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Pierce et al.

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(54) **SKI BIKE SYSTEMS AND DEVICES**

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B62B 13/04 (2006.01)

(52) **U.S. Cl.**
CPC ***B62B 13/046*** (2013.01)

(58) **Field of Classification Search**
CPC B62B 13/02; B62B 13/04; B62B 13/046
See application file for complete search history.

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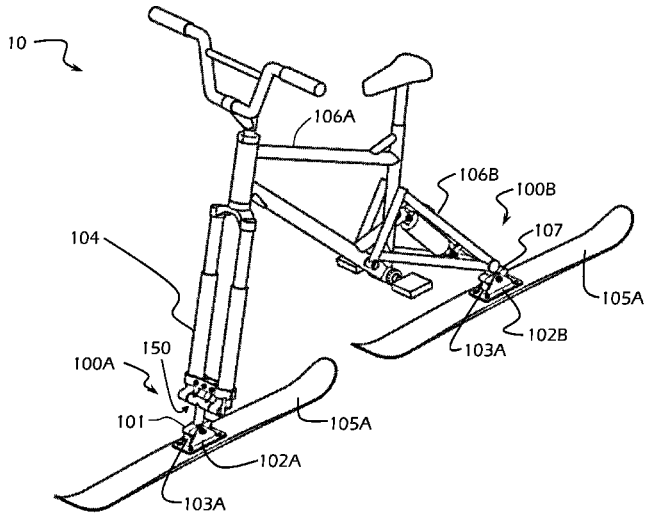
(74) *Attorney, Agent, or Firm* — Maschoff Brennan; Paul G. Johnson

(57) **ABSTRACT**

In some examples, a ski bike includes a frame, a steering mechanism rotatably coupled to the frame, a ski, and a ski retention system. The ski retention system rotatably couples the ski to the frame or the steering mechanism. The ski retention system includes a ski bracket and a fixed member. The ski bracket is rigidly coupled to the ski. The fixed member is rigidly coupled to the frame or the steering mechanism and rotatably coupled to the ski bracket.

19 Claims, 14 Drawing Sheets



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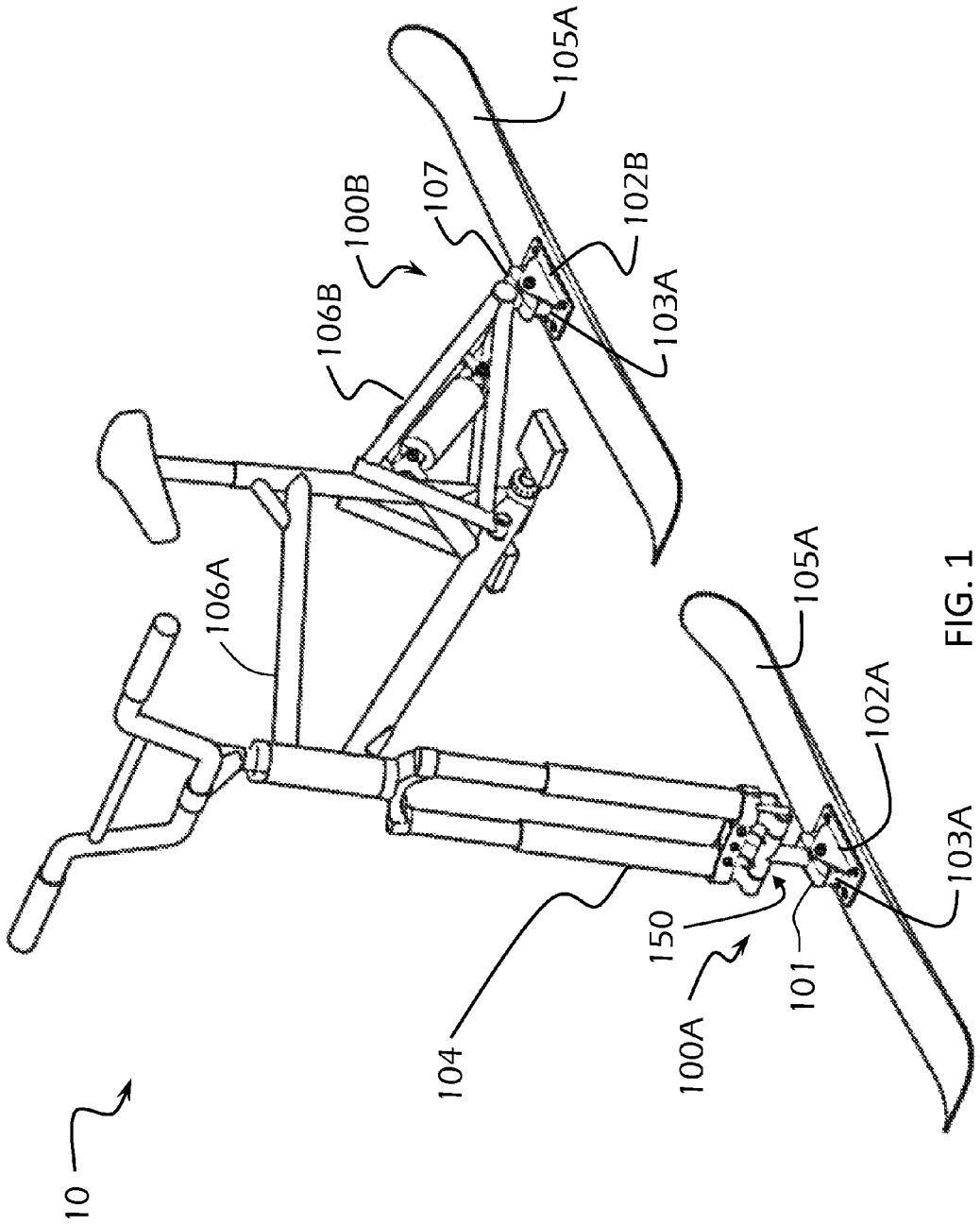
10
104
100A
150
101
103A
102A
105A
106A
106B
100B
107
102B
103A
105A

FIG. 1

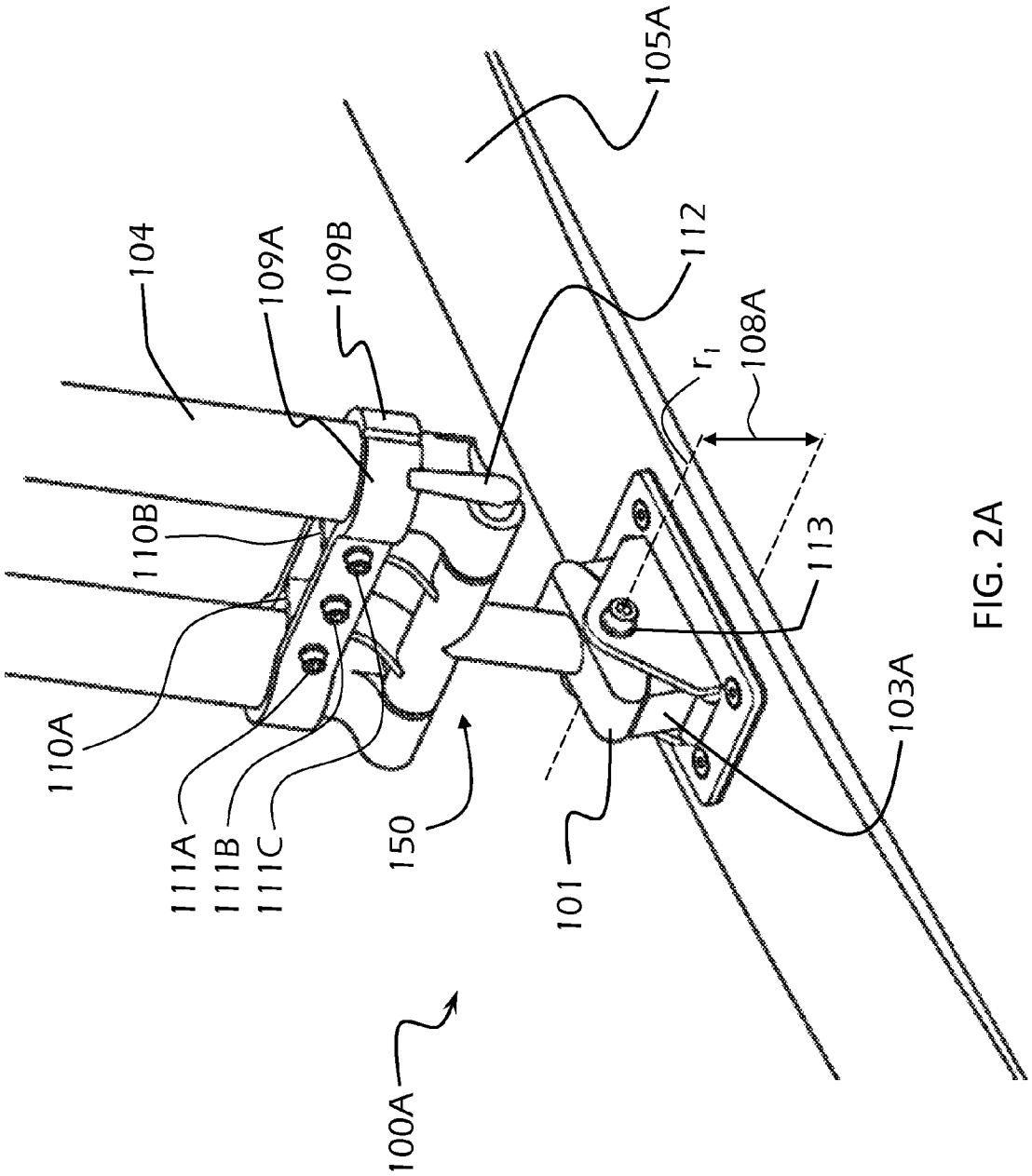
105A
104
109A
109B
112
108A
r_1
110B
113
110A
111A
111B
111C
150
101
103A
100A

