pivot connection between the hanger and the kingpin.

18. A skateboard as claimed in claim 17 wherein the pivot engagement between the base and the hanger comprises, a pivot connection between the base and the hanger, and wherein

each of the pivot connections retains the hanger to the base independently of the other pivot connection, and a pivot axis of the hanger relative to the base is defined by a line between
5 the first and second pivot connections.

19. A skateboard as claimed in either claim 17 or claim 18 wherein a flange on the kingpin retains the hanger and a shank of the kingpin engages a nut retained in the base in such a fashion that the nut can orient to the axis of the kingpin but cannot turn, and

10 a resilient spacer is located about the kingpin compressed between the base and the hanger,

the size of the spacer determining an angular orientation of the axis of the kingpin, a location of the hanger pivot connection to the kingpin, and a pivot axis of the hanger relative to the base.

15

20. A skateboard as claimed in any one of claims 17 to 19 wherein the kingpin extends through an opening in the hanger and is secured at one end portion to the base,

the pivot connection of the hanger on the kingpin excludes translation movement except along the axis of the kingpin, and

20

contact between a surface of the opening of the hanger and the kingpin defines end limits for tilting of the hanger about axes transverse to the axis of the kingpin.

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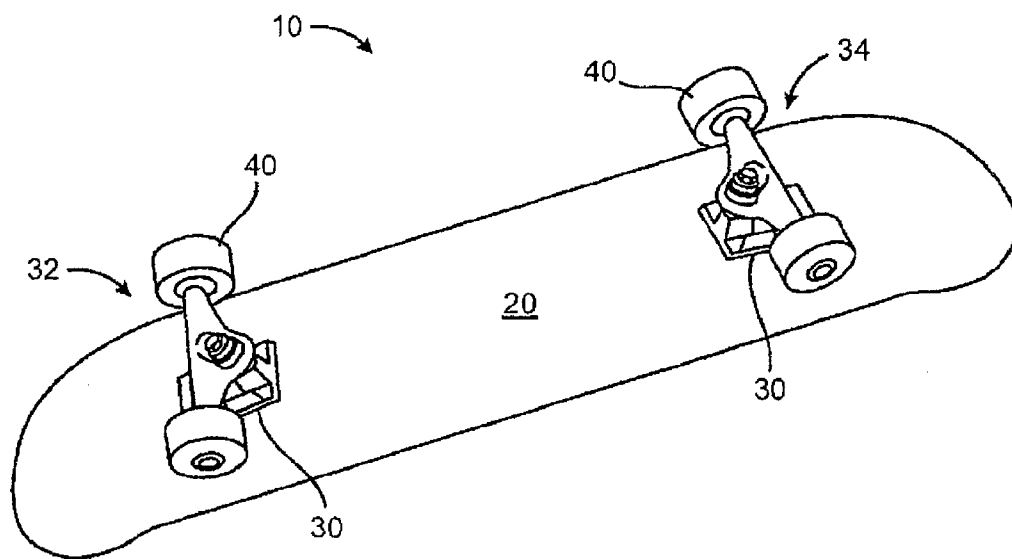
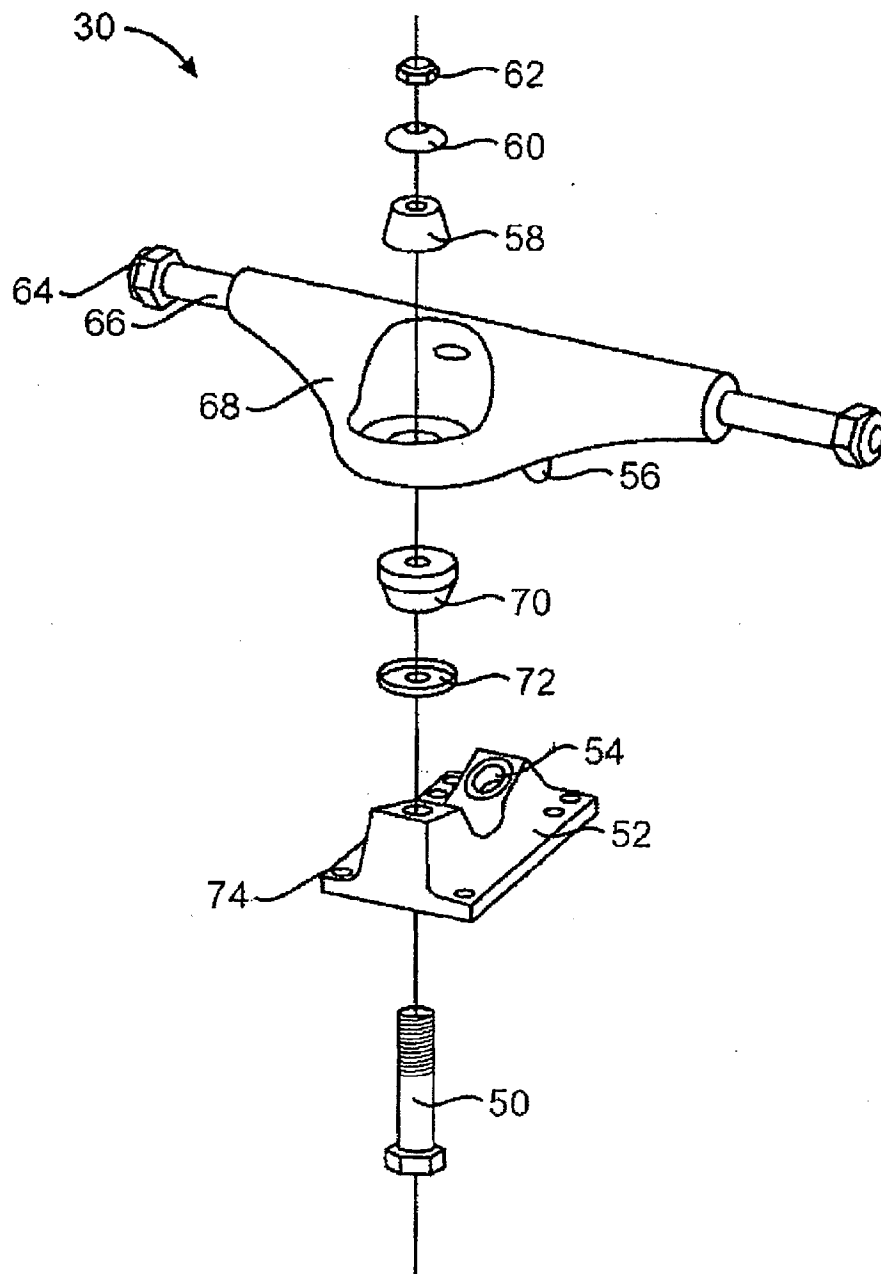


FIGURE 1

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**FIGURE 2**

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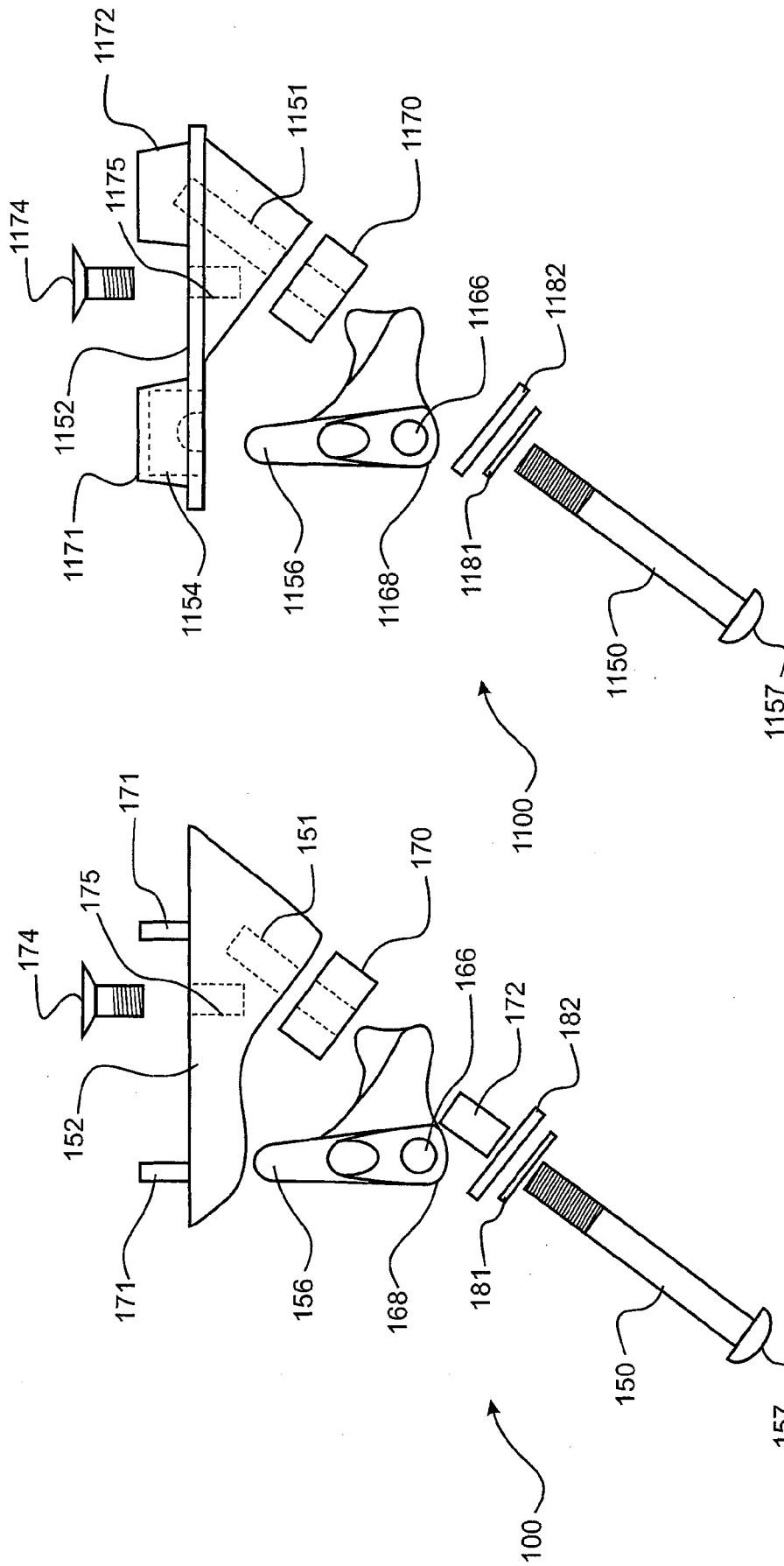


