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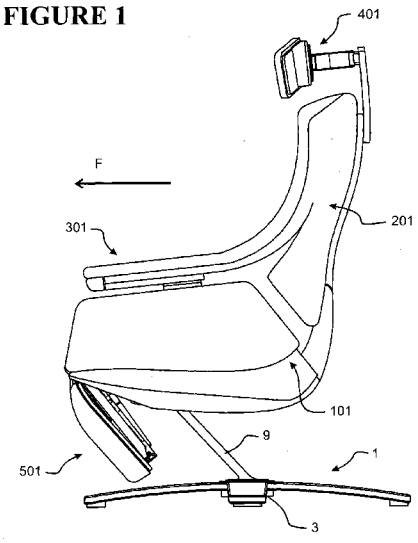
(54) **Title**: A CHAIR AND SUPPORTS

FIGURE 1



(57) **Abstract**: A chair has a supporting frame 1, a seat portion 101, a back portion 201 that has an upper end, a lower end, and is pivotally mounted relative to the supporting frame at a position above its lower end, and a recline mechanism 601. The recline mechanism 601 lifts the seat portion 101 upon a reclining action of the back portion 201, and has an operative connection 603, 611 between the seat portion and the supporting frame and a drag link 602 pivotally connected to the seat portion 101 and pivotally connected to the back portion 201 at a position below the pivotal mounting of the back portion relative to the supporting frame. As the back portion 201 of the chair is reclined, the lower end of the back portion 201 moves forward and the drag link 602 pulls the seat portion 101 upward relative to the supporting frame 1.

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2012319280 30 Oct 2017

A CHAIR AND SUPPORTS

FIELD OF THE INVENTION

The invention relates generally to chairs and supports for use in chairs. More particularly, although not exclusively, the invention relates to reclining and rocking chairs suitable for domestic lounge use.

BACKGROUND TO THE INVENTION

Traditional reclining and/or rocking chairs are often large, heavy chairs that take up significant room. They also often have large housings that extend substantially to the floor to hide bulky mechanisms that provide the rocking and/or reclining action of the chairs. Such chairs often have extendible leg rests or supports which have bulky mechanisms, which again must be hidden in the large housings of the chair for aesthetic purposes and to hide potential pinch points from users.

In more recent times, lighter weight reclining lounge chairs have become available that do not have the large housings. Such chairs are generally mounted on pedestals. However, those chairs often have basic mechanisms that only provide limited functionality in the chair. Those reclining chairs have a less than optimal relationship between the seat and back. When the back of the chair is reclined, the relationship between the seat and back will generally be such that the user will not be comfortable in the chair, particularly over long periods. Such chairs also do not have built in extendible leg rests or supports, due to the lack of housing to hide the mechanisms of such supports. A purchaser generally needs to buy a separate stool or ottoman, if they want a leg support to match their chair.

Typical recliner mechanisms move the seat predominantly forward, so require a tension adjustment of the recline mechanism or a user activated recline lever to suit different user body sizes.

Some chairs have head rests or supports that are adjustable in position to suit a user. Most head rests can be raised or lowered in height relative to a chair back. Some can also be adjusted horizontally. Traditional head rests require the use of two separate actuators to

2012319280 30 Oct 2017

initially adjust the vertical position of the head rest and then adjust the horizontal position of the head rest. This means the head rest adjustment is a two step process, and reduces the likelihood of the headrest position being adjusted. As a result, people may be inclined to use the head rests in a less than optimal position. Often, the user will not be able to adjust the head rest whilst seated due to high friction mechanisms and twin action adjusters, which means the user cannot switch between different head rest positions as needed when moving the chair between upright and reclined positions or when changing between tasks such as watching television and working on a laptop computer.

Some chairs have adjustable foot or leg rest arrangements. However, those arrangements typically only provide two or three discrete adjustment positions. A user may not be provided with optimal comfort with that restricted number of adjustment positions.

It is an object of at least preferred embodiments of the present invention to provide a chair or support that addresses at least one of the disadvantages outlined above, or that at least provides the public with a useful choice.

SUMMARY OF THE INVENTION

In accordance with a first aspect of the present invention, there is provided a chair comprising: a supporting frame; a seat portion for supporting an occupant; a back portion for supporting the back of a seated occupant that has an upper end, a lower end, and is pivotally mounted to the supporting frame at a position above its lower end; and a recline mechanism configured to lift the seat portion upon a reclining action of the back portion, the recline mechanism comprising an operative connection between the seat portion and the supporting frame, and a drag link pivotally connected to the seat portion and pivotally connected to the back portion at a position below the pivotal mounting of the back portion to the supporting frame, the recline mechanism configured such that as the back portion of the chair is reclined, the lower end of the back portion moves forward and the drag link pulls the seat portion upward relative to the supporting frame, wherein the operative connection comprises a rear operative connection between a relatively rearward portion of the seat portion and the supporting frame, wherein the rear operative connection comprises a forward link that is pivotally connected to the supporting frame, a rearward link that is pivotally connected to the supporting frame, and a carrier link that is pivotally

2012319280 30 Oct 2017

connected to the forward link and to the rearward link, wherein the carrier link is pivotally connected to the seat portion.

In an embodiment, the chair comprises a front operative connection between a relatively forward portion of the seat portion and the supporting frame. In an embodiment, the front operative connection comprises a slide arrangement comprising a track on one of the seat portion and the supporting frame, and a follower on the other of the seat portion and the supporting frame, with the follower arranged to travel in the track as the seat portion is moved upward upon recline of the back portion. In an embodiment, the chair comprises two front operative connections, one at or adjacent each side of the seat portion, and wherein each front operative connection comprises a slide arrangement comprising a track on one of the seat portion and the supporting frame, and a follower on the other of the seat portion and the supporting frame, with the follower arranged to travel in the track as the seat portion is moved upward upon recline of the back portion.

In an embodiment, when the back portion is in an upright configuration, the forward link hangs downwardly and rearwardly from its pivot connection to the supporting frame, and the rearward link hangs downwardly and forwardly from its pivot connection to the supporting frame, and when the back portion is fully reclined, the forward link hangs generally downwardly from its pivot connection to the supporting frame, and the rearward link extends generally forwardly from its pivot connection to the supporting frame.

In an embodiment, the pivot connection of the carrier link to the seat portion is positioned rearwardly of the pivot connections of the forward link and rearward link to the carrier link.

In an embodiment, the pivot connection of the drag link to the seat portion is positioned generally above and generally behind the pivot connection of carrier link and the seat portion, when the back portion of the chair is not reclined. In an embodiment, the pivot connection of the drag link to the seat portion is positioned upwardly and rearwardly of the pivot connection of the carrier link and the seat portion, when the back portion of the chair is fully reclined.

2012319280 30 Oct 2017

In an embodiment, the chair comprises two rear operative connections, one at or adjacent each side of the seat portion, and wherein each rear operative connection comprises a forward link that is pivotally connected to the supporting frame, a rearward link that is pivotally connected to the supporting frame, and a carrier link that is pivotally connected to the forward link and to the rearward link, and that is pivotally connected to the seat portion.

In an embodiment, the operative connection(s) between the seat portion and the supporting frame is/are arranged such that the relatively forward and relatively rearward portions of the seat portion move upward and forward with a substantially linear movement as the back portion is reclined, with the amount of movement of the relatively rearward portion being greater than the amount of movement of the relatively forward portion, to provide a forward tilt of the seat portion as the back portion is reclined. The seat portion may have a rearward tilt angle when the back portion is upright, and the seat portion may have a smaller rearward tilt angle when the back portion is fully reclined.

In an embodiment, the upward movement of the relatively rearward portion of the seat portion may be greater than that of the relatively forward portion of the seat portion.

In an embodiment, the back portion comprises a central spine, and a compliant support surface supported by the spine for supporting the back of a seated occupant, wherein a lower portion of the spine is pivotally connected to the supporting frame, with a bottom portion of the spine pivotally connected to the drag link. The compliant support surface may comprise a resiliently flexible shell supported by the spine and a cushion supported by the shell. In an embodiment, the spine is resiliently flexible such that an upper end of the spine can be flexed rearwardly relative to a portion of the spine adjacent the pivot connection of the spine to the supporting frame.

In an embodiment, the spine is resiliently flexible so it can twist with a torsional action around a longitudinal axis of the spine, upon application of a suitable force by a seated occupant to the compliant support surface.

In an embodiment, the supporting frame comprises an intermediate support with a generally horizontally extending portion and a pair of rearward uprights, with the lower portion of the spine positioned between and pivotally connected to the uprights. In an

2012319280 30 Oct 2017

embodiment, the seat portion comprises a seat frame and a support surface mounted to the seat frame for supporting a seated occupant, wherein the operative connection(s) between the seat portion and the supporting frame are connected between the intermediate support and the seat frame.

In an embodiment, the supporting frame comprises a main transom, an intermediate support, and a rocker mechanism that operatively connects the main transom and the intermediate support to provide a rocking motion therebetween, wherein the front and rear operative connections between the seat portion and the supporting frame are connected to the intermediate support. In an embodiment, the intermediate support, and thereby the seat portion, can be rocked between a rearwardly angled rearward rocked position and a forward rocked position. In an embodiment, the rocker mechanism comprises a front rocker arm pivotally connected to the main transom and to the intermediate support, and a rear rocker arm pivotally connected to the main transom and to the intermediate support. The front rocker arm and the rear rocker arm may hang downwardly, from their pivot connections to the main transom, at least when the rocker mechanism is in a neutral position. In an embodiment, when the intermediate support is in the rearward rocked position, the front rocker arm extends generally rearwardly from its pivot connection to the main transom, and the rear rocker arm extends generally downwardly from its pivot connection to the main transom, and when the intermediate support is in the forward rocked position, the front rocker arm extends generally downwardly from its pivot connection to the main transom, and the rear rocker am extends downwardly and forwardly from its pivot connection to the main transom.

In an embodiment, the front rocker arm is longer than the rear rocker arm. The pivot connection of the front rocker arm to the main transom may be positioned vertically higher than the pivot connection of the rear rocker arm to the main transom.

In an embodiment, the rocker mechanism comprises two front rocker arms and two rear rocker arms, positioned at or adjacent respective sides of the seat portion.

In an embodiment, the chair further comprises: an extendable foot or leg support assembly pivotally connected to the seat portion; and a rocking inhibitor arrangement to inhibit forward rocking of the intermediate support relative to the main transom when the foot or leg support assembly is extended.

2012319280 30 Oct 2017

In an embodiment, the rocking inhibitor arrangement is configured to automatically engage to inhibit forward rocking of the intermediate support when the foot or leg support assembly is extended, and to automatically disengage to allow forward rocking of the intermediate support when the foot or leg support assembly is retracted.

In an embodiment, the main transom or the intermediate support comprises one or more resiliently compressible stop(s) and the other of the main transom or intermediate support comprises one or more respective abutment surface(s) configured such that when the intermediate support is rocked sufficiently forward and/or rearward, the stop(s) are compressed against the respective abutment surface(s) to damp and limit the forward and/or rearward rock of the support.

In an embodiment, the recline mechanism is configured such that as the back portion of the chair is reclined, the drag link pulls the seat portion upward and forward relative to the supporting frame.

Described herein is a chair comprising: a supporting frame; a seat portion for supporting an occupant; a back portion for supporting the back of a seated occupant and that is reclinable from an upright position to a reclined position; a recline mechanism configured to lift the seat portion upon a reclining action of the back portion; and a pair of arm assemblies positioned one on either side of the seat portion, each arm assembly comprising an arm rest support that is mounted to the seat portion to move with the seat portion as the seat portion is moved by the recline mechanism, and an arm rest that is slidably mounted to the arm rest support, wherein the arm rests are operatively connected to the back portion such that as the back portion is reclined, the arm rests slide rearwardly on the arm rest supports.

In an embodiment, the back portion comprises a central spine, and a support surface supported by the spine for supporting the back of a seated occupant.

In an embodiment, the recline mechanism is configured to lift and move the seat portion forward upon a reclining action of the back portion.

2012319280 30 Oct 2017

In an embodiment, the supporting frame comprises a main transom, an intermediate support that operatively supports the seat portion and the back portion, and a rocker mechanism that operatively connects the main transom and an intermediate support to provide a rocking motion therebetween, wherein the arm rest supports are mounted to the seat portion to move as the seat portion is rocked by the rocker mechanism. The arm assemblies may alternatively be provided in a reclining chair that does not have a rocker mechanism.

In an embodiment, the seat portion comprises a seat frame and a support surface supported by the seat frame for supporting a seated occupant, and the arm rest supports are mounted to the seat frame.

In an embodiment, the arm rest supports are mounted to the seat portion so that the orientations of the arm rest supports relative to the seat portion are fixed.

In an embodiment, lower portions of the arm rest supports are pivotally connected to the seat portion, the arm rest supports configured such that the orientations of the arm rest supports relative to the seat portion change for at least part of the reclining action of the back portion.

In an embodiment, in each arm assembly, either the arm rest or the arm rest support comprises one or more bearing members, and the other of the arm rest or arm rest support comprises one or more complementary elongate slots for receiving the bearing member(s), the one or more elongate slot(s) extending in the direction of movement of the arm rest on the arm rest support.

In an embodiment, the back portion comprises a resiliently flexible shell to support an occupant's back, with upper body contacting surfaces of the arm rests being resiliently flexible and formed by, or connected to, part of the resiliently flexible shell. In an embodiment, the resiliently flexible shell comprises a central main back supporting portion, and elongate arm rest portions, one on either side of the central main back supporting portion, wherein rear ends of the elongate arm rest portions are connected to the central main back supporting portion and forward ends of the elongate arm rest portions form the upper body contacting surfaces of the arm rests. In an embodiment, rear portions of the

2012319280 30 Oct 2017

elongate arm rest portions are arcuate when the back portion of the chair is in an upright position, and are substantially flat when the back portion of the chair is reclined.

Described herein is a head or neck support assembly for a chair, the head or neck support assembly comprising: a base for mounting the head or neck support assembly to a chair; a first member that is rotatable relative to the base about a first axis; a second member that is rotatable relative to the base about a second axis that is substantially parallel to the first axis; a first linkage arrangement comprising a first pair of generally parallel arms that have first ends that are pivotally connected to the first member about axes that are substantially perpendicular to the first axis and that have second ends; a second linkage arrangement comprising a second pair of generally parallel arms that have first ends that are pivotally connected to the second member about axes that are substantially perpendicular to the second axis and that have second ends; and a head or neck support that is operatively supported by the second ends of the generally parallel arms of the first and second linkage arrangements, wherein the head or neck support is moveable relative to the base with two substantially perpendicular degrees of freedom.

In an embodiment, the second ends of the first pair of generally parallel arms are moveable toward and away from the second ends of the second pair of generally parallel arms, upon movement of the head or neck support relative to the base.

In an embodiment, the second ends of the first pair of generally parallel arms are pivotally connected to a first support link about axes that are substantially parallel to the pivot axes between the parallel arms and the first member, and the second ends of the second pair of generally parallel arms are pivotally connected to a second support link about axes that are substantially parallel to the pivot axes between the parallel arms and the second member, and wherein the first and second support links being rotatable relative to the head or neck support, with the rotation axes of the first and second support links relative to the head or neck support being substantially parallel to the rotation axes of the first and second members relative to the base. In an embodiment, the first and second members are operatively coupled such that as the first member is rotated in one direction relative to the base, the second member rotates a corresponding amount in an opposite direction relative to the base, and wherein the rotating of the first and second members causes corresponding movement of the first and second linkage arrangements about the first and

2012319280 30 Oct 2017

second axes relative to the base and rotation of the first and second support links relative to the head or neck support, with corresponding movement of the first and second support links toward or away from one another. In an embodiment, the head or neck support comprises a housing containing a first toothed rack that is coupled to the first support link, a second toothed rack that is coupled to the second support link, and a pinion gear that is rotatably mounted to the housing and engaged with the first and second toothed racks, wherein movement of the first and second support links toward and away from one another moves the toothed racks, with the racks and pinion gear linking the movement of the first and second support links.

In an embodiment, the head or neck support assembly comprises a locking mechanism to selectively inhibit movement of the first and second members and the first and second linkage arrangements and thereby maintain the head or neck support in a desired position. In an embodiment, the head or neck support assembly comprises a locking member that selectively inhibits pivoting of the first pair of generally parallel arms relative to the first member and that selectively inhibits rotation of the first member relative to the base. In an embodiment, the first pair of generally parallel arms are pivotally connected to a first support link, wherein the locking member is carried by the first support link and is engageable with one of the first pair of generally parallel arms to inhibit pivoting of the first pair of generally parallel arms relative to the first support link and thereby inhibit pivoting of the first pair of generally parallel arms relative to the first member. In an embodiment, an engagement surface is provided on one of the first pair of generally parallel arms, and the locking member comprises a complementary engagement surface for engaging with the engagement surface on one of the first pair of generally parallel arms.

In an embodiment, the head or neck support comprises a housing containing a first toothed rack that is rotatably connected to the first support link, and wherein the locking member is engageable with the first toothed rack to inhibit rotation of the first support link relative to the first toothed rack, thereby inhibiting rotation of the first member relative to the base. In an embodiment, the toothed rack comprises a body having an aperture and an engagement surface, and the locking member extends through the aperture in the body of the toothed rack and through an aperture in the first support link and is moveable only axially relative to the first support link, and wherein the locking member comprises a

2012319280 30 Oct 2017

complementary engagement surface for engaging with the engagement surface on the toothed rack to inhibit rotation therebetween.

In an embodiment, the locking member is configured such that when moving the locking member from an unlocked position to a locked position, the locking member initially inhibits pivoting of the first pair of generally parallel arms relative to the first member and then inhibits rotation of the first member relative to the base. In an embodiment, the locking member comprises a first locking member portion for inhibiting pivoting of the first pair of generally parallel arms relative to the first member, a second locking member portion for inhibiting rotation of the first member relative to the base, and a biasing device between the first locking member portion and the second locking member portion.

In an embodiment, the head or neck support assembly comprises a second locking member that selectively inhibits pivoting of the second pair of generally parallel arms relative to the second member and that selectively inhibits rotation of the second member relative to the base. In an embodiment, the head or neck support comprises an unlock plate with a pair of slots in which the locking members are slidably mounted such that the first and second support links can move toward and away from one another, and at least one actuation lever for actuating by a user, wherein actuation of the actuation lever moves the unlock plate and disengages the locking members to enable the position of the head or neck support to be adjusted. In an embodiment, the head or neck support assembly comprises a biasing device to bias the lever and thereby the unlock plate into a position in which the locking members are engaged to inhibit movement of the head or neck support.

In an embodiment, the head or neck support assembly comprises two actuation levers for actuating by a user, wherein actuation of either or both actuation levers moves the unlock plate and disengages the locking members to enable the position of the head or neck support to be adjusted. In an embodiment, it is sufficient to actuate one of the actuation levers to disengage the locking members to enable the position of the head or neck support to be adjusted. In an alternative embodiment, it is necessary to actuate both of the actuation levers to disengage the locking members to enable the position of the head or neck support to be adjusted. The actuation levers may be positioned adjacent respective sides of the head or neck support. In an embodiment, the actuation levers are arranged for

2012319280 30 Oct 2017

actuation from a rear of the head or neck support. In an alternative embodiment, the actuation levers are arranged for actuation from a front of the head or neck support.

In an embodiment, the head or neck support assembly is mounted to a chair having a back portion with a central spine, wherein the base and the central spine are integral. Alternatively, the base may be separately formed from the central spine, and may be mounted to the back portion by being connected to the spine. Alternatively, the base may be connectable to, or integrally formed, with a part of the back portion other than the spine, for example a frame member or shell of the back portion.

Described herein is an adjustable support arrangement for a chair comprising: a flexible mounting assembly comprising an elongate flexible closure and tension members for movably attaching the support arrangement to a frame or relatively rigid member; a slider arrangement comprising a first slider portion and a second slider portion in fixed relation, the slider portions being slidable together along the closure to open and close a portion of the closure; and a support member operatively connected to the slider arrangement; wherein the support member is adjustable to a plurality of positions between first and second end positions by sliding the slider portions along the closure.

In an embodiment, the first slider portion and the second slider portion are integrally formed. Alternatively, the first slider portion and the second slider portion may be separately formed, but configured to move together with movement of the support member.

In an embodiment, the closure comprises two opposite, engagable sides that engage to close or partially close the respective closure.

In an embodiment, the opposing sides of each closure each comprise a plurality of engagable teeth. The closure may comprise a zipper with first and second slider portions. Alternatively, the opposing sides of the closure may comprise a cooperating projection and recess.

2012319280 30 Oct 2017

In an embodiment, portions of the closure externally of the first and second slider portions are closed. A portion of the closure between the first and second slider portions may form an opening.

The support arrangement may comprise a second elongate closure that is substantially parallel to the first elongate closure, and wherein the slider arrangement comprises third and fourth slider portions that are slidable together along the further second closure. The second elongate closure may have any one or more of the features outlined in relation to the first closure. The first and second closures could be the same, or could differ.

In an embodiment, the support arrangement further comprises a carriage wherein the slider portions are fixed to the carriage and the support member is operatively connected attached to the support carriage. In an embodiment, the slider portions are connected to the carriage by way of a snap connection.

In an embodiment, the support member is removably attached to the carriage. The support member may, for example, be connected to the carriage by way of a snap connection.

In an embodiment, the mounting assembly comprises a flexible load dispersion panel for attachment to the front surface of a cushioned support.

In an embodiment, the support member is a head or neck support and the support member is height adjustable relative to the mounting assembly. In an alternative embodiment, the support member is a lumbar support and the support member is height adjustable relative to the mounting assembly.

Described herein is a chair comprising: a seat portion for supporting an occupant; a back portion for supporting the back of a seated occupant; and an adjustable support arrangement as outlined in relation to the fourth aspect above; wherein the mounting assembly is attached to the back portion.

2012319280 30 Oct 2017

In an embodiment, the back portion is upholstered and the upholstery comprises an elongate aperture substantially parallel to the closure(s), and wherein the slider arrangement comprises a carriage with a forwardly protruding connector portion that protrudes through the aperture for connection to the support member.

Described herein is an adjustable support arrangement for a chair back portion comprising a cushioned portion and an upholstery layer, the adjustable support arrangement comprising: a flexible mounting assembly, the mounting assembly comprising a flexible support rail and a flexible load dispersion panel arranged to be positioned between the front surface of the cushioned portion and a back surface of the upholstery layer; a slider arrangement being slidable along the support rail; and a support member operatively connected to the slider arrangement; wherein the support member is adjustable to a plurality of positions between first and second end positions by sliding the slider arrangement along the support rail, and wherein the flexible load dispersion panel is arranged to disperse a user's load from the support member across the cushioned portion.

In an embodiment, the flexible support rail comprises an elongate closure.

In an embodiment, the load dispersion panel is configured for attachment to the front surface of the cushioned portion. In an embodiment, the load dispersion panel comprises a woven or non-woven fabric.

In an embodiment, the back attachment assembly further comprises tension members for movably attaching the support arrangement to the relatively rigid portion.

In an embodiment, the support member is a head or neck support and the support member is height adjustable relative to the mounting assembly. In an alternative embodiment, the support member is a lumbar support and the support member is height adjustable relative to the mounting assembly.

The support arrangement may have any one or more of the features outlined in relation to the fourth aspect above.

2012319280 30 Oct 2017

Described herein is a chair comprising: a seat portion for supporting an occupant; a back portion for supporting the back of a seated occupant; and an adjustable support arrangement as outlined in relation to the sixth aspect above, wherein the back portion comprises a rear relatively rigid portion and a cushioned portion and the mounting assembly is attached to a front surface of the cushioned portion.

In an embodiment, the flexible load dispersion panel is attached to the front surface of the cushioned portion by an adhesive, and is positioned behind an upholstery layer.

In an embodiment, the mounting assembly comprises tension members that extend through apertures in the cushioned portion and attach to the relatively rigid portion of the back portion.

The term "comprising" as used in this specification means "consisting at least in part of". When interpreting each statement in this specification 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.

As used herein the term "and/or" means "and" or "or", or both.

As used herein "(s)" following a noun means the plural and/or singular forms of the noun

It is intended that reference to a range of numbers disclosed herein (for example, 1 to 10) also incorporates reference to all rational numbers within that range (for example, 1, 1.1, 2, 3, 3.9, 4, 5, 6, 6.5, 7, 8, 9 and 10) and also any range of rational numbers within that range (for example, 2 to 8, 1.5 to 5.5 and 3.1 to 4.7) and, therefore, all sub-ranges of all ranges expressly disclosed herein are hereby expressly disclosed. These are only examples of what is specifically intended and all possible combinations of numerical values between the lowest value and the highest value enumerated are to be considered to be expressly stated in this application in a similar manner.

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

2012319280 30 Oct 2017

BRIEF DESCRIPTION OF THE DRAWINGS

In order that the invention may be more fully understood, some embodiments will now be described by way of example with reference to the accompanying figures in which:

Figure 1 is a side view of a chair in accordance with a preferred form of the present invention, in a neutral rock, no recline position with the leg or foot support assembly retracted and when that chair is unoccupied;

Figure 2 is a side view similar to Figure 1, but once the chair is occupied;

Figure 3 is a side view similar to Figure 2, but with the chair in a forward rocked position;

Figure 4 is side view similar to Figure 3, but with the chair in a rearward rocked position;

Figure 5 is a side view of the chair of Figure 1 in a neutral rock, half reclined and occupied position, with the leg or foot support assembly extended;

Figure 6 is a side view similar to Figure 5, but with the chair in a fully reclined position;

Figure 7 is a side view similar to Figure 6, but with the chair in a rearward rocked position;

Figure 8 is a side view similar to Figure 7, but with the foot or leg support assembly retracted;

Figure 9 is a side view of the skeleton of the chair, in a position similar to Figure 1, but with the chair in a forward rocked position;

Figure 10 is a perspective view corresponding to Figure 9;

Figure 11 is a side view of the skeleton of the chair, in a position corresponding to Figure 5;

Figure 12 is a side view of the skeleton of the chair, in a position corresponding to Figure 7;

Figure 13 is a perspective view corresponding to Figure 12;

Figure 14 is a side view of the cantilevered support frame of the chair, in a position corresponding to the chair being unoccupied;

Figure 15 is a side view similar to Figure 14, but in a position corresponding to the chair being occupied;

Figures 16A to 16C show examples of possible configurations of the resilient member of cantilevered support frame;

Figure 17 is an exploded perspective view of the swivel of the cantilevered support frame of Figures 14 and 15, showing part of the cantilevered support;

Figure 18 is a sectional view through the swivel of the cantilevered support frame of Figures 14 and15;

Figure 19 is a side view of part of the recline mechanism of the chair, when the back portion is in an upright position;

Figure 20 is a part sectional view corresponding to Figure 19;

Figure 21 is a side view similar to Figure 19, but when the back portion is partly reclined;

Figure 22 is a part sectional view corresponding to Figure 21;

Figure 23 is a side view similar to Figure 19, but when the back portion is fully reclined;

Figure 24 is a part sectional view corresponding to Figure 23;

Figure 25 is a side view of part of the rocker mechanism of the chair, when the intermediate support is in a neutral rock position;

Figure 26 is a side view similar to Figure 25, but when the intermediate support is in a forward rocked position;

Figure 27 is a side view similar to Figure 25, but when the intermediate support is in a rearward rocked position;

Figures 28A to 28C are partial sectional views through the cantilevered support frame showing the rocker mechanism connecting the intermediate support frame, and a rock stop arrangement for limiting forward and rearward rock of the intermediate support frame, with Figure 28A showing the intermediate frame rocked rearward and the front intermediate frame stop compressed, Figure 28B showing the intermediate frame in a neutral rock position, and Figure 28C showing the intermediate frame rocked forward and the rear intermediate frame stop compressed;

Figure 29 is a side view of the chair when the back portion is in a neutral rock, upright position, showing the forward sliding position of the arm rests;

Figure 30 is a side view corresponding to Figure 29, with the chair rocked rearward and the back portion is reclined, with a corresponding rearward slide of the arm rests;

Figure 31 is a sectional view through one of the arm rest assemblies;

Figure 32 is an exploded perspective view of one of the arm rest assemblies;

Figure 33 is an underside view of one of the arm rest assemblies;

Figure 34 is a side view of one of the arm rest assemblies;

Figure 35 is an overhead view of the back portion of the chair, schematically showing the twisting action of the back portion;

Figure 36 is a side view of the chair, schematically showing the rearward flexing of the upper end of the back portion, with the rearward flexed position shown in broken lines;

Figure 37 is a left side view of the foot or leg support assembly of the chair when the foot or leg support member is retracted;

Figure 38 is a left side view of the foot or leg support assembly of Figure 37 when the foot or leg support member is partially extended;

Figure 39 is a left side view of the foot or leg support assembly of Figure 37 when the foot or leg support member is extended;

Figure 40 is an underside perspective view of the underside of the foot or leg support assembly of Figure 37 in an extended position;

Figure 41 is an elevation view normal to the support frame of part of the foot or leg support assembly of Figure 37 in an un-extended position;

Figure 42 is a view normal to the support frame of part of the foot or leg support assembly of Figure 37 in a fully extended position;

Figure 43 is a chart showing the relationship between the gas spring extension required for various angular displacements of the foot or leg support frame for the foot or leg support assembly of Figures 37 to 42;

Figure 44 is a section view taken through a centreline of the foot or leg support assembly when the foot or leg support member rest is retracted

Figure 45 is similar view to Figure 44, but with the foot or leg support member in a substantially vertical position when the chair is upright;

Figure 46 is similar view to Figures 44 and 45, but with the foot or leg support member fully extended;

Figure 47 is an overhead front perspective view of a rocking inhibitor arrangement comprising an anti-rock ratchet assembly to inhibit forward rocking of the intermediate

2012319280 30 Oct 2017

support when the foot or leg support is extended and a lock assembly to selectively lock the rock of the seat independent of the position of the foot or leg support, in a configuration where the foot or leg support is extended and forward rocking is prevented;

Figure 48 is a perspective view corresponding to Figure 47 of the underside of the rocking inhibitor arrangement of Figure 47;

Figure 49 is a partially exploded perspective view of the rock inhibitor arrangement of Figure 47, showing the central slide member removed;

Figure 50 is an overhead exploded perspective view of the anti-rock ratchet assembly of the rock inhibitor arrangement of Figure 47;

Figure 51 is an underside exploded perspective view of the anti-rock ratchet assembly of Figure 50;

Figure 52A is a bottom view of the anti-rock ratchet assembly of the rocking inhibitor arrangement of Figure 47, in a configuration where the foot or leg support is retracted and forward rocking is enabled;

Figure 52B is a view corresponding to Figure 52A, but in a configuration where the foot or leg support is extended and forward rocking is prevented;

Figure 53A is an enlarged plan view of the engagement teeth of the anti-rock ratchet assembly of Figure 47 when the foot or leg support has been extended but the teeth on the pawl and ratchet are not aligned and engagement of the teeth is delayed by a biasing device;

Figure 53B is a view corresponding to 53A but with the seat portion rocked slightly forward of the position of Figure 53A, with the ratchet and pawl teeth partly engaged;

Figure 53C is a view corresponding to 53B but with the seat portion rocked slightly forward of the position of Figure 53B, with the ratchet and pawl teeth fully engaged to prevent forward rocking;

Figure 54 is an overhead exploded perspective view of the lock assembly of the rock inhibitor arrangement of Figure 47;

Figures 55A and B are top and bottom perspective views respectively of the rock lock detent pawl;

Figures 56A to 56G are partial overhead views showing the operation of the rock lock assembly, with Figure 56A showing the rock lock in a released configuration with the seat portion free to rock, Figure 56B showing the rock lock during actuation with locking

2012319280 30 Oct 2017

delayed due to misaligned engagement teeth on the central slide member, Figure 56C corresponding to Figure 56B but when the user has released the actuator and the detent pin is in a locked position, Figure 56D showing the seat portion rocked slightly forward from its position in Figures 56B and C and the lock biased into engagement with the teeth on the central slide member, Figure 56E showing the detent pin moved into the unlocked position during actuation by user to unlock the rock lock, Figure 56F showing the detent pin returned to the unlocked position but retraction of the lock pawl delayed due to frictional force, and Figure 56G showing the lock pawl retracted and the rock lock in the released configuration with the seat portion free to rock;

Figure 57 shows the rocking inhibitor arrangement of Figure 47 positioned in the transom of the chair;

Figure 58 is a rear perspective view of a first preferred form head or neck support assembly of the chair;

Figures 59A to F show some of the possible adjustment positions of the head or neck support assembly;

Figure 60 is a rear perspective view similar to Figure 58, but with some of the components removed for clarity;

Figure 61A is a front view of some of the components of the head or neck support assembly, when in a raised position, and Figure 61B is a front view, when in a lowered position;

Figure 62A is a view corresponding to Figure 61A but from behind, and Figure 62B is a view corresponding to Figure 61B but from behind;

Figure 63A is an overhead section view of some of the components of the head or neck assembly, when in a forward position, and Figure 63B is an overhead section view, when in a rearward position;

Figure 64 is an overhead exploded view of some of the components of the head or neck support;

Figure 65 is a rear view of the head or neck support assembly, with the head or neck support housing removed showing section line H-H;

Figure 66 is a horizontal cross-section view taken through line H-H of Figure 65, with the locking members in an unlocked position;

2012319280 30 Oct 2017

Figure 67 is a view similar to Figure 66, but with the locking members in an initial locking position in which they inhibit forward or rearward movement of the support member;

Figure 68 is a view similar to Figure 67, but with the locking members in a fully locking position in which they inhibit both forward or rearward, and up or down, movement of the support member;

Figure 69A is a section view similar to the sectional view of Figure 68, but with the head or neck support assembly in a forward position and showing the head or neck support housing;

Figure 69B is a sectional perspective view similar to the sectional view of Figure 69A;

Figures 70A to 70C are enlarged detail section views of one of the locking mechanisms shown in Figures 66 to 68; Figure 70A corresponds the un-locked position of Figure 66, Figure 70B corresponds the locking position of Figure 67, Figure 70C corresponds the locking position of Figure 68;

Figure 71 is a perspective view of one of the linkage arrangements of the head or neck support assembly;

Figure 72 is a front perspective view of the head or neck support assembly with some parts removed for clarity;

Figure 73 is an exploded view of the assembly shown in Figure 72;

Figure 74 is front exploded view of part of the head or neck support assembly;

Figure 75 is view corresponding to Figure 74 but from the rear;

Figure 76 is a top view of the lever assembly for the neck or head support assembly;

Figure 77 is a front exploded view corresponding to Figure 76;

Figure 78 is a horizontal cross-section view through a second preferred form head or neck support assembly, with the locking members in an unlocked position;

Figure 79 is rear exploded view of part of the head or neck support assembly of Figure 78;

Figure 80 is a top view of the lever assembly for the neck or head support assembly of Figures 78 and 79;

Figure 81 is a front exploded view corresponding to Figure 80;

2012319280 30 Oct 2017

Figures 82A to 82C are top views of the levers of the lever assembly of Figures 78 to 81, with Figure 82A showing the lever position when the head or neck support assembly is locked, Figure 82B showing the lever position when the head or neck support assembly is partially locked; and Figure 82C showing the lever position when the head or neck support assembly is unlocked and free to be repositioned;

Figure 83 is a perspective view of a second preferred form chair incorporating a height adjustable head or neck support assembly;

Figure 84 is a side view of the chair of Figure 83;

Figure 85 is a left side section view through the chair of Figures 83 and 84;

Figure 86 is a perspective view of a preferred form height adjustable head or neck support assembly for attaching to a high back chair such as that shown in Figures 83 and 84, showing the head or neck support member in its highest position;

Figure 87 is a perspective view of the head or neck support assembly shown in Figure 86, showing the head or neck support member in its lowest position;

Figure 88 is a section view of the head or neck support assembly of Figures 86 and 87, taken through a vertical centreline of Figure 86;

Figure 89 is an exploded perspective view of the mounting assembly and slider arrangement of the head or neck support assembly of Figures 86 to 88;

Figure 90 is a front view of the double zipper member and attached sliders of the mounting assembly of Figures 86 to 89;

Figure 91 is a front view of a double zipper member and attached sliders for a mounting assembly according to an alternative embodiment;

Figure 92A is a perspective view of the slider carriage of the support assembly of Figures 86 to 88, with two sliders unattached;

Figure 92B is a plan view of the slider carriage arrangement in Figure 92A;

Figure 92C is a section view taken along A-A of Figure 92B;

Figure 93A is a perspective view of the slider carriage of Figures 92A to 92C, with the two sliders being pressed into place during assembly;

Figure 93B is a plan view of the slider carriage arrangement in Figure 93A;

Figure 93C is a section view taken along B-B of Figure 93B;

Figure 94A is a perspective view of the slider carriage of Figures 92A to 93C, with the sliders attached to the carriage;

2012319280 30 Oct 2017

Figure 94B is a plan view of the slider carriage arrangement in Figure 94A;

Figure 94C is a section view taken along C-C of Figure 94B;

Figure 95A is a front view of the head or neck support of Figures 86 to 88;

Figure 95B is a rear view of the head or neck support of Figure 95A;

Figure 96A is the view of Figure 95B, indicating section line D-D;

Figure 96B is section view taken along D-D of Figure 96A;

Figure 96C is an enlargement of the detail B in Figure 96B;

Figure 97 is a front view of the mounting assembly of Figure 86 to 89, illustrating assembly and stitching of the load dispersion panel, double zipper member and trim strip;

Figure 98A is a rear perspective view of the back attachment assembly shown in Figures 86 to 89;

Figure 98B is an exploded perspective view of the back attachment assembly of Figure 98A;

Figure 99A is a front elevation of the back attachment assembly of Figure 98A;

Figure 99B is a front perspective view of the back attachment assembly of Figure 98A;

Figure 99C is a side elevation of the back attachment assembly of Figure 98A;

Figure 99D is a rear elevation of the back attachment assembly of Figure 98A;

Figure 100 is an exploded perspective view showing assembly of the head or neck support assembly of Figures 86 to 89 to the back portion of the high-back chair of Figures 83 and 84;

Figure 101 is a rear perspective view showing the ends of the straps on the back attachment assembly of Figures 98A to 99D protruding through the back cushion for attaching to the chair back shell;

Figure 102 is a partial front perspective view showing attachment of the load dispersion panel to the back cushion;

Figure 103 is a partial front perspective view of the upholstery on the chair back portion assembled over the mounting assembly of Figure 97, with the support connecting portion of the slider carriage exposed by a slot in the upholstery;

Figure 104A is a partial exploded view showing attachment of the head or neck support to the upholstery covered mounting assembly of Figure 103; and

Figure 104B is a front perspective view showing the head or neck support

attached to the upholstery covered mounting assembly of Figures 103 and 104A, showing the head or neck support adjusted to an upper position.

DETAILED DESCRIPTION OF PREFERRED FORMS

Figures 1 to 8 show a reclining domestic lounger chair according to a preferred embodiment of the present invention. The chair comprises a supporting frame 1 including a base assembly 3, a seat portion 101 for supporting a seated occupant, a back portion 201 for supporting the back of a seated occupant, arm rests 301 for supporting the arms of a seated occupant, an adjustable head or neck rest or support assembly 401 and an extendable and retractable foot or leg rest or support assembly 501.

The chair additionally has a recline mechanism configured to lift the seat portion 101 relative to an intermediate support of the supporting frame 1 upon a reclining action of the back portion 201, and a rocker mechanism that operatively connects a main transom of the supporting frame and the intermediate support of the supporting frame, to provide a rocking motion therebetween. These features will be described in further detail below.

The mechanisms and features operate together to provide a large number of possible occupant supporting configurations of the chair, some of which are shown in Figures 1 to 13. The rocker mechanism enables the body supporting surfaces of the chair (including the seat portion, back portion, foot or leg support, head or neck support, and arm rests) to rock forward and rearward relative to the base assembly 3, for example between a forward rocked position shown in Figure 3, a neutral rock position shown in Figure 2, and a full rearward rocked position shown in Figure 4. The recline mechanism enables the back portion 201 of the chair to be reclined from an upright position shown in Figure 2, through a partly reclined position shown in Figure 5, to a fully reclined position shown in Figure 6. The rocker mechanism is configured such that the chair can be rocked by a seated occupant whether the back portion is in the upright, partly reclined, or fully reclined position. The foot or leg support can be extended or retracted in any position of the back portion. Similarly, the head or neck support can be adjusted in position in any rocked or reclined position of the chair. Therefore, the configurations shown in Figures 1 to 13 are only some of the possible occupant supporting configurations of the chair, and other configurations are possible.

2012319280 30 Oct 2017

Since the figures illustrate the preferred form chairs from various different angles as convenient to explain certain parts, an arrow marked "F" has been inserted into the figures where appropriate to indicate a forward direction of the chair. Accordingly the terms forward, rearward, left side, and right side (or similar) should be construed with reference to the forward direction F of the chair, not necessarily with reference to the orientation shown in the particular figure.

The features of the preferred form chairs are described and shown herein to give a full understanding of the components and operation of the preferred form chair. It will be appreciated that not all of the features described herein need be provided in every chair.

BASE

The lower part of the supporting frame 1 comprises a base 3 for supporting the chair on a support surface. Referring to Figures 10 to 18, the base has a plurality of radially extending legs 5 that intersect at a hub 7. The base can have any suitable number of legs, but preferably has at least three legs to provide the required level of support and balance to the chair on the support surface. In the preferred form shown, the base has four equally angularly spaced legs, but the base could have five or more legs. A base upright 9 extends at a non-perpendicular angle upwardly and forwardly from the hub 7, and at its upper end has a support 11 that extends forwardly at a flatter angle than the majority of the upright 9 of the base. A pivot connection 13 is provided on each side of the support at a forward end thereof, and a main transom 15 is connected to the support 11 at the pivot connections 13, with the main transom cantilevered rearwardly from its connection to the support 11. The seat portion, back portion, recline mechanism, and rocker mechanism are supported either directly or indirectly on the main transom.

The main transom 15 may be supported from the base by at least one resilient member 17 that is arranged to deform and allow generally downward movement of the main transom to absorb initial impact as an occupant sits on the seat portion. This provides a 'plonk' feature, and avoids the hard impact that would generally be experienced when an occupant initially sits on a conventional chair. In the form shown, the supporting frame has two elastomeric blocks 17 that are provided between the main transom 15 and the support 11,

2012319280 30 Oct 2017

one elastomeric block positioned at or toward each side of the support 11. The elastomeric blocks are positioned between the main transom and the base at a position spaced from the pivot connections 13. The elastomeric blocks are compressed between engagement surfaces 11a on the support and engagement surfaces 15a on the main transom, as an occupant sits on the seat portion 101. The elastomeric block(s) or other resilient member(s) may have cut-outs, apertures, or weakened areas to change the amount of deformation force with respect to deformation.

Figure 14 shows the position of the main transom 15 relative to the support 11 before an occupant sits on the seat portion, with the main transom being substantially horizontal (i.e. typically at an angle of about zero degrees). Figure 15 shows the position of the main transom 15 relative to the support 11 after an occupant sits in the seat portion, with the main transom pivoted downwardly and rearwardly about the pivot connections 13 to be rearwardly tilted from horizontal at an angle of about 8 degrees. The elastomeric blocks provide an increasing resistance to the pivoting of the main transom as it moves, to provide a soft landing as the occupant sits down on the seat portion. As shown in Figure 15, a spacing is preferably provided between the sides of the support 11, so that part of the main transom 15 can pass between the sides of the support 11 as the occupant sits on the seat portion.

The elastomeric blocks 17 or other resilient members could be solid with sufficient compressibility to give the required plonk, or could be shaped in such a way as to give the required deflection using less material. Such shapes might include cylindrical cross sections which deform in the radial direction or honeycomb matrixes where the honeycombs collapse. Figures 16A to 16C show three example configurations of the elastomeric blocks 17. Figure 16A shows a 'figure 8' configuration having two adjacent hollow cylinders 17a with respective apertures 17b, and an interconnecting region 17c. Figure16B shows a tapered arrangement having a polygonal exterior shape 17d with at least one internal web 17e, and a plurality of apertures 17f. Figure 16C shows a cellular matrix form having a plurality of polygonal cells 17g, and in the form shown square cells, defining respective apertures 17h.

2012319280 30 Oct 2017

Alternatively, rather than being pivotally connected, the transom 15 may be rigidly fixed to the base upright 9. In one embodiment, the transom 15 and the upright 9 may be integral.

BASE SWIVEL

The base 3 of the supporting frame 1 is preferably configured so that the upright 9 and thereby the main transom 15 and the components supported by the main transom 15 are rotatable about a substantially vertical axis relative to the support surface engaging portion of the base. The hub 7 may be configured as shown in Figures 17 and 18.

Figures 17 and 18 show a preferred swivel arrangement that pivots the cantilevered upright 9 to the base 3. The base 3 has a central recess 3a for receiving the hub 7 of the upright 9. In an alternative configuration, the recess could be formed by a through aperture. An annular bearing plate 31 having an aperture 31a with a smaller diameter than the base recess 3a is fixed to the base 3 and arranged to be concentric with the base aperture, such that the bearing plate protrudes into the base providing upper and lower bearing surfaces 32a and 32b.

Base recess 3a and bearing plate aperture 31a together form a stepped recess in the base. An underside of the hub 7 of the upright 9 has a complementary stepped profile with surfaces that are spaced from the surfaces of the base 3 and bearing plate 31a when the hub is mounted to the base. An upper, top hat washer 33 having a central cylindrical portion 33' and an annular flange 33" at one end thereof is positioned in the stepped recess, between the hub 7 of the upright and an upper planar annular bearing surface 32a, to provide a planar annular bearing surface 34a that bears against surface 32a as the upright rotates relative to the base. A sandwich member 37 is provided on the opposite side of the bearing plate 31 to the hub 7 of the upright, and fixed to the hub 7 at a central portion, for example using bolts 41. A lower washer 35 is positioned between an upper side 37a of the sandwich member and a lower planar annular bearing surface 32b, to provide a planar annular bearing surface 36a to bear against surface 32b as the upright rotates relative to the base. The lower washer 35 has an aperture 35a corresponding in size to an aperture 33a in the upper washer. An o-ring 42 may be positioned between the lower washer 35 and the sandwich member 37. The o-ring 42 is compliant to minimise non-rotational movement of the upright 9 and to reduce the need for fine tolerances on the base swivel components.

2012319280 30 Oct 2017

The upright 9, washers 33, 35, and sandwich member 37 are rotatable in tandem relative to the base 3 and bearing plate 31 to swivel the chair. As the upright 9, washers 33, 35, and sandwich member 37 are rotated, the bearing surfaces 34a and 36a slide against the respective bearing surface on the bearing plate 31.

The upper and lower washers 33, 35 preferably comprise a low friction material such as acetal. The bearing plate 31 comprises a hard bearing material, and may be a metallic material, for example hardened chrome steel or anodised aluminium. The hub 7, legs 5, and sandwich member 37 are all suitably a metallic material. The use of low friction materials in the bearing surfaces provides a smooth low friction swivel with a large surface area for the bearing surfaces suitable for accommodating offset loadings and moment loads such as those produced by the cantilevered upright 9.

Figures 17 and 18 show only one preferred embodiment of the base swivel, however other embodiments are possible. For example, in an alternative embodiment, the underside of the hub 7 of the upright 9 could be a flat surface and the stepped recess could be provided on the sandwich member 37 such that a central portion of the sandwich member 37 extends through the aperture 31a in the bearing plate. Similarly, the upper washer 33 could be a plain washer, and the lower washer 35 a 'top hat' washer. In a further embodiment, the respective sides of the hub 7 of the upright 9 and the sandwich member 37 that are adjacent the respective washers 33, 35 could comprise a flat surface and be spaced apart. In such an arrangement, a spacer may optionally be provided between the two members.

In the embodiment shown, the bearing plate 31, upper washer 33 and lower washer 35 are all separate members. Alternatively one or more of these members may be integral with another component, for example the bearing plate 31 may be integral with the base 3, the upper washer 33 may be integral with the hub of the upright 7, and/or the lower washer 35 may be integral with the sandwich member 37. As a further example, rather than having one or both of the washers 33, 35, the bearing surfaces 34a, 36a may be provided by a coating of a suitable bearing material on the respective upright and/or the sandwich member, and/or the bearing surfaces 32a, 32b may be provided by a coating of suitable bearing material on the upper and lower surfaces of the bearing plate 31.

2012319280 30 Oct 2017

In place of the swivel described in relation to Figures 17 and 18, an alternative off-the-shelf component could be used which may be of similar construction or use an alternative bearing mechanism such as ball or roller bearings.

In an alternative configuration, the main transom could be provided on a more conventional pedestal base. However, such a base would not provide the benefit of the 'plonk' feature described above.

RECLINE MECHANISM

Referring to Figures 19 to 24, the chair comprises a recline mechanism 601 that is configured to lift the seat portion 101 upon a reclining action of the back portion 201. The recline mechanism comprises at least one operative connection between the seat portion 101 and the supporting frame 1.

Reverting to Figure 9 for example, it can be seen that the back portion 201 for supporting the back of a seated occupant that has an upper end 203, a lower end 205, and is pivotally mounted at pivot 207 relative to the supporting frame 1. Pivot 207 is positioned above the lower end 205 of the back portion 201. As shown in Figures 35 and 36, the back portion of the chair comprises a central spine 209, and a compliant support surface 211 supported by the spine for supporting the back of a seated occupant. An upper portion of the spine will preferably have connection feature 212 for connecting the compliant support surface to the spine. A lower portion of the spine 209 is pivotally connected to the supporting frame at pivot 207, with a bottom portion of the spine 205 pivotally connected to a drag link 602. The compliant support surface 211 may be any suitable type. For example, the compliant support surface may comprise a resiliently flexible shell supported by the spine 209 and a cushion supported by the shell. Alternatively, the cushion may not be provided, and instead the compliance in the support surface may be provided by slots, apertures, or regions of enhanced flexibility in the shell.

As shown in Figure 36, the spine 209 is resiliently flexible such that an upper end of the spine can be flexed rearwardly relative to a portion of the spine adjacent the pivot connection 207 of the spine to the supporting frame. Additionally, as shown in Figure 35

2012319280 30 Oct 2017

the spine 209 may be resiliently flexible so it can twist with a torsional action around a longitudinal axis of the spine, upon application of a suitable force by a seated occupant to the compliant support surface 211. These features, and the compliant support surface, enable an occupant to sit in unusual positions and be supported by the chair, thereby increasing the comfort level offered by the chair. Additionally, the configuration encourages healthy blood flow through micro-movements and allows freedom of movement with continuous support of the user.

Similarly, the seat portion comprises a seat frame 103 and a support surface 107 mounted to the seat frame for supporting a seated occupant. The support surface 107 of the seat portion may be compliant or rigid and of any of the types outlined in relation to the back portion.

Referring to Figures 19 to 24, a drag link 602 is pivotally connected at pivot 602a to the seat portion 101. A fixed extension 105 extends rearwardly from a seat frame 103 of the seat portion 101, and the drag link 602 is pivotally connected at pivot 602a to that fixed extension 105. The drag link is also pivotally connected at pivot 602b to the back portion 201 at a position below the pivotal mounting 207 of the back portion relative to the supporting frame. The recline mechanism 601 is configured such that as the back portion 201 of the chair is reclined, the lower end 205 of the back portion moves forward and the drag link 602 pulls the seat portion 101 upward relative to the supporting frame 1. The drag link acts in tension during that pulling action. The drag link 602 preferably moves from a generally vertical orientation when the back portion of the chair is in the upright configuration, to a forwardly inclined orientation when the back portion of the chair is reclined (when the chair is in a neutral rock configuration).

In the form shown, the chair comprises a rocker mechanism 701 as will be described below. The rocker mechanism 701, shown in Figures 25 to 28C, operatively connects the main transom 15 and an intermediate support 21 to provide a rocking motion therebetween. Therefore, rather than being connected to the main transom 15, the recline mechanism 701 supports the seat portion from the intermediate support 21 of the supporting frame. The back portion 201 is also supported by the intermediate support 21. This means that the seat portion 101 and back portion 201 will rock with the intermediate

2012319280 30 Oct 2017

support 21. In an alternative configuration of the chair without a rocker mechanism, the recline mechanism could instead support the seat portion from the main transom 15 of the supporting frame, and the back portion could be supported by the main transom.

As shown in Figures 12 and 19-24, the intermediate support 21 has a generally horizontally extending portion 23 and a pair of rearward uprights 25, with the lower portion 205 of the spine positioned between and pivotally connected to the uprights 25 at pivot 207. As shown in Figures 10 and 13, a portion of the spine below the pivot connection 207 may have one or more stops 213 connected thereto, which engage against uprights 25 to define the maximum rearward movement of the lower portion of the spine relative to the uprights 25. Alternatively the stops 213 may comprise inwardly protruding tabs or ledges on the uprights 25 that are configured to engage a rear surface of the lower portion 205 of the spine to limit its rearward movement.

Reverting to Figures 19-24, the recline mechanism comprises at least one operative connection between the seat portion 101 and the intermediate support 21. In the preferred form shown, the recline mechanism 601 comprises a front operative connection 603 between a relatively forward portion of the seat portion and the supporting frame. The front operative connection 603 guides movement of the relatively forward portion of the seat portion as the back portion is reclined or returned to upright. The front operative connection 603 comprises a slide arrangement comprising a track 605 on the seat portion 101 and a follower 607 on the intermediate support 21 of the supporting frame, with the follower 607 arranged to travel in the track 605 as the seat portion is moved upward upon recline of the back portion. Alternatively, the track 605 could be provided on the intermediate support 21 and the follower provided on the seat portion 101. The track 605 is angled upwardly and forwardly, to cause the forward part of the seat portion 101 to move upwardly and forward as the seat portion 101 is lifted by the drag link 602 of the recline mechanism. Preferably, the recline mechanism comprises two of these front operative connections, one at or adjacent each side of the seat portion 101.

In the preferred form shown, the recline mechanism also comprises a rear operative connection 611 between a relatively rearward portion of the seat portion 101 and the intermediate support 21 of the supporting frame. The rear operative connection 611 guides

2012319280 30 Oct 2017

movement of the relatively rearward portion of the seat portion as the back portion is reclined or returned to upright. The rear operative connection 611 comprises a forward link 613 that is pivotally connected at pivot 613a to the intermediate support 21, a rearward link 615 that is pivotally connected at pivot 615a to the intermediate support 21, and a carrier link 619 that is pivotally connected at pivots 613b, 615b to the forward link and to the rearward link respectively. The carrier link 619 is pivotally connected at pivot 619a to the seat portion 101. The pivot connection 619a of the carrier link 619 to the seat portion 101 is positioned rearwardly of the pivot connections 613b, 615b of the forward link 613 and rearward link 615 to the carrier link 619. The pivot connection 602a (Figures 20, 22, 24) of the drag link 602 to the seat portion 101 is positioned generally above and generally behind the pivot connection 619a of carrier link 619 and the seat portion 101, when the back portion 201 of the chair is not reclined, and is positioned generally above the pivot connection 619a of the carrier link 619 and the seat portion 101, when the back portion of the chair is reclined.

When the back portion 201 is in an upright configuration (Figure 19), the forward link 613 hangs downwardly and rearwardly from its pivot connection 613a to the intermediate support 21, and the rearward link 615 hangs downwardly and forwardly from its pivot connection 615a to the intermediate support. When the back portion is fully reclined (Figure 23), the forward link 613 hangs generally downwardly from its pivot connection 613a to the intermediate support 21, and the rearward link 615 extends generally forwardly from its pivot connection 615a to the intermediate support 21. The pivot connection 602a of the drag link 602 to the seat portion 101 is positioned upwardly and rearwardly of the pivot connection 619a of the carrier link 619 and the seat portion 101, when the back portion 201 of the chair is fully reclined. Preferably, the recline mechanism comprises two of these rear operative connections, one at or adjacent each side of the seat portion 101.

The operative connections 603, 611 between the seat portion 101 and the intermediate support 21 are arranged such that the relatively forward and relatively rearward portions of the seat portion move upward and forward with a substantially linear movement as the back portion is reclined, with the amount of movement of the relatively rearward portion being greater than the amount of movement of the relatively forward portion, to provide a forward tilt of the seat portion 101 as the back portion is reclined. That forward tilt reduces

2012319280 30 Oct 2017

force against the underside of the occupant's thighs as the back portion is reclined, and also reduces 'shirt pull'. Preferably, the seat portion 101 has a rearward tilt angle when the back portion 201 is upright, and the seat portion 101 has a smaller rearward tilt angle when the back portion 201 is fully reclined. Preferably, the upward movement of the relatively rearward portion of the seat portion is greater than that of the relatively forward portion of the seat portion.

In an alternative configuration, the rear operative connections could instead comprise track and follower arrangements of the type described for the front operative connections. In another configuration, the front operative connections could instead comprise pivot and link arrangements of the type described for the rear operative connections.

Because the recline mechanism 601 lifts the seat portion 101 upon recline of the back portion 201, the recline mechanism is a weight compensating mechanism. That is, the occupant's body weight influences the force that must be applied to the back portion to cause it to recline. A lighter weight occupant who would generally be less strong does not need to apply as much force to the back portion, as a heavier occupant who would generally have greater strength. A lighter occupant is also typically shorter and therefore applies force to the back portion at shorter distance above the back pivot 207, achieving less leverage than a taller occupant. The present recline mechanism, has the advantage that for the same force applied to the back portion, less leverage is required (i.e. the force can be applied closer to the back pivot) to lift a lighter occupant than a heavier occupant. These benefits mean that tension adjustment and/or a user activated recline lever are not required.

The use of the drag link 602 and a pivot of the back portion to the supporting frame above the bottom of the back portion enables the lower portion of the back portion and the seat portion to travel on independent paths, reducing the amount of 'shirt pull' that would occur if the back portion was pivoted directly to the seat portion. The position of the pivot 207 of the back portion to the supporting frame also provides optimal lumbar rotation as the back portion is reclined, and reduces the spacing that is required between the back of the chair and a wall to enable the chair to be reclined, despite the back portion of the preferred embodiment chair being reclinable to an angle of about 37 degrees. Additionally,

2012319280 30 Oct 2017

the drag link 602 provides variable gearing through the travel of the back portion 201 and the seat portion 101, due to the changing link angle relative to the back angle. That varies the weight compensation rate inversely to the recline angle of back portion. As the back portion 201 reclines rearward, more of the occupant's weight is on the back portion 201, increasing the weight compensation requirement of the seat portion 101 to keep the rate of change of angle of the back portion recline controlled. The drag link angle change increases the amount of seat lift per degree of back angle, and therefore the effort required to recline, as the back angle increases

Having a recline mechanism that moves the seat portion 101 forward and upward upon recline of the back portion 201 means that the occupant's centre of gravity will be moved a minimal amount upon recline of the back portion. This minimises any undesired rocking of the chair that may otherwise occur due to recline of the back portion.

ROCKER MECHANISM

As discussed above, the supporting frame 1 comprises a main transom 15, an intermediate support 21, and a rocker mechanism 701 that operatively connects the main transom and the intermediate support to provide a rocking motion therebetween. Referring to Figures 25 to 28C, the rocker mechanism 701 comprises a front rocker arm 703 pivotally connected to the main transom 15 at pivot 703a and to the intermediate support 21 at pivot 703b, and a rear rocker arm 705 pivotally connected to the main transom at pivot 705a and to the intermediate support 21 at pivot 705b.

The front rocker arm 703 and the rear rocker 705 arm hang generally downwardly from their pivot 703a, 705a connections to the main transom 15, at least when the rocker mechanism is in a neutral position as shown in Figure 25. As shown in Figure 27, when the intermediate support 21 is in the rearward rocked position, the front rocker arm 703 extends generally rearwardly from its pivot connection 703a to the main transom, and the rear rocker arm 705 extends generally downwardly from its pivot connection 705a to the main transom. When the intermediate support is in the forward rocked position as shown in Figure 26, the front rocker arm 703 extends generally downwardly from its pivot connection 703a to the main transom, and the rear rocker am 705 extends downwardly and forwardly from its pivot connection 705a to the main transom.

2012319280 30 Oct 2017

The arms 703, 705 are configured such that their action simulates rocking motion of a traditional rocking chair utilising a curved piece of wood in contact with the support surface. A traditional rocking chair motion is a combination of rotation and translation. The intermediate support 21, and thereby the seat portion 101 and the back portion 201, can be rocked between a rearwardly angled rearward rocked position as shown in Figure 27 and a forwardly angled forward rocked position as shown Figure 26.

Preferably, the front rocker arm 703 is longer than the rear rocker arm 705. Preferably, the pivot connection 703a of the front rocker arm 703 to the main transom 15 is positioned vertically higher than the pivot connection 705a of the rear rocker arm 705 to the main transom, as shown in Figure 25. 'Plonk' of the chair as a user sits down will affect the pivot positions. This configuration provides a compact package size for the rocker mechanism, while providing the same motion that would be provided if equal length arms were used with their pivots to the main transom positioned the same height from the floor.

Preferably, the rocker mechanism comprises two of said front rocker arms and two of said rear rocker arms, positioned at or adjacent respective sides of the seat portion.

Preferably, the rocker mechanism comprises one or more stops (not shown) to limit forward and/or rearward rock of the intermediate support relative to the transom 15. Figures 28A to 28C illustrate an embodiment having compressible forward 709 and rearward 711 stops fixed to the intermediate support. The forward stop 709 is fixed to a rearward portion of the intermediate support 21 and limits forward rocking of the intermediate support relative to the transom 15. The rearward stop 711 is fixed to a portion of the intermediate support 21 forward of the forward stop 709 and limits rearward rocking of the intermediate support relative to the transom 15. The transom 15 comprises a fixed stop 707 having first and second abutment surfaces 708a, 708b. The forward and rearward stops 709, 711 provided on the intermediate support comprise compressible elastomeric members. The elastomeric members are tapered from their base and comprise apertures 710, 712 to increase their compressibility. The fixed stop 707 of the transom is substantially non-compressible.

2012319280 30 Oct 2017

As the intermediate frame 21 rocks rearward relative to the transom 15, as shown in Figure 28A, the rearward compressible stop 711 comes into contact with the first abutment surface 708a on the fixed stop 707. As the intermediate frame 21 continues to rock rearward, the forward compressible stop 711 is forced into the first abutment surface 708a, compressing the rearward stop 711 and slowing the velocity of the rearward rock. As the rearward stop 711 is compressed further, the velocity of the rock slows further until the stop is fully compressed, limiting the rearward rock of the intermediate member 21. As the intermediate member 21 is rocked forward towards the neutral rock position, the rearward stop 711 expands until it is out of contact with the fixed stop 707 and in its non-compressed configuration as shown in Figure 28B.

Similarly, as the intermediate frame 21 rocks forward relative to the transom 15, the forward compressible stop 709 comes into contact with the second abutment surface 708b on the fixed stop 707. As the intermediate frame 21 continues to rock forward, the forward compressible stop 709 is forced into the second abutment surface 708b, compressing the forward stop 709 and slowing the velocity of the forward rock. As the forward stop 709 is compressed further, the velocity of the rock slows further until the stop is fully compressed, limiting the forward rock of the intermediate member 21. As the intermediate member 21 is rocked rearward towards the neutral rock position, the forward stop 709 expands until it is out of contact with the fixed stop 707 and in its non-compressed configuration.

In an alternative embodiment, the compressible stops could be provided on the transom, and the abutment surfaces may be provided on the intermediate member. In a further embodiment, rather than compressible stops, the intermediate support 21 and/or the transom 15 may comprise front and/or rear hard limit stops to limit the front and rear rock of the seat portion.

The rocker mechanism will function irrespective of whether the back portion is upright or reclined. However, in an embodiment having a foot or leg support assembly as described below, the chair is preferably provided with a rocking inhibitor arrangement to counter the effect of weight change when the foot or leg support is extended.

ARM ASSEMBLIES

2012319280 30 Oct 2017

The chair has a pair of arm assemblies 301 positioned one on either side of the seat portion 101. As shown in Figures 29 to 34, each arm assembly comprises an upright arm rest support 303 and an arm rest 305 that is slidably mounted to the arm rest support at an upper end thereof. The arm rests 305 are operatively connected to the back portion 201 such that as the back portion 201 is reclined, the arm rests 305 slide rearwardly on the arm rest supports 303. When the back portion is returned to the upright position, the arm rests 305 slide forward on the arm rest supports to return to their forward positions. Figure 29 shows the arm rests in their forward positions when the back portion 201 is upright, and Figure 30 shows the arm rests in their rearward positions when the back portion 201 is fully reclined.

Because the chair comprises a recline mechanism 601 configured to lift the seat portion 101 upon a reclining action of the back portion 201, to maintain a desired position between the seat portion and the arm rest supports 303, the arm rest supports 303 are mounted to the seat portion 101 to move with the seat portion as the seat portion is moved by the recline mechanism. Similarly, because the chair comprises a rocker mechanism that operatively connects the main transom 15 and the intermediate support 21 to provide a rocking motion therebetween, by mounting the arm rest supports 303 to the seat portion 101, the arm rest supports 303 will move with the seat portion 101 as the seat portion is rocked by the rocker mechanism.