FIG. 2A

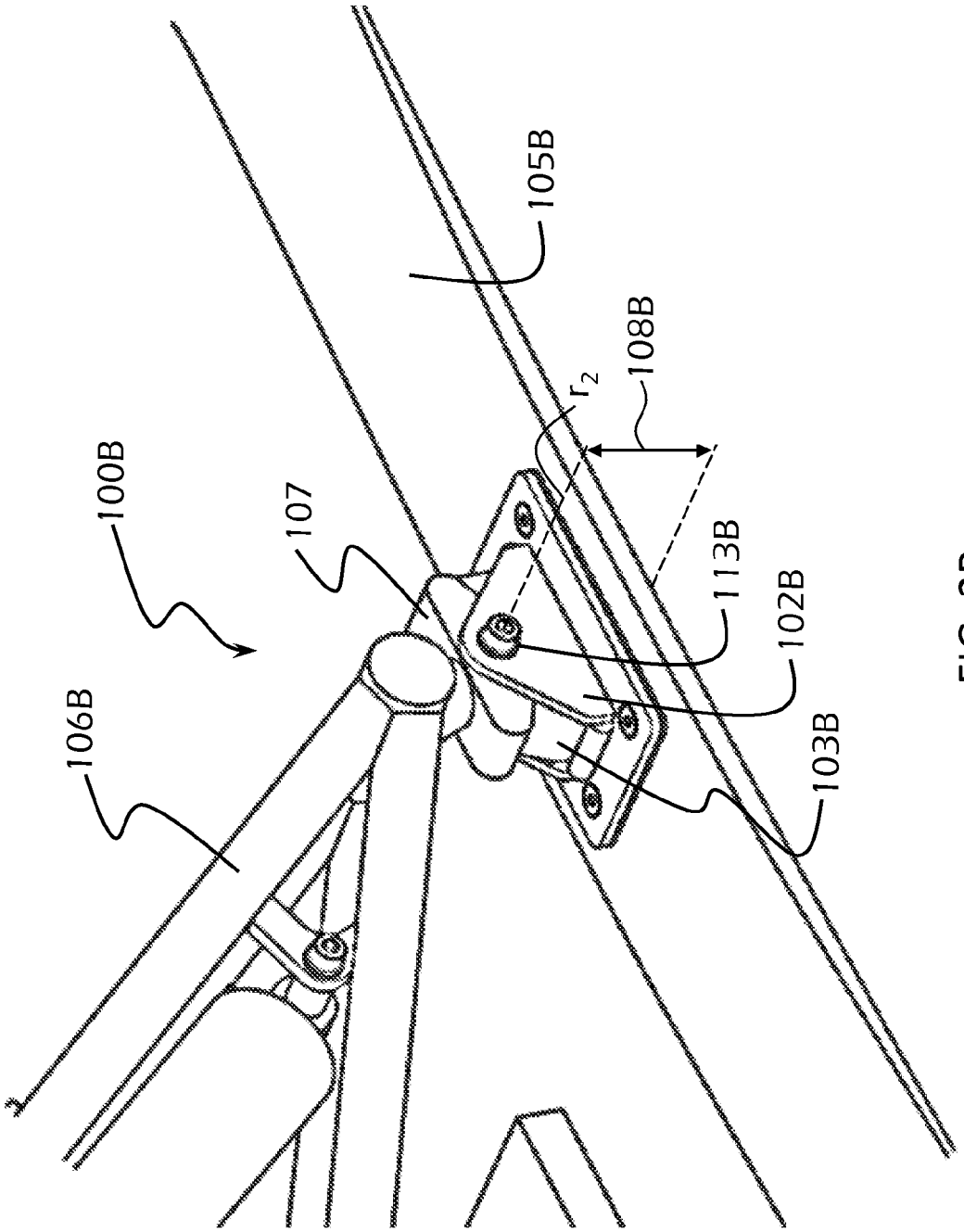

FIG. 2B

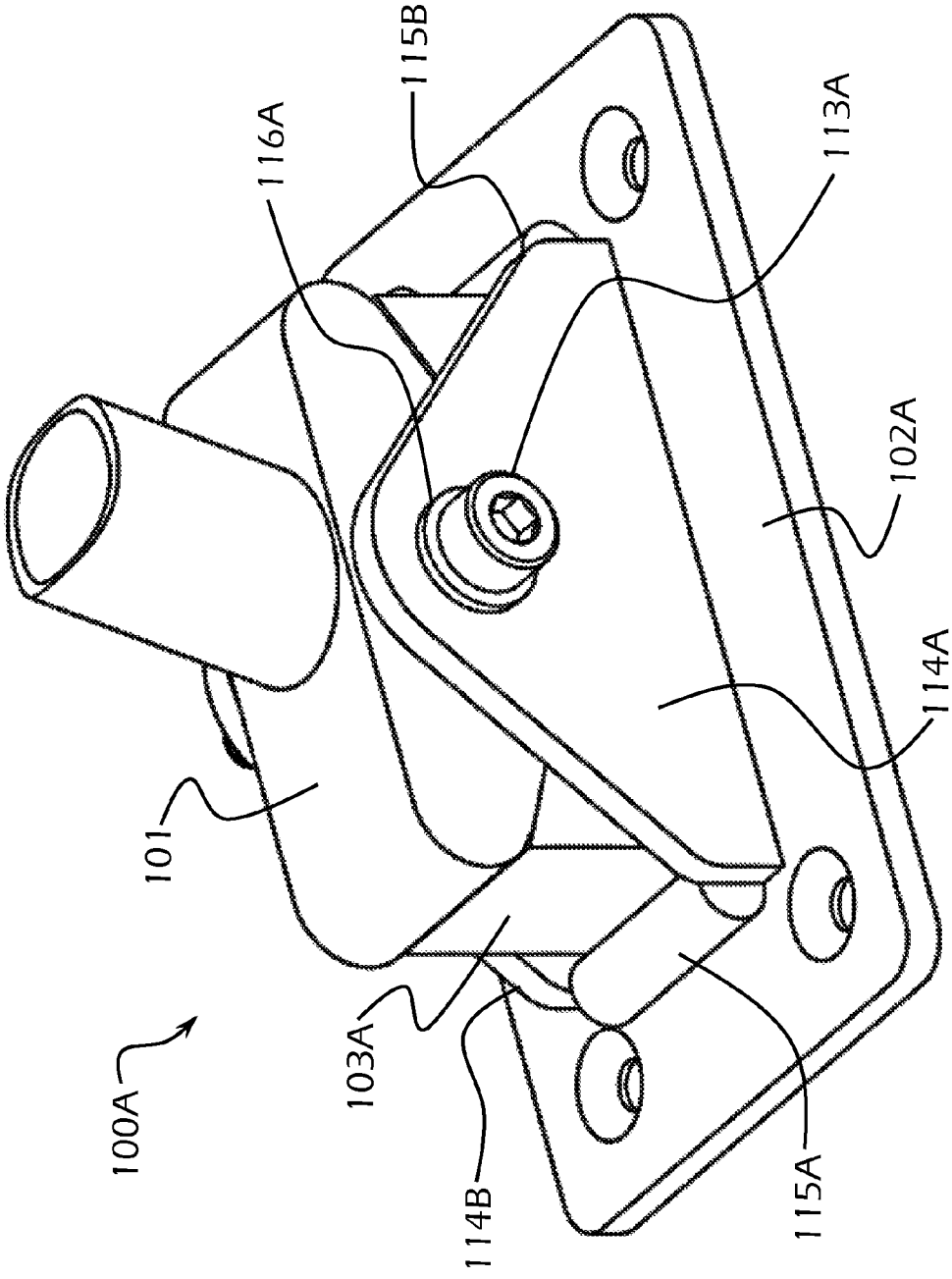

FIG. 3A

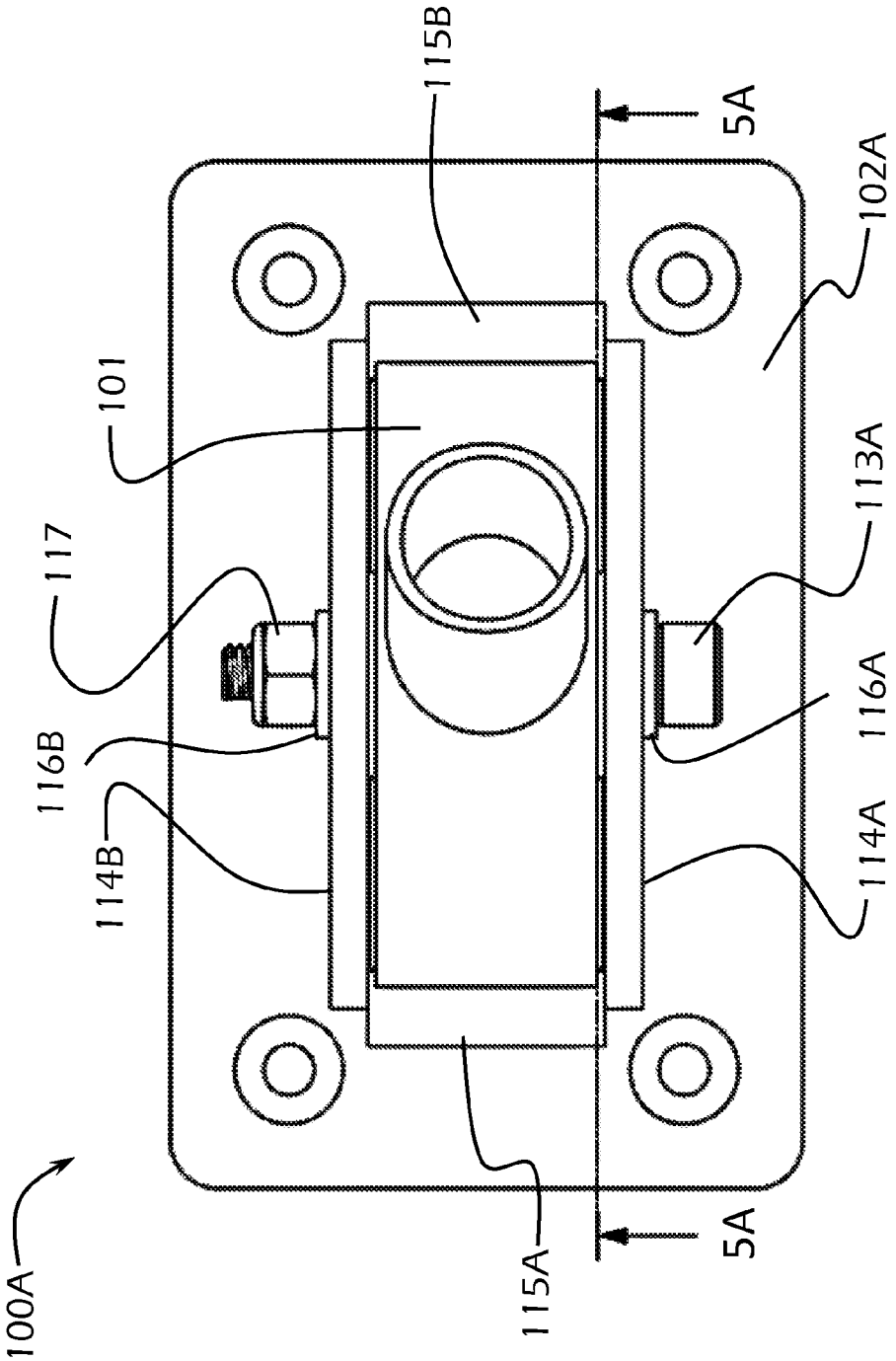

FIG. 3B

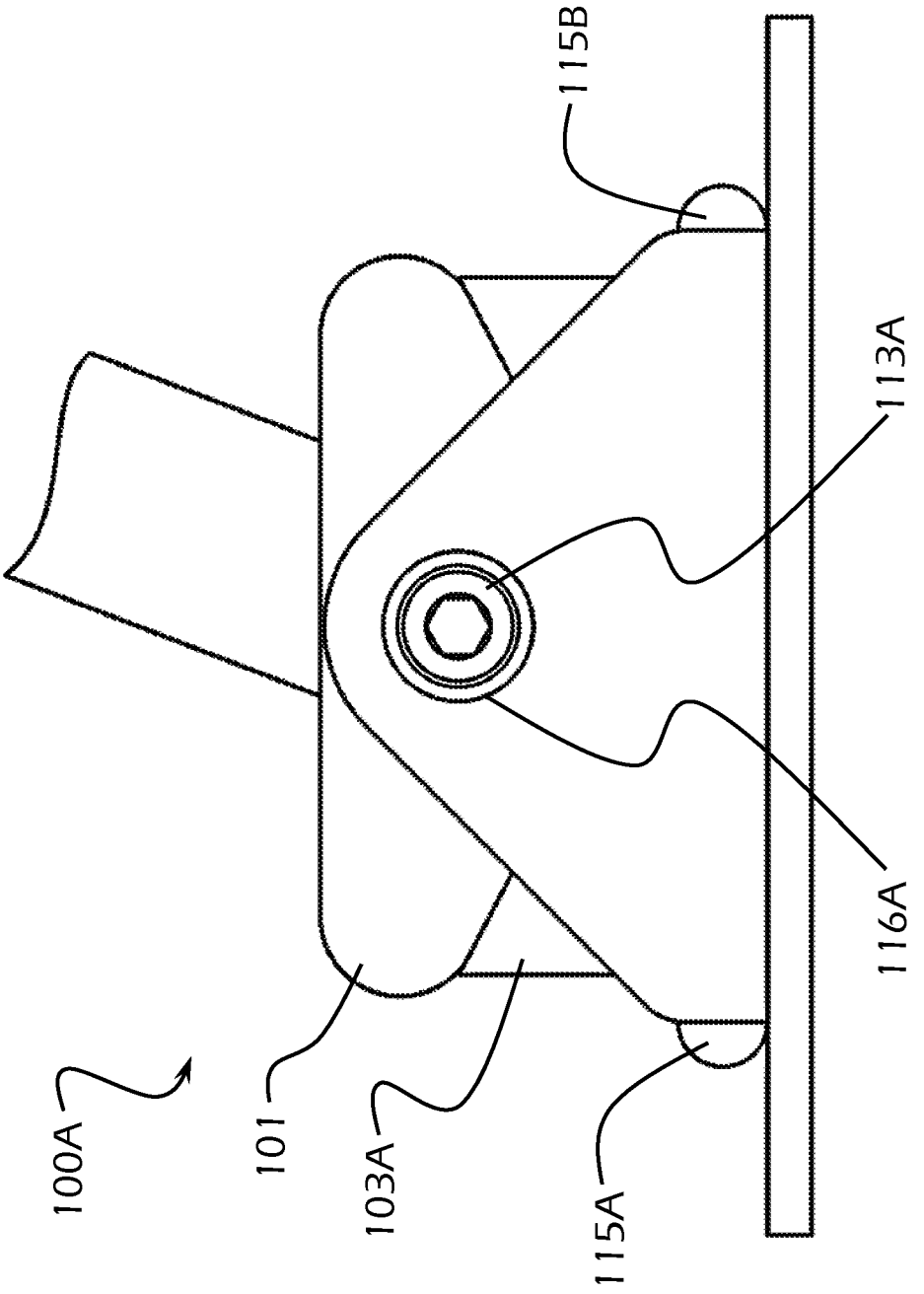

FIG. 3C

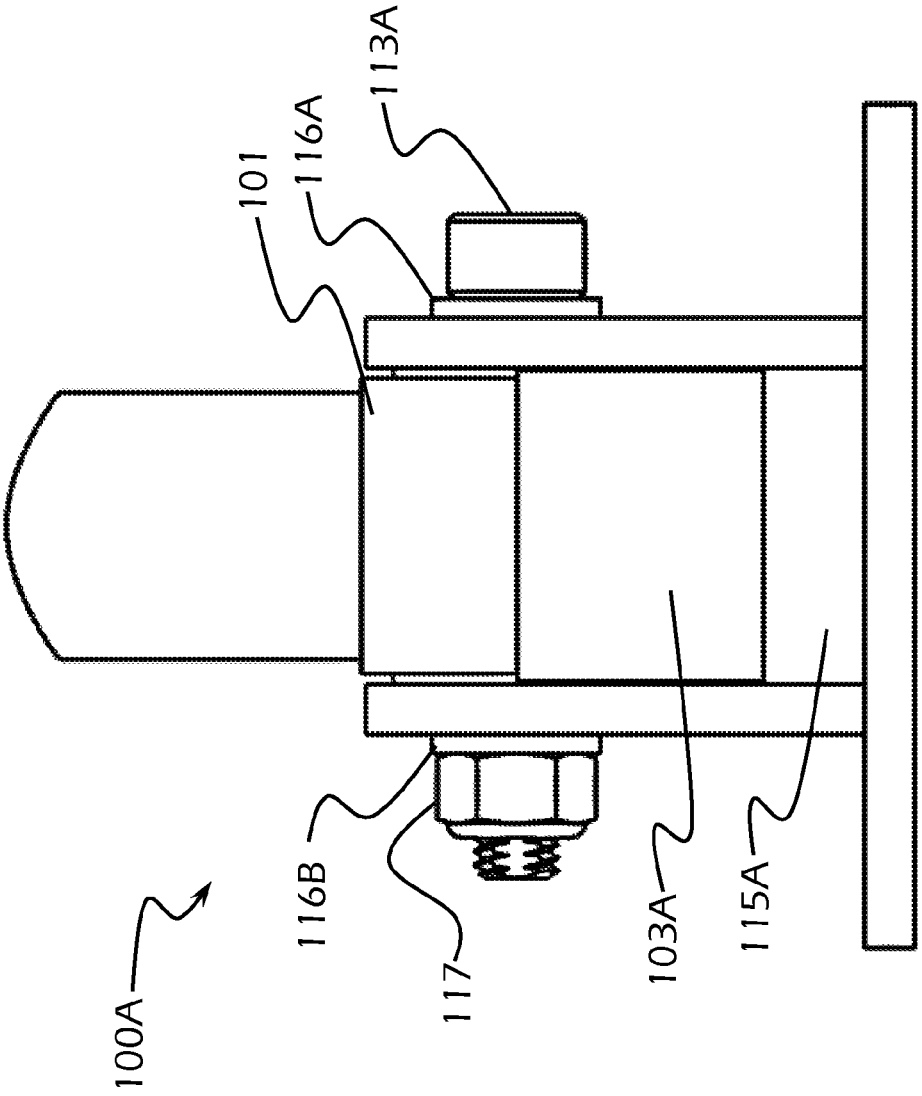