FIGURE 3a

FIGURE 3b

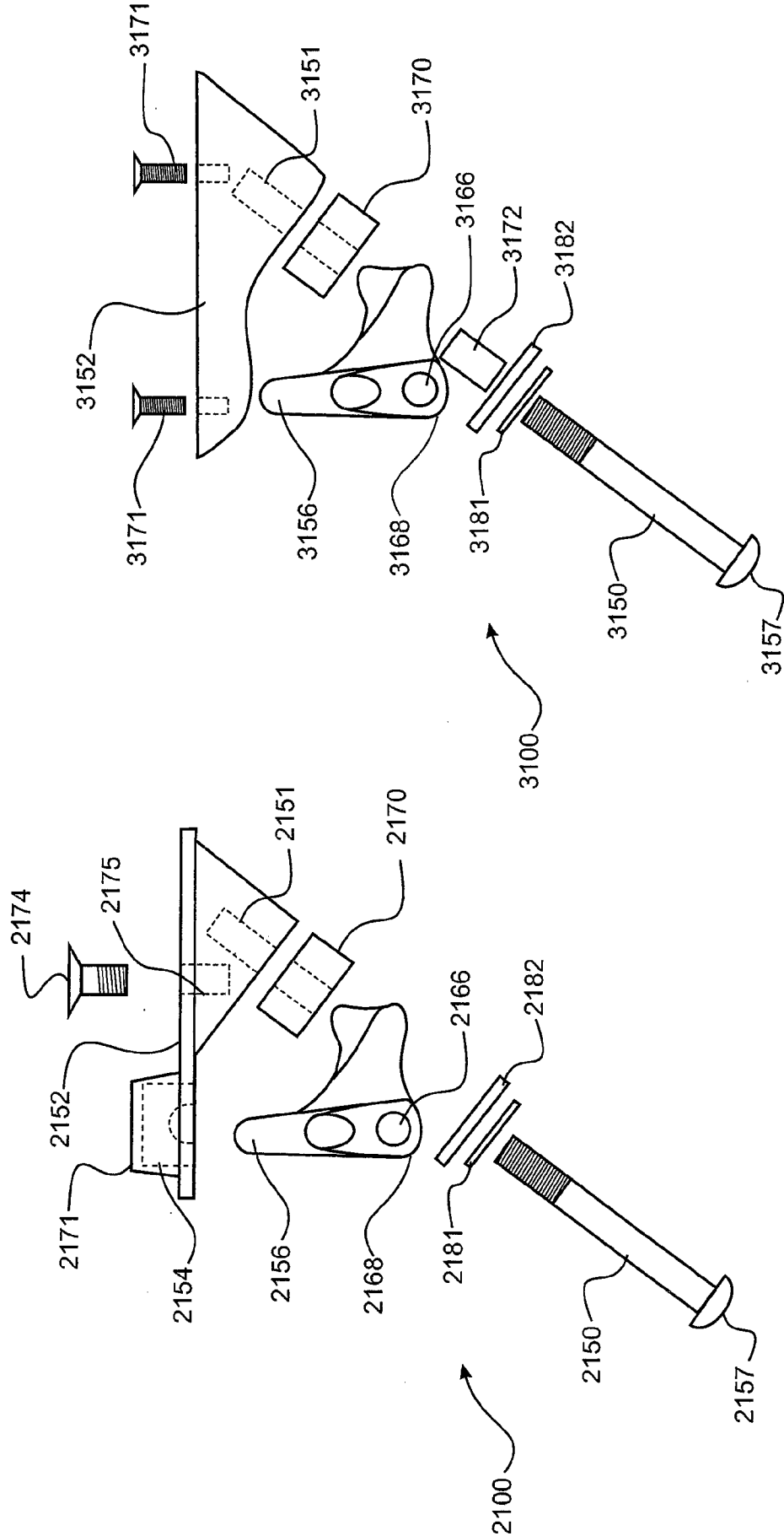


FIGURE 3d

FIGURE 3c

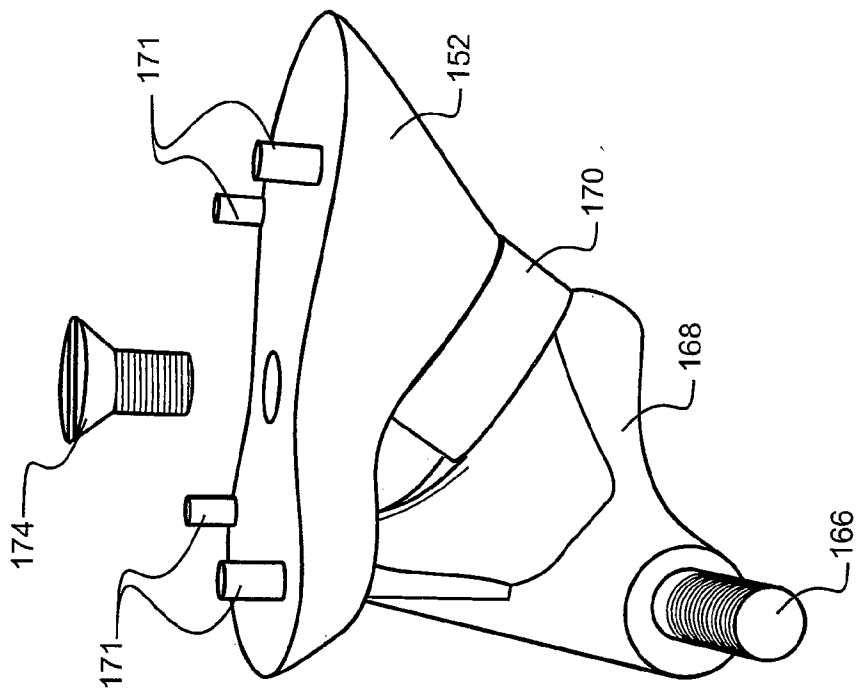


FIGURE 4a

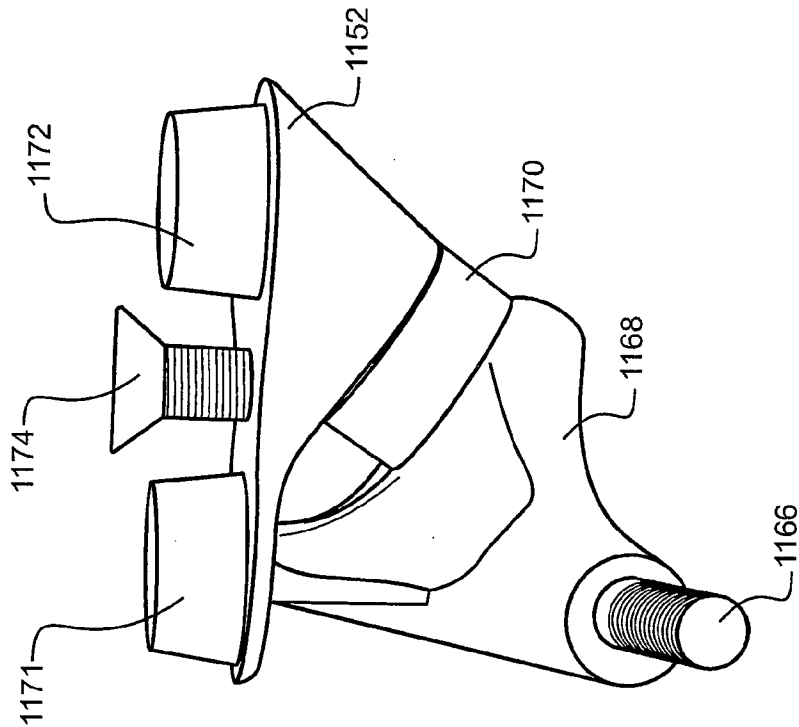