In the form shown, the arm rest supports 303 are mounted to the seat frame of the seat portion 101, so that the orientations of the arm rest supports 303 relative to the seat portion 101 are fixed. In an alternative configuration, lower portions 303a of the arm rest supports 303 are pivotally connected to the seat portion (e.g. to the seat frame 103), with the arm rest supports 303 configured such that the orientations of the arm rest supports relative to the seat portion 101 change for at least part of the reclining action of the back portion. This could occur, for example, by the arm rests 305 initially sliding on the arm rest supports and, at a certain point of the rearward movement of the arm rests 305, the arm rests could catch and cause the arm rest supports to pivot rearwardly.

Referring to Figures 31 to 33, in each arm assembly, either the arm rest 305 or the arm rest support 303 comprises a pair of spaced apart guiding members 307a, and the other of the

2012319280 30 Oct 2017

arm rest 305 or arm rest support 303 comprises a pair of complementary elongate slots 309a that receive the guiding members. The guiding members 307a are spaced apart in a direction transverse to the forward and rearward movement direction of the arm rest on the arm rest support. In the form shown in Figure 32, each arm assembly includes a support 303 with a post plate 303a, an optional slide support 306 mounted to the post plate 303a, and a guide structure 307 mounted to the slide support. The guide structure 307 includes the spaced apart guiding members 307a. The arm rest 305 has slide structure 309 that includes the spaced apart slots 309a, an optional slide top plate 310, and an upper body contacting surface 311. Alternatively the guide structure 307 may directly connect to the post plate 303a and/or the upper body contacting surface 311 may directly connect to the slide structure 309. At least part of the guiding members 307a are generally T-shaped in vertical cross-section, with the upright portion 307a' of the T-shape extending between two inwardly-directed base flanges 309a' of the slide structure 309.

Either the arm rest 305 or the arm rest support 303 of each assembly may further comprise a central guide member 307b, and the other of the arm rest 305 or arm rest support 303 may comprise a complementary central elongate slot 309b that receives the central guide member. When the arm rest 305 is slid forward or rearward relative to the support 303, the surfaces of the central guide member 307b bear against the surfaces of the central slot 309b. The tolerances between the central guide member 307b, and the central slot 309b are finer than the tolerances between the T-shaped guide members 307a and their respective slots 309a so that the central guide member 307b, and the central slot 309b prevent side-to-side movement and twisting of the arm rest support. The T-shaped guide members 307a and their respective slots 309a primarily act to prevent the arm rest 305 being lifted off the arm rest support.

As discussed above, the back portion may comprise a resiliently flexible shell 211. Upper body contacting surfaces 311 of the arm rests may be integrally formed by part of the resiliently flexible shell. The resiliently flexible shell 211 preferably comprises a central main back supporting portion 211a, and elongate arm rest portions 211b, one on either side of the central main back supporting portion. Rear ends of the elongate arm rest portions are connected to the central main back supporting portion and forward ends of the elongate arm rest portions form the upper body contacting surfaces 311 of the arm rests. The

2012319280 30 Oct 2017

elongate arm rest portions 211b may be integrally formed with the resiliently flexible back shell 211 or may be separate members that are connected to the back shell 211, for example by clipping an upper portion 211c of the arm rest to the back shell 211.

The arm rest portions could also be tension members, with biasing members such as springs to return the slides to their forward positions.

Preferably, rear portions 211c of the elongate arm rest portions 211b are arcuate when the back portion 201 of the chair is in an upright position (as shown in Figure 29), and are substantially flat when the back portion 201 of the chair is reclined (Figure 30).

By providing the sliding arm rests with part of the arm rests 305 formed by, or connected to, the back portion of the chair 201, the gap that would otherwise open between the back portion 201 and the arm rest 305 is eliminated. Additionally, because the arm rests 305 slide forward and rearward on the arm rest supports 305 with movement of the back portion, the occupant's arm will not slide excessively on the surfaces of the arm rests, reducing wear on the occupant's clothing and on any upholstery on the arm assemblies. Additionally, the flattening of the rear portions of the arm rests 305 upon recline of the back portion follows the natural straightening of the occupant's arms as the occupant reclines the back portion of the chair.

Cushioning surfaces could be provided on or in the arm rests. For example, cushioning could be provided on or under the surfaces 311. The cushioning may be integral with the cushioning of the back portion 201 of the chair.

Figures 33 and 34 also show a first user actuator 321 mounted to the underside of one of the arm rests 305 for use by a chair occupant to actuate the foot or leg support assembly described below. A corresponding second user actuator may be mounted to the underside of the other one of the arm rests 305 for use by a chair occupant to actuate the rock lock assembly described below. The user actuators each comprise a paddle for gripping by an occupant's fingers, which is operatively connected to a respective cable, the cables being operatively connected to the foot or leg support assembly or to the rock lock assembly respectively. For the foot or leg support assembly, when the paddle is released, the foot or leg support assembly is not actuated. The user actuator 321 could be any other suitable

type, such as a lever or button for example. In an alternative configuration, the actuator could activate an electrically driven foot or leg support via a motor.

The arm assemblies could be incorporated into other types of chairs with reclining back portions which may or may not have recline mechanisms to move the seat portions upon movement of the back portion, and which may or may not have rocker mechanisms.

FOOT OR LEG SUPPORT ASSEMBLY

The chair comprises a foot or leg support assembly 501 as described below. The assembly can be used to support an occupant's feet, legs, or both, depending on the configuration of the assembly and the size of the occupant. References to a foot or leg support assembly should be understood to cover any of: a support assembly that is suitable for supporting an occupant's feet, a support assembly that is suitable for supporting an occupant's legs, or a support assembly that is suitable for supporting an occupant's feet and legs.

The foot or leg support assembly 501 is movable between a deployed and extended position shown in Figure 39 for supporting an occupant's feet or legs, and a retracted position shown in Figure 37. Figure 38 shows an intermediate position of the foot or leg support assembly 501 between the deployed and retracted positions. The foot or leg support assembly is mounted to the seat portion 101 of the chair via a mounting bracket 503 so that the foot or leg support assembly moves with the seat portion 101 when the seat is rocked and/or moved during recline of the back portion in embodiments having rocker or recline mechanisms as described above.

The foot or leg support assembly comprises a frame 505, an extension mechanism 509, an actuator 511 and a movable support portion 513 for receiving and supporting an occupant's feet or legs. The frame 505 is pivoted at a first end 505a to the mounting bracket 503 or directly to the seat portion 101 and configured to be pivoted about its first end by the actuator 511 which is preferably a gas spring. In the retracted position, the frame 505 is preferably angled rearwardly so that the angle ω between the mounting bracket 503 and the frame 505 is about 60 degrees. That corresponds to a rearward angle of the frame 505 of about 30 degrees when the chair is upright and in its neutral rock position. As the frame 505 is pivoted outward toward the deployed position, the extension

mechanism 509 is configured to move the moveable support portion 513 in a direction away from the first frame end, increasing the angle ω, to the extended position shown in Figure 39. Preferably in the extended position, the angle ω between the mounting bracket 503 and the frame 505 is about 170 degrees. That corresponds to an angle of about 10 degrees below horizontal when the chair is upright and in its neutral rock position. The footrest extended to a position slightly below horizontal provides a more comfortable seating position than it would if it extended the entire way to horizontal.

As best seen in Figures 37 to 40 and 44 to 46, the gas spring 511 is operably connected at a first end 511a to the mounting bracket 503 via a linkage 520 and pivotally connected at a second end 511b to the frame 505. The foot or leg support may have a single linkage 520 having the components described below. Alternatively, there could be two spaced apart linkages 520, each having the components described below. The linkage 520 comprises three links 521, 523, 525 forming a four-bar linkage with the mounting bracket 503. A first link 521 is pivotally connected to the mounting bracket 503 at a pivot 521a that is co-linear with the frame 505 pivot 505a, a second link 523 is pivotally connected to the mounting bracket 503 at a pivot 523a spaced rearwardly from the first link pivot 521a. A third link 525 is pivotally attached to the first link 521 at a first pivot 525a and to the second link 523 at a second pivot 525b. The gas spring 511 is pivotally attached to the linkage at the pivot 525a between the first and third links 521, 525. A restrictor link 527 (Figure 40) is pivotally attached at one end to the pivot 525b between the second and third links 523, 525 and pivotally attached at its opposite end to the frame 505. The frame 505 is pivotable outwardly about its first end 505a between the retracted position and the deployed position upon extension of the gas spring 511, and pivotable inwardly about its first end 505a between the deployed position and the retracted position upon compression of the gas spring 511. The restrictor link 527 pulls the linkage forward as the frame 505 pivots outwards, moving the pivoted end of the gas spring 511a forward.

The gas spring 511 may be selectively actuated at any frame 505 position via the user actuator 321. When the frame 505 is in the retracted position, actuation of the user actuator enables the foot or leg support assembly 501 to move from the retracted position to the deployed position.

2012319280 30 Oct 2017

The gas spring 511 is selectively released by an occupant using a user actuator 321 which is coupled to a gas spring release by a cable. Figures 37 and 39 show the frame 505 in the retracted and extended positions with the user actuator 321 released so there is no movement of the frame 505 relative to the seating portion. The frame can be stopped and positioned at any intermediate position between the transition position and the deployed position by an occupant releasing the user actuator 321.

To retract the foot or leg support assembly 501 from any position, a chair occupant must actuate the user actuator 321 and apply an inward force to the foot or leg support member, for example with their legs or feet. The linkage 520 controls the position of the first end 511a of the gas spring 511 so that the position of the first end 511a is a function of the position of the frame 505. Moving the position of the first end 511a of the gas spring 511 changes the ratio between the required gas spring extension or retraction to angularly displace the frame 505 a given amount.

Figure 43 shows the displacement of the gas spring 511 against the angular displacement of the frame 505. When the frame is substantially vertical (at 30 degrees forward of the fully retracted position), the magnitude of the gas spring 511 extension required to pivot the frame 505 outwards 5 degrees is less than the spring extension required to pivot the frame 505 outwards 5 degrees when the frame is 60 degrees forward of the retracted position, for example. This means that, when the foot or leg support 501 is being deployed, the user experiences a rising force rate as the foot or leg support rotates outwards, to assist the user in lifting their legs. The converse is also true. When the frame is substantially vertical, the amount the gas spring 511 must be compressed to pivot the frame 505 inwards 5 degrees is less than the amount the gas spring 511 must be compressed to pivot the frame 505 inwards 5 degrees when the frame is 60 degrees forward of the retracted position, for example. This means that as the foot or leg support assembly is moved back to the retracted position, the user needs to apply less force the closer the footrest is to the retracted position.

The moveable foot or leg support member 513 of the foot or leg support assembly 501 is arranged to slide relative to the frame 505 such that the foot or leg support assembly 501 is extendable from an initial length L1 to an extended length L2. The extension mechanism 509 is configured to slide the moveable support member in a direction away from the first frame end 505a, to an extended position as the frame is moved from the retracted position to the deployed position by the gas spring 511. This sliding of the support member causes the support member to follow an arc similar to the arc through which an occupant's lower legs or feet move as the occupant moves them outward. This results in less 'trouser pull' which is the result of relative movement between a support portion and an occupant's legs or feet as a foot or leg support is deployed.

Referring to Figures 40 to 42, the extension mechanism 509 comprises two drag links 531, a support portion frame 533 that forms part of the movable support member 513, and a linkage arrangement operatively connected between the drag links 531and the support portion frame 533. The drag links 531 are pivotable about respective first pivots 531a spaced below and rearward of the frame pivot 505a, and each have an end 531b that is slidable relative to the frame 505. The linkage arrangement further comprises two driving links 535 pivoted to the frame 505 at a fixed pivot 537 spaced from the first frame end 505a (and preferably at or towards the opposite end of the frame 505 as shown), two drag connecting links 539 each having a first end 539a pivotally connected to a respective driving link 535 and a second end 539b that is pivotable relative to the slidable end 531b of a respective drag link 531 and arranged to slide relative to the frame 505 with the slidable end of the respective drag link 531, and a scissor linkage. The scissor linkage comprises two support connector links 543 each pivotally connected to the movable support portion frame 533, and two main links 541. The main links 541 each comprise a first end 541a pivoted to a respective driving link 535 and a second end 541b pivoted to a respective support connector link 543. The two main links 541 are pivotally connected to each other at a pivot 542 intermediate their first and second ends 541a, 541b. The pivot 542 is movable relative to both the frame 505 and the support portion 513.

In a preferred embodiment, the slidable end 531b of each drag link 531 is pivotally connected to a sliding block 545. Slots 544 are positioned on opposite sides of the centre of the frame 505, and the sliding blocks 545 are each configured to slide longitudinally in a

respective slot 544. The second end 539b of each frame connector link 539 is pivotally connected to a respective sliding block 545 about a pivot that is transverse to the pivots between the drag links 531 and sliding blocks 545, such that each pivot slides relative to the frame 505 with the slidable end of the respective drag link 531 and sliding block 545.

Figure 41 shows the foot or leg support assembly 501 and extension mechanism 509 in an unextended position. This position corresponds to a substantially vertical frame position when the chair is in an upright and neutral rock position. When the frame 505 is pivoted by the gas spring 511 from the position shown in Figure 37 toward the deployed position shown in Figure 39, the slidable ends 531b of the drag links 531 move toward the first end of the frame 505a and the support portion frame 533 moves toward the extended position, as shown in Figure 42.

In the embodiment shown in Figures 40 to 42 the moveable support member 513 is slidably mounted to the frame 505. In the form shown, the support member 513 is mounted to the frame 505 via a slide assembly 551. The slide assembly comprises a first part 551a fixed to the frame 505, a second part 551b fixed to the support member 513, and a floating part 551c slidably attached to both the first and second parts 551a, 551b. In an alternative embodiment, the foot or leg support assembly may comprise two slidable extension members, slidably attached to the frame, with the movable support portion 513 slidably mounted to the extension members. The extension members could be slidable via slots in the frame sides, and guide features on the extension members, or via slots or channels on the extension members and corresponding guide features on the frame 505, for example. In such an embodiment, the slidable extension members would be pulled outwardly along to the frame 505 as the moveable support member 513 is moved to the extended position. The support member 513 or support member frame 533 may have features on its underside to catch the extension members to slide them outward as the support member 513 is extended, allowing the support member 513 to be supported beyond the end of the frame 505 in the extended position. Springs acting between the frame 505 and the extension members may be used to retract the slides as the support member 513 retracts.

2012319280 30 Oct 2017

The single user actuator 321 controls all of the outward pivoting of the frame 505, inward pivoting of the frame 505, and extension and retraction of the support member 513 relative to the frame 505.

Other than the drag links 531, the components of the extension mechanism 509 all move in a plane substantially corresponding to that of the frame 505. That configuration enables a low profile support assembly to be provided. The sliding of the support member 513 as the frame 505 is pivoted outwardly and inwardly means that the support member 513 can stay in an approximately fixed position relative to an occupant's feet or legs, improving comfort and reducing wear on clothing.

The above describes only one preferred form extension mechanism 509. Alternative linkage arrangements may be used to push or pull the movable support member 513 relative to the frame 505 as the frame 505 is pivoted inwards or outwards. In an alternative embodiment, the actuator 511 could be provided in a foot or leg support assembly that doesn't have an extension mechanism. In another alternative embodiment, rather than a gas spring, an alternative actuator, for example a powered actuator, could be used to deploy and retract the foot or leg support assembly 501.

The foot or leg support assembly could be incorporated into other types of chairs that may or may not have recline mechanisms or rocking mechanisms. In embodiments that do not have rocking mechanisms, the frame 505 may instead be pivotally mounted to a main transom rather than to the seat portion.

Because the foot or leg support member 513 of the preferred embodiment can retract to a rearwardly angled position beneath the seat portion of a chair, an occupant can more easily egress the chair than would be the case if the foot or leg support only retracted to a vertical position. An occupant can place their feet flat on the ground partly beneath the seat portion to stand up. In an alternative embodiment, the foot or leg support may comprise a switch and gas spring arrangement that avoids the need of the occupant applying rearward force to fully retract the support member past the vertical position.

2012319280 30 Oct 2017

Figures 44 to 46 show an arrangement 533, 535 coupling the movement of the foot of leg support assembly 501 to a rocking inhibitor arrangement to prevent forward rocking of the chair when the foot or leg support is deployed. This arrangement is discussed further below in relation to the rocking inhibitor.

ROCKING INHIBITOR

Referring to Figures 47 to 57, the chair comprises a rocking inhibitor arrangement 801 to inhibit forward rocking of the intermediate support 21 relative to the main transom 15 when the foot or leg support assembly 501 is extended and to selectively lock forward and rear rocking of the intermediate support 21 independent of the position of the foot or leg support assembly 501. The rocking inhibitor arrangement 801 comprises a mounting member 827 for mounting to the transom 15, an optional anti-rock ratchet assembly 803, a rock lock assembly 805, and a slide assembly 806 connected to the intermediate support 21 and comprising a slide member 811 slidably mounted to the main transom.

Referring to Figures 50 and 51, the anti-rock ratchet assembly 803 comprises a carriage 809 transversely slidable relative to the mounting member 827, a ratchet pawl 807 carried by the carriage 809 and slidable relative to the carriage 809 and transversely slidable relative to the mounting member 827 and slide member 811. A series of ratchet teeth 813 are formed on the slidable member 811 of the slide assembly 806, for engaging with teeth on the ratchet pawl 807. The ratchet pawl 807 is slidable transversely relative to the slidable member 811 between an outward disengaged position and an engaged position. The anti-rock ratchet assembly 803 is configured to automatically engage to inhibit forward rocking of the intermediate support 21 when the foot or leg support assembly 501 is extended, and to automatically disengage to allow forward rocking of the intermediate support when the foot or leg support assembly is retracted.

The central slide member 811 of the slide assembly 806 is slidably mounted to the mounting member 827 via a guide channel 829 in the mounting member. Guide features 831 in the form of inwardly protruding tabs retain the slide member 811 in the channel 829. A connecting member 833 is attached to the central slide member 811 and connected to the intermediate support 21 which rocks relative to the transom and mounting member 827 as the chair is rocked. The connecting member 833 may be integral with the central

2012319280 30 Oct 2017

slide member 811, or alternatively, the central slide member 811 may be directly connected to the intermediate support 21, such as via a pivot connection.

The anti-rock ratchet assembly 803 comprises an actuation assembly 810, shown in exploded form in Figure 51, operatively connected to the foot or leg support 501. The actuation assembly 803 comprises a first actuation link 815 having a first end 815a pivotally connected to the mounting member 827 at pivot 827a towards one side of the mounting member 827, and a second actuation link 817 having a first end 817a pivotally connected to the carriage 809 at a pivot 809a towards the opposite side of the mounting member 827. A second end 815b of the first link 815 is pivotally attached to the second end 817b of the second actuation link 817 at a central pivot 819. A biasing member 821 in the form of a torsion spring is positioned between the mounting member 827 and the pivot 809a between the carriage 809 and second actuation link 817 to bias the first end 817a of the actuation link outwards and the carriage 809 and pawl 807 inwards towards the slide member 811 and therefore the pawl 807 into engagement with the ratchet teeth 813.

A cable 823 is operatively connected to the actuation links 815, 817 at the central pivot 819. As shown in Figures 52A, pulling the cable pulls the central pivot 819 forward, moving the first end 817a of second actuation link 817 inwards and the carriage 809 and ratchet pawl 807 outwards and out of engagement with the ratchet teeth 813. As shown in Figure 52B, releasing the cable tension reverses this action, allowing the first end 817a of second actuation link 817 to move outwards under the bias of biasing member 821 and the carriage 809 and ratchet pawl 807 to move inwards, and back into engagement with the ratchet teeth 813. The cable 823 is operatively attached to the foot or leg support 501.

Figure 52A shows the actuation assembly 810 in a first, disengaged mode of the anti-rock ratchet assembly 803 in which the foot or leg support assembly 501 is retracted and the chair is free to rock. In the first mode, the anti-rock ratchet pawl 807 is in its disengaged position. The retracted foot or leg support 501 tensions the cable, pulling the actuator into the disengaged position shown. The slide assembly 806 is free to move with the seat portion of the chair as it rocks.

2012319280 30 Oct 2017

Figure 52B shows the actuation assembly 810 in a second, engaged mode of the anti-rock ratchet assembly 803 in which the foot or leg support assembly has been at least partially deployed. As the foot or leg support is moved outward from its retracted position, a member that is operatively connected to the foot or leg support acts on the cable 823. That reduces the tension in the cables 823, so that the first biasing spring 821 causes the carriage 809 to move inwards, allowing the actuation arrangement 810 to move into the second, engaged mode shown. Preferably, the actuator arrangement 810 is moved into the second mode when the foot or leg support 501 reaches an approximately vertical position or is moved slightly forward of vertical, and teeth on the ratchet pawl 807, are biased into engagement with teeth 813 on the slide member 811.

As can be seen from Figures 50 and 51, a second biasing member 808 in the form of a compression spring is positioned between the pawl 807 and the carriage 809 and biases the ratchet pawl 807 inwards relative to the carriage 809, towards the slidable member 811 and teeth 813. When the carriage 809 is in the engaged position of the second mode, the ratchet pawl 807 is biased into engagement with the ratchet teeth 813. When the anti-rock ratchet assembly is configured to the second mode, if the teeth of the ratchet pawl 807 and the teeth 813 of the slide member 811 and misaligned as shown in Figure 53A, the ratchet pawl is not forced into engagement but is biased towards the teeth by biasing member 808. The ratchet pawl 807 will then move to engage the teeth 813 of the slide member 811 upon slight forward or rearward sliding of the slide member 811 aligning the teeth as shown in Figures 53B and C. In the second mode, the ratchet pawl 807 can slide outwards relative to the carriage to allow the slide assembly 806 to slide only rearward relative to the transom. Forward rocking of the chair while the foot or leg support 501 is forward of the seat is disabled, preventing the chair from tipping forward due to the weight of the foot or leg support, but still allowing the seat to be rocked rearwardly.

When the foot or leg support is being retracted, the actuator arrangement and anti-rock ratchet assembly 803 is returned to the first mode when the foot or leg support 501 is moved to slightly forward of vertical or a vertical position as it is being retracted.

Referring to Figures 44 to 46, the anti-rock ratchet actuating cable 823 is operatively connected to the foot or leg support assembly 501 by a cable connector arrangement. The

2012319280 30 Oct 2017

cable connector arrangement comprises a moulded housing 535 fixed to the mounting bracket 503 or an underside of the seat portion and a cable connector 533 fixed to the second link 523 of the linkage 520 supporting the gas spring 511. The housing 535 contains a channel, slot or cavity 537 with an aperture at its rearmost end. An end 823a of the cable 823 extends through the aperture and is free to slide in the channel, slot or cavity 537 as the foot or leg support frame 505 pivots. A cable connector 533 attaches the sheath of the anti-rock ratchet cable 823 to the second link 523 of the linkage 520. When the foot or leg support 501 is in an extended position as shown in Figure 46, the second link 523 and therefore the cable connector 533 is close to the moulded housing 535 allowing the cable end 823a to slide forward in the housing 535, such that no tension is being applied to the cable 823 and therefore, the anti-rock ratchet assembly is biased into its locked position.

When the foot or leg support 501 is retracted, the second link 523 and therefore the cable connector 533, is moved away from the moulded housing 535. That pulls the cable end 823a rearward in the housing 535. When the foot or leg support 501 reaches a vertical orientation, as shown in Figure 45, the end of the cable 823a is positioned at the rearmost position in the channel, slot or cavity 537.

As the foot or leg support 501 is retracted further, towards the position shown in Figure 44, the second link 523 and therefore the cable connector 533 continues to be moved away from the moulded housing 535. An enlarged portion or pin on the end of the cable end 823a prevents the cable from being pulled through the aperture and out of the housing 535, instead tensioning the cable 823, pulling the central pivot 819 in the anti-rock ratchet assembly forward to unlock the forward rock. The foot or leg support assembly maintains the anti-rock ratchet assembly 501 in this unlocked configuration as long as it is retracted behind the generally vertical orientation (when the chair is upright).

The rock lock assembly 805 is shown in exploded form in Figure 54. The rock lock 805 comprises a detent assembly 846 which is operatively connected to and actuates a locking assembly 848. The locking assembly comprises a lock carriage 845 transversely slidable in a channel 830 in the mounting member 827, a lock member 841 carried by the lock carriage 845 and which is slidable relative to the lock carriage 845, and the slide member 811. One

2012319280 30 Oct 2017

side of the slide member 811 comprises square lock teeth 840. The lock member 841 comprises complementary square lock teeth 841a that are engageable with the slide member square lock teeth 840 to prevent forward and rearward sliding of the slide member 811 and rocking of the chair. Alternatively, the teeth 840, 841a could be different shapes.

In the locking assembly, 848, a lock biasing member 843 is positioned between the lock carriage 845 and the lock member 841, biasing the lock member 841 towards the slide member 811. The lock carriage 845 is biased outwards, away from the slide member 811 by a carriage biasing member 847 positioned between a projection on the lock carriage 845 and a projection on the mounting member 827.

The detent assembly 846 comprises a detent pawl 851 pivotally mounted on the mounting member 827, a slidable pin carrier 855 slidably mounted on the mounting member 827, and a detent pin 857 protruding downwardly from the pin carrier. A biasing member comprising a spring 861 is positioned between the pin carrier 855 and a protrusion 862 on the mounting member 827 to bias the pin carrier rearwardly. A cable 863 is operatively connected to a front end of the pin carrier 855 and to a paddle (not shown) or lever for actuation by a user to lock and unlock the rocking of the chair.

The detent pawl 851 is shown in Figures 55A and B. The detent pawl 851 is pivotally attached to the mounting member 827 through an aperture 849 in the mounting member about an off-centre pivot 852. A heart-shaped groove 853a on the top surface of the pawl 851 receives the detent pin 857. The groove 853a has a central projection 853b and a stepped surface to guide the pin 857 in the groove 853a. A resilient member 859 (Figure 54) movably connects the detent pin 857 to the pin carrier 855 to enable some up and down movement of the pin 857, biasing the pin downwardly towards the surface of the groove so that the pin contacts the stepped surface of the groove 853a at every position in the groove 853a. The off-centre pivot 852 of the pawl 851 enables the pawl to pivot towards the left or right in response to movement of the pin carrier 855 and pin 857 in the groove 853a.

An underside of the pin carrier 855 comprises a cam 856. The lock carriage 845 of the locking assembly comprises a camming surface 845a with two parallel end portions and a

2012319280 30 Oct 2017

rearwardly inwardly angled intermediate portion (Figure 56A). The cam 856 contacts the camming surface 845a to operate the lock.

Operation of the lock assembly will now be described with reference to Figures 56A to 56G. In a first stage shown in Figure 56A, the rock lock is released and the seat portion is free to rock. In this configuration, the user has released the actuation paddle and the pin carrier 855 and pin is biased rearwardly by spring 861 to a first stop position in the detent pawl 851. The cam 856 on the underside of the pin carrier 855 is therefore also in its rearmost position. The lock carriage 845 and camming surface 845a are biased outwardly by spring 847, into contact with the cam 856. The extent of the outward movement of the lock carriage 845 is limited by the position of the cam 856. In this stage, the cam is in its rearmost position to allow maximum outward movement of the lock carriage 845 and lock member 841, so that the teeth 840, 841a on the slide member and lock member 811, 841 are disengaged.

In a second stage shown in Figure 56B the user is actuating the actuation paddle or lever to lock the chair rock. This tensions the cable 863 and pulls the pin carrier 855, pin 857, and cam 856 forward to their forward-most position. The movement of the cam 856 along the lock carriage camming surface 845a pushes the lock carriage 845 and lock member 841 inwards. In the configuration shown, the user has actuated the lock assembly when the teeth 840 on the central slide 811 and the teeth 841a on the lock member 841 are misaligned. This means that when the lock carriage 845 is moved inwards, the lock member 841 moves outwards relative to the lock carriage 845, compressing biasing member 843, to delay locking until the slide member 811 is moved to align the teeth.

Figure 56C shows a third stage where the user has released the actuation paddle or lever, releasing tension in the cable 863. The spring 861 causes the pin carriage 855 to again move rearwardly, and the pin 857 to move rearwardly in the detented groove 853a. The stepped, angled surfaces within the groove 853a prevent the pin from returning to the first stop position of stage one, and instead direct the pin 857 to a second stop position between the pin positions of stages one and two, as shown. The cam 856 moves rearwardly with the pin carriage 855 but remains forward of the angled portion of the camming surface 845a and holds the lock carriage 845 in the position of stage two.

2012319280 30 Oct 2017

The fourth stage shown in Figure 56D corresponds to the third stage where the actuation paddle is released, but the seat has been rocked slightly forward from its position in Figures 56B and C. The forward rocking slides the slide member teeth 840 to a position where they are aligned with the teeth 841a on the lock member 841. The lock member 841 biased inwardly on the lock carrier 845 by spring 843, is then forced into engagement with the slide member teeth 840 to lock forward and rearward rock of the chair relative to the transom.

Figure 56E shows a fifth stage where the user is actuating the actuation paddle or lever to release the lock. The cable 863 is tensioned pulling the pin carriage 855, pin 857, and cam 856 forward to their forward most position. The pin 857 travels forward in the detent pawl groove 853a, but to a different side of the pawl than in stage two. The movement of the cam 856 forward along the lock carriage camming surface 845a retains the lock carriage 845 and lock member 841 in their engaged positions.

In a sixth stage, shown in Figure 56F, the user has once again released the actuation paddle or lever, releasing tension in the cable 863. The spring 861 causes the pin carriage 855 to again move rearwardly, causing the pin 857 to move rearwardly in the detented groove 853a. The stepped, angled surfaces within the groove 853a direct the pin 857 back to the first stop position of the first stage. The cam 856 moves rearward with the pin carrier 855. Friction between the lock member teeth 841a and the slide member teeth 840 may prevent the lock member 841 and carriage 845 sliding outwards, out of engagement, meaning the camming surface 845a is no longer in contact with cam 856, as shown, delaying unlocking of the rock.

Figure 56G shows a final stage, corresponding to the sixth stage of Figure 56F but where the pressure on the seat portion has been shifted, releasing the frictional forces between the lock member teeth 841a and the slide member teeth 840. This allows the lock 841 and lock carriage 845 to move out of engagement with the slide member 811, into the configuration of the first stage so that the chair is free to rock relative to the transom.

2012319280 30 Oct 2017

The lock assembly 805 enables a user to selectively lock forward and rearward rocking of the intermediate support 21, independent of the position of the foot or leg support assembly 501. A first 'click' of the actuation paddle or lever moves the assembly to a locking configuration (stages three and four) and a second 'click' moves the lock assembly to a release configuration (stages one, six and seven).

In the embodiment shown, the slide member 811 forms part of both the anti-rock ratchet assembly 803 and the lock assembly 805. Angled teeth 813 are provided on one side of the slide member to interact with the ratchet pawl 807, and square teeth 840 are provided on the opposite side of the slide member 811 to interact with the lock member 841. Alternatively, separate slidable members could be provided for each of the anti-rock ratchet assembly 803 and the lock assembly 805. Alternative embodiments of the chair may comprise only one of the anti-rock ratchet assembly 803 or the lock assembly 805. Embodiments of the chair having no foot or leg support would not include the anti-rock ratchet assembly.

Preferably, the components in the rocking inhibitor arrangement 801 are designed to be thin so that the arrangement is compact for packaging under the seat. Figure 57 shows the mounting member 827 carrying the rocking inhibitor arrangement 801 positioned in the transom 15. Alternatively, the rocking inhibitor arrangement 801 may be arranged in a vertical plane.

FIRST PREFERRED FORM SUPPORT ASSEMBLY

The chair may comprise a head or neck support assembly 401 as described below. The assembly can be used to support an occupant's head, neck, or both, depending on the configuration of the assembly and the size of the occupant. References to a head or neck support assembly should be understood to cover any of: a support assembly that is suitable for supporting an occupant's head, a support assembly that is suitable for supporting an occupant's neck, or a support assembly that is suitable for supporting an occupant's head and neck.

Referring to Figures 58 to 77, the head or neck rest assembly 401 comprises a base 403 (only shown in some views, for clarity) for mounting the assembly 401 to the chair. In the

2012319280 30 Oct 2017

form shown, the base 403 is a mounting plate, with a lower part 403a of the plate being connected to the spine 209 at the upper end 203 thereof. The base 403 could alternatively be any suitable shape to provide a desired aesthetic. The connection of the lower part 403a of the plate to the spine 209 can be any suitable type, such as a fastener(s) or clip(s) for example. The connection of the plate to the spine may be permanent or may be reversible, so a user can reconfigure the chair with or without the support assembly. Alternatively, the base 403 may be integral with the spine 209. The remainder of the support assembly is mounted to the upper part of the plate.

The upper part 403b of the plate has two forwardly-directed spigots 405a, 405b. A first member 407a is rotatably connected to the base by being rotatably mounted on the first spigot 407a. A second member 407b is rotatably connected to the base by being rotatably mounted on the second spigot 407b. The first axis 405a'of the first member 407a on the first spigot 405a is substantially parallel to the second axis 405b' of the second member 407b on the second spigot 405b.

The first and second members 407a, 407b are preferably operatively coupled by gear surfaces 407a', 407b' (Figures 61A to 62B) such that as the first member 407a is rotated in one direction relative to the base 403, the second member 407b rotates a corresponding amount in an opposite direction relative to the base. It will be appreciated from the geometry and arrangement of components that the first and second members 407a, 407b can only be rotated by substantially less than 360 degrees.

The first member 407a carries a first linkage arrangement 409a comprising a first pair of generally parallel arms 411a, 413a that have first ends that are pivotally connected to the first member about axes 411a', 413a' that are substantially perpendicular to the first axis 405a'. The second member 407b carries a second linkage arrangement 409b comprising a second pair of generally parallel arms 411b, 413b that have first ends that are pivotally connected to the second member about axes 411b', 413b' that are substantially perpendicular to the second axis 405b'. As first and second members 407a, 407b are rotated relative to the base about axes 405a', 405b', the first and second linkage arrangements pivot with the first and second members. This movement is controlled by the gearing at 407a', 407b', to control movement of the head or neck support as the first

2012319280 30 Oct 2017

and second members 407a, 407b are rotated relative to the base. In the form shown, the arms 411a, 413a on the first base member 407a and the arms 411b, 413b on the second base member 407b extend outwardly away from each other. Alternatively the two sets of arms 411a, 413a and 411b, 413b could extend in the same direction, so that the arm 411a is substantially parallel to arm 411b, and so that the arm 413a is substantially parallel to the arm 413b.

Arms 413a, 413b act as protective covers over the parallel arms 411a, 411b. Alternatively separate protective covers could cover the first and second pairs of parallel arms. The arms 411a, 411b will typically be identical to each other, but could differ. It will be appreciated from reviewing the figures that the arms 411a, 413a, and 411b, 4113b need not be truly parallel, and can instead be any suitable shape that provides a four bar linkage of the type shown with substantially parallel pivot axes on members 407a, 407b and on support mounting links 415a, 415b described below. Indeed, in the form shown, arms 411a and 413a, and arms 411b, 413b are different shapes, with arms 413a, 413b at least partly encapsulating arms 411a, 411b within recesses in the arms. In the form shown, the arms 413a, 413b are each two-part members comprising two halves, with connectors 412a, 412b joining the two halves together to partly encapsulate the respective parallel arm 411a, 411b. By using generally parallel arms, the head or neck support 417 will stay substantially parallel to the base 403, rather than possibly becoming skewed during adjustment.

A head or neck support 417 is operatively supported by the second ends of the generally parallel arms 411a, 413a, 411b, 413b of the first and second linkage arrangements. In the form shown, the second ends of the first pair of generally parallel arms 411a, 413a are pivotally connected to a first support link 415a about axes 411a", 413a" that are substantially parallel to the pivot axes 411a', 413a' between the parallel arms 411a, 413a and the first member 407a. The second ends of the second pair of generally parallel arms 411b, 413b are pivotally connected to a second support link 415b about axes 411b", 413b" that are substantially parallel to the pivot axes 411b', 413b' between the parallel arms 411b, 413b and the second member 407b. The first and second support links 415a, 415b are pivotable relative to the head or neck support 417, with the pivot axes 415a', 415b' of the first and second support links 415a, 415b relative to the support 417 being substantially

2012319280 30 Oct 2017

parallel to the pivot axes 405a', 405b' of the first and second members 407a, 407b relative to the base.

The second ends of the first pair of generally parallel arms 411a, 413a are moveable toward and away from the second ends of the second pair of generally parallel arms 411b, 413b (in a widthwise direction of the chair), upon movement of the head or neck support 417 relative to the base 403. The movement toward and away from each other of the second ends of the first and second pairs of generally parallel arms, causes a corresponding movement toward and away from each other of the first and second support links 415a, 415b.

The head or neck support 417 comprises a housing having a front part 417a and a back part 417b. The housing 417 houses a unlock plate 419 containing a first toothed rack 421a that is coupled to the first support link 415a, a second toothed rack 421b that is coupled to the second support link 415b, and a pinion gear 423 that is rotatably mounted to unlock plate 419 and engaged with the first and second toothed racks 421a, 421b, wherein movement of the first and second support links 415a, 415b toward and away from one another moves the toothed racks 421a, 421b, with the racks and pinion gear linking the movement of the first and second support links 415a, 415b and thereby movement of the second ends of the first and second generally parallel arms. This arrangement also prevents the head or neck support 417 from moving to an off-centred position to one side relative to the base 403.

The head or neck rest assembly also comprises a locking mechanism 431a, 431b to selectively inhibit movement of the first and second support links 415a, 415b, the first and second linkage arrangements 409a, 409b, and indirectly, the first and second members 407a, 407b, to thereby maintain the head or neck support 417 in a desired adjusted position. As shown in Figures 64 to 71 and 75 to 77, the locking mechanism 431a, 431b comprises at least one locking member 433a that selectively inhibits pivoting of the first pair of generally parallel arms 411a, 413a relative to the first support link 415a and thereby inhibits pivoting of the first pair of generally parallel arms relative to first member 407a, and that selectively inhibits rotation of the first support link 415a and thereby inhibits rotation of first member 407a relative to the base 403. Preferably, the locking mechanism also comprises a second locking member 433b that selectively inhibits pivoting of the

2012319280 30 Oct 2017

second pair of generally parallel arms 411b, 413b relative to the second support link 415b and thereby inhibits pivoting of the second pair of generally parallel arms relative to the second member 407b, and that selectively inhibits rotation of the second support link 415b and thereby inhibits rotation of the second member 407b relative to the base 403. However, in an alternative embodiment, a single locking member could be provided to lock movement on one side of the head or neck support assembly. As a result of the linking of movement of members 415a and 415b, and the interactions of the racks 421a, 421b and pinion gear 423, locking movement on one side of the assembly would lock movement of the assembly overall.

Member 417b comprises a rear plate 451 made of stainless steel for example and comprising two spaced apart transversely extending elongate slots 451a, 451b within which first and second support links 415a, 415b are slidably mounted.

With reference to the right hand side of the head or neck support assembly, the first locking member 433b is carried by the first support link 415b and is engageable with one of the first pair of generally parallel arms 411b, 413b to inhibit pivoting of the first pair of generally parallel arms relative to the first support link 415b and thereby inhibit pivoting of the first pair of generally parallel 411b, 413b arms relative to the first member 407b. An engagement surface 435b (Figures 65 to 70C) is provided on one of the first pair of generally parallel arms, and in form shown is provided on arm 413b. The locking member 433b comprises a complementary engagement surface 437b for engaging with the engagement surface 435b. The engagement surface 435b is an arcuate gear surface with a plurality of teeth, and the engagement surface 437b has complementary teeth to engage with the teeth of the arcuate gear surface. The teeth on the gear surface 435b are concentric with the pivot 413b" of the arm 413b to the first support link 415b. The pivot axis 413b" passes through the shank of the locking member 433b which extends through the first support link 415b.

The first locking member 433b is engageable with the first toothed rack 421b to inhibit pivoting of the first support link 415b relative to the first toothed rack 421b about axis 415b', thereby inhibiting pivoting of the first member 407a relative to the base 403. The first toothed rack 421b comprises a body 439b having an aperture 441b and an engagement surface 443b, and the locking member 433b extends through the aperture 441b in the body

2012319280 30 Oct 2017

of the toothed rack and through an aperture 416b in the first support link 415b. The cross-section of the aperture 416b in the first support link 415b is non-circular, as is the cross-section of the shank of the locking member, so that the locking member 433b is moveable only axially relative to the first support link 415b along axis 415b' but is rotatable relative to the toothed rack 421b in aperture 441b as the link 415b rotates relative to the rack. The locking member has a complementary engagement surface 445b for engaging with the engagement surface 443b on the toothed rack to inhibit pivoting therebetween. Preferably, the engagement surface on the toothed rack comprises an arcuate or semi-arcuate gear surface surrounding the aperture 441b, and the locking member has a head with a complementary gear feature on its underside.

Figure 73 shows how the rack 421b, the second support link 415b and the pinion 423 are assembled in the rear portion of the housing 417b. The support link 415b has a rearwardly projecting spigot 477 with a groove. The rack 421b comprises a removable portion 473b that can be removed to insert the spigot 477 into the aperture 441b in the rack 421b so that the rack holds the support link 415b at its grooved part preventing the support link 415b from moving normal to the rack 421b. The removable portion is then held in place by way of a snap fit. Alternatively the removable portion could be held in place by a key, for example as in the embodiment shown in Figures 78 to 82. Figure 73 also shows an additional plate 460 that is a finger trap guard that covers the slot 420b. Two such plates will be provided.

The locking members 433a, 433b are configured such that when moving the locking member 433b from an unlocked position as shown in Figure 66, to a locked position as shown in Figure 68, the locking member initially inhibits pivoting of the first pair of generally parallel arms 411a, 411b relative to the first member 407b and then inhibits pivoting of the first member 407b relative to the base 403. The locking member 433b comprises a first locking member portion 433b' for inhibiting pivoting of the first pair of generally parallel arms relative to the first member and which carries the engagement surface 437b, a second locking member portion 433b" for inhibiting pivoting of the first member relative to the base and which carries the engagement surface 445b, and a biasing device 433d between the first locking member portion and the second locking member portion to bias the first locking member portion 433b' away from the second locking

member portion 433b". The biasing device can be any suitable type, such as an elastomeric block or a compression spring for example. As shown in Figure 67, axial movement of the locking member 433b initially causes the engagement surface 437b to engage with engagement surface 435b. Engagement surfaces 443b, 445b are still disengaged. As shown in Figure 68, further axial movement of the locking member 433b causes engagement surfaces 443b, 445b to engage. This arrangement prevents fouling of one of the sets of teeth, which could otherwise occur and prevent the locking mechanism from working.

In embodiments having two locking members 433a, 433b, the features and functioning of the left locking member 433a and interaction of the left locking member 433a with other components is the same as described above for the right locking member 433b. Like reference numerals indicate like parts, with suffix 'a' rather than 'b'.

The locking members 433a, 433b are slidably mounted in slots 419a, 419b in unlock plate 419 such that the first and second support links 415a, 415b can move toward and away from one another. The heads of the locking members 433a, 433b are configured with recesses that interact with the unlock plate, so that the heads of the locking members can only move relative to unlock plate 419 toward and away from each other or rotate relative to the rack 421, and not in any other direction.

As shown in Figure 77, the unlock plate 419 is operatively connected to at least one actuation lever 469a, 469b, 469a', 469b' each connected at one end to a paddle 461a, 461b for actuating by a user. Unlock plate 419 has grooves at or toward opposite ends thereof for pivotally receiving the ends of the levers 469a, 469b, 469a', 469b'. In one embodiment, a single actuation lever 469a could be provided on each side; however, it is preferred that two levers are provided. The levers comprise pivot pins 455a, 455b that are received in respective grooves 462a', 462b' in pivot supports 462a, 462b (Figure 75), to connect the levers to the member 451. The pivot supports 462a, 462b attach to the inner surface of the front housing portion 417a and the grooves 462a', 462b' provide a fulcrum for the levers to pivot about. The levers 469a and 469a' could be one and the same part as the paddle 461a, or separate and coupled to the paddle; with the same configuration on the other side.

2012319280 30 Oct 2017

The outer parts of the levers are attached to paddles 461a, 461b for use by a chair occupant to release the locking mechanism to enable the head or neck support to be moved to a desired position. The levers 469a, 469b, 469a', 469b' are normally biased forward, which corresponds to the unlock plate 419 and the locking members 433a, 433b being biased rearwardly so the head or neck support is locked in position. The biasing could be provided by any suitable biasing device such as one or more springs acting on the levers or the unlock plate for example. Preferably, the biasing device biases the levers 461a, 461b and thereby the unlock plate 419 into a position in which the locking members are engaged to inhibit movement of the head or neck support.

The front portion of the housing 417a comprises two movable portions 418a, 418b positioned on either side of the front portion of the housing 417a, in front of the paddles 461a, 461b. The movable portions of the housing are hinged at respective resilient hinges 418c, 418d. Actuation of the actuation levers 469a, 469b, 469a', 469b' by pushing both movable housing portions 418a, 418b and thereby both paddles 461a, 461b rearwardly relative to the rear housing member 417b moves unlock plate 419 and disengages the locking members 433a, 433b to enable the position of the head or neck support 417 to be adjusted. Rearward pressure must be applied to both movable portions 418a, 418b to adjust the head or neck support 417. This prevents inadvertent disengaging of the locking members 433a, 433b if a user leans their head against one of the movable portions.

Figures 78 to 82 show an alternative embodiment mechanism of the head or neck support 401. Unless described below, the features and functioning should be considered to be the same as described above. This embodiment comprises an alternative actuation arrangement with paddles 481a, 481b that are actuated by pushing the paddles forward from the rear. The embodiment comprises an unlock plate 485 with a pair of slots 485c, 485d and attached pins 485a, 485b. Actuation levers 483a, 483b, 483a', 483b' connected to paddles 481a, 481b comprise respective slots 484a, 484b, 484a', 484b' that receive the pins 485a, 485b.

Inner ends of the actuation levers 483a, 483b, 483a', 483b'are geared to each other at 487 and 487' respectively, so that movement of one lever will also cause movement of the other lever to which it is geared.

2012319280 30 Oct 2017

The paddles project from a rear surface of the head or neck support housing 491 adjacent respective sides thereof through openings 491a, 491b. The levers 483a, 483b, 483a', 483b' are normally biased rearwardly, which corresponds to the unlock plate 485 and the locking members 433a, 433b being biased rearwardly so the head or neck support is locked in position. Actuation of the actuation levers 483a, 483b, 483a', 483b' by pushing or pulling the paddles 481a, 481b forward relative to the head or neck support moves the unlock plate 485 and disengages the locking members 433a, 433b to enable the position of the head or neck support 417 to be adjusted. Because the actuation levers 483a, 483b, 483a', 483b' are geared together, forward movement of either or both paddles moves the unlock plate 485 and disengages the locking members 433a, 433b to enable the position of the head or neck support 417 to be adjusted.

The head or neck support 417 is moveable relative to the base 403 with two substantially perpendicular degrees of freedom. That is, the support 417 can be moved up and down, and forward and rearward relative to the base 403, in any combination of movements simultaneously, when the actuation lever(s) are actuated by a user. The support 417 can be simultaneously vertically and horizontally adjusted, such as by moving the head or neck support in a diagonal movement relative to the base. The head or neck support can then be maintained in the desired adjusted position by simply releasing the actuation lever(s) so the locking member(s) engage. Figures 59A to 59F show a selection some of the possible adjusted positions of the head or neck support.

The orientation of the head rest mechanism could be varied. While in the form shown the pivoting of the generally parallel arms relative to the first members and support links causes forward and rearward movement of the head or neck support relative to the base 403, and the pivoting of members 407a, 407b relative to the base causes height adjustment of the head or neck support relative to the base, the mechanism could be mounted in a different orientation depending on the specific application and space considerations.

SECOND PREFERRED FORM SUPPORT ASSEMBLY

Figures 83 and 84 show a second preferred form chair. Unless described below, the features and functioning of the chair are the same as described above, and like reference

2012319280 30 Oct 2017

numerals indicate like parts with the addition of a prime (').

This chair differs in that it is a high backed chair, with the upper end 203' of the back portion 201' extending upwardly beyond the upper end of the spine 209'. A preferred embodiment adjustable head support arrangement 901 is supported by the back portion 201'.

Figures 86 to 104B show preferred embodiments of the adjustable support arrangement 901. The adjustable support arrangements 901 comprise a mounting assembly 903 with first and second parallel closures defining slits 912, a slider arrangement 904 slidable relative to the mounting assembly 903, and a support member 905 operatively connected to the slider arrangement 904. The mounting assembly 903 is configured for attachment to the back portion 201' of the chair. The support member 905 is preferably a head support, but alternatively could be a neck support, and is slidable substantially vertically relative to the mounting assembly 903 and chair back portion 201' when the back portion is generally upright, between an upper position shown in Figure 86 and a lower position shown in Figure 87, to adjust the height of the head or neck support member 905.

First and second parallel elongate closures each comprise two opposed, engagable sides 912a, 912b that engage to close or partially close the respective slit 912 in the closure. The slider arrangement 904 comprises two pairs of sliders 923 and a carriage 925. The sliders 923 act to open or close the respective slit 912 as they slide along the slits 912. The closures provide compliant flexible support rails upon which the support member 905 is supported.

One pair of the sliders 923 is arranged on each of the first and second slits 912, as shown in Figure 90, with the two sliders in each pair oppositely oriented. The carriage 925 attaches to each of the sliders 923 to fix the sliders relative to each other. As the carriage 925 is moved up and down relative to the mounting arrangement 903, all four sliders slide along the respective slits to the same extent. The head or neck support member 905 in turn is connectable to the carriage 925. As the sliders 923 in each pair are oppositely opposed, as the carriage is moved the leading slider in the direction of movement opens the slit 912 of the closure, and the trailing slider in the direction of movement closes the slit 912 of the closure.

2012319280 30 Oct 2017

In the embodiment of Figure 90, the closures and sliders 923 each comprise a flexible zipper with the opposed sides 912a, 912b of the zipper having engagable teeth. The upper zipper slider 923 in each pair of sliders is arranged so that the zipper 912 is closed above the slider and open immediately below the slider. The lower slider 923 in each pair is oppositely arranged so that the slit 912 is open immediately above the slider 923 and closed below the slider 923. By that configuration, the only portion of each zipper slit 912 that is open is the portion between the sliders 923. That portion will be hidden in use by the support panel 905, when viewed from the front of the chair.

Preferably, the teeth of the zippers have 10 mm width when engaged, and the closures are preferably about 230 mm long to provide about 170 mm range of adjustable travel of the support member 905. The zippers are positioned a suitable distance apart, such as about 60 mm between slits 912 for example. Alternative sizes and configurations could be used.

In an alternative embodiment shown in Figure 91 the two elongate parallel closures each comprise slits 912' and sliders 935 in a flexible zip-lock type arrangement. The two opposed, engagable sides 912a', 912b' of the closures comprise complementary elongate projections and recesses running along the length of the slits. A two-part slider 935 comprising and upper portion 935a and a lower portion 935b is arranged on each slit. Each upper portion 935a causes engagement of the complementary projections to close the respective slit 912' above the slider as the slider is lowered, and parts the two sides 912a', 912b' immediately below the portion 935a as the slider is raised. Conversely, each lower portion 935b causes engagement of the complementary projections to close the slit below the slider as the slider is raised, and parts the two sides 912a', 912b' immediately above the portion 935b as the slider is lowered. With this arrangement, the slits 912' are closed above and below the slider arrangement for any position of the slider arrangement intermediate the two ends. The upper and lower portions 935a, 935b of each slider 935 may be separate parts or may be integral.

In further alternative embodiments, the sliders 923, 935 may be oppositely oriented so that the slits 912, 912' are open above and below the slider arrangement 904 and closed between sliders 923 or slider portions 935a, 935b on the same slit. The orientation of the sliders on the first slit may be different to the orientation of the sliders on the second slit.

2012319280 30 Oct 2017

For example, the first slit and the respective slider(s) may be arranged so that the first slit is open above and below the slider arrangement 904; and the second slit and the respective slider(s) may be arranged so that the second slit is closed above and below the slider arrangement 904 as the slider arrangement is moved up and down.

While the following description relates to the zipper embodiment, it will be appreciated that the features and functioning for the zip-lock type embodiment will be the same.

The support member 905 is adjustable to a plurality of intermediate positions between the upper and lower positions of Figures 86 and 87 by sliding the sliders along the respective closures. The engagement between the opposing sides of each slit 912, 912' holds the sliders and the support 905 in place in the absence of an applied force. To adjust the height of the support 905, an upward or downward force must be applied that is sufficient to slide the sliders along the closures 912, 912' closing and opening respective portions of the slits.

Figures 92A to 94C show the carriage 925 of Figures 86 to 89, and attachment of the zipper sliders 923 to the carriage 925. An underside of the carriage 925 comprises four recesses 928 shaped to receive a top portion of the zipper sliders 923. An upper portion of each recess 928 comprises an aperture, a boss 926, and a resilient flap 927. To attach the sliders 923 to the carriage, the sliders 923 are pressed into the carriage recesses. Each zipper slider 923 comprises a crown 924, which in conventional zippers is for attaching a pull tab. The crowns 924 on the sliders push the flaps 927 upwards, as shown in Figures 93A to 93C. The slider 923 can then be slid sideways onto the respective boss 926 so that the boss 926 is positioned between the slider crown 924 and the slider body. The respective flap 927 then snaps downwards to lock the slider 923 on the boss 926 to fixing it to the carriage 925, as shown in Figures 94A to 94C.

In an alternative embodiment, the carriage and the sliders 923 or 935 may be integral.

The carriage 925 comprises a centrally positioned support connector 929 protruding from an opposite surface of the carriage 925 from the sliders, for attaching the head or neck support 905 to the carriage and thereby to the mounting assembly 903. The support connector 929 comprises four hollow compartments 930 which are open at a

2012319280 30 Oct 2017

front end, for receiving portions of complementary connector(s) on the support 905. The two middle compartments each comprise at least one side aperture 931 at their base.

Figures 95A to 96C show the head or neck support member 905. The head or neck support member 905 comprises a support panel 915. A back side of the support panel 915 comprises a ribbed portion 916. The ribbed portion 916 provides additional strength to the support 905 and preferably allows some flexing of the support panel 915. In the embodiment shown, the ribbing in the ribbed portion is in the form of a lattice, but alternatively other ribbing patterns may be used. The back side of the support panel 915 comprises a non-ribbed surface 915a around the periphery of the ribbed portion 916, for attaching upholstery.

The head or neck support member 905 may further comprise one or more layers of cushioning, and covering upholstery. The support member 905 shown in Figure 88 comprises three foam cushioning layers 905a, 905b, 905c of different densities. The first foam layer 905a adjacent the support panel 915 has the highest hardness and density, the middle foam layer 905b is less dense than the first layer 905a, and the outer layer 905c has the lowest density and is the softest layer to provide maximum compliance to a user's head or neck. Alternatively, the cushioning may comprise a single moulded foam member.

The support panel 915 comprises a rearwardly projecting carriage connector 933 for connecting the support to the carriage 925. Alternatively, the connector 933 may be a separate member attached to the support panel 915.

The carriage connector 933 comprises a plurality of projections protruding from the main support panel 915 configured to fit into the compartments on the support connector 929 on the carriage 925. Two of the projections 934 for receipt by the two central compartments on the support connector 929 each comprise a lateral lip or catch 934a. Apertures 937 in the main support panel 915 adjacent to those two projections 934 enable those projections to be resiliently moved relative to the main support panel 915. The carriage connector 933 and the support connector 929 are connectable by way of a snap-fit. As the support connector 929 and the carriage connector are moved into engagement, the central projections 934 deflect resiliently inwards. When the lips or

2012319280 30 Oct 2017

catches 934a reach the base of the respective compartment, the lips or catches move into the apertures 931 at the base of the support connector 929 to engage the support connector 929.

In an alternative embodiment, the head or neck support 905 and the carriage 925 may be integral and/or the carriage 925 and the sliders 923 may be integral.

Figure 97 shows a front view of the mounting assembly 903. The mounting assembly 903 comprises a double zipper member 911, which comprises the two parallel slits 912, a load dispersion panel 909, and a back attachment assembly 906. The double zipper member 911 and load dispersion panel 909 are both preferably compliant flexible members and the double zipper member 911 is stitched to a front surface of the load dispersion panel 909. The bold lines 932 in Figure 97 indicate where the double zipper member is stitched.

With reference to Figures 98A to 99D, the back attachment assembly 906 comprises a main back attaching member 907 and a retainer 908. The main back attaching member 907 comprises a substantially planar, generally rectangular body with two straps 919a, 919b for attaching the member 907 to the back portion 201' of a chair. A first one of the two straps 919a extends upwardly and rearwardly from a central upper portion of the body. A second one of the two straps 919b extends downwardly and rearwardly from a central lower portion of the body. Similarly the retainer 908 comprises a generally rectangular body with two straps 920a, 920b for attaching the retainer 908 to the back portion 201' of a chair. A first one of the two retainer straps 920a extends upwardly and rearwardly from a central upper portion of the retainer body. A second one of the two straps 920b extends downwardly and rearwardly from a central lower portion of the retainer body. The upper straps 919a, 920a on the retainer 908 and the back attaching member 907 each comprise an enlarged portion 919c, 920c that allow the two upper straps 919a, 920a to be attached to the back portion with sufficient strength using the same fasteners. The straps act in tension, but are compressible to enable the dispersion panel 909, zippers, carriage, and support member to be moved rearwardly under load. In alternative embodiments, rather than rearwardly extending straps, the back attachment member may comprise any other suitable tension member for example cords or fabric members to attach the back attachment member to the back portion of the chair.

A central portion of the back attaching member 907 comprises two apertures 907a, 907c for receiving the retainer straps 920a, 920b. The lower aperture 907c is substantially rectangular to receive the lower strap 920b. The upper aperture 907a is the same width as the lower aperture but comprises an enlarged upper portion to enable the enlarged end 920c of the upper retainer strap 920a to pass through the aperture 907a. When assembled, the main body of the retainer 908 sits against the front surface of the back attachment member 907, and the retainer straps extend through the apertures 907a 907c and rearward from the back attachment member 907. The retainer body comprises projections 908a that are received by complementary locating apertures 907b on the back attachment member 907 to correctly position the retainer 908 on the back attachment member 907 and prevent the retainer moving relative to the back attachment member 907.

The back attaching member 907 is flexible about a horizontal axis to allow the assembly 906 to flex rearward upon contact with a user's back, for example when the head or neck support is in its highest position. Preferably, the rectangular portion 907 is thicker at its upper end than at its lower end, so that the flexibility of the back attaching member 907 transitions from relatively stiff at its upper end to relatively flexible at its lower end. The stiffness of the upper end provides stability of the head or neck support while the flexibility of the lower end provides a compliant contact surface for a taller occupant's back when the support member 905 is in the highest position. Preferably the back attaching assembly 906 is less flexible about a substantially vertical axis, to minimise side-to-side rotation of the head or neck support during use. In the embodiment shown, the back attaching assembly 906 is forwardly concave to match the curvature of the chair, for comfort. Alternatively the back attaching assembly 906 could be flat.

The retainer 908 and the back attaching member 907 preferably comprise polypropylene, or an elastomer such as Hytrel from DuPont, and are preferably made of the same materials. Rather than being two separate members, the retainer 908 and the back attaching member 907 may instead be integral.

Referring to Figure 100, the back portion 201' of a chair according to one embodiment comprises a relatively rigid portion comprising a back shell or frame 253, a compliant cushion layer 255, and an upholstery layer 257. The upholstery could be any suitable

type, such as natural or synthetic leather, fabric, or a polymeric material for example. As discussed above in relation to the preferred form chair, the back shell may be resiliently flexible, but will still be more rigid than the compliant cushion layer 255. The slider arrangement 904 and the mounting assembly 903 are substantially positioned between a front surface of the cushion 255 and a back surface of the upholstery 257. The load dispersion panel 909 is attached to the front surface of the cushion 255 by an adhesive, as shown in Figure 102. Alternatively, the load dispersion panel 909 may not be fixed to the cushion 255. The load dispersion panel 909 provides a larger area than the double zipper member 911 for transferring the load from the head or neck support 905 to the cushion 255. By dispersing the user's load across the cushion, the load dispersion panel 909 also helps to mask the edge of the retainer 908 from the user's back, improving comfort. Preferably the load dispersion panel comprises a non-woven fabric, for example microsuede, but woven fabrics may also be used.

The cushion 255 comprises four central apertures 256. The back attachment assembly straps 919a, 919b, 920a, 920b extend through these apertures to a rear side of the cushion 255, as shown in Figure 101. The straps 919a, 919b, 920a, 920b comprise apertures 921a, 921b, 922a, 922b at their ends. Fasteners 917 such as screws, push fasteners, or the like are placed through these apertures 921a, 921b, 922a, 922b and fasten to apertures 259 in the back shell 253 to secure the head or neck support assembly 901 to the back shell 253. Due to limited space on the back portion above the back attaching member 907, the upper strap 919a on the back attaching member is shorter than the other straps 919b, 920a, 920b, and attaches to the back portion at the same point as the upper strap 920a on the retainer 908. To reinforce the connection, the upper strap 920a on the retainer 908 folds over the top and in front of the upper strap 919a of the back attaching member 907, so the enlarged portion of the upper strap 919a on the back attaching member 907 is positioned nearest the back portion and the apertures 921a and 922a are aligned.

Two fasteners 917 pass through the two aligned apertures 922a, 921a on the upper retainer strap 920a and the upper back attaching member strap 919a, to provide a stronger connection to the back portion than if only one fastener were used. In an alternative embodiment where the back portion has sufficient height above the back attaching member 907, the upper straps 920a, 919a may each comprise only one aperture

2012319280 30 Oct 2017

and connect to the back portion independently in the same manner as the lower straps 920b, 919b. The direct attachment of the back attachment assembly 906 to the back shell 253 minimises undesirable rotation of the support about a horizontal axis.

Because the straps 919a, 919b, 920a, 920b are flexible, the mounting assembly can move rearward or be tilted or twisted in response to rearward force on the head or neck support and compression of the cushion member 255.

The upholstery 257 comprises an elongate aperture 258 that is substantially parallel to the two slits 912 and is preferably positioned between the two slits 912. The aperture may be an elongate rectangular slot, or alternatively may be a slit in the upholstery. In a preferred embodiment, a polypropylene reinforcement member 959 with a central slot is optionally provided on a back side of the upholstery. The upholstery is wrapped around the slot and stitched to the polypropylene member 959 to reinforce and stiffen the elongate aperture 258. In alternative embodiments, there may be no separate reinforcement member, or the reinforcement member may comprise any suitable material other than polypropylene. The support connector 929 protrudes forwardly through the upholstery aperture 258, as shown in Figure 103, and the head or neck support 905 attaches to the support connector 929, as shown in Figures 104A and 104B. The head or neck support and the sliders 923 are positioned on opposite sides of the upholstery layer 257. The support connector 929 slides in the upholstery aperture 258 during height adjustment of the head or neck support 905.

In a preferred embodiment, the mounting assembly 903 further comprises a trim strip 913 that is made from the same material as the upholstery, or from another fabric or material similar in colour and appearance to the upholstery. The trim strip 913 is positioned between the two slits 912 in the double zipper member and is preferably stitched to the load dispersion panel 909 as illustrated in Figure 97. The trim strip 913 covers the only part of the mounting assembly 903 that would be visible through the aperture 258 in the upholstery 257 to minimise the visibility of the aperture.

The support assembly has been described above and is shown in the drawings with reference to a height adjustable head or neck support for a chair. Alternatively, the support assembly may be a height adjustable lumbar support, or alternatively a support

2012319280 30 Oct 2017

that is adjustable side-to-side. In an assembly with a side-to-side adjustable support 905, the slits 912 would be oriented substantially horizontally.

Rather than having two spaced-apart elongate closures, a single elongate closure could be provided, with the slider(s) supporting the support panel 905 from the single closure. However, the spaced-apart closures are preferred, as they minimise undesirable rotation of the support panel about a horizontal axis extending forward/rearward through the back portion and twisting about a vertical axis. For the zipper embodiment, rather than having separate sliders 923 that are configured to move together during adjustment of the support member, the sliders in the pair that engage one closure could be integrally formed. Equally, for the zip-lock type embodiment, the sliders 935 could be separately formed and configured to move together during movement of the support member 905. The opposed pairs of sliders (or integrally formed effective opposed pairs) provide four points of stability for the carriage 925 and thereby the support member 905, to thereby minimise undesirable rotation about a horizontal axis extending forward/rearward through the back portion of the chair.