FIG. 3D

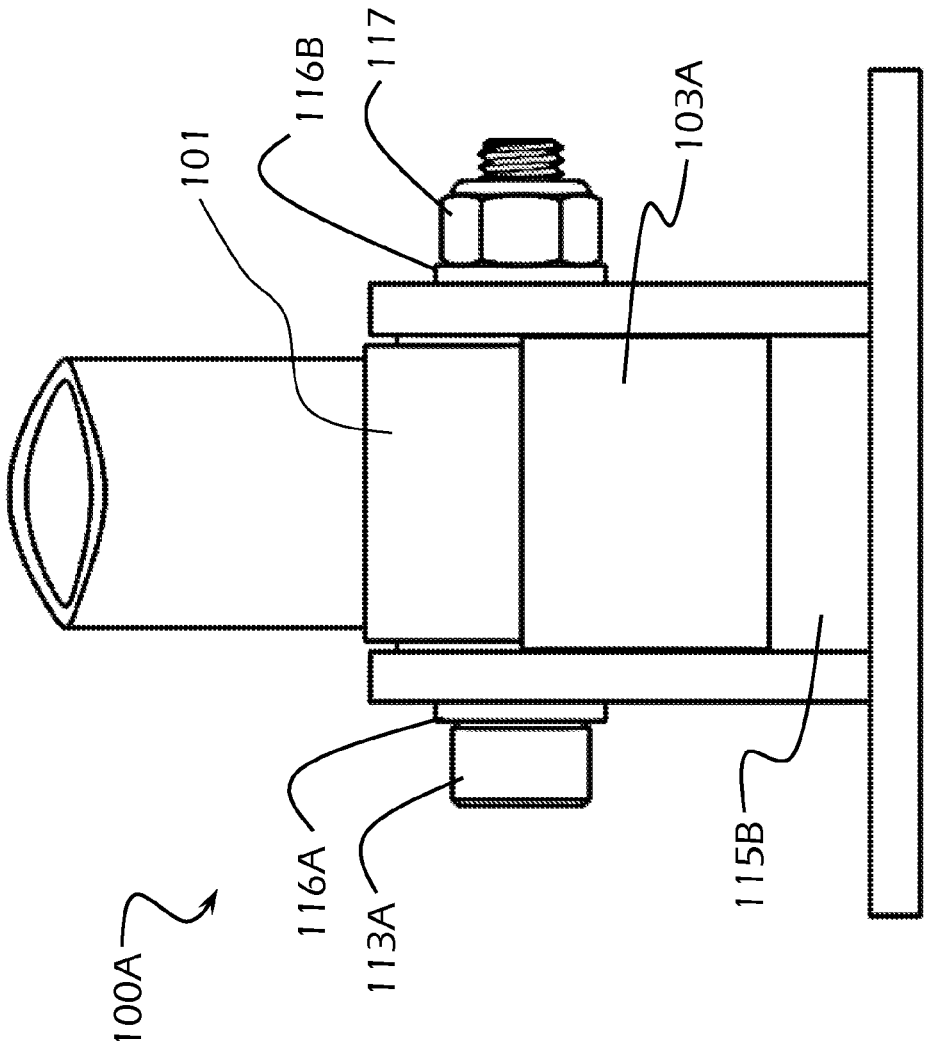

FIG. 3E

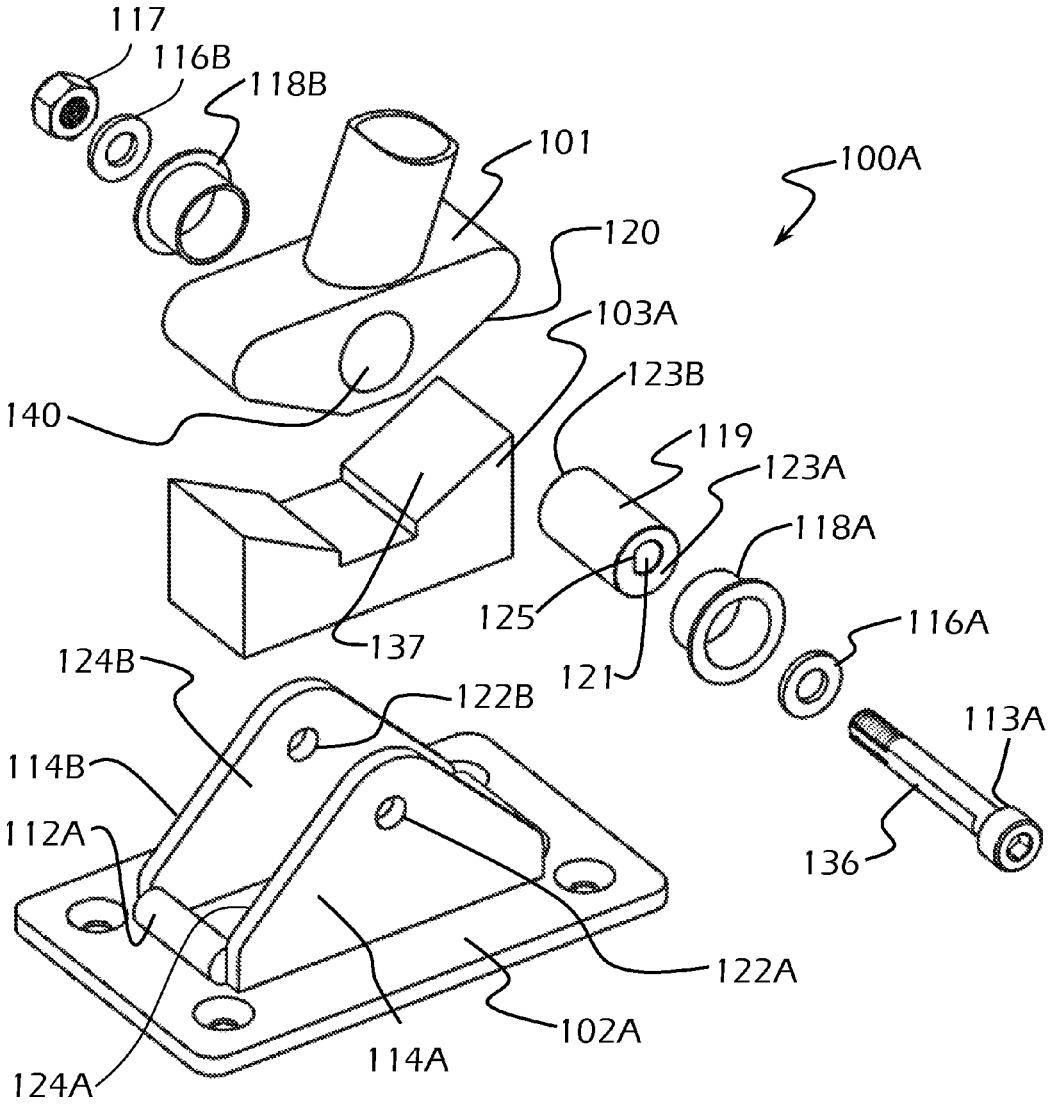
117
116B
118B
101
100A
120
103A
123B
140
119
123A
118A
125
116A
121
137
124B
122B
113A
114B
112A
136
122A
102A
114A
124A