FIGURE 4b

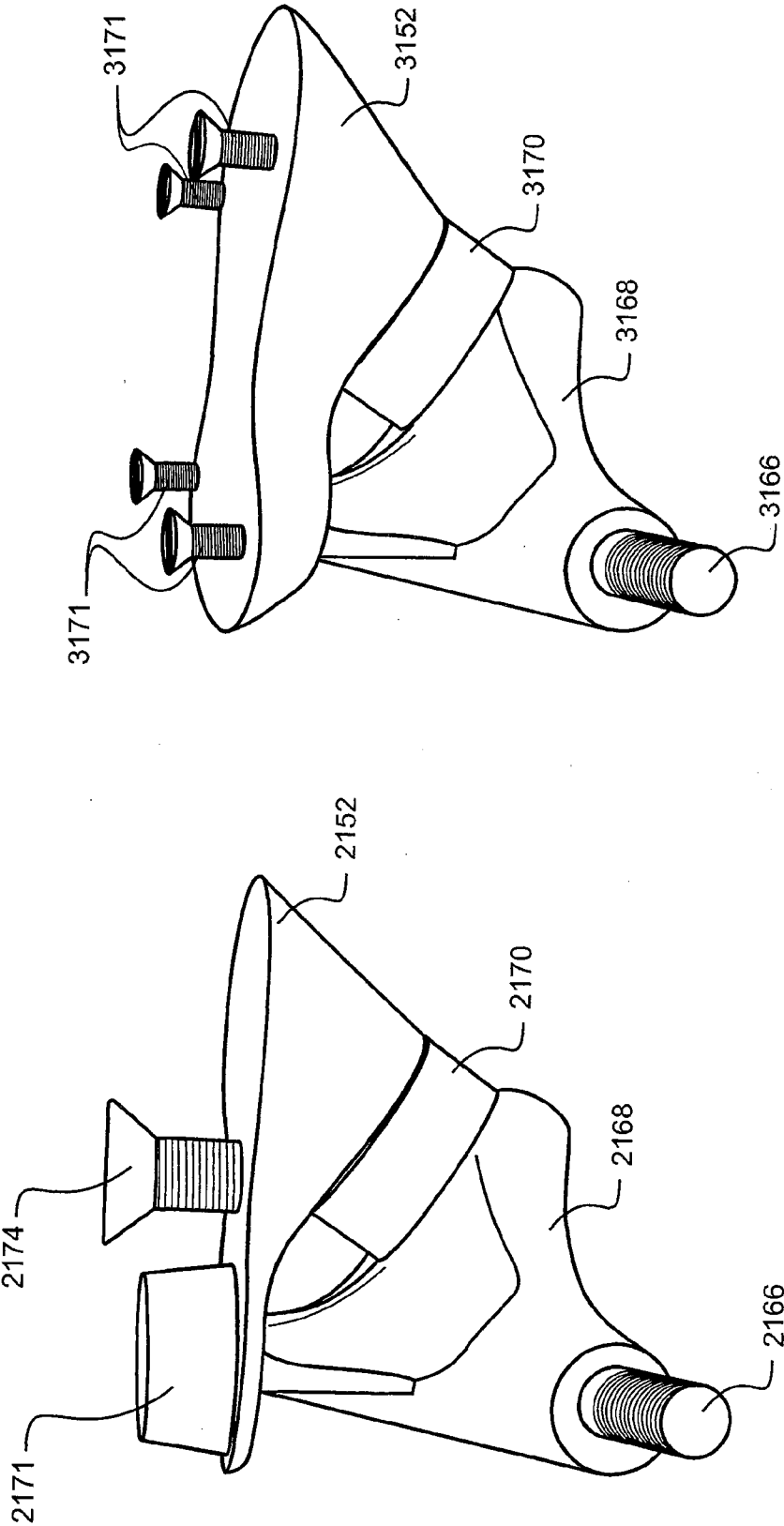


FIGURE 4d

FIGURE 4c

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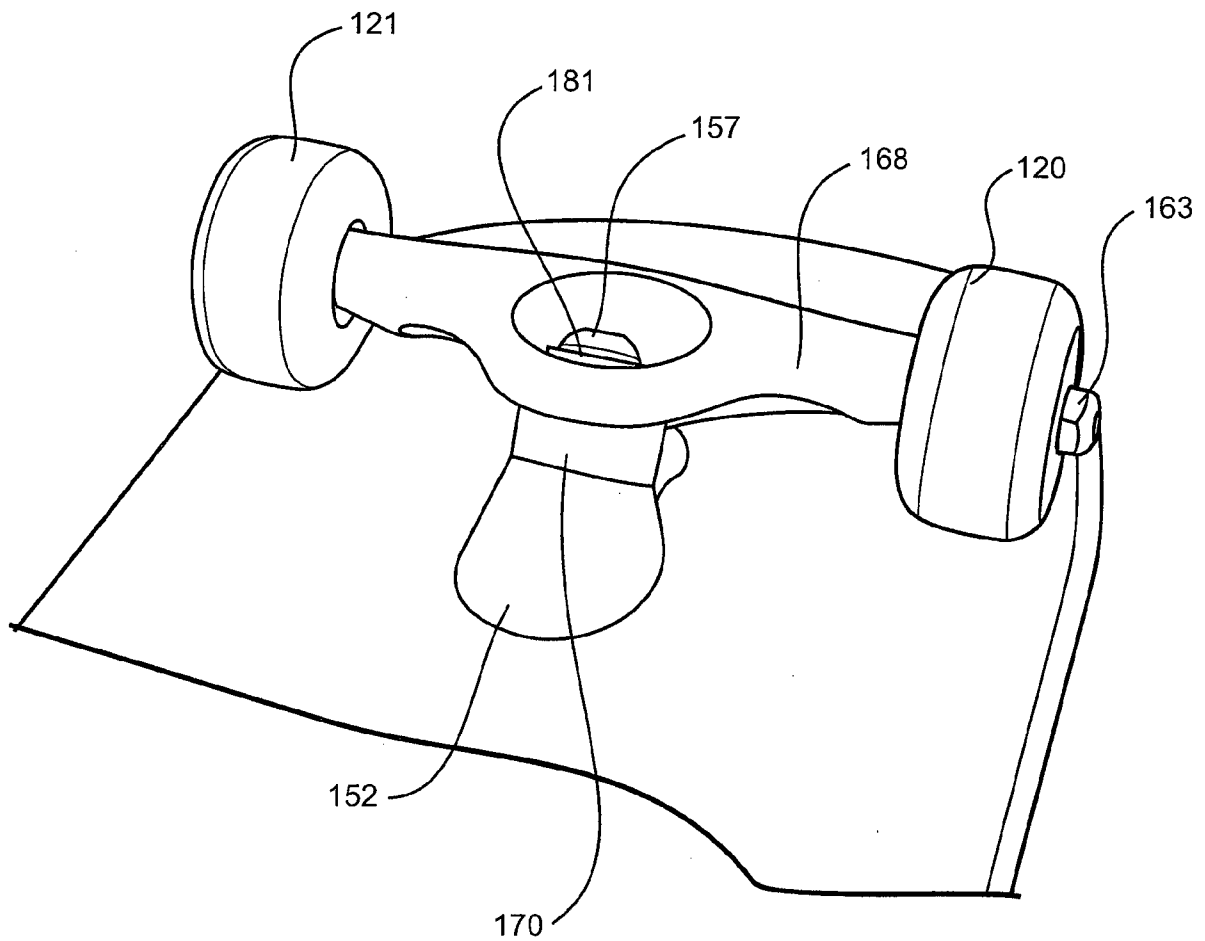