The above describes preferred forms of the present invention, and modifications can be made thereto without departing from the scope of the present invention.

For example, the preferred form features are described and shown with reference to a domestic lounger chair. However, it will be appreciated that many of the features can readily be incorporated into different types of chairs, such as office chairs, vehicle chairs (e.g. aircraft, marine, or motor vehicle chairs), cinema, or theatre chairs for example. The supporting frame could be modified accordingly, so as to be fixed to the ground or a wall panel for example for a cinema or theatre chair. References herein to a chair should be construed sufficiently broadly to encompass these alternative applications.

Additionally, a number of the features described herein can be incorporated into chairs having different features. They need not all be incorporated into the same chair.

To those skilled in the art to which the invention relates, many changes in construction and widely differing embodiments and applications of the invention will suggest themselves

without departing from the scope of the invention as defined in the appended claims. The disclosures and the descriptions herein are purely illustrative and are not intended to be in any sense limiting. 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.

2012319280 30 Oct 2017

CLAIMS

1. A chair comprising:

a supporting frame;

a seat portion for supporting an occupant;

a back portion for supporting the back of a seated occupant that has an upper end, a lower end, and is pivotally mounted to the supporting frame at a position above its lower end;

and a recline mechanism configured to lift the seat portion upon a reclining action of the back portion, the recline mechanism comprising an operative connection between the seat portion and the supporting frame, and a drag link pivotally connected to the seat portion and pivotally connected to the back portion at a position below the pivotal mounting of the back portion to the supporting frame, the recline mechanism configured such that as the back portion of the chair is reclined, the lower end of the back portion moves forward and the drag link pulls the seat portion upward relative to the supporting frame,

wherein the operative connection comprises a rear operative connection between a relatively rearward portion of the seat portion and the supporting frame, wherein the rear operative connection comprises a forward link that is pivotally connected to the supporting frame, a rearward link that is pivotally connected to the supporting frame, and a carrier link that is pivotally connected to the forward link and to the rearward link, wherein the carrier link is pivotally connected to the seat portion.

2. A chair as claimed in claim 1, comprising a front operative connection between a relatively forward portion of the seat portion and the supporting frame.

3. A chair as claimed in claim 2, wherein the front operative connection comprises a slide arrangement comprising a track on one of the seat portion and the supporting frame, and a follower on the other of the seat portion and the supporting frame, with the follower arranged to travel in the track as the seat portion is moved upward upon recline of the back portion.

2012319280 30 Oct 2017

4. A chair as claimed in claim 3, comprising two front operative connections, one at or adjacent each side of the seat portion, and wherein each front operative connection comprises a slide arrangement comprising a track on one of the seat portion and the supporting frame, and a follower on the other of the seat portion and the supporting frame, with the follower arranged to travel in the track as the seat portion is moved upward upon recline of the back portion.

5. A chair as claimed in any one of claims 1 to 4, wherein when the back portion is in an upright configuration, the forward link hangs downwardly and rearwardly from its pivot connection to the supporting frame, and the rearward link hangs downwardly and forwardly from its pivot connection to the supporting frame, and when the back portion is fully reclined, the forward link hangs generally downwardly from its pivot connection to the supporting frame, and the rearward link extends generally forwardly from its pivot connection to the supporting frame.

6. A chair as claimed in claim 5, wherein the pivot connection of the carrier link to the seat portion is positioned rearwardly of the pivot connections of the forward link and rearward link to the carrier link.

7. A chair as claimed in claim 5 or 6, wherein the pivot connection of the drag link to the seat portion is positioned generally above and generally behind the pivot connection of carrier link and the seat portion, when the back portion of the chair is not reclined.

8. A chair as claimed in claim 7, wherein the pivot connection of the drag link to the seat portion is positioned upwardly and rearwardly of the pivot connection of the carrier link and the seat portion, when the back portion of the chair is fully reclined.

9. A chair as claimed in any one of claims 1 to 8, comprising two rear operative connections, one at or adjacent each side of the seat portion, and wherein each rear operative connection comprises a forward link that is pivotally connected to the supporting frame, a rearward link that is pivotally connected to the supporting frame, and a carrier link that is pivotally connected to the forward link and to the rearward link, and that is pivotally connected to the seat portion.

2012319280 30 Oct 2017

10. A chair as claimed in any one of claims 1 to 9, wherein the operative connection(s) between the seat portion and the supporting frame is/are arranged such that the relatively forward and relatively rearward portions of the seat portion move upward and forward with a substantially linear movement as the back portion is reclined, with the amount of movement of the relatively rearward portion being greater than the amount of movement of the relatively forward portion, to provide a forward tilt of the seat portion as the back portion is reclined.

11. A chair as claimed in claim 10, wherein the seat portion has a rearward tilt angle when the back portion is upright, and the seat portion has a smaller rearward tilt angle when the back portion is fully reclined.

12. A chair as claimed in claim 10 or 11, wherein the upward movement of the relatively rearward portion of the seat portion is greater than that of the relatively forward portion of the seat portion.

13. A chair as claimed in any one of claims 1 to 12, wherein the back portion comprises a central spine, and a compliant support surface supported by the spine for supporting the back of a seated occupant, wherein a lower portion of the spine is pivotally connected to the supporting frame, with a bottom portion of the spine pivotally connected to the drag link.

14. A chair as claimed in claim 13, wherein the compliant support surface comprises a resiliently flexible shell supported by the spine and a cushion supported by the shell.

15. A chair as claimed in claim 14, wherein the spine is resiliently flexible such that an upper end of the spine can be flexed rearwardly relative to a portion of the spine adjacent the pivot connection of the spine to the supporting frame.

16. A chair as claimed in claim 14 or 15, wherein the spine is resiliently flexible so it can twist with a torsional action around a longitudinal axis of the spine, upon application of a suitable force by a seated occupant to the compliant support surface.

17. A chair as claimed in any one of claims 13 to 16, wherein the supporting frame comprises an intermediate support with a generally horizontally extending portion

2012319280 30 Oct 2017

and a pair of rearward uprights, with the lower portion of the spine positioned between and pivotally connected to the uprights.

18. A chair as claimed in claim 17, wherein the seat portion comprises a seat frame and a support surface mounted to the seat frame for supporting a seated occupant, wherein the operative connection(s) between the seat portion and the supporting frame are connected between the intermediate support and the seat frame.

19. A chair as claimed in any one of claims 1 to 18, wherein the supporting frame comprises a main transom, an intermediate support, and a rocker mechanism that operatively connects the main transom and the intermediate support to provide a rocking motion therebetween, wherein the front and rear operative connections between the seat portion and the supporting frame are connected to the intermediate support.

20. A chair as claimed in claim 19, wherein the intermediate support, and thereby the seat portion, can be rocked between a rearwardly angled rearward rocked position and a forward rocked position.

21. A chair as claimed in claim 20, wherein the rocker mechanism comprises a front rocker arm pivotally connected to the main transom and to the intermediate support, and a rear rocker arm pivotally connected to the main transom and to the intermediate support.

22. A chair as claimed in claim 21, wherein front rocker arm and the rear rocker arm hang downwardly, from their pivot connections to the main transom, at least when the rocker mechanism is in a neutral position.

23. A chair as claimed in claim 22, wherein when the intermediate support is in the rearward rocked position, the front rocker arm extends generally rearwardly from its pivot connection to the main transom, and the rear rocker arm extends generally downwardly from its pivot connection to the main transom, and when the intermediate support is in the forward rocked position, the front rocker arm extends generally downwardly from its pivot connection to the main transom, and the rear

2012319280 30 Oct 2017

rocker am extends downwardly and forwardly from its pivot connection to the main transom.

24. A chair as claimed in claim 22 or 23, wherein the front rocker arm is longer than the rear rocker arm.

25. A chair as claimed in claim 24, wherein the pivot connection of the front rocker arm to the main transom is positioned vertically higher than the pivot connection of the rear rocker arm to the main transom.

26. A chair as claimed in any one of claims 19 to 25, further comprising:

an extendable foot or leg support assembly pivotally connected to the seat portion; and

a rocking inhibitor arrangement to inhibit forward rocking of the intermediate support relative to the main transom when the foot or leg support assembly is extended.

27. A chair as claimed in claim 26, wherein the rocking inhibitor arrangement is configured to automatically engage to inhibit forward rocking of the intermediate support when the foot or leg support assembly is extended, and to automatically disengage to allow forward rocking of the intermediate support when the foot or leg support assembly is retracted.

28. A chair as claimed in any one of claims 19 to 27, wherein the main transom or the intermediate support comprises one or more resiliently compressible stop(s) and the other of the main transom or intermediate support comprises one or more respective abutment surface(s) configured such that when the intermediate support is rocked sufficiently forward and/or rearward, the stop(s) are compressed against the respective abutment surface(s) to damp and limit the forward and/or rearward rock of the support.

29. A chair as claimed in any one of claims 1 to 28, wherein the recline mechanism is configured such that as the back portion of the chair is reclined, the drag link pulls the seat portion upward and forward relative to the supporting frame.

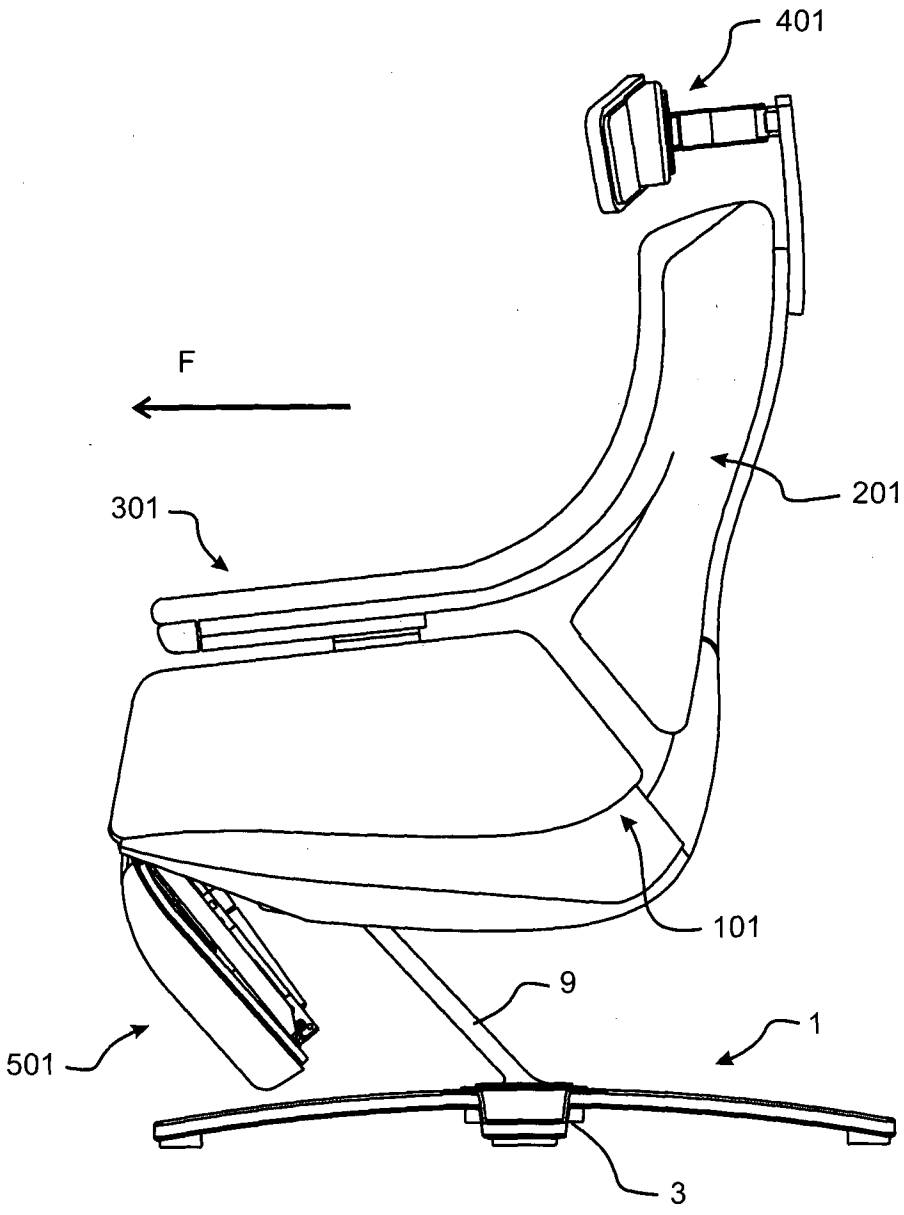


FIGURE 1

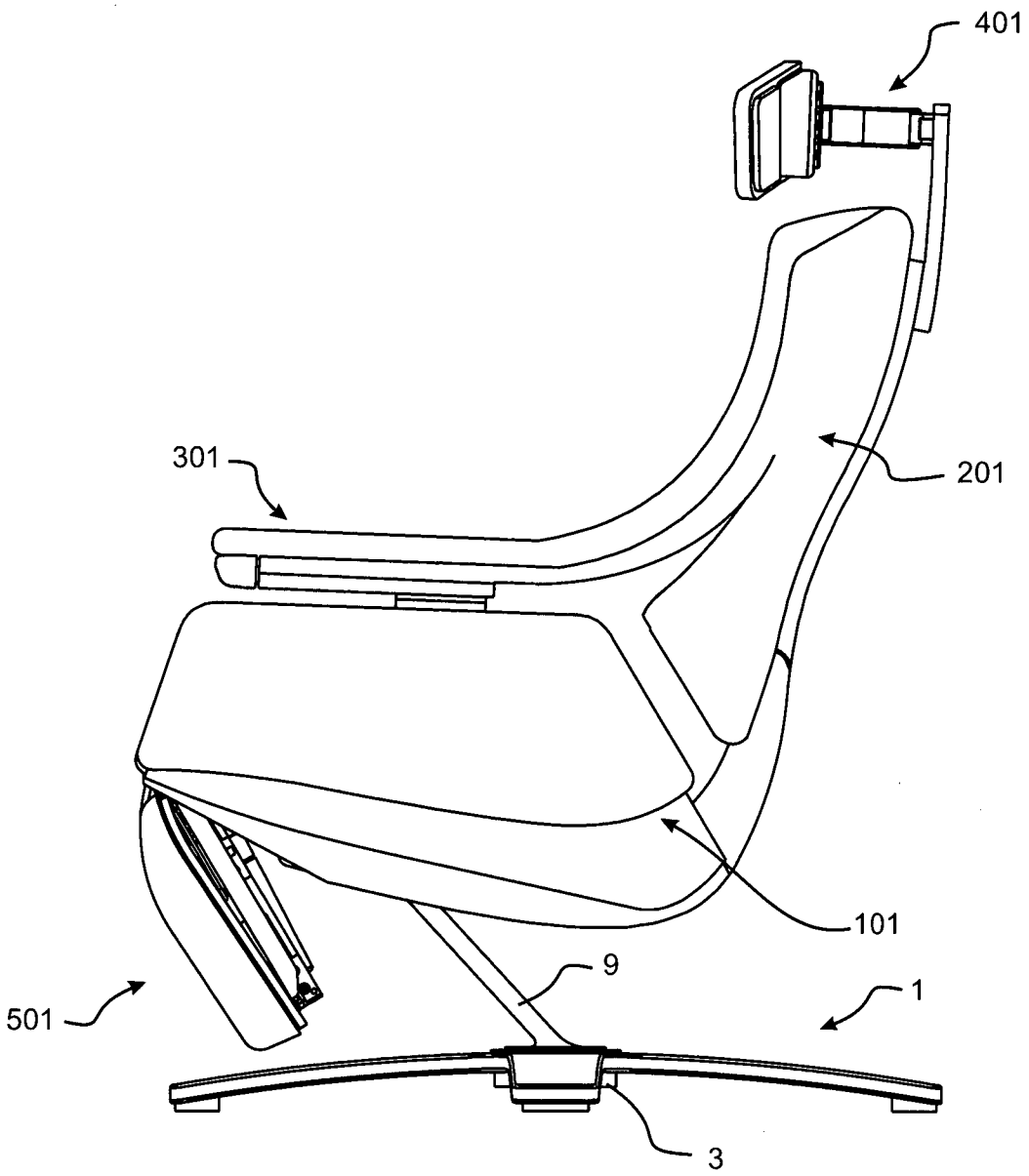


FIGURE 2

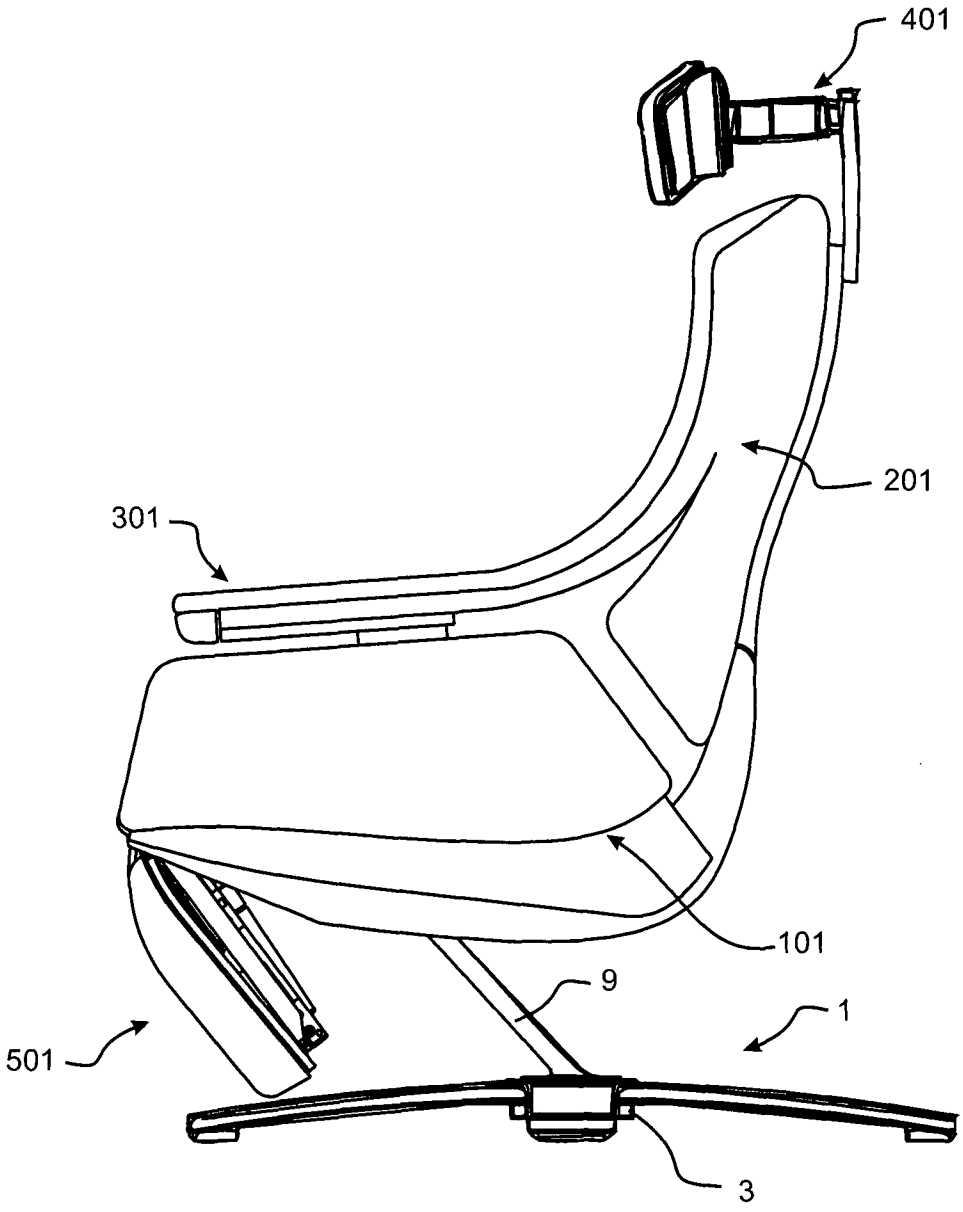


FIGURE 3

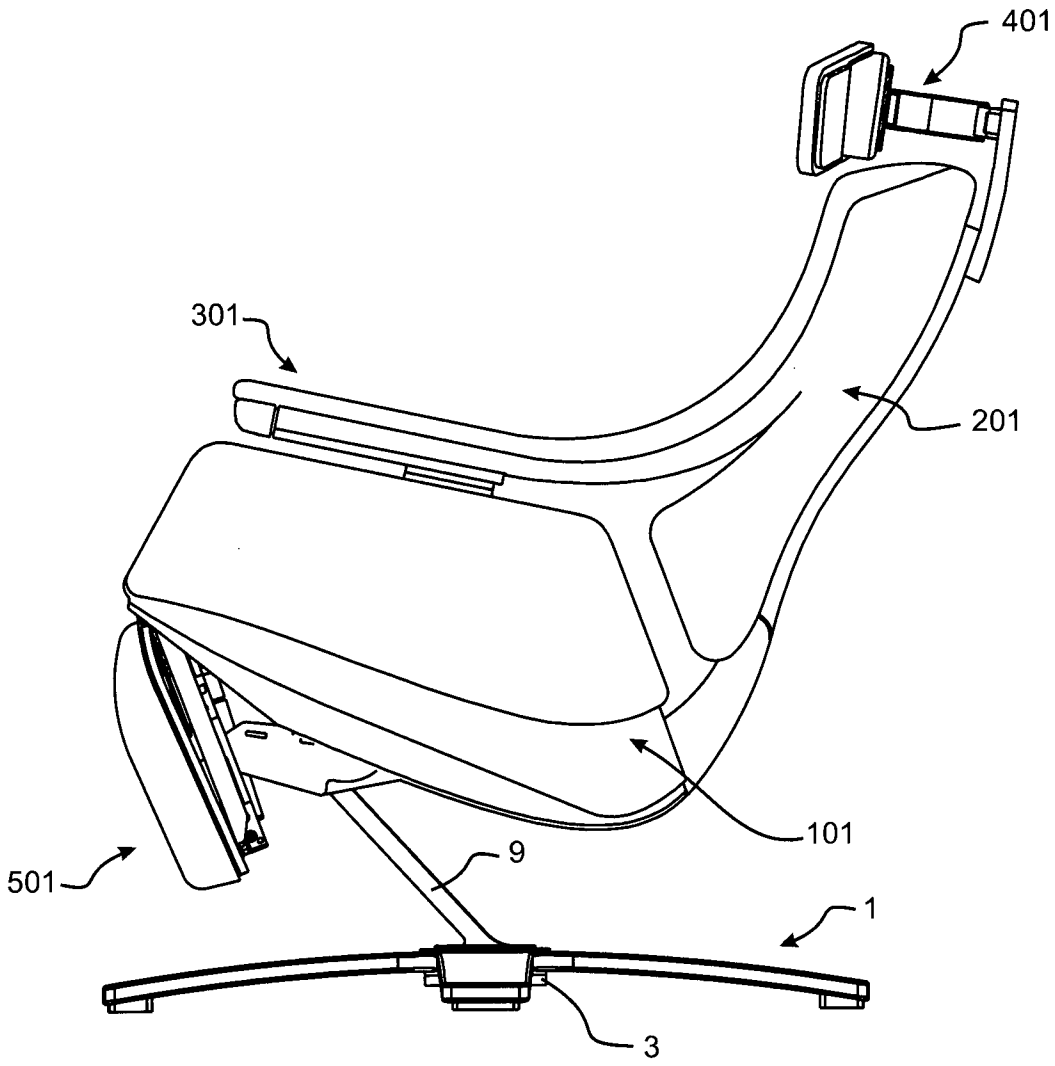


FIGURE 4

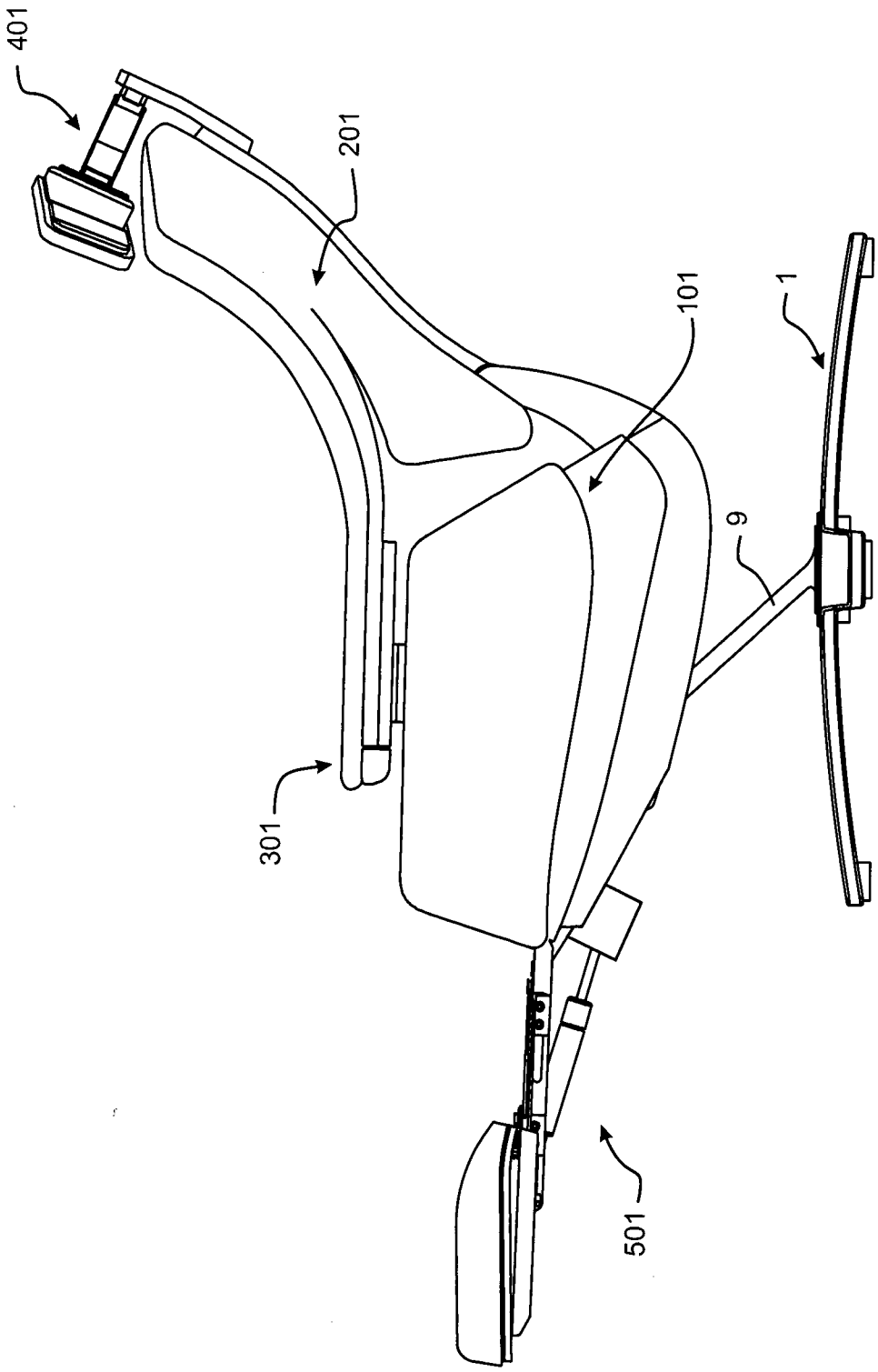


FIGURE 5

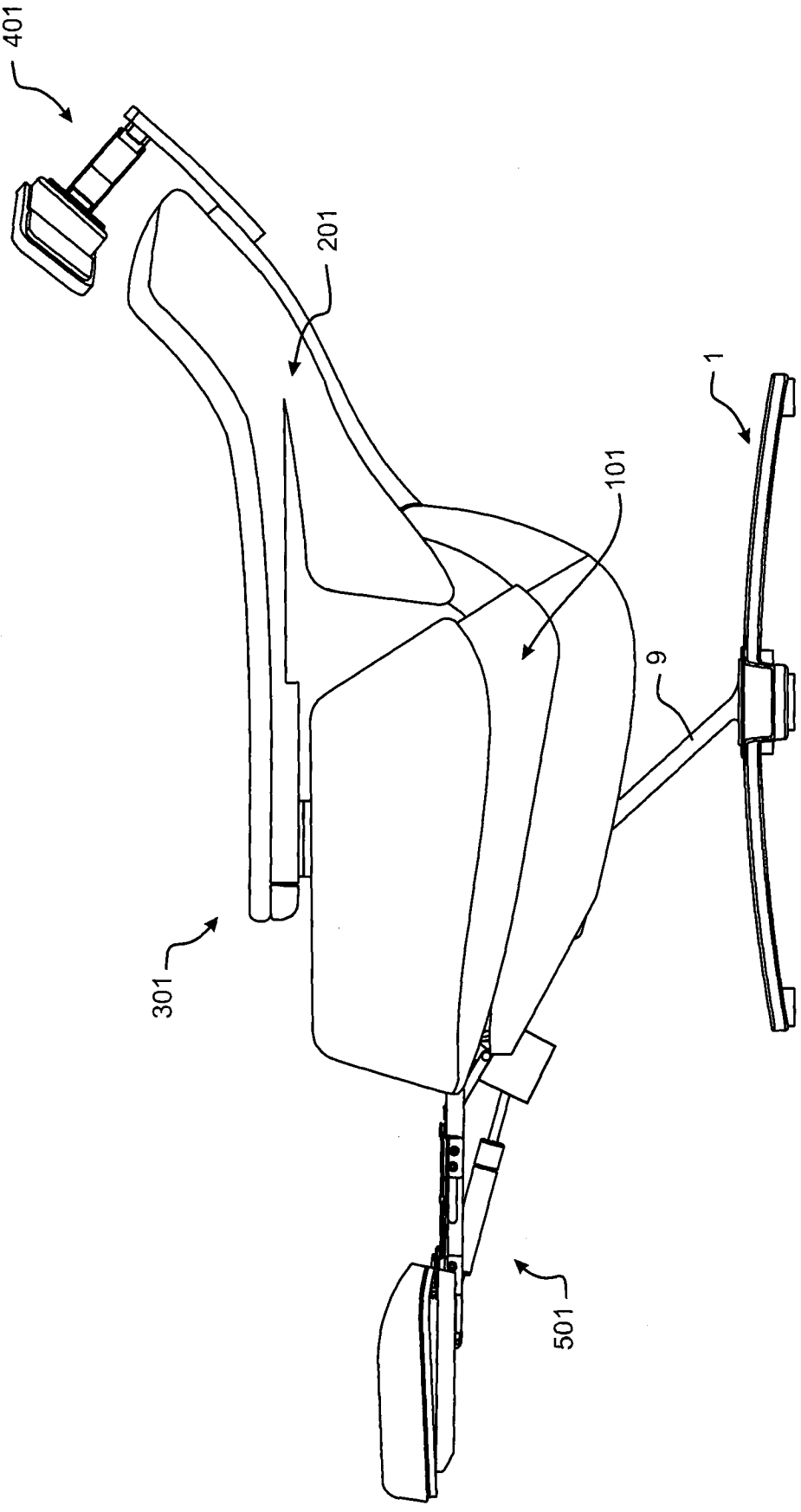


FIGURE 6

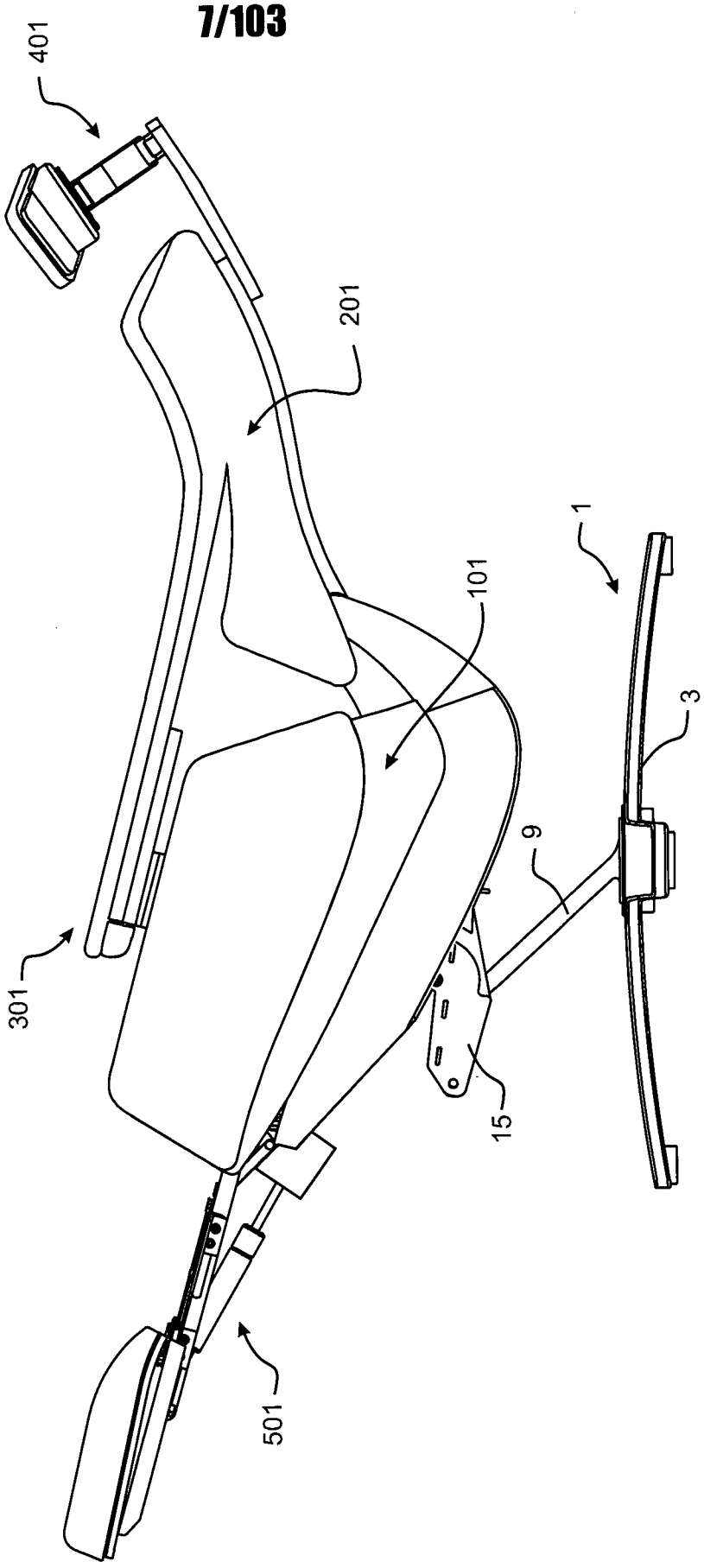


FIGURE 7

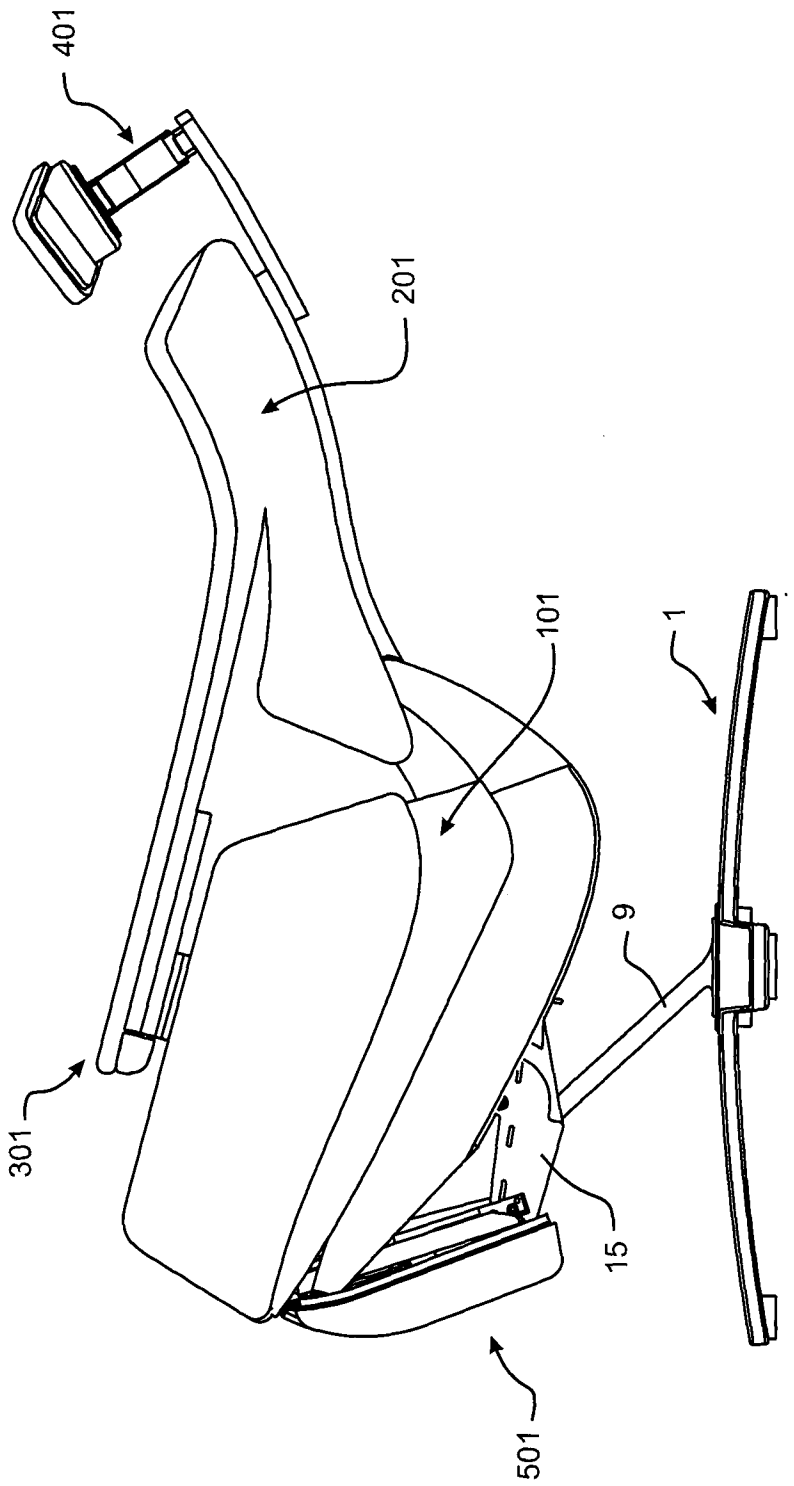


FIGURE 8

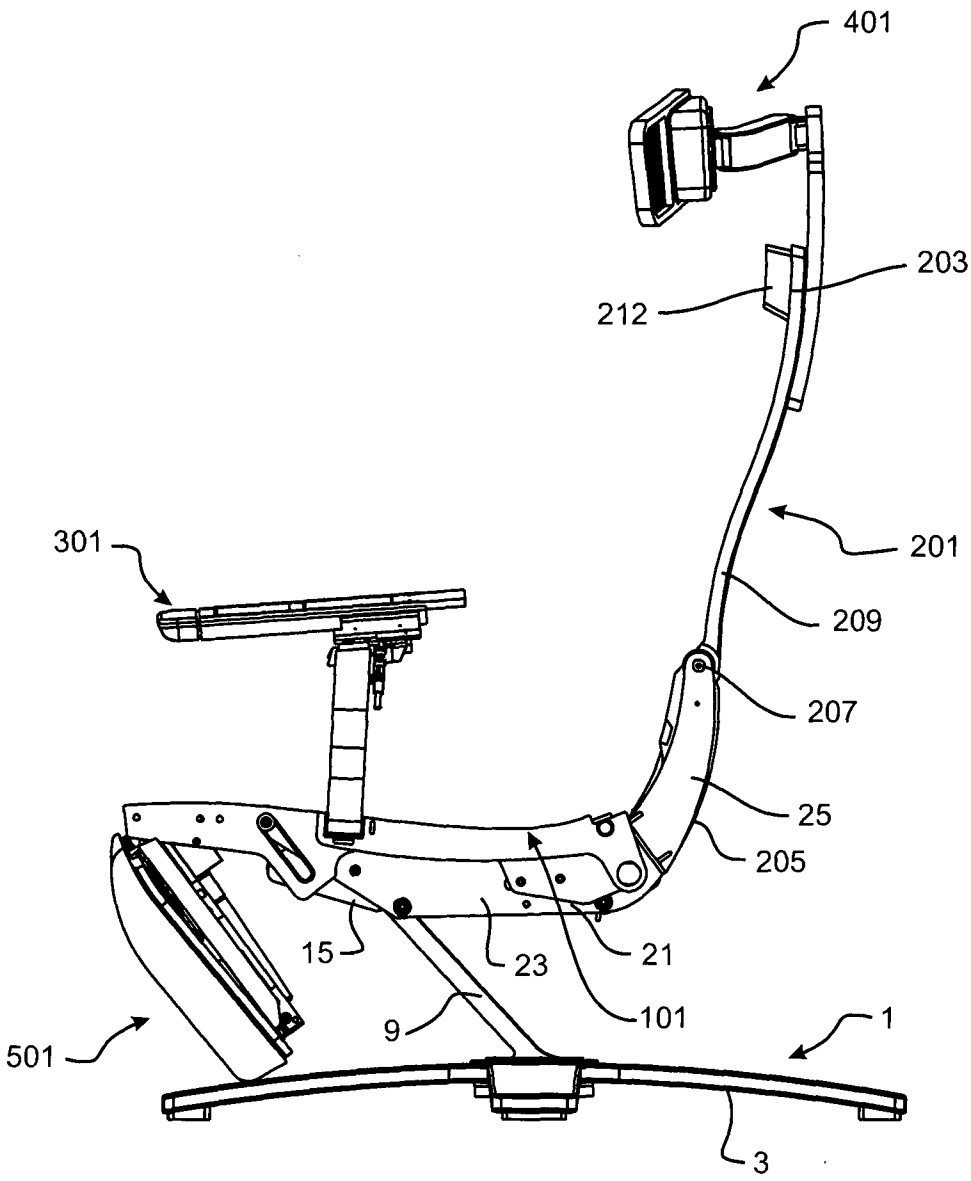


FIGURE 9

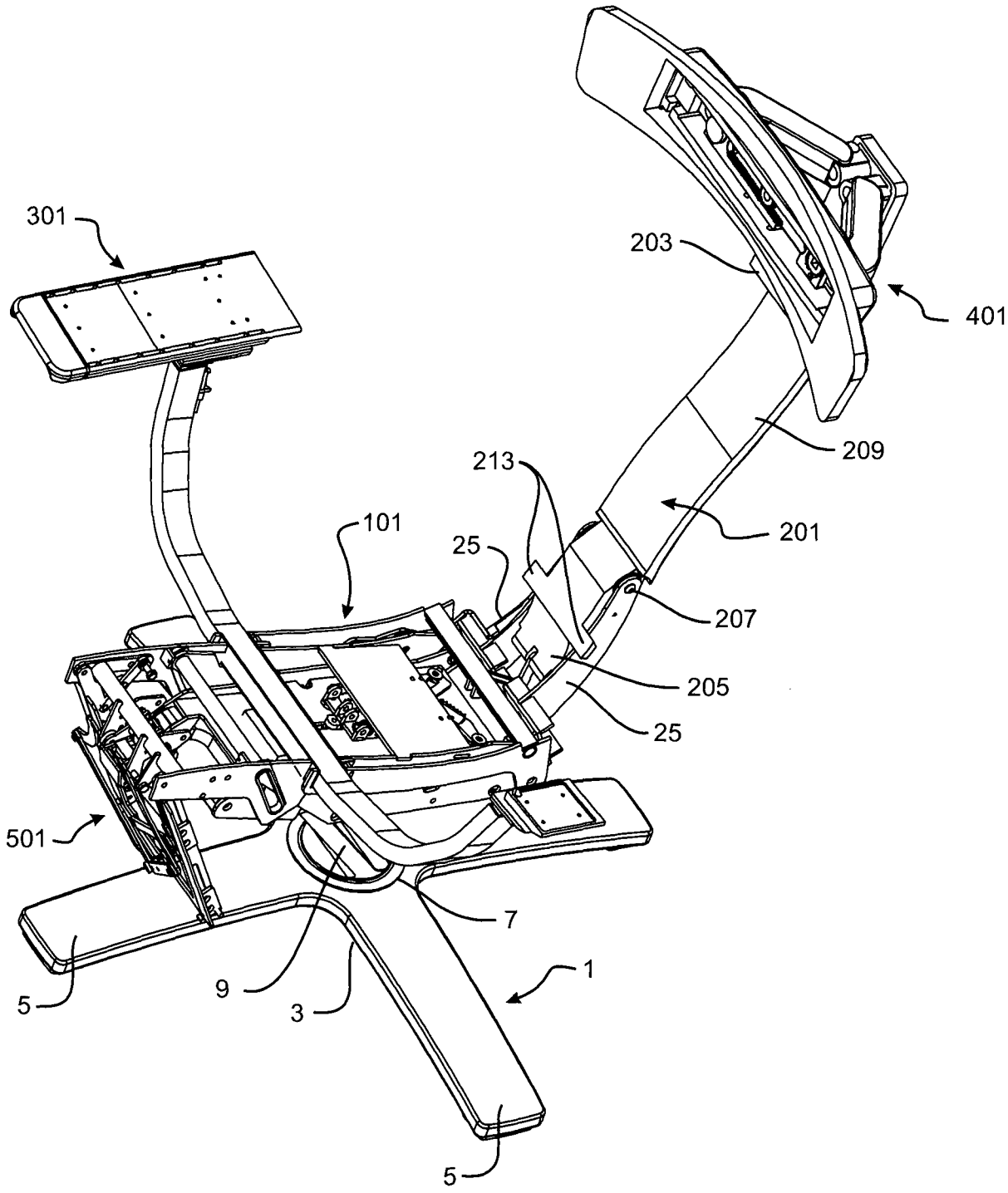


FIGURE 10

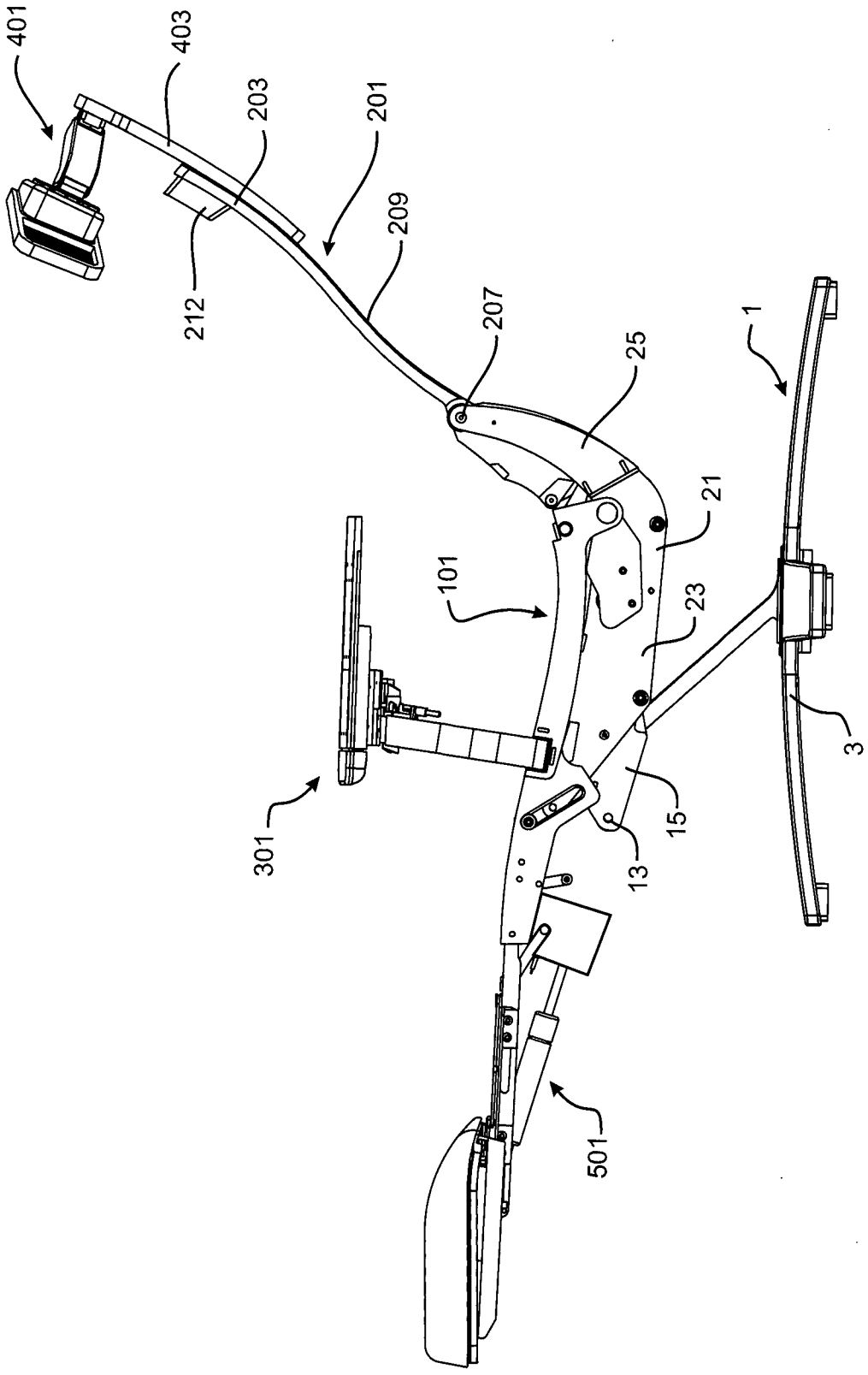


FIGURE 11

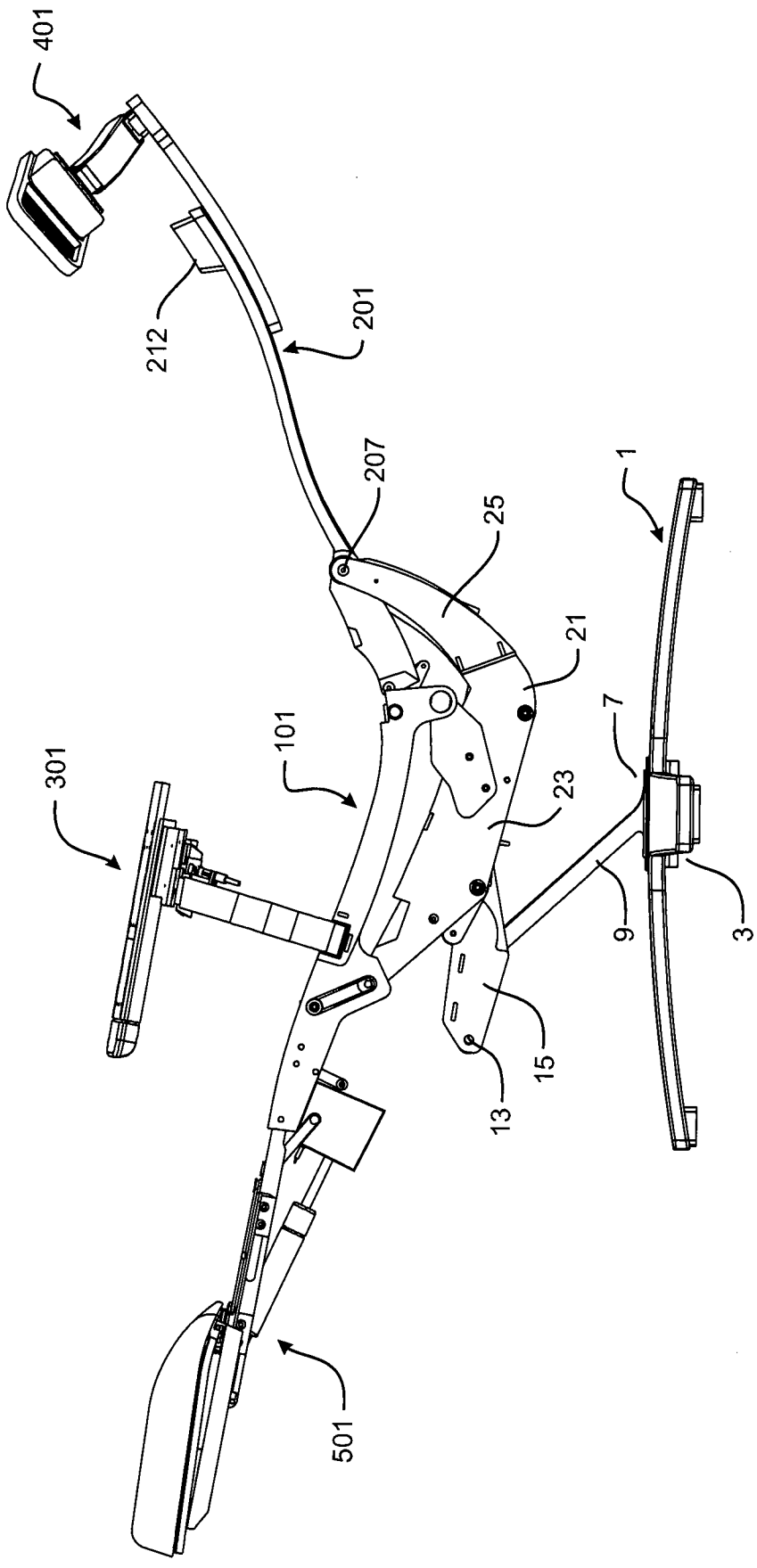


FIGURE 12

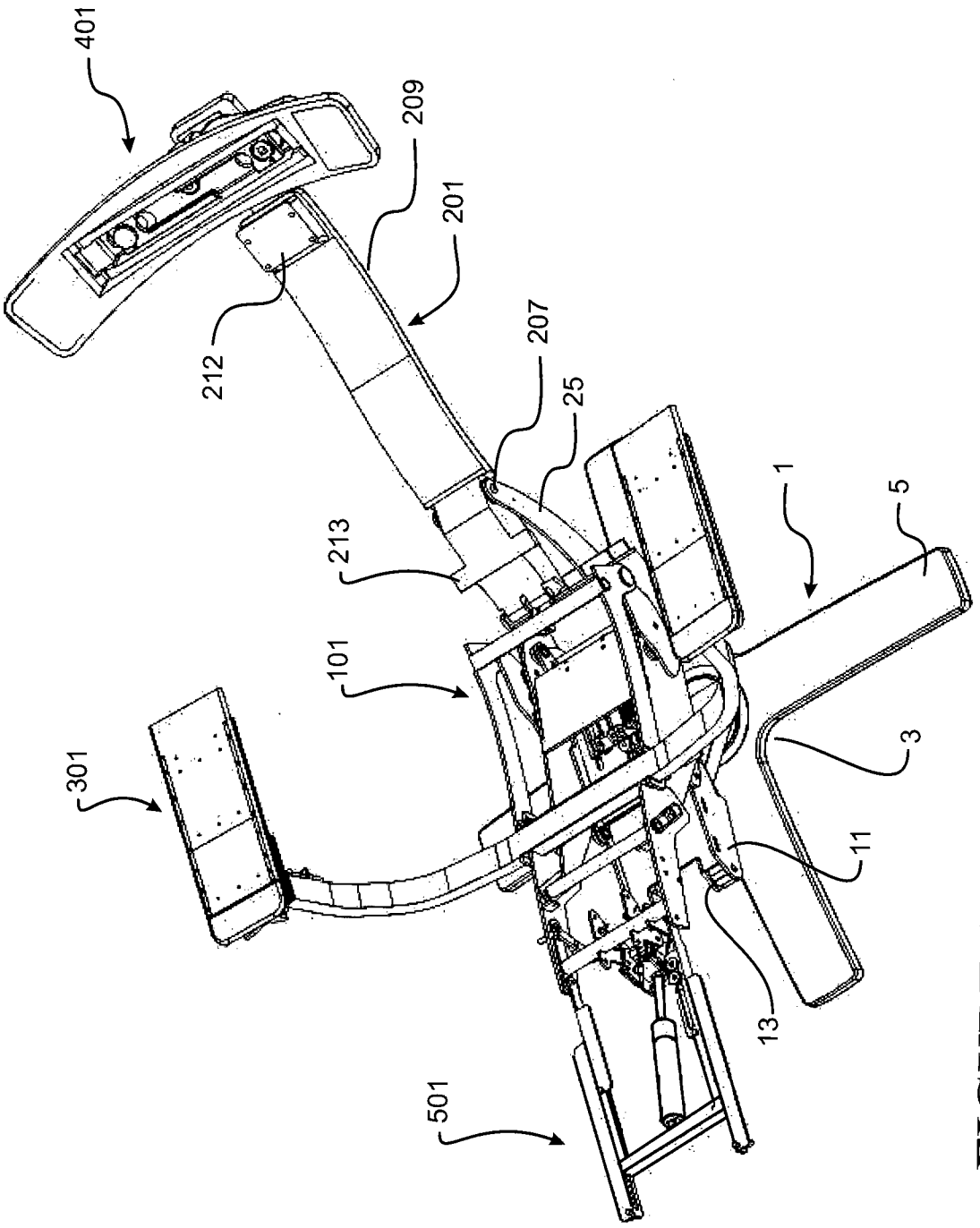


FIGURE 13

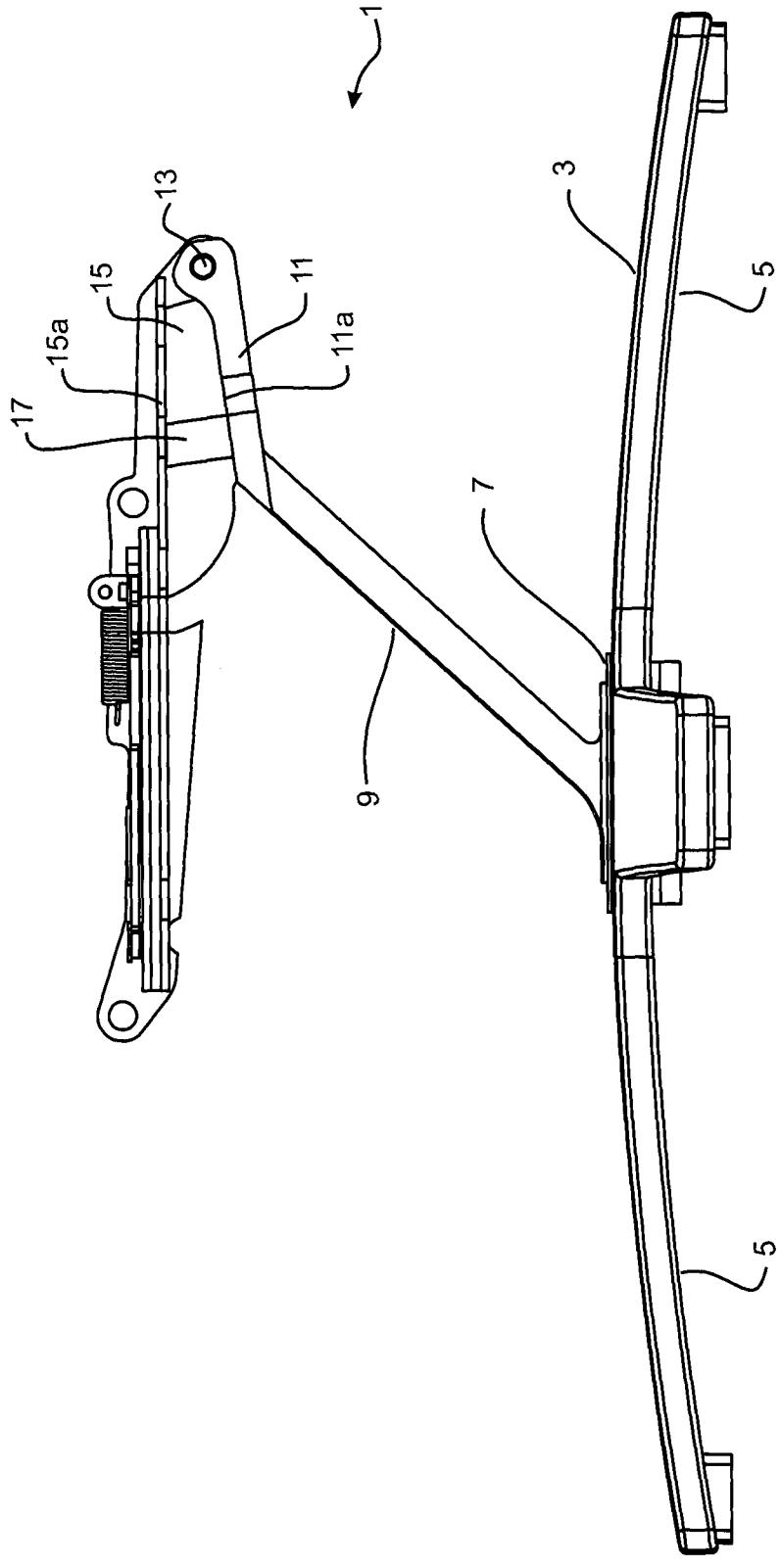


FIGURE 14

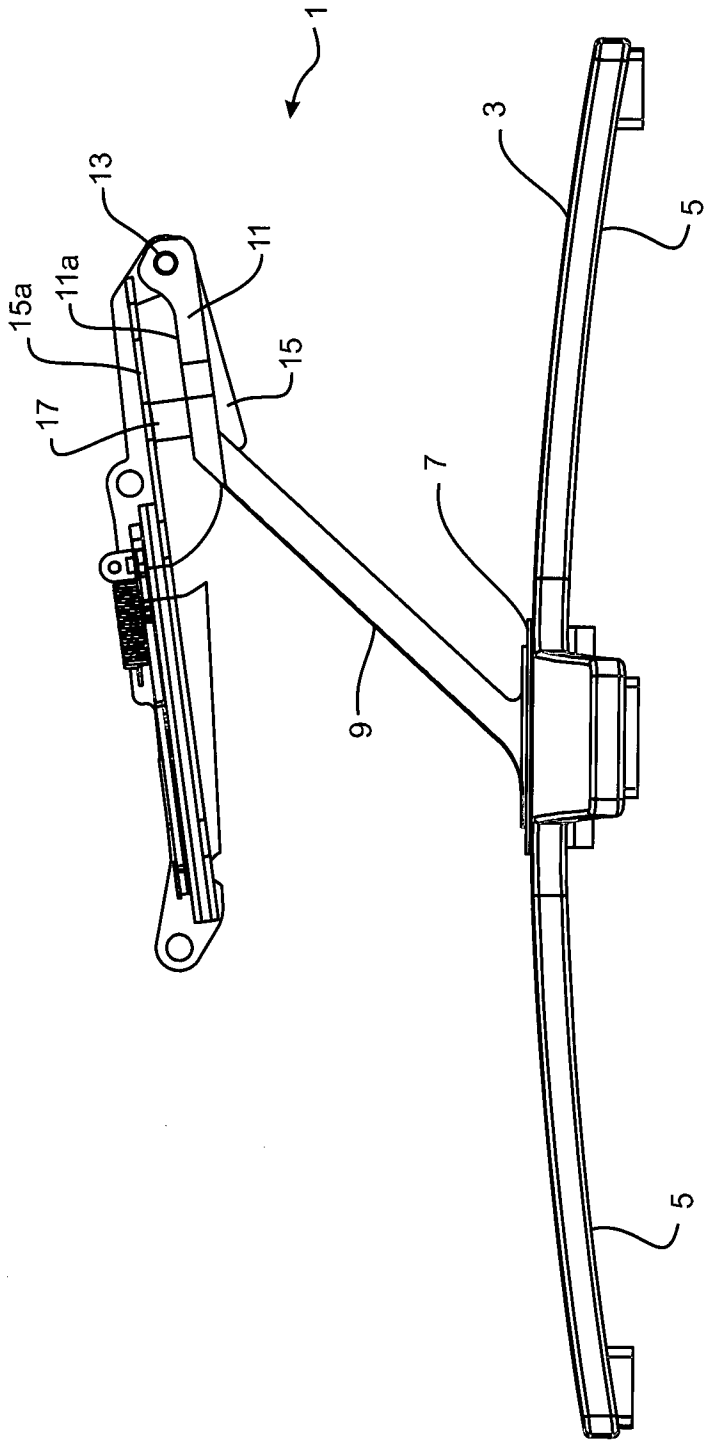


FIGURE 15

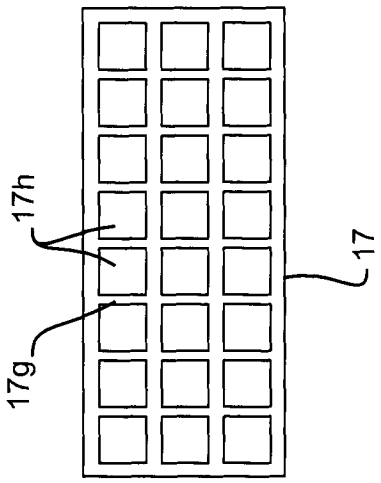


FIGURE 16C

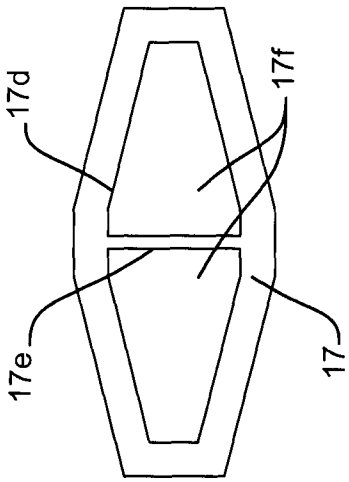


FIGURE 16B

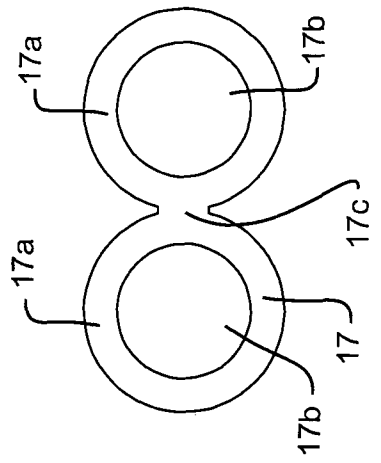


FIGURE 16A

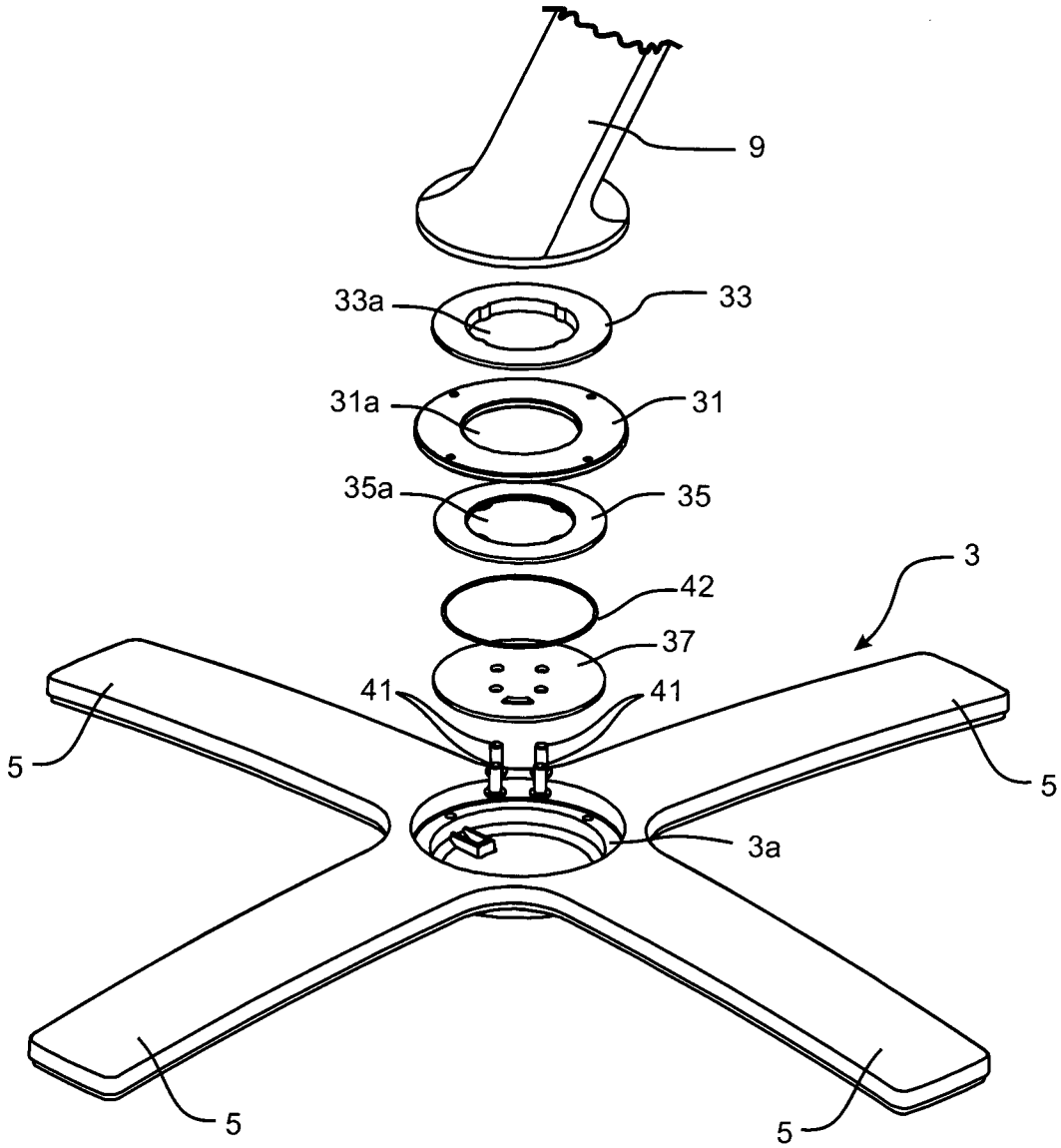


FIGURE 17

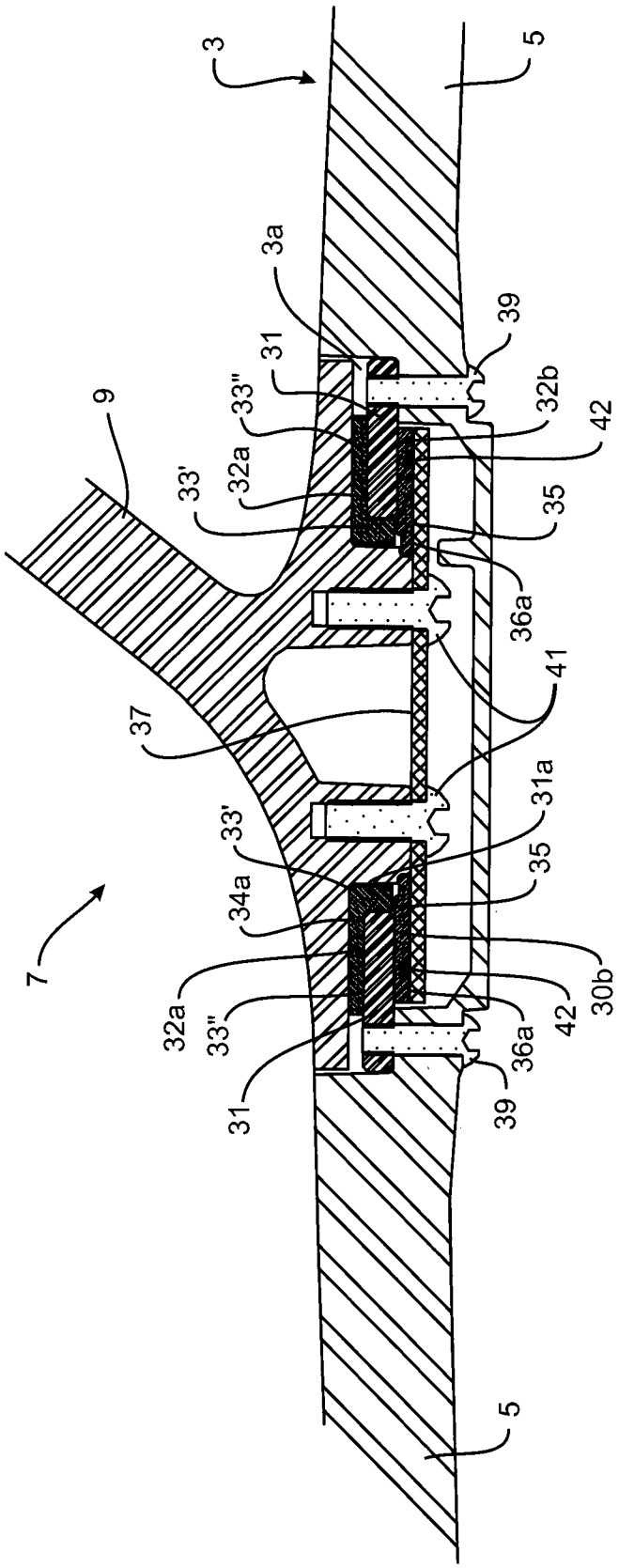

3
5
3a
39
31
33"
32b
42
9
32a
33'
35
36a
41
37
31a
33'
35
34a
7
32a
33"
31
39
36a
42
30b
5