FIG. 4

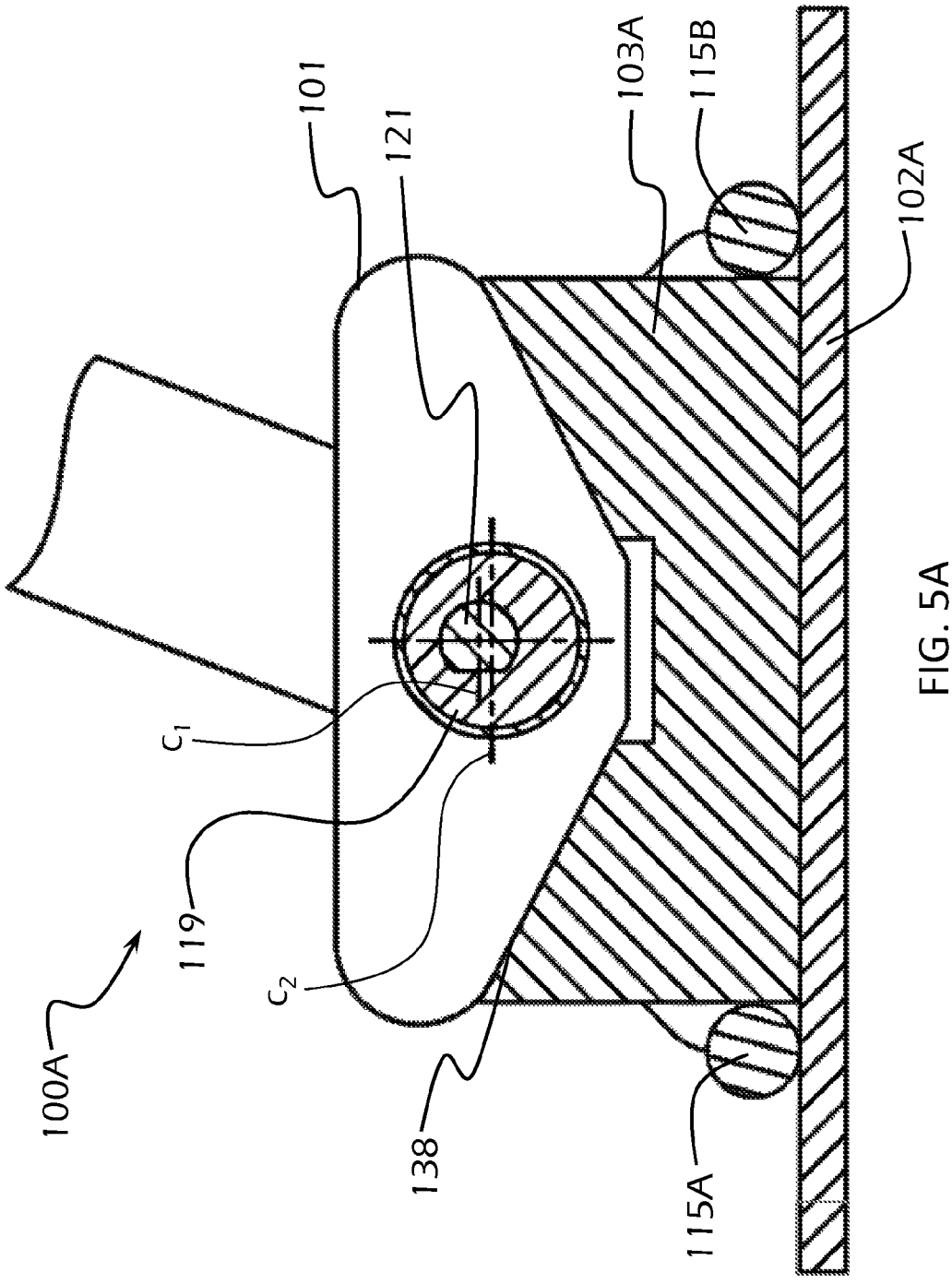

FIG. 5A

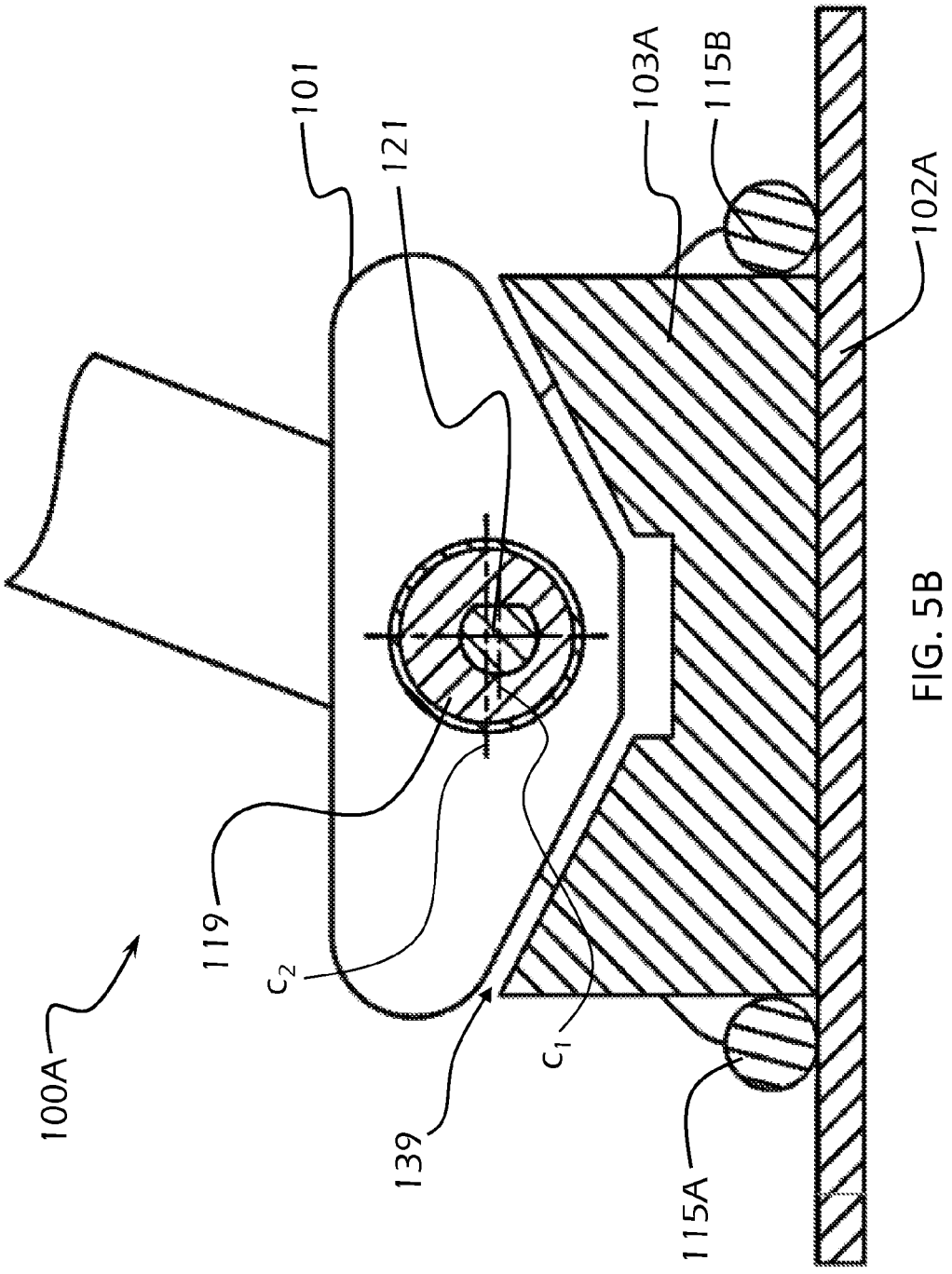

FIG. 5B

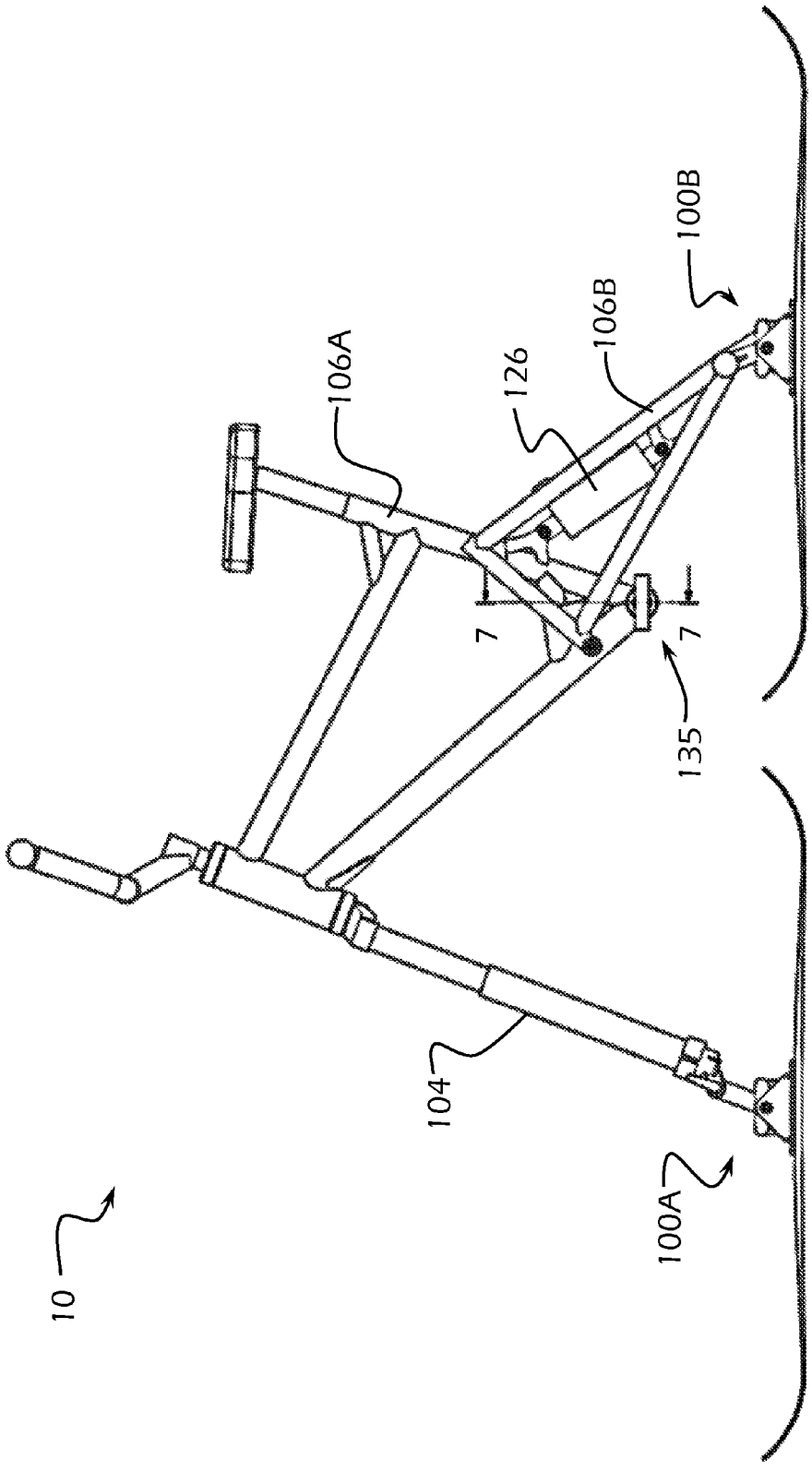

FIG. 6

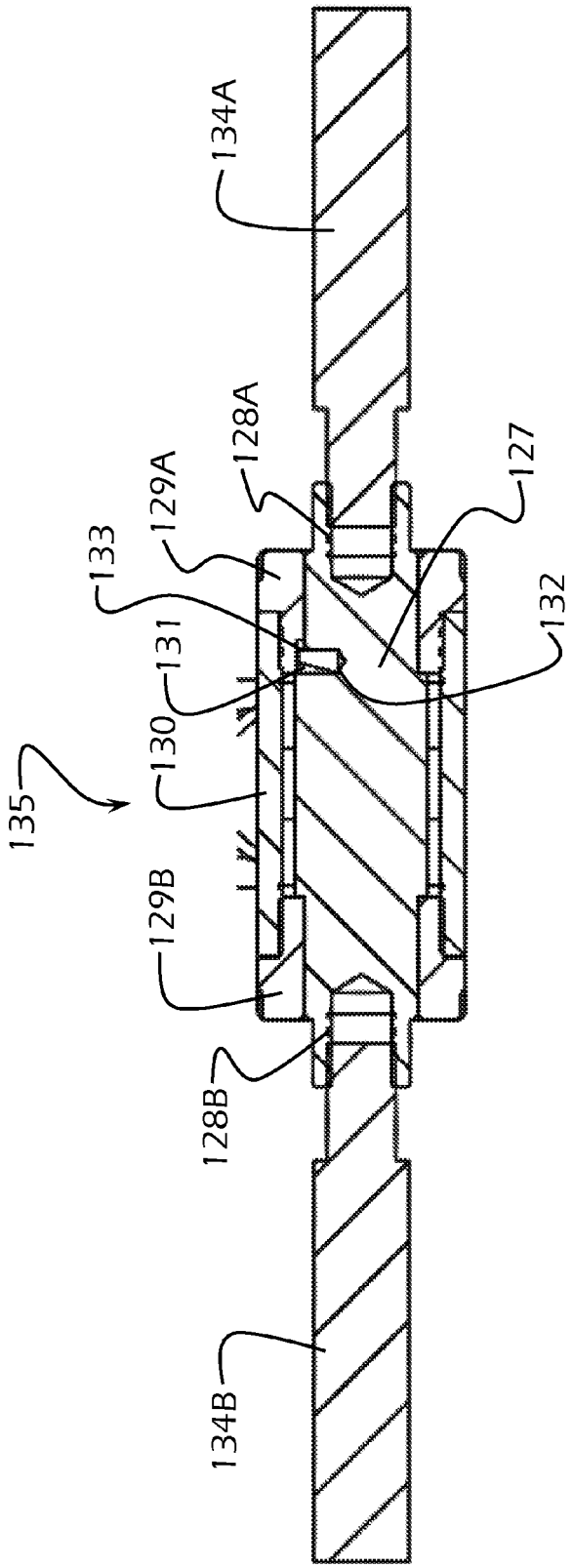

FIG. 7

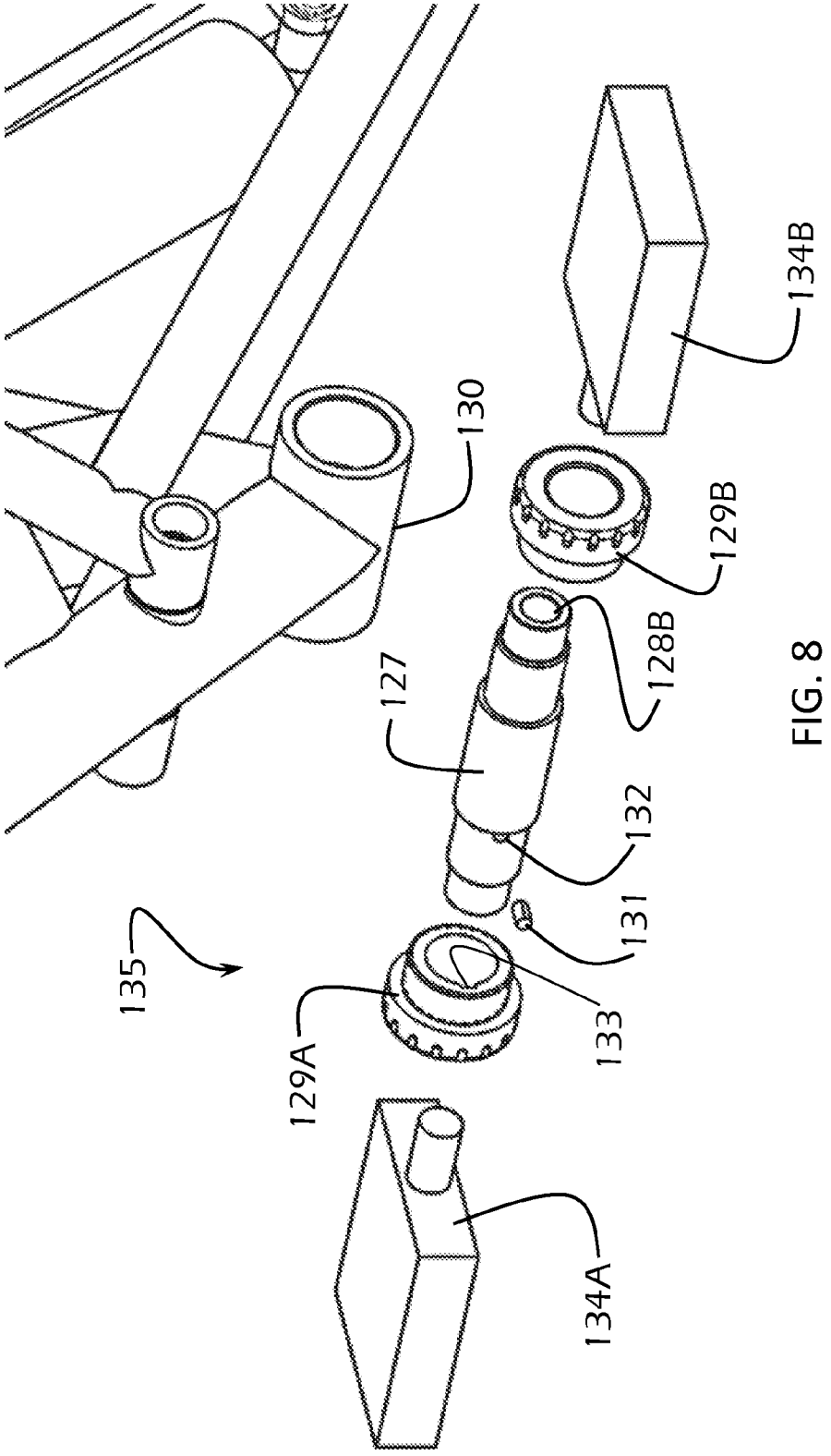

FIG. 8

SKI BIKE SYSTEMS AND DEVICES

CROSS-REFERENCE TO RELATED APPLICATION

This application claims the benefit of and priority to U.S. Provisional App. No. 62/400,489, filed Sep. 27, 2016, which is incorporated herein by reference in its entirety.

FIELD

Embodiments disclosed herein generally relate to ski bike systems and devices, such as ski bike handling systems, suspension systems and/or foot placement apparatus.

BACKGROUND

Unless otherwise indicated herein, the materials described herein are not prior art to the claims in the present application and are not admitted to be prior art by inclusion in this section.

A ski bike is a recreational device, typically used at lift-served ski areas. As the name implies, it moves along the snow using skis and has the general form of a bicycle.

Ski bikes have been around for over a century. During that time, two primary designs have emerged to suit different riding styles. The first design utilizes a ski bike that is straddled by the rider, with the rider augmenting control of the ski bike with short foot skis. This style is typically referred to as the "skibob" style. The second design utilizes a ski bike where only the two skis of the bike are in contact with the snow; foot skis are not used. This style is typically referred to as the "pegger" style since the location where the rider's feet rest can be referred to as pegs. Both skibob style ski bikes and pegger style ski bikes have a loyal following, and both can provide recreational enjoyment with the proper design.

Skibob style ski bikes have gained a loyal following since the 1950's. Skibob style ski bikes have gained worldwide acceptance, especially in Europe where they were initially developed. At various times, skibob style ski bikes have even enjoyed enough popularity to prompt world championship races. Skibob style ski bikes are characterized as very rideable on groomed ski slopes. Groomed slopes provide the terrain where skibob style ski bikes can be ridden both fast and with good control.

Pegger style ski bikes have more recently gained popularity. Their popularity is driven by a desire to more closely replicate the experience found in modern mountain bicycles while on the snow. Pegger style ski bikes are truly ridden, with no part of the rider in contact with the ground. Since the bike isn't being straddled with the rider's feet in contact with the ground, pegger style ski bikes allow the rider to enjoy more extreme terrain than skibob style ski bikes.

The subject matter claimed herein is not limited to embodiments that solve any disadvantages or that operate only in environments such as those described above. Rather, this background is only to provide to illustrate one example technology where some embodiments described herein may be practiced.

SUMMARY

Embodiments described herein generally relate to ski bike systems and devices.

In an example embodiment, a ski retention system is connected to a bicycle steering mechanism or similar interface. The ski retention system includes a fixed member, which in this embodiment is rigidly attached directly to the bicycle steering mechanism or indirectly through an adapter, a bracket (hereafter "ski bracket") attached to a snow ski that is rotatably attached to the fixed member, and a resistance damper that may provide rotational resistance and modulation of the snow ski and ski bracket relative to the fixed member. An axis of rotation of the ski relative to the steering mechanism may be near the ski, such as less than four inches above a bottom surface of the ski. An axle that couples the fixed member and the ski bracket together may include bushings and a spacer with an offset D-shaped through-hole that acts as a cam when rotated. A D-shaped screw may be placed through the D-shaped hole in the spacer cam device, and when the screw is rotated the cam may provide an offsetting motion that may be used to tighten the fixed member into the resistance damper and ski bracket. This tightening action may provide a preload (or compression) of the resistance damper between the fixed member and the ski bracket that may allow the ski to rotate and move over undulations in the snow while providing resistance for riding and turning the ski bike.

In another example embodiment, a ski bike ski retention system is connected to a bicycle steering mechanism or similar interface. The retention system includes a fixed member, which in this embodiment is rigidly attached to the bicycle steering mechanism, a ski bracket attached to the snow ski that is rotatably attached to the fixed member, and a resistance damper that may provide rotational resistance and modulation of the snow ski and ski bracket relative to the fixed member. An axis of rotation of the ski relative to the ski bike may be near the ski. An axle that couples the fixed member and the bracket may include bushings and a spacer. The ski bracket may include an oversize hole with a nut with offset hole placed in the oversized hole that acts as a cam when rotated, hereafter referred to as a cam nut. A screw may be placed through the bracket, cam nuts, and spacer. When the cam nut is rotated, the screw may push on the axle spacer and provide an offsetting motion that may be used to tighten the fixed member into the resistance damper and bracket. This tightening action may provide a preload of the resistance damper between the fixed member and the ski bracket that may allow the ski to rotate and move over undulations in the snow while providing resistance for riding and turning the ski bike.

