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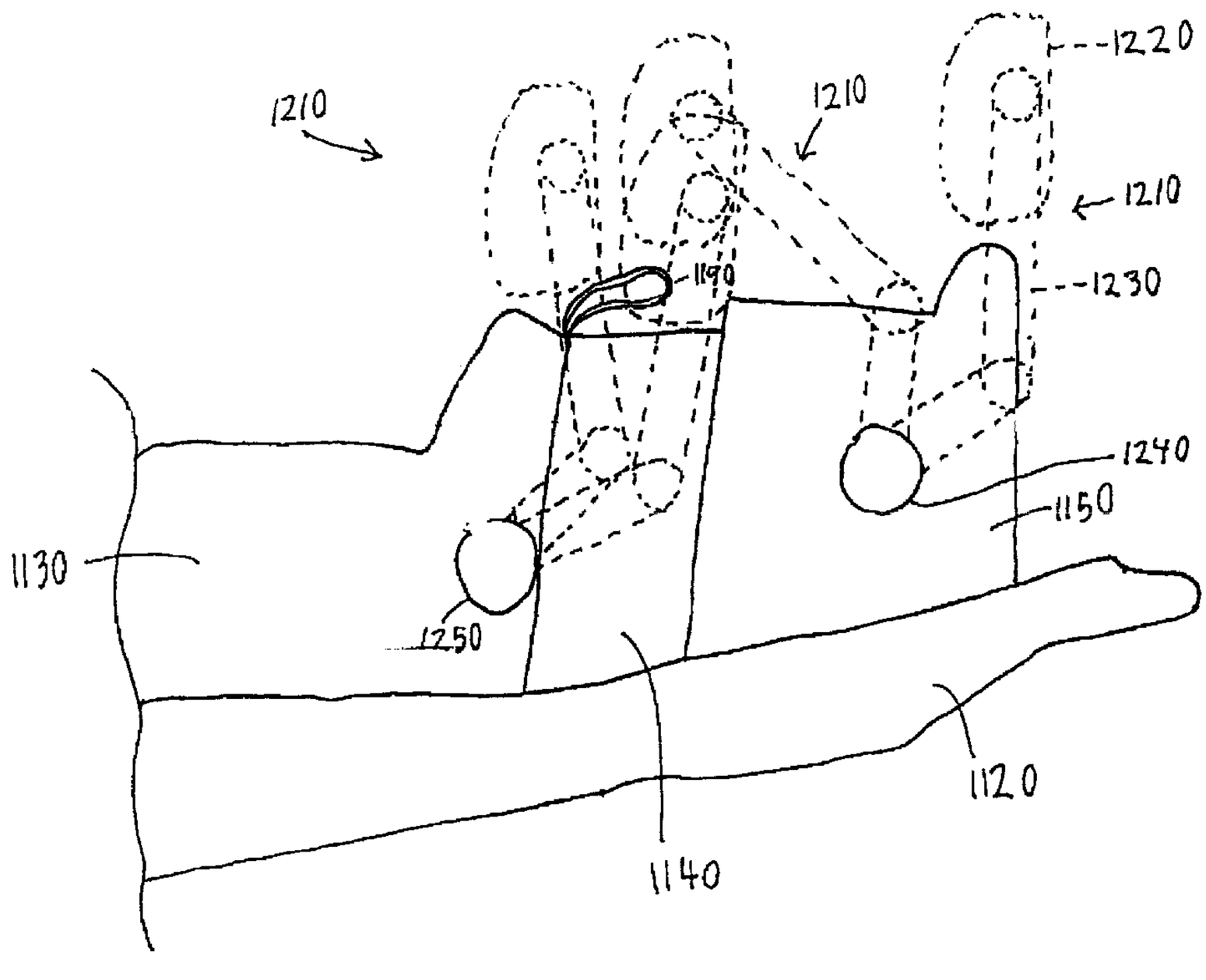



(57) Abrégé/Abstract:
A snowmobile positions riders close to the center of gravity of the snowmobile, reduces jostling forces, and improves the comfort and ridability of the snowmobile. The snowmobile has a straddle-type seat assembly has three seat portions that are designed to accommodate one, two, or three riders. The second and third seat portions may be selectively removed to provide storage space and a variety of seat configurations. Hand holds are provided for the first and second passengers (second and third riders) on the first and second seat portions. An adjustable backrest is selectively attached to the first, second or third seat portion to provide back support in a variety of seat configurations.

## ABSTRACT

A snowmobile positions riders close to the center of gravity of the snowmobile, reduces jostling forces, and improves the comfort and ridability of the snowmobile. The snowmobile has a straddle-type seat assembly has three seat portions that are designed to accommodate one, two, or three riders. The second and third seat portions may be selectively removed to provide storage space and a variety of seat configurations. Hand holds are provided for the first and second passengers (second and third riders) on the first and second seat portions. An adjustable backrest is selectively attached to the first, second or third seat portion to provide back support in a variety of seat configurations.

# THREE-SEAT SNOWMOBILE WITH MODULAR SEAT

[0001] This application claims the benefit of priority to U.S. Patent Application No. 60/472,733 filed on May 23, 2003.

## BACKGROUND OF THE INVENTION

### 1. Field of the Invention

[0002] The present invention relates generally to the overall design and construction of a snowmobile, and more particularly to a design of a snowmobile that improves the driver's control over the snowmobile and the riders' comfort.

### 2. Description of the Related Art

[0003] Conventional snowmobiles 110 (FIG. 1) share a common construction: they combine features and elements so that the rider (driver) 26 sits in a generally upright position in a location toward the rear of the snowmobile 110. When seated in this fashion, the rider 26 sits a considerable distance behind the center of gravity 146 of the snowmobile 110, which is located at or in proximity to the axis of the forward-most axle 144 of the drive track 120.

[0004] When the snowmobile 110 encounters a bump as it travels over the ground, it naturally tends to pivot about its center of gravity 146. Accordingly, the further the rider 26 is positioned from the center of gravity 146 of the snowmobile 110, the more strongly the rider 26 will feel each bump. This occurs because the snowmobile 110 acts as a lever that amplifies the magnitude of the forces transferred from bumps on the ground to the rider 26.

[0005] As illustrated in FIG. 1, the positions of the handlebars, seat, and footrests of a conventional snowmobile 110 relative to its center of gravity 146 place the driver 26 far behind the center of gravity 146 of the snowmobile 110. Consequently, the rider 26 experiences significant forces as the snowmobile 110 traverses each bump. When a second rider (passenger) 28 sits on the snowmobile 110 behind the driver 26 in a second seat (2-up rider positioning), the passenger 28 is positioned even farther away from the snowmobile's center of gravity 146 and experiences even more uncomfortable jostling when the snowmobile 110 encounters a bump.

[0006] While it would be desirable to add a third seat to accommodate a second passenger (third rider), it has not been done because the riders are positioned so far back on the conventional snowmobile 110, that a third rider, who would be positioned even farther rearward on a third seat, would experience prohibitively large jostling forces.

[0007] Accordingly, while the positioning of the driver and passenger on the conventional snowmobile is entirely adequate for enjoying the sport of snowmobiling, a need has arisen for a snowmobile where the driver's and passenger's positions are improved to minimize the effect on the riders of the snowmobile's movement over uneven terrain.

[0008] In addition, a desire has developed for a snowmobile that may comfortably accommodate two passengers in addition to the driver (3-up rider positioning).

## SUMMARY OF THE INVENTION

[0009] The present invention improves upon the conventional design by repositioning the riders on the snowmobile and redesigning the layout of the snowmobile to minimize the effect of the snowmobile's movement on the driver and passenger(s) as they pass over uneven terrain. This improvement facilitates the addition of a third seat for a third rider, who experiences a reasonably comfortable ride.

[0010] One aspect of the present invention is to provide a snowmobile having a frame, an engine disposed on the frame in front of the seat; a drive track disposed below the frame and connected operatively to the engine for propulsion of the snowmobile; two skis disposed on the frame; a steering device; and a straddle-type seat assembly attached to the frame, the straddle-type seat comprising a first seat portion for a driver, a second seat portion for a first passenger, the second seat portion being disposed behind the first seat portion, a third seat portion for a second passenger, the third seat portion being disposed behind the second seat portion.

[0011] Another aspect of the present invention is to provides a snowmobile further comprising a rear idler wheel interposed between the drive track and the frame, the rear idler wheel having a rotational axis, wherein the third seat portion defines a seat position that is disposed forward of the rotational axis of the rear idler wheel.

[0012] Yet another aspect of the present inventions provides the second seat portion selectively detachable from the frame.

[0013] Another aspect of the present invention has the second and third seat portions permanently attached to each other and are selectively detachable from the frame.

[0014] Yet another aspect of the present invention provides a backrest mounted to the third seat portion and the first seat portion, wherein the first seat portion further includes a backrest mounting pivot, and the backrest is removably mounted to the third seat portion and capable of being removably mounting to the backrest mounting pivot on the first seat portion.

[0015] Another aspect of the present invention is to have the first seat portion with a first seat surface, the second seat portion has a second seat surface that is higher than the first seat surface, and the third seat portion has a third seat surface that is higher than the first seat surface.

[0016] Yet another aspect of the present invention provides a snowmobile comprising a frame; an engine disposed on the frame in front of the seat; a drive track disposed below the frame and connected operatively to the engine for propulsion of the snowmobile; two skis disposed on the frame; a steering device; and a straddle-type seat assembly attached to the frame, the straddle-type seat comprising a first seat portion for a driver, the first seat portion having a first backrest mounting point, and a backrest mounted to at least one of the first seat portion and the second seat portion.

[0017] Another aspect of the present invention provides the snowmobile with a second seat portion for a first passenger, the second seat portion being disposed behind the first seat portion, the second seat portion having a second backrest mounting point.

[0018] Still another aspect of the present invention provides a third seat portion for a second passenger, the third seat portion being disposed behind the second seat portion, the third seat portion having a third backrest mounting point for receiving the backrest.

[0019] Yet another aspect of the present invention has the backrest selectively movable relative to the third seat portion between first and second passenger backrest positions, the backrest is disposed above a rearward end of the third seat portion when in the

second passenger backrest position, and the backrest is disposed above a rearward end of the second seat portion when in the first passenger backrest position.

[0020] Yet another aspect of the present invention provides the backrest selectively movable relative to the third seat portion into a driver backrest position in which the backrest is disposed above a rearward end of the first seat portion.

[0021] Another aspect of the present invention provides the third seat portion detachable from the frame.

[0022] Yet another aspect of the present invention provides the backrest attached to the first seat portion, the backrest is movable between a driver backrest position and a first passenger backrest position, the backrest is disposed above a rearward end of a first passenger's seat portion when in the first passenger backrest position, and the backrest is disposed above a rearward end of the first seat portion when in the driver backrest position.

[0023] Yet another aspect of the present invention provides a snowmobile comprising a frame; an engine disposed on the frame in front of the seat; a drive track disposed below the frame and connected operatively to the engine for propulsion of the snowmobile; two skis disposed on the frame; a steering device; and a straddle-type seat assembly attached to the frame, the straddle-type seat comprising a first seat portion for a driver, a second seat portion for a first passenger, the second seat portion being disposed behind the first seat portion, a third seat portion for a second passenger, the third seat portion being disposed behind the second seat portion, and left and right grab handles attached to left and right sides of the third seat portion.

[0024] Still another aspect of the present invention provides the snowmobile with a straddle-type seat assembly further comprising a first passenger hand hold mounted to a forward portion of the second seat portion.

[0025] Yet another aspect of the present invention shows the first passenger hand hold comprised of a looped strap.

[0026] Still another aspect of the present invention has the straddle-type seat assembly further comprising a first passenger hand hold mounted to a rearward portion of the first seat portion.

[0027] Additional and/or alternative aspects, objects, and features of embodiments of the present invention will be made more apparent in the description that follows.

## BRIEF DESCRIPTION OF THE DRAWINGS

[0028] Various exemplary embodiments of the present invention will be described with reference to the following drawings, wherein like reference numbers denote like features, in which:

[0029] FIG. 1 is a side view illustration of a conventional snowmobile;

[0030] FIG. 2 is a side view illustration of a snowmobile according to a first embodiment of the present invention;

[0031] FIG. 3 is a side view illustration of a snowmobile according to a second embodiment of the present invention;

[0032] FIGS. 4A and 4B show side views of a snowmobile according to a third embodiment of the present invention;

[0033] FIG. 5 is a side view illustration of a snowmobile according to a fourth embodiment of the present invention;

[0034] FIGS. 6A and 6B show side view illustrations of a snowmobile according to a fifth embodiment of the present invention;

[0035] FIG. 7 is a side view illustration of a snowmobile according to a sixth embodiment of the present invention;

[0036] FIG. 8 is a table comparing various dimensions of conventional snowmobiles and snowmobiles according to the present invention;

[0037] FIGS. 9 and 10 show the dimensions of a standard rider;

[0038] FIGS. 11A through 11D show the operation of a cover according to either the third or fifth embodiment;

[0039] FIGS. 12A through 12E show alternative seat and support arrangements for either the third or fifth embodiment;

[0040] FIG. 13 is a side view of a three-person snowmobile according to a seventh embodiment of the present invention;

[0041] FIG. 13A is a top view of the second seat with a portion of the seat cut away to illustrate internal components.

[0042] FIG. 13B is a cross-section of the second seat along A-A shown in FIG. 13A.

[0043] FIG. 13C is a bottom view of the third seat portion.

[0044] FIG. 13D is a side view of the third seat portion of FIG. 13C.

[0045] FIG. 13E is a top view of a portion of the rear of the tunnel including mounting pins.

[0046] FIG. 14 is a side view of the snowmobile illustrated in FIG. 13 in a two-person seat configuration;

[0047] FIG. 15 is a side view of the snowmobile illustrated in FIG. 13 in a one-person seat configuration;

[0048] FIG. 16 is a partial side view of the snowmobile illustrated in FIG. 13;

[0049] FIG. 17 is a side view of the snowmobile illustrated in FIG. 13 with three riders thereon; and

[0050] FIG. 18 is a side view of a three-person snowmobile according to an eighth embodiment of the present invention.

[0051] FIG. 19 is the commercial embodiment of the snowmobile of the present invention.

[0052] FIG. 20 is a side view of the seat shown in FIG. 19 showing the dimensions of the various seat portions.

## DESCRIPTION OF EXEMPLARY EMBODIMENTS

[0053] Throughout the description of the various embodiments of the present invention, reference will be made to various elements, the construction of which is readily known to those skilled in the art. Accordingly, an exhaustive description of each and every component is not provided. Components that are similar to components in other embodiments will be referenced by identical reference characters but with different prefix digits.

[0054] The inventors of the present invention realized that it is possible to improve the construction of a snowmobile to alter the positioning of the riders to considerably improve the handling and ride of the snowmobile. By shifting the steering device of the snowmobile forward, the centers of gravity of the riders are likewise shifted forward and closer to the center of gravity of the snowmobile. As a result, the riders experience significantly less jostling when the snowmobile encounters uneven terrain. Moreover, the driver is able to maintain better control over the snowmobile.

[0055] In addition, by moving the positioning of the first and second riders forward, the inventors of the present invention have been able to add a third seat for a third rider behind the second rider, while avoiding the prohibitively large forces that a third rider would have experienced on a conventional snowmobile.

[0056] FIG. 8 compares various dimensions of the embodiments of the present invention and conventional snowmobiles 110. Reference characters A-N and ε represent variables and are commonly defined herein. With respect to distances, the positive direction is backward relative to the direction of travel of the snowmobile. Horizontal distances are measured when the unloaded (riderless) snowmobile is positioned on level ground. Some of the dimensions will not apply to all of the embodiments. See FIGS. 1, 2, 3, 4A and 7.

[0057] Distance A is measured horizontally from the axis of the forward-most drive axle to the center of gravity of the unloaded snowmobile. Distance B is measured horizontally from the steering position to the center of gravity of the unloaded snowmobile. Distance C is measured horizontally from the center of gravity of the unloaded snowmobile to the center of gravity of a first rider (driver). Distance D is measured horizontally from the center of gravity of the unloaded snowmobile to a seat position of the first rider (driver). Distance E is measured horizontally from the center of gravity of the first rider to a center of

gravity of a second rider. Distance F is measured horizontally from the seat position of the first rider (driver) to a seat position of a second rider (first passenger). Distance G is measured horizontally from the center of gravity of the second rider to the center of gravity of a third rider (second passenger). Distance H is measured horizontally from the second seat position to a third seat position. Distance I is measured horizontally from the center of gravity of the unloaded snowmobile to a combined center of gravity of the snowmobile and first rider. Distance J is measured horizontally from the center of gravity of the unloaded snowmobile to a combined center of gravity of the snowmobile, first rider, and second rider. Distance K is measured horizontally from the center of gravity of the unloaded snowmobile to the combined center of gravity of the snowmobile and first through third riders. Distance L is measured horizontally from the steering position to a rearward-most seat position. Distance M is measured horizontally from the back end of the frame of the snowmobile to the back end of the second seat section. Distance N is measured horizontally from the back end of the frame of the snowmobile to the rear-most seat position. Angle ε is measured between vertical and an angular position of a steering shaft of the snowmobile. Lengths A-N are measured in millimeters. While FIG. 8 discloses the most preferred dimensions for each embodiment, the range of lengths for each dimension according to the present invention shall be understood to be preferably within 25 mm of the stated dimension, more preferably within 15 mm of the dimension, and even more preferably within 5 mm of the dimension.

[0058] To facilitate comparison of the present invention to the conventional snowmobiles 110 in FIG. 8, several additional aspects of the conventional snowmobile 110 must be identified. As shown in FIG. 1, the steering shaft 136 operatively connects the steering device 132 to the skis 116. The steering device 132 has a steering position 134, which is defined in the same manner as in the below embodiments. The driver (first rider) 26 has a center of gravity 127, which is located slightly forward of his torso because his arms and legs extend forward of his body while riding the snowmobile 110, and sits in a seat position 152. Similarly, the first passenger (second rider) 28 has a center of gravity 129, and sits in a seat position 154. A combined center of gravity 170 of the snowmobile 110 and the first rider 26 is located behind the center of gravity 146 of the snowmobile 110 without riders. A combined center of gravity 172 of the snowmobile 110 and first and second riders 26, 28 is located farther behind the center of gravity 146 of the snowmobile 110 without any riders.

[0059] FIG. 2 illustrates a first embodiment of the snowmobile 10. The snowmobile 10 has a forward end 11 and a rearward end 13 that are defined consistently with the travel direction of the snowmobile 10. The snowmobile 10 includes a body 12 (*i.e.*, the exterior upper portions) and a frame 14. A motor 17, such as an internal combustion engine, is carried by the frame 14 at the forward end 11. In addition, two skis 16 are attached to the forward end 11 of the frame 14 through a suspension system 18. It should be noted, however, that a single centered ski would also work with the invention. A drive track 20 is disposed under frame 14 and is connected operatively to the engine 17 for propulsion of the snowmobile 10.

[0060] At the front 11 of the frame 14, the snowmobile 10 includes fairings 22 that enclose the engine 17 to protect it and to provide an external shell that can be decorated so that the snowmobile 10 is aesthetically pleasing. Typically, the fairings 22 comprise a hood and a bottom pad (neither of which have been individually identified in the drawing figures). A windshield (not shown) may be connected to fairings 22 near the forward end 11 of snowmobile 10 in front of a steering device 32 to lessen the force of the air on the first rider (driver) 26 when the snowmobile 10 is moving.

[0061] A straddle-type seat 50 is disposed on the frame 14 behind the engine 17. The seat 50 has a first seat position 52, which is defined as a portion of the seat 50 that is adapted to support a center of a weight distribution of the first rider 26 on the seat 50. Because snowmobiles typically have elongated straddle seats and are adapted to permit riders to sit in a variety of front-back positions, numerous seat positions will exist on any straddle seat. The inventors of the present invention define the term "seat position" to point out particular positions on the snowmobile that are adapted to function as the seat position for a standard rider.

[0062] FIGS. 9 and 10 illustrate the various dimensions of a standard rider of the type depicted throughout the drawings. The standard rider is a 50$^{th}$ percentile North-American adult male. All lengths in FIGS. 9 and 10 are in centimeters. The middle of each set of three dimensions represents the standard rider. The standard rider weighs 78 kgs. and has the body build illustrated in FIGS. 9 and 10. The dimensions of the standard rider are a "ruler" by which the dimensions of the various embodiments of the snowmobile of the present invention are measured. Riders 26, 28, 30 are standard riders.

[0063] The steering device 32, such as a handlebar, is positioned at the forward end of the snowmobile 10 above the engine 17. The steering device 32 has a steering position 34, which is defined by a center of a portion of the steering device adapted to be held by the hands of the rider 26. The steering position 34 is defined when the skis 16 are positioned straight-forward. For example, if the steering device 32 comprises handlebars (as illustrated in FIG. 2), the steering position 34 is the center of the grips of the handlebars.

[0064] While the steering device 32 is shown in the various figures as a handlebar, the steering device 32 should not be limited to just this particular construction. It would be understood by those skilled in the art that any suitable steering device 32 may be used for the snowmobile 10. For example, the steering device 32 could be a steering wheel or a yoke of the type used in aircraft. In accordance with the above definition of the steering position 34, if the steering device 32 is a steering wheel or yoke, the steering position 34 is the center of the steering wheel or yoke.

[0065] Moreover, the positioning of the steering device 32 above the engine 17 also should not be considered to be limited to the position illustrated in FIG. 2. As would be understood by those skilled in the art, depending on the particular arrangement of elements for the snowmobile 10, it is possible that the steering device 32 could be positioned higher or lower than shown in FIG. 2 without departing from the scope and spirit of the present invention.

[0066] A steering shaft 36 operatively connects the steering device 32 to the two skis 16 and is disposed over the engine 17 at an angle $\varepsilon$ from vertical. The inventors altered the positioning of the axis of the steering shaft 36 so that it is more steeply sloped than steering shafts 136 in prior art snowmobiles 110 having steering shafts over the engine. According to the present invention, and as illustrated in FIGS. 2 and 8, the angle $\varepsilon$ is less than 45°. More preferably, angle $\varepsilon$ lies between about 25 and 40°. Even more preferably, angle $\varepsilon$ lies between about 30 and 35°. Most preferably, angle $\varepsilon$ is about 33°.