FIGURE 18

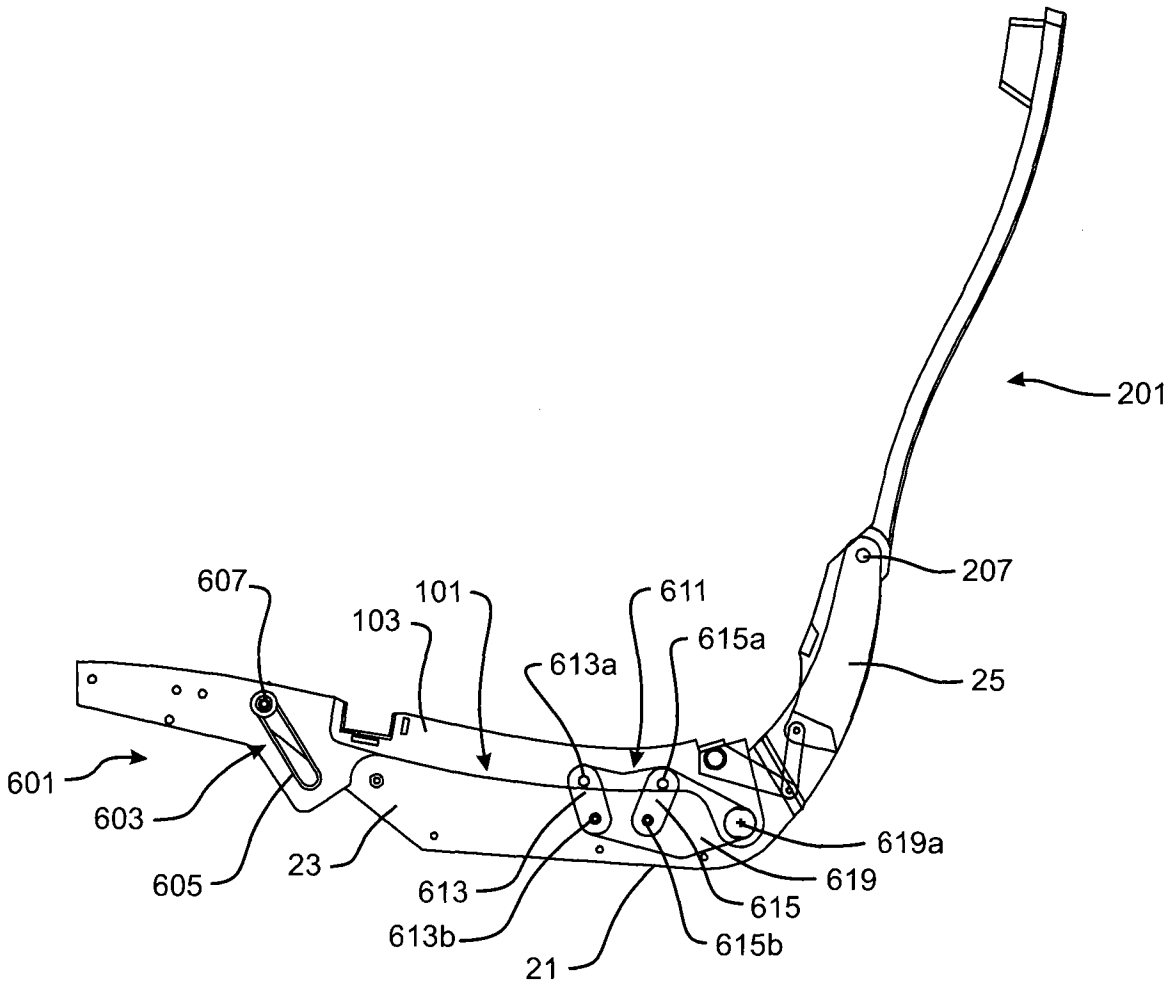

201
207
607
101
103
611
615a
613a
25
601
603
605
23
613
613b
21
615b
615
619
619a