In another example embodiment, a ski bike ski retention system includes a fixed member with an axle interface integral to the ski bike. A ski bracket attached to the snow ski is rotatably attached to the fixed member. Between the ski bracket and fixed member is a resistance damper that provides rotational resistance and modulation of the snow ski and ski bracket relative to the fixed member. An axis of rotation of the ski relative to the ski bike may be near the ski. An axle that couples the fixed member and the ski bracket may include bushings and a spacer with an offset D-shaped through-hole that may act as a cam when rotated. A D-shaped screw may be placed through the D-shaped hole in the spacer cam device, and when the screw is rotated the cam may provide an offsetting motion that may be used to tighten the fixed member into the resistance damper and ski bracket. This tightening action may provide a preload of the resistance damper between the fixed member and the ski bracket that may allow the ski to rotate and move over undulations in the snow while providing resistance for riding and turning the ski bike.

In another example embodiment, a ski bike ski retention system includes a fixed member with an axle interface

integral to the ski bike. A ski bracket attached to the snow ski is rotatably attached to the fixed member. Between the ski bracket and fixed member is a resistance damper that may provide rotational resistance and modulation of the snow ski and ski bracket relative to the fixed member. An axis of rotation of the ski relative to the ski bike may be near the ski. The resistance damper may alternatively or additionally include or be referred to as an elastomeric bumper that resists rotation. An axle that couples the fixed member and the bracket together may include bushings and a spacer. The ski bracket may include an oversize hole with a nut with offset hole placed in the oversized hole that acts as a cam when rotated, hereafter referred to as a cam nut. A standard screw may be placed through the bracket, cam nut, and spacer. When the cam nut is rotated, the screw may push on the axle spacer and provide an offsetting motion that is used to tighten the fixed member into the resistance damper and bracket. This tightening action may provide a preload of the resistance damper between the fixed member and the ski bracket that may allow the ski to rotate and move over undulations in the snow while providing resistance for riding and turning the ski bike.

In some example embodiments of a ski bike, the ski bike is a full suspension design. The suspension design is configured such that a shock used in a rear of the ski bike is protected from potential damaging impacts by a rear triangle of the ski bike.

In some example embodiments of a ski bike, the ski bike is configured to accept pedals or other platforms which the rider places their feet upon. This and other embodiments may include a standard bicycle bottom bracket with two bearing members that thread into a tube, e.g., the bottom bracket, in the ski bike frame. The bearing members may be threaded with standard bicycle bottom bracket threads. Within the bearing members is a tube that interfaces with pedals or other platforms on which feet are placed. Also in the tube there may be a hole in which may be placed a pin. The pin may interface with the right or left bearing member to prevent rotation of the entire assembly once tight.

In another example embodiment, a ski bike includes a frame, a steering member rotatably coupled to the frame, a ski, and a ski retention system that rotatably couples the ski to the frame or the steering mechanism. The ski retention system includes a ski bracket and a fixed member. The ski bracket is rigidly coupled to the ski. The fixed member is rigidly coupled to the frame or the steering mechanism and is rotatably coupled to the ski bracket.

In another example embodiment, a ski bike includes a front triangle, a steering mechanism rotatably coupled to the front triangle, a rear triangle or swing arm rotatably coupled to the front triangle, a ski coupled to the rear triangle or the swing arm, and a rear shock. The rear shock may have a first end coupled to the front triangle and a second end coupled to the rear triangle or the swing arm. The rear shock may be disposed within an envelope defined by the rear triangle or the swing arm.

In another example embodiment, a foot peg or pedal assembly may be configured to be coupled to a bottom bracket interface of a ski bike. The foot peg or pedal assembly may include a first cup, a second cup, and a pedal tube. The first cup may be configured to be coupled to a first side of the bottom bracket interface. The second cup may be configured to be coupled to a second side of the bottom bracket interface opposite the first side. The pedal tube may be configured to be disposed in the bottom bracket interface with a first end that extends out through the first cup and a second end that extends out through the second cup. The first cup may include a slot to receive a protrusion that extends outward from the pedal tube or the pedal tube may include a slot to receive a protrusion that extends inward from the first cup. The protrusion when received in the slot may be configured to fix the pedal tube with respect to the bottom bracket interface to prevent rotation of the pedal tube relative to the bottom bracket interface during installation and removal of pegs or pedals in the first and second ends of the pedal tube.

This summary is provided to introduce a selection of concepts in a simplified form that are further described below in the Detailed Description. This Summary is not intended to identify key features or essential characteristics of the claimed subject matter, nor is it intended to be used as an aid in determining the scope of the subject matter.

Additional features and advantages of the invention will be set forth in the description which follows, and in part will be obvious from the description, or may be learned by the practice of the invention. The features and advantages of the invention may be realized and obtained by means of the instruments and combinations particularly pointed out in the appended claims. These and other features of the present invention will become more fully apparent from the following description and appended claims, or may be learned by the practice of the invention as set forth hereinafter.