[0067] There are several reasons to have a small angle $\varepsilon$. For example, the small angle $\varepsilon$ is preferred because it facilitates placement of the steering position 34 in a position forward of that for the conventional snowmobile 110. The forward position of the steering position 34 moves the riders' 26, 28 positions closer to the center of gravity 46 of the snowmobile 10 and improves the comfort of riders 26, 28. Additionally, the turning force

applied by the rider 26 is more directly applied to steer the snowmobile 10 when angle ε is small.

[0068] Because the steering device 32 is shifted forward, relative the to the conventional snowmobile 110, the steering position 34 is disposed in front of the center of gravity 46 by a distance B. According to the first embodiment of the present invention shown in FIG. 2, distance B is greater than 0 and preferably between 105 mm and 155 mm. More preferably, distance B is between 115 mm and 145 mm. Even more preferably, distance B is between 125 mm and 135 mm. Most preferably, distance B is about 130 mm. In contrast, the steering position 134 of the conventional snowmobile 110 is behind the center of gravity 146 of the snowmobile (see FIGS. 1 and 8) such that distance B for conventional snowmobiles are –160 mm for long frames and –240 mm for short frames. Long and short frames will be described later.

[0069] A drive track 20, which is operatively connected to the engine 17, is positioned below the frame 14. The drive track 20 is a continuous belt that runs around a number of axles including a forward-most axle 44. The continuous belt has a 136-inch circumference in the first embodiment illustrated in FIG. 2, though the invention is in no way limited to a snowmobile with a particular belt size. The forward-most drive axle 44 is disposed behind the steering position 34 by a distance calculated as distance B minus distance A. According to the present invention, the forward-most drive axle 44 is disposed behind the steering position 34. Preferably, the distance is between 40 mm and 90 mm. More preferably, the distance is between 50 mm and 80 mm. Even more preferably, the distance is between 60 mm and 70 mm. Most preferably, the distance is about 65 mm. In contrast, the steering positions 134 on conventional snowmobiles are positioned behind the forward-most drive 144 axle by 270 mm (see FIGS. 1 and 8).

[0070] Two footrests are positioned on either side of seat 50 to accommodate the feet of the riders 26, 28. The footrests extend outwardly from the frame 14. The footrests may be disposed in a horizontal orientation, or alternatively, in an angled orientation.

[0071] An adjustable backrest 92 is attached to the seat 50 near the back end of the seat 50. Various embodiments of the backrest 92 are described throughout the specification, where preferred. As would be understood by those skilled in the art, the backrest 92 need not

have only the construction shown or be located in the position depicted. In fact, the backrest 92 need not be provided at all.

[0072] The first seat position 52 is located behind the forward-most drive axle 44 by a horizontal distance calculated as distance D plus distance A. According to the present invention, this distance is less than 590 mm and preferably between 540 mm and 590 mm. More preferably, this distance is between 550 mm and 580 mm. Even more preferably, this distance is between 560 mm and 570 mm. Most preferably, this distance is about 565 mm. In contrast, the first seat position 152 in conventional snowmobiles 110 is a much larger 905 mm behind the forward-most drive axle 144 (see FIGS. 1 and 8).

[0073] A second seat position 54 is disposed on the seat 50 behind the first seat position 52 and is adapted to accommodate a second rider 28 (first passenger) behind the driver 26 (first rider). As the rider 26 is positioned closer to the center of gravity 46 of the snowmobile 10 than on a conventional snowmobile 110, the ride for the second rider 28 on the snowmobile 10 is improved because the second rider 28 is also disposed closer to the center of gravity 46 of the snowmobile 10 (by comparison with a second rider 28 on a conventional snowmobile 110). The second seat position 54 is disposed a distance F behind the first seat position 52. According to this embodiment, distance F is between 315 mm and 365 mm. Preferably, distance F is between 325 mm and 355 mm. More preferably, distance F is between 335 mm and 345 mm. Most preferably, distance F is about 340 mm. Consequently, the second seat position 54 of the second rider 28 is most preferably about 840 mm behind the center of gravity 46 of snowmobile 10 (distance D plus distance F). As illustrated in FIG. 8, the first seat position 152 on a conventional short frame snowmobile 110 is 875 mm behind the center of gravity 146 and 795 mm behind the center of gravity 146 of a conventional long frame snowmobile 110 (distance D). As the position of the second rider 28 relative to the snowmobile's center of gravity 46 is similar to a position of a first rider (driver) 26 of a conventional snowmobile 110 relative to the conventional snowmobile's center of gravity 146, the second rider 28 on the snowmobile 10 of the present invention experiences forces similar to the forces experienced by the driver 26 of a conventional snowmobile 110.

[0074] In this embodiment, the first and second seat positions 52, 54 are disposed on the seat 50, which comprises an integral seat unit. The integral seat unit 50 may be rigidly mounted to the snowmobile 10 or it may be removably mounted.

[0075] A center of gravity 70 of the combined weight of the snowmobile 10 and rider 26 is disposed behind the center of gravity 46 of the snowmobile 10 without a rider. A center of gravity 72 of the combined weight of the snowmobile 10 and two riders 26, 28 is disposed farther rearward of the center of gravity 46. The first rider 26 has a center of gravity 27, which is positioned slightly forward of the rider's 26 torso because the rider's arms and legs are in a forwardly-extending position. Similarly, the second rider 28 has a center of gravity 29.

[0076] As illustrated in FIG. 8, the centers of gravity of the riders 26, 28 of the snowmobile 10 are positioned closer to the center of gravity 46 of snowmobile 10 than in conventional snowmobiles 110. The center of gravity 27 of the first rider 26 on the snowmobile 10 is preferably between 325 mm and 375 mm behind the center of gravity 46 of the snowmobile 10, more preferably between 335 mm and 365 mm behind the center of gravity 46, even more preferably between 345 mm and 355 mm behind the center of gravity 46, and most preferably about 350 mm (distance C) behind the center of gravity 46. In contrast, the center of gravity 127 of the first rider 26 on a conventional snowmobile 110 is disposed behind the center of gravity 146 of the convention snowmobile 110 by 645 mm for long frames and 725 mm for short frames.

[0077] The center of gravity 29 of a second rider 28 on the snowmobile 10 is disposed behind the center of gravity 46 of the snowmobile 10 by a distance calculated as distance C plus distance E. This distance is preferably between 695 mm and 745 mm, more preferably between 705 mm and 735 mm, even more preferably between 715 mm and 725 mm, and most preferably about 720 mm. In contrast, the center of gravity 129 of a second rider 128 on a conventional snowmobile 110 is disposed behind the center of gravity 146 of the conventional snowmobile 110 by 1015 mm for short frames and by 1095 mm for long frames.

[0078] FIG. 3 illustrates a second embodiment of the present invention. The snowmobile 210 of the second embodiment has a shorter frame 214 than the frame 14 of the snowmobile 10 of the first embodiment. The frame 14 preferably has a length of about 1913 mm. The frame 214 preferably has a length of about 1493 mm. The difference in length between the long frame and the short frame is approximately 420 mm. The long frame provides for two permanent seats and a larger cargo space. In addition, the long frame is simpler and less expensive to manufacture than the short frame as it has less moving parts,

and less parts in general, than the short frame. The shorter frame 214, however, provides the driver 26 with the feeling that the snowmobile is lighter and more maneuverable than a snowmobile having the long frame. The short frame also reduces the polar moment of inertial of the snowmobile about the vertical axis. The short frame also provides a tail landing for the snowmobile (*i.e.*, the short frame provides more space for a rear idler wheel to travel higher upon compression of the rear suspension). It should be appreciated that the frame 14 and the frame 214 may have lengths that differ from the preferred embodiments discussed above.

[0079] In the second embodiment shown in FIG. 3, a 121 inch drive track 220 is illustrated instead of the 136 inch track 20 of the snowmobile 10 of the first embodiment. The short frame 214 and the 121 inch drive track 220 reduce the rotational inertia of snowmobile 210 and consequently improve its handling performance. As a result of these differences, some of the dimensions are correspondingly altered as shown in FIG. 8.

[0080] A steering shaft 36 operatively connects the skis 16 to the steering device 32. The axis of the steering shaft 36 forms an angle ε with vertical that is the same as the orientation described in relation to the first embodiment illustrated in FIG. 2. As in the first embodiment, the angular position of the steering shaft 36 permits placement of the steering position 34 in a position forward of that for the conventional snowmobile 110, which moves the positions of the riders 26, 28 closer to the center of gravity 246 of the snowmobile 210 and improves the comfort of the riders 26, 28.

[0081] Because the steering device 32 is shifted forward relative to conventional snowmobiles 110, the forward-most drive axle 244 is disposed behind the steering position 34 by a distance calculated as distance B minus distance A. According to the present embodiment, this distance is positive. Preferably, the distance is between 40 mm and 90 mm. More preferably, the distance is between 50 mm and 80 mm. Even more preferably, the distance is between 60 mm and 70 mm. Most preferably, the distance is about 65 mm. In contrast, the steering positions 134 on conventional snowmobiles 110 are positioned behind the forward-most drive axle 144 by 270 mm (see FIGS. 1 and 8).

[0082] A first seat position 252 is defined on the seat 250 behind the forward-most drive axle 244 by a horizontal distance calculated as distance D plus distance A. While this distance is always positive, it is preferably between 540 mm and 590 mm. More preferably,

this distance is between 550 mm and 580 mm. Even more preferably, this distance is between 560 mm and 570 mm. Most preferably, this distance is about 565 mm. In contrast, the first seat position 152 in conventional snowmobiles 110 is a much larger 905 mm behind the forward-most drive axle 144 (see FIGS. 1 and 8).

[0083] A second seat position 254 is disposed a horizontal distance F behind the first seat position 252. According to this embodiment, distance F is between 315 mm and 365 mm. Preferably, distance F is between 325 mm and 355 mm. More preferably, distance F is between 335 mm and 345 mm. Most preferably, distance F is about 340 mm.

[0084] Like the seat 50 of the first embodiment, the seat 250 may comprise an integral seat unit that may either be rigidly mounted to the snowmobile 210 or may be removable. Alternatively, the seat 250 may include more than one section.

[0085] A center of gravity 270 of the combined weight of the snowmobile 210 and rider 26 is disposed behind the center of gravity 246 of the snowmobile 210 without a rider. A center of gravity 272 of the combined weight of the snowmobile 210 and two riders 26, 28 is disposed farther rearward of the center of gravity 246. The first rider 26 has a center of gravity 227, which is positioned slightly forward of the rider's 26 torso because the rider's arms and legs are in a forwardly-extending position. Similarly, the second rider 28 has a center of gravity 229.

[0086] The centers of gravity 227, 229 of the riders 26, 28, respectively, of the snowmobile 210 are positioned closer to the center of gravity 246 of snowmobile 210 than in conventional snowmobiles 110 (see distances C and E in FIG. 8). The center of gravity 227 of the first rider 26 on the snowmobile 210 is preferably between 295 mm and 345 mm behind the center of gravity 246 of the snowmobile 210, more preferably between 305 mm and 335 mm behind the center of gravity 246, even more preferably between 315 mm and 325 mm behind the center of gravity 246, and most preferably about 320 mm behind the center of gravity 246.

[0087] The center of gravity 229 of a second rider 28 on the snowmobile 210 is disposed behind the center of gravity 246 of the snowmobile 210 by a distance calculated as distance C plus distance E. This distance is preferably between 665 mm and 715 mm, more

preferably between 675 mm and 705 mm, even more preferably between 685 mm and 695 mm, and most preferably about 690 mm.

[0088] FIGS. 4A and 4B illustrate a third embodiment of the present invention. Like the snowmobile 210 of the second embodiment, the snowmobile 310 has a short frame 314 and a 121 inch drive track 320.

[0089] As with the previous embodiments, the axis of the steering shaft 36 forms an angle ε with vertical that is less than 45 degrees. As in the first embodiment, the angular position of steering shaft 36 permits placement of steering position 34 in a position forward of that for the conventional snowmobile 110, which moves the positions of the riders 26, 28 closer to the center of gravity 346 of the snowmobile 310 and improves the comfort of the riders 26, 28.

[0090] The forward-most drive axle 344 is disposed behind the steering position 34 by a distance calculated as distance B minus distance A. According to the present invention, the distance is positive. Preferably, the distance is between 40 mm and 90 mm. More preferably, the distance is between 50 mm and 80 mm. Even more preferably, the distance is between 60 mm and 70 mm. Most preferably, the distance is about 65 mm. In contrast, the forward-most drive axle on conventional snowmobiles is positioned in front of the steering position by 270 mm (see FIG. 8).

[0091] The seat 350 comprises a first seat section 350' and a second seat section 350". In this embodiment, the second seat section 350" is removable. A cargo space 394, which is preferably plastic, is provided behind the first seat section 350' beneath the second removable seat section 350". As shown in FIGS. 11A through 11D, a cover 395 can be attached over the cargo space 394 to enclose the cargo space 394 when the second seat section 350" is not attached. The cover 395 is hinged to the cargo space 394. One or more latches are provided to secure the cover 395 in a closed position.

[0092] A first seat position 352 is defined on the first seat section 350' behind the forward-most drive axle 344 by a horizontal distance calculated as distance D plus distance A. According to the present invention, this distance is less than 590 mm and preferably between 540 mm and 590 mm. More preferably, this distance is between 550 mm and 580 mm. Even more preferably, this distance is between 560 mm and 570 mm. Most preferably,

this distance is about 565 mm. In contrast, the first seat position 152 in conventional snowmobiles 110 is a much larger 905 mm behind the forward-most drive axle 144 (see FIGS 1 and. 8).

[0093] A second seat position 354 is defined on the second seat section 350" a horizontal distance F behind the first seat position 352. According to this embodiment, distance F is between 315 mm and 365 mm. Preferably, distance F is between 325 mm and 355 mm. More preferably, distance F is between 335 mm and 345 mm. Most preferably, distance F is about 340 mm.

[0094] A support element 360 extends upwardly and rearwardly from the frame 314. Fasteners (not shown) are used to secure the second seat 350" to the frame 314 via the support element 360. FIG. 4B shows an enlarged side view of the removable second seat section 350".

[0095] A tunnel 314' forms the back end 314" of the frame 314. The drive track 320 is mounted below the tunnel 314'. A snow flap 380 extends rearwardly behind the back end 314".

[0096] As shown in FIG. 4A, the support element 360 extends rearwardly beyond the back end 314" of the frame 314 to structurally support the second seat section 350" behind the back end 314". The second seat position 354 is disposed on the second seat section 350" a distance N behind the back end 314" of the frame 314. For this embodiment, distance N is always greater than zero. Preferably, distance N is between 55 mm and 105 mm. More preferably, distance N is between 65 mm and 95 mm. Even more preferably, distance N is between 75 mm and 85 mm. Most preferably, distance N is about 80 mm. In contrast, the second seat positions 154 of conventional snowmobiles 110 do not extend behind the back end of the frame because the second rider 28 would be prohibitively far away from the center of gravity 146 of the snowmobile 110. Conventional snowmobiles 110 position the second seat position 154 in front of the back end of the frame by 290 mm for long frames and 120 mm for short frames (see FIGS. 1 and 8).

[0097] A rearward-most end of seat section 350" is disposed a distance M behind the back end 314" of the frame 314. For this embodiment, distance M is always greater than zero. Preferably, distance M is between 205 mm and 255 mm. More preferably, distance M

is between 215 mm and 245 mm. Even more preferably, distance N is between 225 mm and 235 mm. Most preferably, distance M is about 230 mm. In contrast, the rearward-most end of the seat of conventional snowmobiles 110 is disposed in front of the back end of the frame by 50 mm for long frames and at the back end of the frame for short frames (*i.e.*, 0 mm, see FIG. 8).

[0098] A center of gravity 370 of the combined weight of the snowmobile 310 and rider 26 is disposed behind the center of gravity 346 of the snowmobile 310 without a rider. A center of gravity 372 of the combined weight of the snowmobile 310 and two riders 26, 28 is disposed farther rearward of the center of gravity 346. The first rider 26 has a center of gravity 327, which is positioned slightly forward of the rider's 26 torso because the rider's arms and legs are in a forwardly-extending position. Similarly, the second rider 28 has a center of gravity 329.

[0099] As illustrated in FIG. 8, the centers of gravity 327, 329 of the riders 26, 28 of the snowmobile 310 are positioned closer to the center of gravity 346 of snowmobile 310 than the centers of gravity 127, 129 are positioned to the center of gravity 146 in conventional snowmobiles 110. The center of gravity 327 of the first rider 26 on the snowmobile 310 is preferably between 295 mm and 345 mm behind the center of gravity 346 of the snowmobile 310, more preferably between 305 and 335 mm behind the center of gravity 346, even more preferably between 315 and 325 mm behind the center of gravity 346, and most preferably about 320 mm behind the center of gravity 346.

[00100] The center of gravity 329 of a second rider 28 on the snowmobile 310 is disposed behind the center of gravity 346 of the snowmobile 310 by a distance calculated as distance C plus distance E. This distance is preferably between 665 mm and 715 mm, more preferably between 675 mm and 705 mm, even more preferably between 685 mm and 695 mm, and most preferably about 690 mm.

[00101] FIG. 5 illustrates a fourth embodiment of the present invention. Like the snowmobile 10 of the first embodiment, the snowmobile 410 has a long frame 414 and a 136 inch drive track 20.

[00102] As with the first embodiment, the axis of the steering shaft 36 forms an angle ε with vertical that is less than 45 degrees. Similarly, the angular position of steering

shaft 36 permits placement of steering position 34 in a position forward of that for the conventional snowmobile 110, which moves the positions of the riders 26, 28 closer to the center of gravity 446 of the snowmobile 410 and improves the comfort of the riders 26, 28.

[00103] The forward-most drive axle 444 is disposed behind the steering position 34 by a distance calculated as distance B minus distance A. According to the present invention, the forward-most drive axle 444 is disposed behind the steering position 34. Preferably, the distance is between 40 mm and 90 mm. More preferably, the distance is between 50 mm and 80 mm. Even more preferably, the distance is between 60 mm and 70 mm. Most preferably, the distance is about 65 mm. In contrast, the steering positions 134 on conventional snowmobiles 110 are positioned behind the forward-most drive axle 144 by 270 mm (see FIGS. 1 and 8).

[00104] Like the seat 50 of the first embodiment, the seat 450 of snowmobile 410 comprises an integral seat unit that may either be rigidly mounted to the snowmobile 410 or removable. A first seat position 452 is defined on the seat 450 behind the forward-most drive axle 444 by a horizontal distance calculated as distance D plus distance A. According to the present invention, this distance is less than 590 mm and preferably between 540 mm and 590 mm. More preferably, this distance is between 550 mm and 580 mm. Even more preferably, this distance is between 560 mm and 570 mm. Most preferably, this distance is about 565 mm. In contrast, the first seat position 152 in conventional snowmobiles 110 is a much larger 905 mm behind the forward-most drive axle (see FIG. 8).

[00105] A second seat position 454 is disposed on the seat 450 a horizontal distance F behind the first seat position 452. According to this embodiment, distance F is between 315 mm and 365 mm. Preferably, distance F is between 325 mm and 355 mm. More preferably, distance F is between 335 mm and 345 mm. Most preferably, distance F is about 340 mm. Consequently, the seat position 454 of the second rider 28 is most preferably about 735 mm behind the center of gravity 446 of snowmobile 410 (distance D plus distance F).

[00106] A third seat position 456 is added behind the second seat position 454 on the seat 450 in order to accommodate a third rider 30. The forward placement of the steering position 34 permits a third rider 30 to ride the snowmobile 410 without experiencing prohibitively large jostling forces. The center of gravity 431 of the third rider 30 is

positioned behind the center of gravity of snowmobile 410 by a distance calculated as distance C plus distance E plus distance G, which is preferably between 900 mm and 950 mm. The distance is more preferably between 910 mm and 940 mm. The distance is even more preferably between 920 mm and 930 mm. The distance is most preferably about 925 mm. In contrast, the second rider 28 on the conventional snowmobile 110 is positioned behind the center of gravity 146 of the conventional snowmobile 110 by 1015 mm for a long frame and 1095 mm for a short frame (distance C plus distance E). Consequently, the third rider 30 (second passenger) on snowmobile 410 is closer to the center of gravity 446 of the snowmobile 410 and experiences less jostling forces than a second rider 28 (first passenger) would normally experience on a conventional snowmobile 110.

[00107] A center of gravity 470 of the combined weight of the snowmobile 410 and rider 26 is disposed behind the center of gravity 446 of the snowmobile 410 without a rider. A center of gravity 472 of the combined weight of the snowmobile 410 and two riders 26, 28 is disposed farther rearward of the center of gravity 446 of the riderless snowmobile 410. A center of gravity 474 of the combined weight of the snowmobile 410 and three riders 26, 28, 30 is disposed even farther rearward of the center of gravity 446 of the riderless snowmobile 410. The first rider 26 has a center of gravity 427, which is positioned slightly forward of the rider's 26 torso because the rider's arms and legs are in a forwardly-extending position. Similarly, the second and third riders 28, 30 have centers of gravity 429, 431, respectively.

[00108] FIG. 8 illustrates the relevant spatial relationships for the fourth embodiment and shows that the centers of gravity of the riders 26, 28, 30 are disposed closer to the center of gravity 446 of the snowmobile than in conventional snowmobiles 110.

[00109] The center of gravity 427 of the first rider 26 on the snowmobile 410 is preferably between 220 mm and 270 mm behind the center of gravity 446 of the snowmobile 410, more preferably between 230 mm and 260 mm behind the center of gravity 446, even more preferably between 240 mm and 250 mm behind the center of gravity 446, and most preferably about 245 mm behind the center of gravity 446.

[00110] The center of gravity 429 of a second rider 28 on the snowmobile 410 is disposed behind the center of gravity 446 of the snowmobile 410 by a distance calculated as distance C plus distance E. This distance is preferably between 590 mm and 640 mm,

more preferably between 600 mm and 630 mm, even more preferably between 610 mm and 620 mm, and most preferably about 615 mm.