FIGURE 19

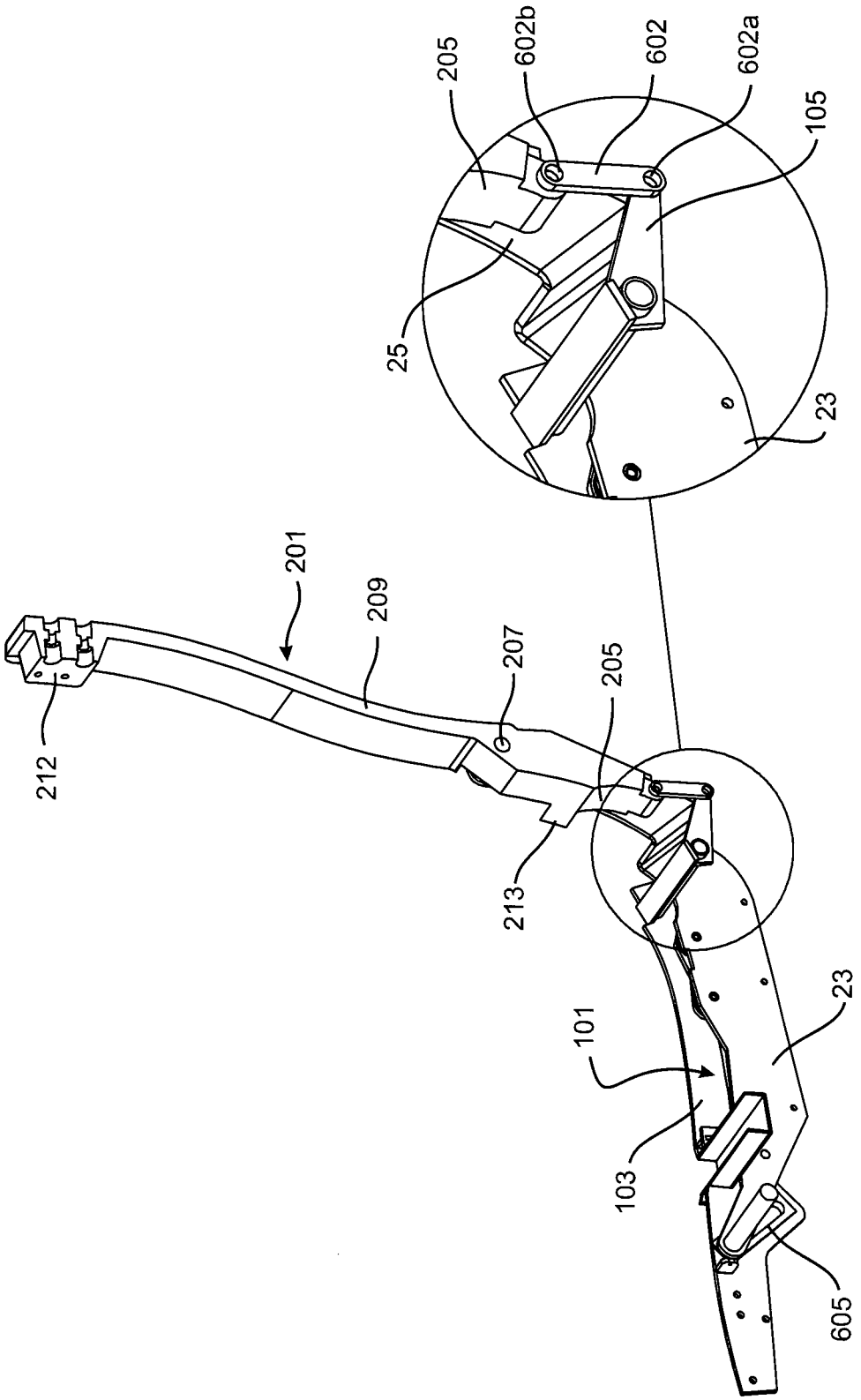

205
602b
602
602a
105
25
23
201
209
207
205
212
213
101
23
103
605

FIGURE 20

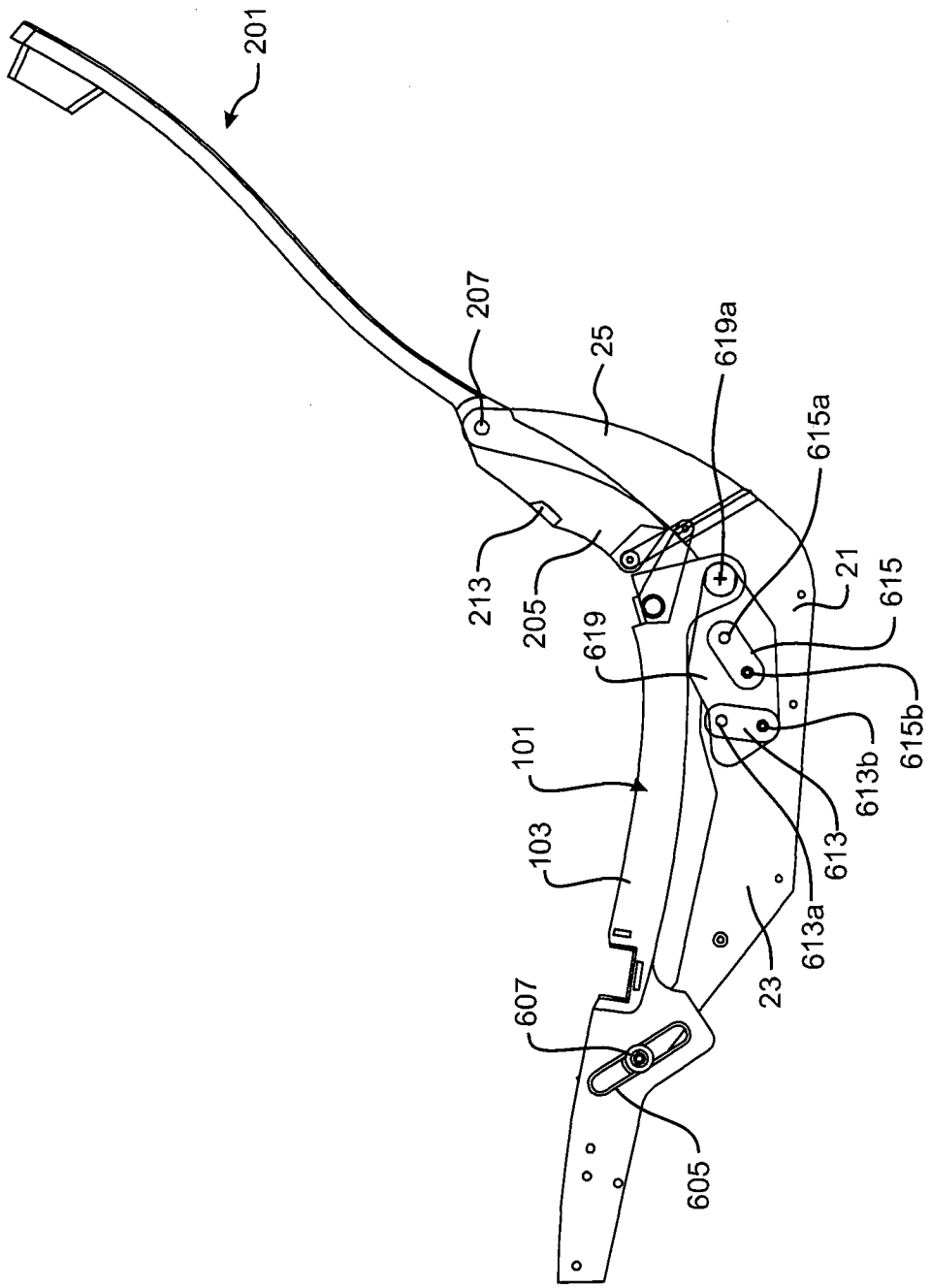

201
207
25
619a
615a
213
205
619
21
615
615b
613b
613
613a
101
103
607
23
605

FIGURE 21

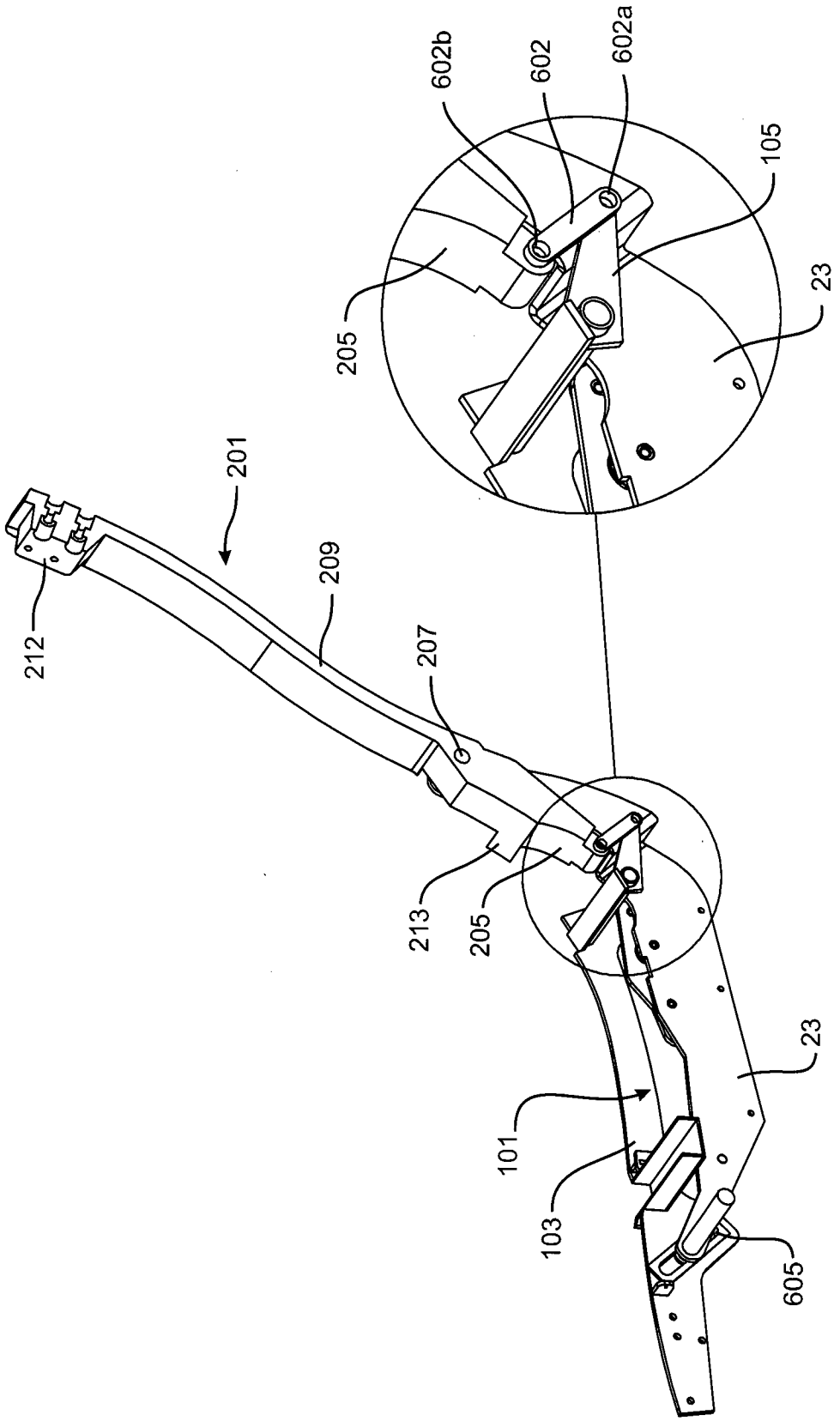


FIGURE 22

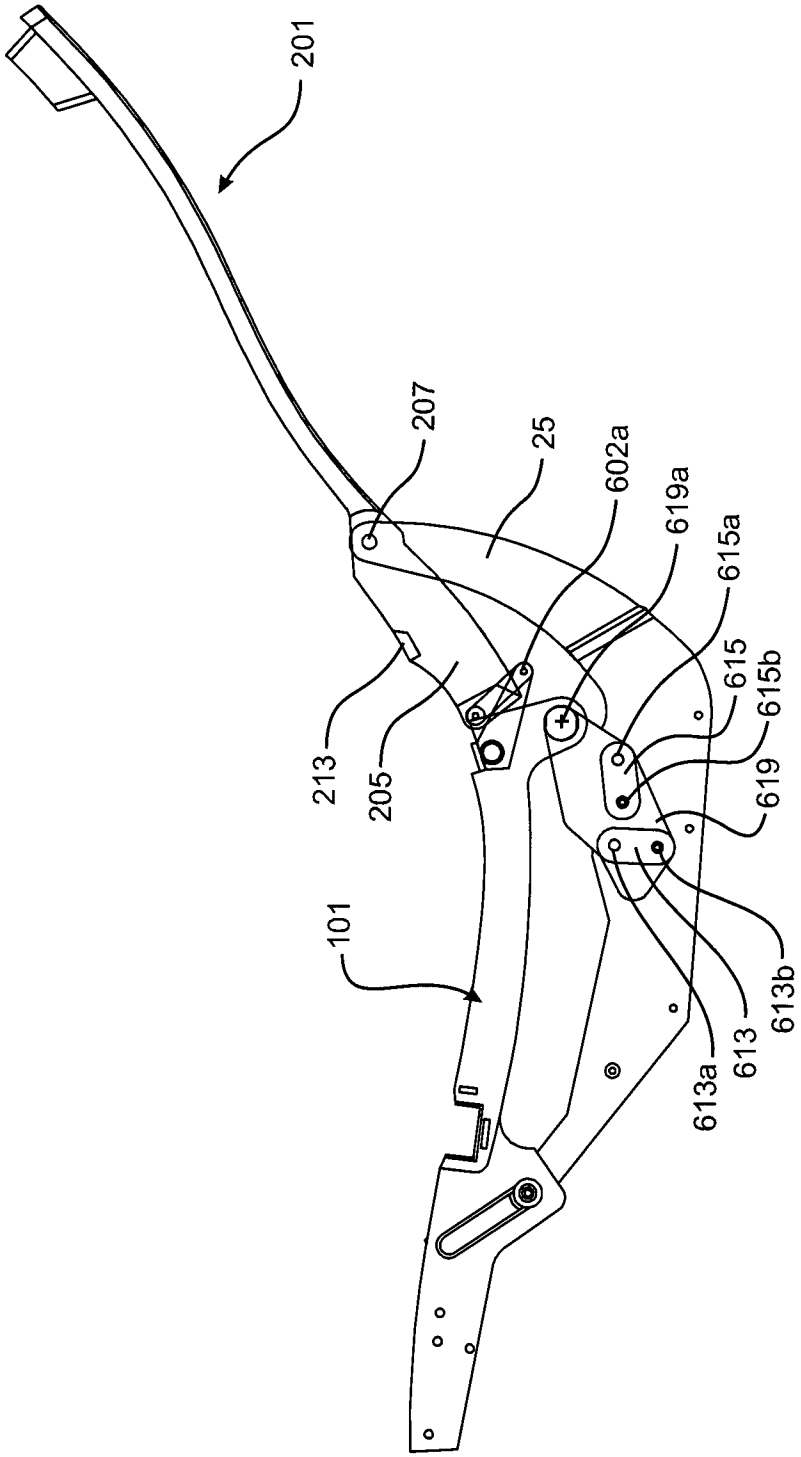

201
207
25
602a
619a
615a
615
615b
619
213
205
101
613b
613
613a

FIGURE 23

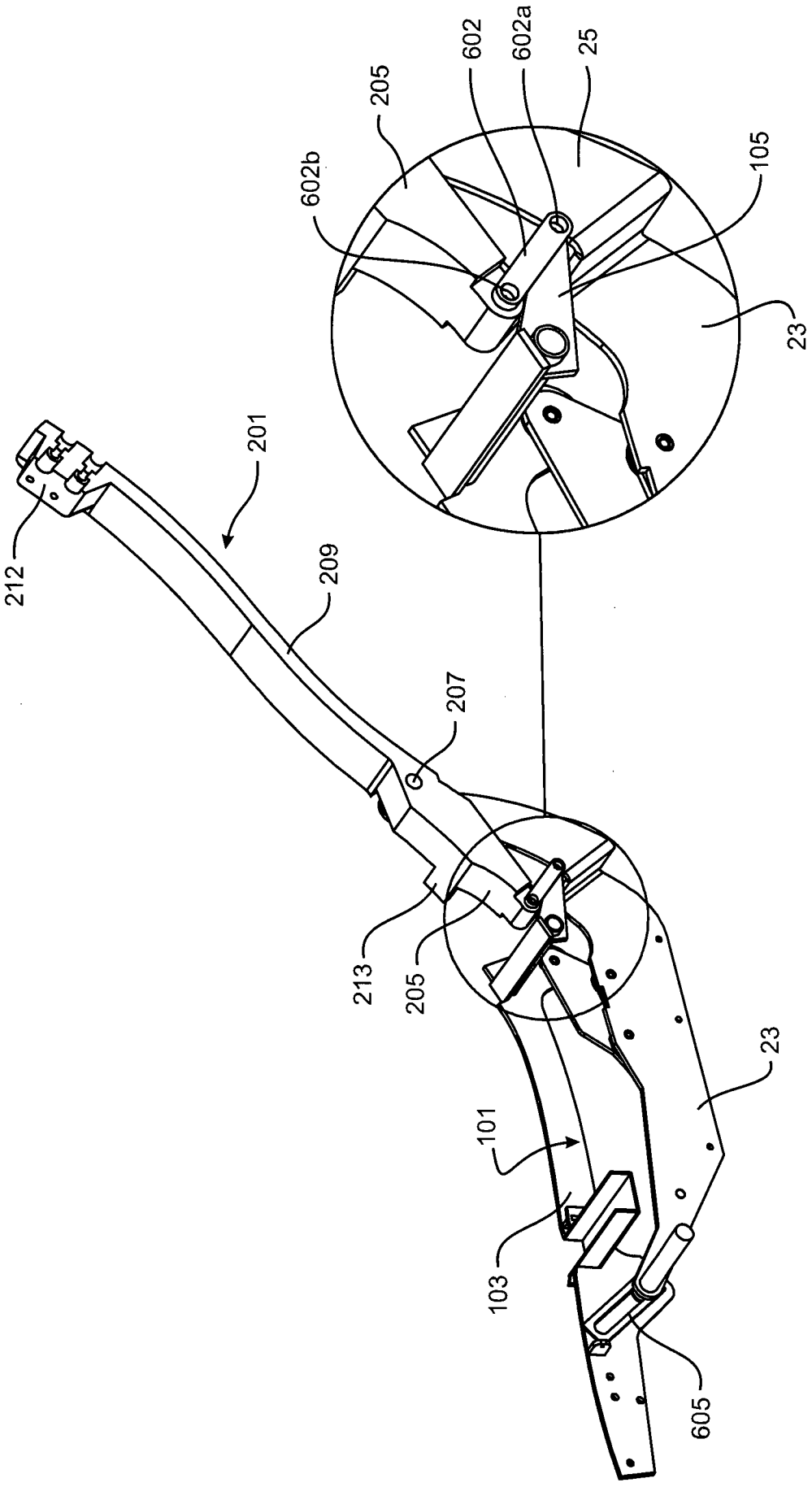

602
602a
25
205
105
602b
23
201
212
209
207
213
205
23
101
103
605

FIGURE 24

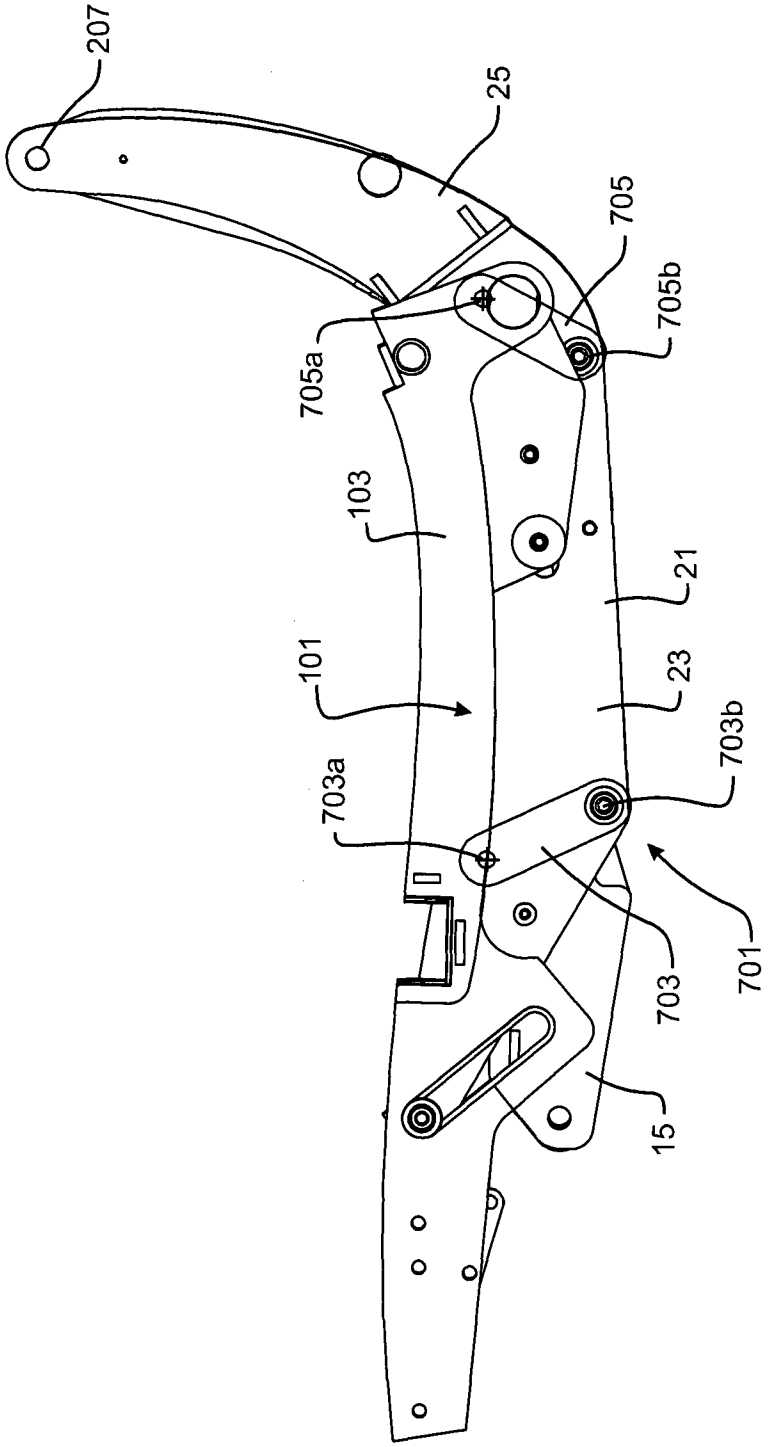


FIGURE 25

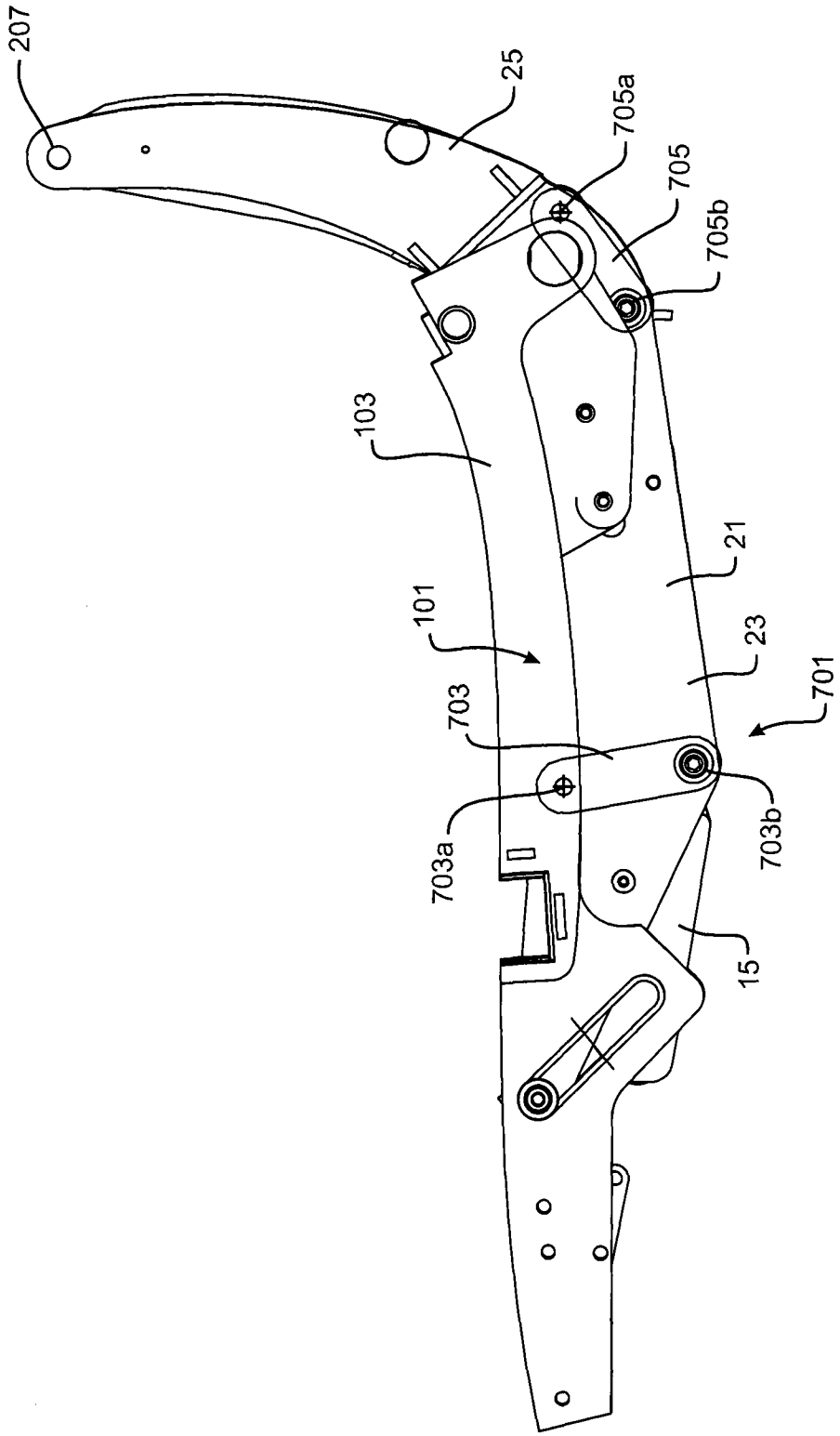


FIGURE 26

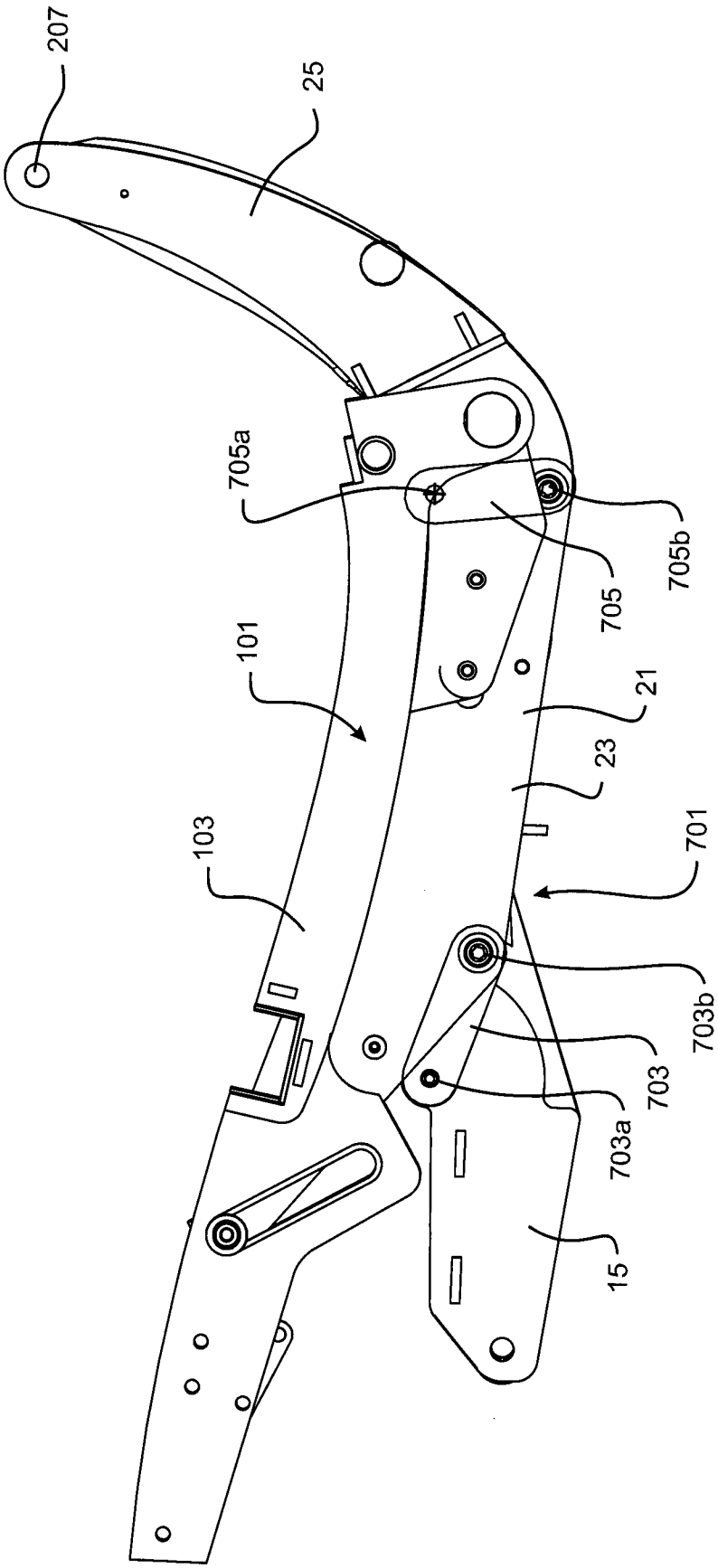


FIGURE 27

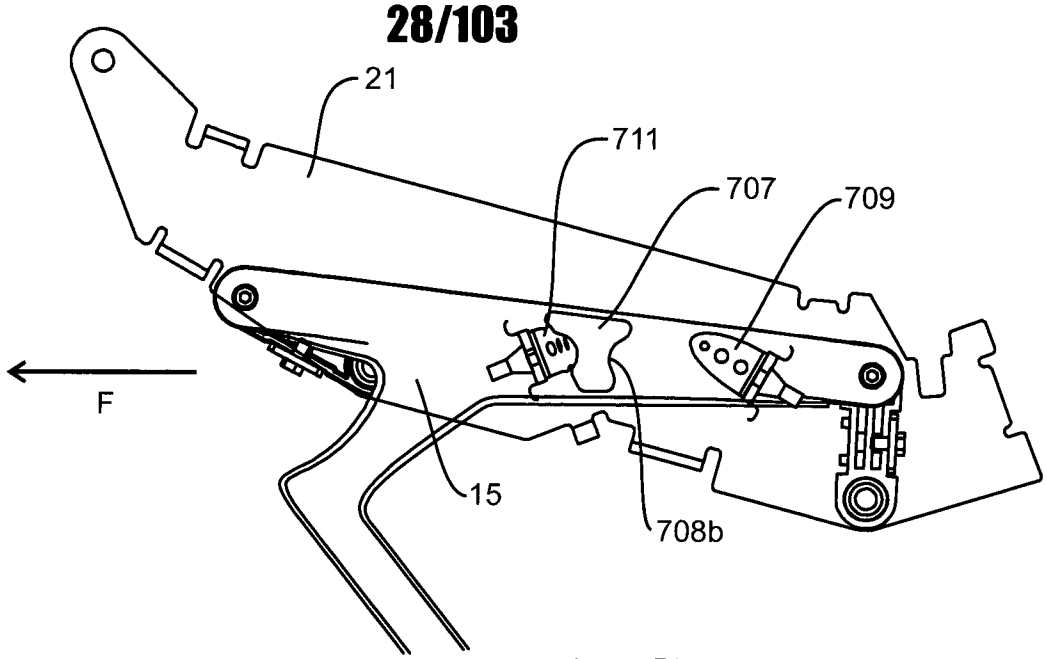


FIGURE 28A

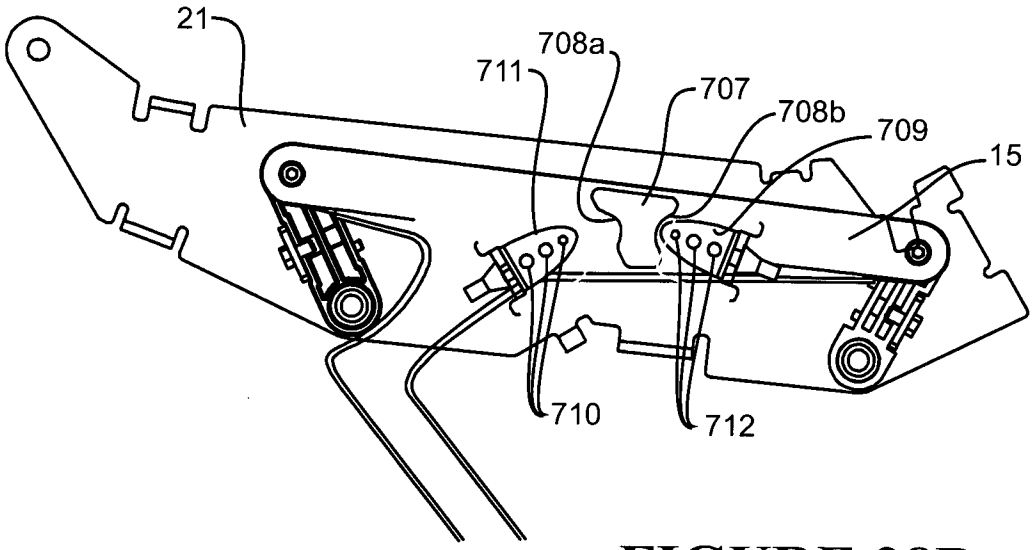


FIGURE 28B

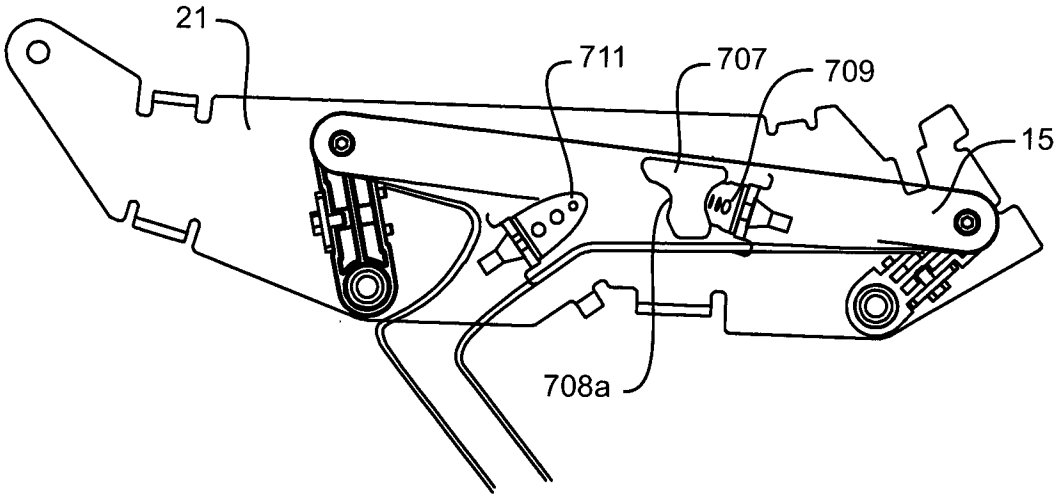


FIGURE 28C

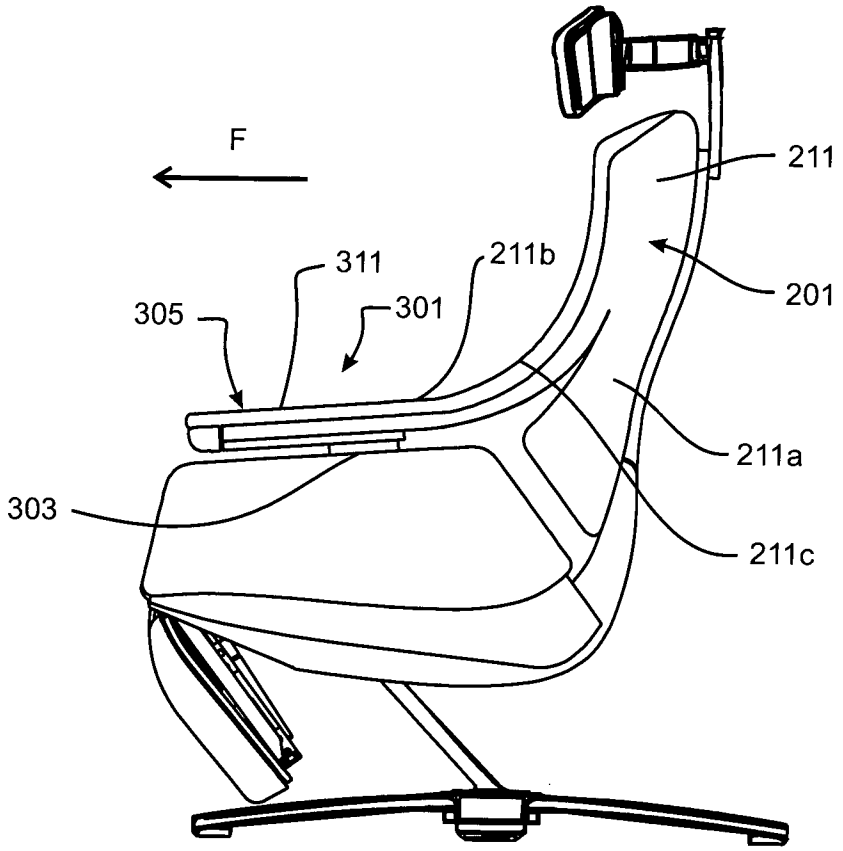


FIGURE 29

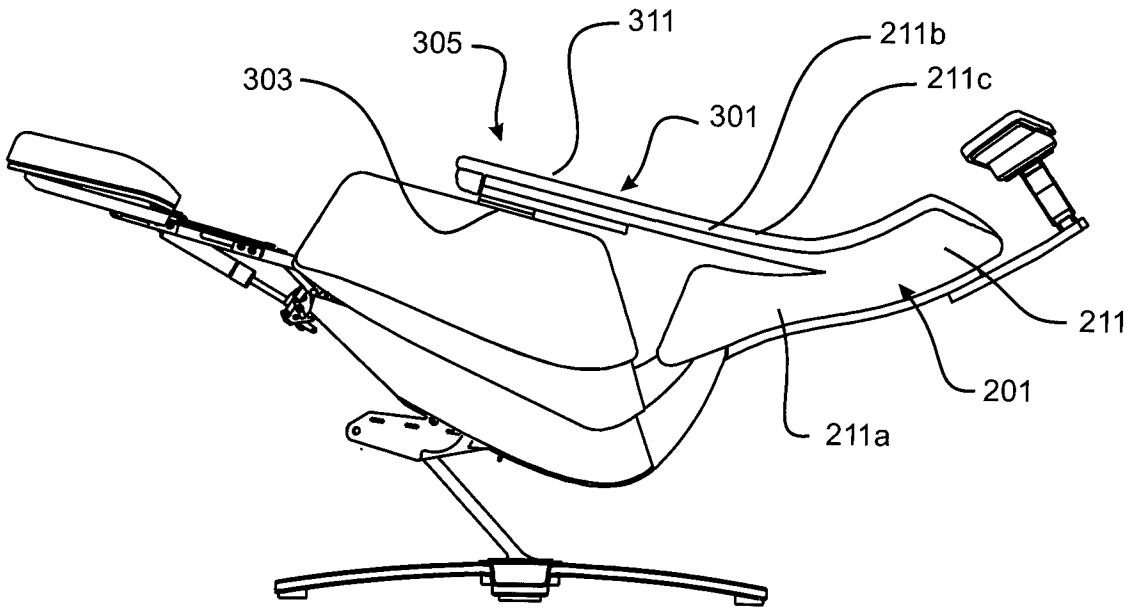


FIGURE 30

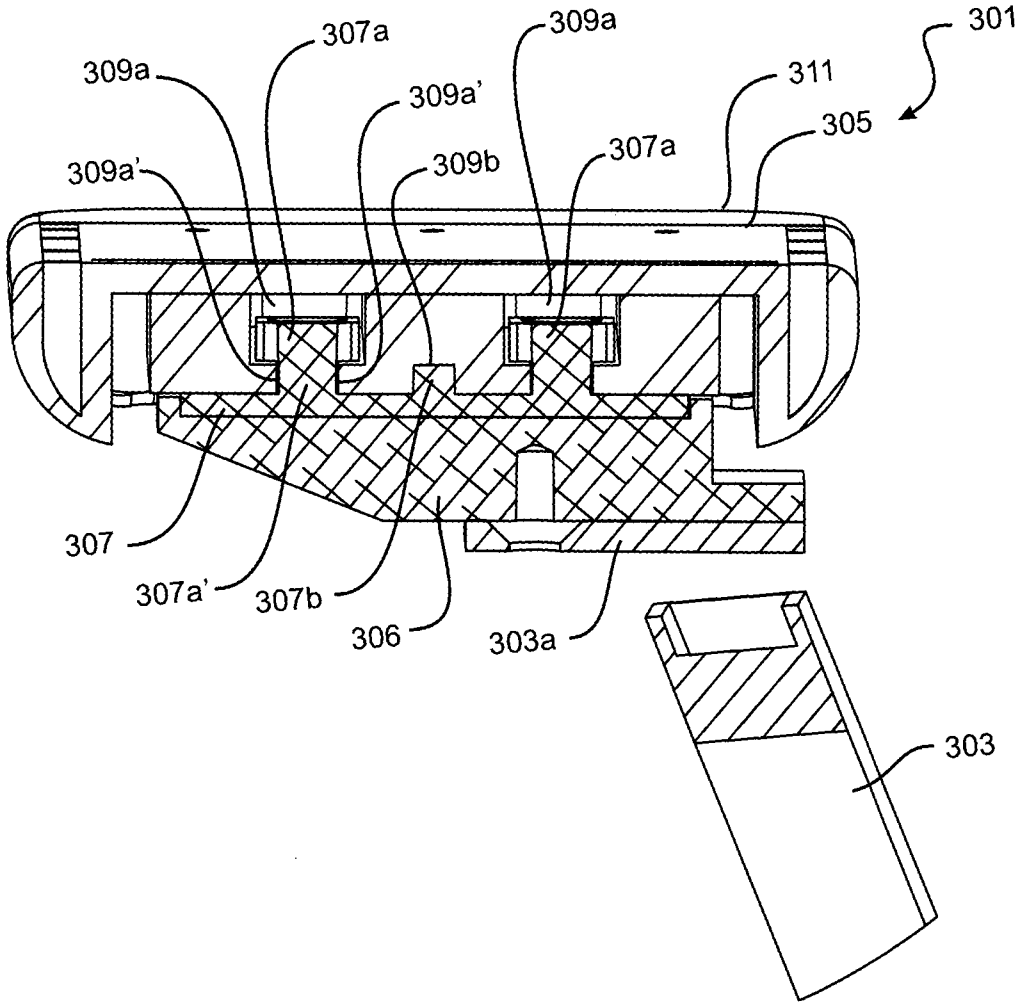

301
307a
309a
309a
309a'
311
305
309a'
309b
307a
307
307a'
307b
306
303a
303

FIGURE 31

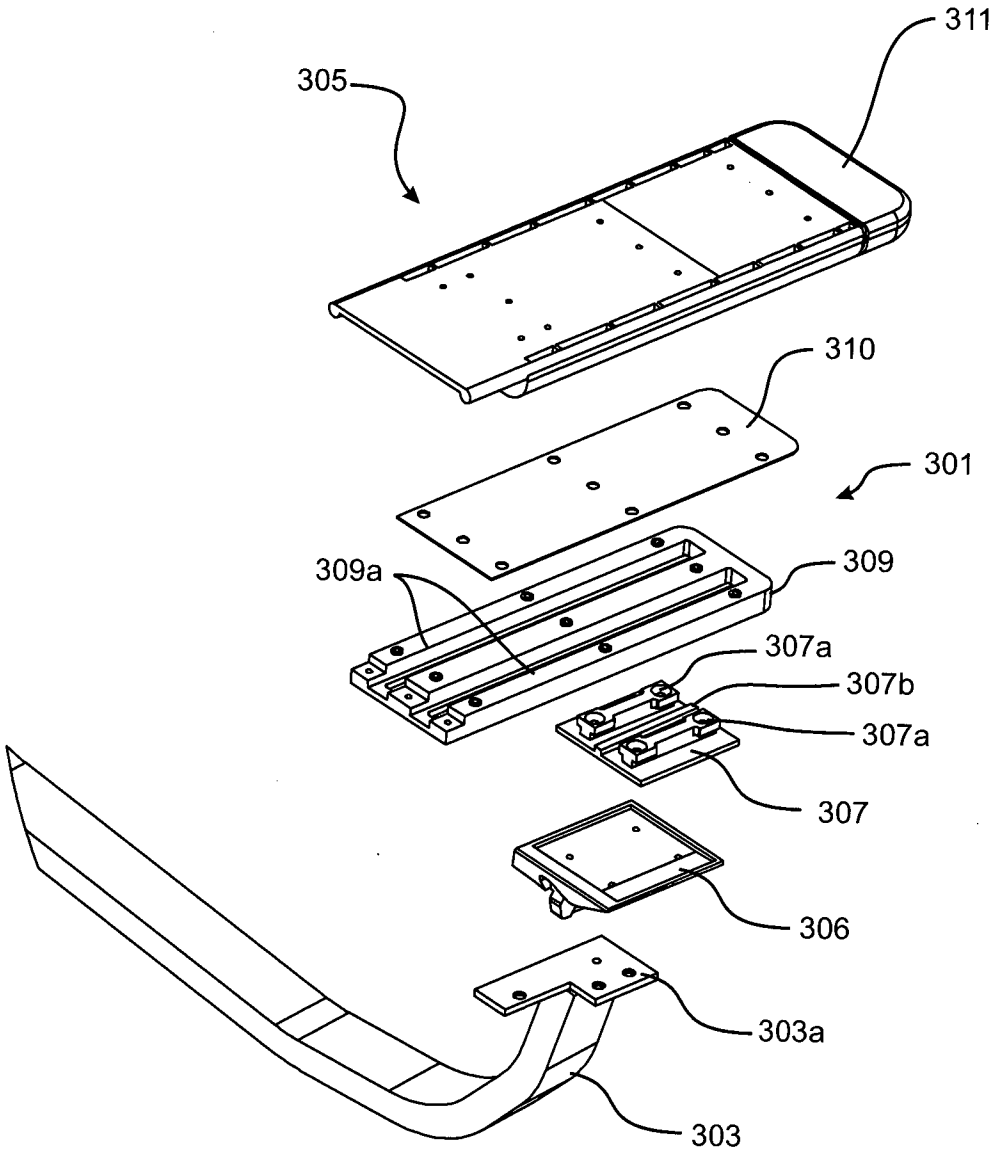


FIGURE 32

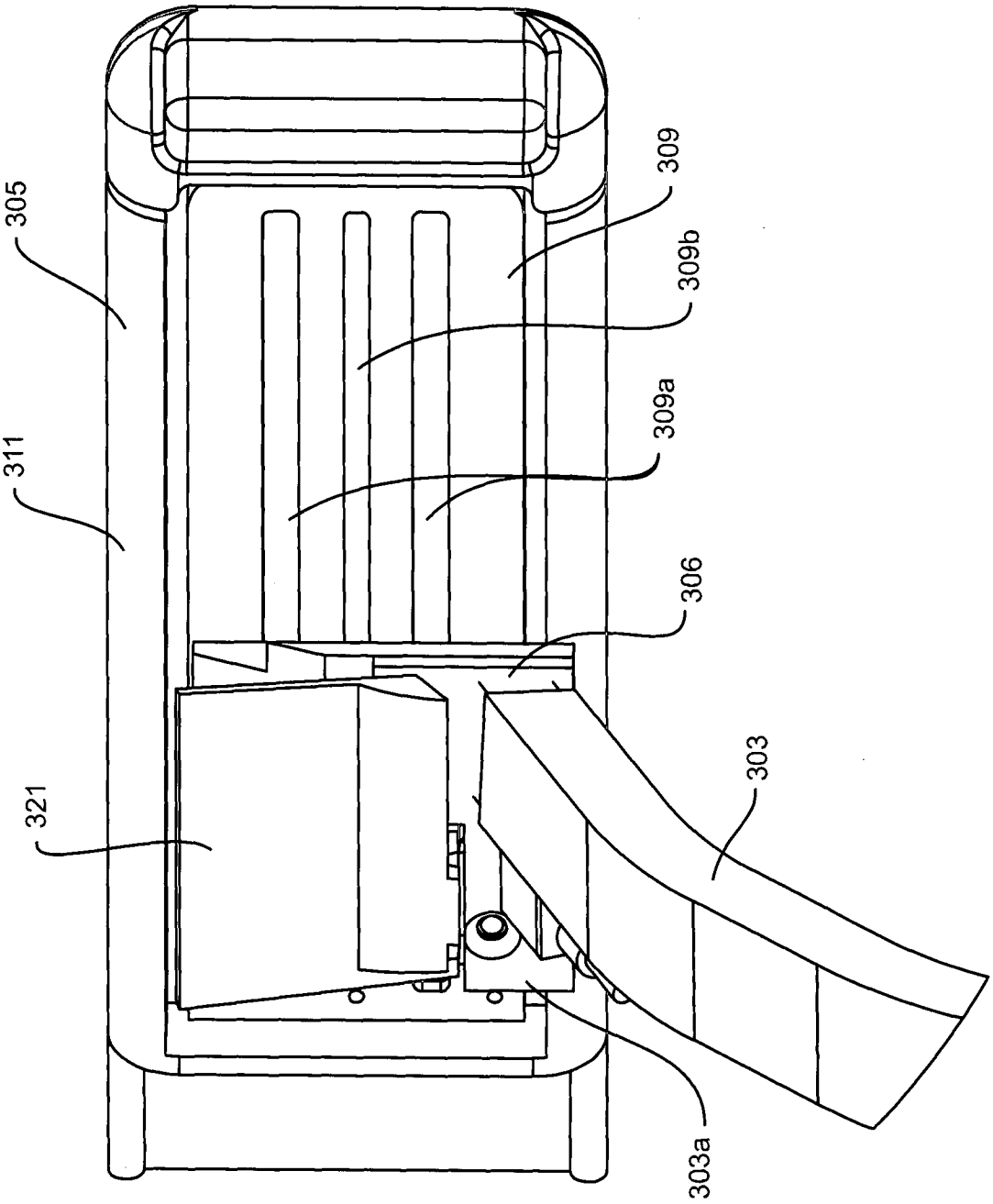


FIGURE 33

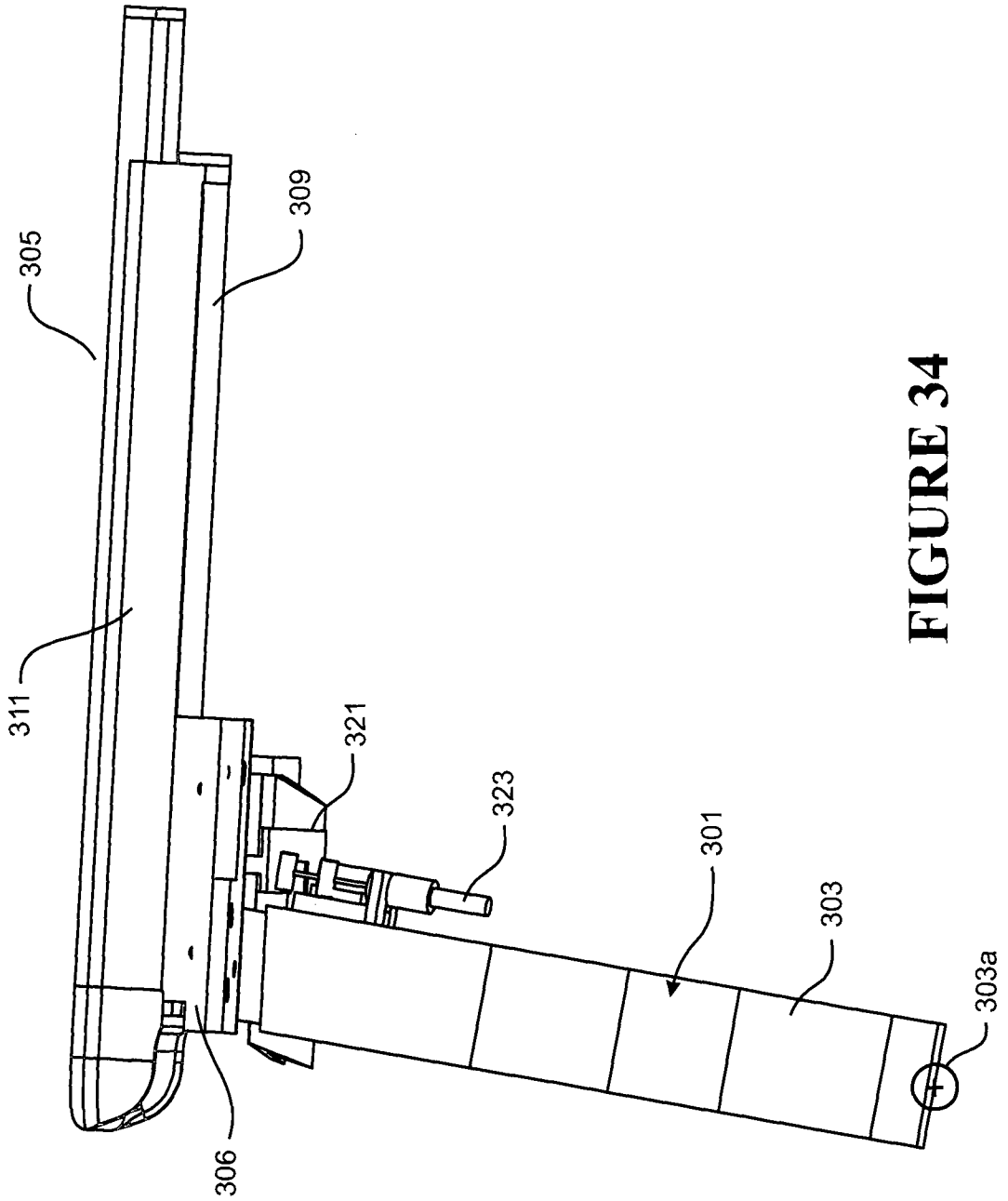


FIGURE 34

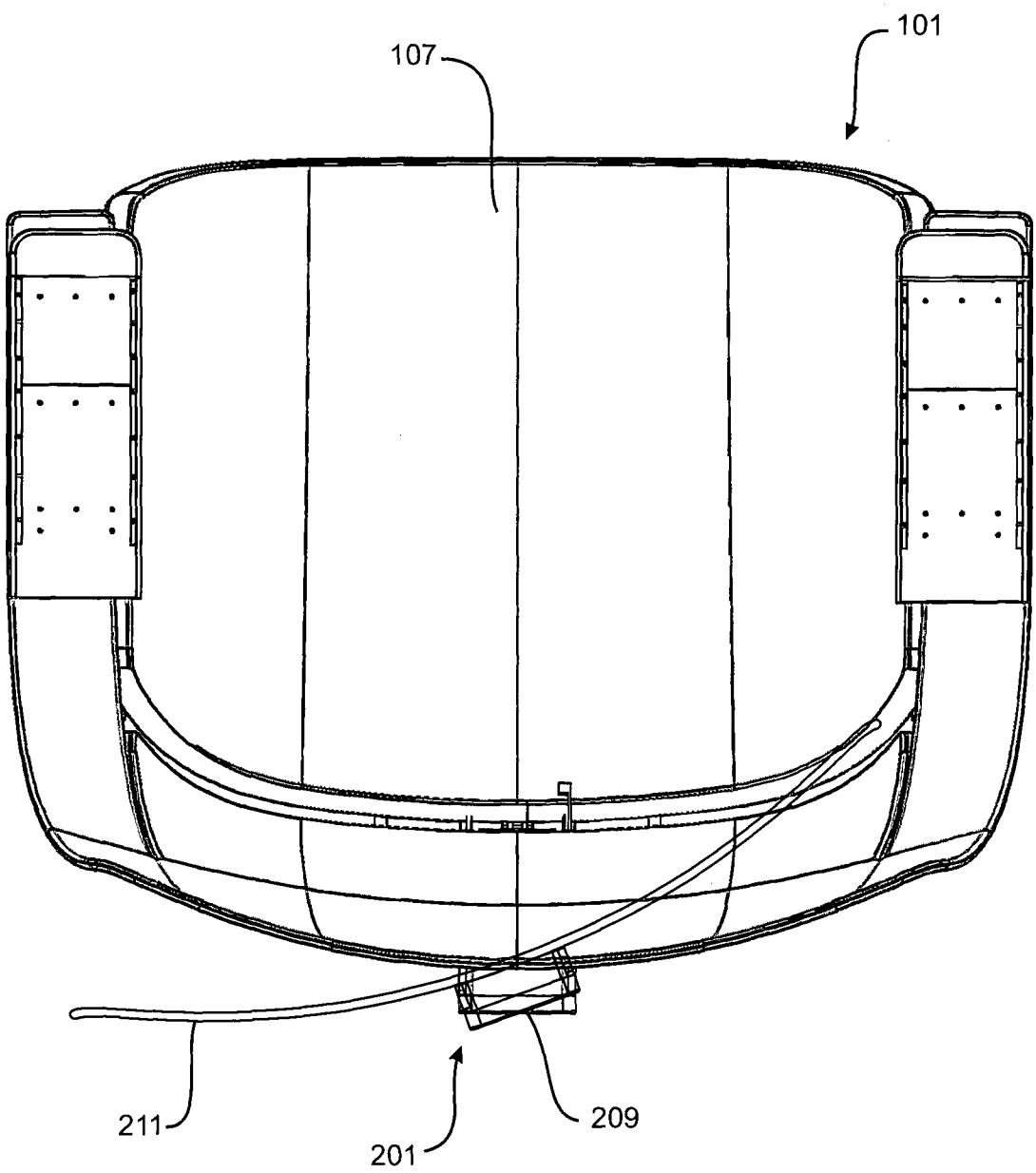


FIGURE 35

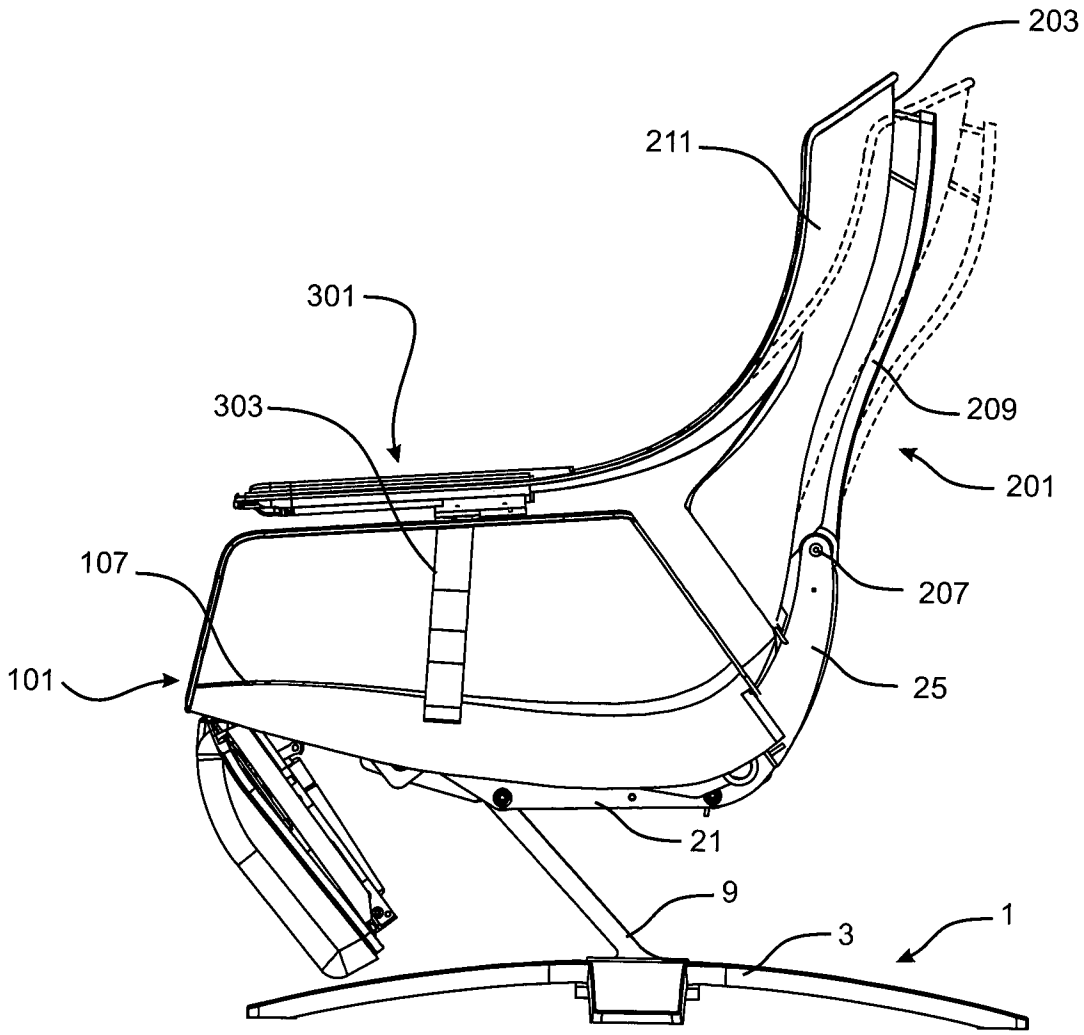


FIGURE 36

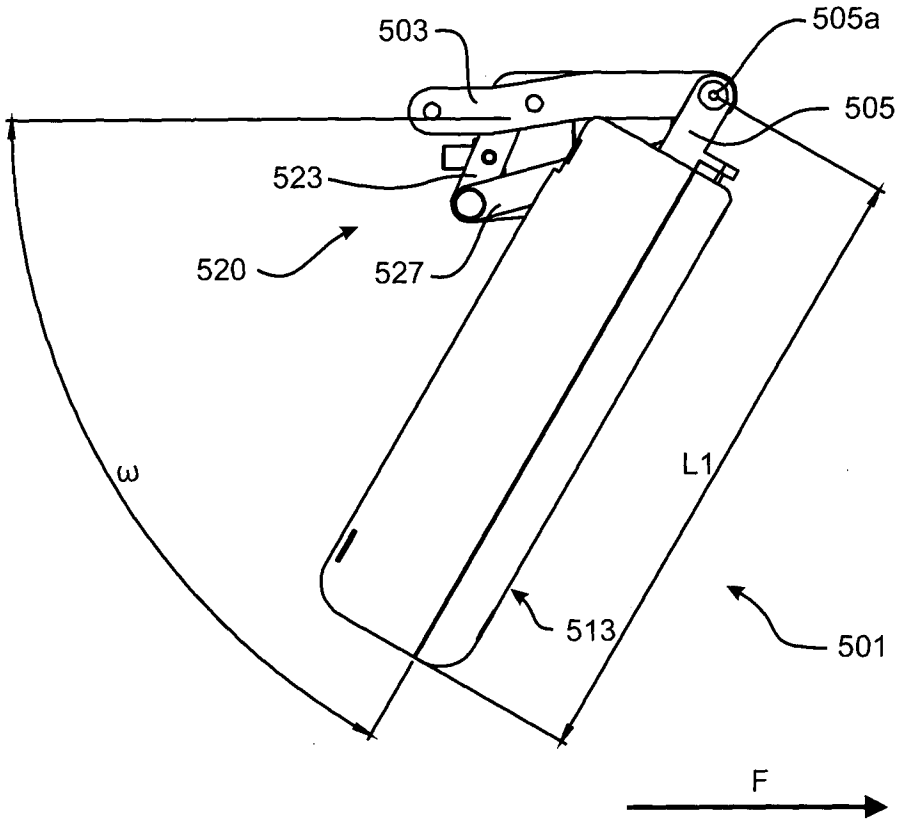


FIGURE 37

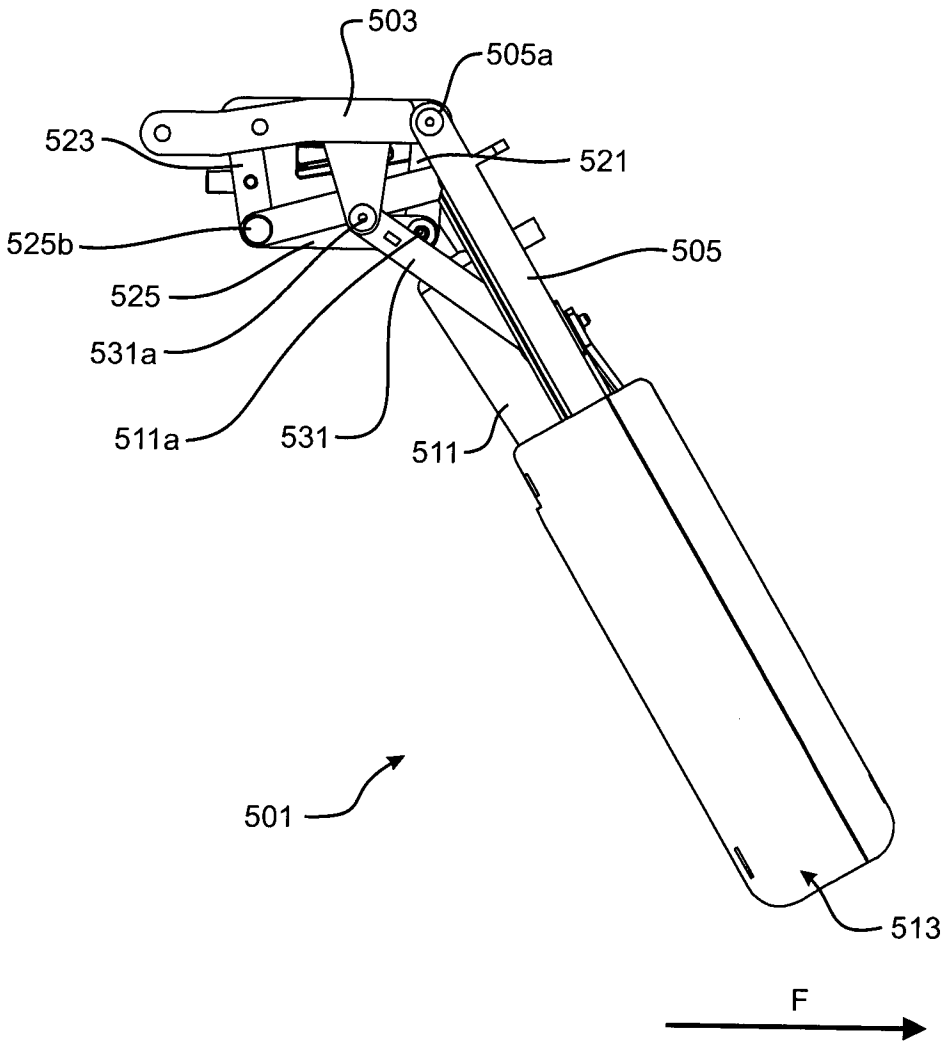


FIGURE 38

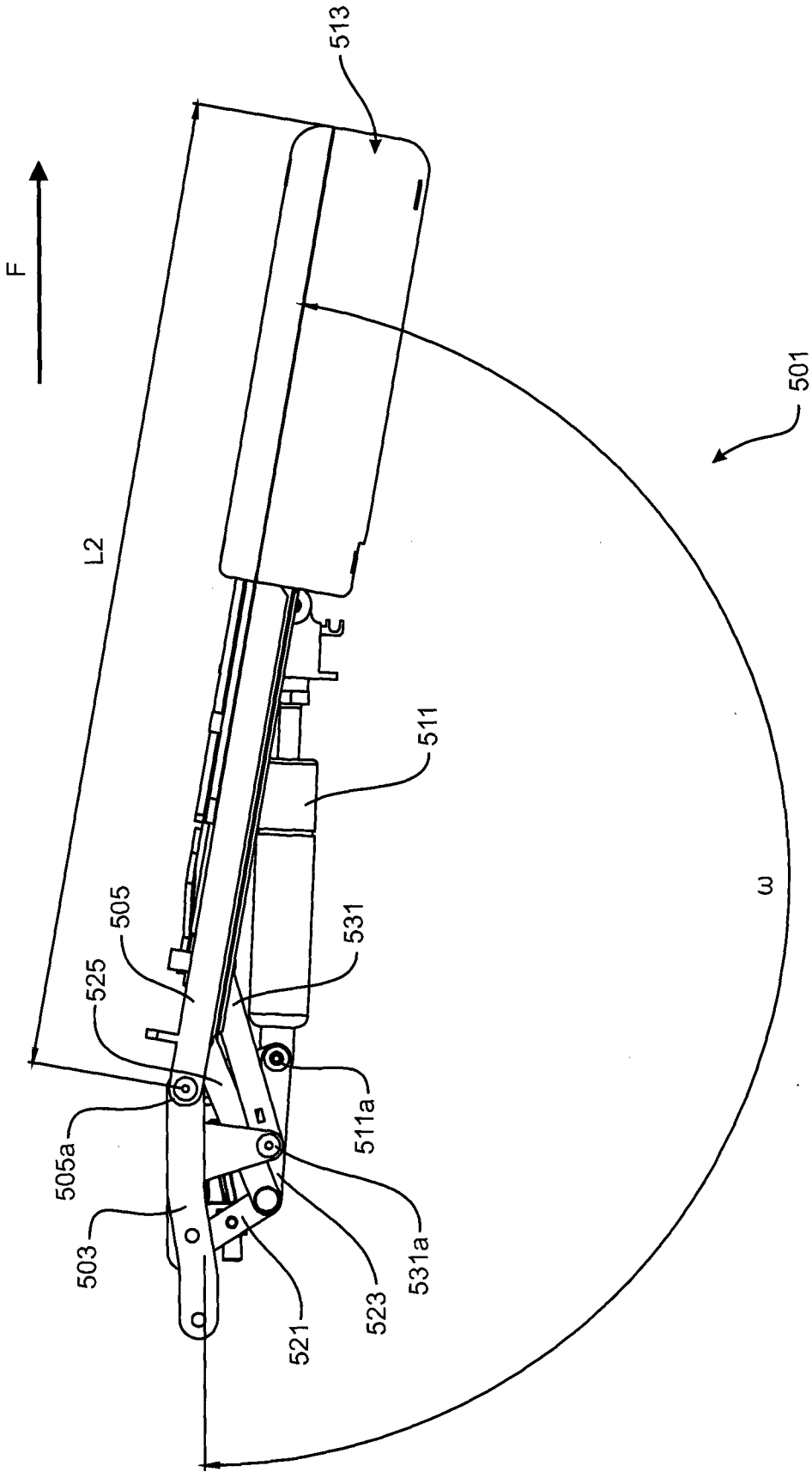


FIGURE 39

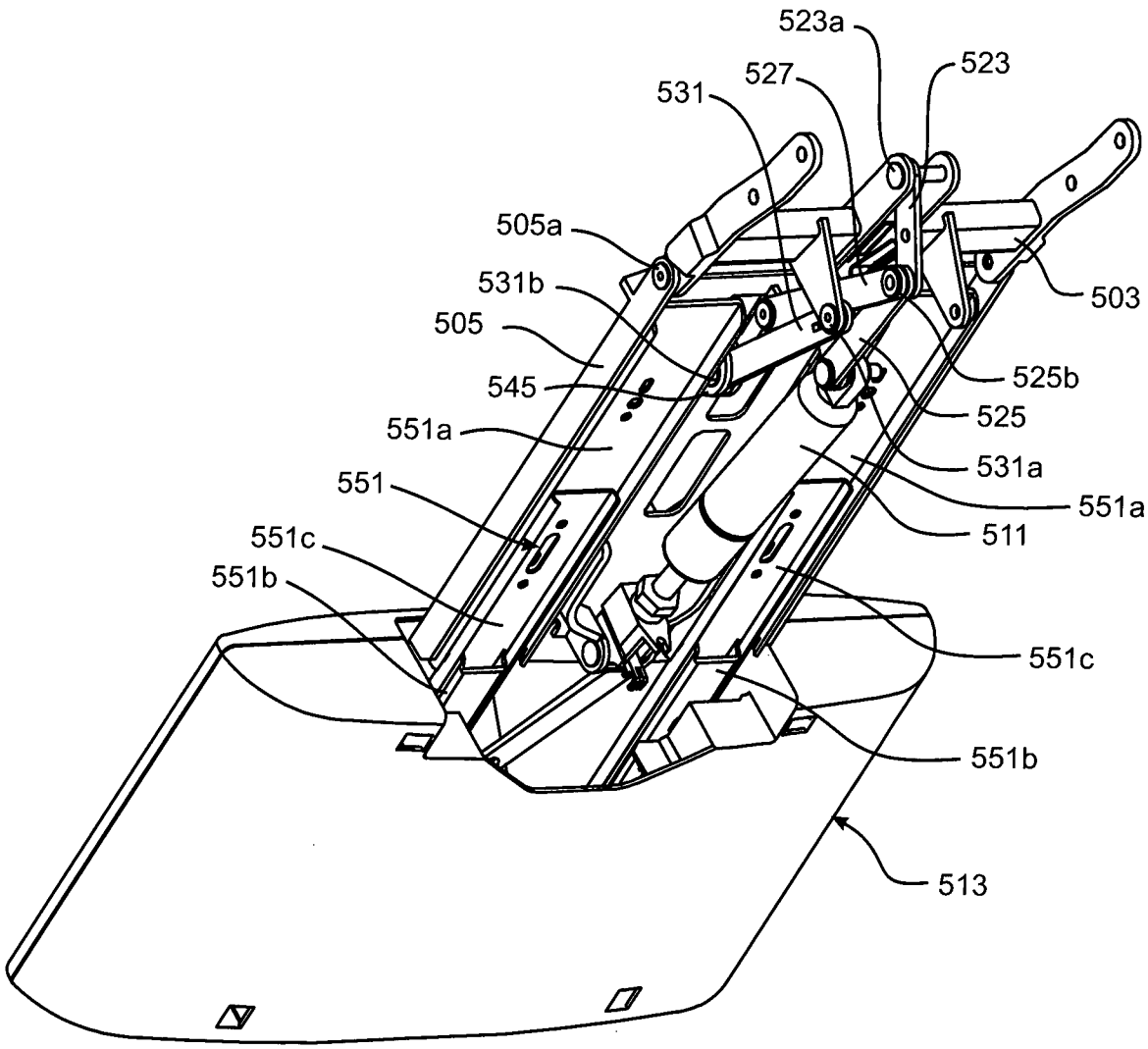

523a
527
523
531
505a
531b
503
505
525b
545
525
551a
531a
551
551a
551c
511
551b
551c
551b
513

FIGURE 40

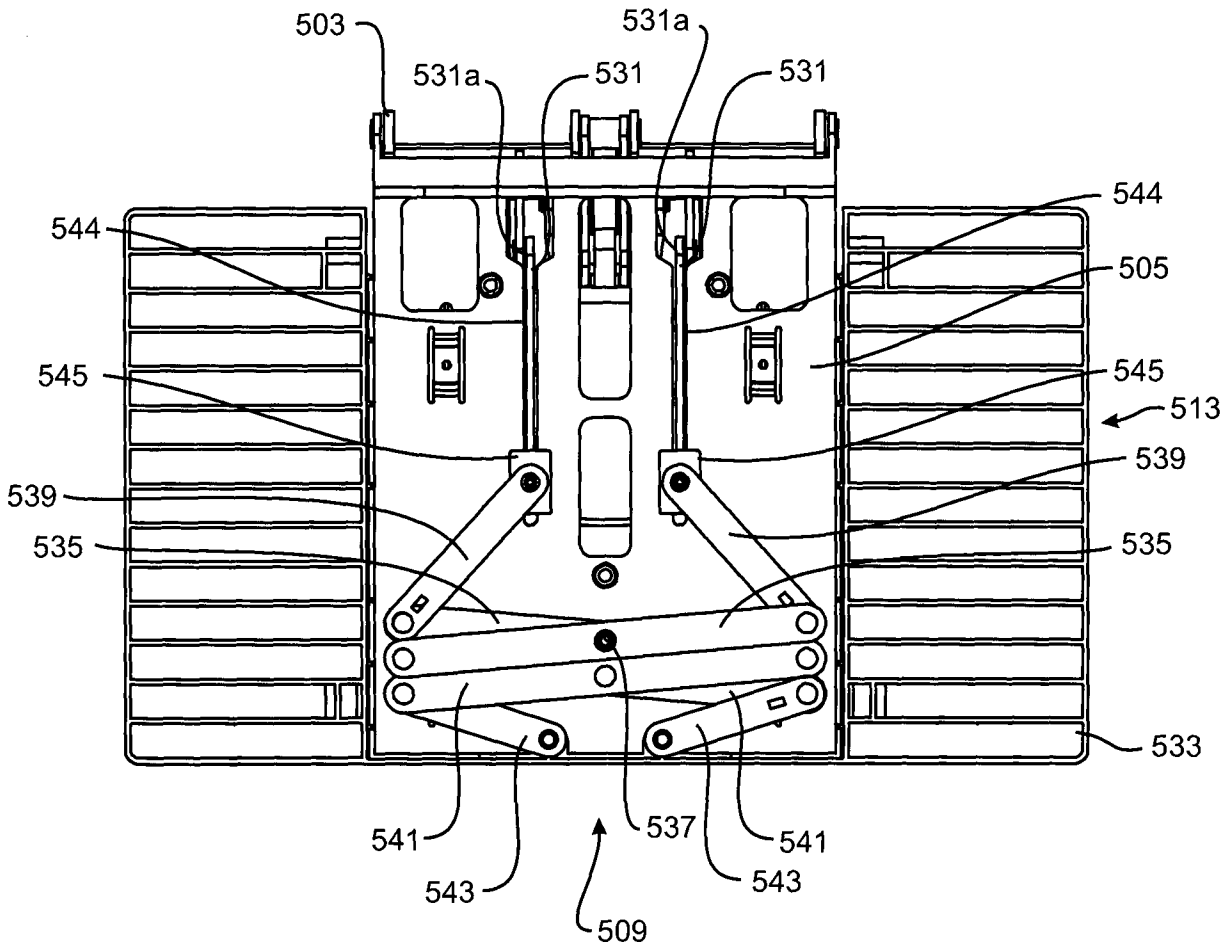

503
531a
531a
531
531
544
544
505
545
545
513
539
539
535
535
533
541
543
537
541
543
509

FIGURE 41

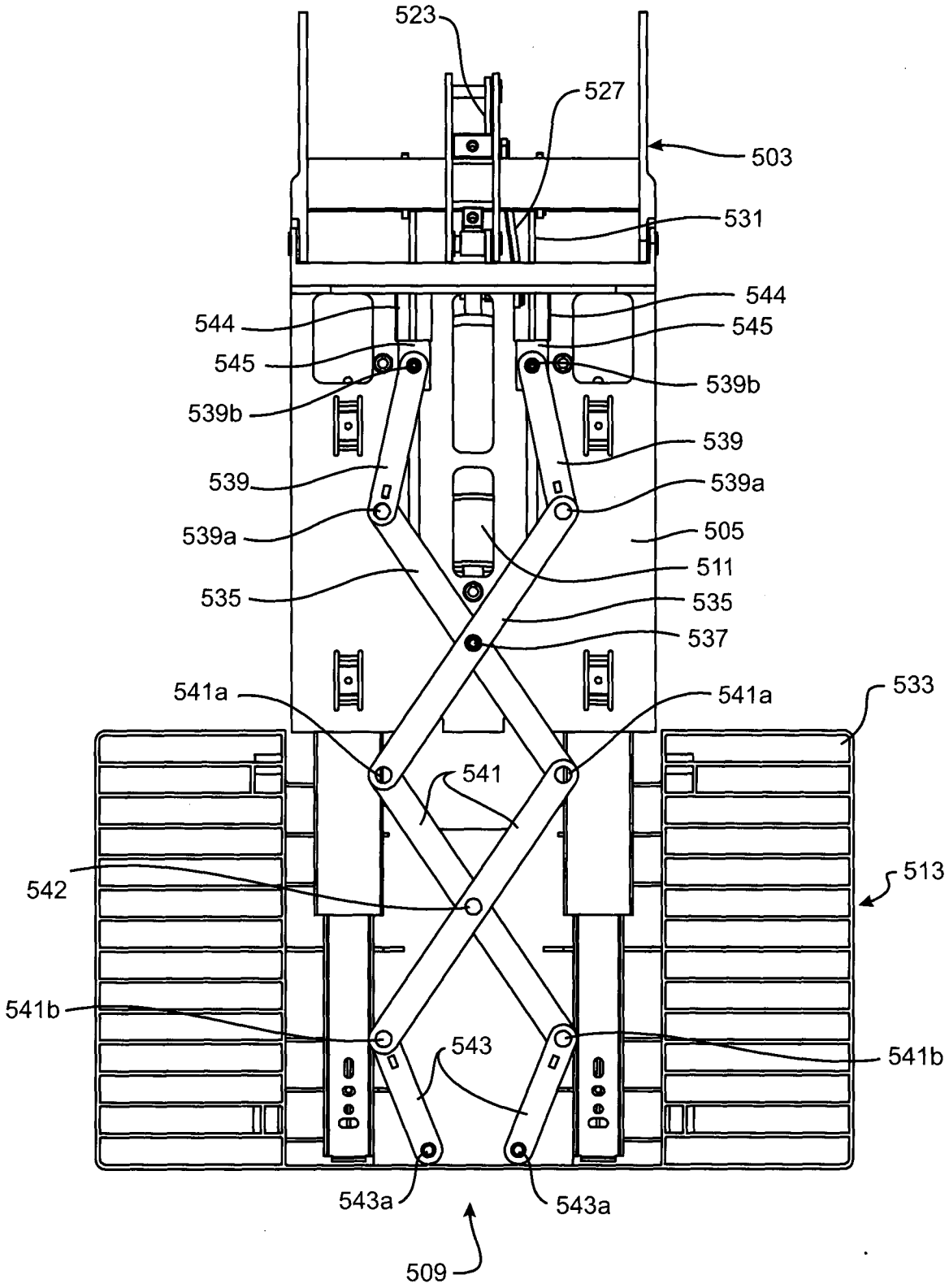

523
527
503
531
544
544
545
545
539b
539b
539
539
539a
539a
505
511
535
535
537
541a
541a
533
541
513
542
541b
541b
543
543a
543a
509

FIGURE 42

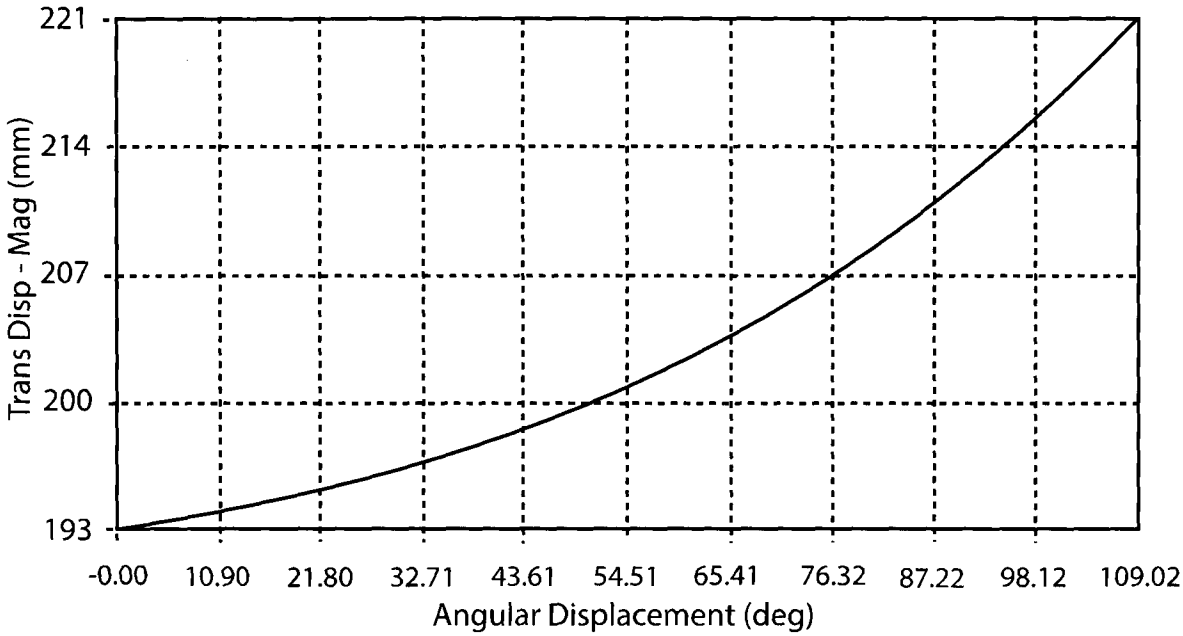

221
214
207
200
193
Trans Disp - Mag (mm)
-0.00
10.90
21.80
32.71
43.61
54.51
65.41
76.32
87.22
98.12
109.02
Angular Displacement (deg)

FIGURE 43

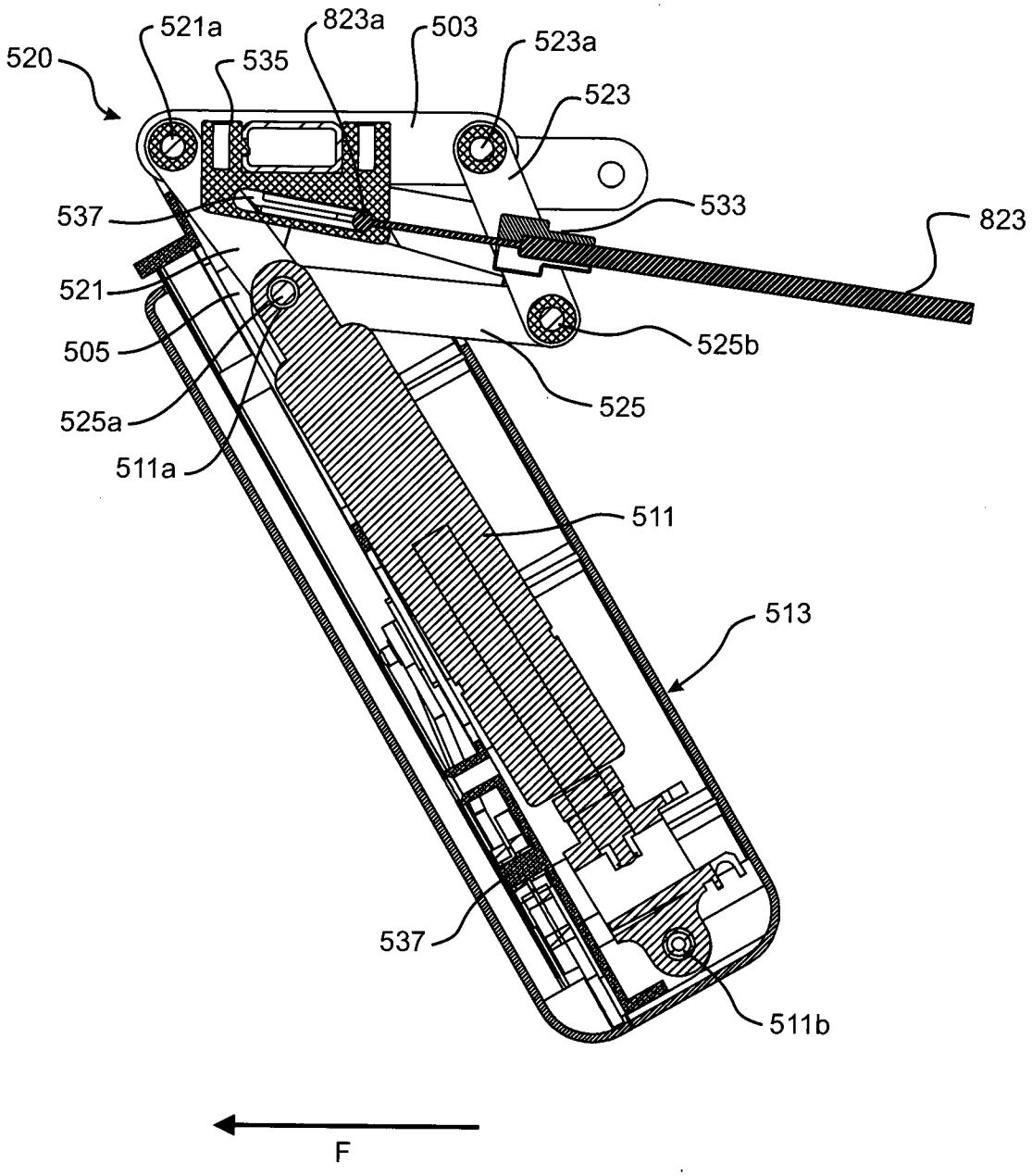

520
521a
535
823a
503
523a
523
533
823
537
521
505
525a
511a
525b
525
511
513
537
511b
F

FIGURE 44

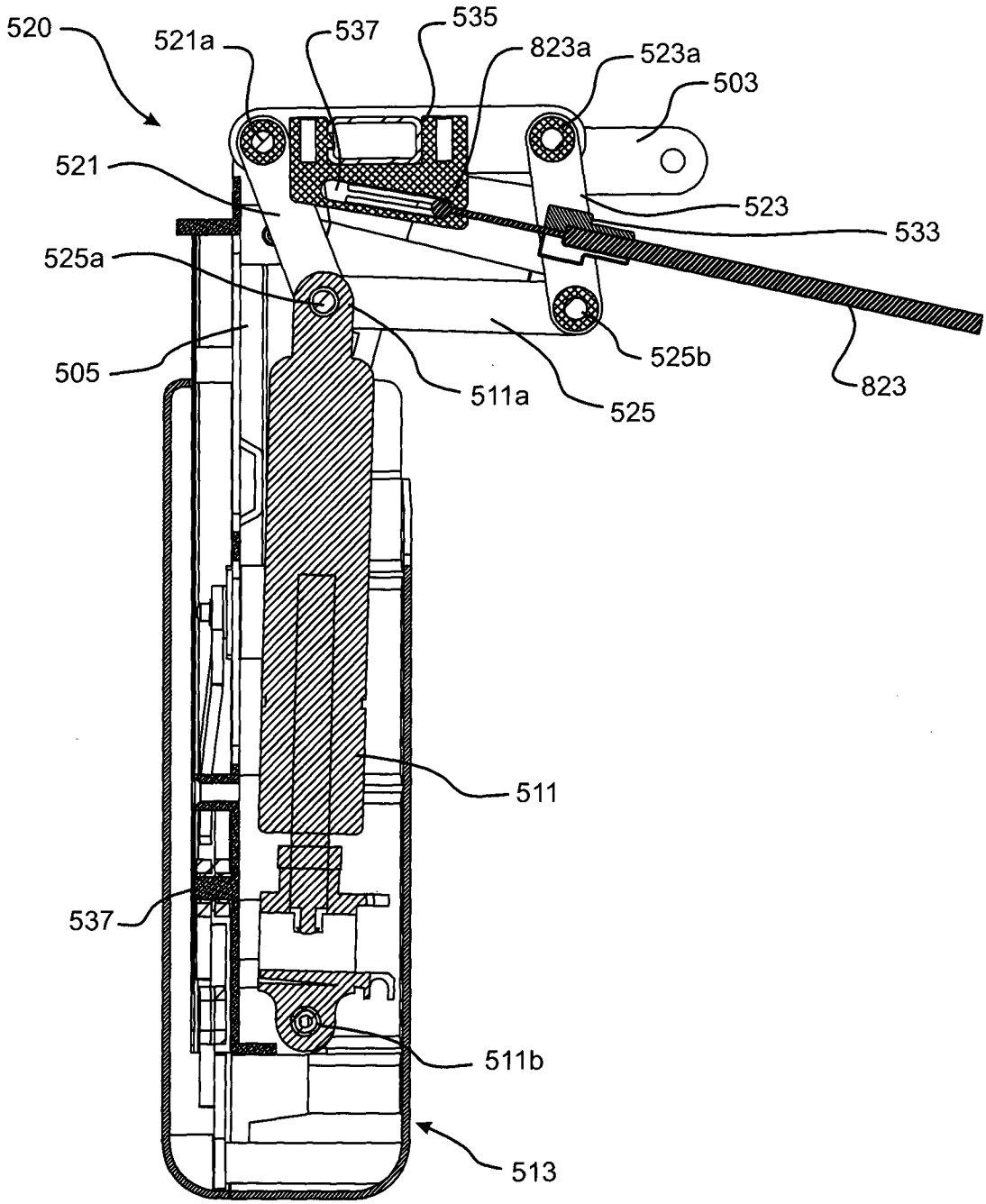
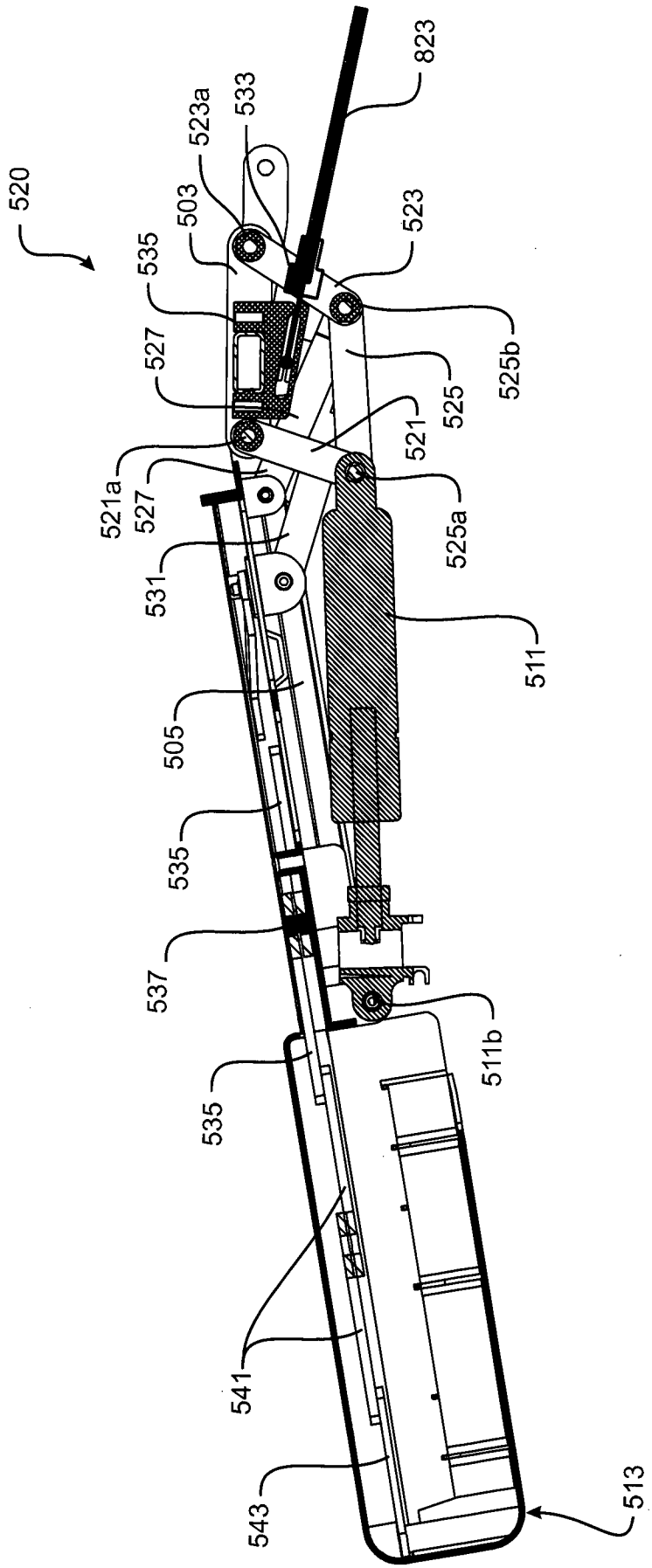

520
521a
537
535
823a
523a
503
521
523
533
525a
525b
505
511a
525
823
511
537
511b
513

FIGURE 45


520
823
533
523a
503
535
523
527
525b
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521
521a
527
525a
531
511
505
535
537
511b
535
541
543
513

FIGURE 46

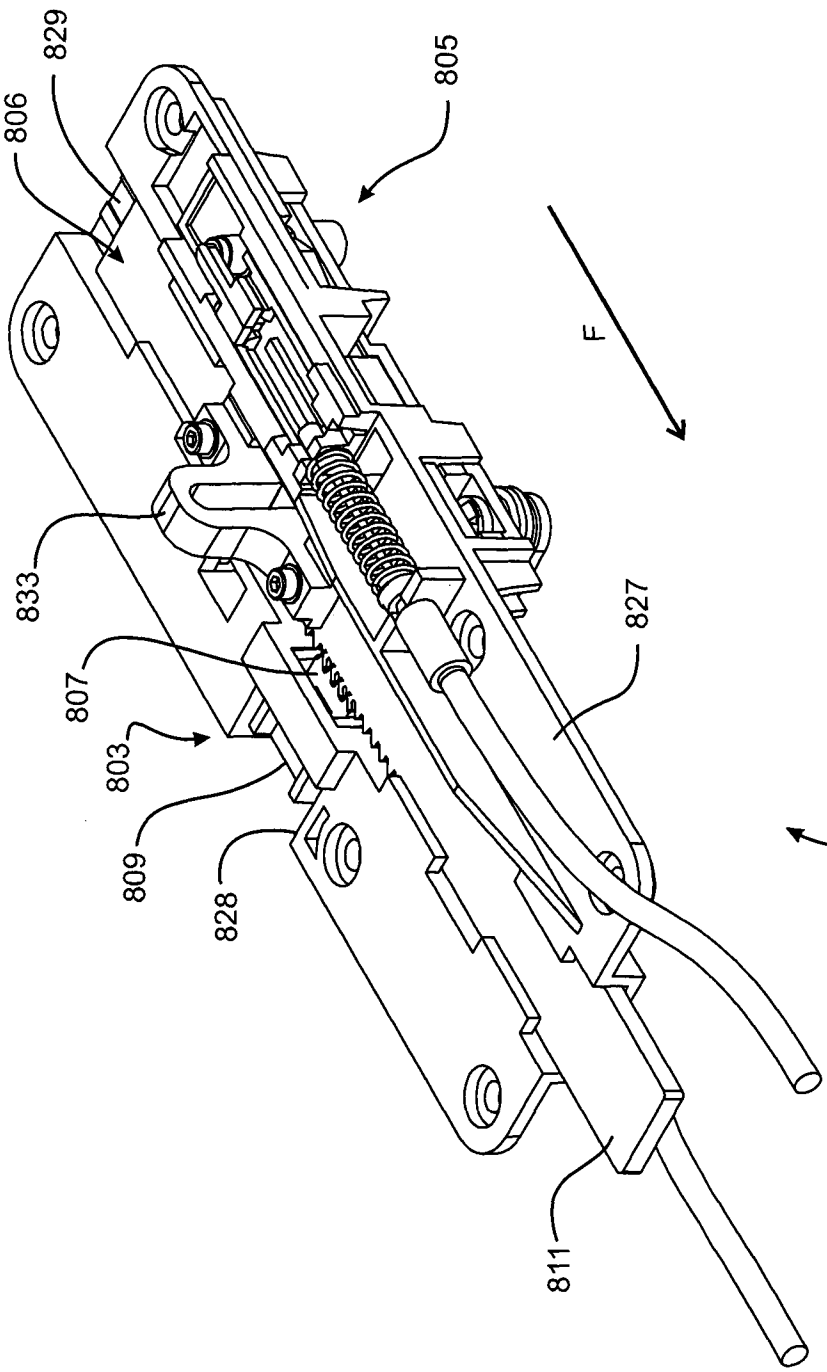


FIGURE 47

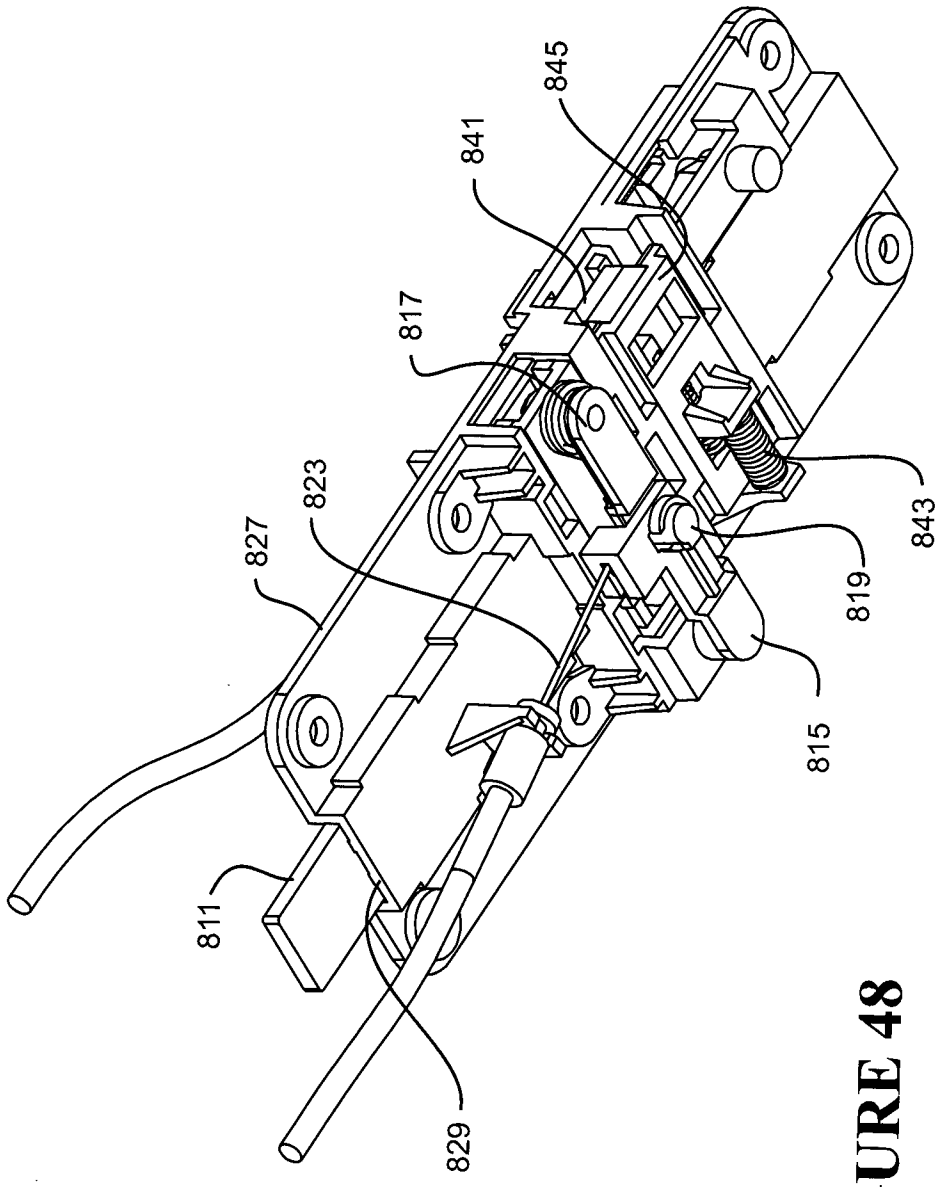


FIGURE 48

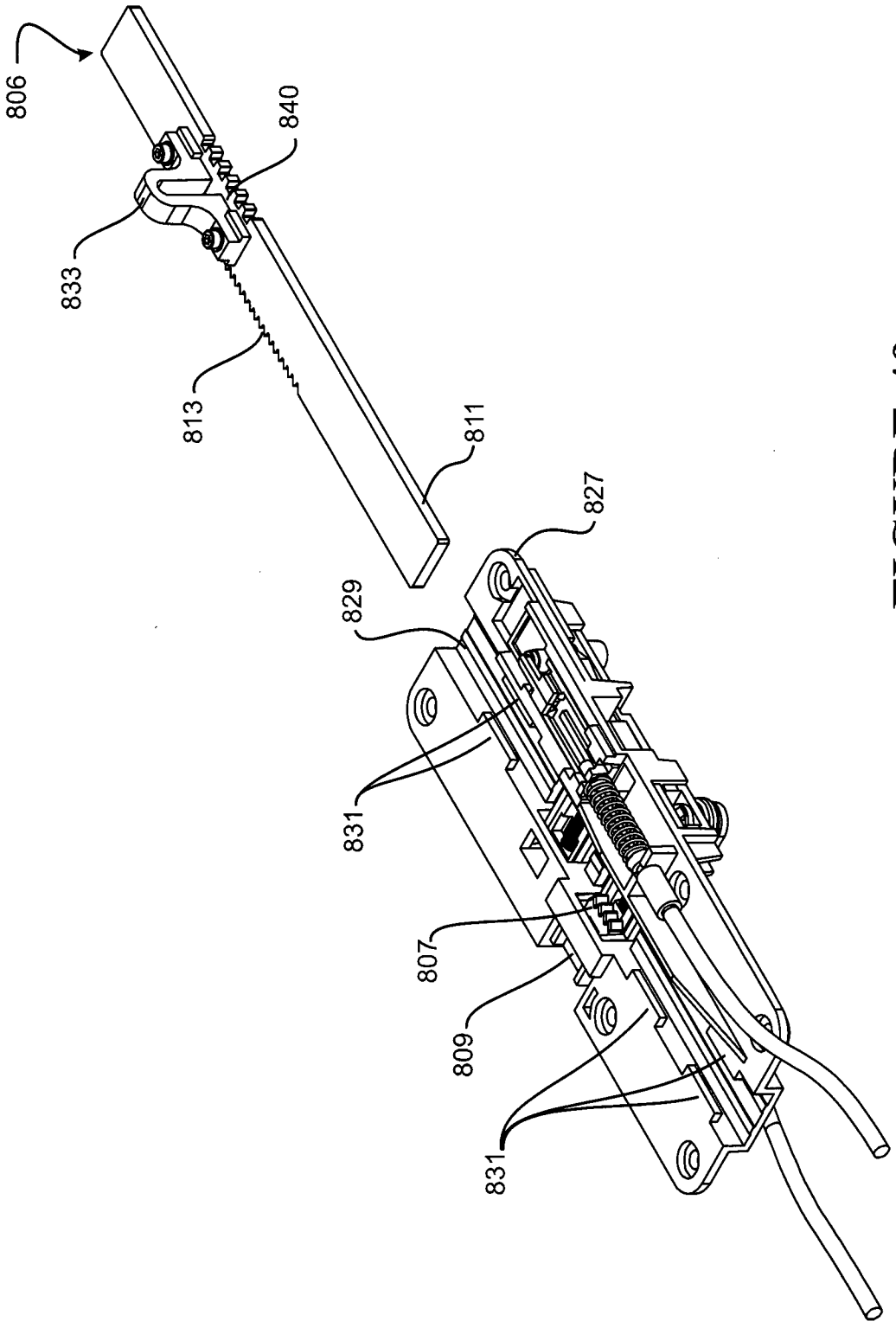


FIGURE 49

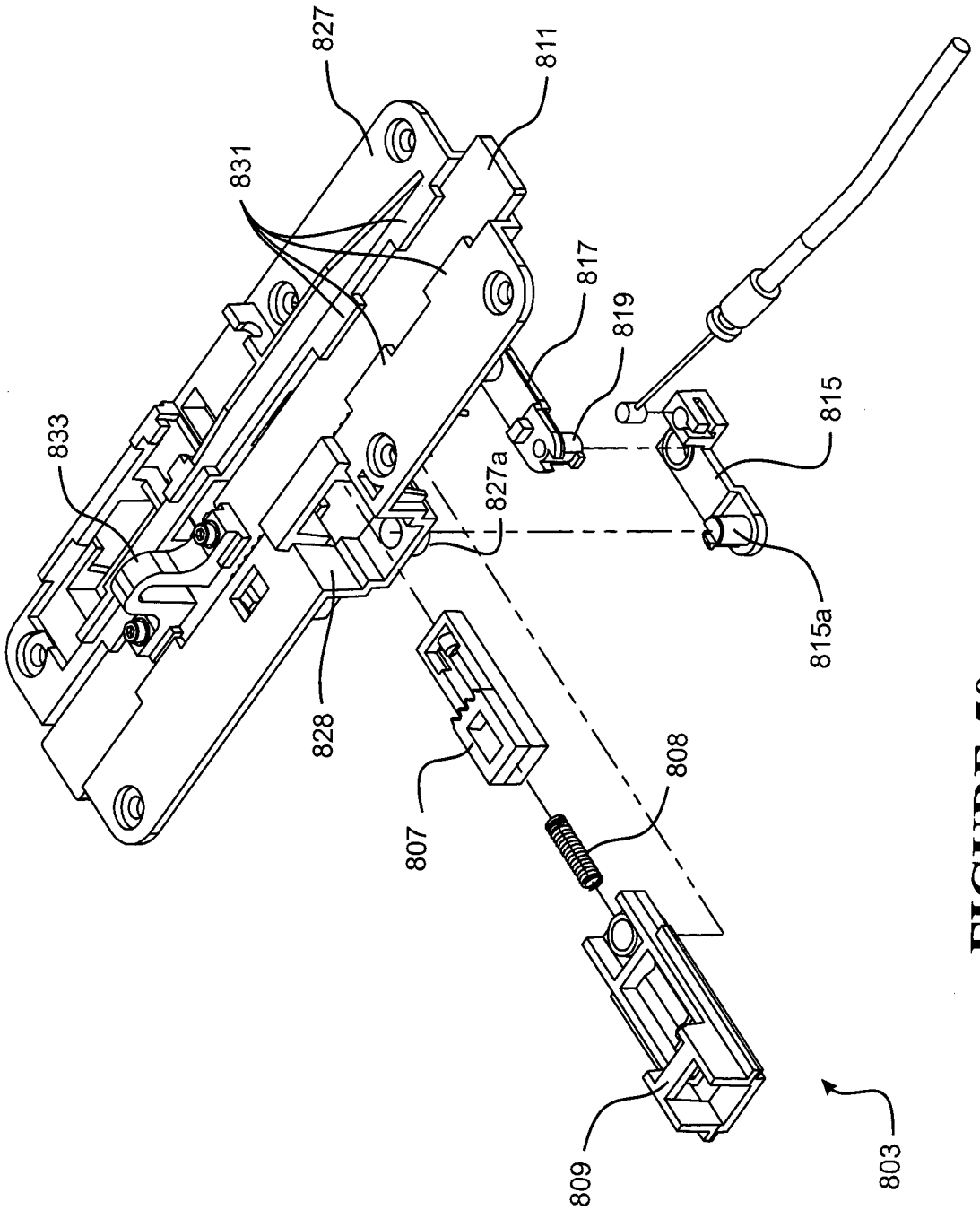


FIGURE 50

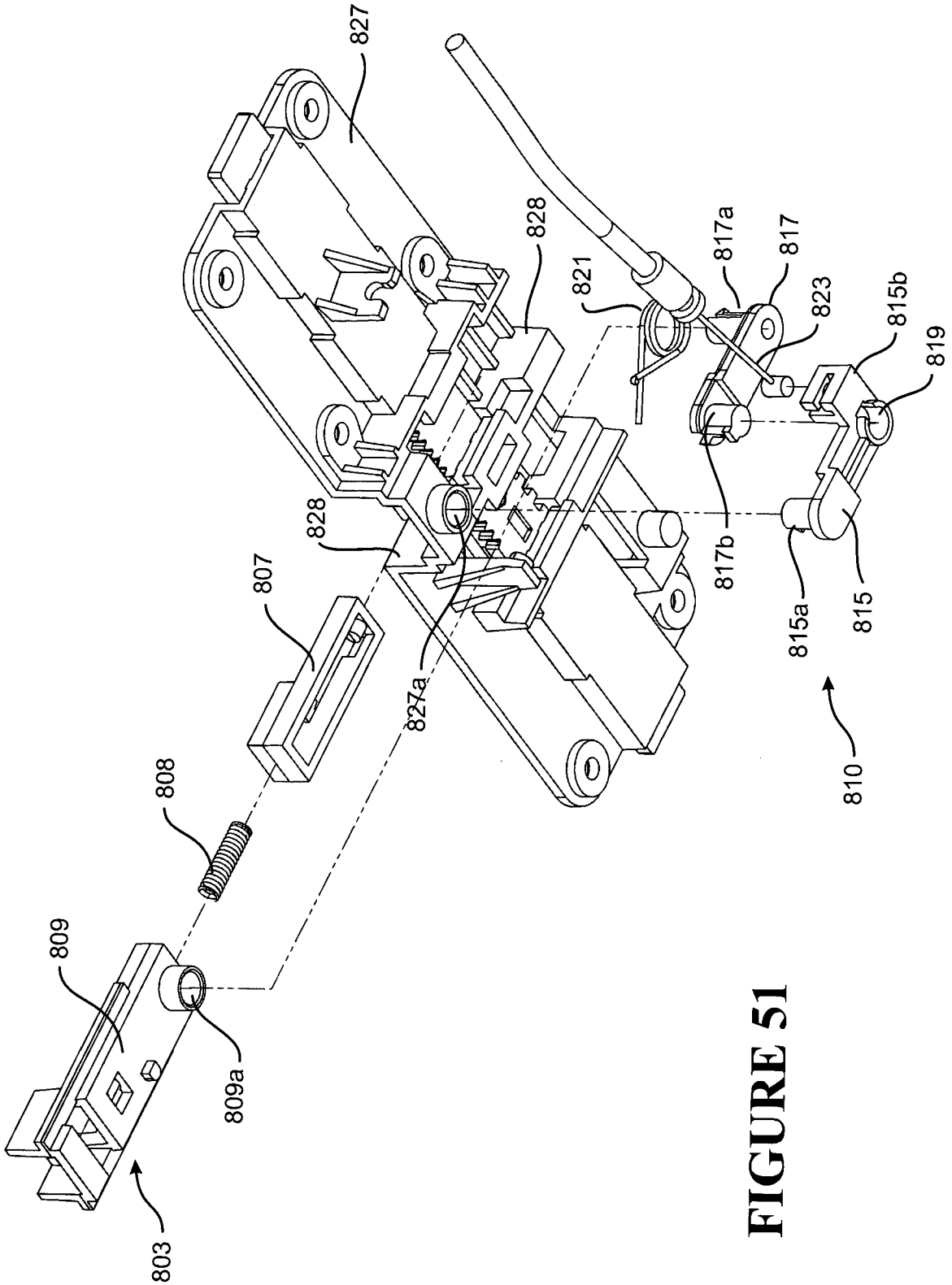

827
828
821
817a
817
823
815b
819
828
807
827a
817b
815a
815
810
808
809
809a
803