BRIEF DESCRIPTION OF THE DRAWINGS

To further clarify the above and other advantages and features of the present invention, a more particular description of the invention will be rendered by reference to specific embodiments thereof which are illustrated in the appended drawings. It is appreciated that these drawings depict only typical embodiments of the invention and are therefore not to be considered limiting of its scope. The invention will be described and explained with additional specificity and detail through the use of the accompanying drawings in which:

FIG. **1** shows a perspective view of a ski bike with two example ski retention systems;

FIGS. **2**A and **2**B show perspective detailed views of the two ski retention systems of FIG. **1**;

FIGS. **3**A-**3**E respectively show a perspective view, a top view, a side view, a front view and a back view of a lower portion of one of the ski retention systems of FIG. **1**;

FIG. **4** shows an exploded perspective view of the ski retention system of FIGS. **3**A-**3**E;

FIG. **5**A shows a cross-sectional view of the ski retention system of FIG. **3**B along a cutting plane **5**A-**5**A of FIG. **3**B arranged in a "tight" or "closed" position;

FIG. **5**B shows a cross-sectional view of the ski retention system of FIG. **5**A arranged in a "loose" or "open" position;

FIG. **6** shows a side view of an example embodiment of the ski bike of FIG. **1** with a rear shock tucked within a rear triangle of the ski bike to form a protected suspension system;

FIG. **7** shows a cross-sectional view of a foot peg or pedal assembly that may be included in the ski bike of FIG. **6**; and

FIG. **8** shows an exploded perspective view of the foot peg or pedal assembly of FIG. **7**,

all arranged in accordance with at least one embodiment described herein.

DETAILED DESCRIPTION OF SOME EXAMPLE EMBODIMENTS

Various aspects of both types of ski bikes (skibobs and peggers), when present, may contribute to making ski biking

a safe and/or enjoyable recreational activity. First, the ski bike may be loadable on a ski lift for transport to the top of a mountain. If the ski bike is overly bulky or doesn't contain provisions for transportation on the lift, it may be difficult or impossible to transport on the lift. Another aspect that may contribute to enjoyment of a ski bike is how comfortable it is. Safety is another aspect. The ski bike must be able to be retained in the case that the rider is separated from the ski bike. All of these aspects, when properly combined, make ski bikes safe and enjoyable.

Another aspect is that the ski bike must handle effectively. The ski bike must glide over the snow, allow for turning, and must provide adequate ability for the ski to move over the undulations of the snow. Several variables go into a proper handling ski bike including:

ski position relative to a center of gravity of the ski bike and rider combination;

where the ski rotates relative to the bike, and

the ski's resistance to rotation.

This combination of variables may be controlled and/or determined by the combination and arrangement of components used to couple the ski to the ski bike. The combination and arrangement of components used to couple the ski to the ski bike may be referred to herein as the "ski retention system" of the ski bike.

Both types of ski bikes require an adequate ski retention system. Skibob style ski retention systems have evolved based on the unique requirements of the skibob style ride. In a skibob, handling is influenced by both the forces of the rider transmitted through the ski bike into the skis, as well as the forces of the rider transmitted through the rider's foot skis. Since the skibob rider has the ability to remove their weight entirely from the skibob, even if only momentarily, much of the handling sensitivity of the bike itself can be compensated for by the rider.

This is not the case with a pegger style ski bike. In a pegger style ski bike, all of the force of the rider is transmitted through the bike frame, through the ski retention system and finally through the skis. Since all the forces of the rider are transmitted through the ski retention system in a pegger style bike, the overall ability to ride a pegger style ski bike is more dependent on the ski retention system than is the case for skibob style ski bikes. Design of the ski retention system is a variable in pegger style ski bike performance that can significantly influence handling of pegger style ski bikes.

Ski bike prior art, generally, does not appear to disclose detailed designs of ski retention systems, either for skibob or pegger style ski bikes.

In order to provide comfort for the rider and a greater ability to ride a variety of terrain, many modern ski bikes use a full suspension frame design. With a full suspension design, shock absorbers are used in the front and rear of the bike to provide the rider, through the ski bike, the ability to absorb bumps.

Accordingly, some embodiments disclosed herein include a ski bike ski retention system configured to connect a ski bike frame or bicycle steering mechanism to a snow ski. In some embodiments, the ski retention system may include:

a fixed member, which may be rigidly attached to another part of the ski bike, such as the steering mechanism, or may be integral to the ski bike frame;

a ski bracket attached to the snow ski that is rotatably attached to the fixed member; and

a resistance damper between the ski bracket and fixed member that provides rotational resistance and modulation of the snow ski and ski bracket relative to the fixed member.

An axle that couples the fixed member and the ski bracket together may include bushings and a spacer with an offset D-shaped through-hole that acts as a cam when rotated. A D-shaped screw is placed through the D-shaped hole in the spacer, and when the D-shaped screw is rotated the spacer provides an offsetting motion that is used to tighten the fixed member into the resistance damper and ski bracket. This tightening action provides a preload of the resistance damper between the fixed member and the ski bracket that allows the snow ski to rotate and move over undulations in the snow while providing resistance for riding and turning the ski bike.

Reference will now be made to the drawing to describe various aspects of some example embodiments of the invention. It is to be understood that the drawings are diagrammatic and schematic representations of such exemplary embodiments, and are not limiting of the present invention, nor are they necessarily drawn to scale.

FIG. **1** shows a ski bike **10** with two example ski retention systems **100**A and **100**B, arranged in accordance with at least one embodiment described herein. The ski retention system **100**A connects a steering mechanism **104** to a front ski **105**A using a fixed member **101**, a ski bracket **102**A, and an adapter **150**. The steering mechanism **104** of FIG. **1** and other figures is depicted as a suspension style fork. More generally, the steering mechanism **104** may include a fork with or without suspension, a single-sided "fork" with or without suspension, or other suitable steering mechanism. The fixed member **101** may integrally formed with the adapter **150** and/or the fixed member **101** may be separately formed from the adapter **150** and subsequently coupled to the adapter **150** using one or more nuts, bolts, other fasteners, adhesive, or other suitable coupler(s).

Between the fixed member **101** and the ski bracket **102**A, the ski retention system **100**A additionally includes a resistance damper **103**A. The steering mechanism **104** is connected to a ski bike frame front triangle **106**A (hereinafter "front triangle **106**A") which is connected to a ski bike frame rear triangle **106**B (hereinafter "rear triangle **106**B") or swing arm. In other embodiments, the front triangle **106**A and the rear triangle **106**B may be a single integral unit.

The ski retention system **100**B includes a fixed member **107** that is integral to the rear triangle **106**B and/or coupled directly to the rear triangle **106**B without use of an adapter. The ski retention system **100**B connects the rear triangle **106**B to a rear ski **105**B using the fixed member **107** and a ski bracket **102**B. Between the fixed member **107** and the ski bracket **102**B, the ski retention system **100**B additionally includes a resistance damper **103**B.

In the ski retention system **100**A, the combination of the adapter **150**, the fixed member **101**, the ski bracket **102**A, and the resistance damper **103**A may provide a primary structure that allows the front ski **105**A to rotate and move over undulations in the snow while providing resistance for riding and turning the ski bike **10**. Analogously, in the ski retention system **100**B, the combination of the fixed member **107**, the ski bracket **102**B, and the resistance damper **103**B may provide a primary structure that allows the rear ski **105**B to rotate and move over undulations in the snow while providing resistance for riding and turning the ski bike **10**.

As will be described in more detail below, the fixed member **101** may be rigidly clamped to the steering mechanism **104** with the adapter **150**. The fixed member **107** may

be integral to and/or directly coupled to the rear triangle **106**B and may thereby be rigidly fixed with respect to the rear triangle **106**B. More generally, any arrangement that holds the fixed member **101** or **107** rigid with respect to the front or rear of the ski bike **10** may be implemented.

The ski bike **10** illustrated in FIG. **1** is implemented as a pegger style ski bike. Generally, however, any style of ski bike, whether pegger style, skibob style, or other style, may be implemented with one or more of the various aspects illustrated in FIGS. **1**-**8**. Further, the various aspects of the ski bike **10** may be implemented alone, all in combination, or in subcombinations.

FIGS. **2**A and **2**B show perspective detailed views of, respectively, the ski retention system **100**A and the ski retention system **100**B of FIG. **1**, arranged in accordance with at least one embodiment described herein. The ski retention system **100**A of FIG. **2**A may include a rotational axis r_1 about which the ski bracket **102**A and the front ski **105**A may rotate relative to the fixed member **101** and more generally the rest of the ski bike **10**. The ski retention system **100**B of FIG. **2**B may include a rotational axis r_2 about which the ski bracket **102**B and the rear ski **105**B may rotate relative to the fixed member **107** and more generally the rest of the ski bike **10**.

In each of the ski retention systems **100**A and **100**B, the corresponding rotational axis r_1 or r_2 between the fixed member **101** or **107** and the ski bracket **102**A or **102**B may be a corresponding height **108**A (FIG. **2**A) or **108**B (FIG. **2**B) above a plane where the front or rear ski **105**A or **105**B contacts ground or snow. Each of the heights **108**A and **108**B may be any value in a range from zero inches to four inches, or in a range from 0.5 inches to four inches, or in a range from one inch to four inches. The range of one to four inches for each of the heights **108**A and **108**B may provide a good tradeoff between providing adequate space to design and package the corresponding joint and limited height to prevent a pendulum type effect of the front or rear ski **105**A or **105**B about the corresponding rotational axis r_1 or r_2. In some embodiments, the height **108**A of the ski retention system **100**A and the height **108**B of the ski retention **108**B system are equal. In other embodiments, the height **108**A of the ski retention system **100**A may have a first value in the range of zero to four inches while the height **108**B of the ski retention system **100**B may have a different second value in the range of zero to four inches.

In the ski retention system **100**A of FIG. **2**A, the fixed member **101** is rigidly clamped to the steering mechanism **104** using the adapter **150** that includes two connecting members **109**A and **109**B that clamp around the steering mechanism **104**. Thus, the two connecting members **109**A and **109**B together form a clamp. The clamp, which includes the two connecting members **109**A and **109**B in this example couple the fixed member **101** to each of two fork tines of the steering mechanism **104** at locations on the steering mechanism **104** above axle fastener holes or slots in bicycle fork wheel dropouts of the steering mechanism **104** included near bottoms of the two fork tines. The rear triangle **106**B or other portion of the frame of the ski bike **10** may analogously include bicycle wheel dropouts that may be used in an analogous manner as the bicycle fork wheel dropouts of the steering mechanism **104**.

Two extended tabs **110**A and **110**B that are integral to the adapter **150** extend upward from a barrel or main body of the adapter **150**. The extended tabs **110**A and **110**B are captured between the two connecting members **109**A and **109**B and are held tight using fasteners **111**A, **111**B and **111**C (collectively "fasteners **111**"). This and other configurations may prevent rotational motion of the adapter **150** and/or the fixed member **101** relative to the steering mechanism **104** and ultimately relative to the ski bike **10**.

Translational motion of the adapter **150** and/or the fixed member **101** relative to the steering mechanism **104** is prevented by coupling the fixed member **101** to the steering mechanism **104** using, e.g., a bicycle axle interface and thru axle fastener **112** such as typically used to couple wheels to bicycle steering mechanisms in standard bicycles. The bicycle wheel thru axle fastener **112** is received through a hole formed in the adapter **150**, e.g., in the barrel or main body of the adapter **150**, and through the axle fastener holes or slots included in the steering mechanism **104**, e.g., near the bottoms of the fork tines of the steering mechanism **104**.

The fixed member **101** is rotatably attached to the ski bracket **102**A using a fastener **113**A. Between the fixed member **101** and the ski bracket **102**A is the resistance damper **103**A. The fixed member **101** is coupled to the ski bracket **102**A with the intervening resistance damper **103**A to form a joint which allows rotation of the front ski **105**A relative to the steering mechanism **104** and the ski bike **10**, which joint may be referred to as the front joint. Aspects of the front joint according to an example embodiment will be described with respect to FIG. **4** in additional detail.

The fixed members **101**, **107** may be attached to the ski bike **10** either directly (as in the case of the fixed member **107**) or indirectly (as in the case of the fixed member **101**) through an adapter such as the adapter **150**. Alternatively or additionally, the fixed members **101**, **107** and/or the adapter **150** may be attached to the ski bike **10** through wheel dropouts of the steering mechanism **104**, of the rear triangle, or of other portion of a frame of the ski bike **10**. In some embodiments, the wheel dropouts may include brake bosses with threaded holes and screws may be used to couple the fixed members **101**, **107** and/or the adapter **150** to the ski bike **10** through the brake bosses.

There are many options for attaching the fixed member **101** to the steering mechanism **104**. In some embodiments of the ski retention system **100**A, the fixed member **101** may be rigidly attached to the steering mechanism **104** by any means necessary to create the rigid attachment. Possible embodiments include the adapter **150** with clamp design as shown, an integral joint with a custom-style fork or other steering mechanism, or any other integral or joining method that holds the fixed member **101** in a similar relative position to that shown in FIG. **2**A.