[00111] The center of gravity 431 of the third rider 30 on the snowmobile 410 is disposed behind the center of gravity 446 of the snowmobile 410 by a distance calculated as distance C plus distance E plus distance G. This distance is preferably between 900 mm and 950 mm, more preferably between 910 mm and 940 mm, even more preferably between 920 mm and 930 mm, and most preferably about 925 mm.

[00112] A horizontal distance H between the second seat position 454 the third seat position 456 is preferably between 285 mm and 335 mm. Distance H is more preferably between 295 mm and 325 mm. Distance H is even more preferably between 305 mm and 315 mm. Distance H is most preferably about 310 mm. A horizontal distance G between the center of gravity 429 of the second rider 428 and the center of gravity 431 of the third rider 430 is about the same as distance H for this embodiment (see FIG. 8).

[00113] FIGS. 6A and 6B illustrate a fifth embodiment of the present invention. Like the snowmobile 10 of the first embodiment, snowmobile 510 has a long frame 514 and a 136 inch drive track 520. As in previous embodiments, the axis of the steering shaft 36 forms an angle ε with vertical that is less than 45 degrees. The forward-most drive axle 544 is disposed behind the steering position 34 by a distance calculated as distance B minus distance A. According to this embodiment, the forward-most drive axle 544 is disposed behind the steering position 34. Preferably, the distance is between 40 mm and 90 mm. More preferably, the distance is between 50 mm and 80 mm. Even more preferably, the distance is between 60 mm and 70 mm. Most preferably, the distance is about 65 mm.

[00114] Similar to the seat 350 of the snowmobile 310 of the third embodiment, seat 550 is formed by a first seat section 550' and a second seat section 550". The second seat section 550" is removable. When the second seat section 550" is removed, a cover 395 (as illustrated in FIGS. 11A-D and discussed with respect to the third embodiment) may be used to cover a cargo space 594 that is located beneath the second seat section 550" and behind the first seat section 550'.

[00115] A first seat position 552 is defined on the first seat section 550' behind the forward-most drive axle 544 by a horizontal distance calculated as distance D plus

distance A. According to the present invention, this distance is less than 590 mm and preferably between 540 mm and 590 mm. More preferably, this distance is between 550 mm and 580 mm. Even more preferably, this distance is between 560 mm and 570 mm. Most preferably, this distance is about 565 mm.

[00116] A second seat position 554 is disposed on the first seat section 550' a horizontal distance F behind the first seat position 552. According to this embodiment, distance F is between 265 mm and 315 mm. Preferably, distance F is between 275 mm and 305 mm. More preferably, distance F is between 285 mm and 295 mm. Most preferably, distance F is about 290 mm.

[00117] A third seat position 556 is positioned on the second seat section 550" behind the second seat position 554 by a horizontal distance H, which is preferably between 320 mm and 370 mm. Distance H is more preferably between 330 mm and 360 mm. Distance H is even more preferably between 340 mm and 350 mm. Distance H is most preferably about 345 mm.

[00118] A tunnel 514' forms the back end 514" of the frame 514. The drive track 520 is mounted below the tunnel 514'. A snow flap 580 extends rearwardly behind the back end 514".

[00119] As in the third embodiment, a support element 560 extends upwardly and rearwardly from the back end 514" of the frame 514 to provide support for the second seat section 550". The third seat position 556 and back end of the third seat position 556 extend behind the back end 514" of the frame 514 by distances N and M, respectively. Distance N is always positive and preferably between 35 mm and 85 mm. Distance N is more preferably between 45 mm and 75 mm. Distance N is even more preferably between 55 mm and 65 mm. Distance N is most preferably about 60 mm. Distance M is always positive and preferably between 265 mm and 315 mm. Distance M is more preferably between 275 mm and 305 mm. Distance M is even more preferably between 285 mm and 295 mm. Distance M is most preferably about 290 mm.

[00120] A center of gravity 570 of the combined weight of the snowmobile 410 and rider 26 is disposed behind the center of gravity 546 of the snowmobile 510 without a rider. A center of gravity 572 of the combined weight of the snowmobile 510 and two riders

26, 28 is disposed farther rearward of the center of gravity 546 of the riderless snowmobile 510. A center of gravity 574 of the combined weight of the snowmobile 510 and three riders 26, 28, 30 is disposed even farther rearward of the center of gravity 546 of the riderless snowmobile 410. The first rider 26 has a center of gravity 527, which is positioned slightly forward of the rider's 26 torso because the rider's arms and legs are in a forwardly-extending position. Similarly, the second and third riders 28, 30 have centers of gravity 529, 531, respectively.

[00121] FIG. 8 illustrates the relevant spatial relationships for the fifth embodiment and illustrates that the centers of gravity of the riders 26, 28, 30 are disposed closer to the center of gravity 546 of the snowmobile 510 than in the conventional snowmobiles 110.

[00122] The center of gravity 527 of the first rider 26 on the snowmobile 510 is preferably between 220 mm and 270 mm behind the center of gravity 546 of the snowmobile 510, more preferably between 230 mm and 260 mm behind the center of gravity 546, even more preferably between 240 mm and 250 mm behind the center of gravity 546, and most preferably about 245 mm behind the center of gravity 546.

[00123] The center of gravity 529 of a second rider 28 on the snowmobile 510 is disposed behind the center of gravity 546 of the snowmobile 510 by a distance calculated as distance C plus distance E. This distance is preferably between 590 mm and 640 mm, more preferably between 600 mm and 630 mm, even more preferably between 610 mm and 620 mm, and most preferably about 615 mm.

[00124] The center of gravity 531 of the third rider 30 on the snowmobile 510 is disposed behind the center of gravity 546 of the snowmobile 510 by a distance calculated as distance C plus distance E plus distance G. This distance is preferably between 935 mm and 985 mm, more preferably between 945 mm and 975 mm, even more preferably between 955 mm and 965 mm, and most preferably about 960 mm.

[00125] It should be noted that while the third and fifth embodiments include a removable back seat that simply attaches to the support element 360, 560, other ways of creating a removable seat section, which are known by those of ordinary skill in the art, are also intended to be included in the invention. For example, a second seat section might be

slidable along a longitudinal track such that a third seat could be inserted like a leaf of a table between the first and second seats. Similarly, a backrest might be slidably mounted to a longitudinal track behind a first seat and permit the insertion of second and/or third seats between the first seat and the backrest.

[00126] Furthermore, while the third and fifth embodiments illustrate particular embodiments of the second seat sections 350, 550 and support pieces 360, 560, numerous other embodiments of such components, which would be apparent to those skilled in the art, could also be utilized and are intended to be included in the present invention. For example, FIGS. 12A through 12E illustrate several alternative seats having first seat sections 650', 750', 850', 950', 1050', second seat sections 650", 750", 850", 950", 1050", and support pieces 660, 760, 860, 960, 1060.

[00127] FIG. 7 illustrates a sixth embodiment of the snowmobile 610. The snowmobile 610 of the sixth embodiment may have a short or long frame 614 and a snow flap 680 extending from the back end of the frame 614. The snowmobile 610 has a 136 inch drive track 620.

[00128] As with the previous embodiments, the axis of the steering shaft 36 forms an angle ε with vertical that is less than 45 degrees. As in the first embodiment, the angular position of steering shaft 36 permits placement of steering position 34 in a position forward of that for the conventional snowmobile 110, which moves the position of the driver 26 closer to the center of gravity 646 of the snowmobile 610 and improves the comfort of the driver 26.

[00129] The forward-most drive axle 644 is disposed behind the steering position 34 by a distance calculated as distance B minus distance A. According to the present invention, the distance is positive. Preferably, the distance is between 40 mm and 90 mm. More preferably, the distance is between 50 mm and 80 mm. Even more preferably, the distance is between 60 mm and 70 mm. Most preferably, the distance is about 65 mm. In contrast, the forward-most drive axle 144 on conventional snowmobiles 110 is positioned in front of the steering position 134 by 270 mm (see FIG. 8).

[00130] The snowmobile 610 has a seat 650 configured for a single rider 26 (1-up rider positioning) that defines a seat position 652. The seat position 652 is behind the

forward-most drive axle 644 by a horizontal distance calculated as distance D plus distance A. According to the present invention, this distance is less than 590 mm and preferably between 540 mm and 590 mm. More preferably, this distance is between 550 mm and 580 mm. Even more preferably, this distance is between 560 mm and 570 mm. Most preferably, this distance is about 565 mm. In contrast, the first seat position 152 in conventional snowmobiles 110 is a much larger 905 mm behind the forward-most drive axle 144 (see FIGS. 1 and 8).

[00131] As illustrated in FIG. 7, the center of gravity 627 of the rider 26 of the snowmobile 610 is positioned closer to the center of gravity 646 of the snowmobile 610 than in conventional snowmobiles 110. The center of gravity 627 of the rider 26 on the snowmobile 610 is preferably between 295 mm and 345 mm behind the center of gravity 646 of the snowmobile 610, more preferably between 305 mm and 335 mm behind the center of gravity 646, even more preferably between 315 mm and 325 mm behind the center of gravity 646, and most preferably about 320 mm behind the center of gravity 646.

[00132] FIGS. 13-17 illustrate an additional alternative embodiment of the present invention, which is similar to the embodiment illustrated in FIG. 6A. Like the snowmobile 510 illustrated in FIG. 6A, the snowmobile 1100 is designed to accommodate up to three riders (a driver and first and second passengers). Accordingly, a three-person straddle-type seat assembly 1110 is mounted to a frame 1120 of the snowmobile 1100.

[00133] FIGS. 13 and 17 illustrate a first configuration of the seat assembly 1110, which is specifically designed to accommodate 3 riders. The straddle type seat assembly 1110 comprises distinct first, second, and third seat portions 1130, 1140, 1150 for the driver, first passenger, and second passenger, respectively. The seat portions 1130, 1140, 1150 define seat positions 1130a, 1140a, 1150a, respectively for the driver and the two passengers.

[00134] The seat position 1150a of the second passenger is disposed forward of an axis 1152 of a rear idler wheel 1154 of an endless track 1156 of the snowmobile 1100. By placing the seat position 1150a forward of the rear idler wheel 1154, the skis of the snowmobile 1100 and the second passenger are disposed on the same side of the "see-saw" fulcrum created by the rear idler wheel 1154 so that the second passenger's weight does not lift the steering skis or impair the steerability of the snowmobile 1100. In conventional

snowmobiles, on the other hand, if a third rider attempts to squeeze onto a snowmobile, his weight would be positioned behind the rear idler wheel and, disadvantageously, would tend to lift the skis from the ground or reduce the steering force applied by the skis.

[00135] Second seat portion 1140 is shown in greater detail in FIGS 13A and 13B. Seat portion 1140 comprises a base 1141, preferably made from plastic or light weight metal and a foam 1143 placed on top of the base 1141. The top portion of foam 1143 defines seat position 1140a where a rider will be seated. A flexible, preferably waterproof cover will cover the foam 1143 and attach to the base 1141 to hold the foam and base together as a single unit. Base 1141 further includes tongues 1142 extending forwardly from the front of the base 1141. Tongues 1142 are used to secure seat 1140 to the first seat portion 1130 as will be described in greater detail below. Base 1141 also includes cavities 1146 situated toward the rear of the base 1141. Cavities 1146 serve to accept tongues 1152 of seat 1150 shown in FIGS. 13C and 13D. In the preferred embodiment, two cavities are used to accept two tongues of the seat placed behind it, it will be appreciated that one or more than two tongues and cavities could be used.

[00136] Best seen in FIG. 13E the tunnel 1120 has two holders 1162, one on the right-hand side of the tunnel and one on the left-hand side of the tunnel, to accept tongues 1142 and/or 1152 of the second and third seat portions 1140 and/or 1150 respectively. The two forward-most holders 1162 are preferably situated on the tunnel 1120 such that they coincide with the rear bottom corners of the first seat portion 1130 and second seat portion 1140 best shown in FIG. 13. When the second seat portion 1140 is to be attached to the snowmobile 1100, the bottom surface 1145 of second seat portion 1140 is placed on top of frame/tunnel 1120 such that the tongues 1142 are aligned with the two forward-most holders 1162. The seat 1140 is then pushed forward until surface 1144 of the second seat portion 1140 contacts the first seat portion 1130. The bottom surface 1145 of the second seat portion 1140 further includes cavities 1146 which accept the rear-most holders 1162 and permit the second seat portion 1140 to lie flat onto the tunnel 1120. In order to prevent the second seat portion from moving rearward relative to the first seat portion, a third seat portion 1150 is attached to top of the tunnel 1120 behind the second seat portion 1140 as will be described in greater detail below.

[00137] Also shown in FIG. 13E are pins 1164 which are used to attach the third seat portion 1150 to the tunnel 1120 in a manner described below. The preferred

embodiment uses two laterally spaced pins to attach the seat in each of the two positions, i.e. when the third seat portion 1150 is placed directly behind the first seat portion 1130, the two forward-most pins 1164 are used, when the third seat portion 1150 is placed behind the second seat portion 1140, which is itself placed behind the first seat portion 1130, the two rear-most pins 1164 are used. It would be appreciated that one or more than two pins could be used to secure the seat portion to the tunnel. The pins 1164 have a circular shaft (not shown) with an enlarged head portion 1166. The pins 1164 are preferably placed in indentations 1168 within the tunnel 1120 such that the enlarged heads 1166 do not protrude beyond the upper surface of the tunnel and interfere with any cargo placed in that area when the seat portions are not being used. A cargo rack 1170 is also placed on the tunnel 1120 to prevent cargo from falling off the tunnel 1120. The wall 1170 could also be used to support additional accessories or the passenger hand grips 1200 such as is shown in FIG. 14.

[00138] FIGS. 13C and 13D illustrate further aspects of the third seat portion 1150. Third seat portion 1150 comprises a base 1153, preferably made of plastic or a lightweight metal, and foam 1154 placed above the base 1153. A flexible, preferably waterproof cover will cover the foam 1154 and attach to the base 1153 to hold the foam and base as a single unit. The top surface of foam 1154 defines the seating surface 1150b. As discussed above, third seat portion 1150 also includes two tongues 1152 extending forwardly from the base 1153. Base 1153 further includes two apertures 1154 toward the rear bottom corners of the base 1153 as can be seen in FIGS 13C and 13D. Apertures 1154 are provided to accept mounting pins 1164 shown in FIG. 13E.

[00139] Base 1153 also includes a latch mechanism for holding and releasing the third seat portion 1150 to the tunnel 1120. The latch mechanism uses a strap 1155, extending from the rear of the seat 1150 and connected to a piece of wire 1156, which, when the seat is installed onto the tunnel 1120, engages the enlarged portions 1166 of the mounting pins 1164 preventing the seat from being pulled away from the tunnel 1120. Wire 1156 is shaped such that it passed through at least a portion of the aperture 1154. When strap 1155 is pulled, the wire is flexed away from the aperture 1154, disengaging the pins 1164 and allowing the seat to be removed from the tunnel.

[00140] It is to be understood, that, in order to install the third seat portion 1150 to the top of the tunnel 1120 behind the second seat portion 1140, or behind the first seat portion 1130, one would slightly tip the seat toward the front, insert the tongues 1152 into

cavities 1162 and proceed to push the rear of the seat toward the tunnel until pins 1164 are inserted into apertures 1154 and wire 1156 has flexed and passed over the enlarged top portion 1166 of the pins 1164 securing the seat to the tunnel 1120. The second seat portion 1140, when in used, relies on its tongues 1142 inserted into the two forward-most cavities 1162 and the tight fit with between the first seat portion and the third seat portion to keep it in place. As would be appreciated by one skilled in the art, a similar attachment system including the pins and flexible wire explained for the third seat portion 1150 could be used to attach the second seat portion 1140 to the tunnel 1120 without deviating from the present invention.

[00141] In the preferred embodiment, the second seat portion 1140 can only be installed if the third seat portion 1150 has been removed from the tunnel 1120. It is contemplated that the second seat portion, without the tongues 1142, could be used and simply inserted between the first seat portion 1130 and the third seat portion 1150 (also without tongues 1152) and rely on a tight fit between the two seats to prevent the second seat portion 1140 from being inadvertently removed from the tunnel 1120.

[00142] Base 1153 of the third seat portion 1150 further includes rubber bumpers 1157. Bumpers 1157 make contact with the top surface of the tunnel 1120 when the third seat portion 1150 is attached to the tunnel 1120. Bumpers 1157 are sized such that they are compressed between the seat and the tunnel once the seat is installed onto the tunnel, thus pushing the seat vertically away form the tunnel creating constant contact between the wire 1156 and the enlarged portion 1166 of pins 1164, eliminating any small vertical movements between the seat and the tunnel when the rider is not seated on the seat. It would be understood that the force created by the bumpers 1157 would be insufficient to cause the third seat portion to be inadvertently forced away from the tunnel.

[00143] To facilitate comfortable seating of all three riders, a surface 1130b of a seat defined by the first seat portion 1130 is preferably disposed below a surface 1140b of a seat defined by the second seat portion 1140. The surface 1140b is preferably disposed below or at the same height as a surface 1150b of a seat of the third seat portion 1150.

[00144] FIG. 13D also shows backrest assembly 1210 mounted to the third seat portion 1150 through the mounting points 1240. Mounting points 1240 allow the backrest assembly 1210 to pivot with respect to the third seat portion 1150 in the direction of the

arrows. A lever, 1241, when rotated counterclockwise, engages a release mechanism (not shown) which allows the spring to bias the backrest 1220 toward the front. When lever 1241 is rotated clockwise, the release mechanism prevents further movement of the backrest 1220 relative to the third seat portion 1150. This allows the passenger to adjust the positioning of the backrest 1220 to a comfortable position. Lever 1241 may also be spring biased to a position which prevents the backrest 1220 from any movement with respect to the third seat portion 1150.

[00145] FIG. 14 illustrates a second configuration of the seat assembly 1110, which is designed to accommodate 2 riders, (a driver and one passenger). As may be appreciated from the discussion that follows, the second configuration of the seat assembly 1110 presents a variation on the configuration depicted in FIG. 13.

[00146] So that these two configurations are possible, each seat portion 1130, 1140, 1150 is individually mounted to the frame 1120. The first seat portion 1130 is mounted to the frame 1120. The second seat portion 1140 is selectively detachable from the frame 1120. The third seat portion 1150 is movably attached to the frame 1120 for selective positioning in a rearward position (see FIG. 13) and a forward position (see FIG. 14). Accordingly, when the second seat portion 1140 is detached from the snowmobile 1100, the third seat portion 1150 may be selectively moved forward to abut against the first seat portion 1130. In this second seat assembly 1110 configuration, the driver is supported by the first seat portion 1130 and a first passenger is supported by the third seat portion 1150. For this configuration, a storage space 1160 is provided behind the third seat portion 1150 and above the frame 1120 in the space created by moving the third seat portion 1150 forward.

[00147] FIG. 15 illustrates a third seat assembly 1110 configuration, which is designed to accommodate one rider. In addition to being movably attached to the frame 1120, the third seat portion 1150 is also detachably mounted to the frame 1120. Accordingly, when both the second and third seat portions 1140, 1150 are detached, the seat assembly 1100 provides support for one rider via the first seat portion 1130. A large storage space 1170 is provided behind the first seat portion and above the frame 1120 in the space that is no longer occupied by the second and third seat portions 1140, 1150.

[00148] As illustrated in FIGS. 13 and 17, various hand holds are preferably provided on the seat assembly 1110 to help the riders secure themselves in their positions on

the snowmobile 1100. The driver remains secure on the seat assembly 1110 because he holds the steering device 1180 (such as handlebars) with his/her hands.

[00149] The first passenger holds onto a looped strap 1190 that is mounted to the second seat portion 1140. When the first passenger rests on the second seat portion 1140, the looped strap 1190 is disposed between his/her legs and is positioned to enable the first passenger to hold onto the looped strap 1190 with his/her hands. In the illustrated embodiment, the looped strap 1190 comprises a looped piece of fabric webbing. However, various other types of hand holds could alternatively be provided for the first passenger. For example, flexible rubber or plastic handles could be mounted to the forward middle portion of the second seat portion 1140. Alternatively, grab handle(s) could be formed in the second seat portion 1140. Hand holds for the first passenger could alternatively be attached to or formed in a back end of the first seat portion 1130.

[00150] Since the looped strap 1190 is mounted on the second seat portion 1140, detachment of the second seat portion 1140 from the snowmobile 1100 also detaches the looped strap 1190 from the snowmobile 1100. Of course, in the alternative, the looped strap 1190 could be attached to the rear of the first seat portion 1130 without deviating from the scope of the present invention.

[00151] In the embodiment illustrated in FIG. 17, left and right grab handles 1200 (only the left grab handle is shown) mount to the left and right sides of the third seat portion 1150. The grab handles 1200 extend upwardly above the surface 1150b of the seat of the third seat portion 1150 to enable the second passenger to easily grab the handles 1200 with his/her hands without having to strain his/her arms. The grab handles preferably comprise blow-molded plastic or rubber that is relatively flexible. Such grab handles are preferably of the type described in U.S. Patent Application No. 10/361,682, filed February 11, 2003, titled "QUICK RELEASE PASSENGER SEAT WITH FLEXIBLE GRAB HANDLE", which is incorporated by reference herein in its entirety. In the alternative, as would be appreciated by those skilled in the art, the grab handles 1200 may not be attached to the third seat portion 1150. Alternatively, a strap, such as the looped strap 1190, may be attached thereto.

[00152] As illustrated in FIGS. 13, 13D, and 14, a backrest assembly 1210 mounts to the third seat portion 1150. The backrest assembly 1210 includes a cushioned

backrest 1220 connected to an adjustable backrest mount 1230. The third seat portion 1150 includes backrest mounting points 1240 on its left and right sides. The backrest mount 1230 has left and right arms that extend downwardly from the cushioned backrest 1220 and are constructed and arranged to adjustably and detachably mount to the backrest mounting points 1240 of the third seat portion 1150. As illustrated in FIG. 16, the backrest mount 1230 selectively pivotally connects to the mounting points 1240 to enable the position of the backrest 1220 to be adjusted. The backrest mount 1230 may include one or more internal backrest 1220 adjustment mechanisms, e.g., pivotal connections, telescopic connections, etc. The backrest assembly 1210 can therefore be adjusted for use by the first or second passenger.