FIGURE 5

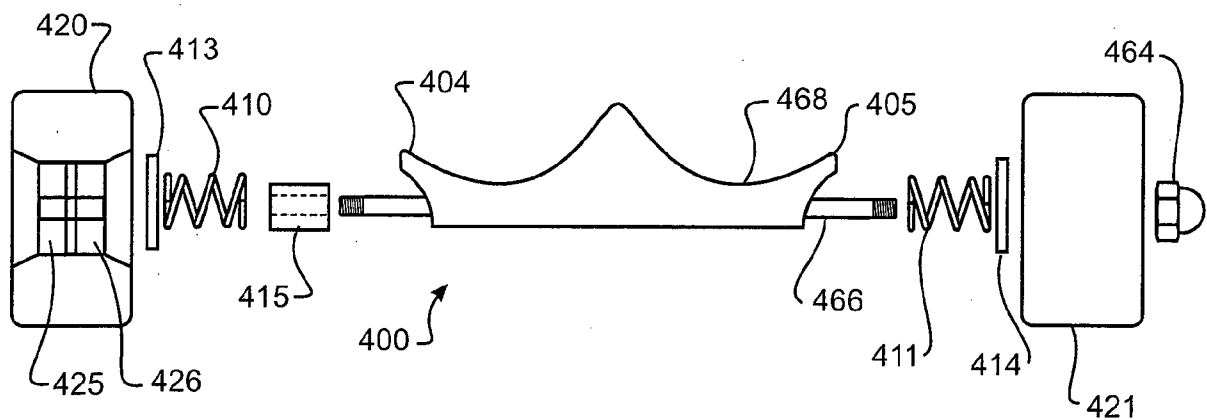


FIGURE 6

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FIGURE 7

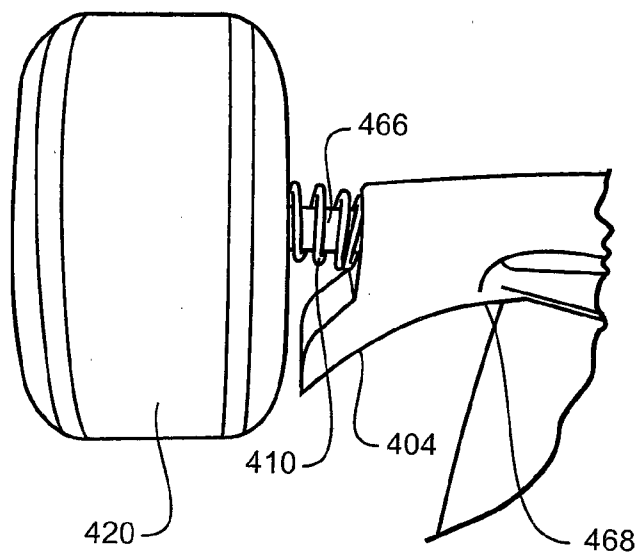


FIGURE 8

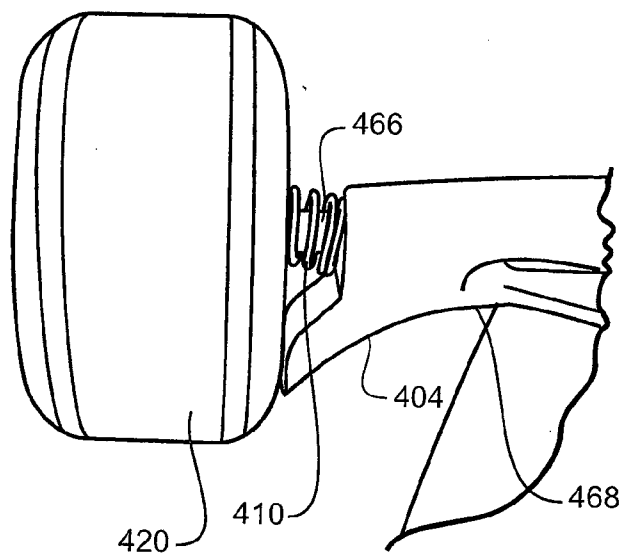
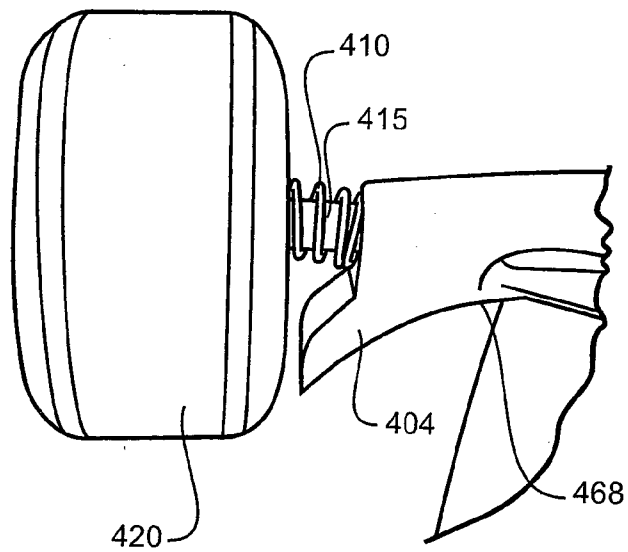


FIGURE 9



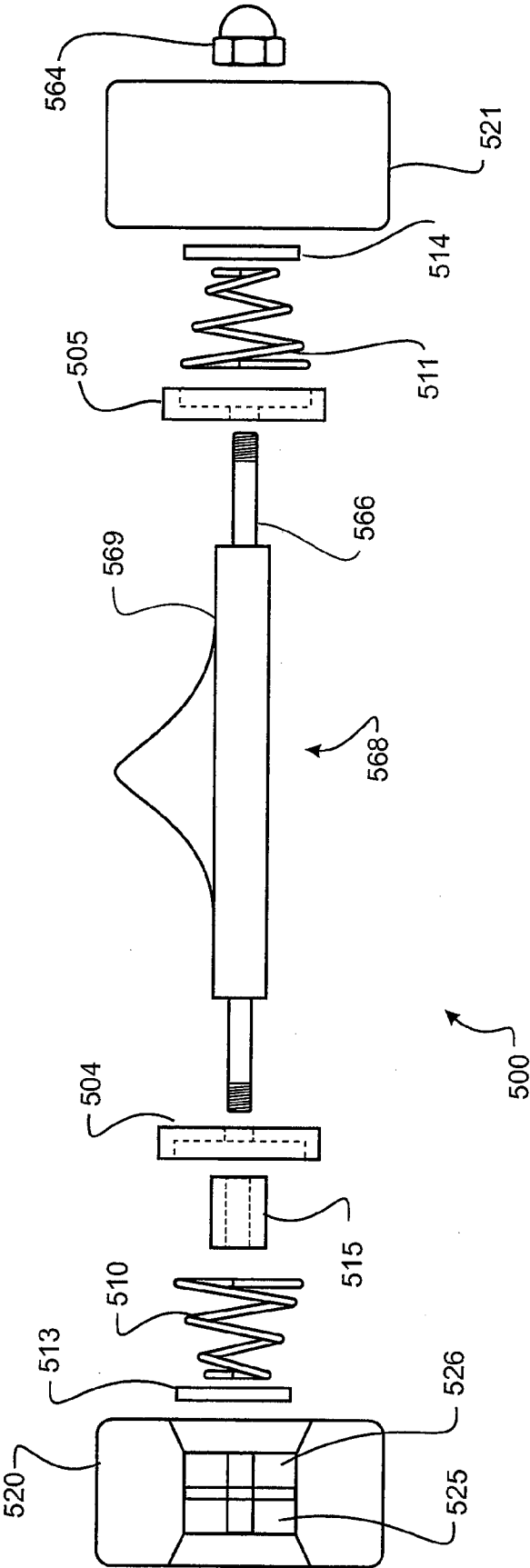


FIGURE 10

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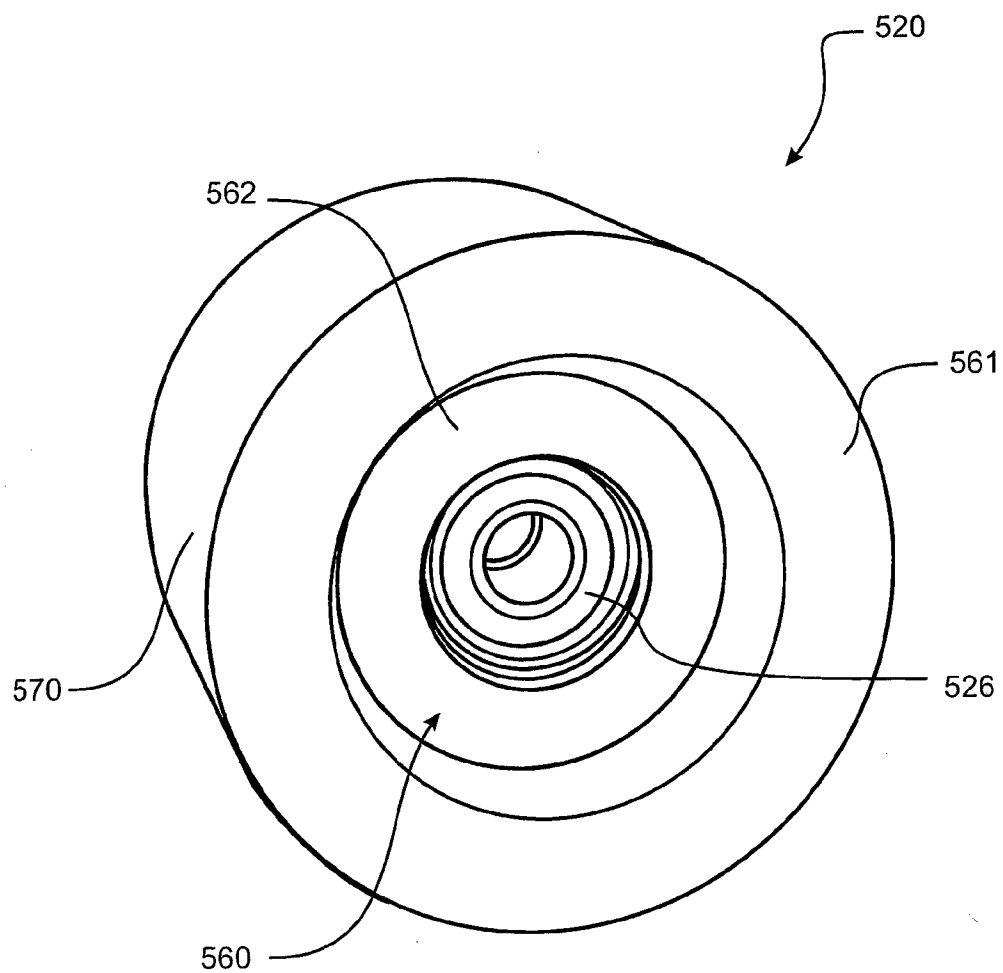