There are many options for the steering mechanism **104**. The primary function of the steering mechanism **104** is to provide a means to steer the ski bike **10**. The steering mechanism **104** illustrated in FIG. **2**A and other figures is a suspension-style fork, but a rigid (e.g., non-suspension) steering mechanism or even a single straight member serving as the steering mechanism would be acceptable.

In the ski retention system **100**B illustrated in FIG. **2**B, the fixed member **107** is integral to and/or coupled directly to the rear triangle **106**B of the ski bike **10**. Since the fixed member **107** is integral to and/or coupled directly to the rear triangle **106**B, its motion may be the same as the motion of the rear triangle **106**. The fixed member **107** is rotatably attached to the ski bracket **102**B using a fastener **113**B. Between the fixed member **107** and the ski bracket **102**B is the resistance damper **103**B. The fixed member **107** is coupled to the ski bracket **102**B with the intervening resistance damper **103**B to form a joint which allows rotation of the rear ski **105**B relative to the rear triangle **106**B and the ski bike **10**, which joint may be referred to as the rear joint.

Aspects of the rear joint according to an example embodiment will be described with respect to FIG. **4** in additional detail.

FIGS. **3**A-**3**E respectively show a perspective view, a top view, a side view, a front view, and a back view of a lower portion of the ski retention system **100**A, all arranged in accordance with at least one embodiment described herein. A lower portion of the ski retention system **100**B may be configured, mutatis mutandis, similar to the lower portion of the ski retention system **100**A illustrated in and described with respect to FIGS. **3**A-**3**E.

FIG. **3**A shows an example embodiment of how the resistance damper **103**A may be captured between the fixed member **101** and the ski bracket **102**A. As illustrated, the resistance damper **103**A is captured between the fixed member **101** and the ski bracket **102**A in the vertical direction. In a lateral horizontal direction (e.g., a direction perpendicular to a length of the ski bracket **102**A and perpendicular to a length of the front ski **105**A), the resistance damper **103**A is captured between two flanges **114**A and **114**B of the ski bracket **102**A. In a longitudinal horizontal direction (e.g., a direction parallel to the length of the ski bracket **102**A and parallel to the length of the front ski **105**A), the resistance damper **103**A is captured by two stops **115**A and **115**B which may be integral to the ski bracket **102**A. This combination of features captures the resistance damper **103**A in such a way that, when in use, it does not move appreciably in any direction relative to the ski bracket **102**A and therefore resists rotation of the ski bracket **102**A (and the front ski **105**A) relative to the fixed member **101**.

FIGS. **3**A-**3**E additionally illustrate portions of various fasteners to attach the fixed member **101** to the ski bracket **102**A. The illustrated fasteners include a screw or bolt **113**A, washers **116**A and **116**B, and a nut **117**. All fasteners may be of various forms. For instance, screw **113**A could have any type of head. Washers **116**A and **116**B could be flat or various locking styles or not used at all. Nut **117** could be any type of nut from a simple hex nut to various locking style nuts. More generally, each of one or more fasteners used to attach the fixed member **101** to the ski bracket **102**A may include a screw, a nut, a bolt, a washer, a clevis pin, a cotter pin, or other suitable fastener.

FIG. **4** shows an exploded perspective view of the lower portion of the ski retention system **100**A illustrated in FIGS. **3**A-**3**E, arranged in accordance with at least one embodiment described herein. The lower portion of the ski retention system **100**B may be configured, mutatis mutandis, similar to the lower portion of the ski retention system **100**A illustrated in and described with respect to FIG. **4**. FIG. **4** illustrates the ski bracket **102**A, the resistance damper **103**A, a portion of the fixed member **101**, the screw **113**A, the washers **116** A and **116**B, and the nut **117**. FIG. **4** additionally illustrates bushings **118**A and **118**B and a spacer **119**. Each of the foregoing components will be described in turn.

The ski bracket **102**A, the fixed member **101**, the resistance damper **103**A, and optionally the adapter **150**, may form the primary components of the ski retention system **100**A and may provide the means to allow the front ski **105**A to rotate and move over undulations in the snow while providing resistance for riding and turning the ski bike **10**. A shape of a lower member **120** of the fixed member **101** may be virtually any shape. In addition, a top surface **137** of the resistance damper **103**A may be virtually any shape but in general may be complementary in shape to the lower member **120** of the fixed member **101**. For instance, as illustrated, the lower member **120** of the fixed member **101** has a somewhat trapezoidal cross-sectional shape while the top surface **137** of the resistance damper **103**A has a somewhat flat-bottomed v-channel cross-sectional shape. Rotational resistance provided by the resistance damper **103**A may be infinitely tunable by, e.g., varying the interface between the lower member **120** of the fixed member **101** and the surface **137** of the resistance damper **103**A. Variations may include any shape of the lower member **120**, any shape of the surface **137** of the resistance damper **103**A, and a hardness of the resistance damper **103**A. Hardness could vary from very soft to rigid. Alternatively or additionally, different hardnesses may be suitable for different snow conditions or rider sizes. For instance, a relatively soft resistance damper **103**A may be more suitable for a lighter rider while a relatively hard resistance damper **103**A may be more suitable for a heavier rider.

Furthermore, the resistance damper **103**A may include a single homogeneous material with, e.g., a single consistent hardness throughout or may include multiple hardnesses. Example embodiments and methods using multiple hardnesses may include using inserts, bonding multiple materials, or molding multiple materials. Multiple hardness embodiments are not limited to these examples.

In the illustrated embodiment, the fixed member **101** may be fastened to the ski bracket **102**A using the bushings or bearings **118**A and **118**B, the spacer **119** and the fasteners **113**A, **116**A, **116**B and **117** (hereinafter the "fastener assembly"). The spacer **119** may be configured to maintain a distance between the two flanges **114**A and **114**B of the ski bracket **102**A as the fastener assembly is tightened. The spacer **119** has outward facing surfaces **123**A and **123**B that bear against inward facing flange surfaces **124**A and **124**B of the flanges **114**A and **114**B to maintain the spacing between the two flanges **114**A and **114**B.

In some embodiments, it may improve performance of the ski retention system **100**A if the resistance damper **103**A is in full contact with the fixed member **101** and the ski bracket **102**A. Full contact, which might also be described as preload, may be difficult to achieve without a mechanical advantage since the parts when in full contact are in intimate contact with the resistance damper **103**A slightly compressed. To facilitate ease of assembly of the fixed member **101** to the ski bracket **102**A with the resistance damper **103**A therebetween, a cam-style mechanical advantage device may be implemented in the ski retention system **100**A, as illustrated in FIG. **4**. Any other mechanical advantage may be implemented to achieve the noted contact and/or preload. The cam-style mechanical advantage device is just one of many possible embodiments. Other mechanical advantage devices that may be implemented herein may include using cam nuts with offset hole, previously discussed, or similar cam devices with levers. The cam-style mechanical advantage device illustrated in FIG. **4** may operate as follows. The bushings or bearings **118**A and **118**B are assembled into a hole **140** defined in the lower member **120** of the fixed member **101**. The hole **140** may pass completely through the lower member **120**. The spacer **119** is placed axially within the bushings or bearings **118**A and **118**B within the hole **140** of the fixed member **101**. The resistance damper **103**A is placed into the ski bracket **102**A as previously discussed. The spacer **119** includes an offset D-shaped hole **121** that passes through the spacer **119** from one surface **123**A to the other surface **123**B. With the bushings or bearings **118**A and **118**B and the spacer **119** assembled into the hole **140** of the fixed member **101**, the foregoing components can then be placed on top of the resistance damper **103**A with the D-shaped offset hole coaxial with holes **122**A and **122**B defined in the ski bracket **102**A. The screw **113**A includes a

flat surface **136** with its overall profile similar or complementary to the D-shaped offset hole **121** in the spacer **119**. With the spacer **119** and the D-shaped offset hole **121** in the "loose" position (to be later described in FIGS. **5**A and **5**B), the screw **113**A may be inserted through the washer **116**A, the hole **122**A of the ski bracket **102**A, the spacer **119** (noting that a flat **125** of the D-shaped offset hole **121** and the flat **136** of the screw **113**A must be aligned), the hole **122**B of the ski bracket **102**A, and the washer **116**B. The nut **117** may also be installed loosely on the end of the screw **113**A. By rotating the screw **113**A, the flat **136** of the screw **113**A bears against the flat **125** in the D-shaped offset hole **121**, and by a cam action the fixed member **101** is tightened against the resistance damper **103**A and is rotatably attached to the ski bracket **102**A.

FIG. **5**A shows a cross-sectional view of the ski retention system **100**A of FIG. **3**B in the "tight" position, arranged in accordance with at least one embodiment described herein. In the "tight" position, a centerline c_1 of the offset D-shaped hole **121** is above a centerline c_2 of the spacer **119**. Since the holes **122**A and **122**B in the ski bracket **102**A are fixed, the effect of the offset D-shaped hole **121** in this "tight" position is to tighten or preload the fixed member **101** against the resistance damper **103**A, as denoted in FIG. **5**A at **138**.

FIG. **5**B shows a cross-sectional view of the ski retention system **100**A in the "loose" position, arranged in accordance with at least one embodiment described herein. In the "loose" position, the centerline c_1 of the offset D-shaped hole **121** is below the centerline c_2 of the spacer **119**. Since the holes **122**A and **122**B in the ski bracket **102**A are fixed, the effect of the offset D-shaped hole **121** in this "loose" position is to loosen the fixed member **101** from the resistance damper **103**A, as indicated by a gap denoted at **139** between the fixed member **101** and the resistance damper **103**A.

FIG. **6** shows a side view of an example embodiment of the ski bike **10** of FIG. **1**, arranged in accordance with at least one embodiment described herein. This example embodiment is a full suspension ski bike based on the suspension provided by the steering mechanism **104** and a rear shock **126**. Some embodiments described herein protect the rear shock **126** from impact. Protecting the rear shock **126** from impact may preserve its functionality. When hauled on chair lifts, the rear of the ski bike **10** may be subject to impacts from the chair lifts, e.g., when the ski bike **10** is loaded on chair lifts. The configuration of the ski bike **10** illustrated in FIG. **6** may protect the rear shock **126** from such impacts as the rear shock **126** is generally surrounded by the rear triangle **106**B or a swing arm. While objects narrower than open gaps of the rear triangle **106**B might in some cases enter the rear triangle **106**B and come in contact with the rear shock **126**, the rear triangle **106**B will interfere with and prevent relatively broad objects like chair lift seats, with dimensions larger than the open gaps of the rear triangle **106**B, from penetrating inside the rear triangle **106**B and coming in contact with the rear shock **126**.

FIG. **6** additionally illustrates a foot peg or pedal assembly **135** (hereinafter "assembly **135**"). FIG. **7** shows a cross-sectional view of the assembly **135** of FIG. **6** at the cutting plane **7**-**7** in FIG. **6**, arranged in accordance with at least one embodiment described herein. FIG. **8** shows an exploded perspective view of the assembly **135** FIGS. **6** and **7**, arranged in accordance with at least one embodiment described herein.

With combined reference to FIGS. **7** and **8**, the assembly **135** may include a pedal tube **127**, which may be replaceable in some embodiments. The ability to have the pedal tube **127** be replaceable may be useful in a ski bike since it may allow for replacement due to damage or normal wear. In addition, the pedal tube **127** can be configured with standard pedal threads **128**A and **128**B such that an end user can configure the end user's ski bike with any pedals or platforms **134**A and **134**B the end user chooses. Alternatively or additionally, the end user may configure their standard wheeled bicycle frame as a ski bike by installing the assembly **135** in the bicycle's bottom bracket as described below as well as connecting the bicycle's steering mechanism and rear triangle to front and rear skis (as opposed to wheels), e.g., through the ski retention systems **100**A, **100**B.

With continued reference to FIGS. **7** and **8**, the pedal tube **127** may be attached to the ski bike **10** as follows. A right cup **129**A is configured with a left-hand thread, as is a right side of a bottom bracket **130** of the ski bike **10**. The right cup **129**A is threaded into the right side of the bottom bracket **130** and tightened. A pin **131** is placed in a blind hole **132** of the pedal tube **127**. The pedal tube **127** is placed through the bottom bracket **130** from the left side, and the pin **131** is aligned with a slot **133** in the right cup **129**A. A left cup **129**B, which may be configured with a right-hand thread, is then threaded into a left side of the bottom bracket **130** of the ski bike **10**, where the left side of the bottom bracket **130** also is configured with a right-hand thread. As the pedals or platforms **134**A and **134**B are threaded into the pedal tube **127**, torque is reacted through the pin **131**, the slot **133** and into the right cup **129**A, which is already tight. The pin **131** and slot **133** combination may be on either the right or left side depending on whether pedal **134**A or **134**B torque is to be reacted for a tightening or loosening operation. This configuration may allow the assembly **135** to be fully replaceable while meeting requirements of strength and rigidity.