[00153] While only the extreme positions of the backrest assembly 1210 are illustrated, the backrest assembly 1210 is preferably selectively positionable in a variety of intermediate and more extreme positions. For example, as illustrated in dotted lines in FIG. 13, the backrest assembly 1210 may be attached to the third seat portion 1150 and pivoted forward enough that the driver may use the backrest 1220 for back support. Similarly, as illustrated in dotted lines in FIG. 14, when the second seat portion 1140 is removed, the backrest assembly 1210 may also be adjusted to provide back support for the driver sitting on the first seat portion 1130.

[00154] As illustrated in FIGS. 13, 15, and 16, the first seat portion 1130 also has left and right backrest mounting points 1250. As illustrated in FIG. 15, when the third seat portion 1150 is not used, the backrest assembly 1210 may be detached from the mounting points 1240 and attached to the mounting points 1250 so that the back rest 1220 may be used by the driver. As illustrated in FIG. 16, when attached to the mounting points 1250, the backrest assembly 1210 may also be pivoted rearwardly enough to provide back support to a first passenger. Also illustrated in FIG. 16, backrest assembly 1250 selectively pivotally connects to the backrest mounting points 1260 on the second seat portion 1140.

[00155] Although the second and third seat portions 1140, 1150 in this embodiment are independently detachable from the frame, various other seat assembly configurations are within the scope of the present invention. For example, all three seat portions 1130, 1140, 1150 could be integrally formed or permanently attached to each other. Such a combination of seat portions 1130, 1140, 1150 could be permanently attached to the frame or removably attached to the frame. Alternatively, the first and second seat portions

1130, 1140 could be integrally formed with each other such that just the third seat portion 1150 would be detachable.

[00156] FIG. 18 illustrates yet another alternative embodiment of a snowmobile according to the present invention. The snowmobile 1300 is identical to the snowmobile 1100 illustrated in FIG. 13 except for an alternative seat assembly 1310. The seat assembly 1310 is identical to the seat assembly 1110 illustrated in FIG. 13 except that the second and third seat portions 1140, 1150 are integrally formed with (or otherwise permanently attached to) each other. The second and third seat portions 1140, 1150 can therefore be simultaneously detached from frame 1120 to create a storage space behind the first seat portion 1130. To use the seat assembly 1310 in a two rider configuration, the combined second and third seat portions 1140, 1150 are removed and a separate additional third seat portion 1150 is attached to the frame 1120 behind the first seat portion (see FIG. 14).

[00157] FIG. 19 shows a commercial embodiment of the present invention. Snowmobile 1300 is very similar to snowmobile 1100 shown in FIG. 14. Snowmobile 1300 has a frame 1320, an engine 1317 disposed on the frame 1320, a drive track 1321 disposed below the frame 1320 and operatively connected to the engine 1317. A straddle-type seat assembly 1310 is disposed on the frame 1320 rearward of the engine 1317 and two front skis 1316 are disposed forward of the engine 1317. Handlebars 1332 are operatively connect to the two front skis 1316 for steering the snowmobile 1300.

[00158] The straddle-type seat assembly 1310 is very similar to that of seat assembly 1110 shown in FIGS. 13-18 in that it comprises a first seat portion 1330, a second seat portion 1340 and a third seat portion 1350. Seat assembly 1310 also includes a back rest 1320 pivotally connected to the third seat portion 1350. Backrest 1322 pivotally connects to the third seat portion 1350 in the same manner as described above with respect to backrest 1220 and third seat portion 1150. Backrest 1322 is spring biased (not shown) toward the front of the seat as described above with respect to backrest 1220. As also shown in FIG. 19, handgrips 1301 and wind deflectors 1302 are provided on left and right sides of the third seat portion 1350. Cargo boxes 1303 may also be attached to the right and left sides of the third seat portion 1350 to provide extra storage space when travelling with all three seat portions.

[00159] FIG. 19 shows the preferred dimensions of the first, second and third seat portions 1330, 1340, and 1350 respectively. First seat portion 1330 is approximately

764mm +/- 50mm in length. The second seat portion is approximately 207 mm +/- 50mm in length and the third seat portion is approximately 398mm in length. The first seating portion has a first seating position 1330a, which is approximately 478mm +/- 50mm from the steering position 1334. The second seat portion has a second seating position 1340a which is approximately 380mm +/- 50mm behind the first seating position 1330a and the third seat portion 1350 has a third seat position 1350a which is approximately 300mm +/- 50mm behind the second seating position 1340a. The total length of the seat assembly 1310 comprising first, second and third seat portions 1330, 1340, and 1350 is 1369mm +/- 150mm.

[00160] While the invention has been described with reference to the various exemplary embodiments outlined above, it will be understood by those skilled in the art that various changes may be made and equivalents may be substituted for elements thereof without departing from the spirit and scope of the present invention. In addition, many modifications may be made to adapt a particular situation, component, or material to the teachings of the present invention without departing from its teachings as claimed.

What is claimed is:

1. A snowmobile comprising:

a frame;

an engine disposed on the frame;

a drive track disposed below the frame and operatively connected to the engine for propulsion of the snowmobile;

a straddle-type seat assembly attached to the frame rearward of the engine, the straddle-type seat comprising

a first seat portion for a driver,

a second seat portion for a first passenger,

a third seat portion for a second passenger,

the second seat portion and the third seat portion being selectively detachable from the frame;

two skis disposed on the frame; and

a steering device disposed on the frame forward of the seat assembly and operatively connected to the two skis for steering the snowmobile.

2. The snowmobile of claim 1, wherein the frame comprises a tunnel and the seat assembly is attached to the tunnel.

3. The snowmobile of claim 2, wherein the second seat portion and the third seat portion are integral and only detachable from the frame as a unit.

4. The snowmobile of claim 3, wherein the first seat portion is selectively detachable from the frame.

5. The snowmobile of claim 3, wherein a storage space is created when the second seat portion and the third seat portion are detached from the frame.

6. The snowmobile of claim 2, wherein the second seat portion and the third seat portion are separately selectively detachable from the frame.

7. The snowmobile of claim 6, wherein a storage space is created when at least one of the second seat portion and the third seat portion are detached from the frame.

8. The snowmobile of claim 6, wherein the third seat portion is constructed and arranged to be selectively releasably attachable to the frame adjacent to and rearward of the first seat portion when the second seat portion has been detached from the frame.

9. The snowmobile of claim 8, wherein when the third seat portion is attached to the frame adjacent to and rearward of the first seat portion, the snowmobile further comprises a storage space rearward of the third seat position.

10. The snowmobile of claim 8, further comprising a backrest mounted to the third seat portion.

11. The snowmobile of claim 10, wherein the backrest is movably mounted to the third seat portion.

12. The snowmobile of claim 6, wherein, the third seat portion is constructed and arranged to be selectively releasable attachable to the frame adjacent to and rearward of the first seat portion and the second seat portion is constructed and arranged to be selectively releasable attachable to the frame adjacent to and rearward of the third seat portion, whereby the second seat portion and the third seat portion are interchangeable on the snowmobile.

13. The snowmobile of claim 3, wherein each of the seat positions comprises a seat surface and the seat surface of the second seat position and the seat surface of the third seat position are higher than the seat surface of the first seat position.

14. The snowmobile of claim 13, wherein the seat surface of the third seat position is higher than the seat surface of the second seat position.

15. A snowmobile comprising:

a frame;

an engine disposed on the frame;

a drive track disposed below the frame and operatively connected to the engine for propulsion of the snowmobile;

a straddle-type seat assembly attached to the frame rearward of the engine, the straddle-type seat comprising

a first seat portion for a driver,

a second seat portion for a first passenger,

a third seat portion for a second passenger,

each of the seat positions comprising a seat surface, the seat surface of the second seat position and the seat surface of the third seat position being higher than the seat surface of the first seat position

two skis disposed on the frame; and

a steering device disposed on the frame forward of the seat assembly and operatively connected to the two skis for steering the snowmobile.

16. The snowmobile of claim 15, wherein the seat surface of the third seat position is higher than the seat surface of the second seat position.