FIGURE 51

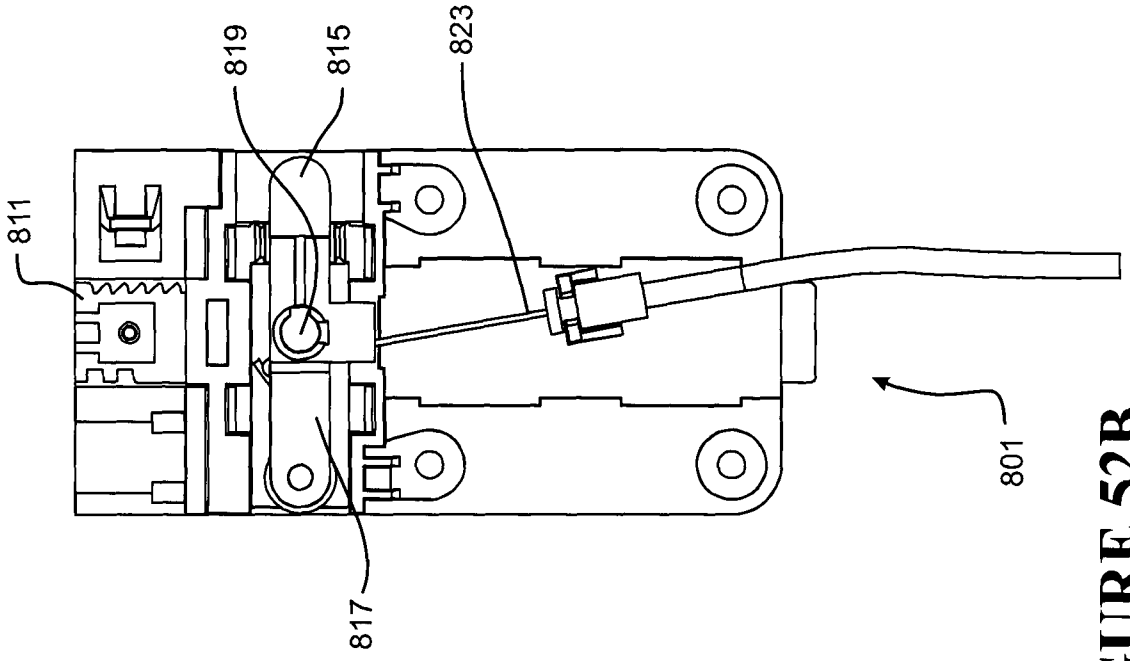


FIGURE 52B

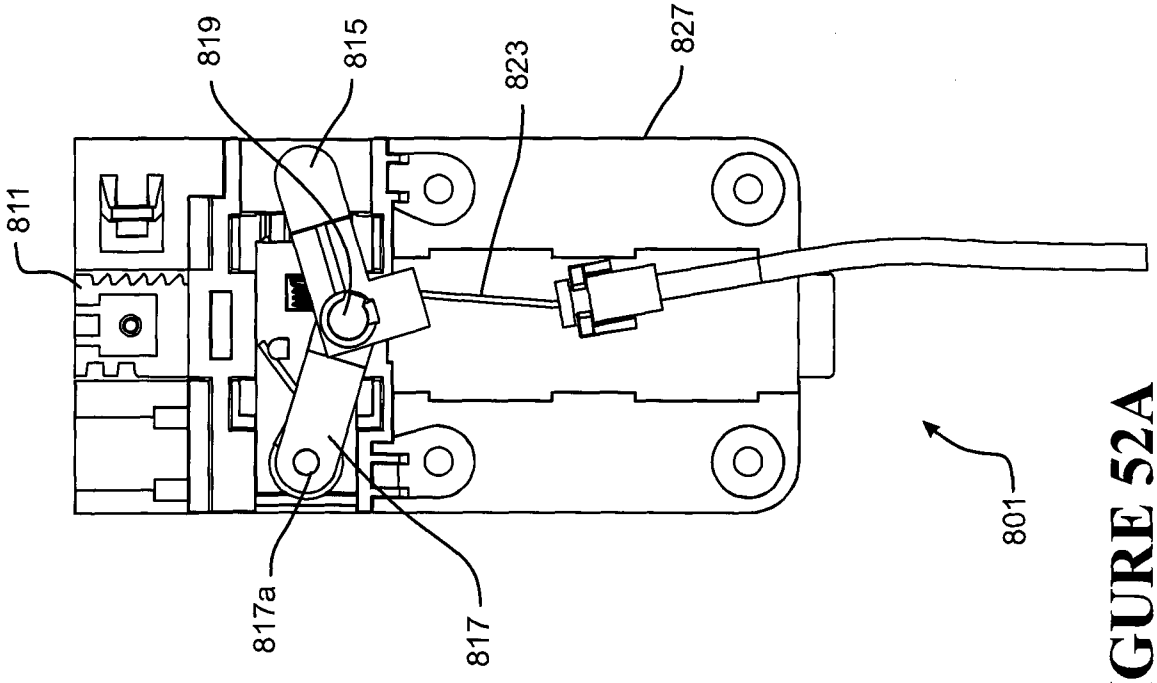


FIGURE 52A

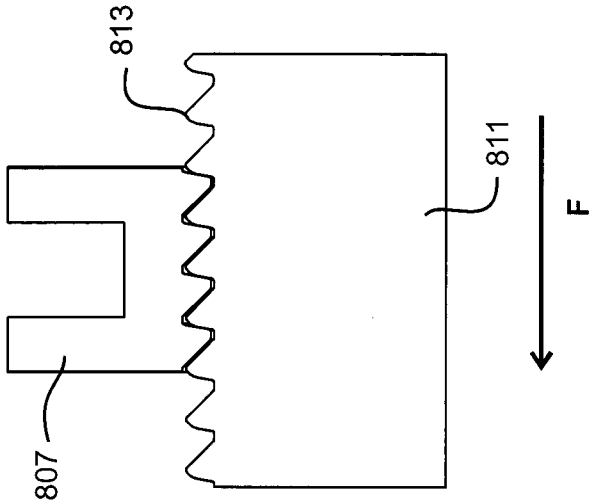


FIGURE 53C

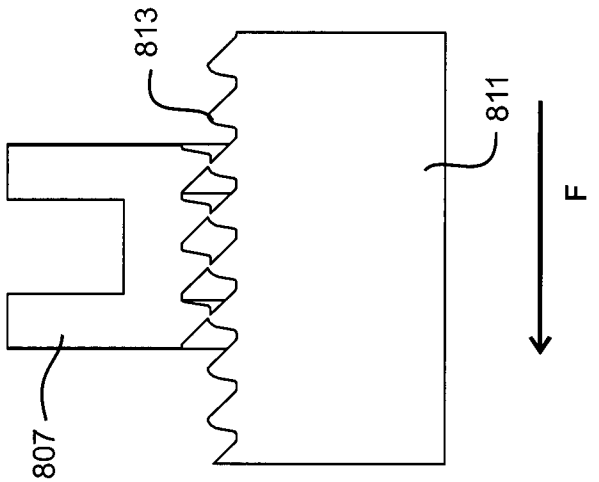


FIGURE 53B

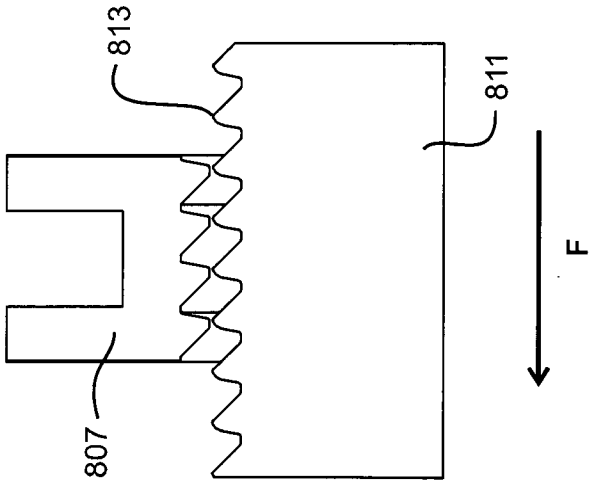


FIGURE 53A

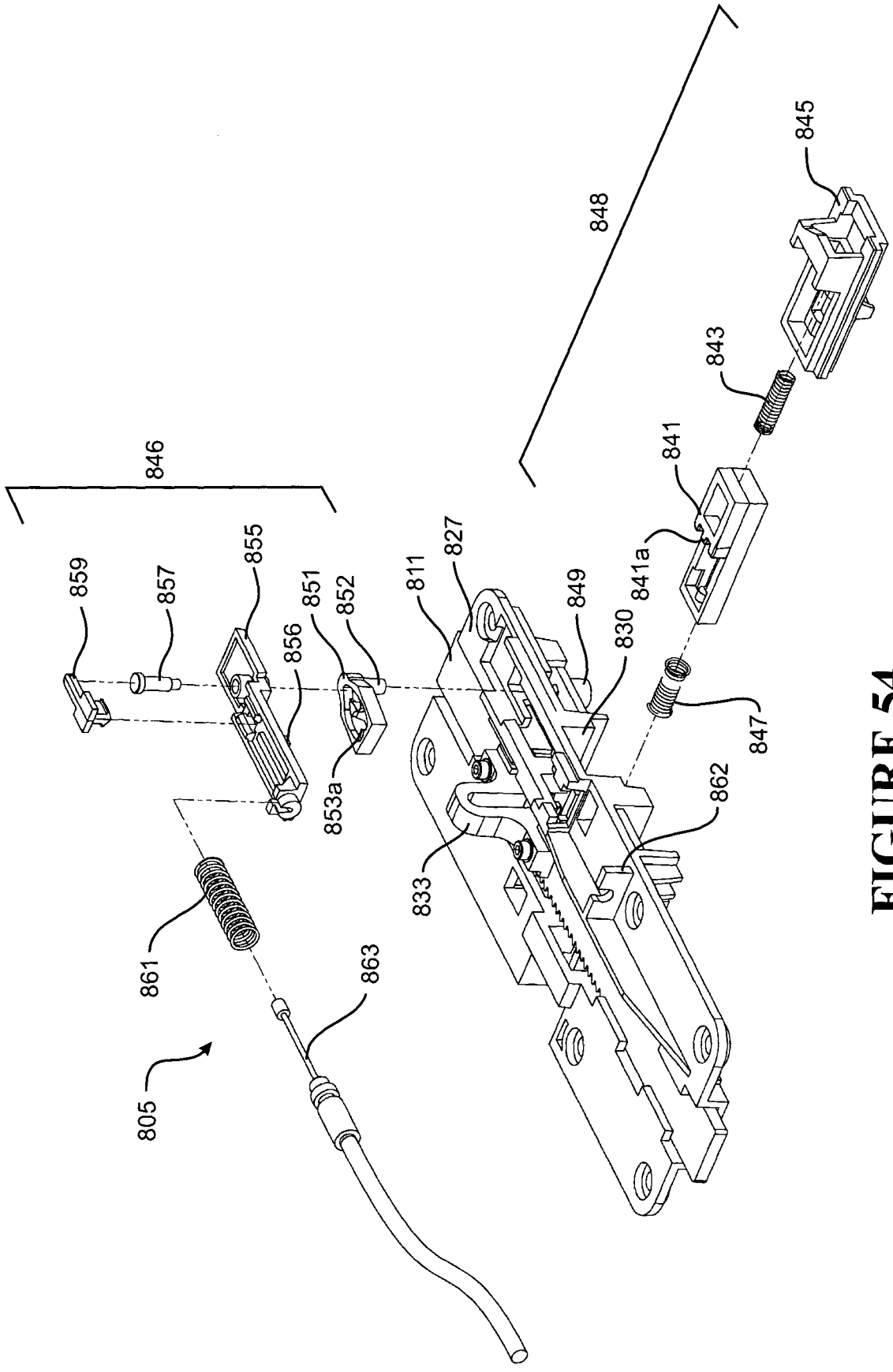

848
845
843
841
841a
846
859
857
855
856
851
852
853a
811
827
849
830
847
862
833
861
863
805

FIGURE 54

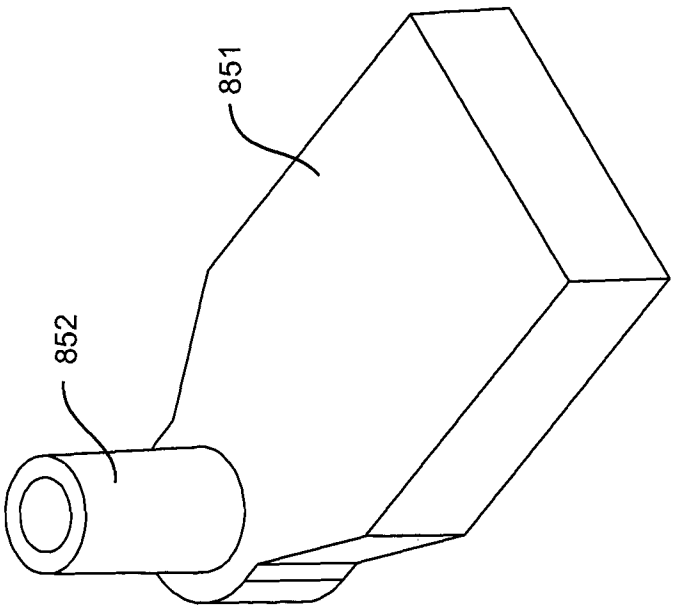


FIGURE 55B

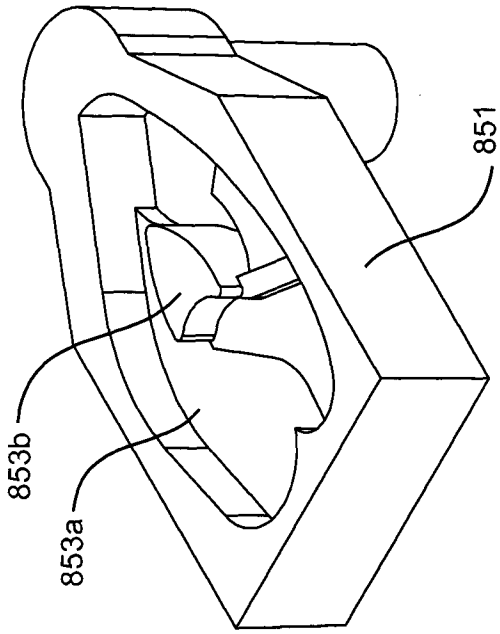


FIGURE 55A

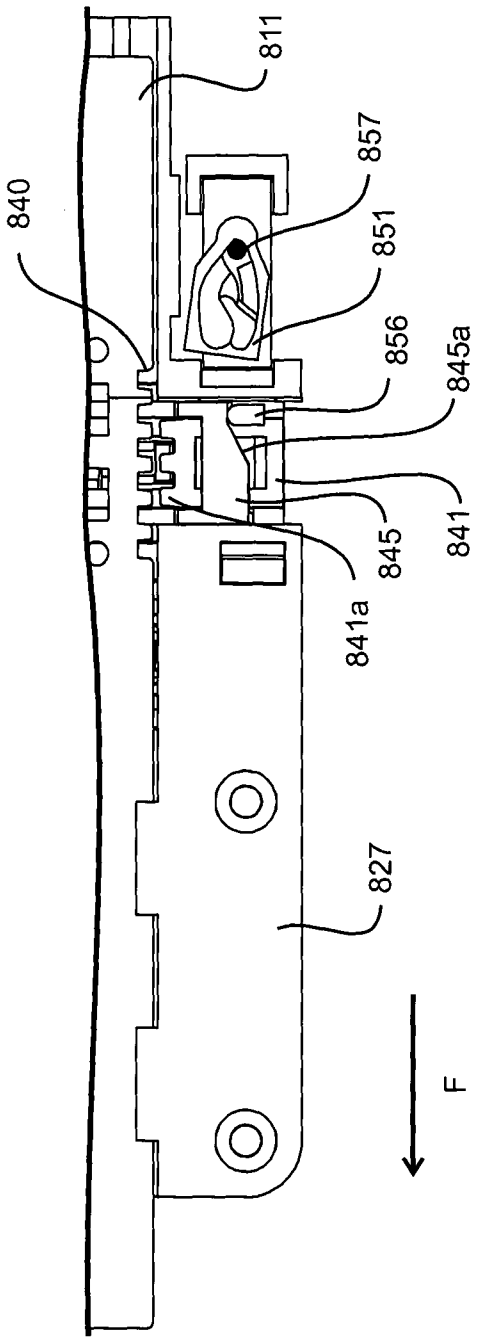


FIGURE 56A

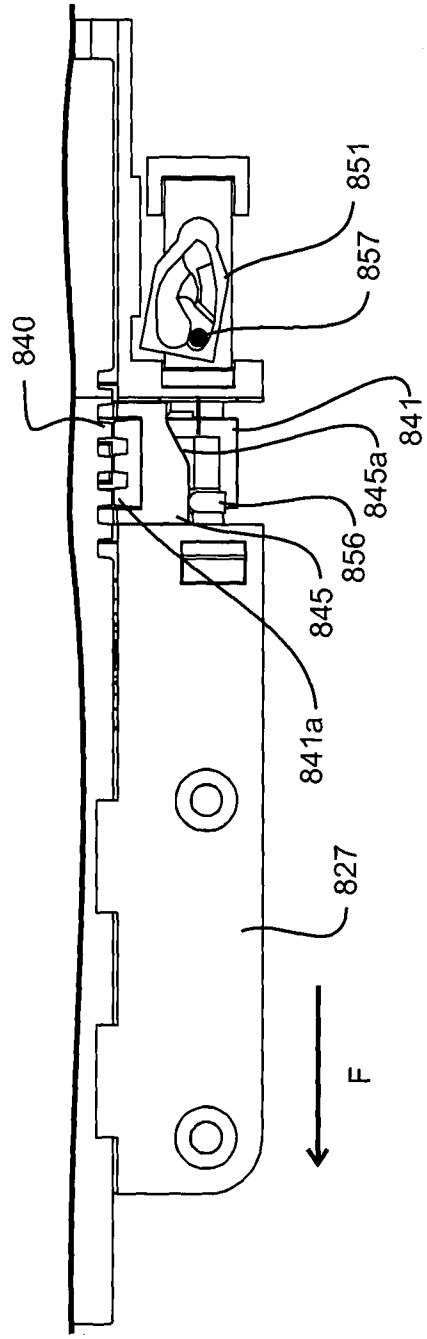


FIGURE 56B

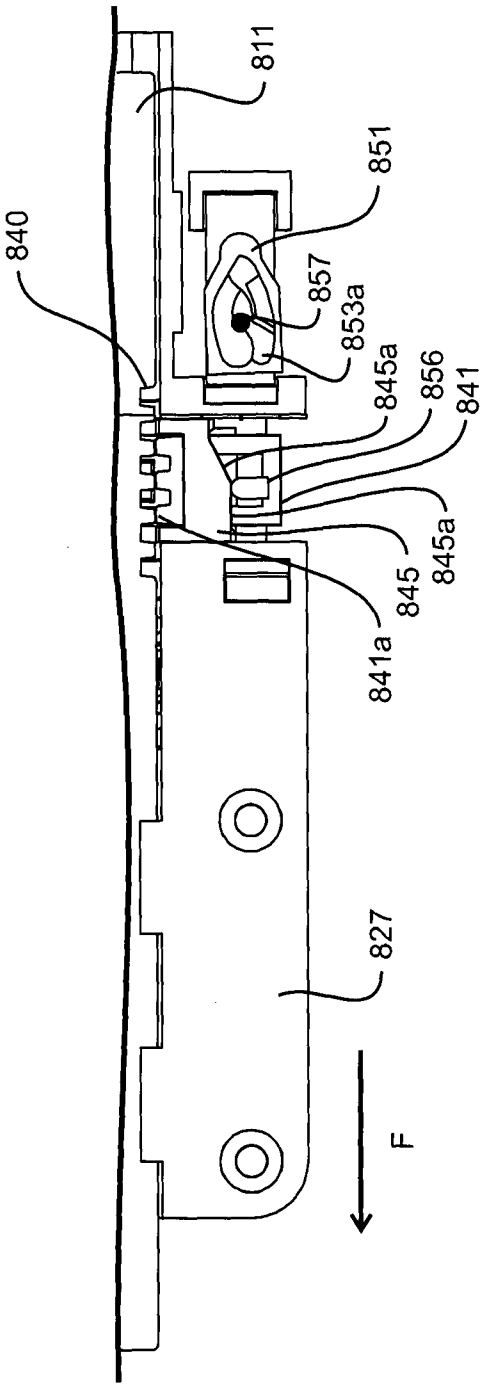


FIGURE 56C

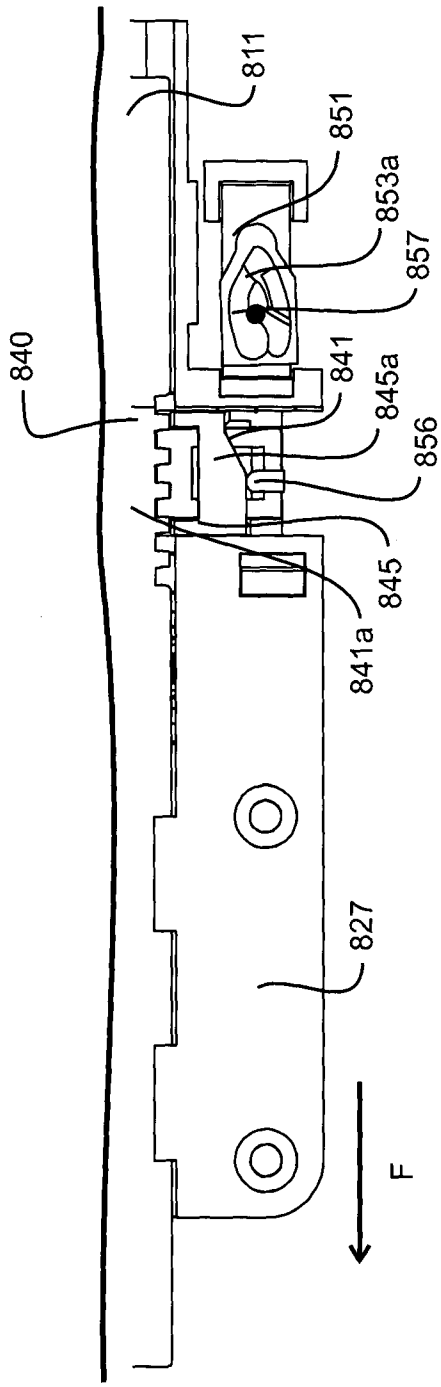


FIGURE 56D

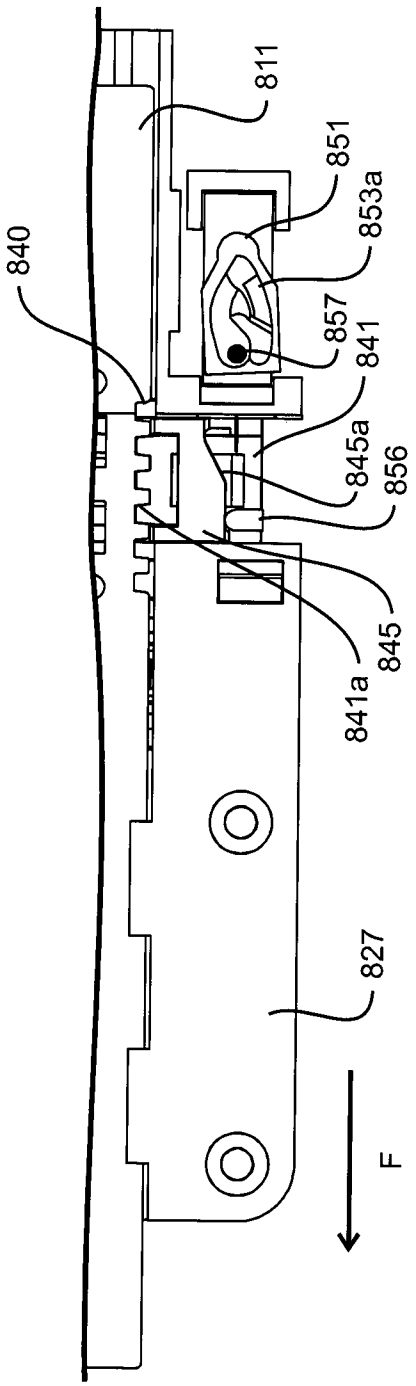


FIGURE 56E

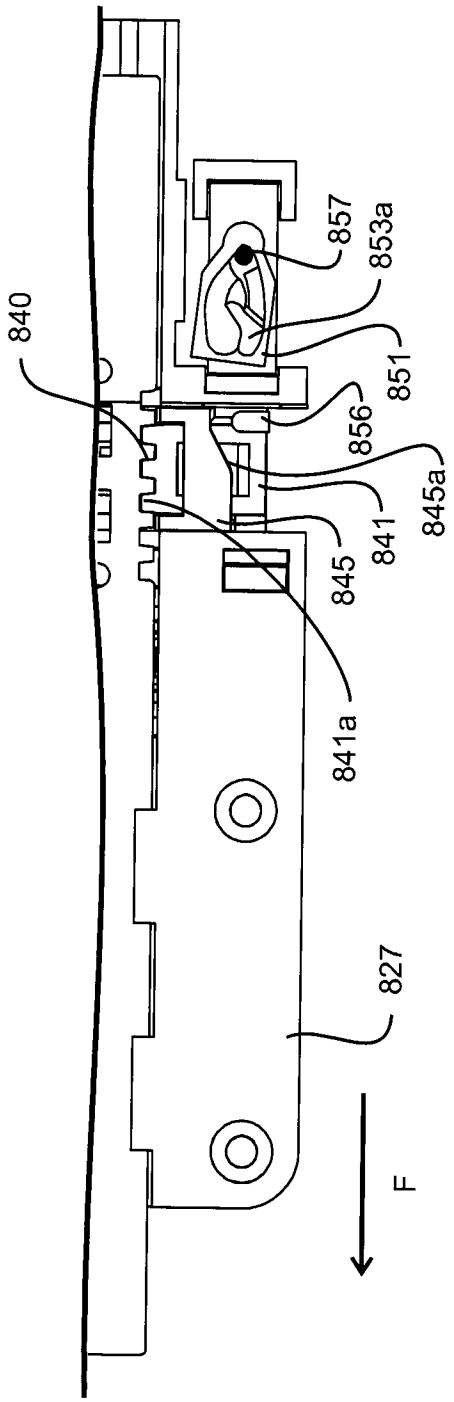


FIGURE 56F

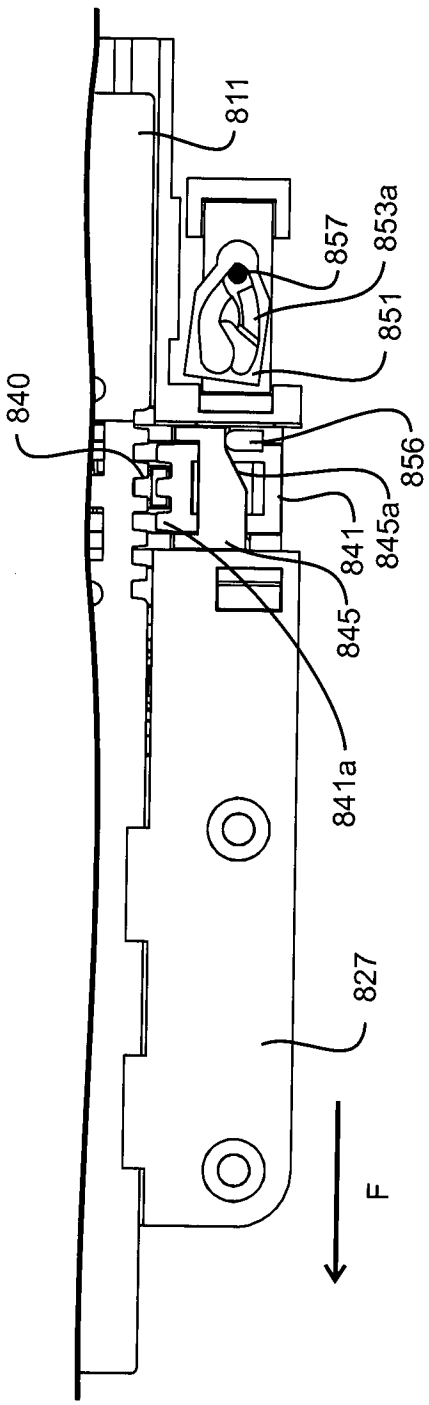


FIGURE 56G

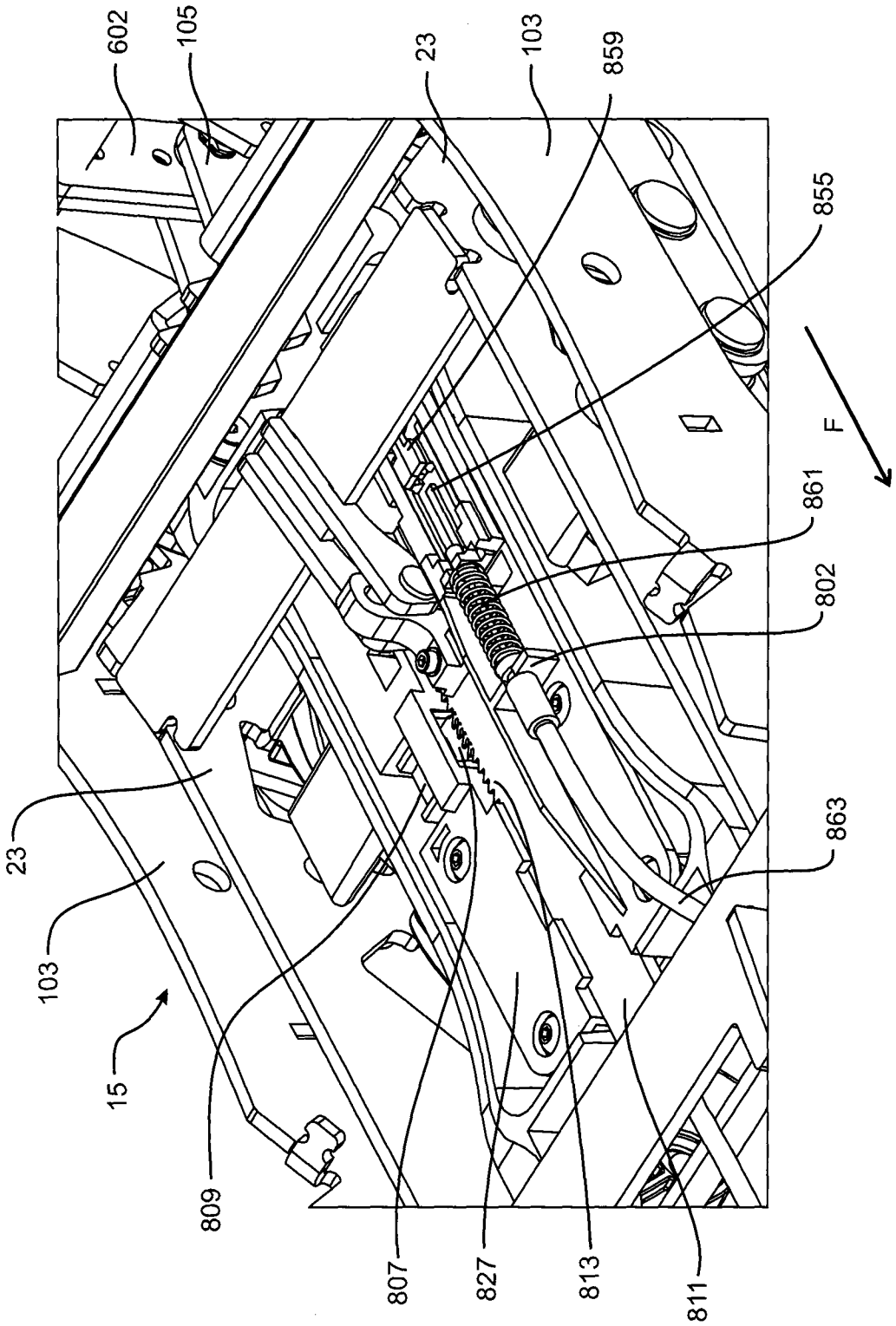


FIGURE 57

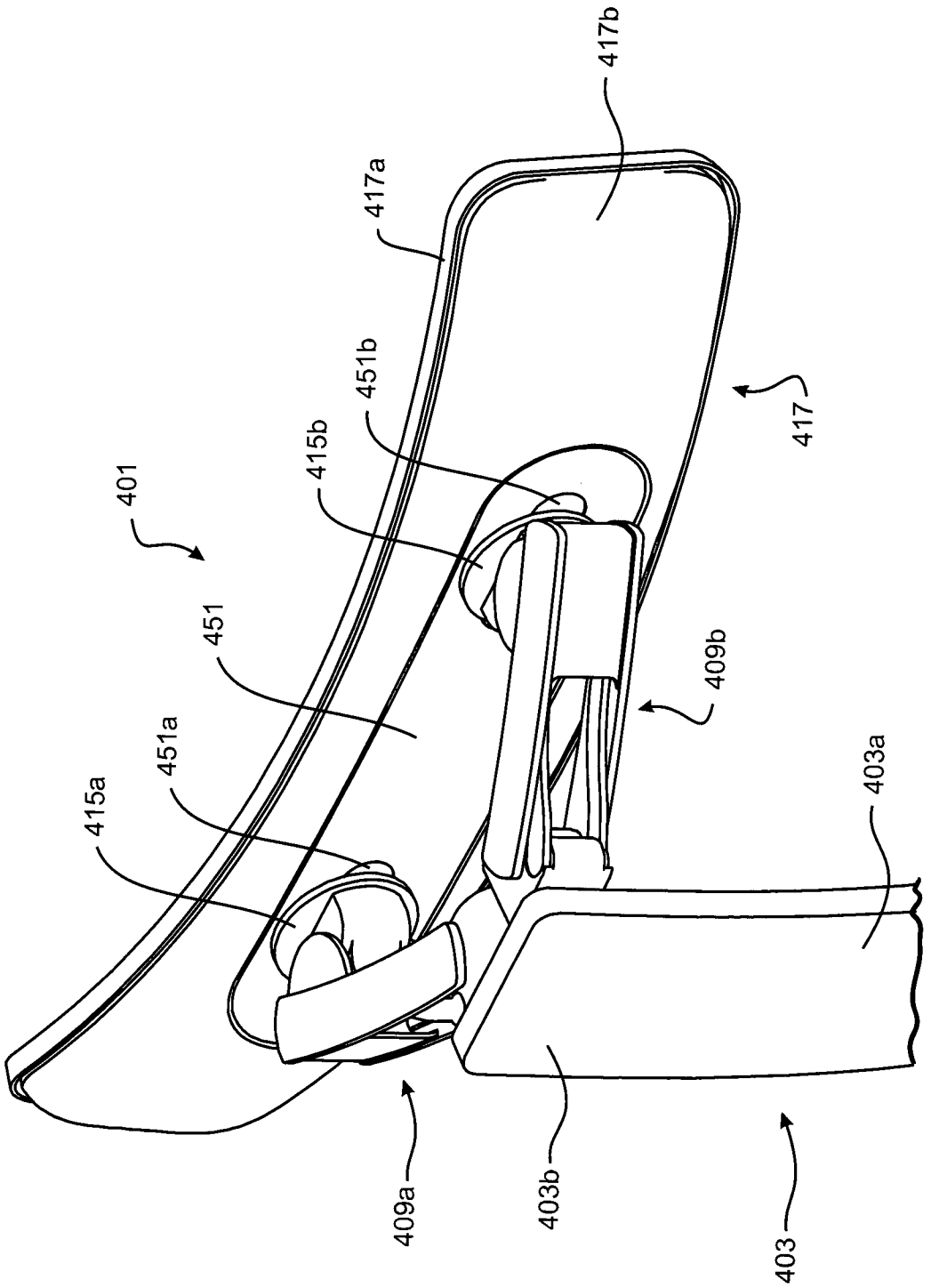

417b
417a
451b
415b
401
451
451a
415a
417
409b
403a
409a
403b
403

FIGURE 58

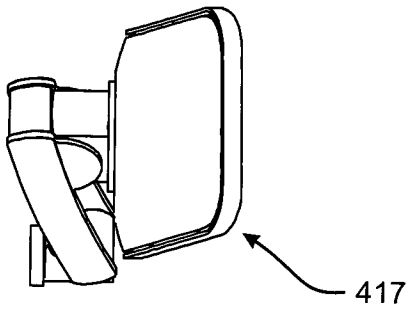


FIGURE 59A

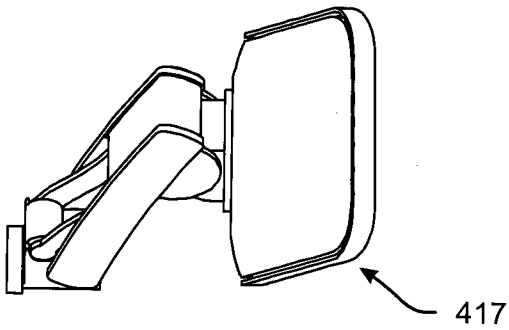


FIGURE 59D

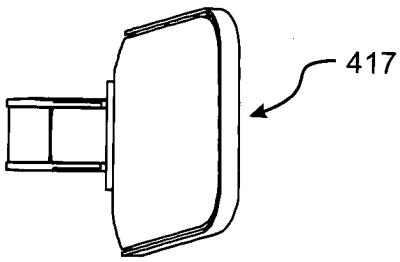


FIGURE 59B

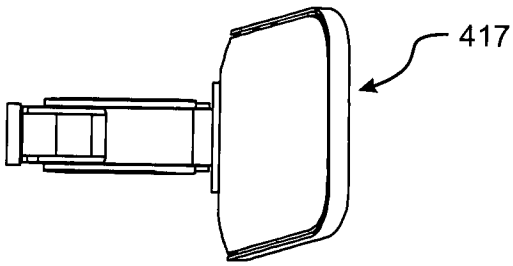


FIGURE 59E

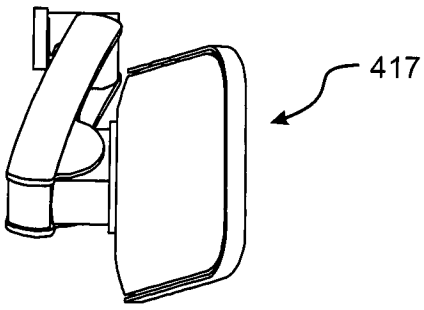


FIGURE 59C

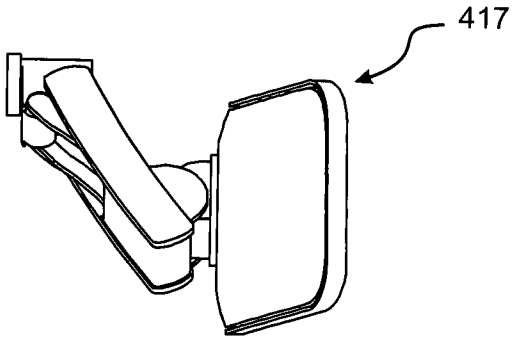
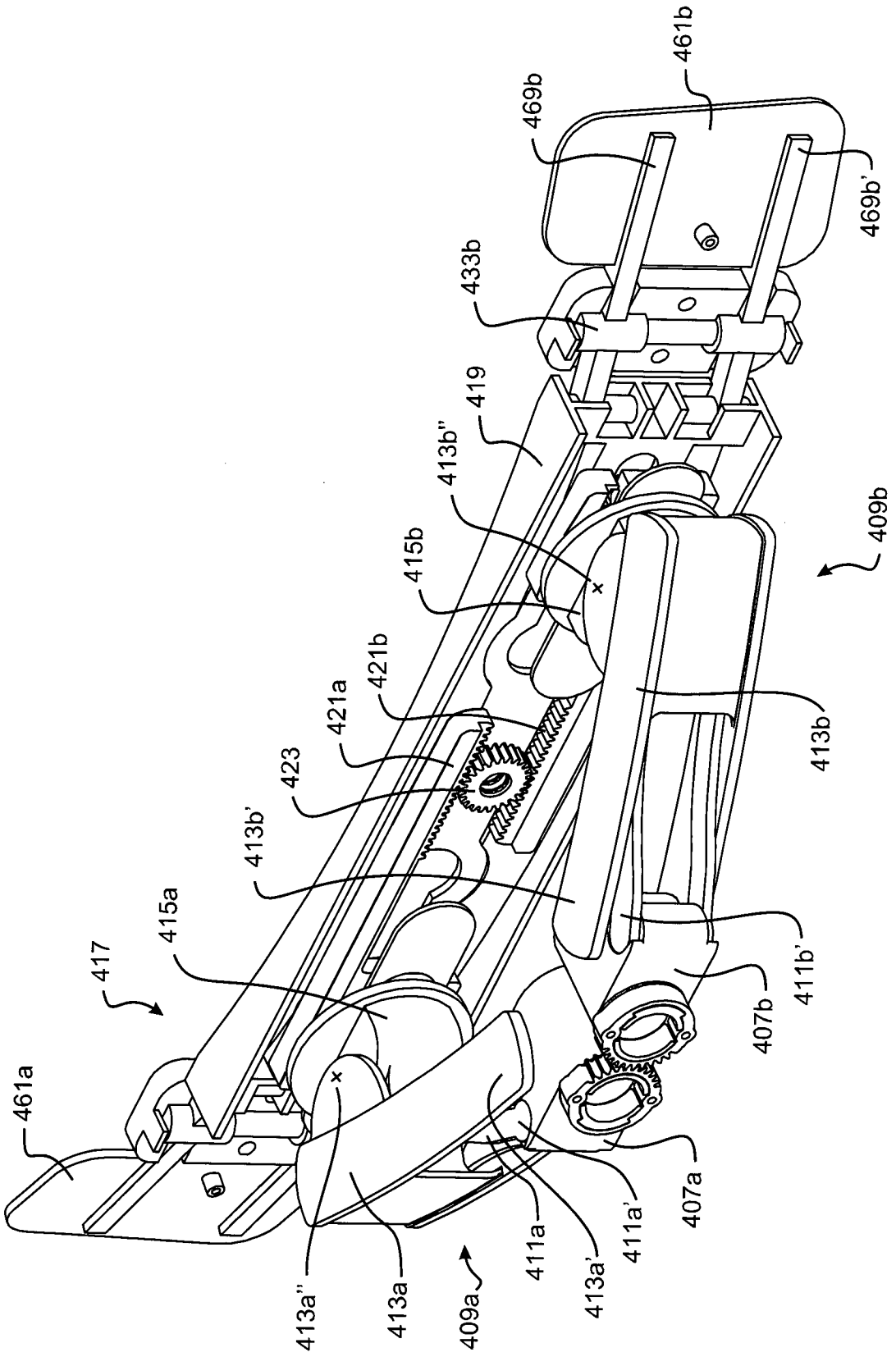


FIGURE 59F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469b
469b'
433b
419
413b"
415b
409b
421b
421a
423
413b'
415a
417
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413b
411b'
407b
407a
411a'
413a'
411a
409a
413a
413a"

FIGURE 60

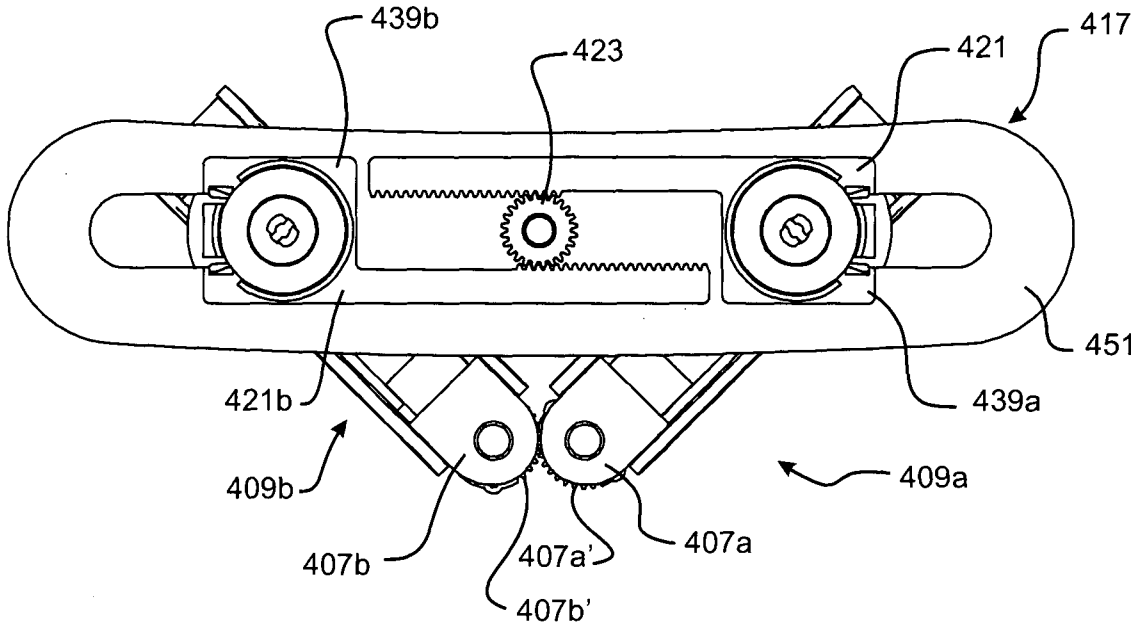


FIGURE 61A

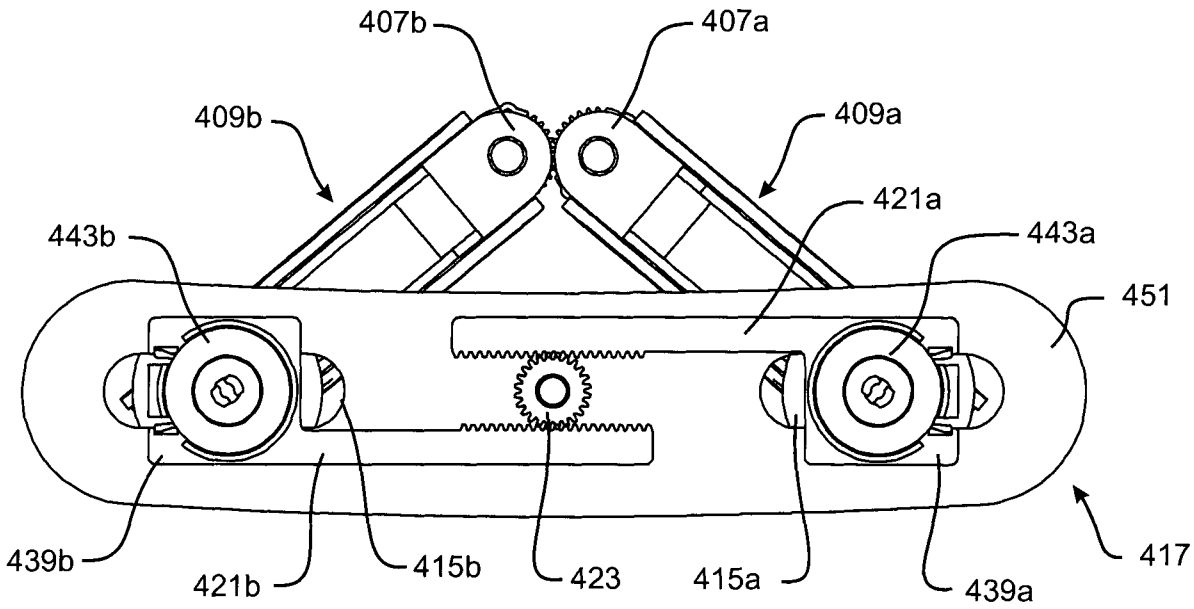


FIGURE 61B

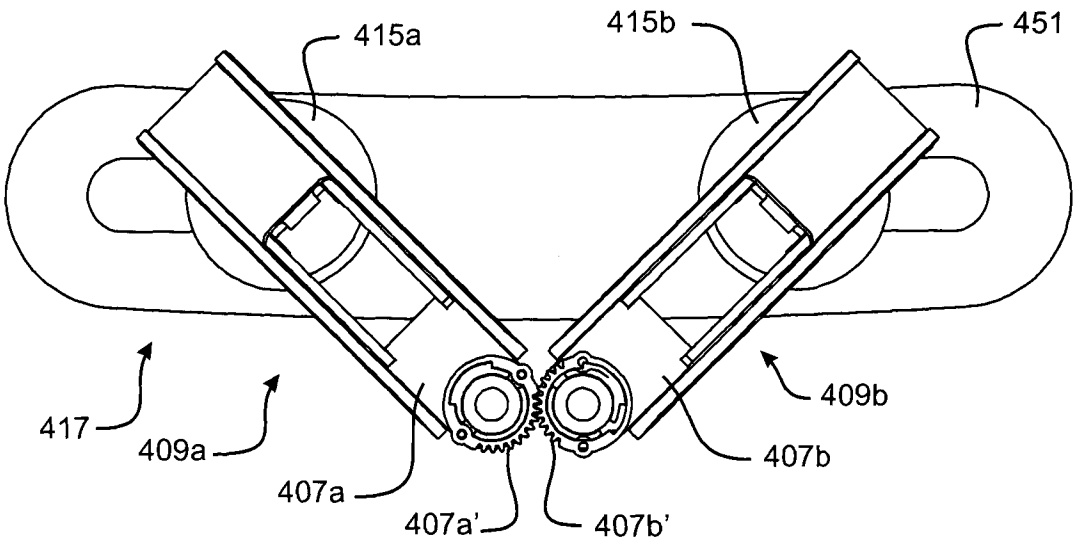


FIGURE 62A

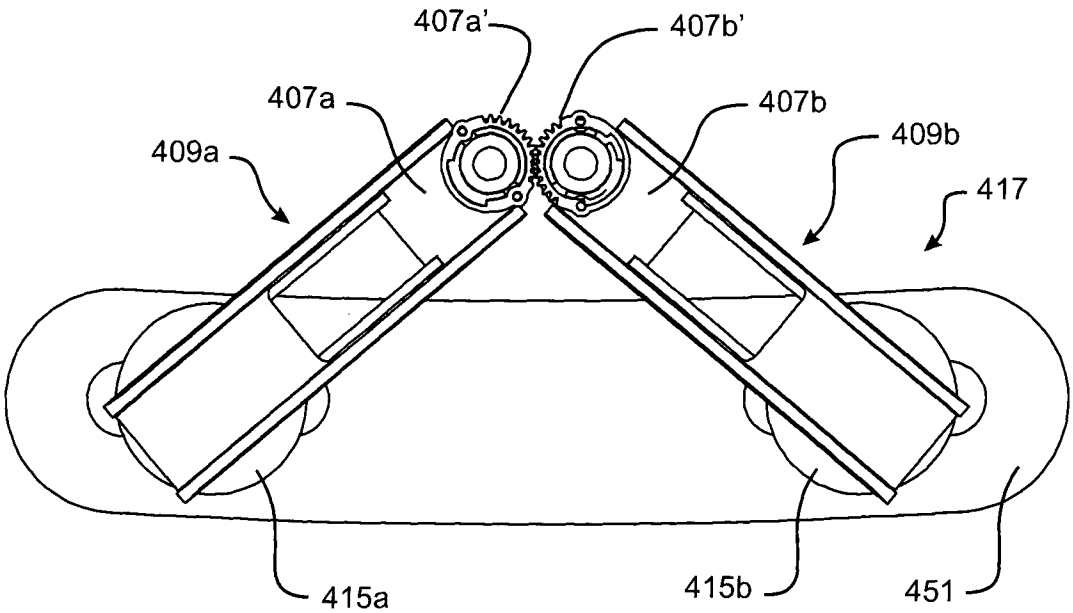


FIGURE 62B

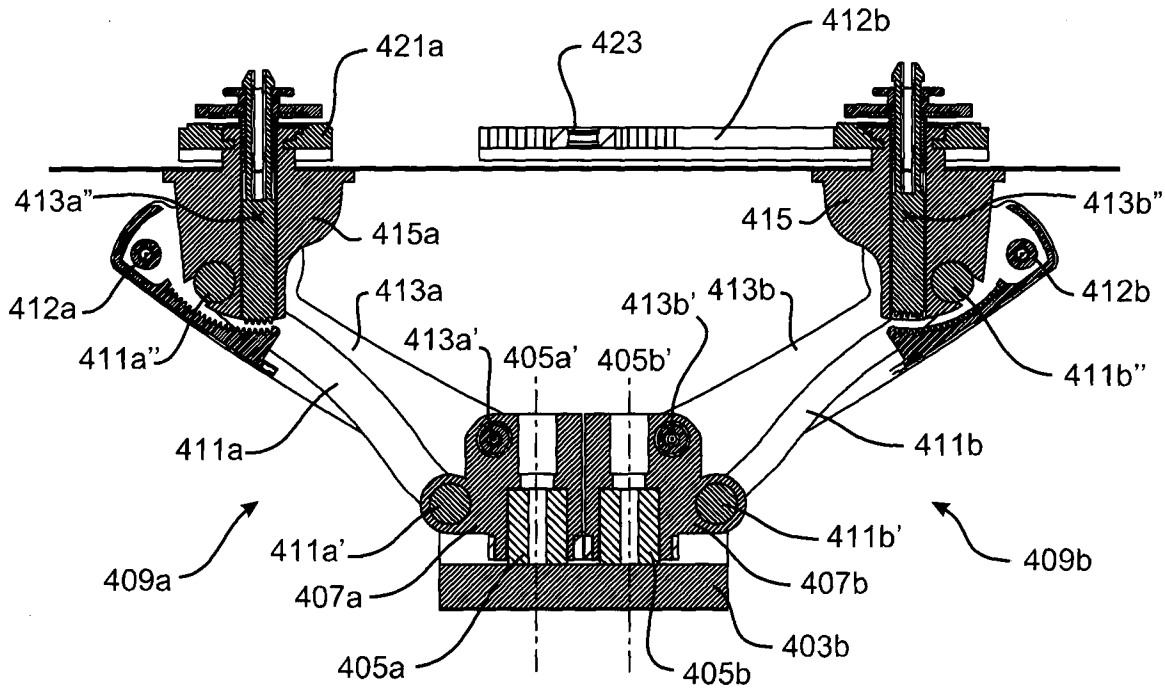


FIGURE 63A

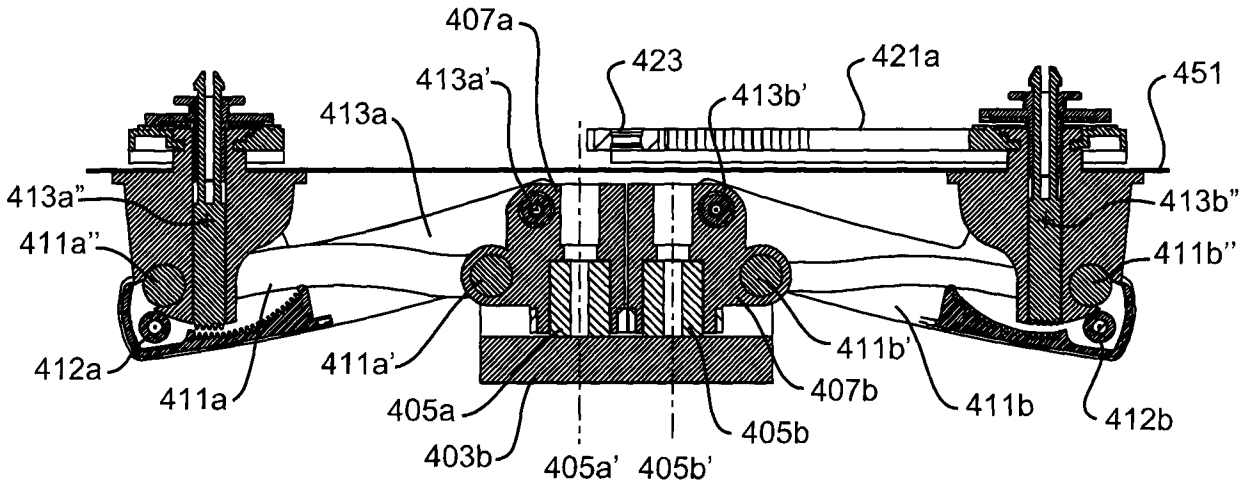
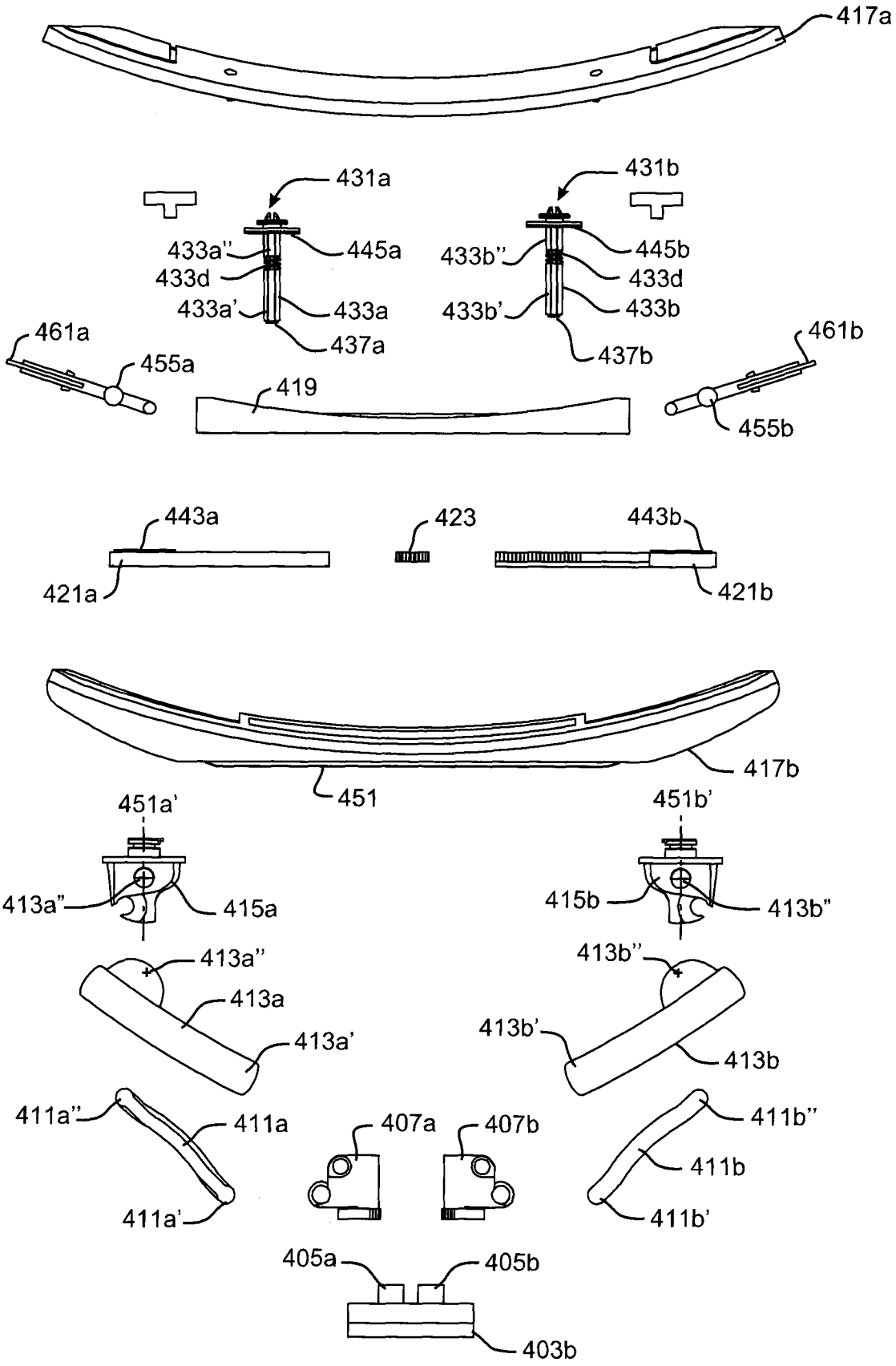


FIGURE 63B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433a
437a
433b''
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433d
433b'
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437b
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455a
419
461b
455b
443a
423
443b
421a
421b
417b
451
451a'
451b'
413a''
415a
415b
413b''
413a''
413a
413a'
413b''
413b'
413b
411a''
411a
411a'
407a
407b
411b''
411b
411b'
405a
405b
403b

FIGURE 64

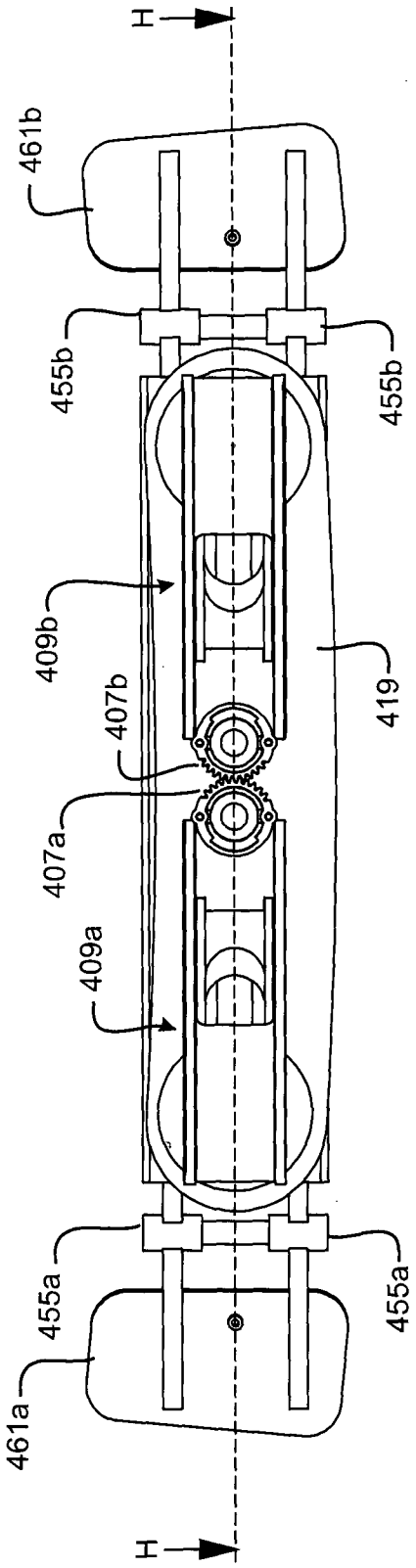


FIGURE 65

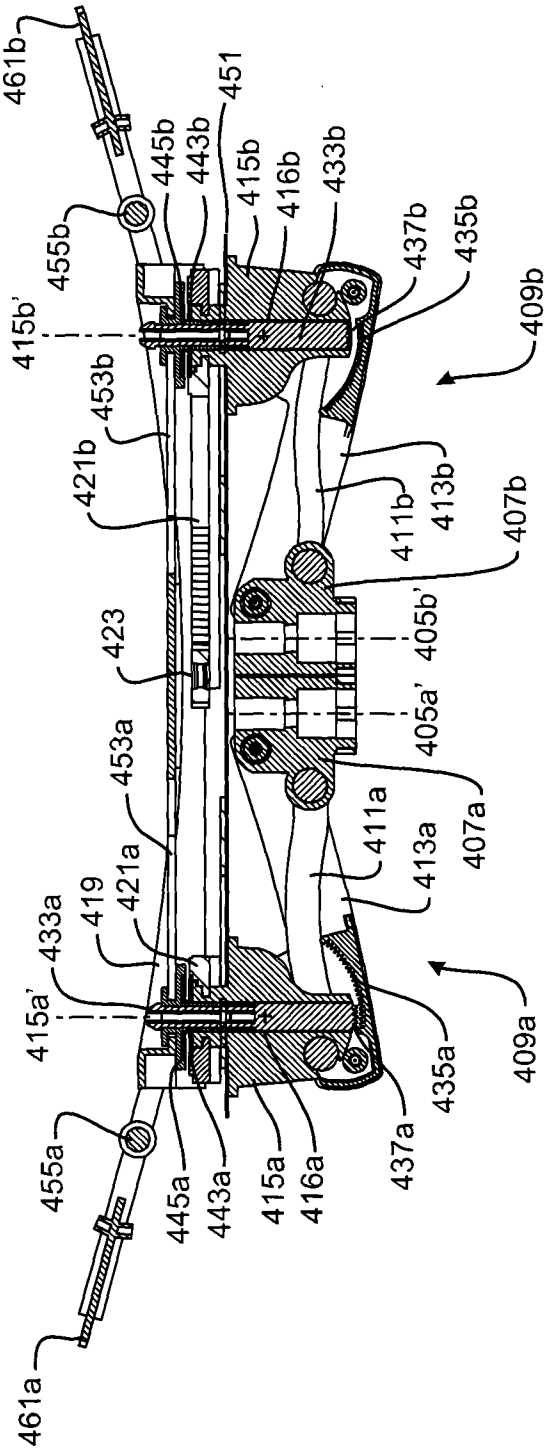
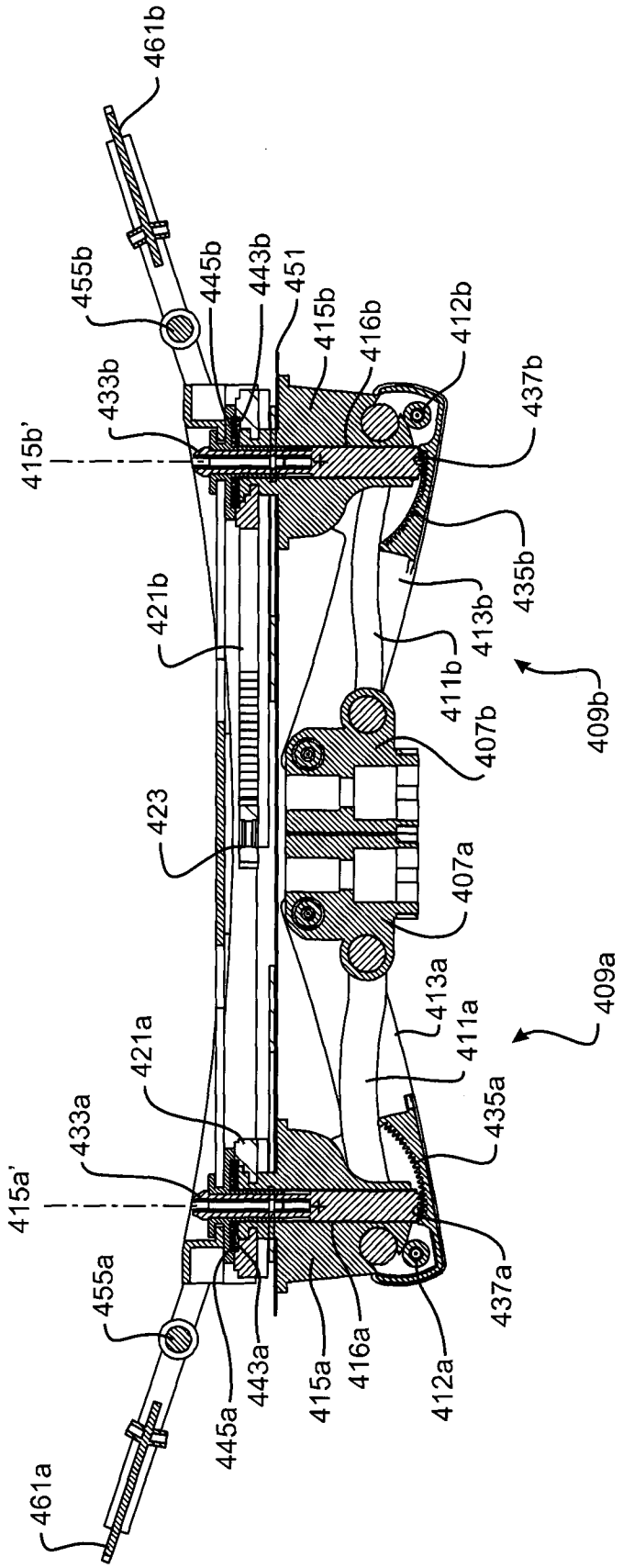