Various alternative arrangements for the assembly **135** will be apparent in view of the instant disclosure instead of or in addition to the mirrored alternative already mentioned. For instance, the pin **131** may be placed in a blind hole inside the right cup **129**A or the left cup **129**B to be aligned with and received into a slot that extends axially on an exterior of the pedal tube **127**.

Moreover, the pin **131** is an example of a discrete component separable from the pedal tube **127** and/or the right and left cups **129**A, **129**B that can be used to prevent rotation of the pedal tube **127** relative to one or both of the right cup **129**A or the left cup **129**B. More generally, a protrusion that extends, e.g., outward from the pedal tube **127** or inward from the right or left cup **129**A, **129**B, may be aligned with and received into a slot formed on, e.g., an interior of the right or left cup **129**A, **129**B or an exterior of the pedal tube **127**, respectively. Such a protrusion may be separable from the other components as in the case of the pin **131**, or integrally formed with one of the other components.

The present disclosure is not to be limited in terms of the particular embodiments described herein, which are intended as illustrations of various aspects. Many modifications and variations can be made without departing from its spirit and scope. Functionally equivalent methods and apparatuses within the scope of the disclosure, in addition to those enumerated herein, are possible from the foregoing descriptions. Such modifications and variations are intended to fall within the scope of this disclosure. It is also to be understood that the terminology used herein is for the purpose of describing particular embodiments only, and is not intended to be limiting.

With respect to the use of substantially any plural and/or singular terms herein, those having skill in the art can

translate from the plural to the singular and/or from the singular to the plural as is appropriate to the context and/or application. The various singular/plural permutations may be expressly set forth herein for sake of clarity.

In general, terms used herein, and especially in the appended claims (e.g., bodies of the appended claims) are generally intended as "open" terms (e.g., the term "including" should be interpreted as "including but not limited to," the term "having" should be interpreted as "having at least," the term "includes" should be interpreted as "includes but is not limited to," etc.). It will be further understood by those within the art that if a specific number of an introduced claim recitation is intended, such an intent will be explicitly recited in the claim, and in the absence of such recitation, no such intent is present. For example, as an aid to understanding, the following appended claims may contain usage of the introductory phrases "at least one" and "one or more" to introduce claim recitations. However, the use of such phrases should not be construed to imply that the introduction of a claim recitation by the indefinite articles "a" or "an" limits any particular claim containing such introduced claim recitation to embodiments containing only one such recitation, even when the same claim includes the introductory phrases "one or more" or "at least one" and indefinite articles such as "a" or "an" (e.g., "a" and/or "an" should be interpreted to mean "at least one" or "one or more"); the same holds true for the use of definite articles used to introduce claim recitations. In addition, even if a specific number of an introduced claim recitation is explicitly recited, those skilled in the art will recognize that such recitation should be interpreted to mean at least the recited number (e.g., the bare recitation of "two recitations," without other modifiers, means at least two recitations, or two or more recitations). Furthermore, in those instances where a convention analogous to "at least one of A, B, and C, etc." is used, in general, such a construction is intended in the sense one having skill in the art would understand the convention (e.g., "a system having at least one of A, B, and C" would include but not be limited to systems that include A alone, B alone, C alone, A and B together, A and C together, B and C together, and/or A, B, and C together, etc.). In those instances where a convention analogous to "at least one of A, B, or C, etc." is used, in general, such a construction is intended in the sense one having skill in the art would understand the convention (e.g., "a system having at least one of A, B, or C" would include but not be limited to systems that include A alone, B alone, C alone, A and B together, A and C together, B and C together, and/or A, B, and C together, etc.). It will be further understood by those within the art that virtually any disjunctive word and/or phrase presenting two or more alternative terms, whether in the description, claims, or drawings, should be understood to contemplate the possibilities of including one of the terms, either of the terms, or both terms. For example, the phrase "A or B" will be understood to include the possibilities of "A" or "B" or "A and B."

In addition, where features or aspects of the disclosure are described in terms of Markush groups, those skilled in the art will recognize that the disclosure is also thereby described in terms of any individual member or subgroup of members of the Markush group.

For any and all purposes, such as in terms of providing a written description, all ranges disclosed herein also encompass any and all possible sub ranges and combinations of sub ranges thereof. Any listed range can be easily recognized as sufficiently describing and enabling the same range being broken down into at least equal halves, thirds, quarters, fifths, tenths, and/or others. As a non-limiting example, each range discussed herein can be readily broken down into a lower third, middle third and upper third, etc. All language such as "up to," "at least," and the like include the number recited and refer to ranges which can be subsequently broken down into sub ranges as discussed above. Finally, a range includes each individual member. Thus, for example, a group having 1-3 cells refers to groups having 1, 2, or 3 cells. Similarly, a group having 1-5 cells refers to groups having 1, 2, 3, 4, or 5 cells, and so forth.

From the foregoing, various embodiments of the present disclosure have been described herein for purposes of illustration, and various modifications may be made without departing from the scope and spirit of the present disclosure. Accordingly, the various embodiments disclosed herein are not intended to be limiting.

What is claimed is:

1. A ski bike comprising:
- a frame;
- a steering mechanism rotatably coupled to the frame;
- a ski; and
- a ski retention system that rotatably couples the ski to the frame or the steering mechanism, wherein the ski retention system includes:
  - a ski bracket rigidly coupled to the ski;
  - a fixed member rigidly coupled to the frame or the steering mechanism and rotatably coupled to the ski bracket;
  - a resistance damper disposed between the ski bracket and the fixed member; and
  - a mechanism to preload the resistance damper between the ski bracket and the fixed member.

2. The ski bike of claim **1**, wherein the resistance damper prevents free rotation of the ski bracket relative to the fixed member.

3. The ski bike of claim **1**, wherein the resistance damper prevents excessive rotation of the ski bracket relative to the fixed member.

4. The ski bike of claim **1**, wherein the mechanism includes:
- a spacer disposed in a hole formed in the fixed member, wherein the spacer includes an offset D-shaped through hole and the spacer acts as a cam when rotated; and
- a D-shaped screw disposed within the offset D-shaped through hole of the spacer.

5. The ski bike of claim **4**, wherein:
- rotation of the D-shaped screw is effective to control a location of a centerline of the offset D-shaped through hole relative to a centerline of the spacer;
- in response to positioning the centerline of the offset D-shaped through hole above the centerline of the spacer, the resistance damper is preloaded between the fixed member and the ski bracket; and
- in response to positioning the centerline of the offset D-shaped through hole below the centerline of the spacer, the resistance damper is separated from the fixed member by a gap such that the D-shaped screw can be easily removed from or inserted through the offset D-shaped through hole.

6. The ski bike of claim **1**, wherein the ski retention system further includes a rotation limiting mechanism, whereby the rotation limiting mechanism prevents excessive rotation of the ski bracket relative to the fixed member.

7. The ski bike of claim **1**, wherein an axis of rotation of the ski bracket relative to the fixed member is in a range of zero inches to four inches above a bottom surface of the ski.

8. The ski bike of claim 1, wherein the ski bike further includes an adapter that rigidly couples the frame or the steering mechanism to the fixed member.

9. The ski bike of claim 8, wherein:

the adapter rigidly couples the frame to the fixed member at bicycle wheel dropouts of the frame; or

the steering mechanism comprises a fork with bicycle fork wheel dropouts and the adapter rigidly couples the fork with bicycle fork wheel dropouts to the fixed member.

10. The ski bike of claim 9, further comprising a bicycle wheel thru axle fastener received through a hole formed in the adapter and through axle fastener holes or slots included in the bicycle wheel dropouts of the frame or the bicycle fork wheel dropouts of the fork, the bicycle wheel thru axle fastener coupling the adapter to the frame or the fork to prevent, when fastened, the adapter and the fixed member from translating relative to the bicycle wheel dropouts of the frame or the bicycle fork wheel dropouts of the fork.

11. The ski bike of claim 10, wherein the bicycle fork wheel dropouts of the fork are formed near bottoms of two tines of the fork, wherein the adapter includes a clamp that couples the adapter to the two tines of the fork at locations on the tines above the axle fastener holes included in the bicycle fork wheel dropouts near the bottoms of the two tines, the clamp preventing the adapter and the fixed member from rotating relative to the bicycle fork wheel dropouts.

12. The ski bike of claim 11, wherein the fixed member includes at least one extended tab that extends out from the fixed member and that is captured in the clamp.

13. The ski bike of claim 9, wherein the bicycle wheel dropouts of the frame or the bicycle fork wheel dropouts of the fork include bicycle brake bosses with threaded holes, further comprising screws that couple the adapter to the bicycle brake bosses, the screws and the bicycle brake bosses preventing the adapter and the fixed member from rotating relative to the fork.

14. The ski bike of claim 1, wherein the frame includes a front triangle and a separate rear triangle or swing arm rotatably coupled to the front triangle, the ski bike further comprising a rear shock having a first end coupled to the front triangle and a second end coupled to the rear triangle or the swing arm, wherein the rear shock is disposed within an envelope defined by the rear triangle or the swing arm.

15. The ski bike of claim 1, further comprising:

a bottom bracket interface formed in the frame; and

a foot peg or pedal assembly coupled to the bottom bracket interface, wherein the foot peg or pedal assembly includes:

a first cup coupled to a first side of the bottom bracket interface;

a second cup coupled to a second side of the bottom bracket interface opposite the first side; and

a pedal tube disposed in the bottom bracket interface with a first end that extends out through the first cup, a second end that extends out through the second cup, wherein one of:

the first cup includes a slot that receives a protrusion that extends outward from the pedal tube; or

the pedal tube includes a slot that receives a protrusion that extends inward from the first cup; and

wherein the protrusion received in the slot is configured to fix the pedal tube with respect to the bottom bracket interface to prevent rotation of the pedal tube relative to the bottom bracket interface during installation and removal of pegs or pedals in the first and second ends of the pedal tube.

16. A ski bike, comprising:

a front triangle;

a steering mechanism rotatably coupled to the front triangle;

a rear triangle or a swing arm rotatably coupled to the front triangle;

a ski coupled at the rear triangle or the swing arm;

a rear shock having a first end coupled to the front triangle and a second end coupled to the rear triangle or the swing arm, wherein the rear shock is disposed within an envelope defined by the rear triangle or the swing arm;

a bottom bracket interface formed in the front triangle; and

a foot peg or pedal assembly coupled to the bottom bracket interface, wherein the foot peg or pedal assembly includes:

a first cup coupled to a first side of the bottom bracket interface;

a second cup coupled to a second side of the bottom bracket interface opposite the first side; and

a pedal tube disposed in the bottom bracket interface with a first end that extends out through the first cup, a second end that extends out through the second cup, wherein one of:

the first cup includes a slot that receives a protrusion that extends outward from the pedal tube; or

the pedal tube includes a slot that receives a protrusion that extends inward from the first cup; and

wherein the protrusion received in the slot is configured to fix the pedal tube with respect to the bottom bracket interface to prevent rotation of the pedal tube relative to the bottom bracket interface during installation and removal of pegs or pedals in the first and second ends of the pedal tube.

17. A ski bike comprising:

a frame;

a steering mechanism rotatably coupled to the frame;

a ski;

a ski retention system that rotatably couples the ski to the frame or the steering mechanism, wherein the ski retention system includes:

a ski bracket rigidly coupled to the ski; and

a fixed member rigidly coupled to the frame or the steering mechanism and rotatably coupled to the ski bracket;

an adapter that rigidly couples the frame or the steering mechanism to the fixed member, wherein:

the adapter rigidly couples the frame to the fixed member at bicycle wheel dropouts of the frame; or

the steering mechanism comprises a fork with bicycle fork wheel dropouts and the adapter rigidly couples the fork with bicycle fork wheel dropouts to the fixed member; and

a bicycle wheel thru axle fastener received through a hole formed in the adapter and through axle fastener holes or slots included in the bicycle wheel dropouts of the frame or the bicycle fork wheel dropouts of the fork, the bicycle wheel thru axle fastener coupling the adapter to the frame or the fork to prevent, when fastened, the adapter and the fixed member from translating relative to the bicycle wheel dropouts of the frame or the bicycle fork wheel dropouts of the fork.

18. The ski bike of claim 17, wherein the bicycle fork wheel dropouts of the fork are formed near bottoms of two tines of the fork, wherein the adapter includes a clamp that couples the adapter to the two tines of the fork at locations on the tines above the axle fastener holes included in the

bicycle fork wheel dropouts near the bottoms of the two tines, the clamp preventing the adapter and the fixed member from rotating relative to the bicycle fork wheel dropouts.

19. The ski bike of claim **18**, wherein the fixed member includes at least one extended tab that extends out from the fixed member and that is captured in the clamp.

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