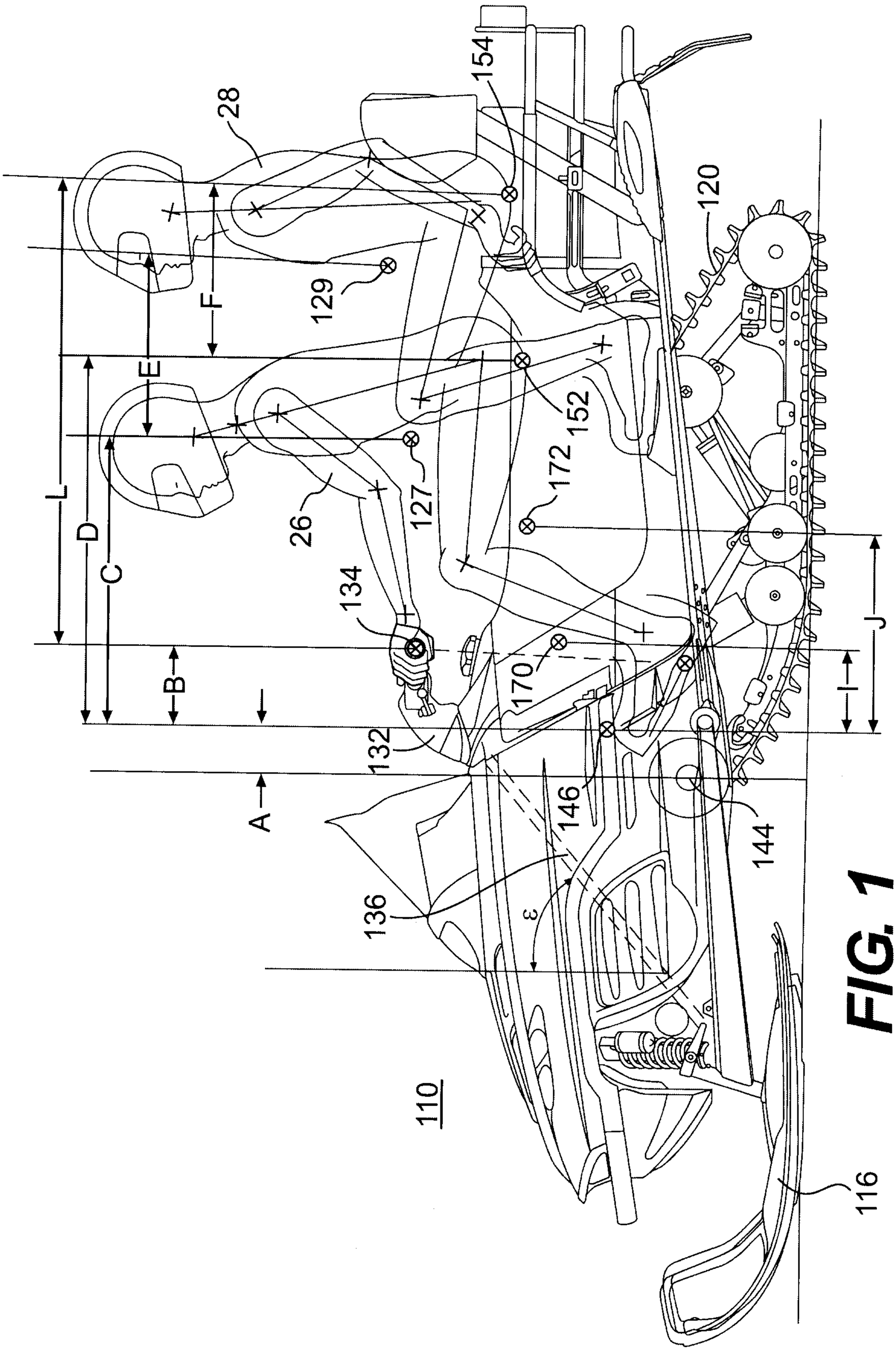



FIG. 1
PRIOR ART

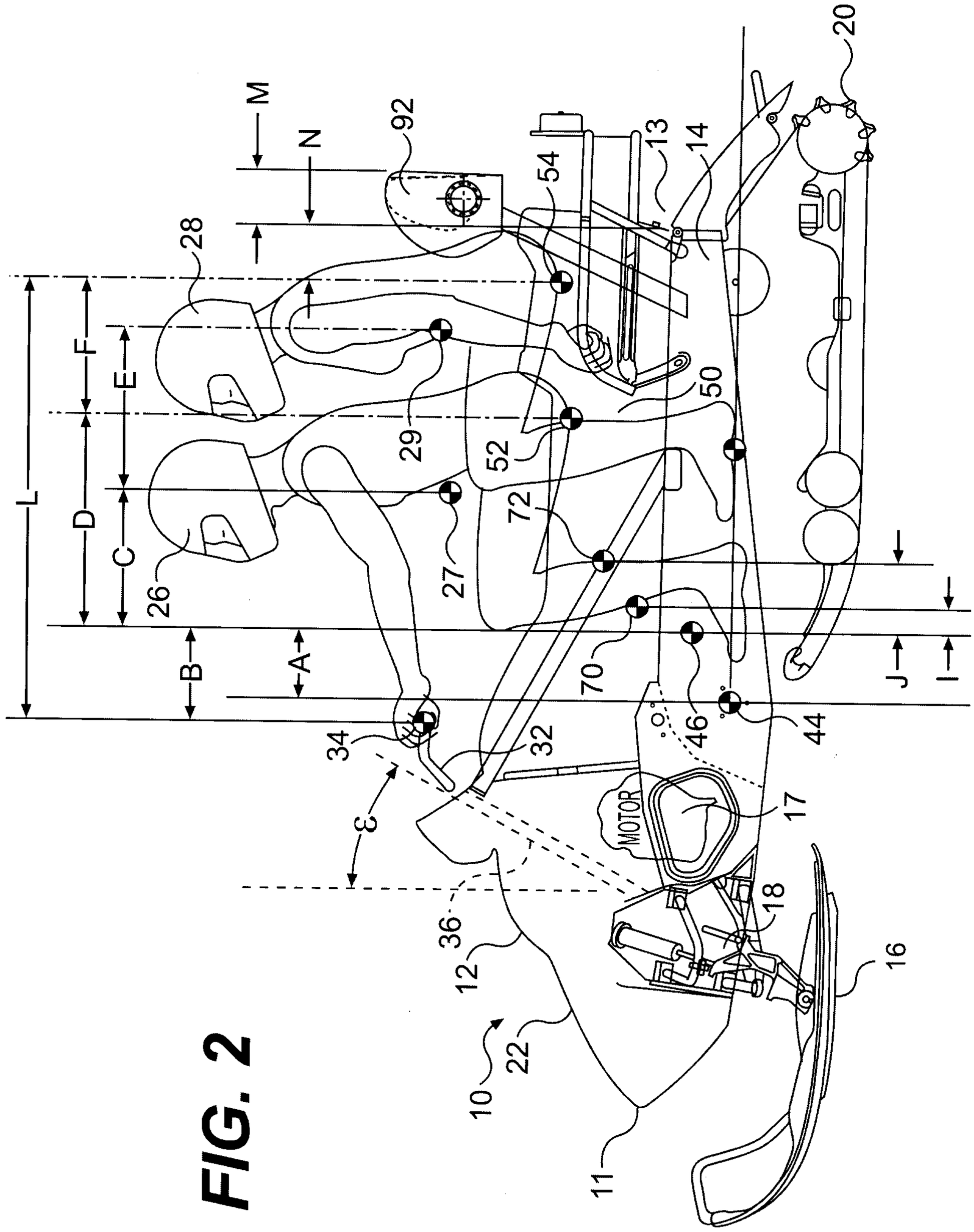

M
N
92
28
54
13
14
20
L
F
E
D
C
B
A
26
29
52
50
72
27
70
46
44
J
I
34
32
ε
MOTOR
17
18
16
36
12
22
10
11

FIG. 2

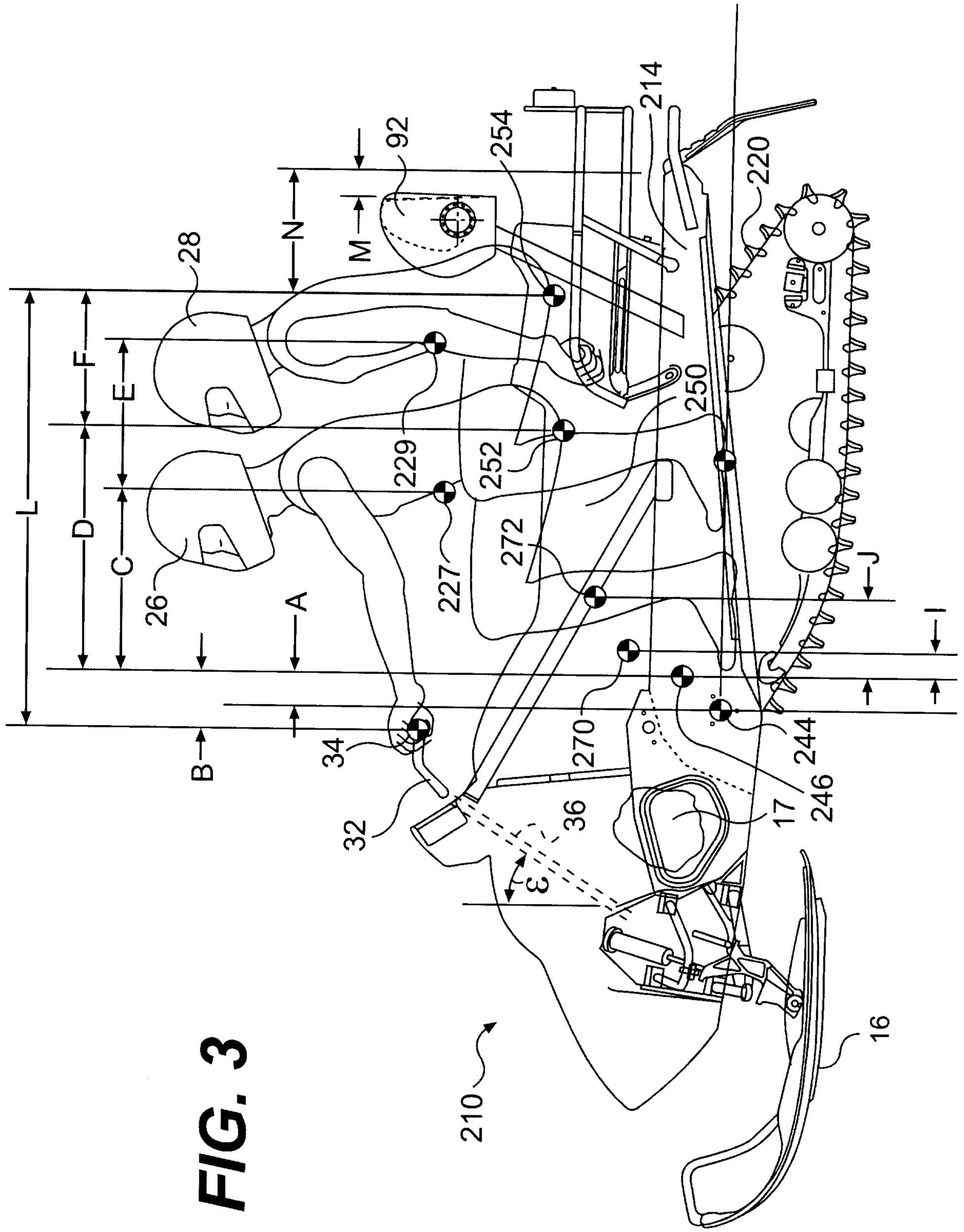

214
92
254
220
28
N
M
F
E
L
D
C
A
B
250
229
252
272
227
26
34
270
244
246
17
32
36
ε
J
I
16
210

FIG. 3

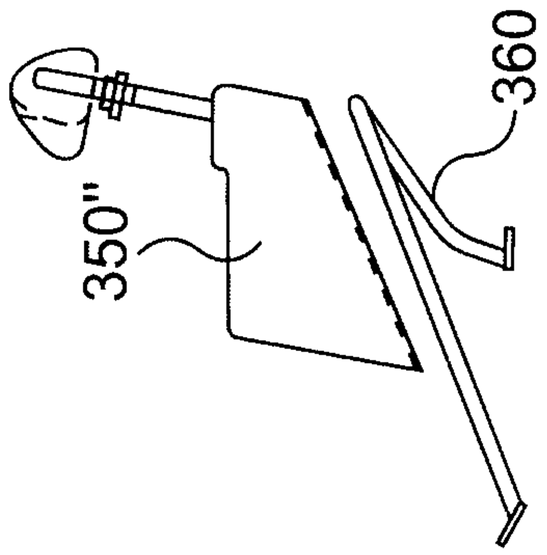

350"
360

FIG. 4B

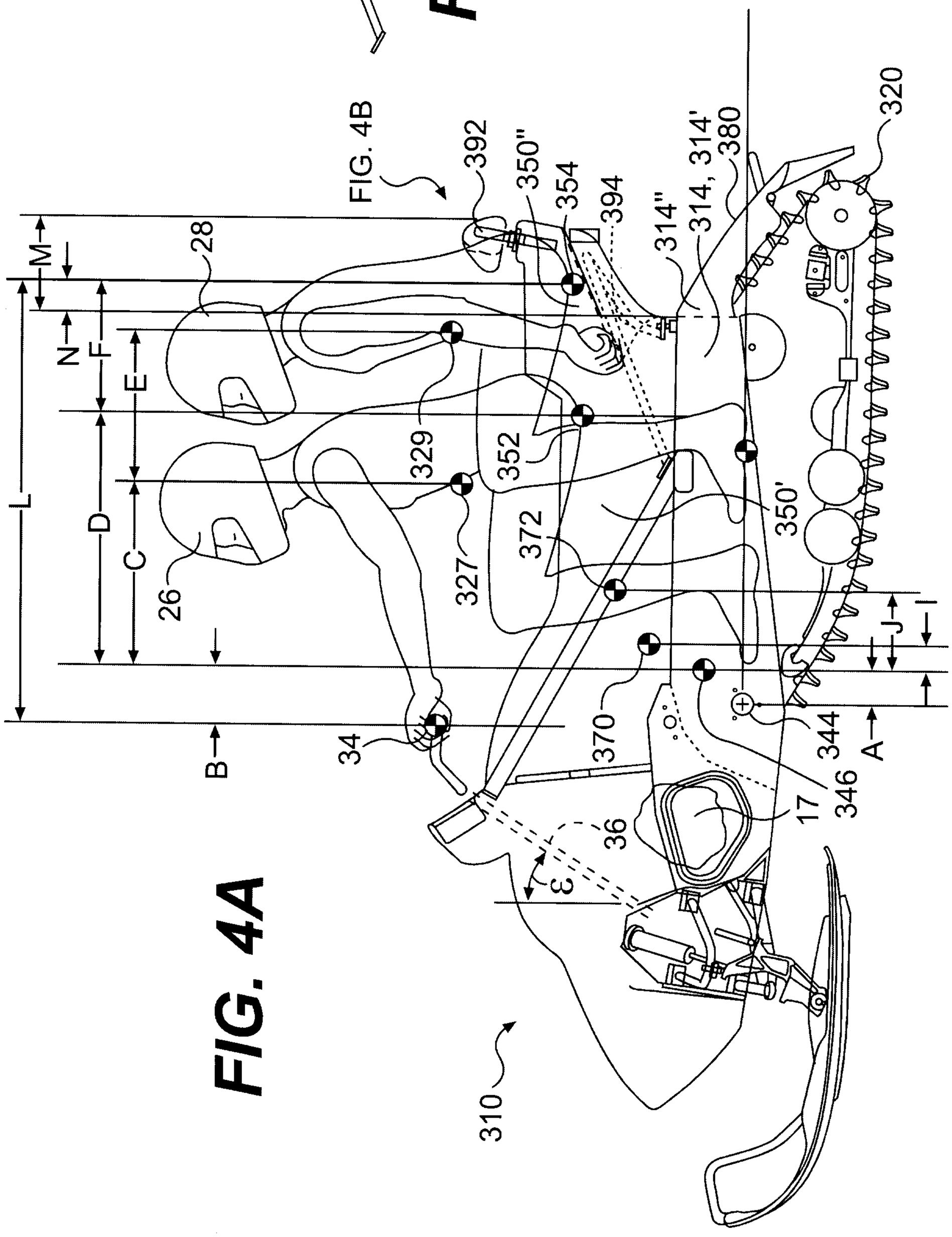


FIG. 4B
392
350"
354
394
314"
314, 314'
380
320
28
M
N
F
E
L
D
C
B
329
352
327
372
350'
26
34
370
344
A
346
17
36
ε
310

FIG. 4A

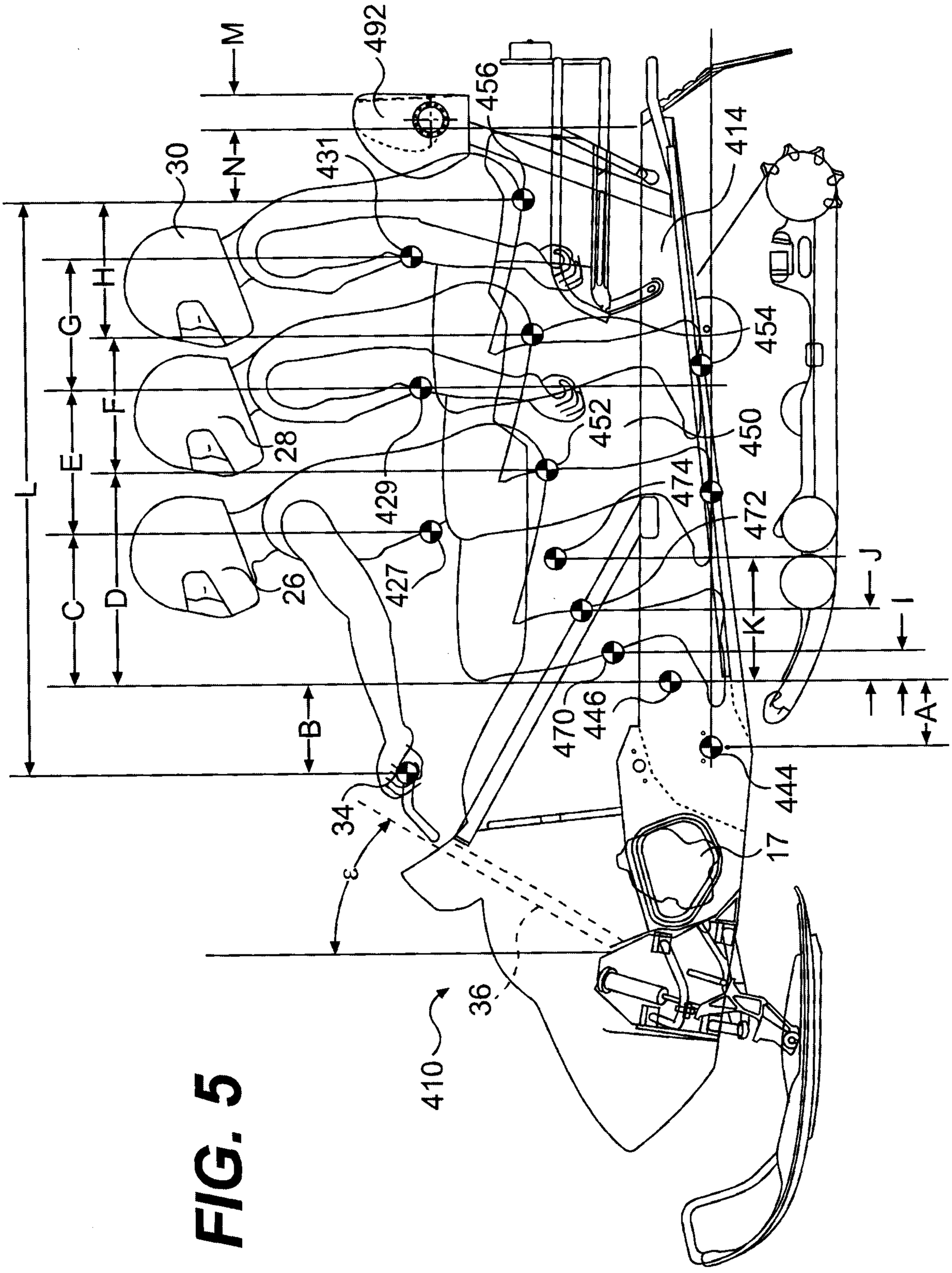

M
492
56
456
414
30
N
431
H
G
454
F
452
450
28
E
L
429
474
472
J
I
K
427
26
C
D
B
470
446
A
34
444
ε
17
36
410

FIG. 5

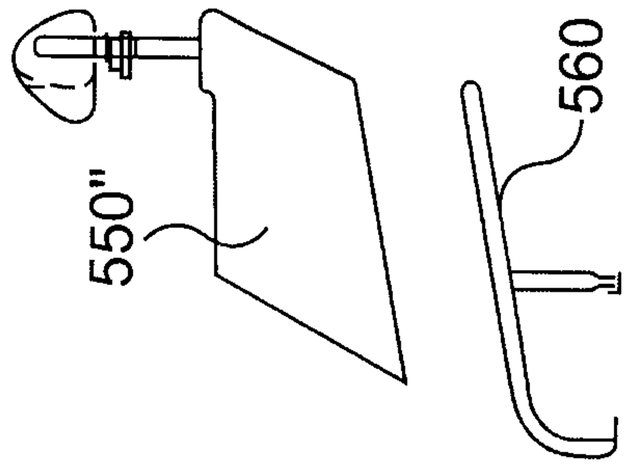

550"
560

FIG. 6B

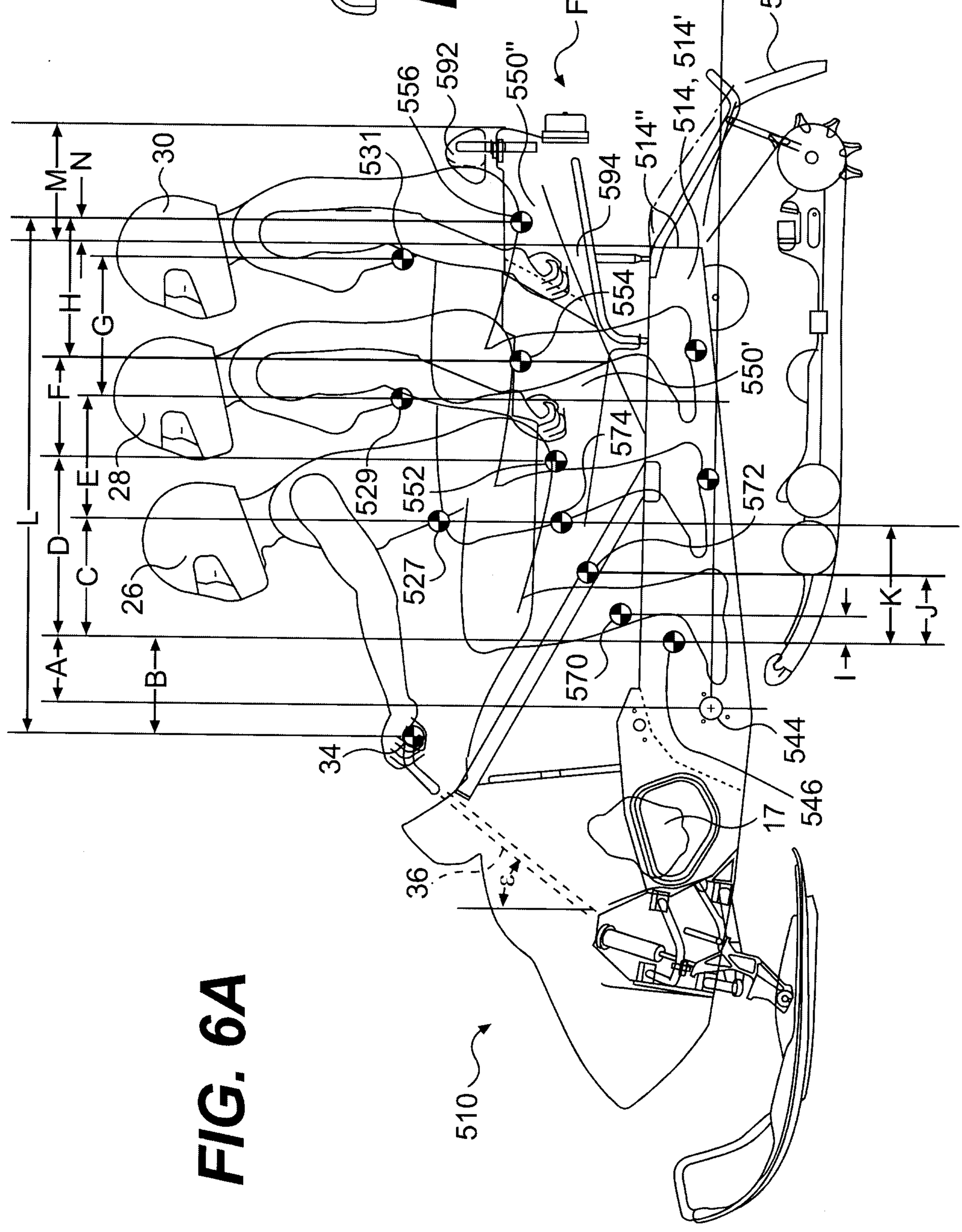


FIG. 6B
580
514', 514'
514"
550"
556
592
531
30
M
N
H
G
F
L
D
E
C
A
B
28
26
34
36
3
529
552
527
574
572
594
554
550'
570
544
546
17
510
K
J
I

FIG. 6A

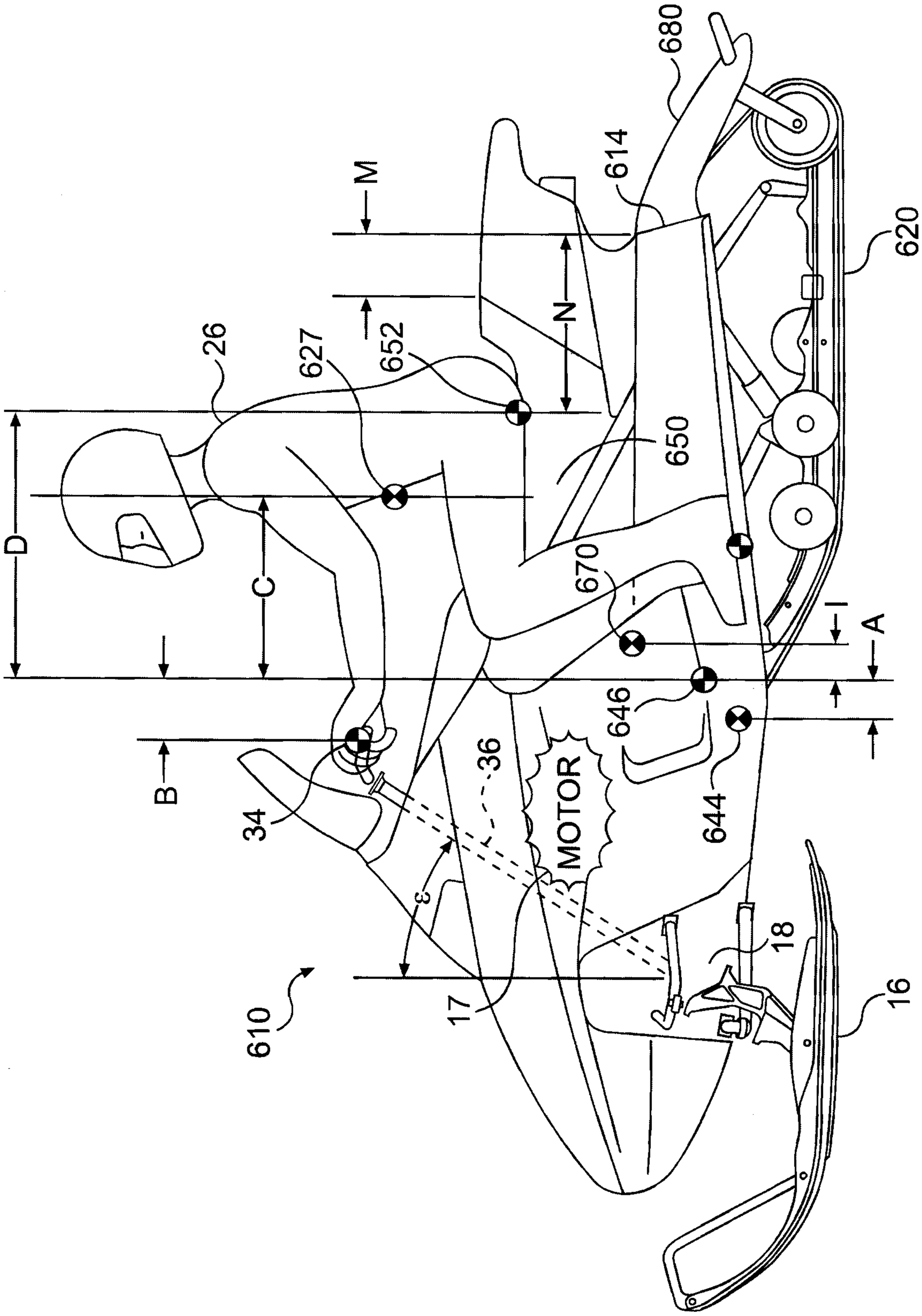
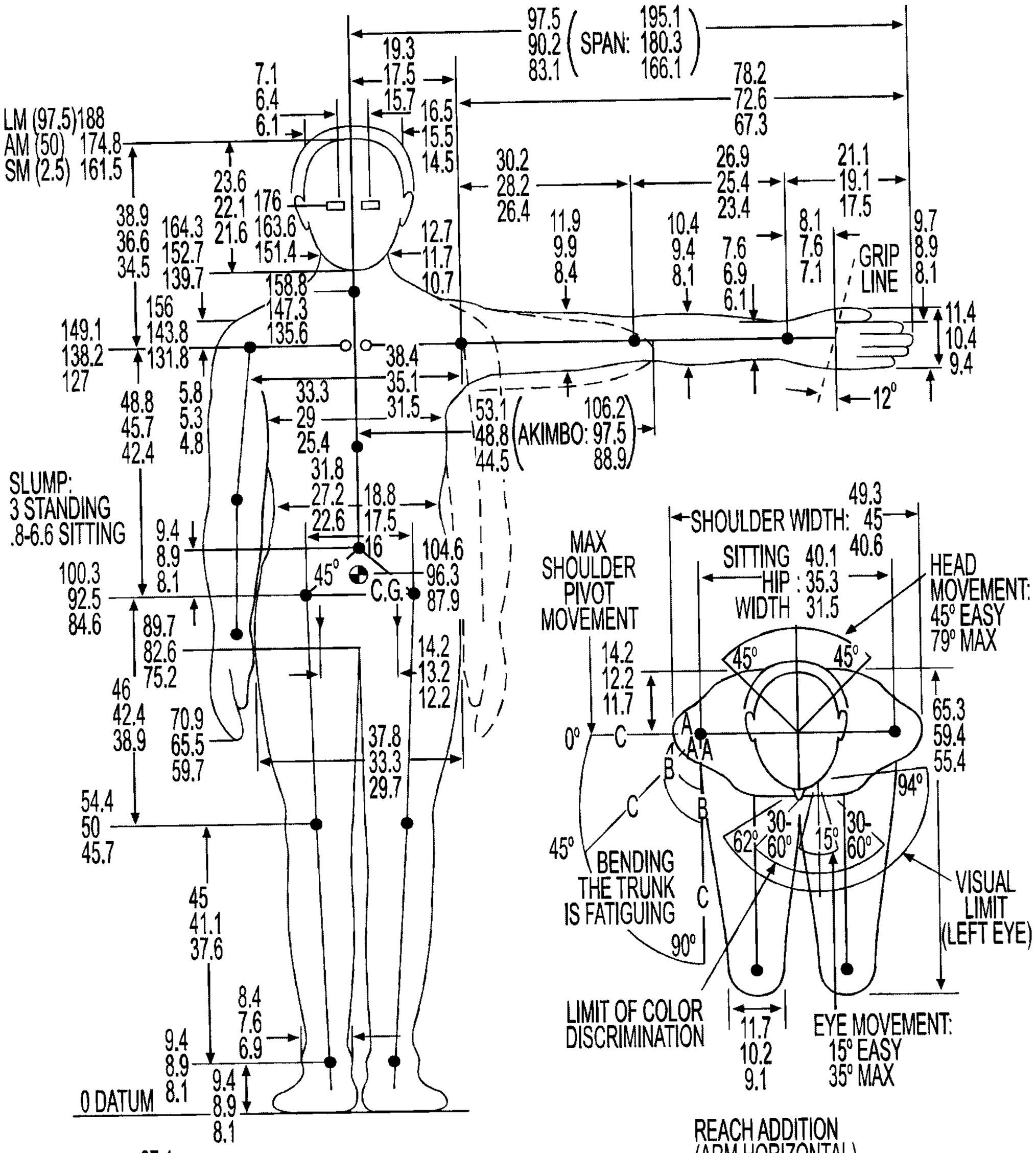

680
614
620
M
N
26
627
652
650
D
C
670
I
A
646
644
B
34
36
MOTOR
ε
610
17
18
16

FIG. 7

| DISTANCE (mm) | | | VEHICLE | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | CONVENTIONAL | | INVENTION | | | | | |
| REF.# | FROM: | TO (GOING BACK): | LONG | SHORT | 1ST EMBODIMENT 2-UP LONG (FIG. 2) | 2ND EMBODIMENT 2-UP SHORT (FIG. 3) | 3RD EMBODIMENT 1+1 SHORT (FIG. 4A) | 4TH EMBODIMENT 3-UP LONG (FIG. 5) | 5TH EMBODIMENT 2+1 LONG (FIG. 6A) | 6TH EMBODIMENT 1-UP (FIG. 7) |
| A | FORWARD AXLE | CG (VEHICLE) | 110 | 30 | 65 | 95 | 95 | 170 | 170 | 95 |
| B | STEERING POS. | CG (VEHICLE) | -160 | -240 | 130 | 160 | 160 | 235 | 235 | 160 |
| C | CG (VEHICLE) | CG (RIDER 1) | 645 | 725 | 350 | 320 | 320 | 245 | 245 | 320 |
| D | CG (VEHICLE) | SEAT POS (1) | 795 | 875 | 500 | 470 | 470 | 395 | 395 | 470 |
| E | CG (RIDER 1) | CG (RIDER 2) | 370 | 370 | 370 | 370 | 370 | 370 | 370 | N/A |
| F | SEAT POS (1) | SEAT POS (2) | 340 | 340 | 340 | 340 | 340 | 340 | 290 | N/A |
| G | CG (RIDER 2) | CG (RIDER 3) | N/A | N/A | N/A | N/A | N/A | 310 | 345 | N/A |
| H | SEAT POS (2) | SEAT POS (3) | N/A | N/A | N/A | N/A | N/A | 310 | 345 | N/A |
| I | CG (VEHICLE) | CG (V+1 RIDER) | 180 | 160 | 70 | 50 | 50 | 60 | 70 | 50 |
| J | CG (VEHICLE) | CG (V+2 RIDERS) | 290 | 280 | 175 | 190 | 190 | 170 | 170 | N/A |
| K | CG (VEHICLE) | CG (V+3 RIDERS) | N/A | N/A | N/A | N/A | N/A | 300 | 300 | N/A |
| L | STEER POS. | REAR SEAT POS. | 975 | 975 | 970 | 970 | 970 | 1280 | 1265 | N/A |
| M | BACK OF FRAME | BACK OF SEAT | -50 | 0 | 100 | -100 | 230 | 60 | 290 | -110 |
| N | BACK OF FRAME | REAR SEAT POS. | -290 | -120 | -130 | -340 | 80 | -200 | 60 | -260 |
| ANGLES (DEGREES) | | | | | | | | | | |
| EPSILON VERT. AND STEERING SHAFT | | | >=45 | >=45 | ALL <45, PREFERABLY 25-40, MORE PREFERABLY 30-35, MOST PREFERABLY 33 | | | | | |