FIGURE 11

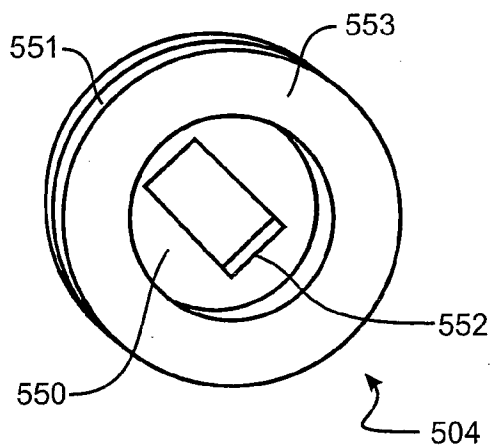


FIGURE 12

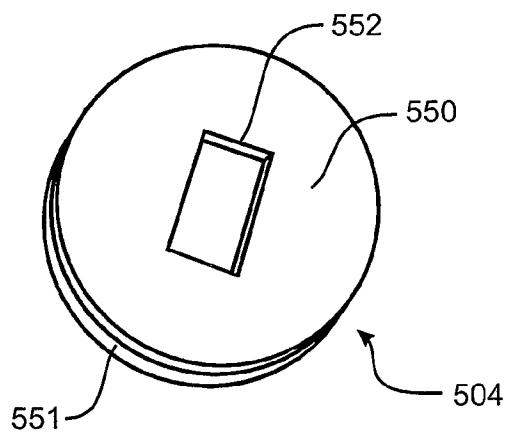


FIGURE 13

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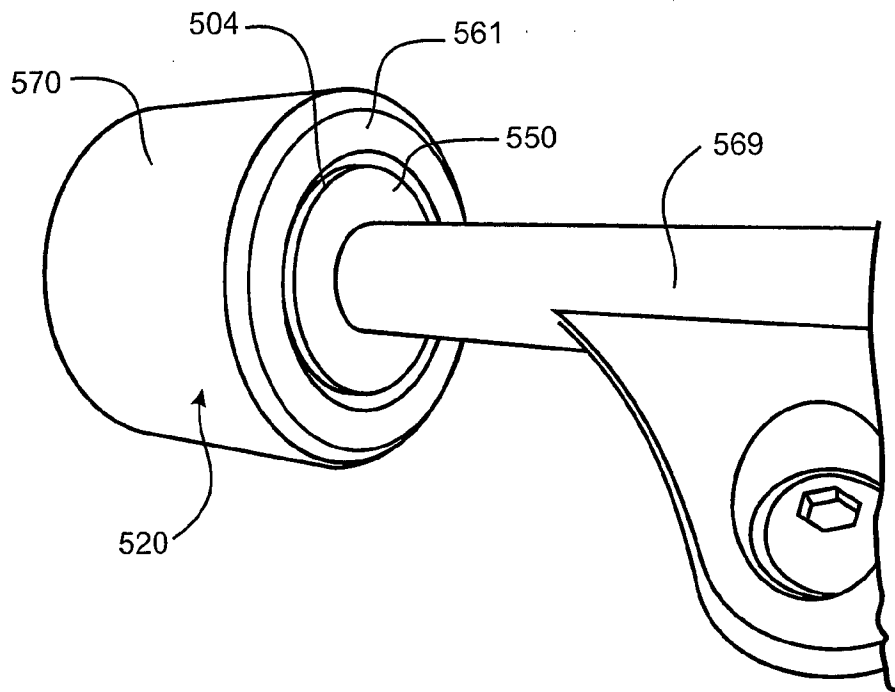
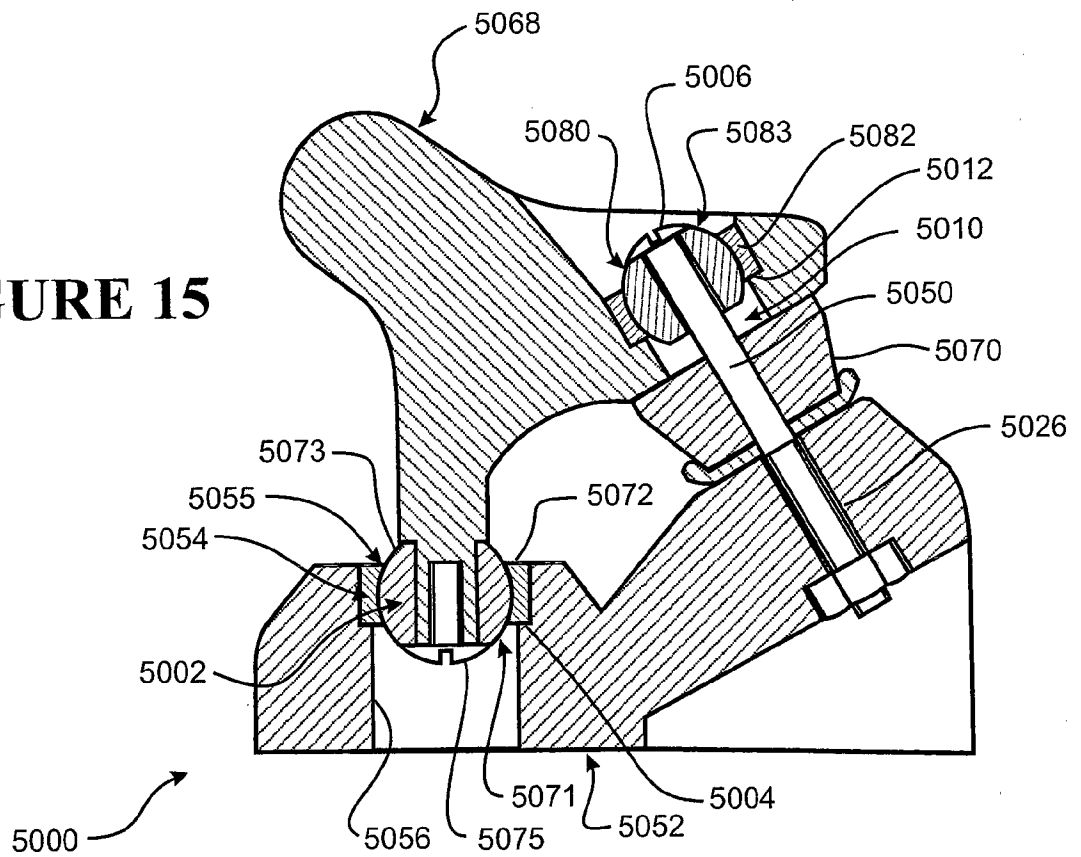


FIGURE 14

FIGURE 15



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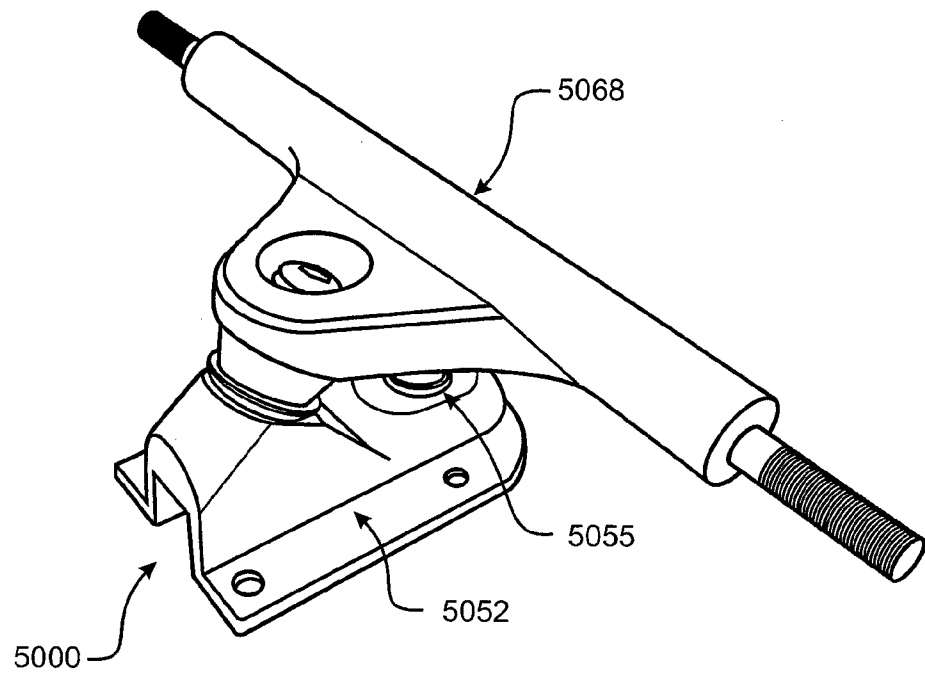