FIGURE 66


461b
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443b
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415b
416b
412b
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415b'
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435b
421b
413b
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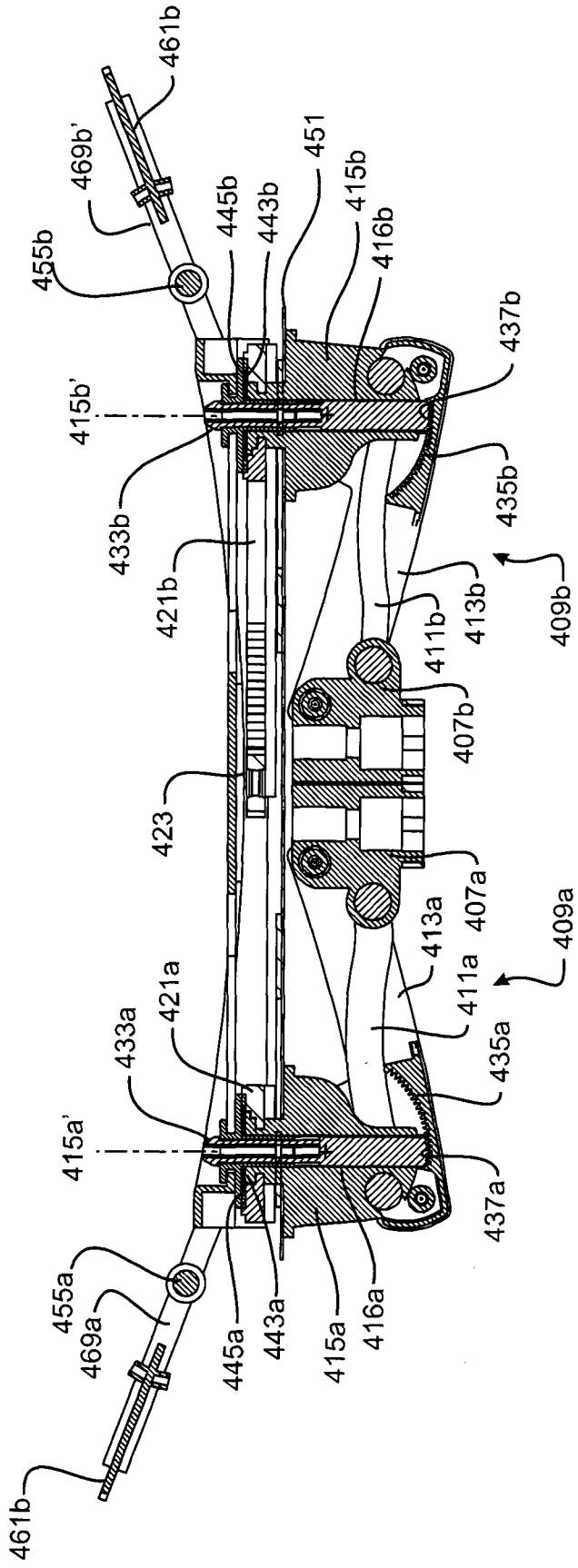
407b
423
407a
409a
413a
411a
421a
435a
433a
415a'
455a
437a
443a
415a
416a
412a
445a
461a

FIGURE 67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469b'
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443b
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415b
416b
437b
415b'
433b
435b
421b
411b
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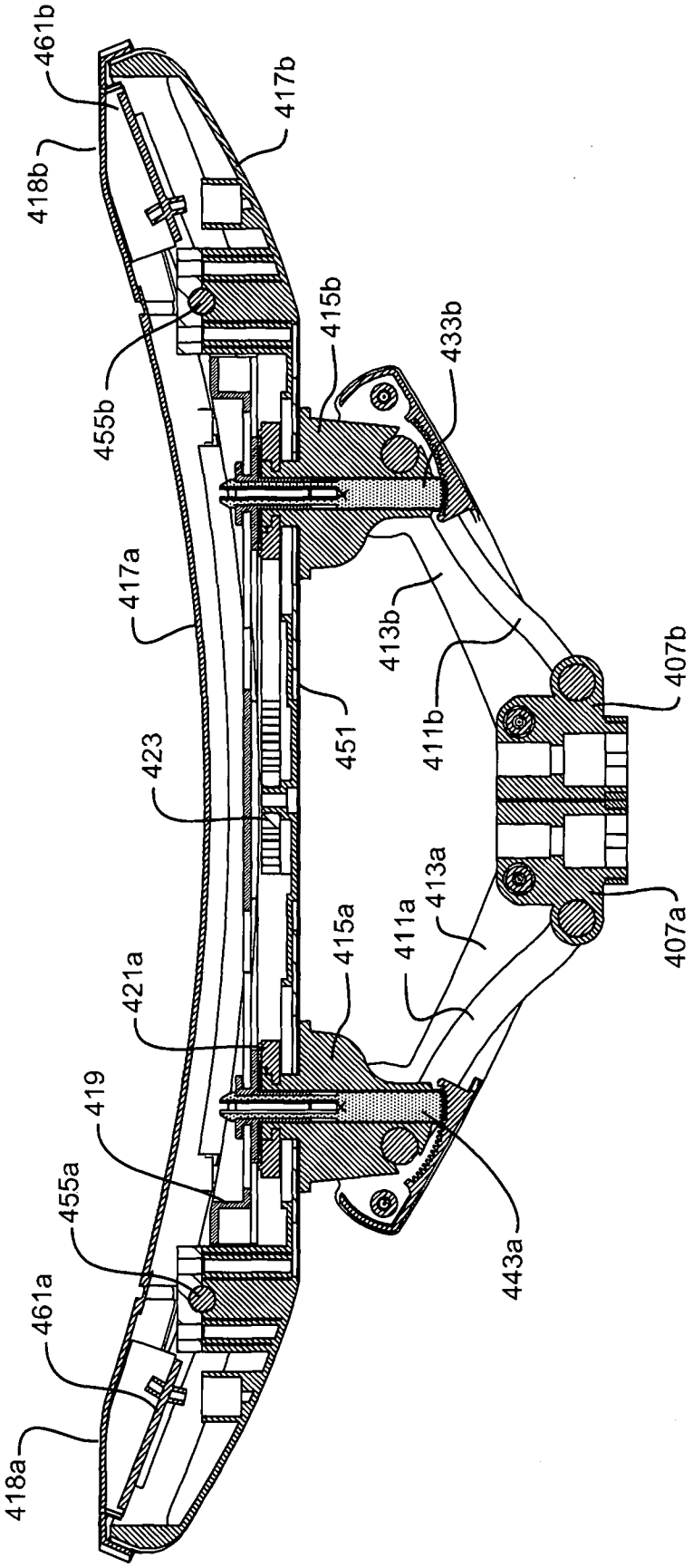
409b
407b
423
413a
407a
409a
411a
421a
433a
435a
415a'
437a
455a
469a
445a
443a
415a
416a
461b

FIGURE 68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418b
417b
455b
415b
433b
417a
413b
407b
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411b
423
413a
411a
415a
407a
421a
419
455a
443a
461a
418a

FIGURE 69A

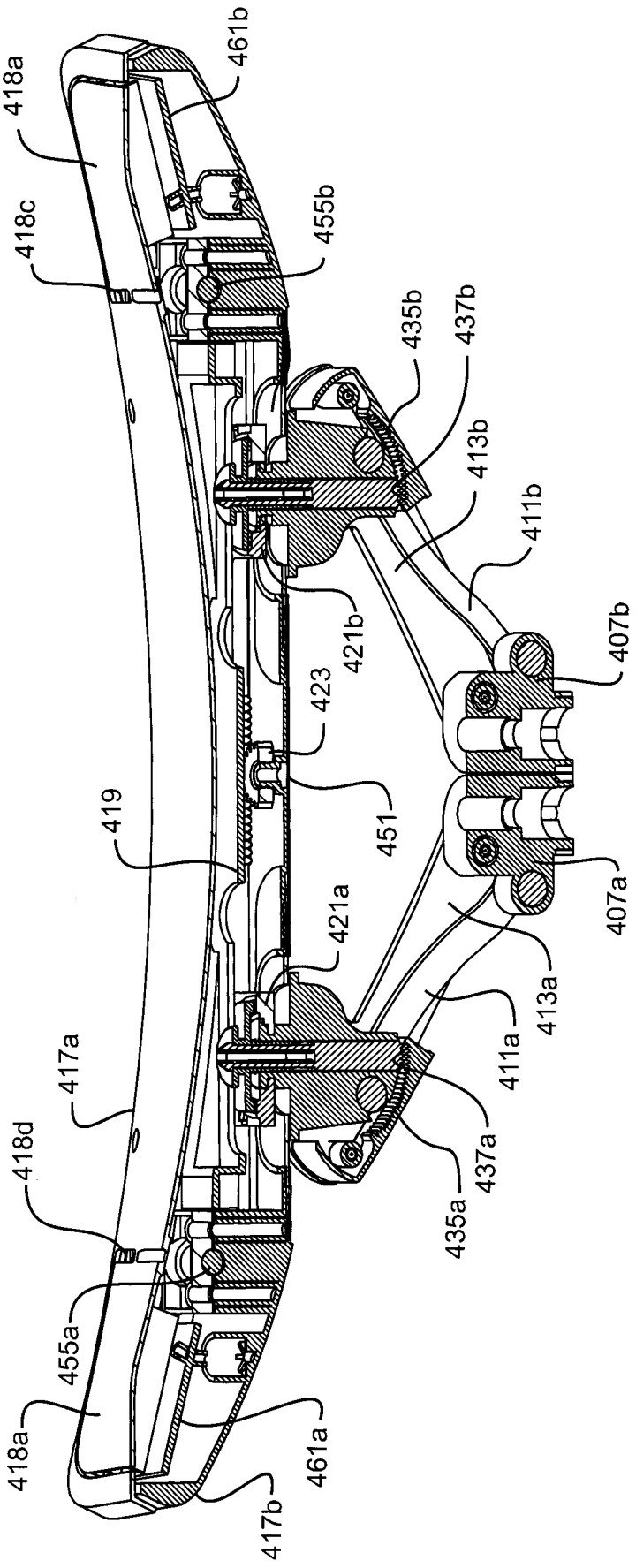

418a
461b
418c
455b
435b
437b
413b
411b
421b
407b
423
451
419
421a
407a
413a
411a
417a
437a
418d
435a
455a
418a
461a
417b

FIGURE 69B

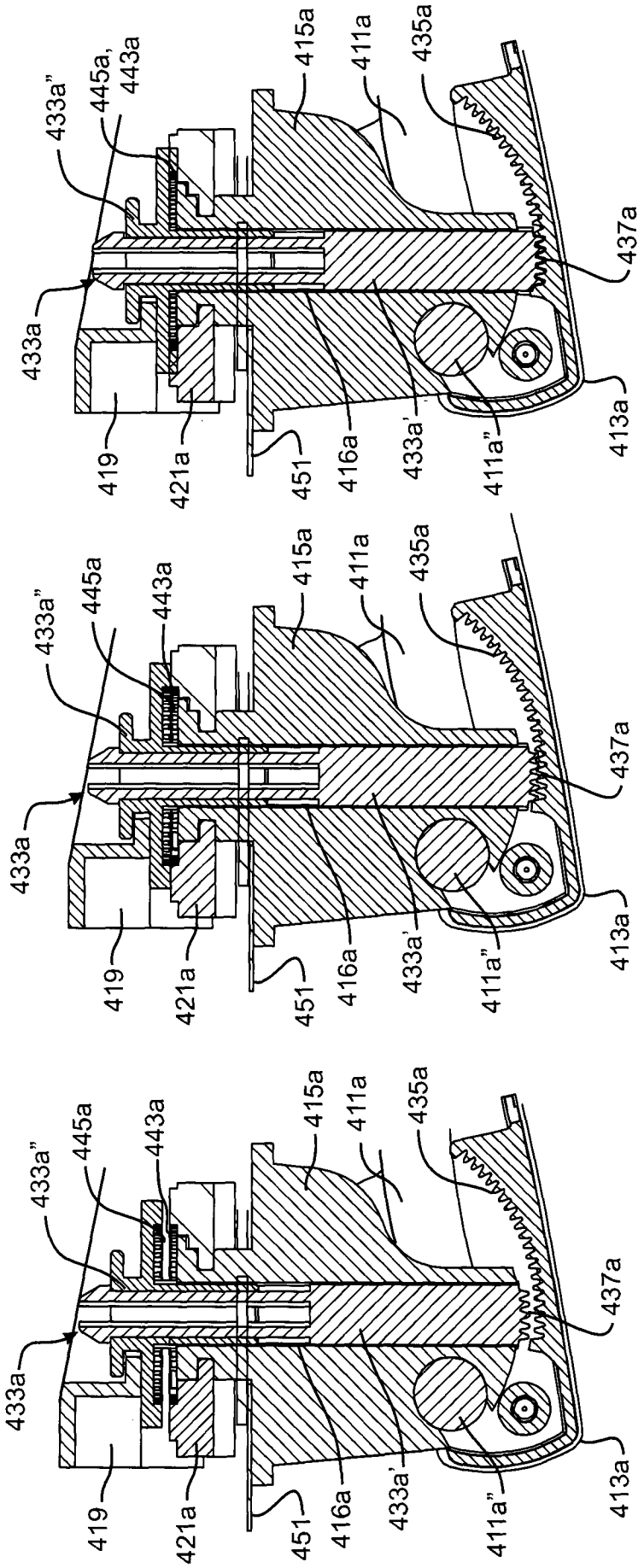


FIGURE 70C

FIGURE 70B

FIGURE 70A

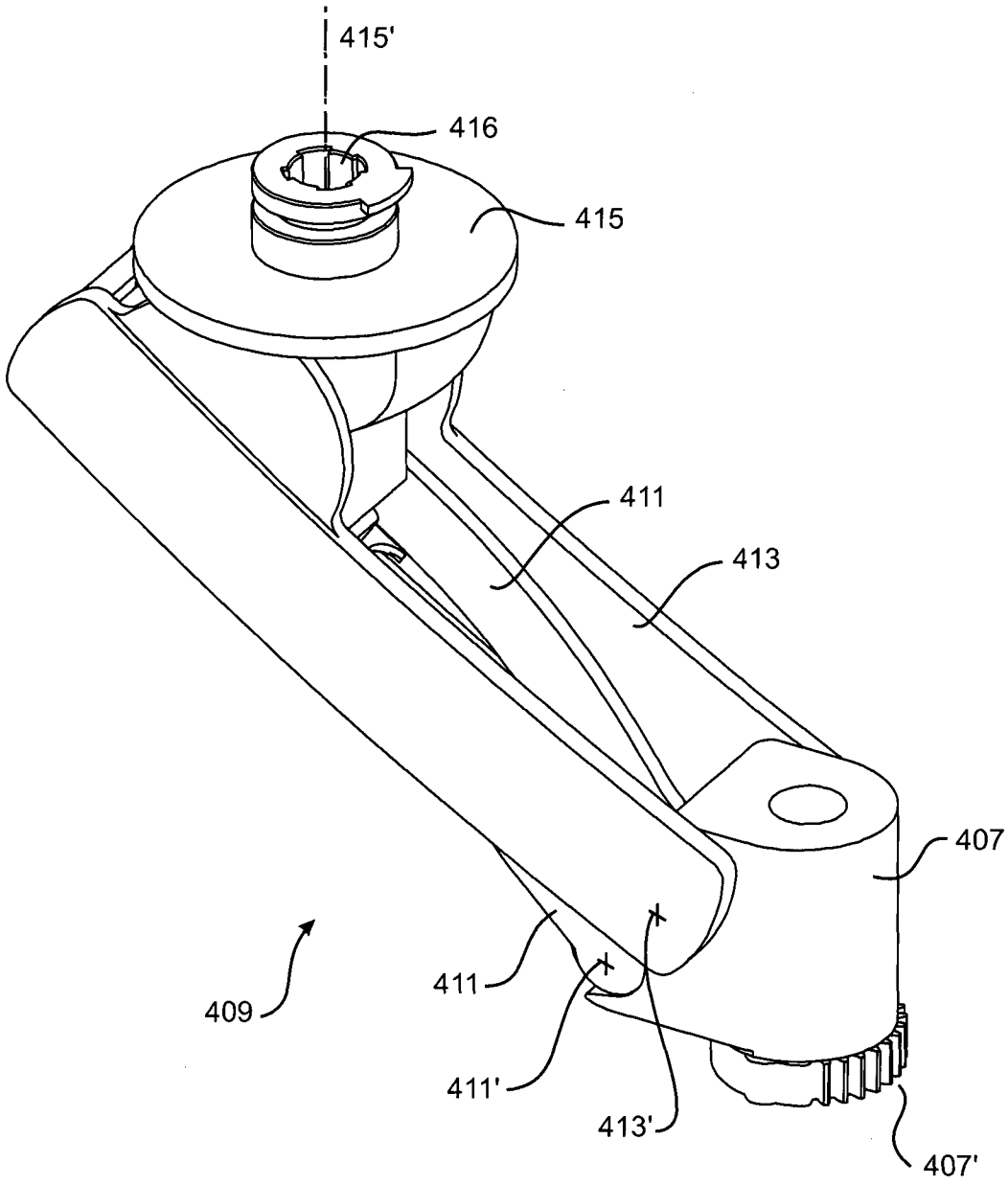


FIGURE 71

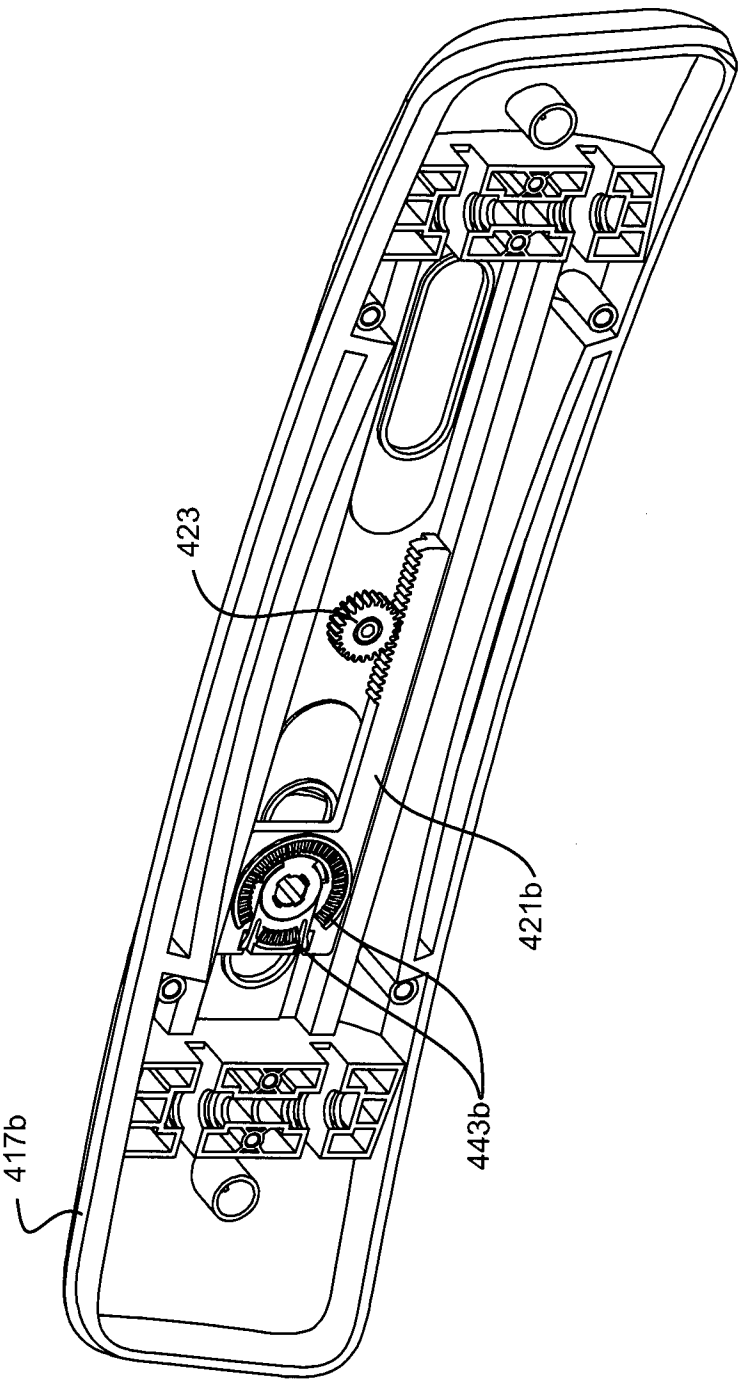


FIGURE 72

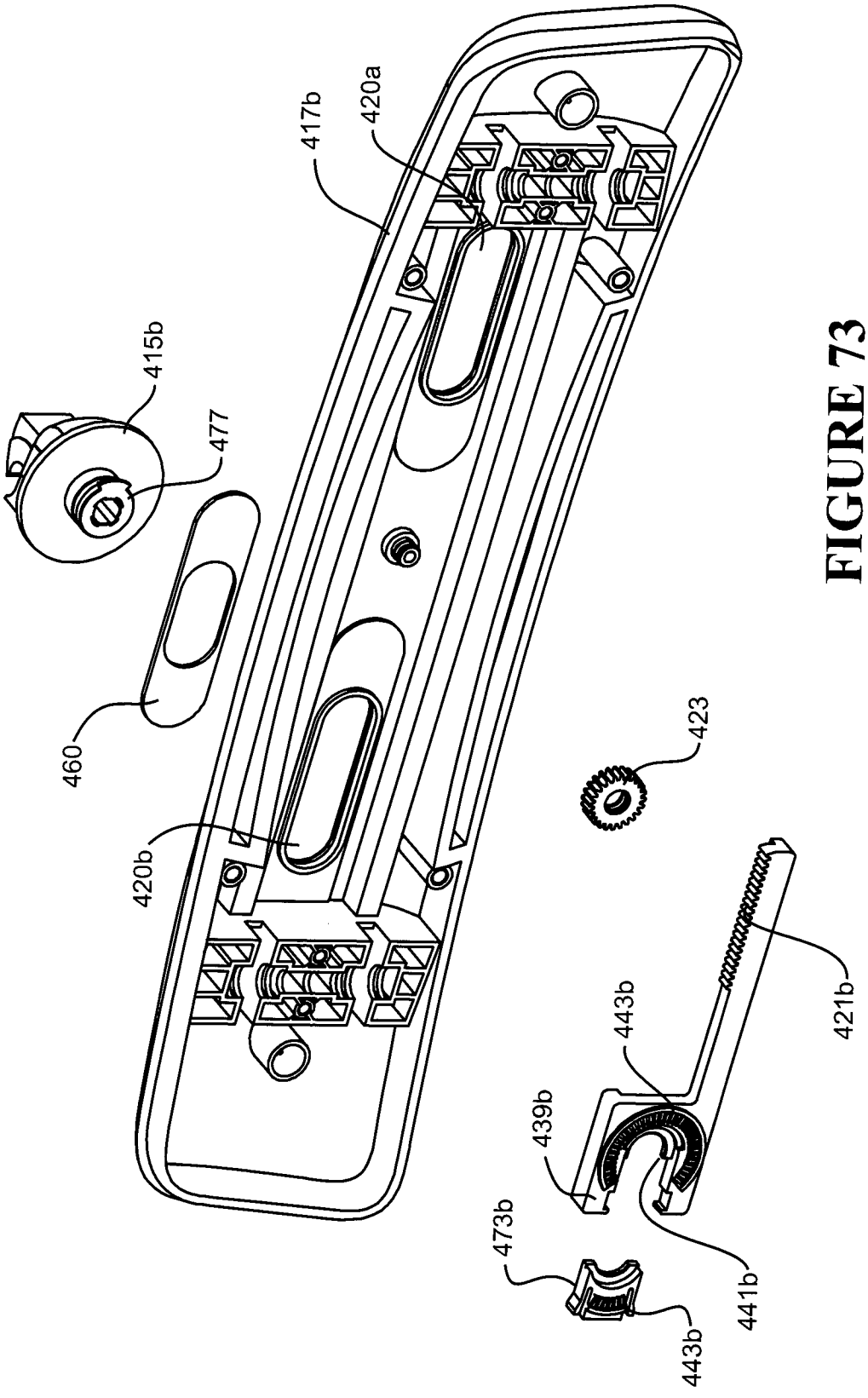
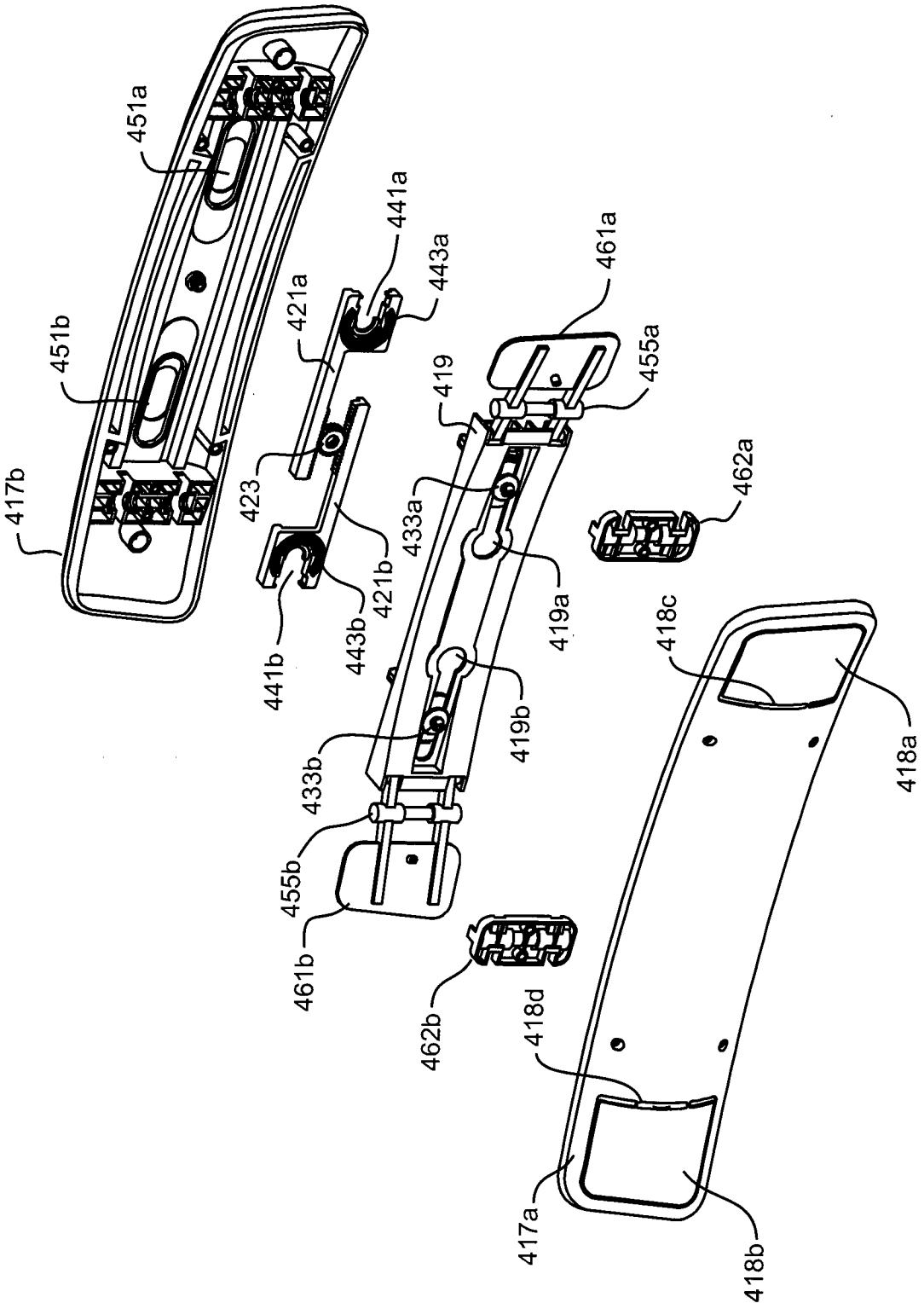


FIGURE 73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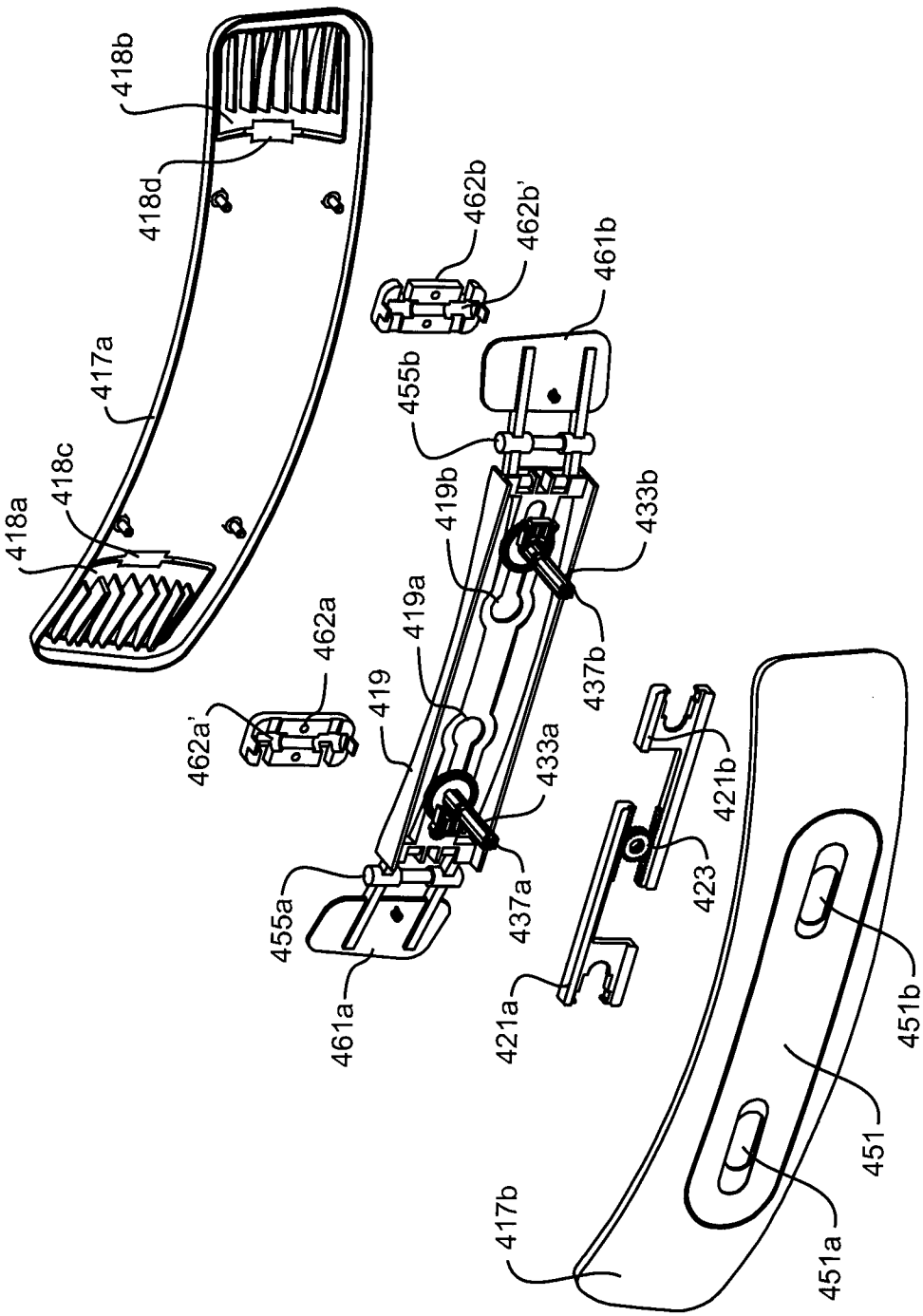
441a
443a
421a
423
421b
443b
441b
461a
455a
419
433a
419a
462a
419b
433b
455b
461b
462b
418c
418a
418d
417a
418b

FIGURE 74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418d
417a
418c
418a
462b
462b'
461b
455b
419b
433b
462a
419a
462a'
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437b
433a
421b
423
455a
437a
461a
421a
451b
451
417b
451a

FIGURE 75

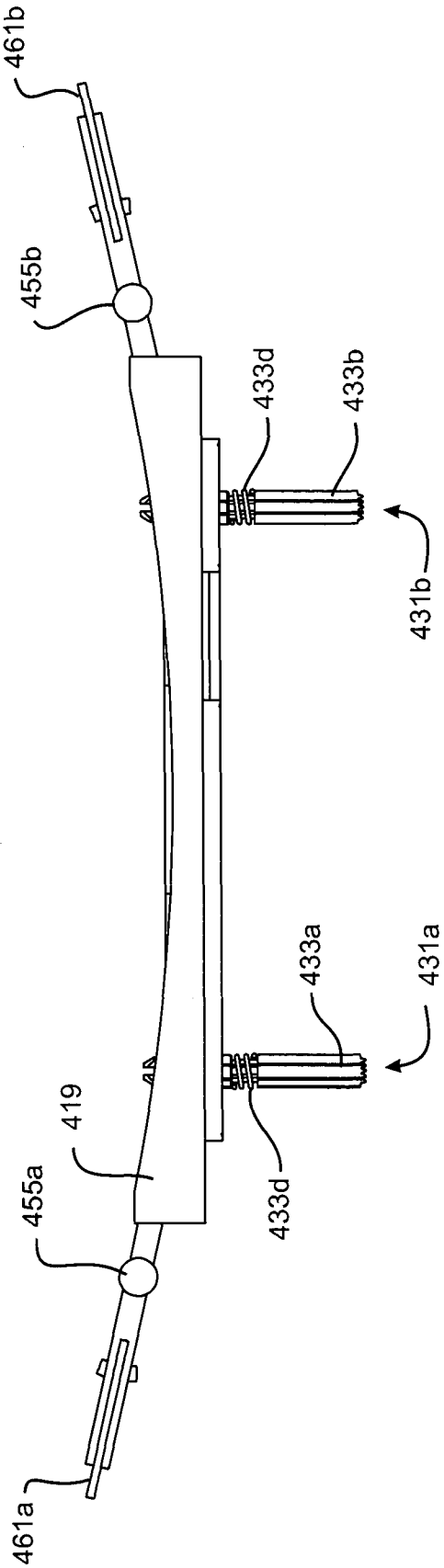


FIGURE 76

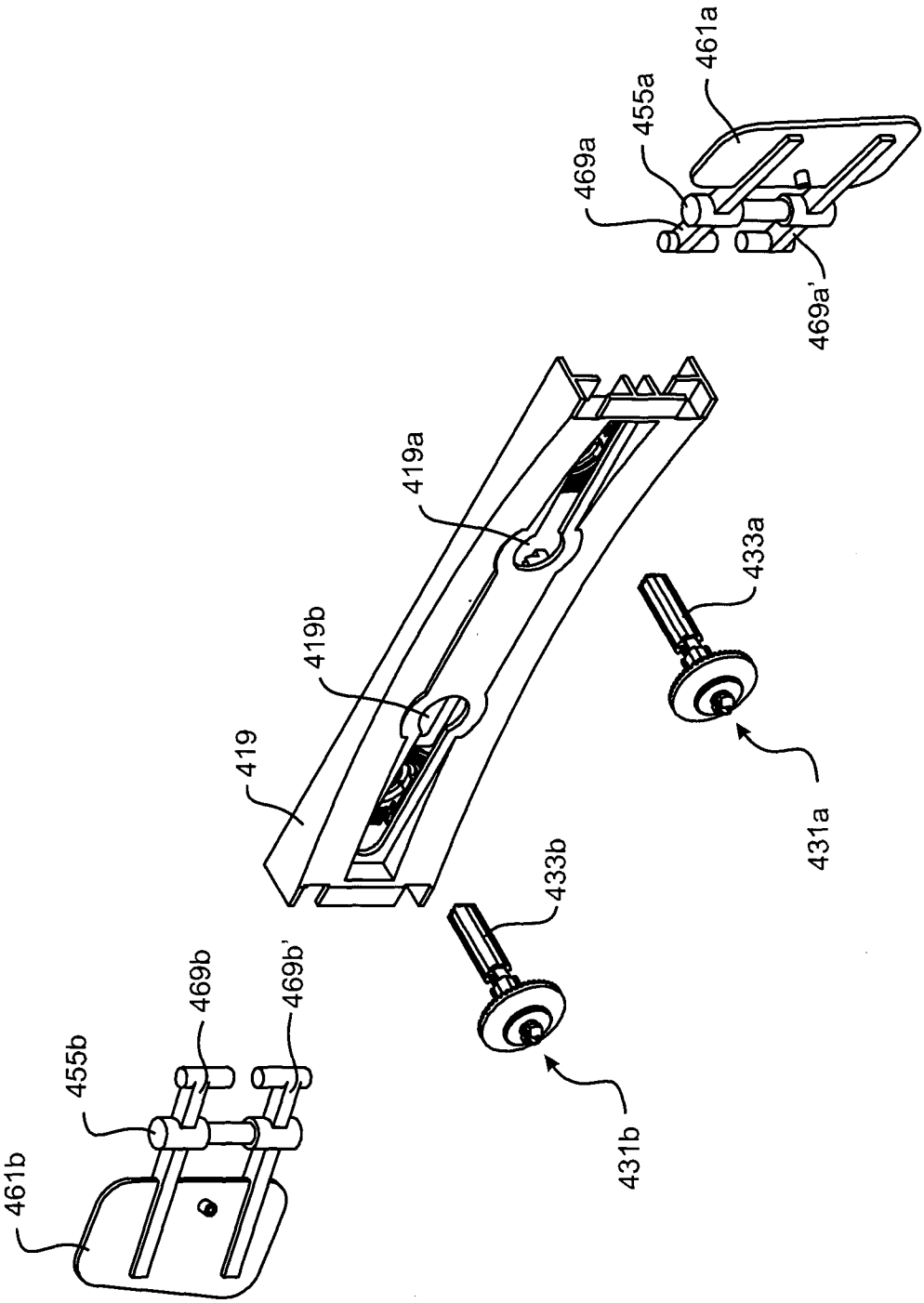
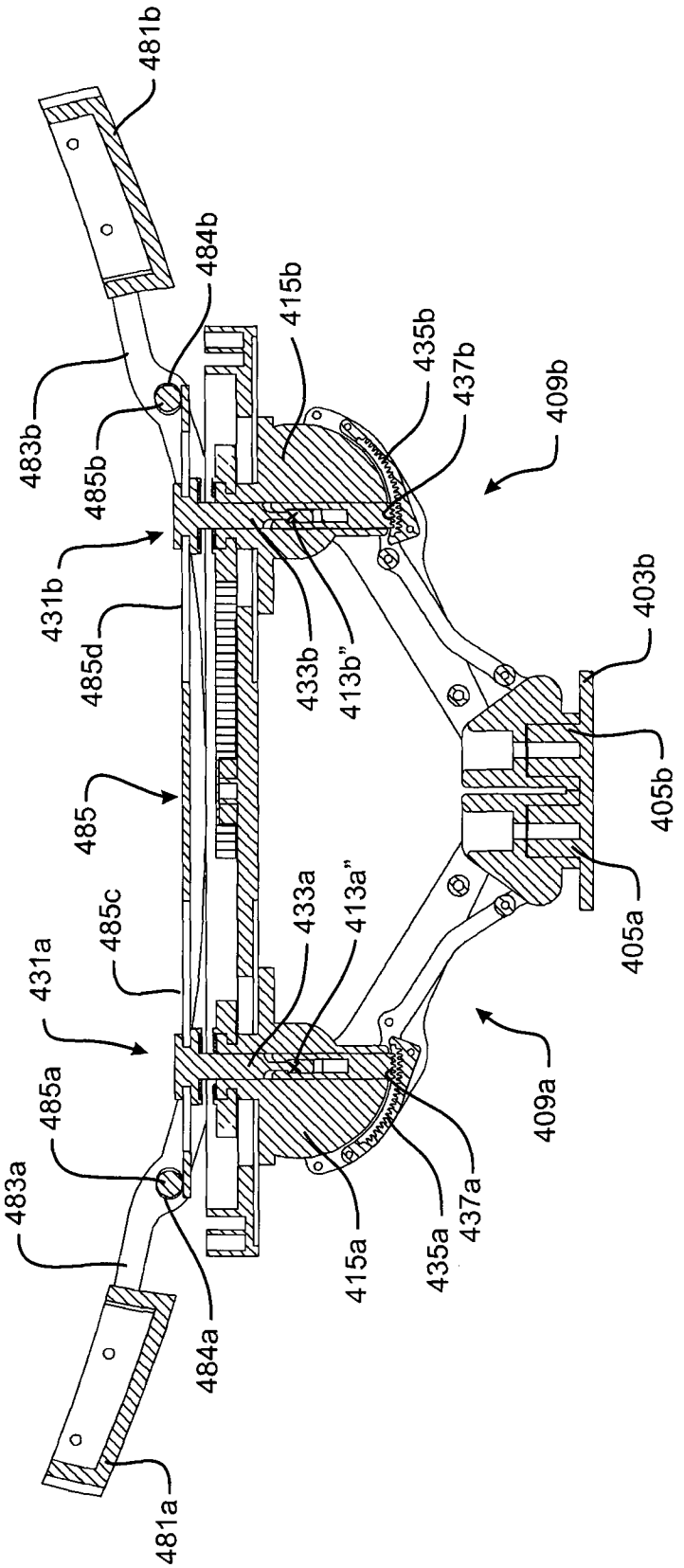

461a
455a
469a
469a'
419a
433a
419b
419
431a
433b
469b
469b'
455b
461b
431b

FIGURE 77


481b
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415b
435b
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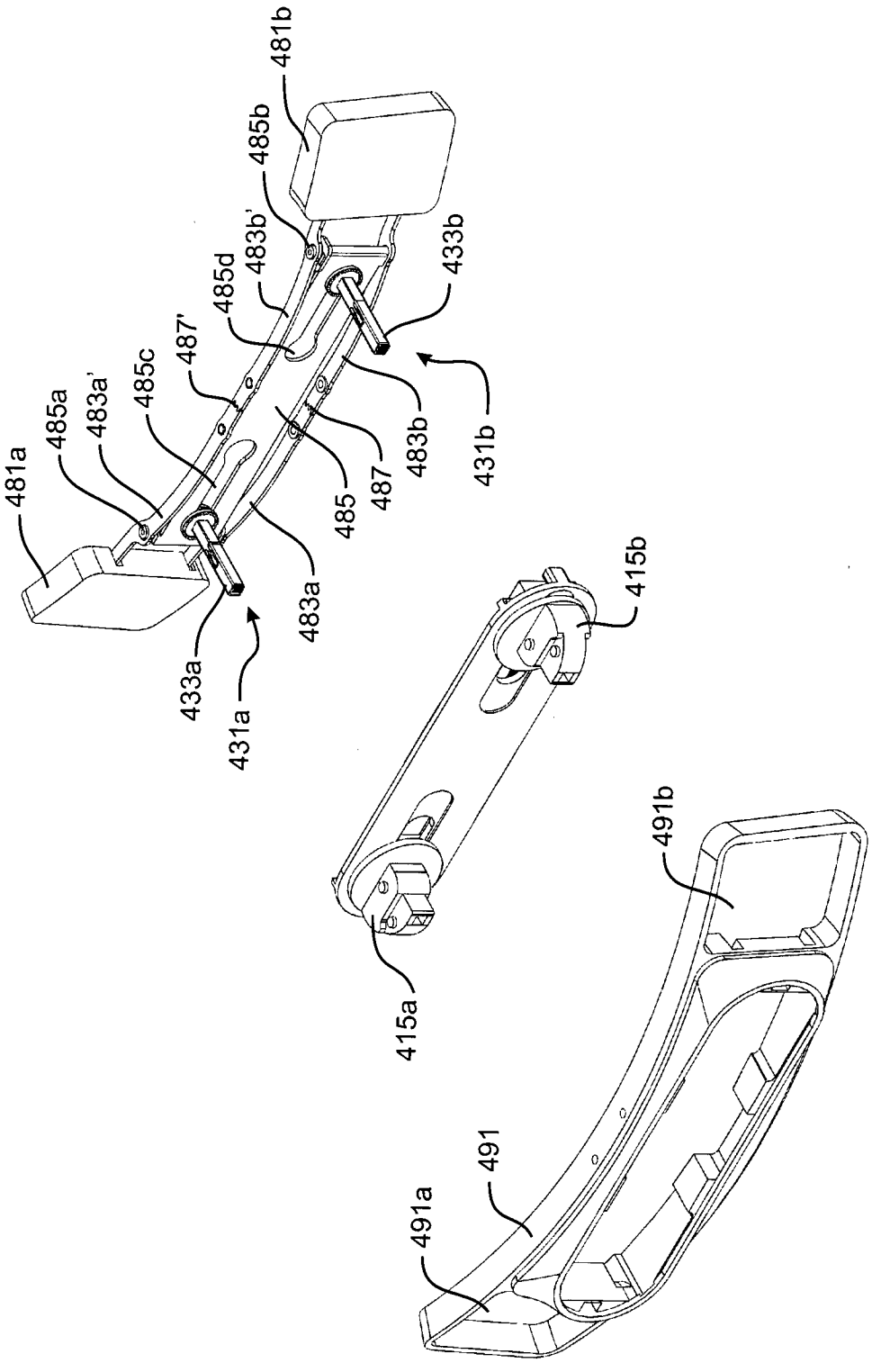
409b
483b
485b
431b
485d
433b
413b"
403b
485
405b
485c
433a
413a"
431a
405a
485a
409a
483a
437a
435a
415a
484a
481a

FIGURE 78


481b
485b
483b'
485d
487'
485c
483a'
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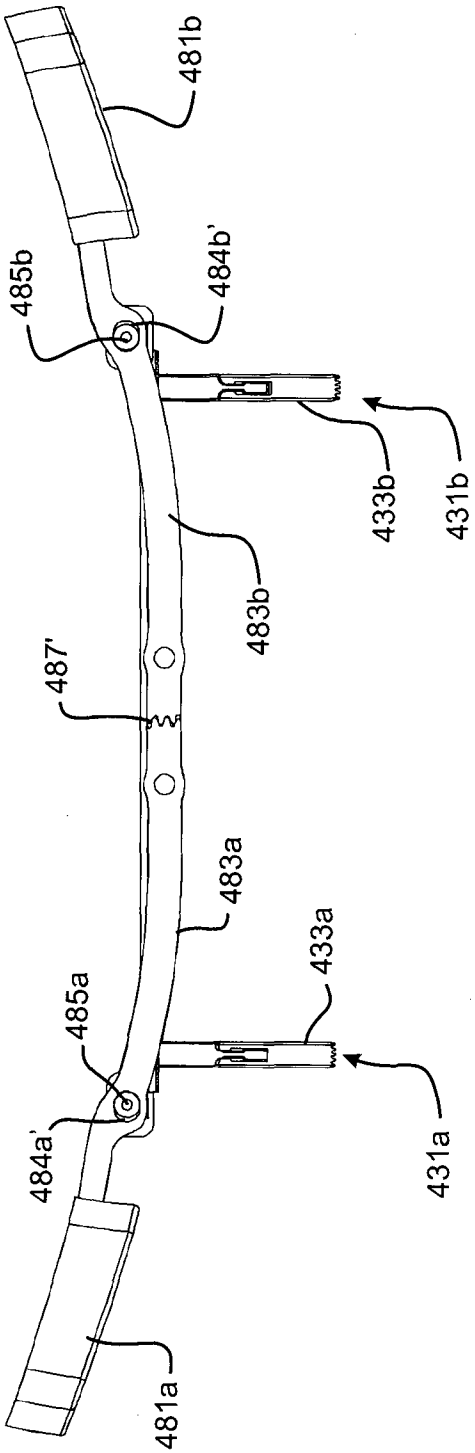
431a
483a
485
487
483b
431b
433b
415b
415a
491b
491
491a

FIGURE 79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484b'
485b
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431b
483b
487'
483a
433a
485a
484a'
431a
481a

FIGURE 80

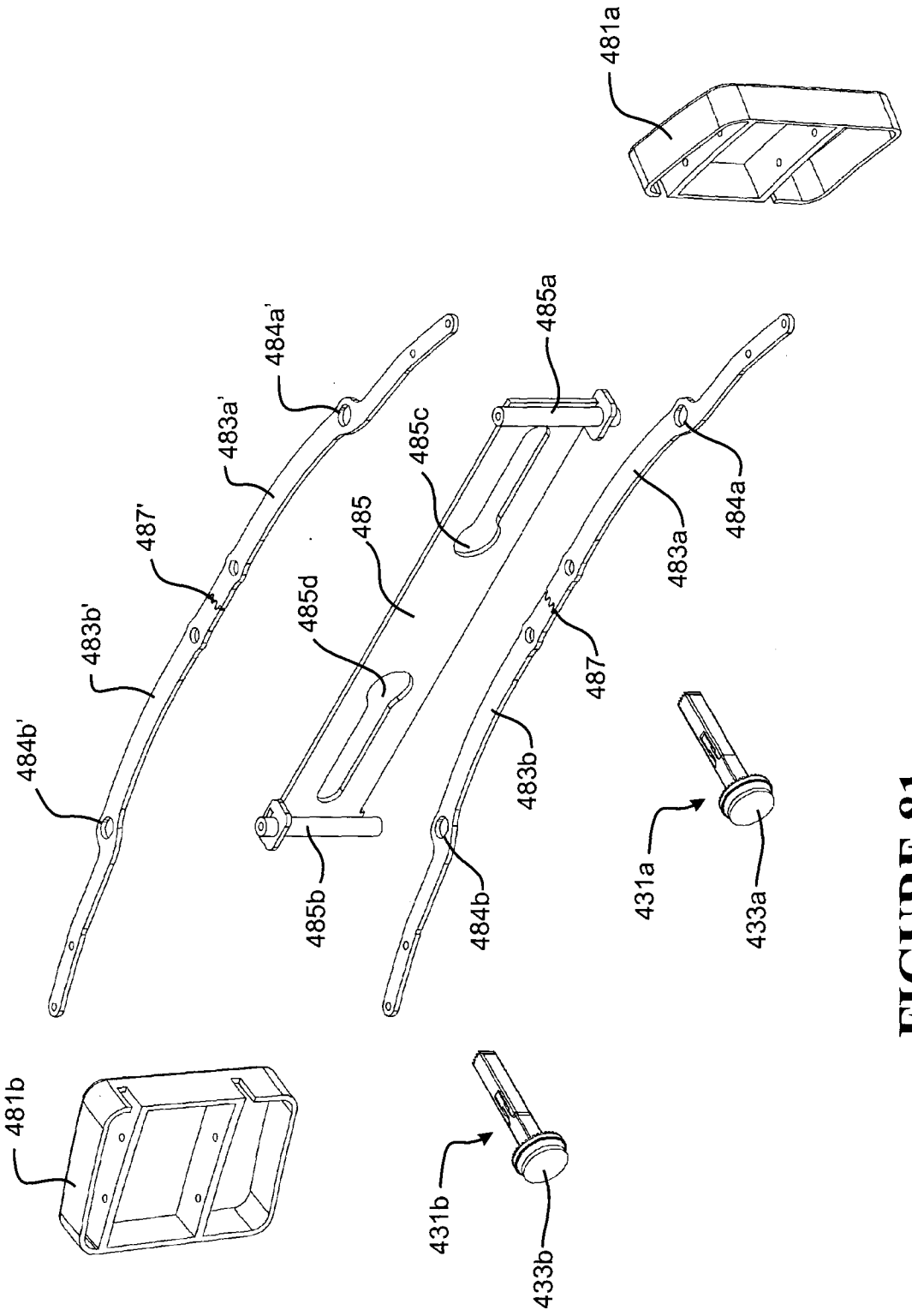
481a
484a'
485a
483a'
485c
487'
485
484a
483a
483b'
485d
484b'
487
483b
431a
485b
484b
433a
481b
431b
433b