FIG. 8

CA 02468330 2004-09-30




REACH SUBTRACTION

| | | | | | |
|---|---|---|---|---|---|
| HAND GRIP | 13.7 12.2 11.2 | | FINGER GRIP | 8.9 7.9 6.6 | |

REACH ADDITION (ARM HORIZONTAL)

| DIRECTION | | 0° | 45° | 90° |
|---|---|---|---|---|
| EXTEND SHOULDER | A | 5.1 | 7.6 | 10.2 |
| ROTATE TRUNK | B | 0 | 2.5 | 5.1 |
| BEND TRUNK | C | 15.2 | 20.3 | 25.4 |
| TOTAL | | 20.3 | 30.5 | 40.6 |

FIG. 9

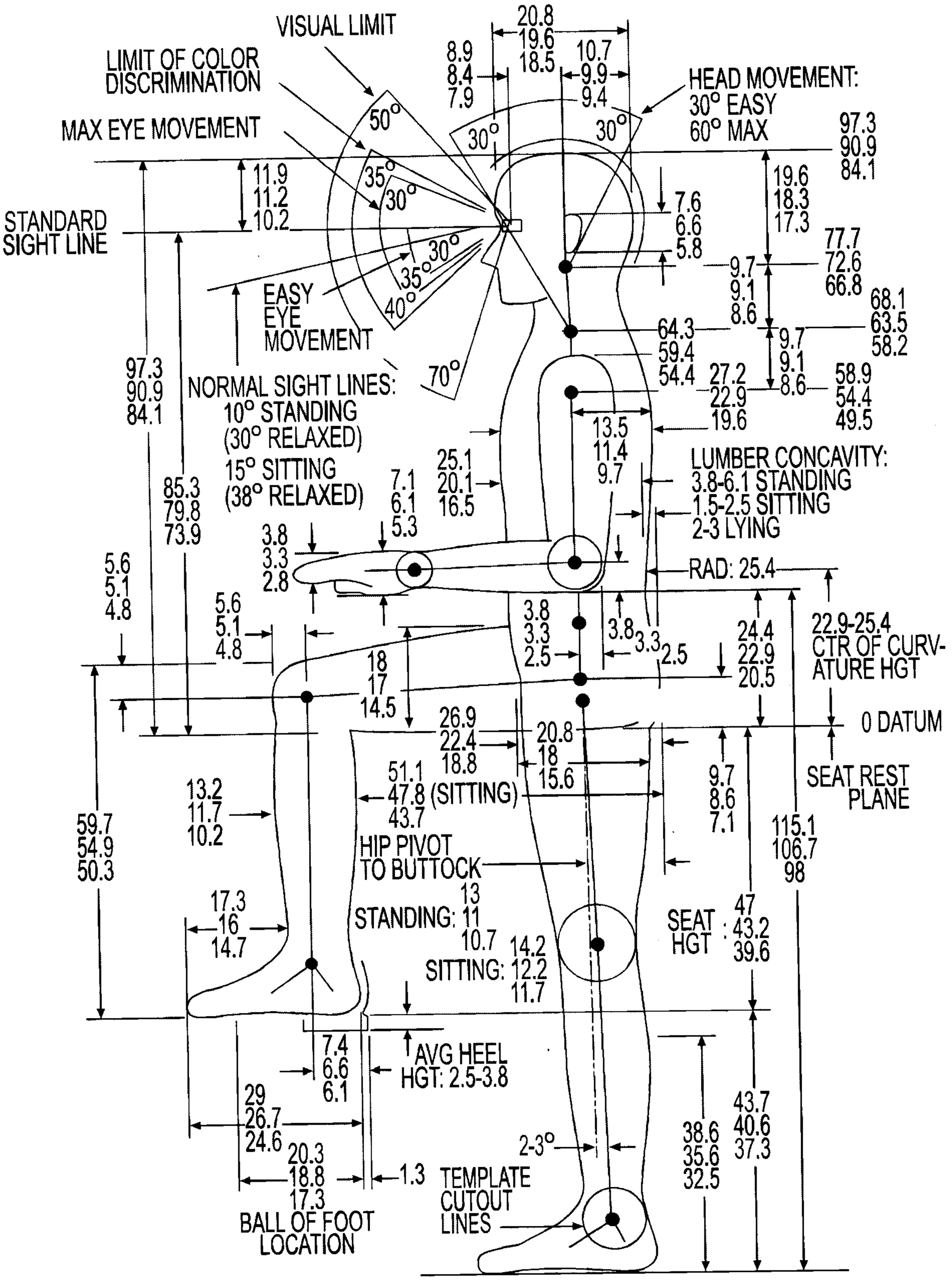

VISUAL LIMIT
LIMIT OF COLOR DISCRIMINATION
MAX EYE MOVEMENT
STANDARD SIGHT LINE
EASY EYE MOVEMENT
NORMAL SIGHT LINES:
10° STANDING
(30° RELAXED)
15° SITTING
(38° RELAXED)
HEAD MOVEMENT:
30° EASY
60° MAX
LUMBER CONCAVITY:
3.8-6.1 STANDING
1.5-2.5 SITTING
2-3 LYING
RAD: 25.4
22.9-25.4
CTR OF CURV-
ATURE HGT
0 DATUM
SEAT REST
PLANE
SEAT HGT
HIP PIVOT
TO BUTTOCK
STANDING:
SITTING:
(SITTING)
AVG HEEL
HGT: 2.5-3.8
TEMPLATE
CUTOUT
LINES
BALL OF FOOT
LOCATION
50°
35°
30°
40°
70°
2-3°