FIGURE 16

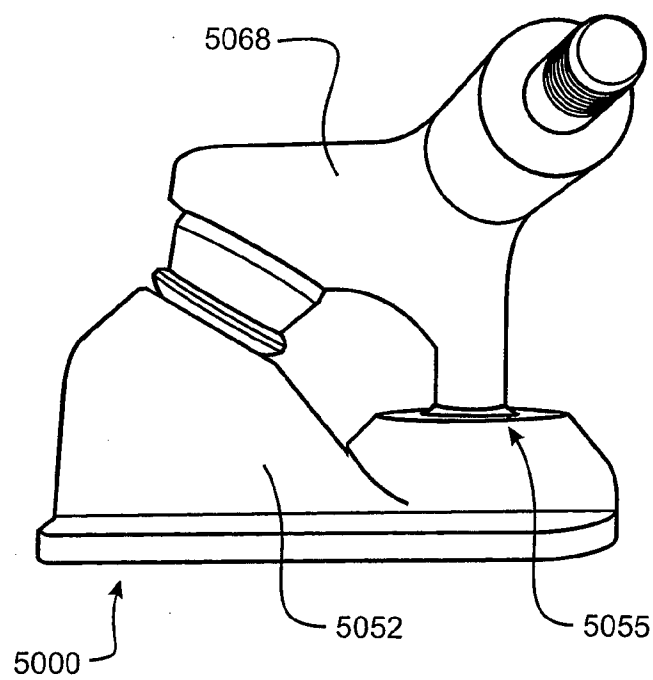


FIGURE 17

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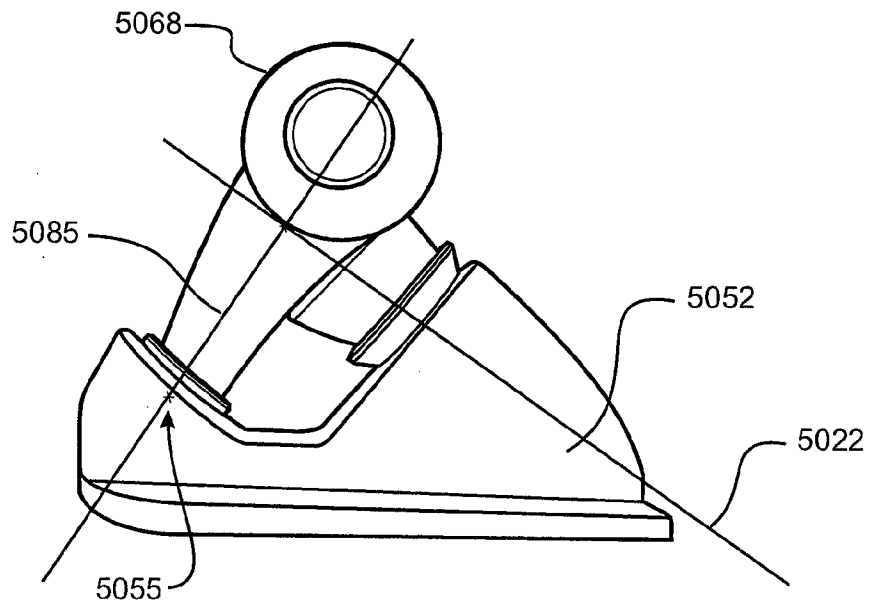


FIGURE 18

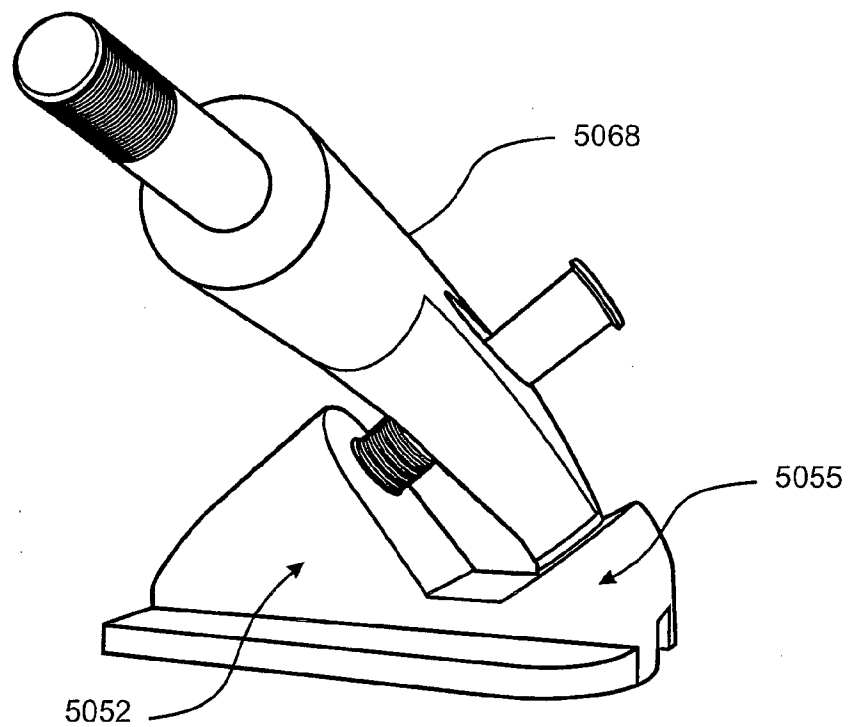


FIGURE 19

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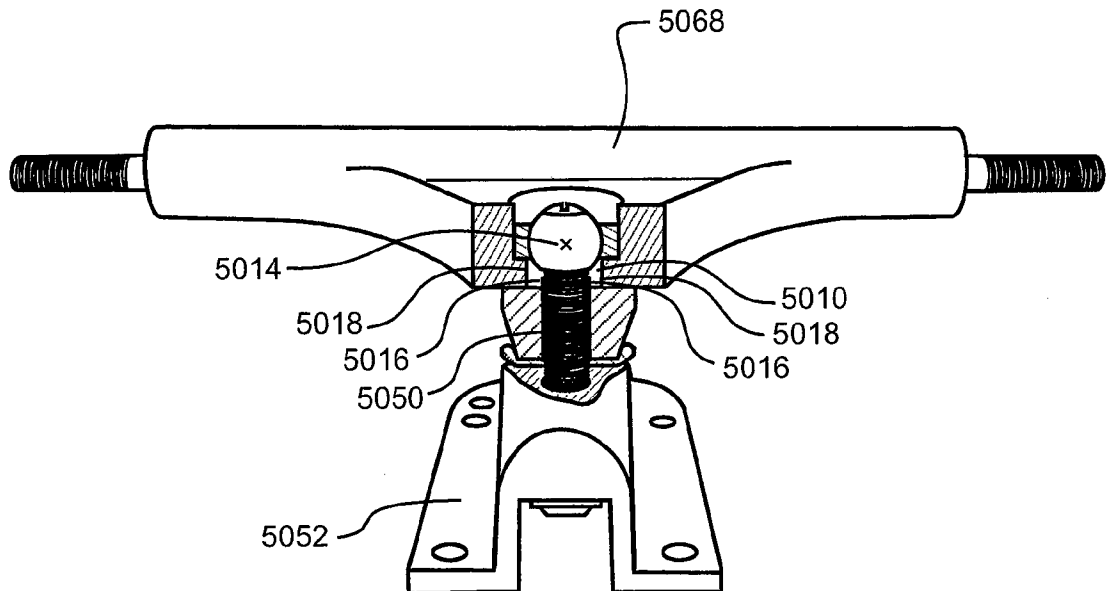