FIGURE 81

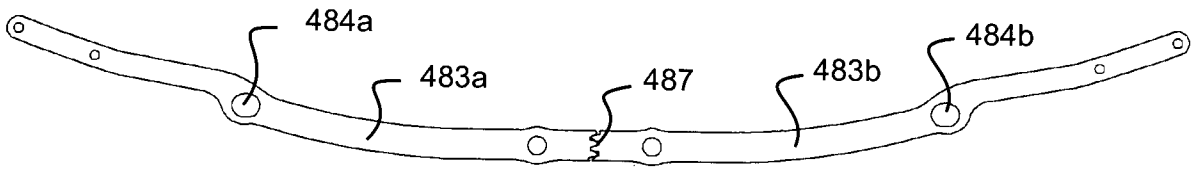

FIGURE 82A

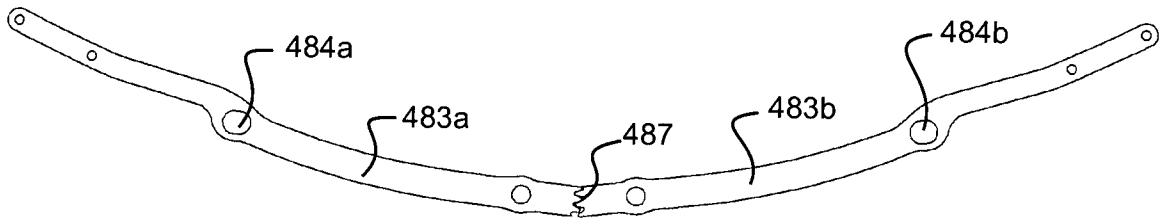

FIGURE 82B

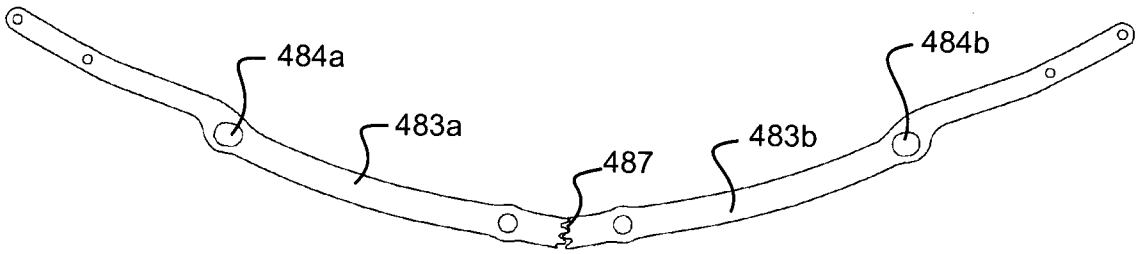

FIGURE 82C

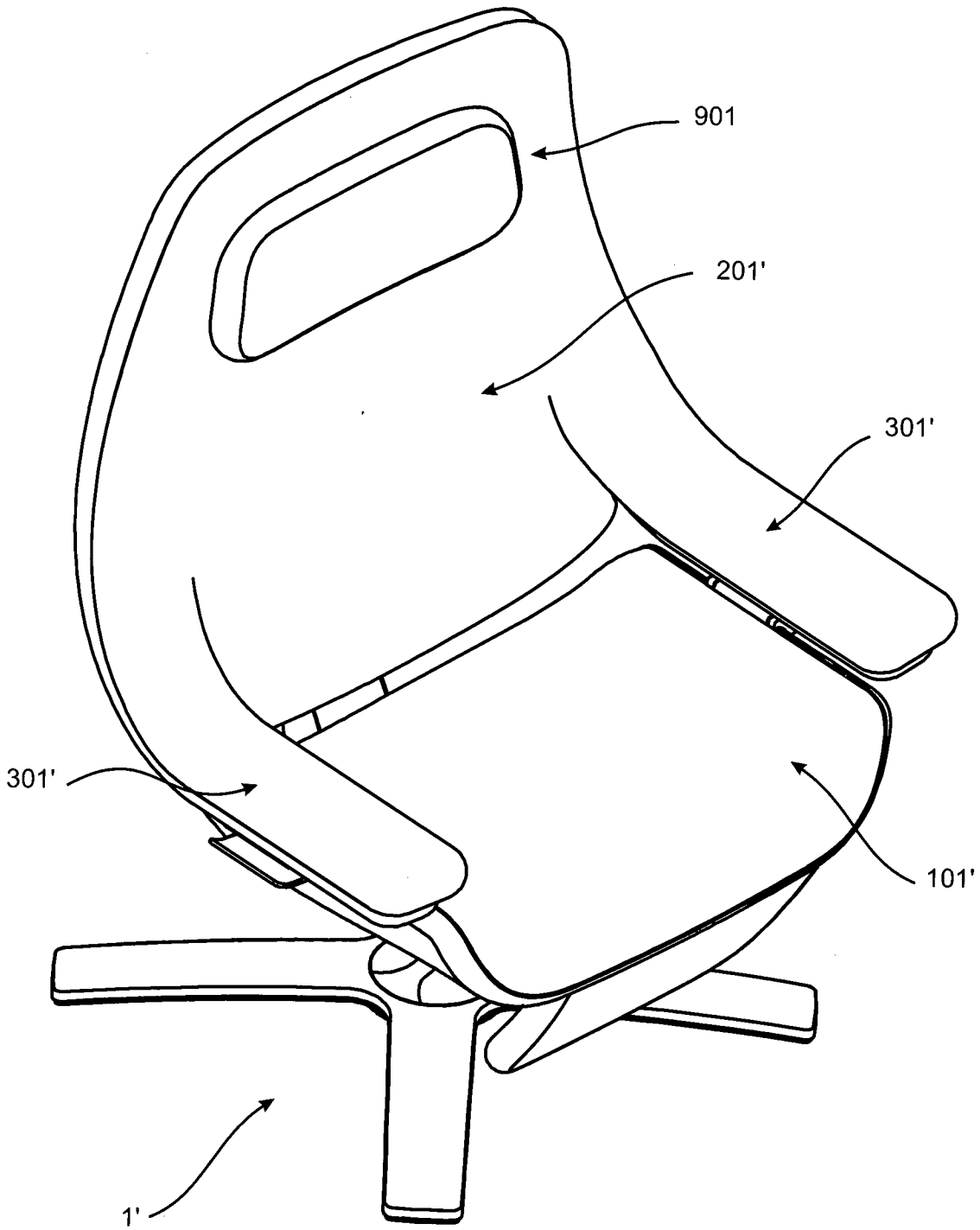

FIGURE 83

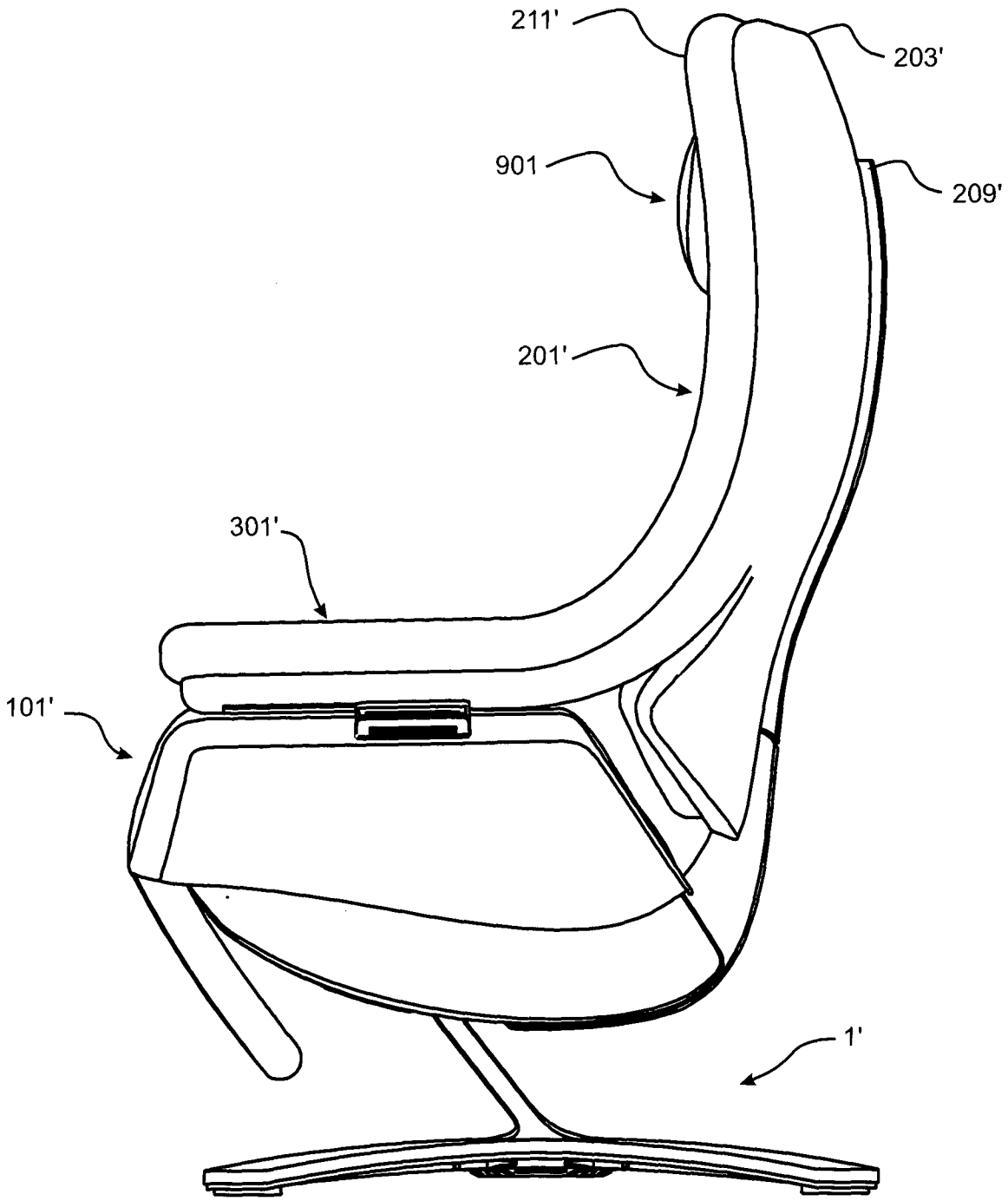

FIGURE 84

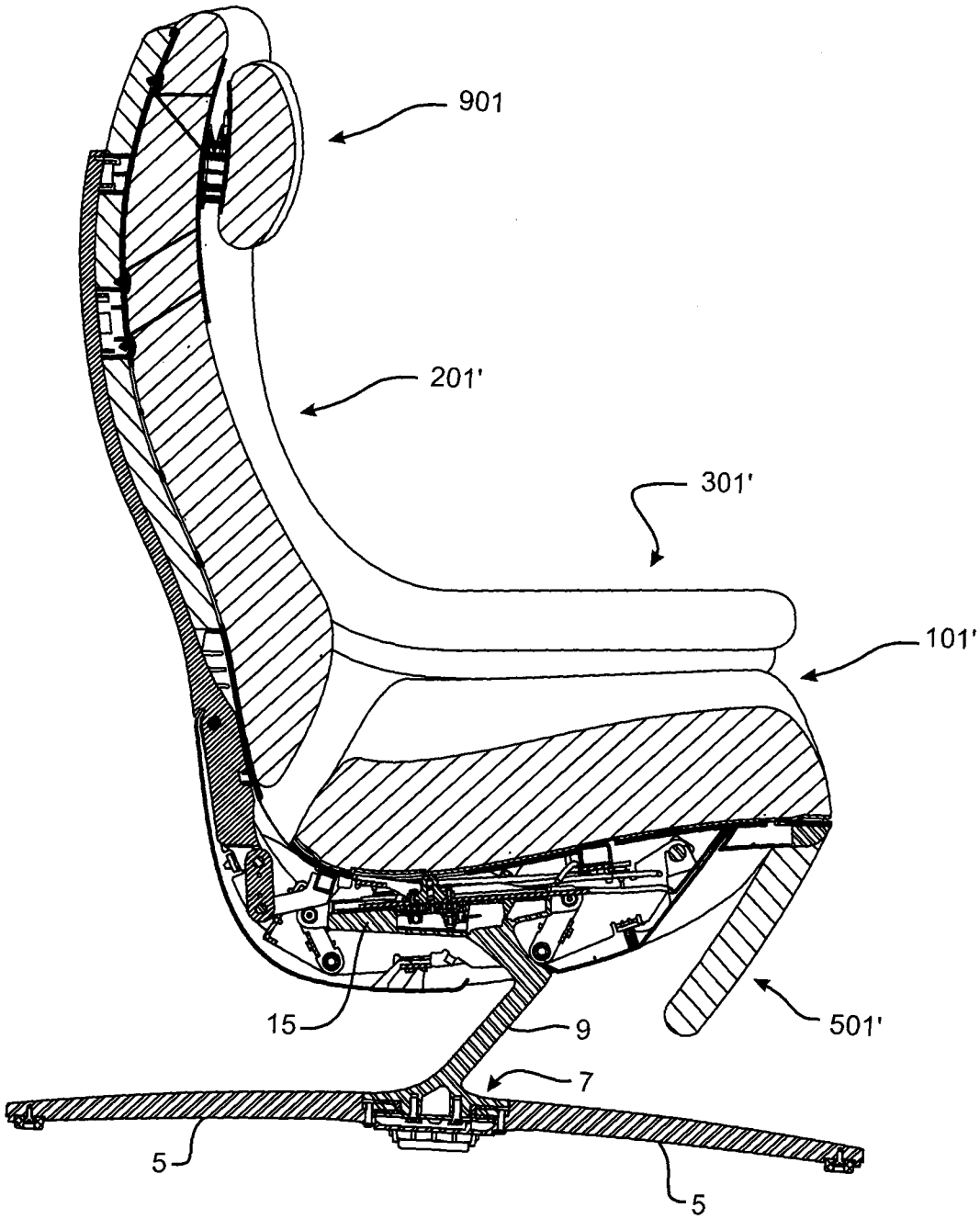

FIGURE 85

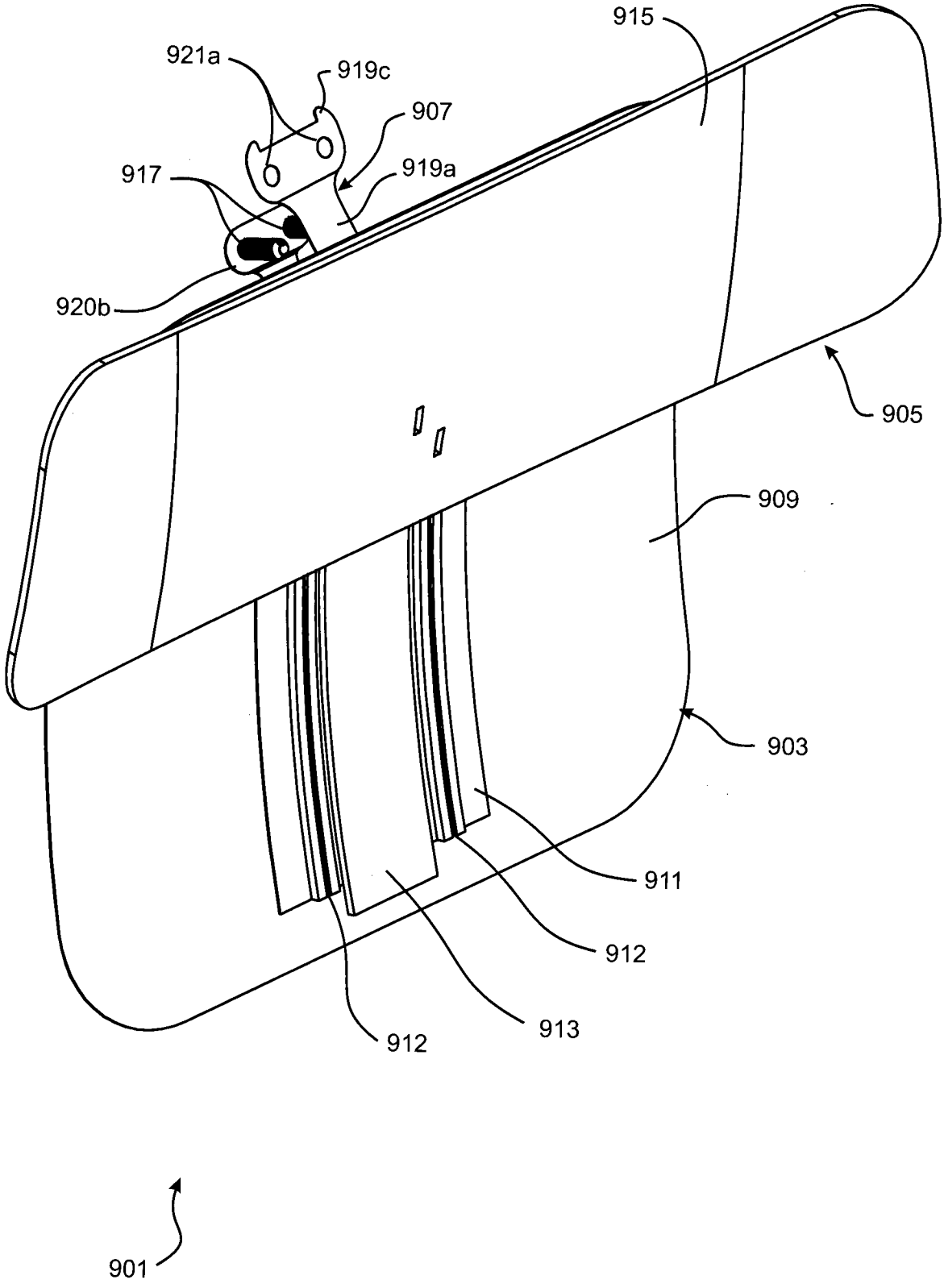

FIGURE 86

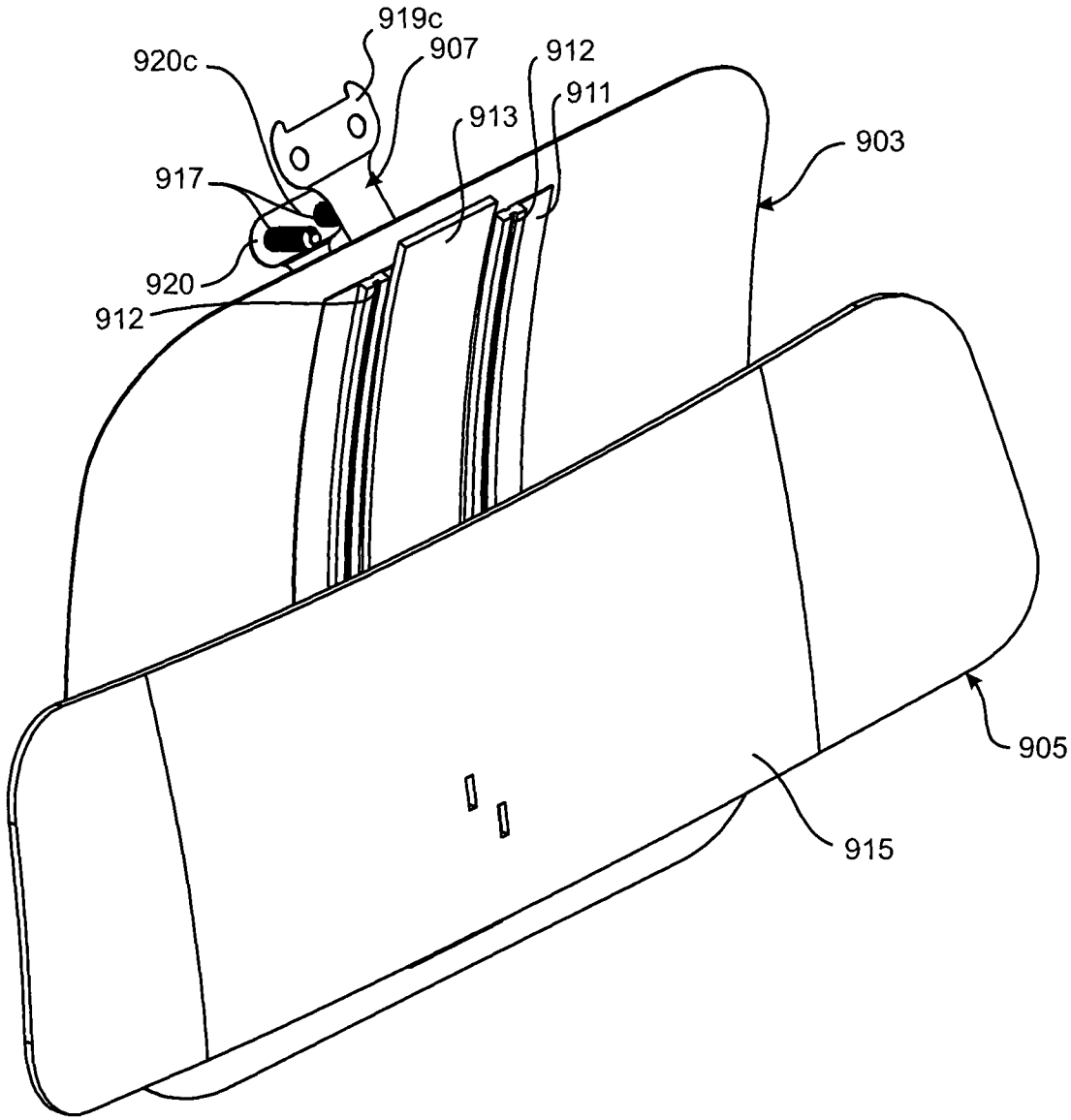

FIGURE 87

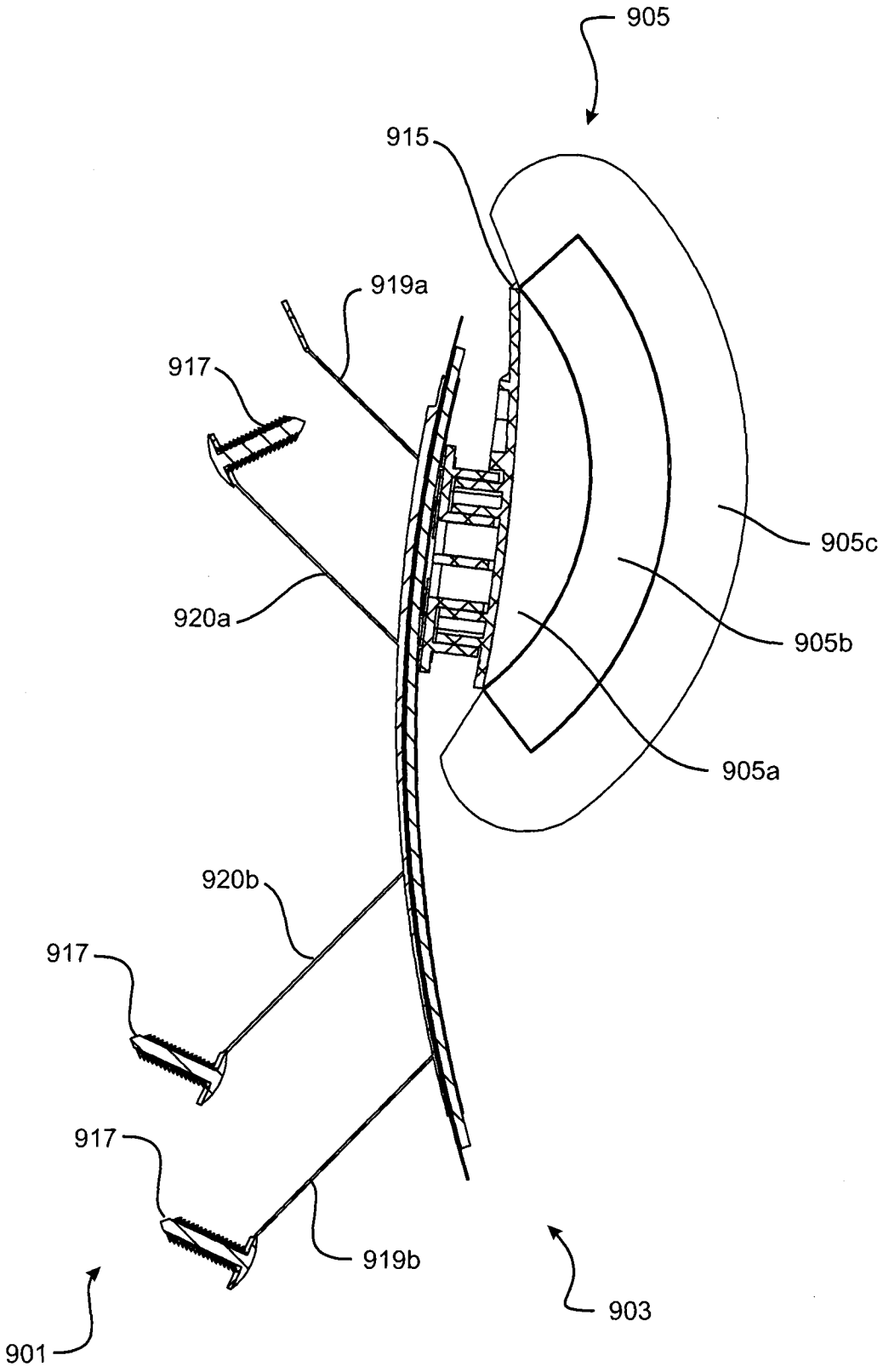

FIGURE 88

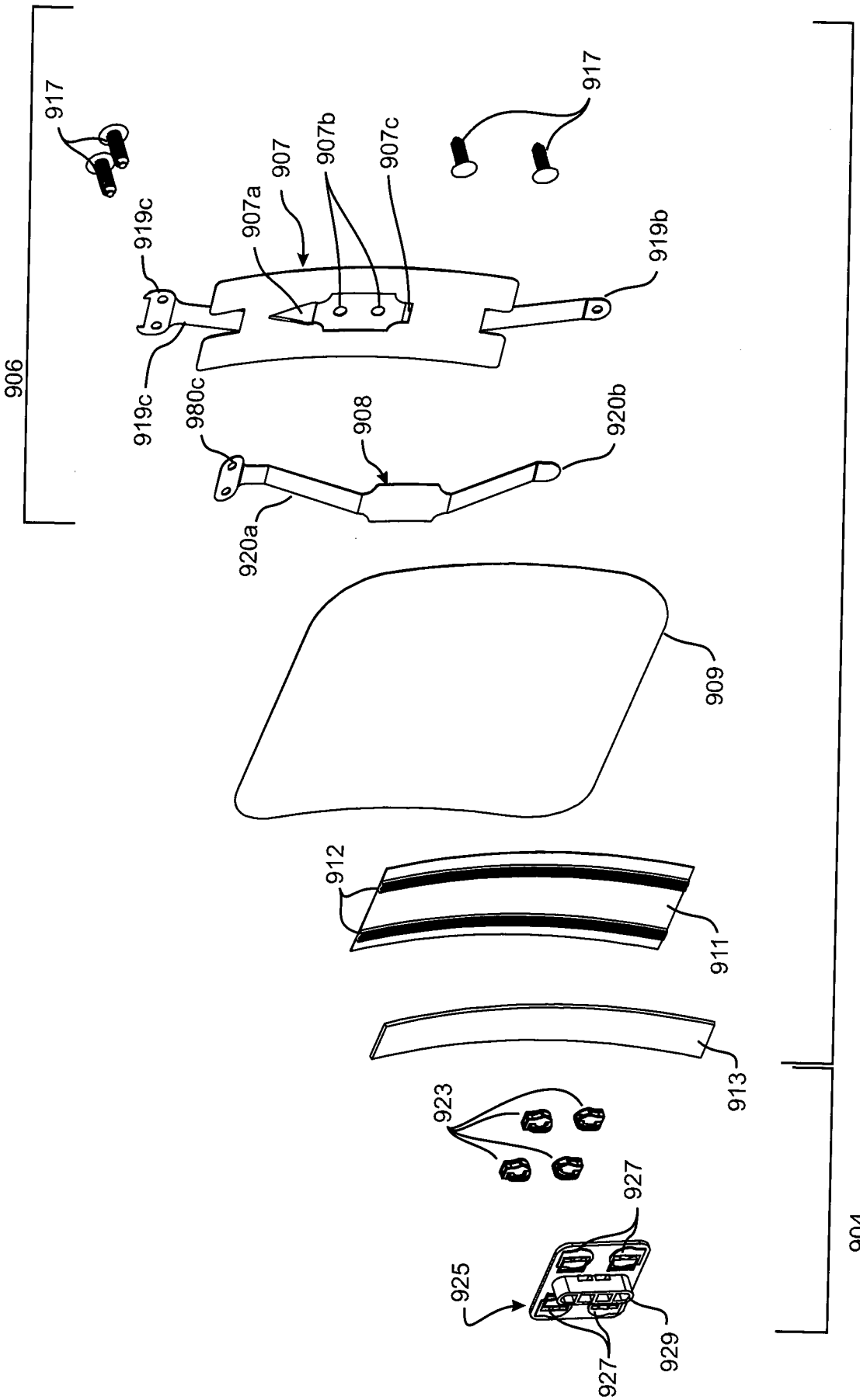
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FIGURE 89

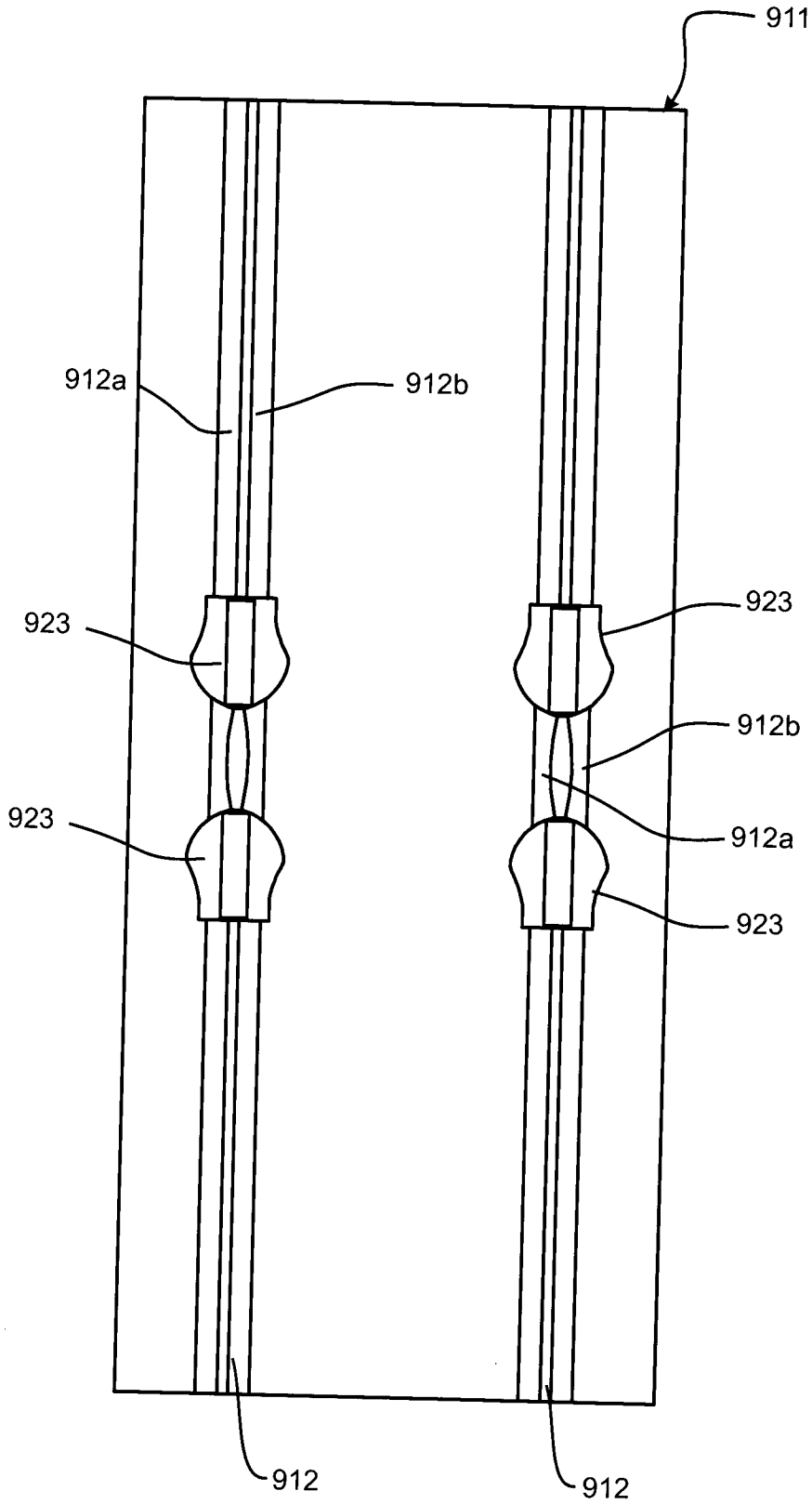


FIGURE 90

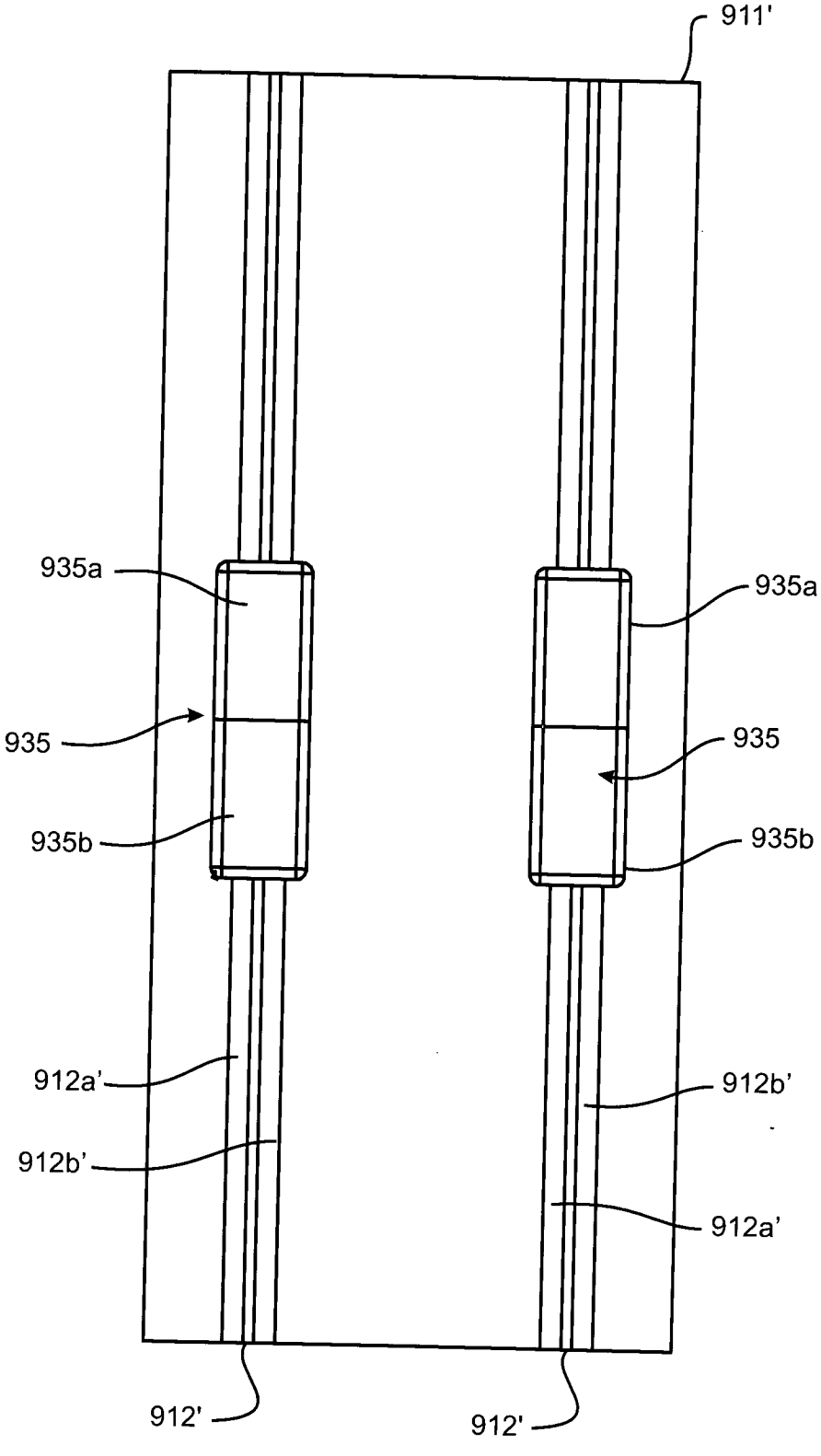


FIGURE 91

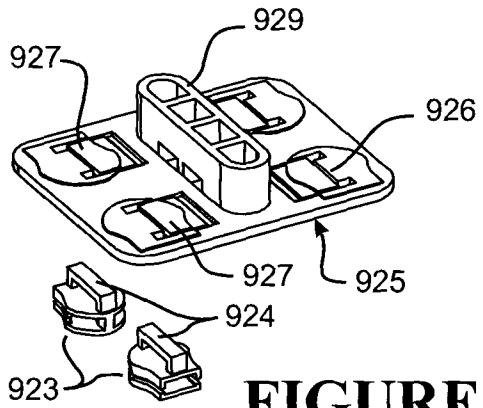


FIGURE 92A

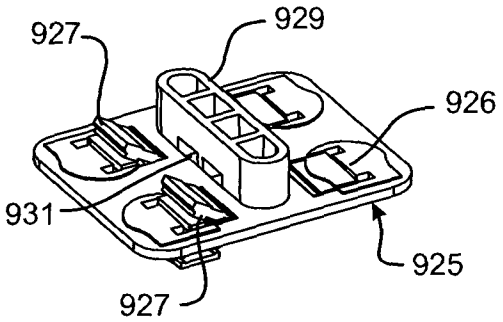


FIGURE 93A

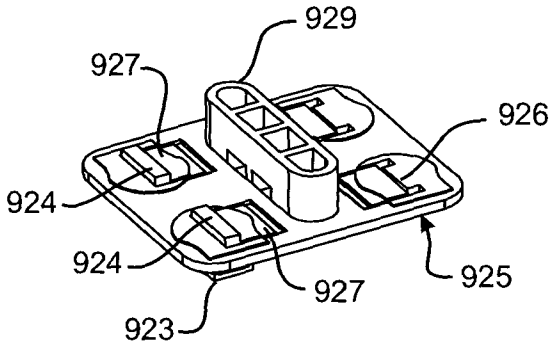


FIGURE 94A

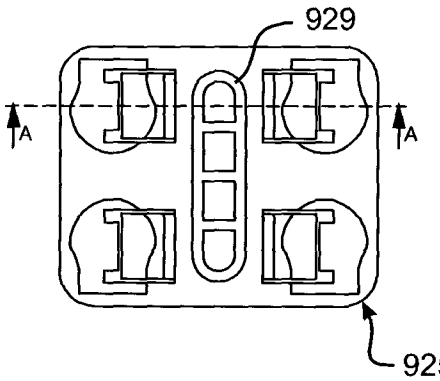


FIGURE 92B

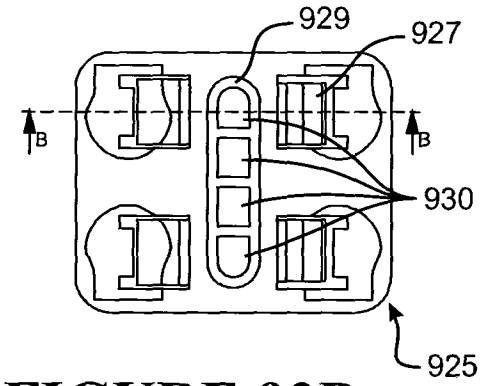


FIGURE 93B

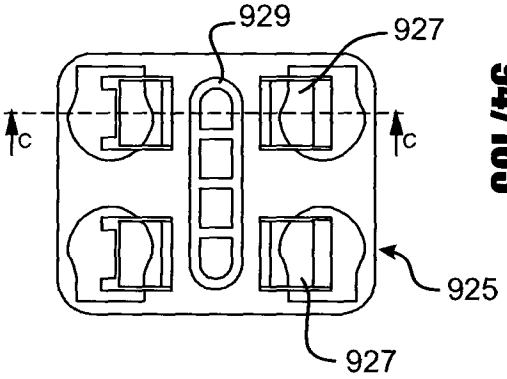
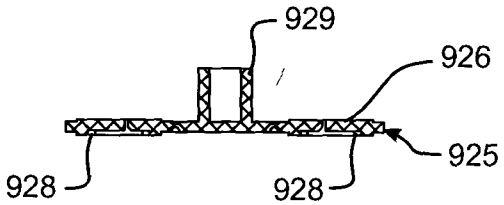


FIGURE 94B



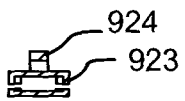


FIGURE 92C

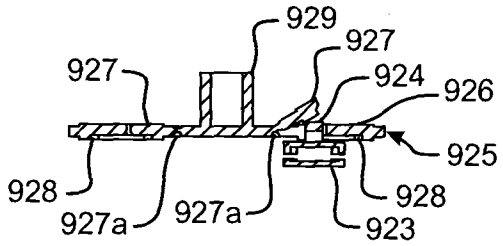


FIGURE 93C

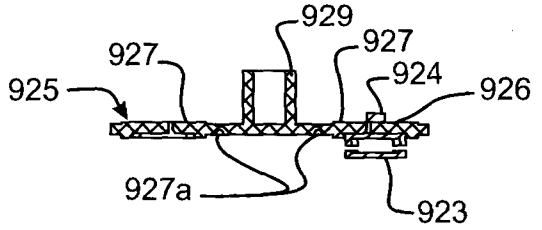


FIGURE 94C

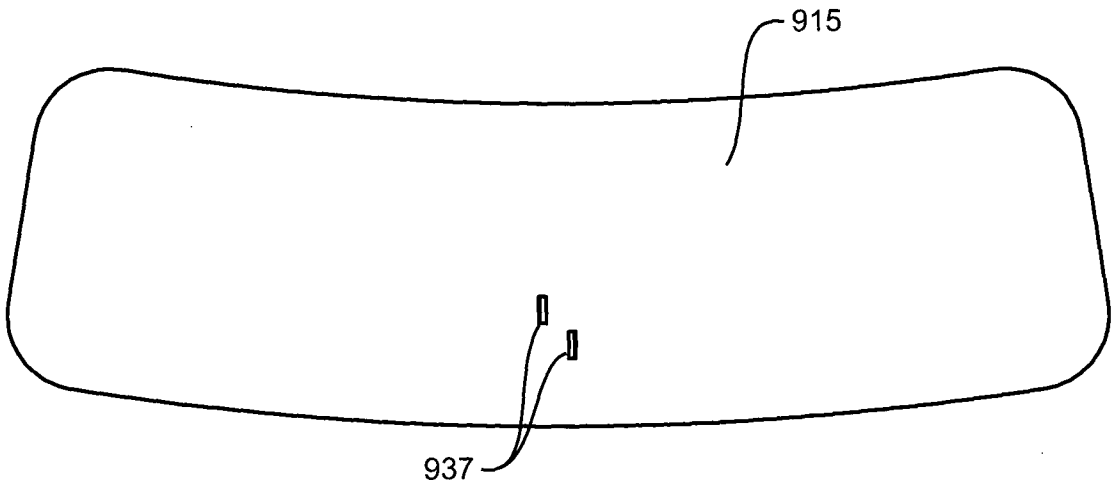


FIGURE 95A

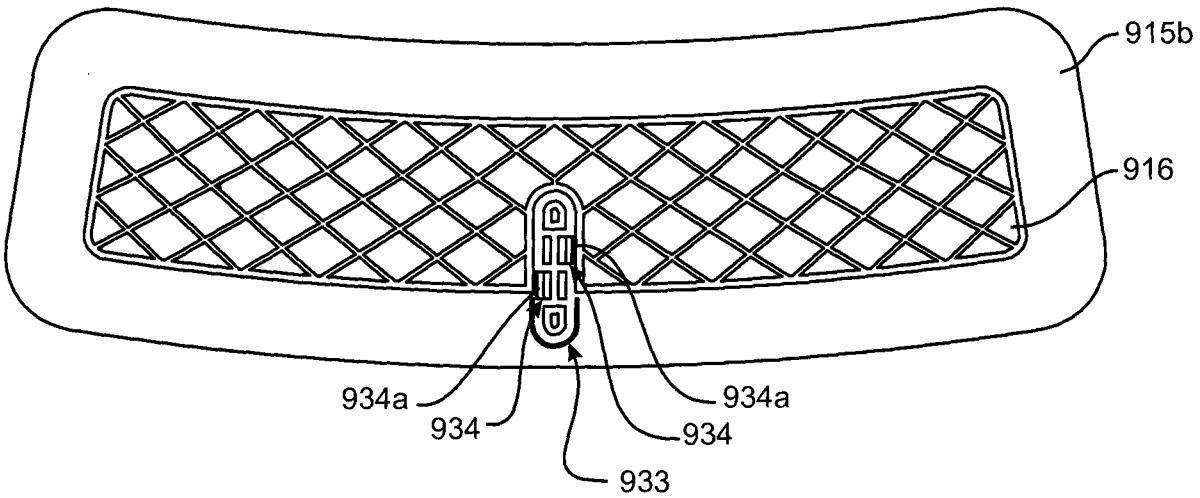


FIGURE 95B

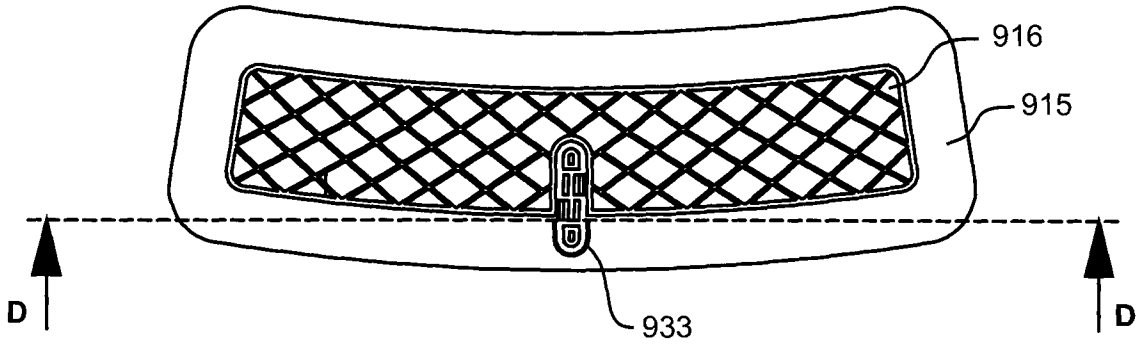


FIGURE 96A

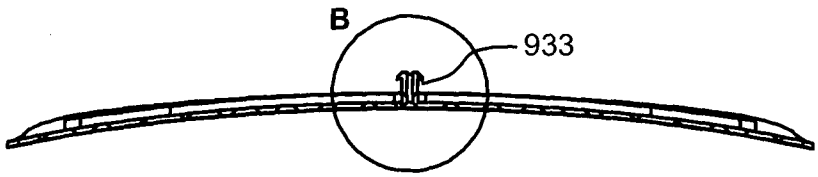


FIGURE 96B

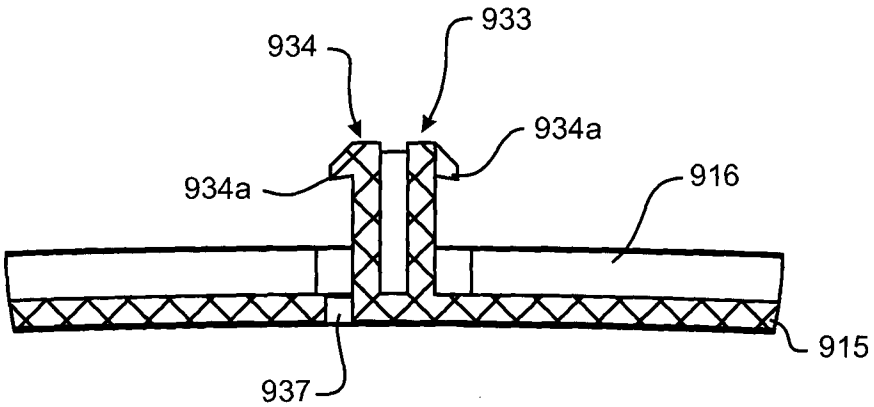


FIGURE 96C

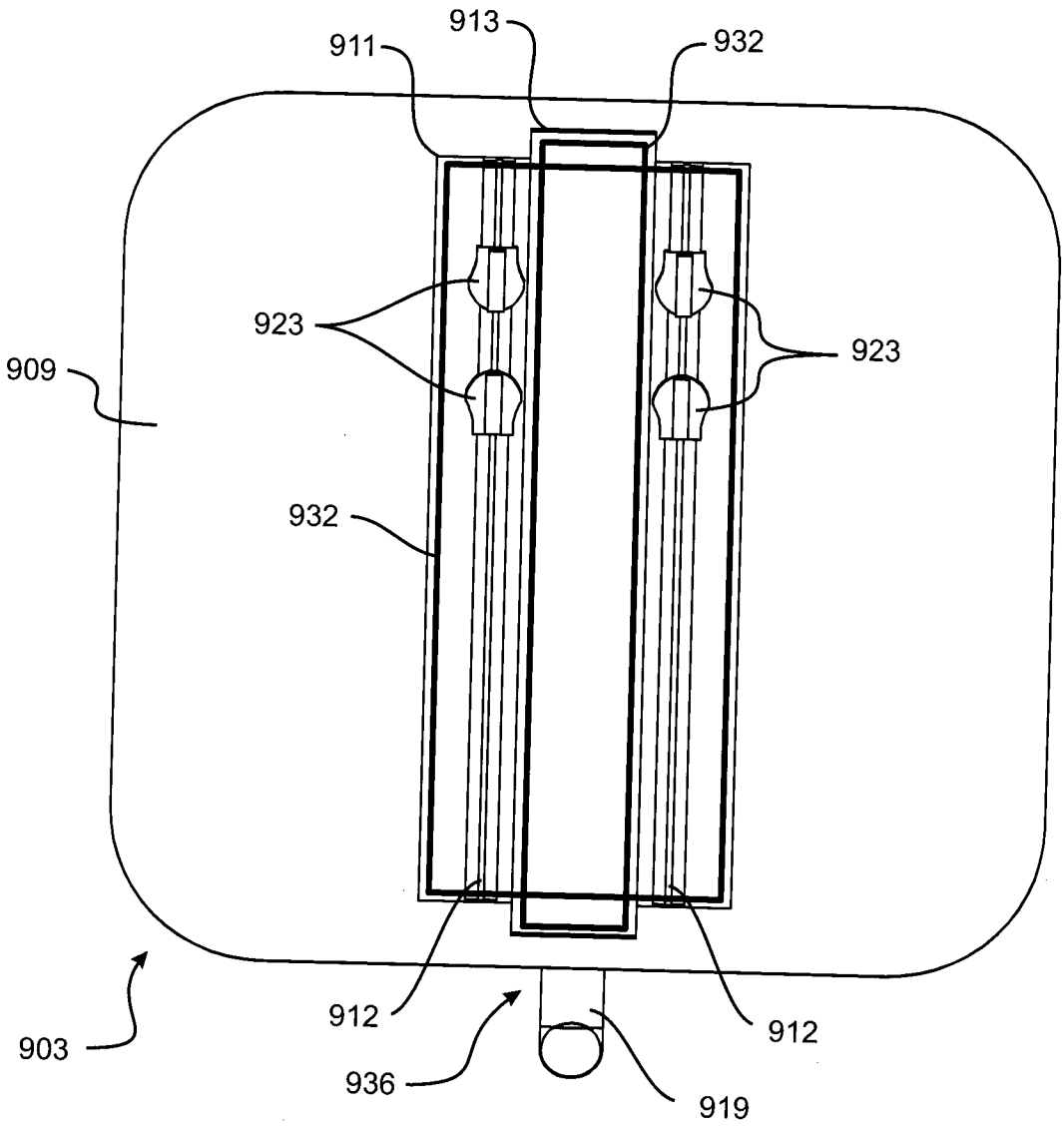


FIGURE 97

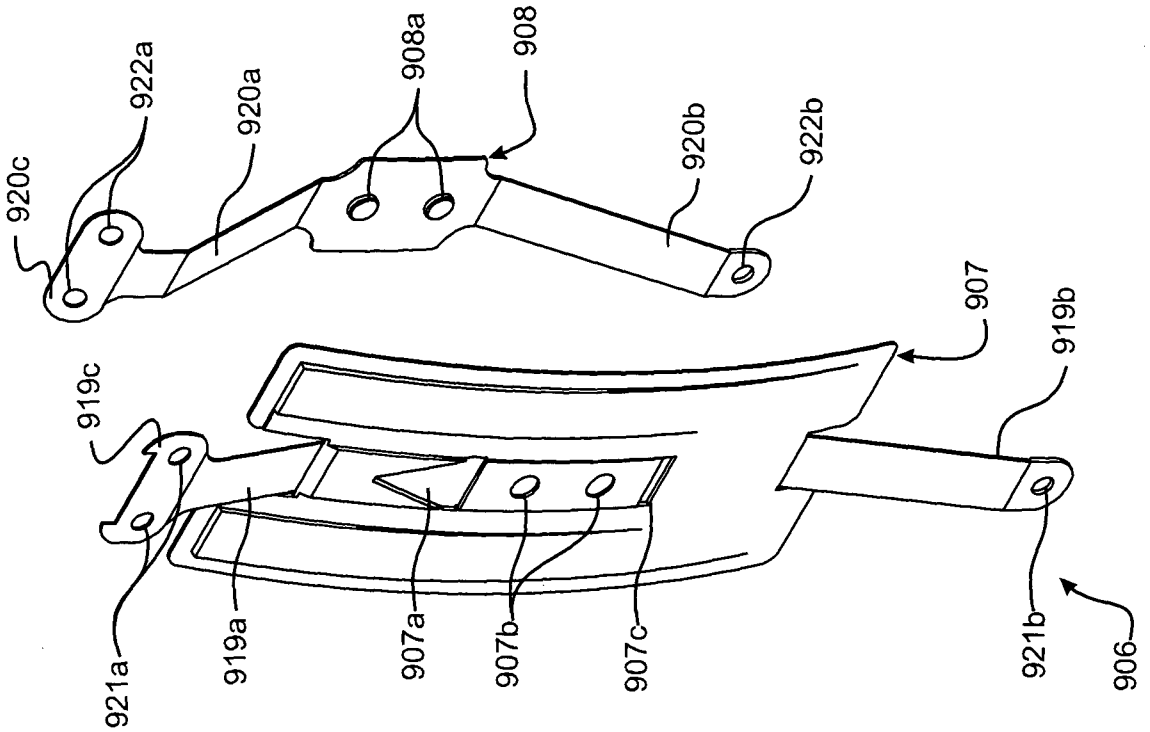


FIGURE 98B

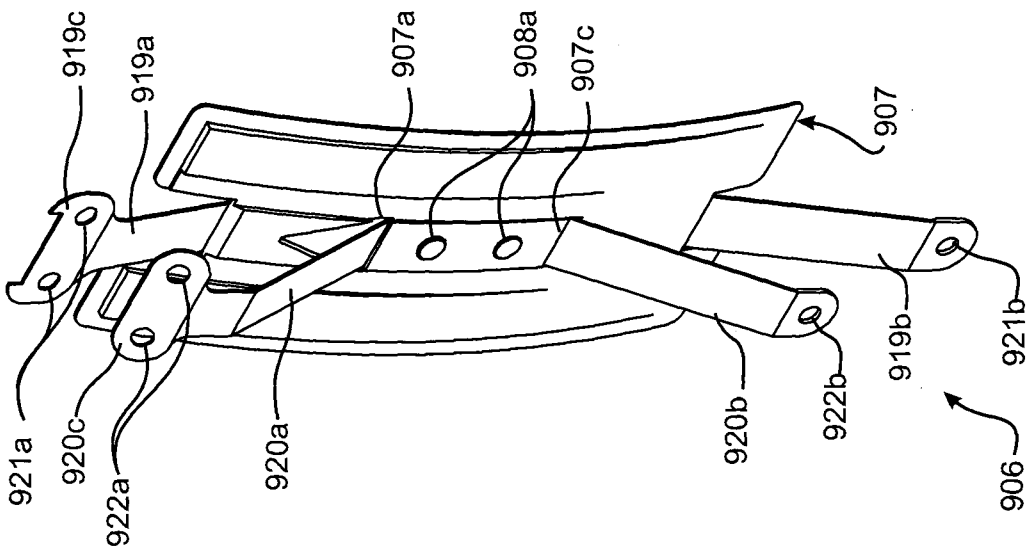


FIGURE 98A

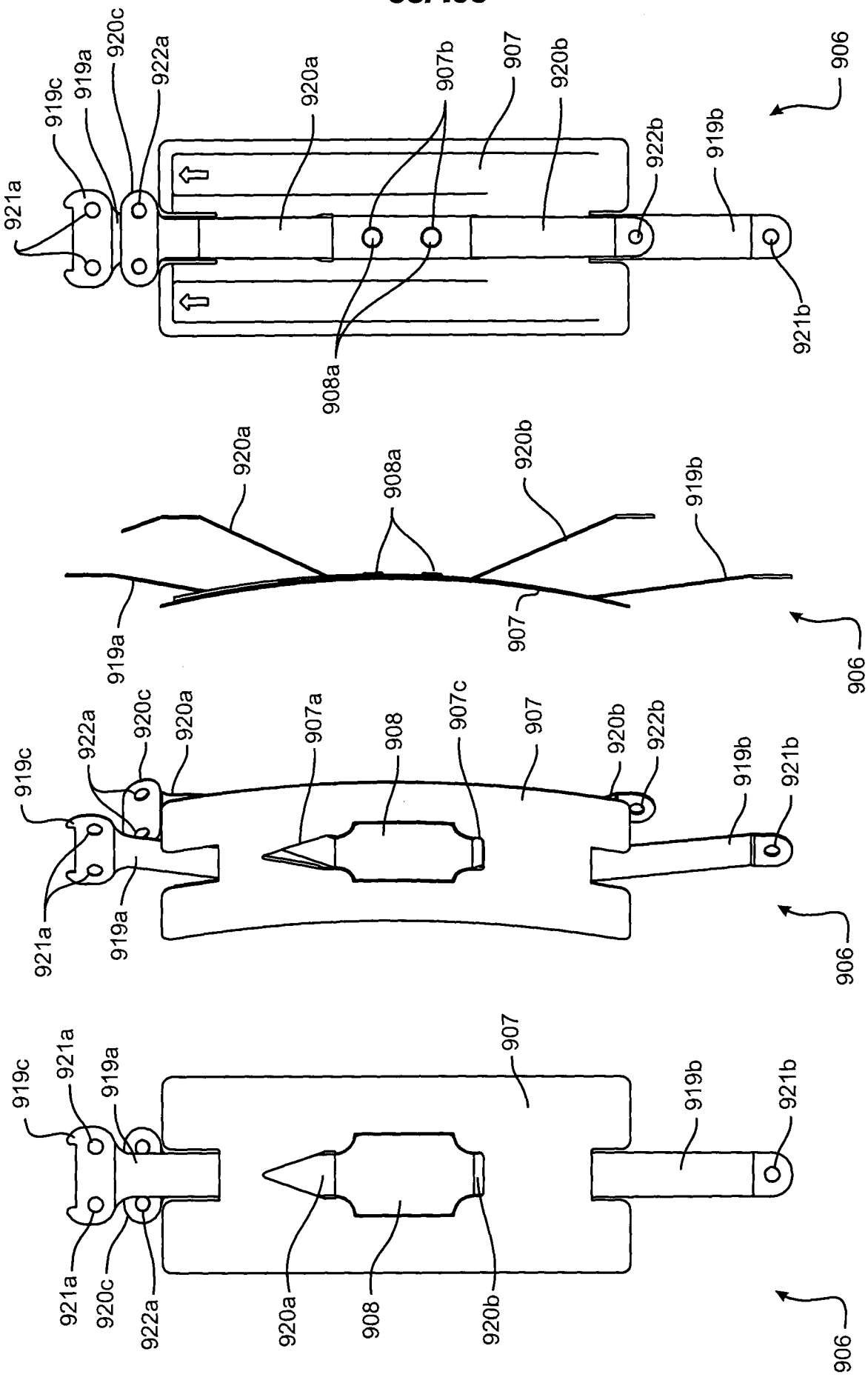


FIGURE 99A FIGURE 99B FIGURE 99C FIGURE 99D

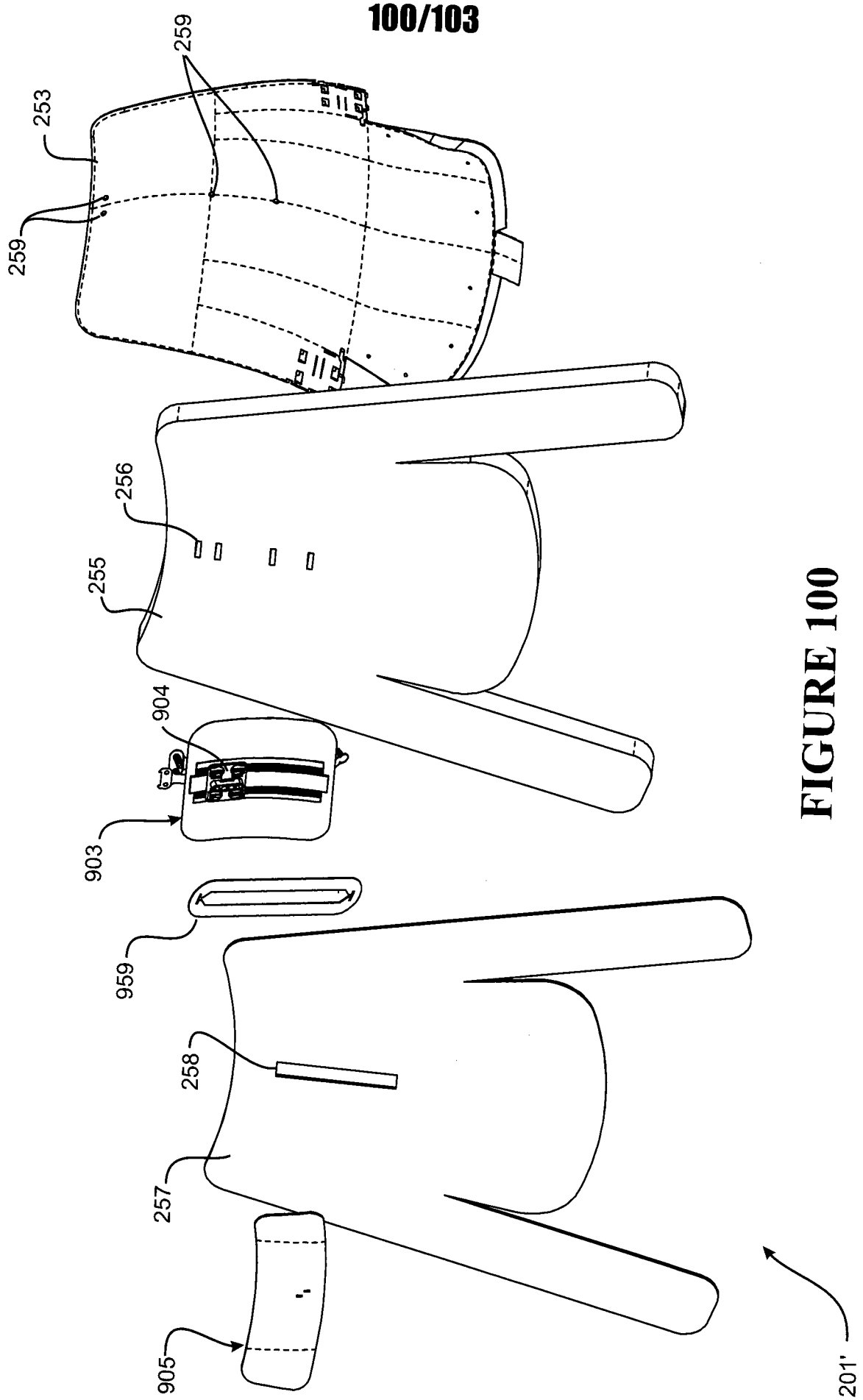


FIGURE 100

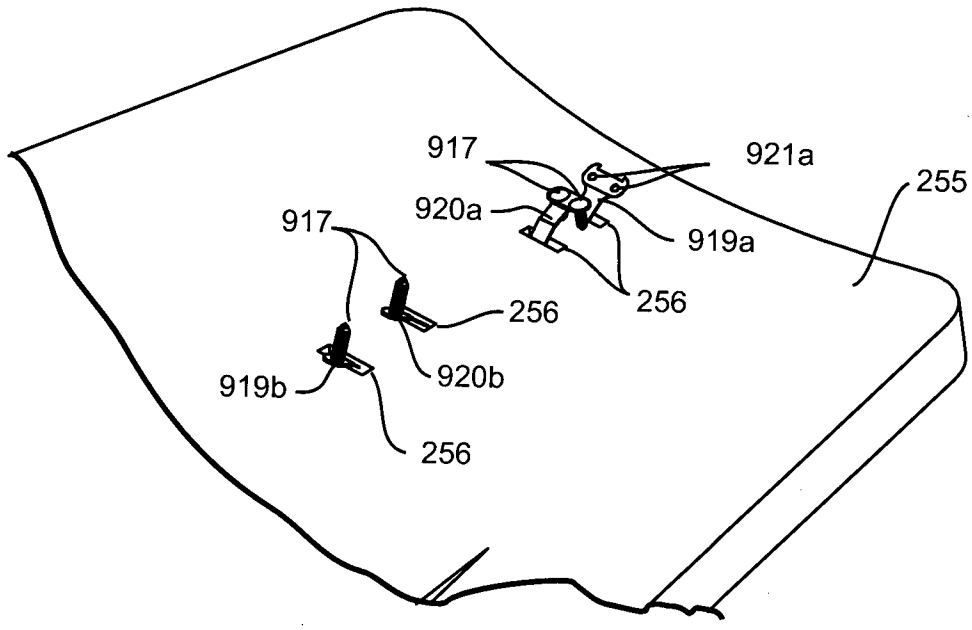


FIGURE 101

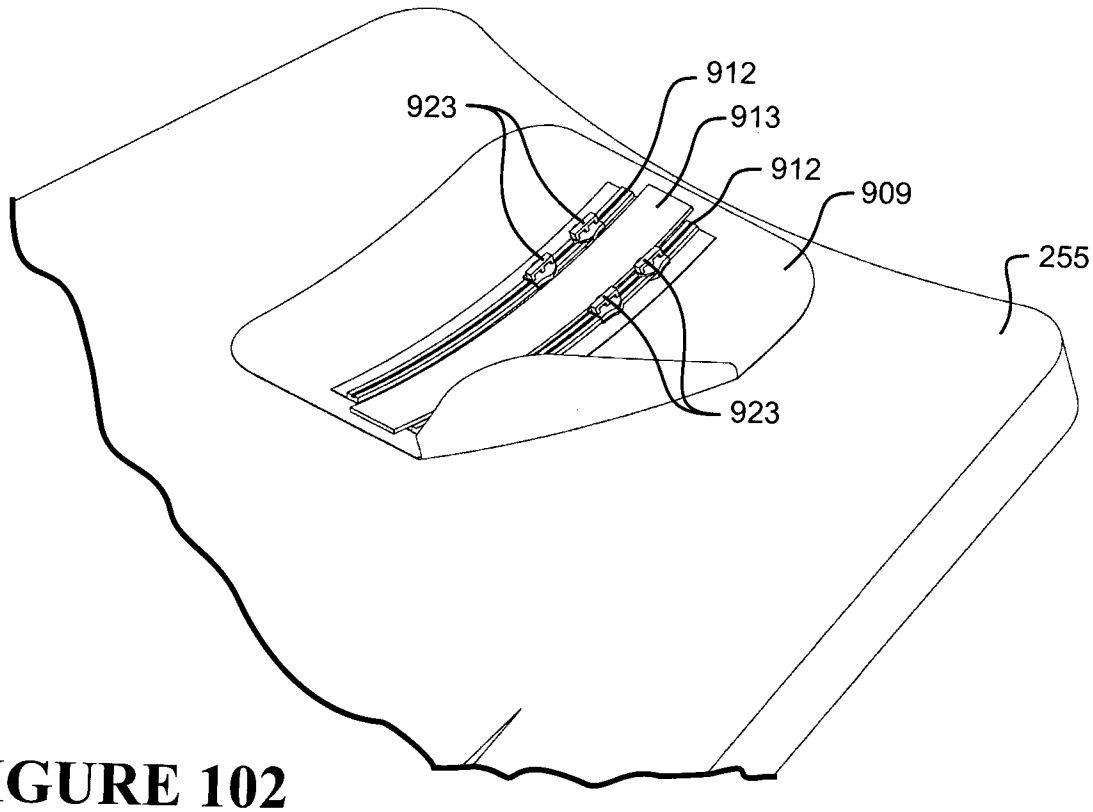


FIGURE 102

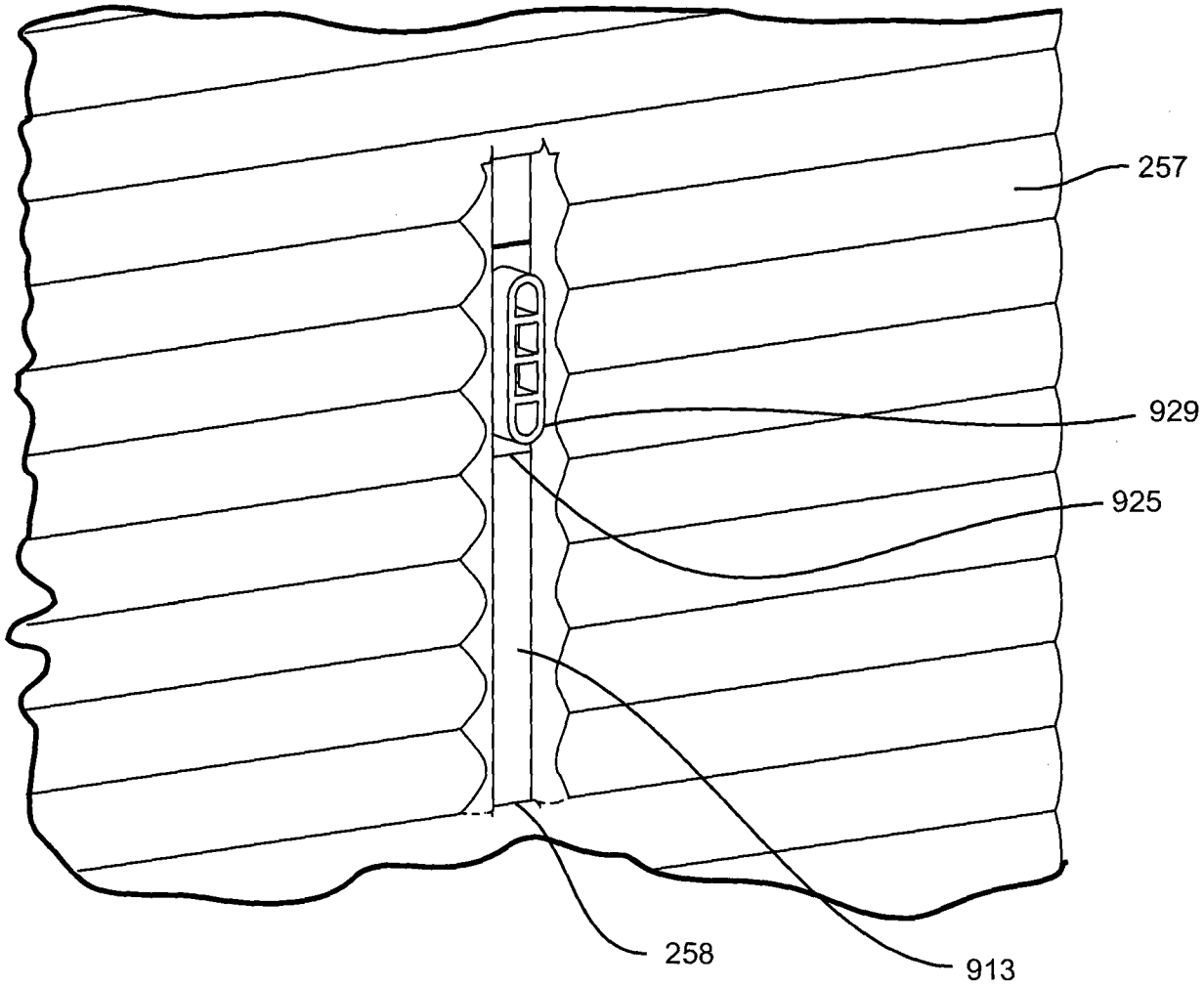


FIGURE 103

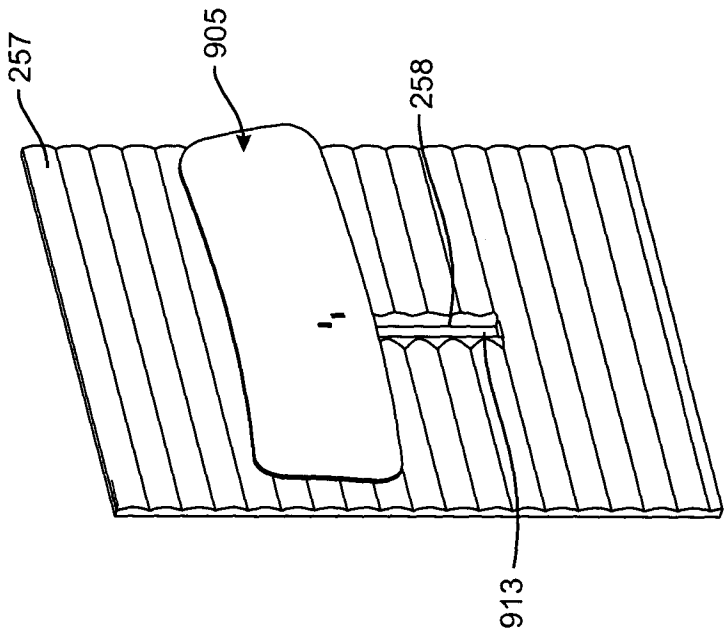


FIGURE 104B

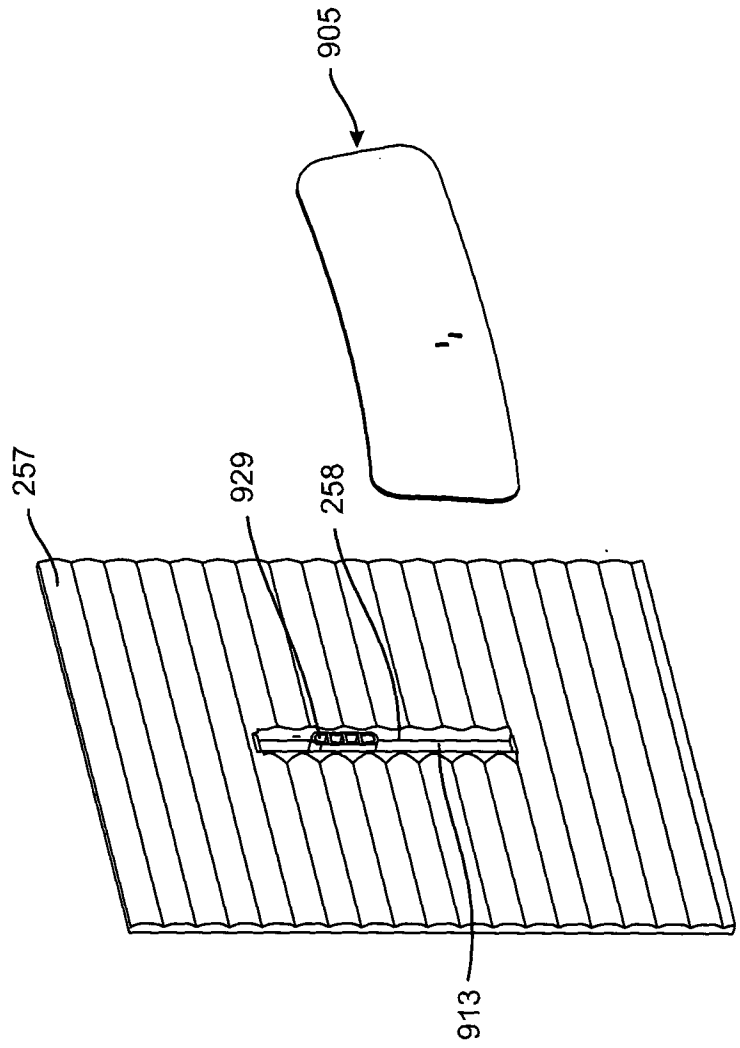


FIGURE 104A