FIG. 10

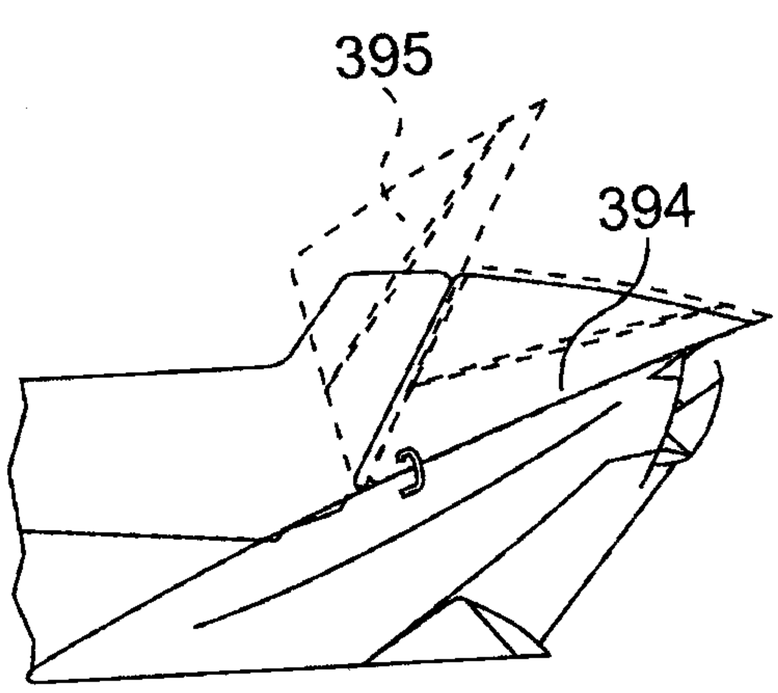



FIG. 11A

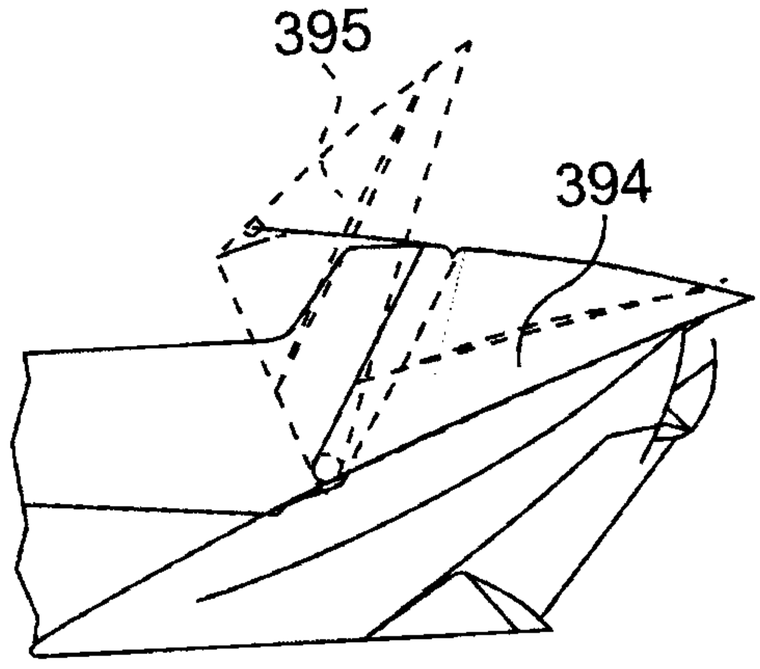



FIG. 11B

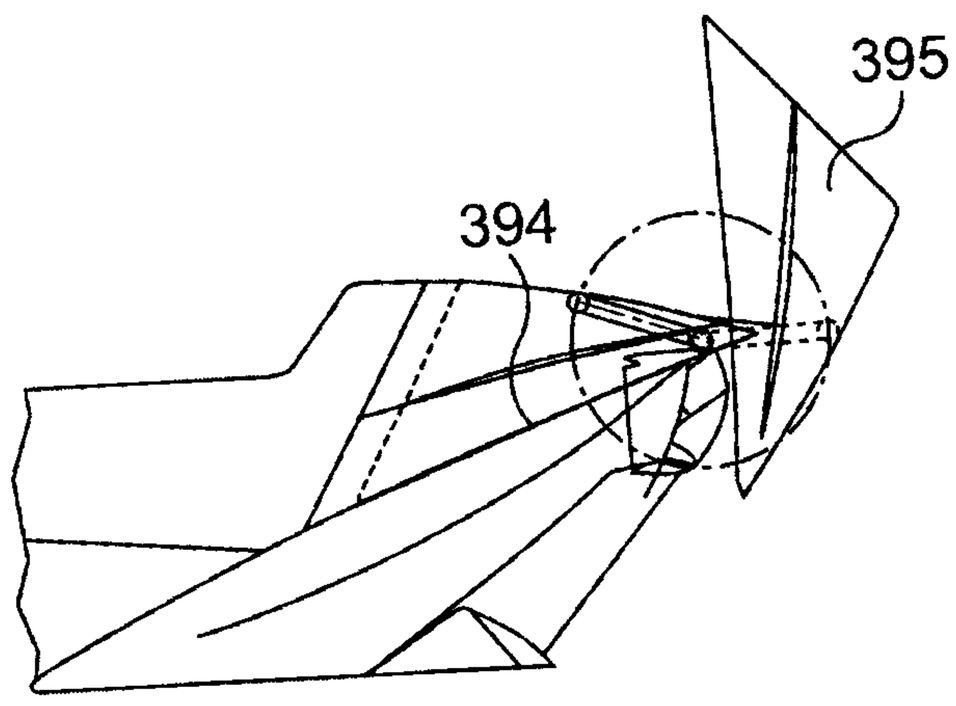



FIG. 11C

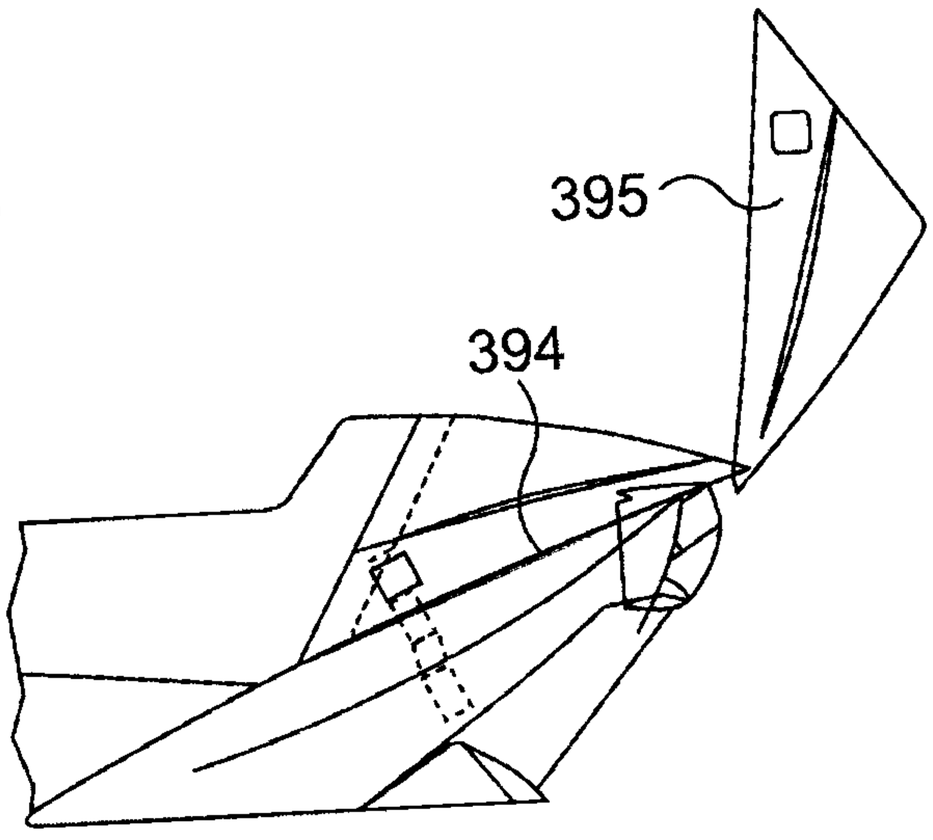



FIG. 11D

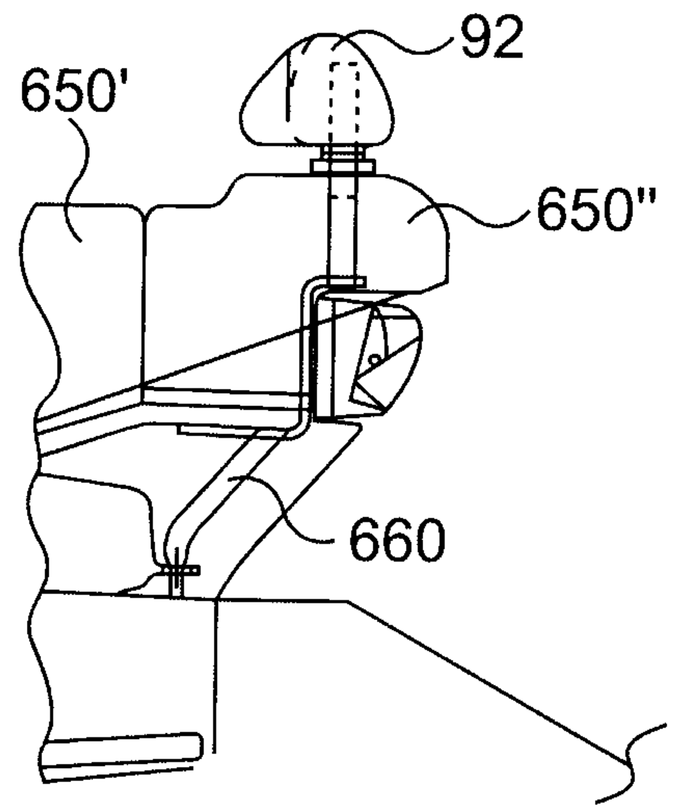



FIG. 12A

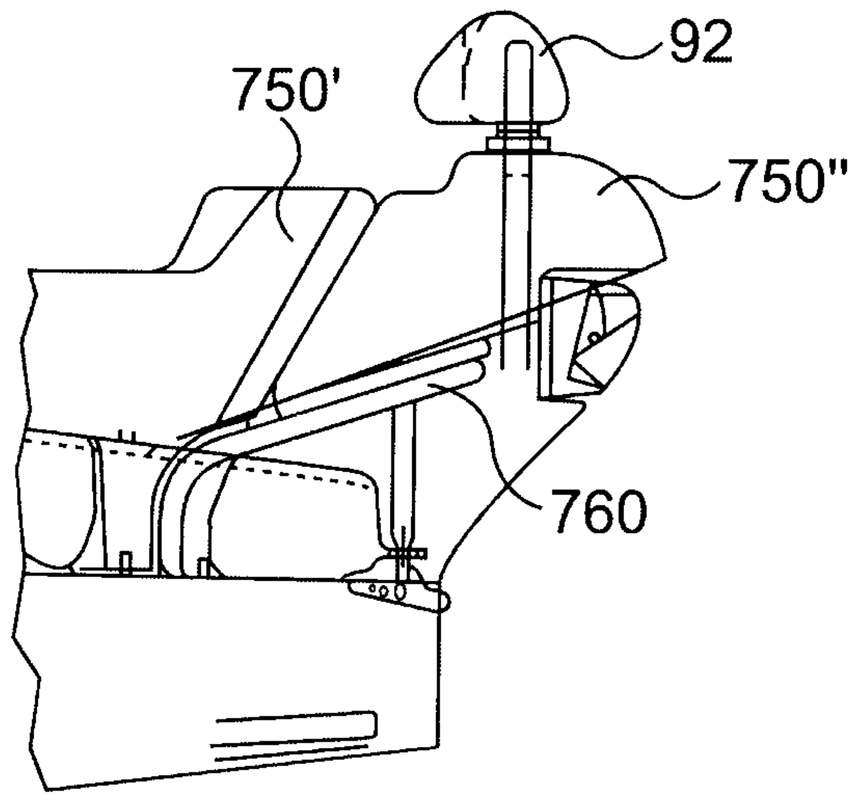



FIG. 12B

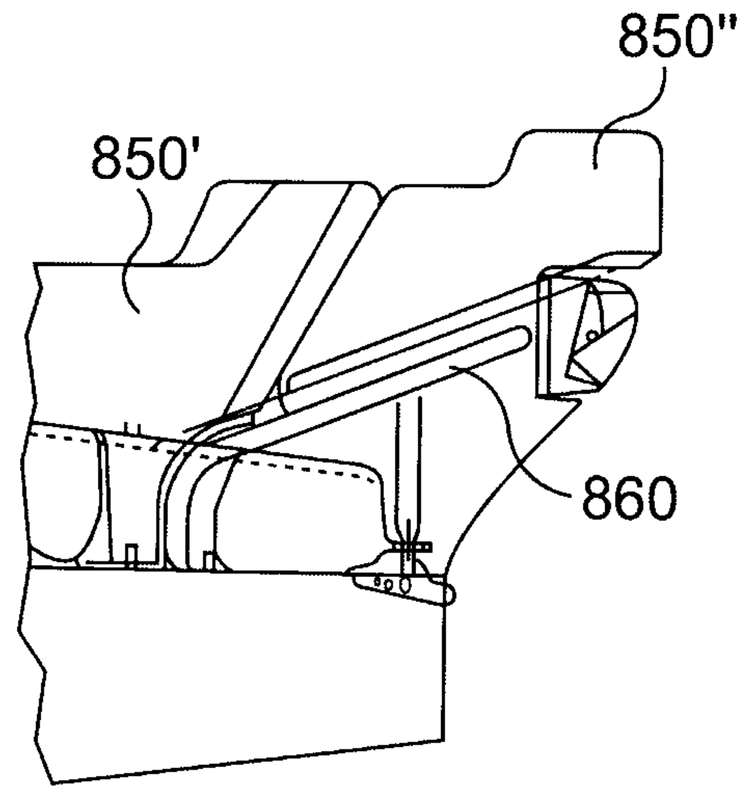



FIG. 12C

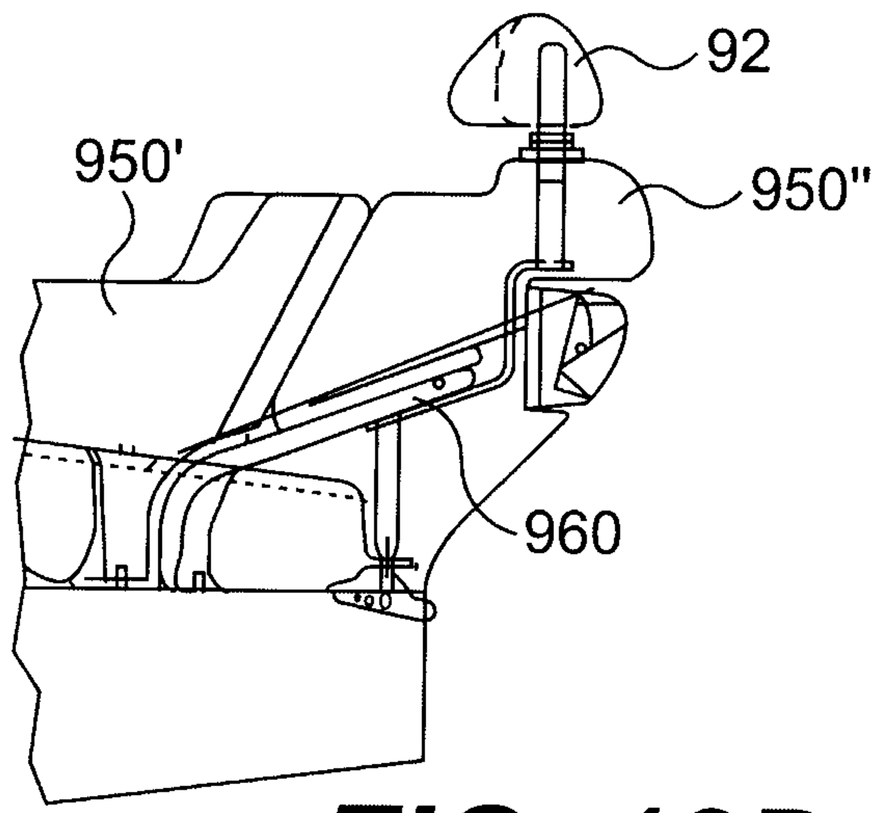



FIG. 12D

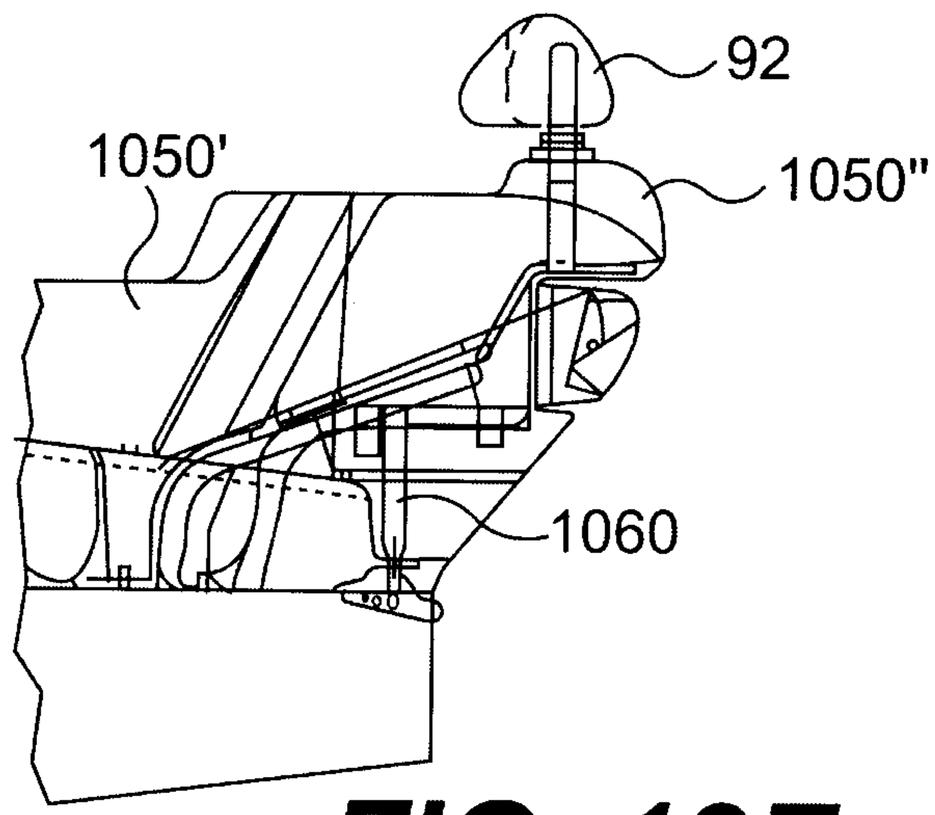



FIG. 12E

CA 02468330 2004-09-30

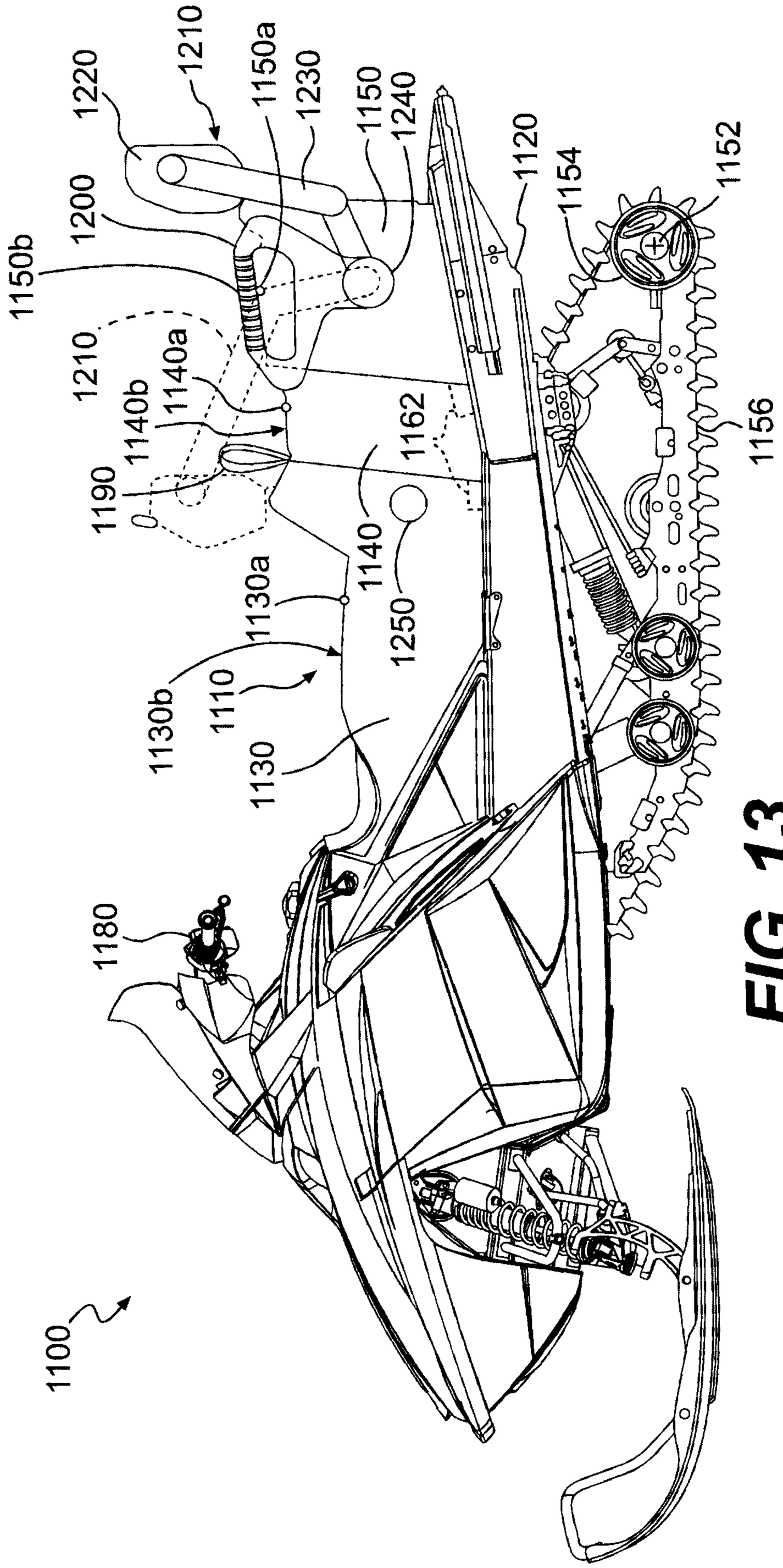

1100
1180
1130b, 1130a
1110
1130
1140
1250
1162
1156
1190
1140b
1140a
1210
1200
1150b
1220
1210
1150a
1230
1150
1240
1120
1154
1152