FIGURE 20

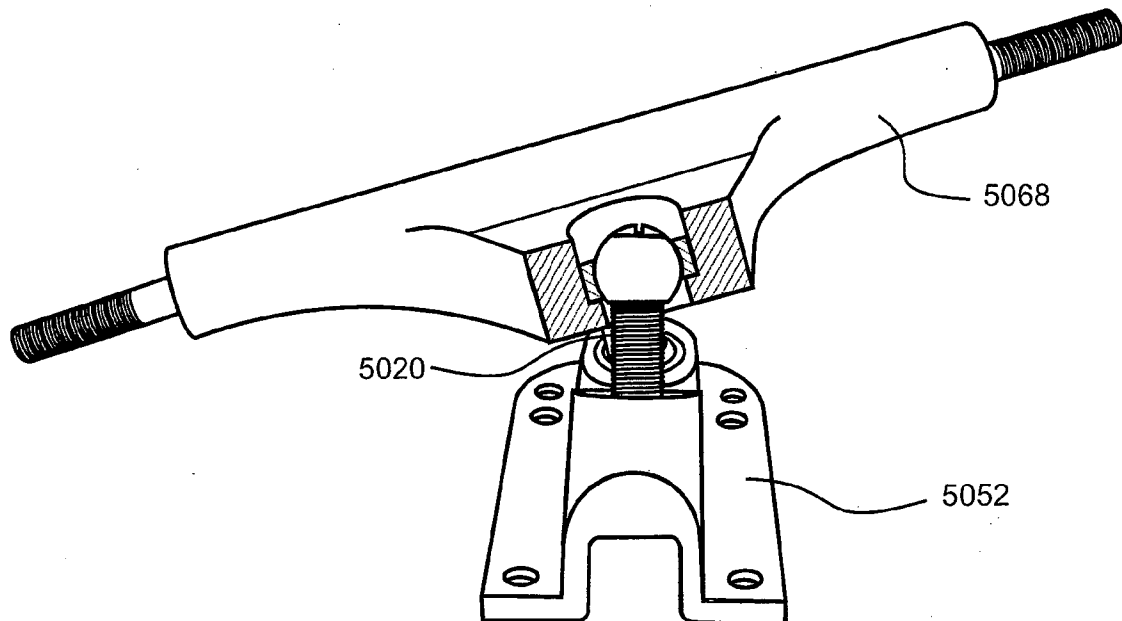


FIGURE 21

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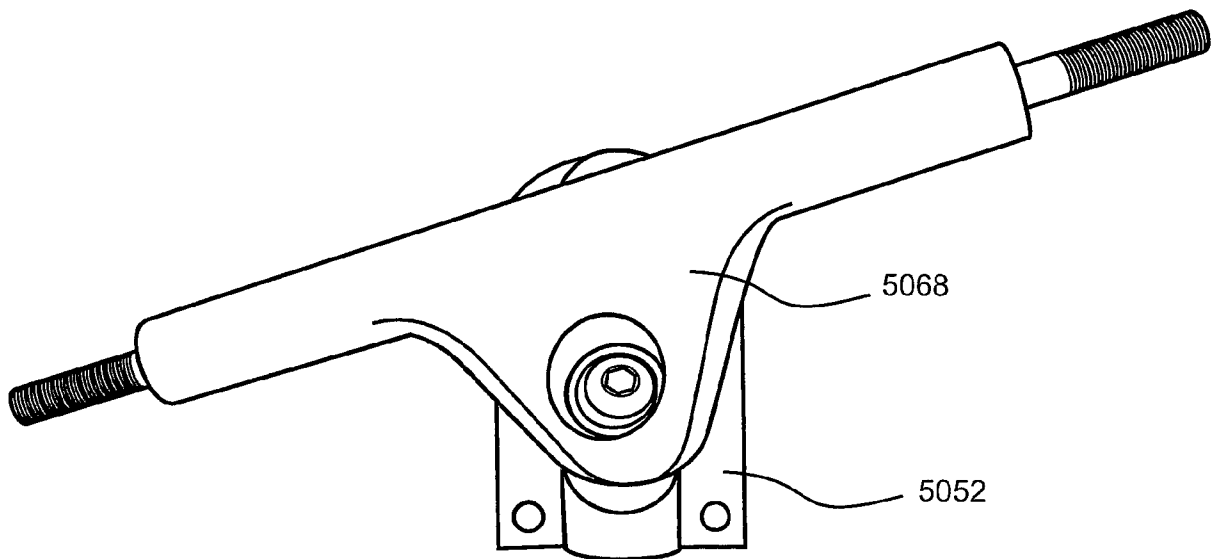
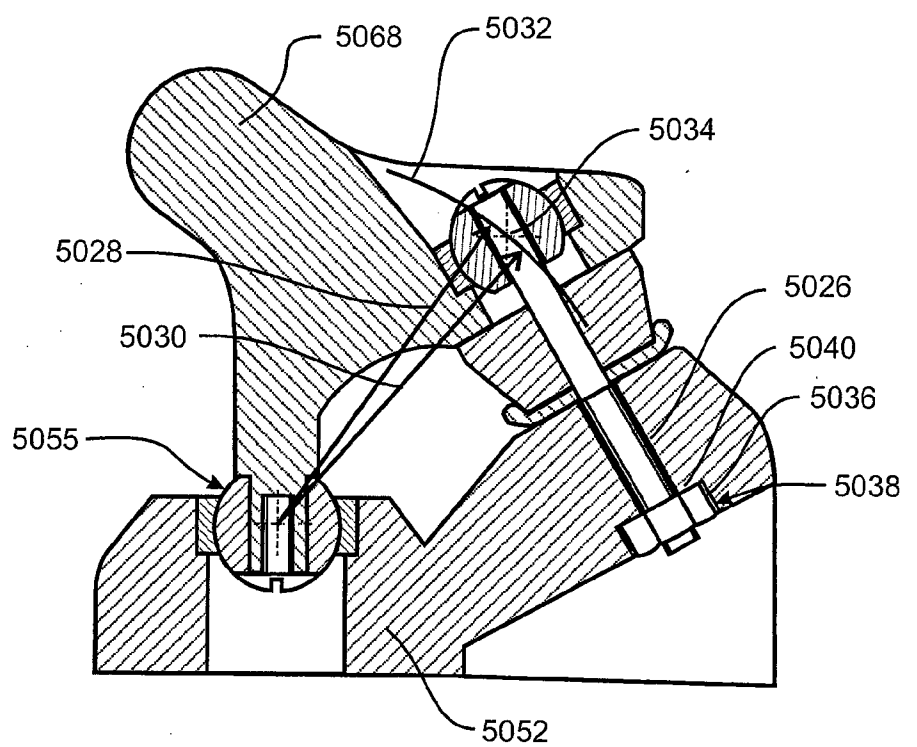


FIGURE 22

FIGURE 23



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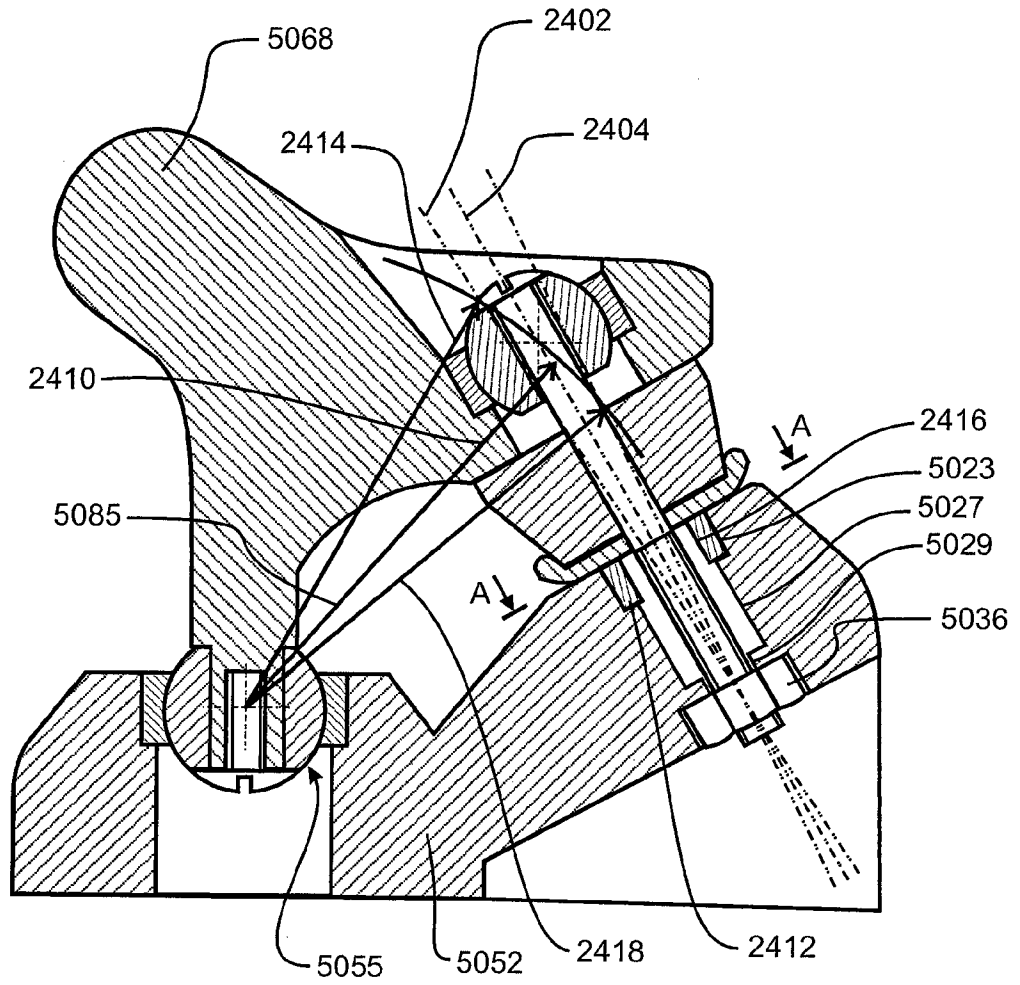


FIGURE 24

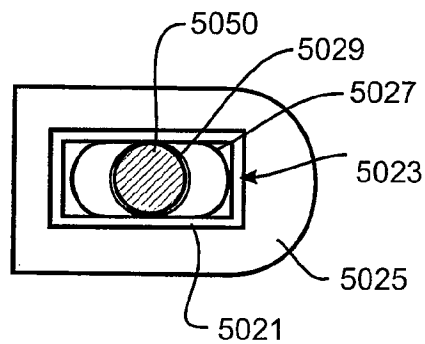


FIGURE 25A

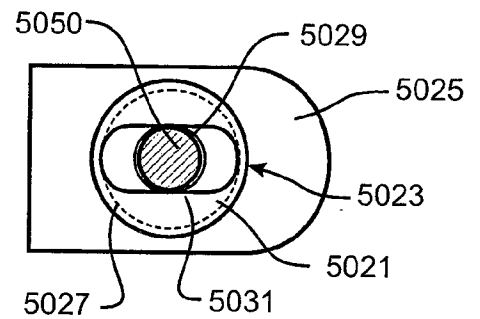


FIGURE 25B

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FIGURE 26A

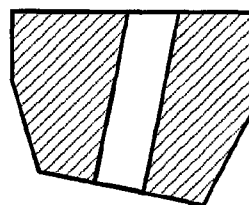


FIGURE 26B

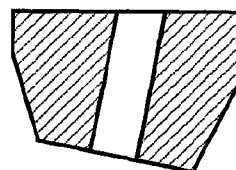


FIGURE 26C

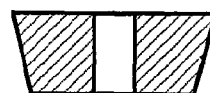


FIGURE 26D



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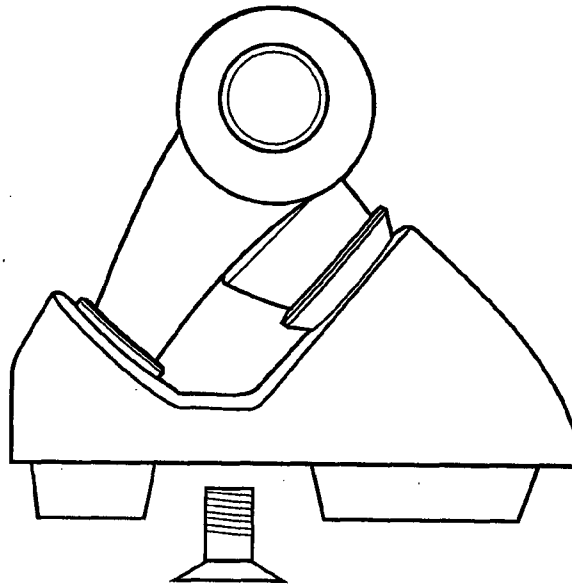


FIGURE 27

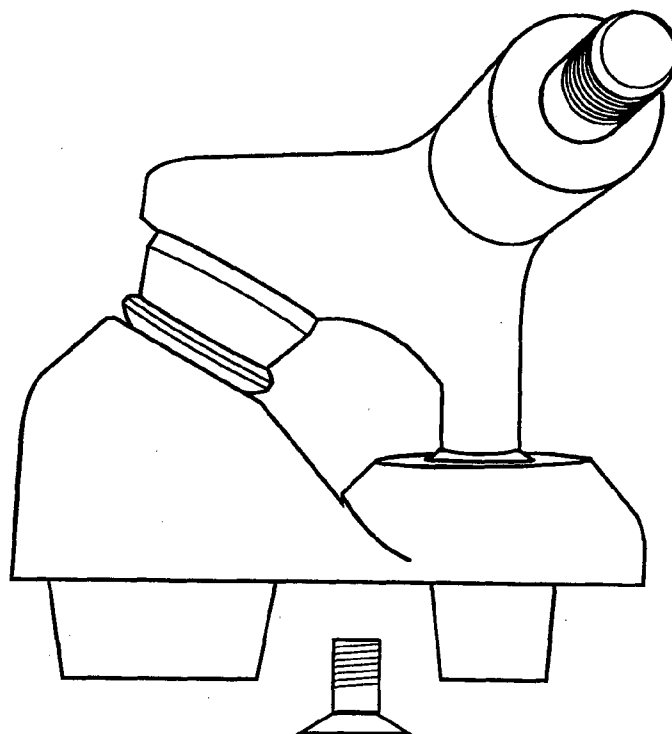


FIGURE 28

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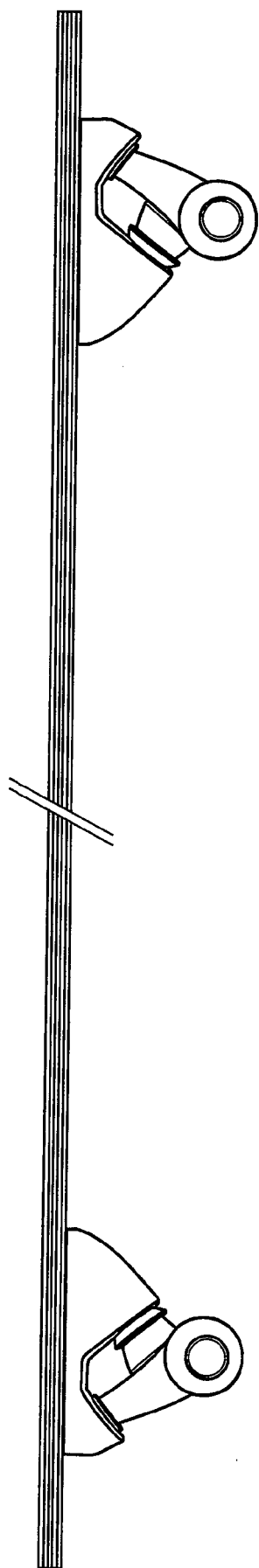


FIGURE 29

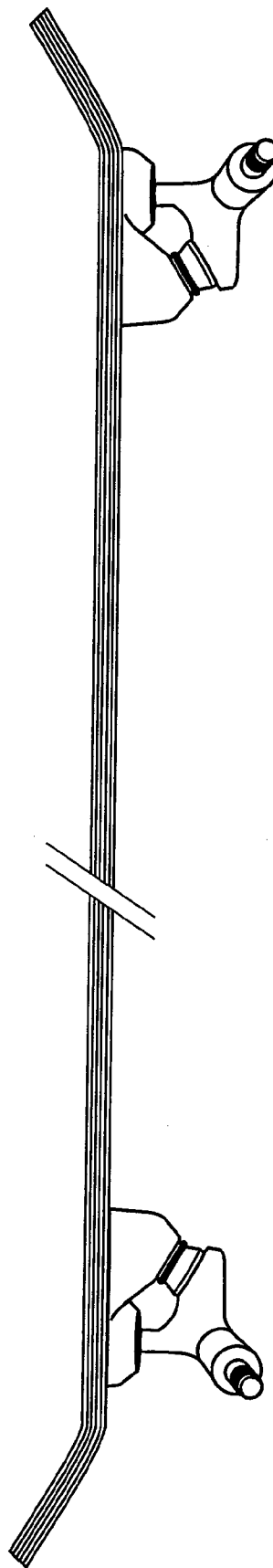


FIGURE 30

INTERNATIONAL SEARCH REPORT

 International application No.
PCT/NZ2012/000078
A. CLASSIFICATION OF SUBJECT MATTER**A63C 17/02 (2006.01)**

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)

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)

WPI, Google Patents: A63C17, skateboard, shortboard, longboard, truck, pivot, yaw, roll, pitch, tilt, kingpin, bolt, angle, angular, spacer, rubber, grommet, and like terms

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
	Documents are listed in the continuation of Box C	

☒ 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	"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
"E" earlier application or patent but published on or after the international filing date	"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
"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)	"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
"O" document referring to an oral disclosure, use, exhibition or other means	"&" document member of the same patent family
"P" document published prior to the international filing date but later than the priority date claimed	
Date of the actual completion of the international search 22 August 2012	Date of mailing of the international search report 23 August 2012
Name and mailing address of the ISA/AU AUSTRALIAN PATENT OFFICE PO BOX 200, WODEN ACT 2606, AUSTRALIA Email address: pct@ipaustalia.gov.au Facsimile No.: +61 2 6283 7999	Authorized officer Lili Eng AUSTRALIAN PATENT OFFICE (ISO 9001 Quality Certified Service) Telephone No. 0262833138

INTERNATIONAL SEARCH REPORT C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		International application No. PCT/NZ2012/000078
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2010/0327547 A1 (WILSON et al.) 30 December 2010 Whole document, in particular: abstract, paragraphs [0009, 0015, 0032-0035, 0038, 0041-0042, 0045-0046, 0049-0052], figures [1- 3, 5b-c, 6-8]	1-20

INTERNATIONAL SEARCH REPORT Information on patent family members		International application No. PCT/NZ2012/000078	
This Annex lists known patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.			
Patent Document/s Cited in Search Report		Patent Family Member/s	
Publication Number	Publication Date	Publication Number	Publication Date
US 2010/0327547 A1	30 Dec 2010	AU 2010263129 A1	19 Jan 2012
		CN 102458974 A	16 May 2012
		EP 2445780 A1	02 May 2012
		US 2010327547 A1	30 Dec 2010
		US 8152176 B2	10 Apr 2012
		US 2012104706 A1	03 May 2012
		WO 2010151457 A1	29 Dec 2010
End of Annex			
Due to data integration issues this family listing may not include 10 digit Australian applications filed since May 2001. Form PCT/ISA/210 (Family Annex)(July 2009)			