FIG. 13

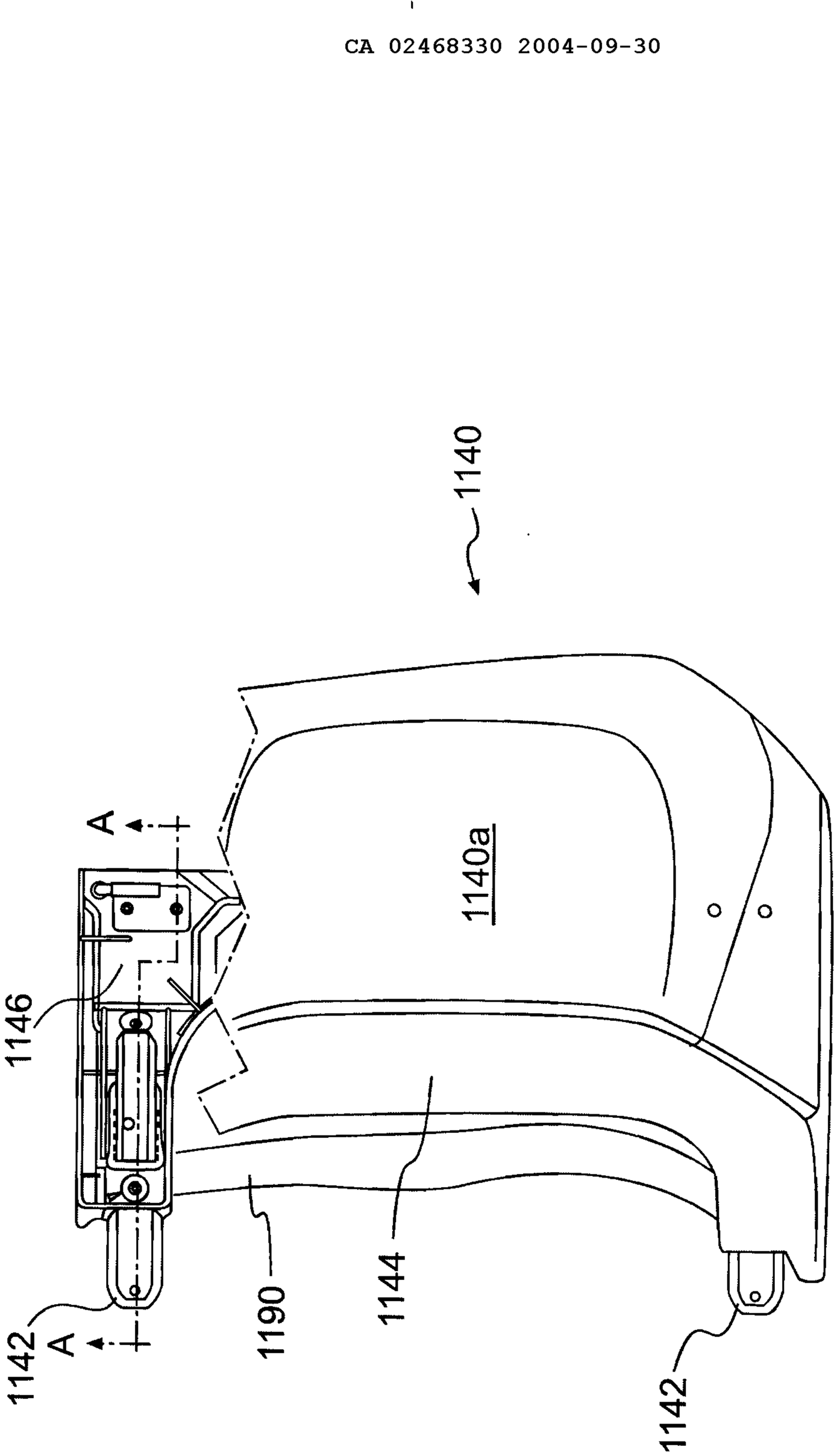



FIG. 13A

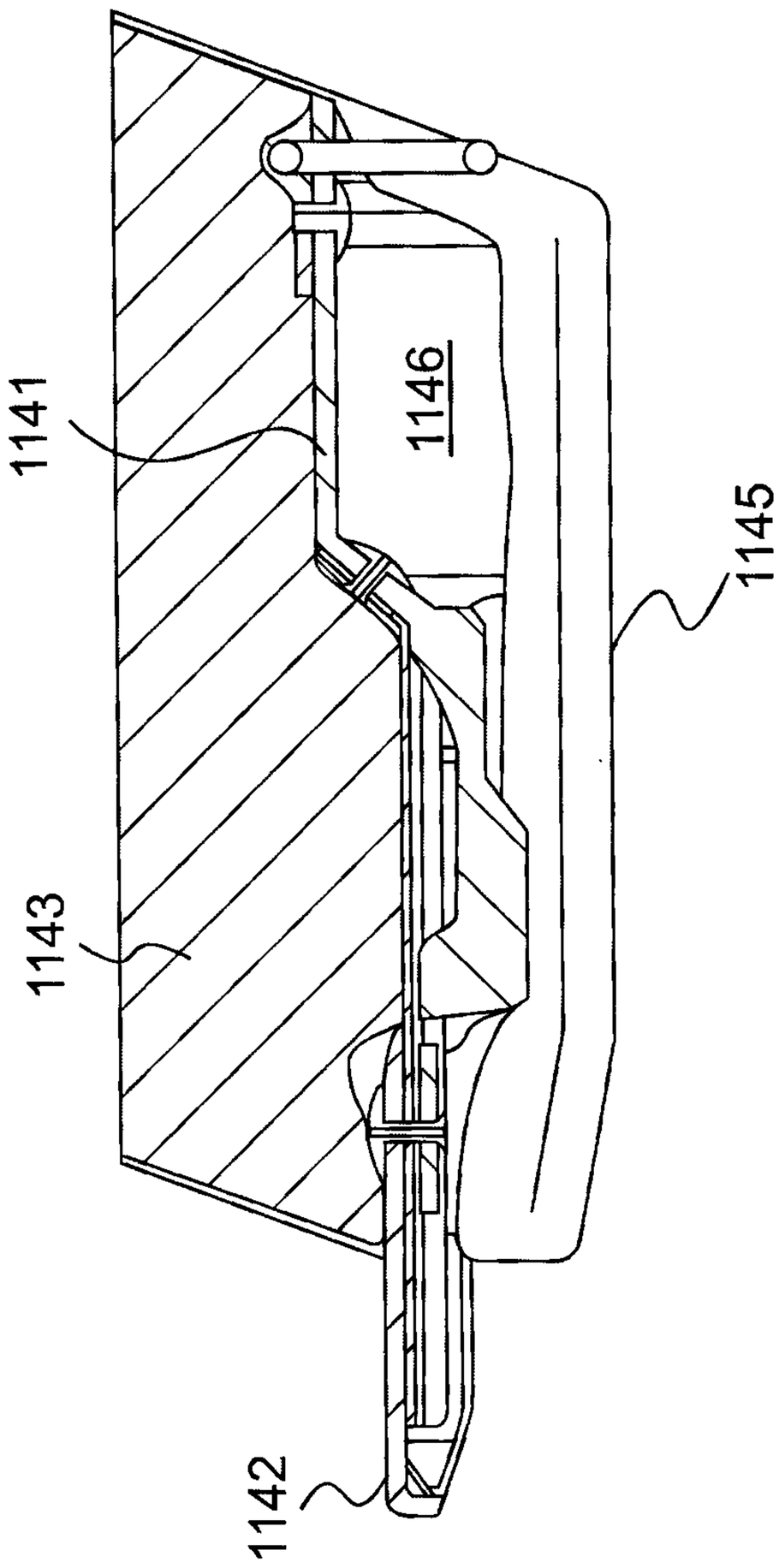



FIG. 13B

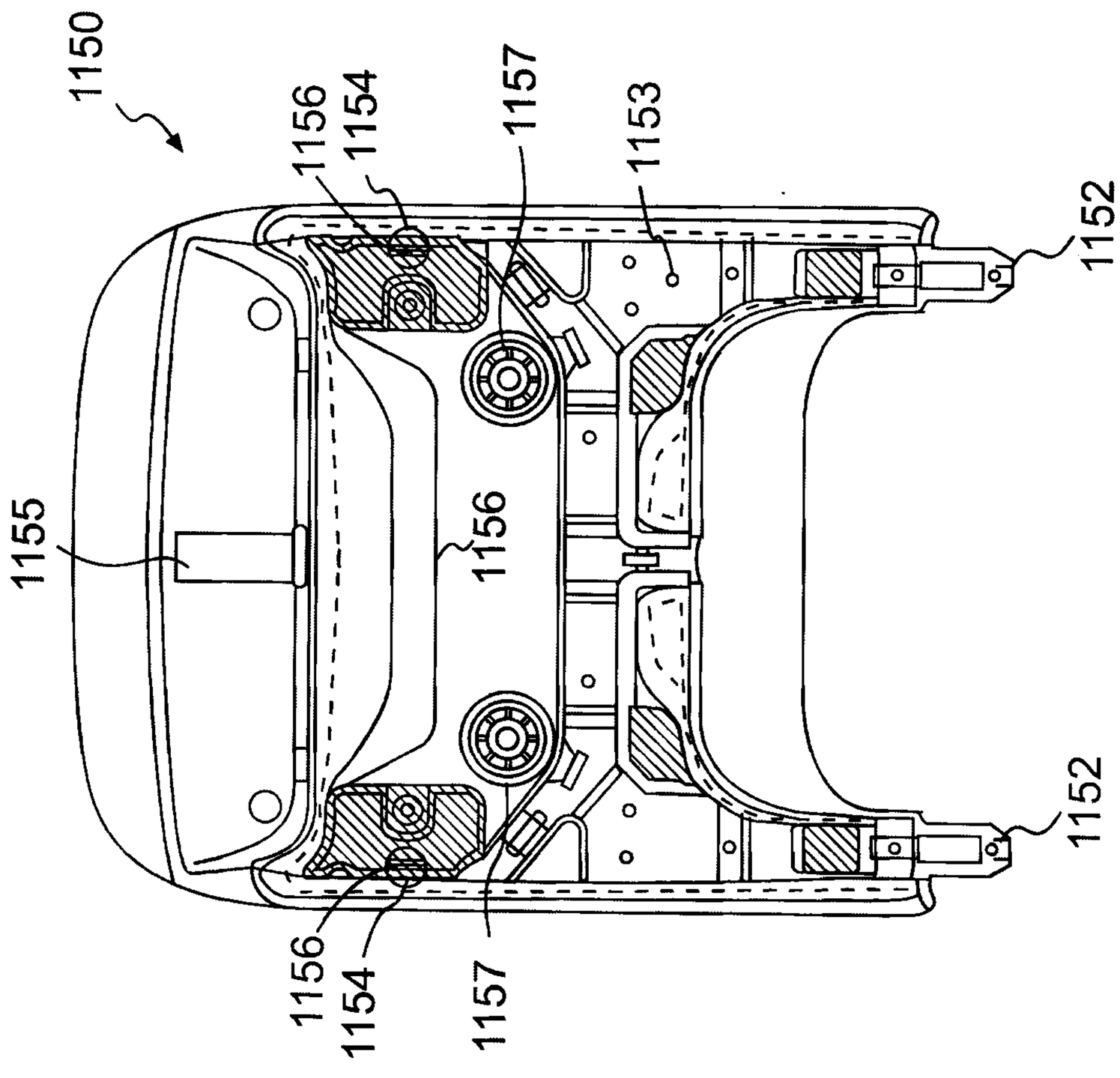



FIG. 13C

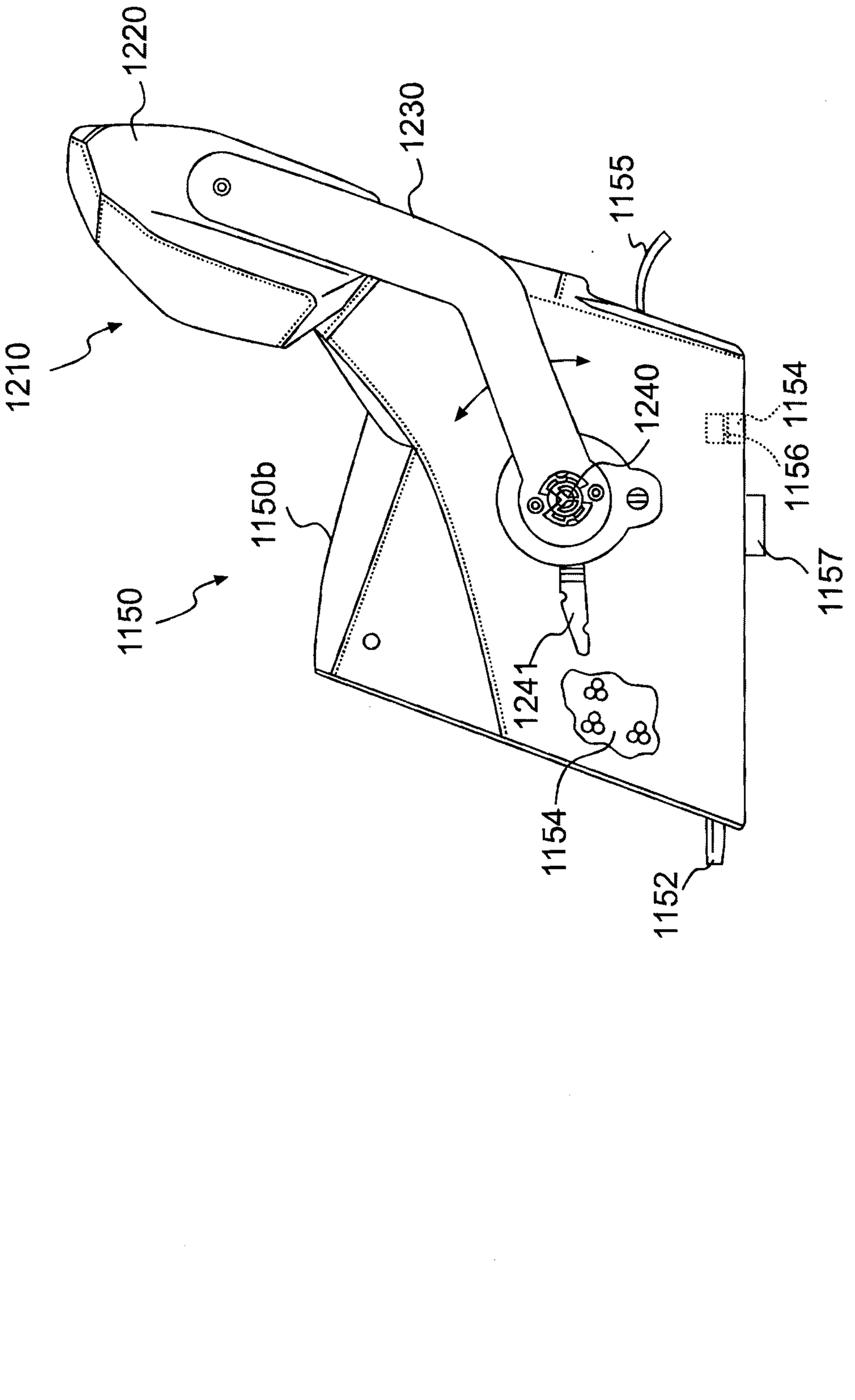

1220
1230
1155
1210
1240
1156 1154
1150b
1150
1241
1157
1154
1152

FIG. 13D

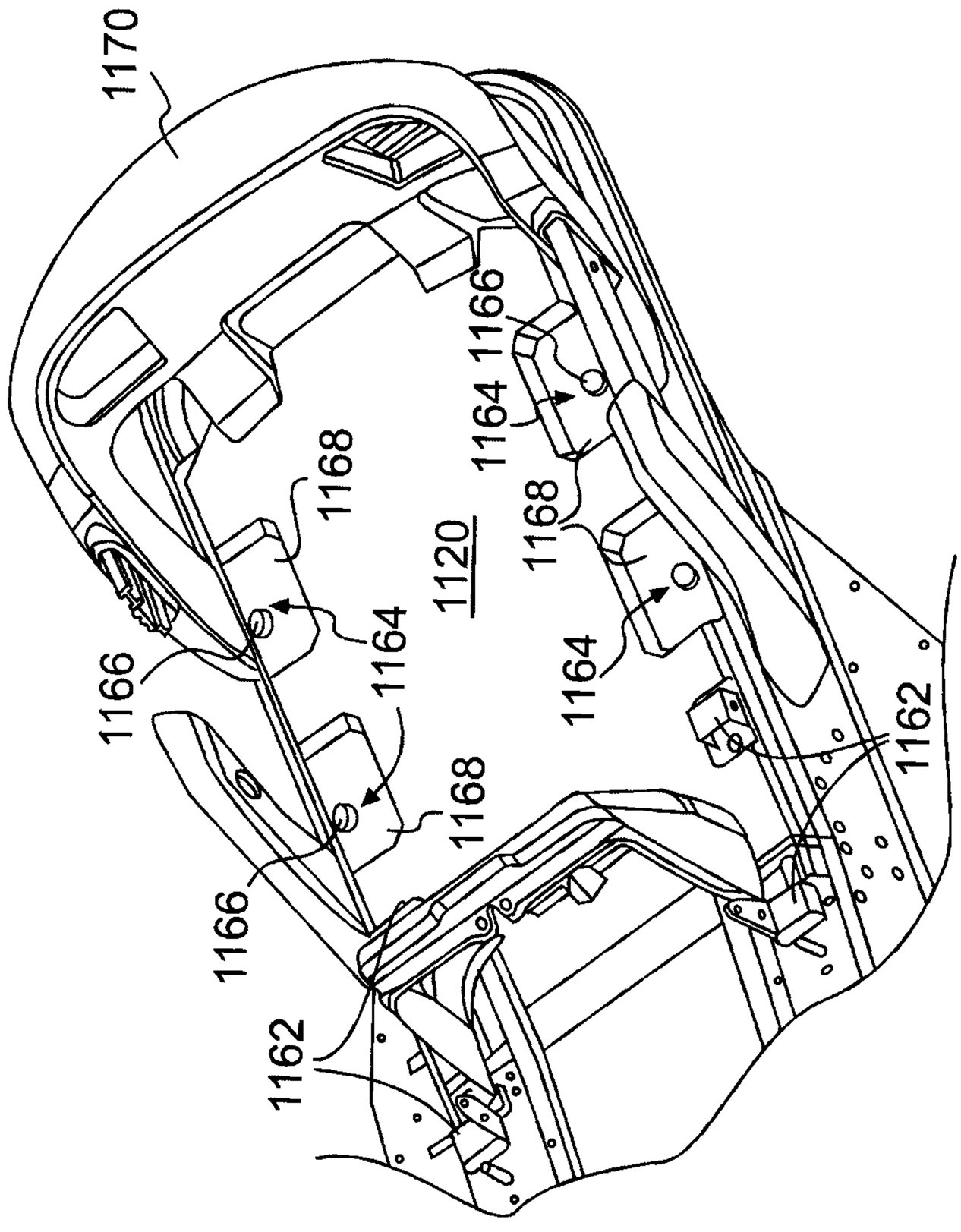



FIG. 13E

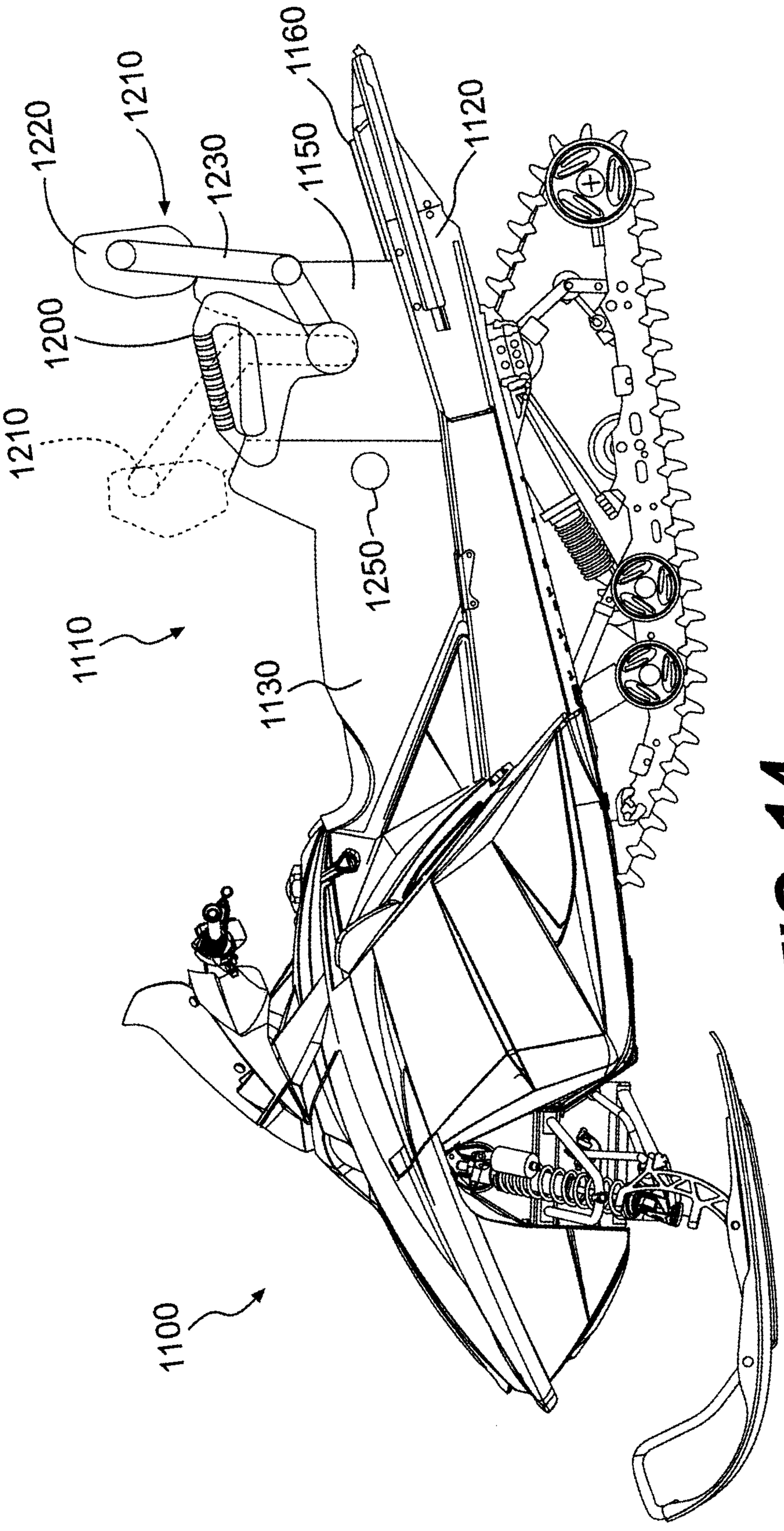



FIG. 14

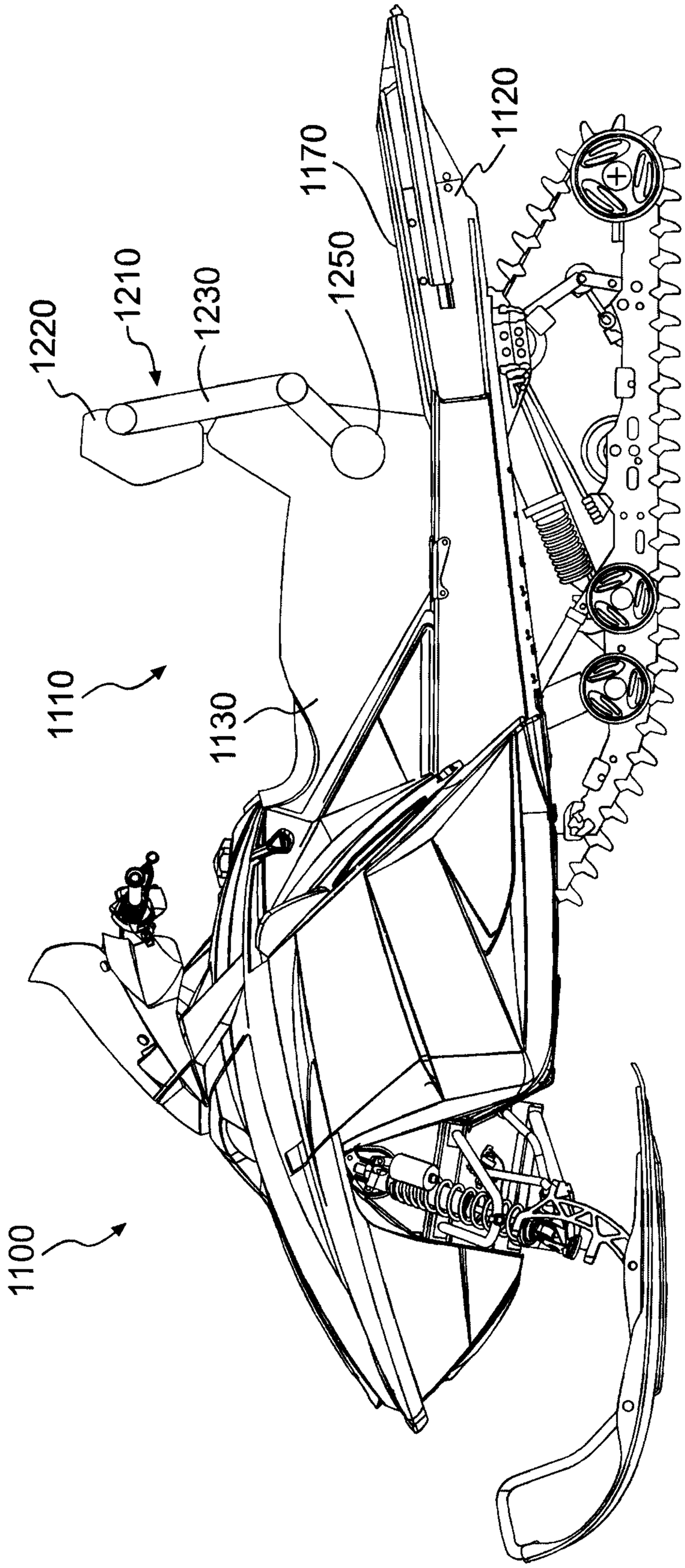



FIG. 15

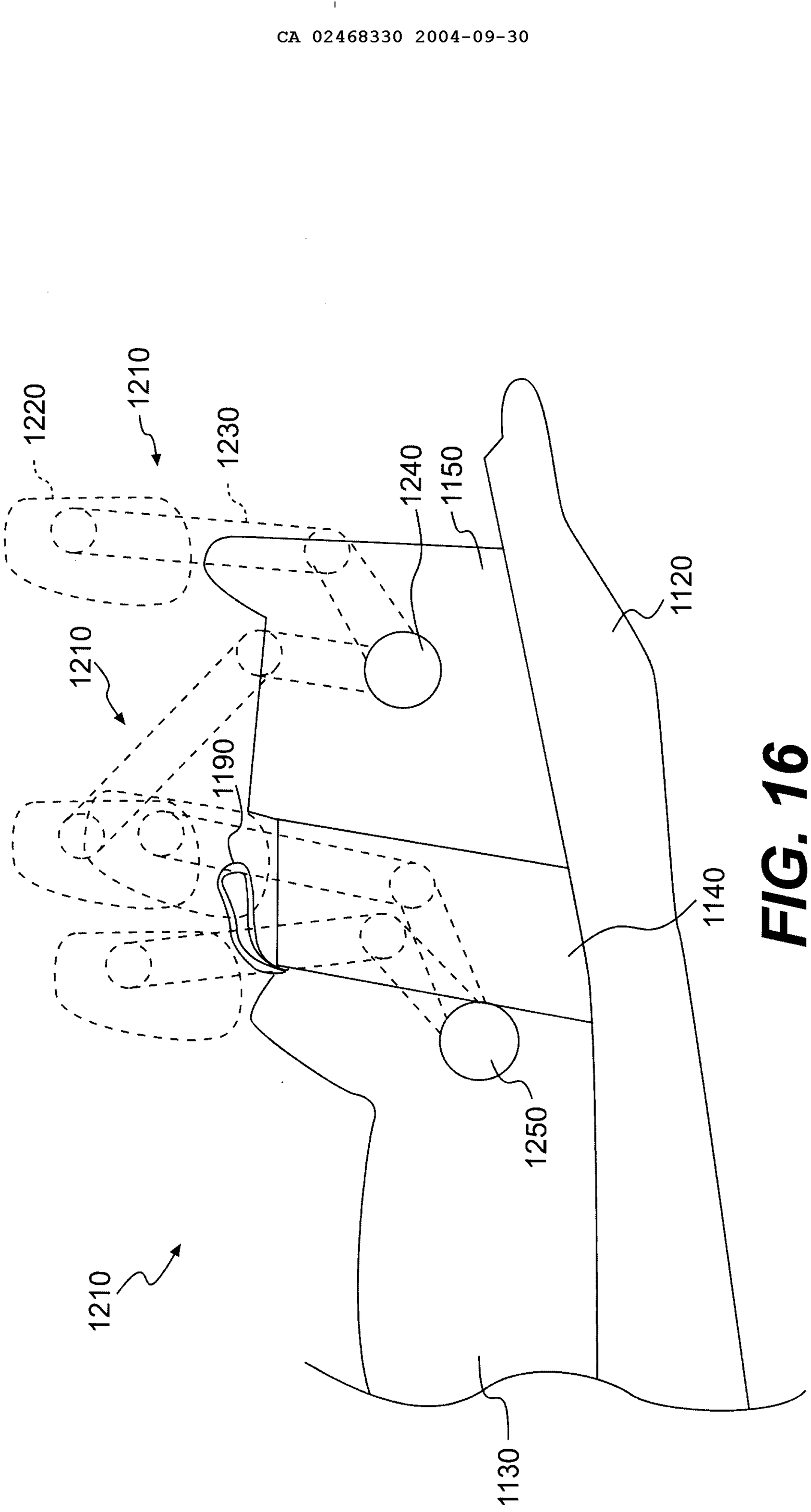
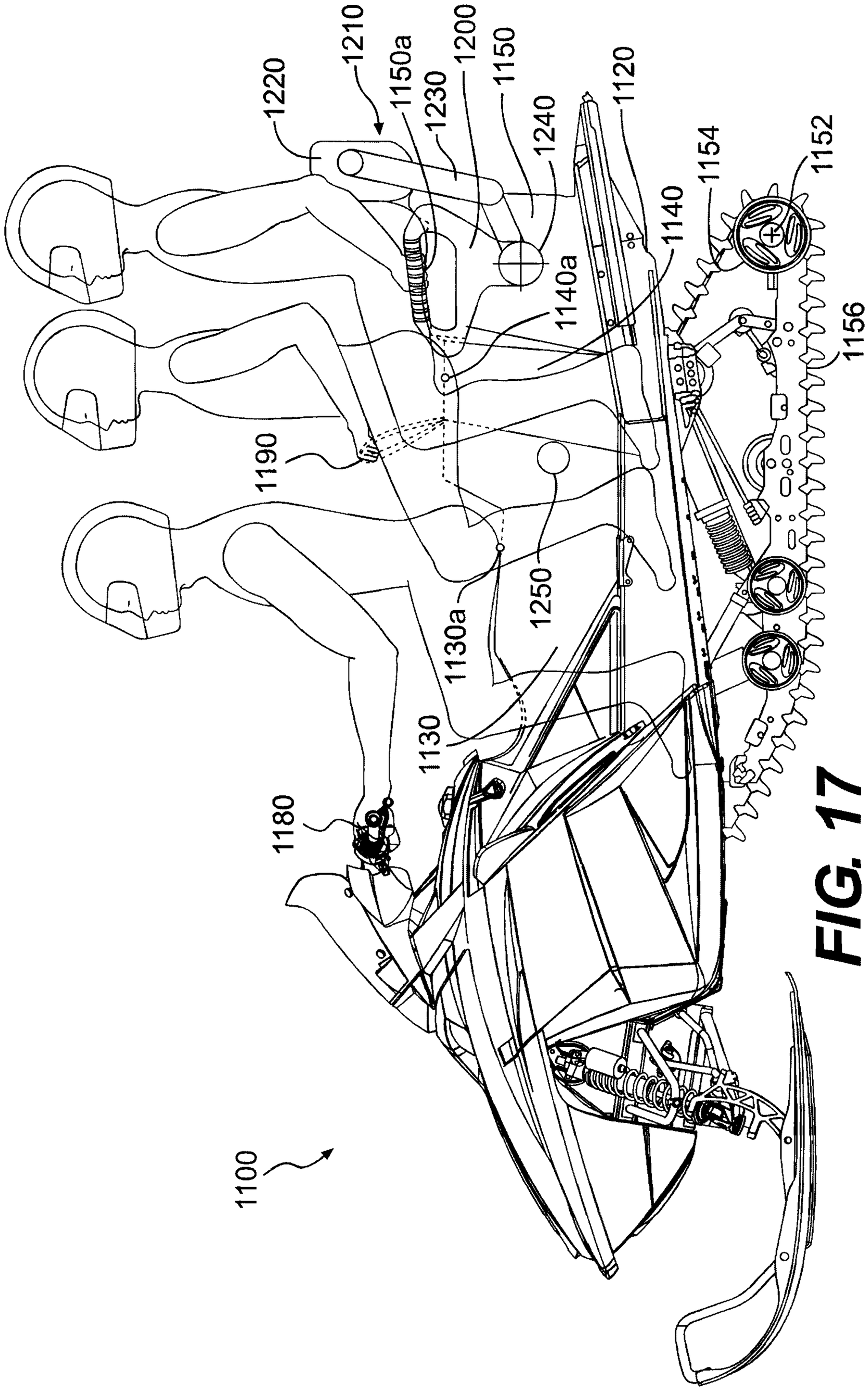



FIG. 16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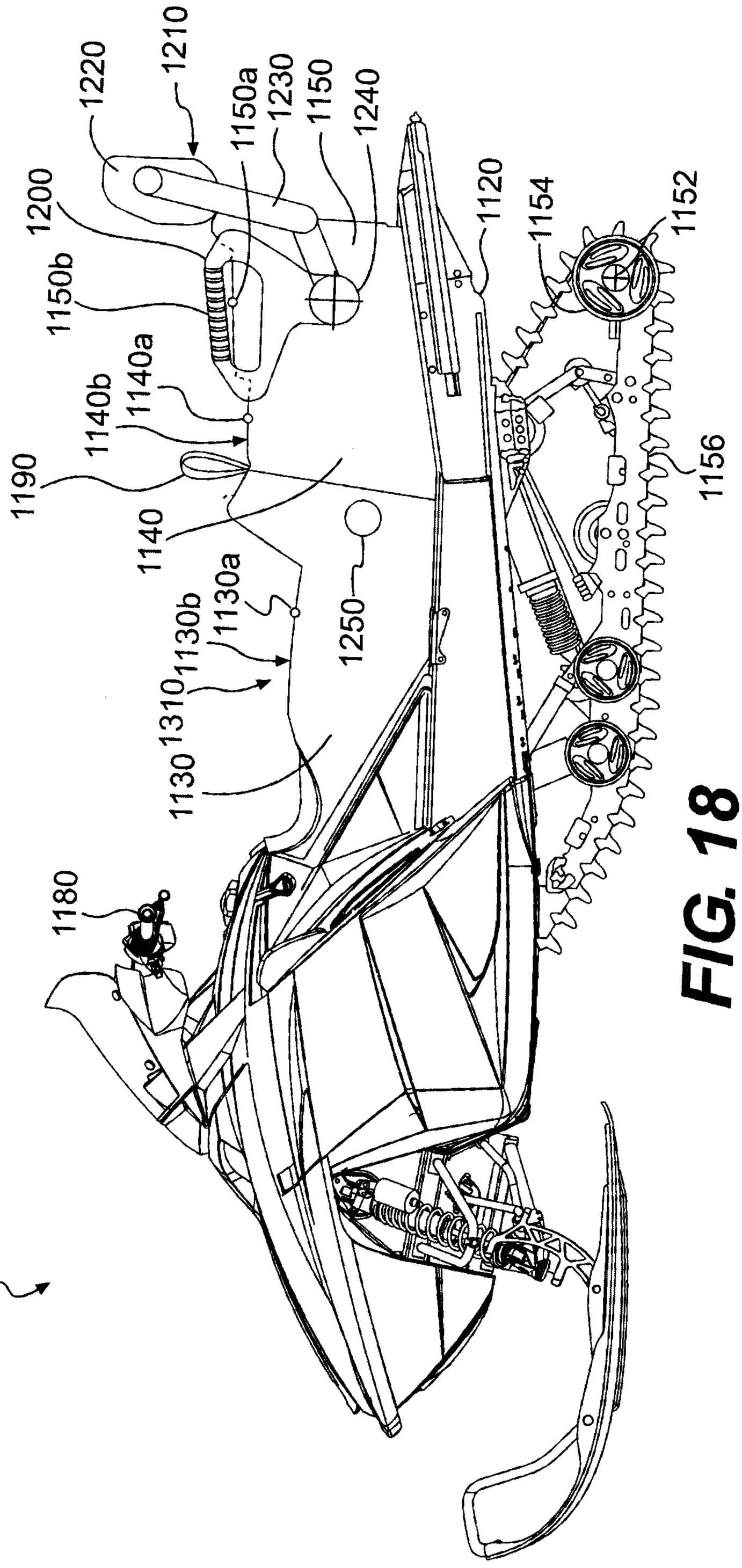
1230
1200
1150
1240
1120
154
1152
1140
1140a
1156
1190
1250
1130a
1130
1180
1100

FIG. 17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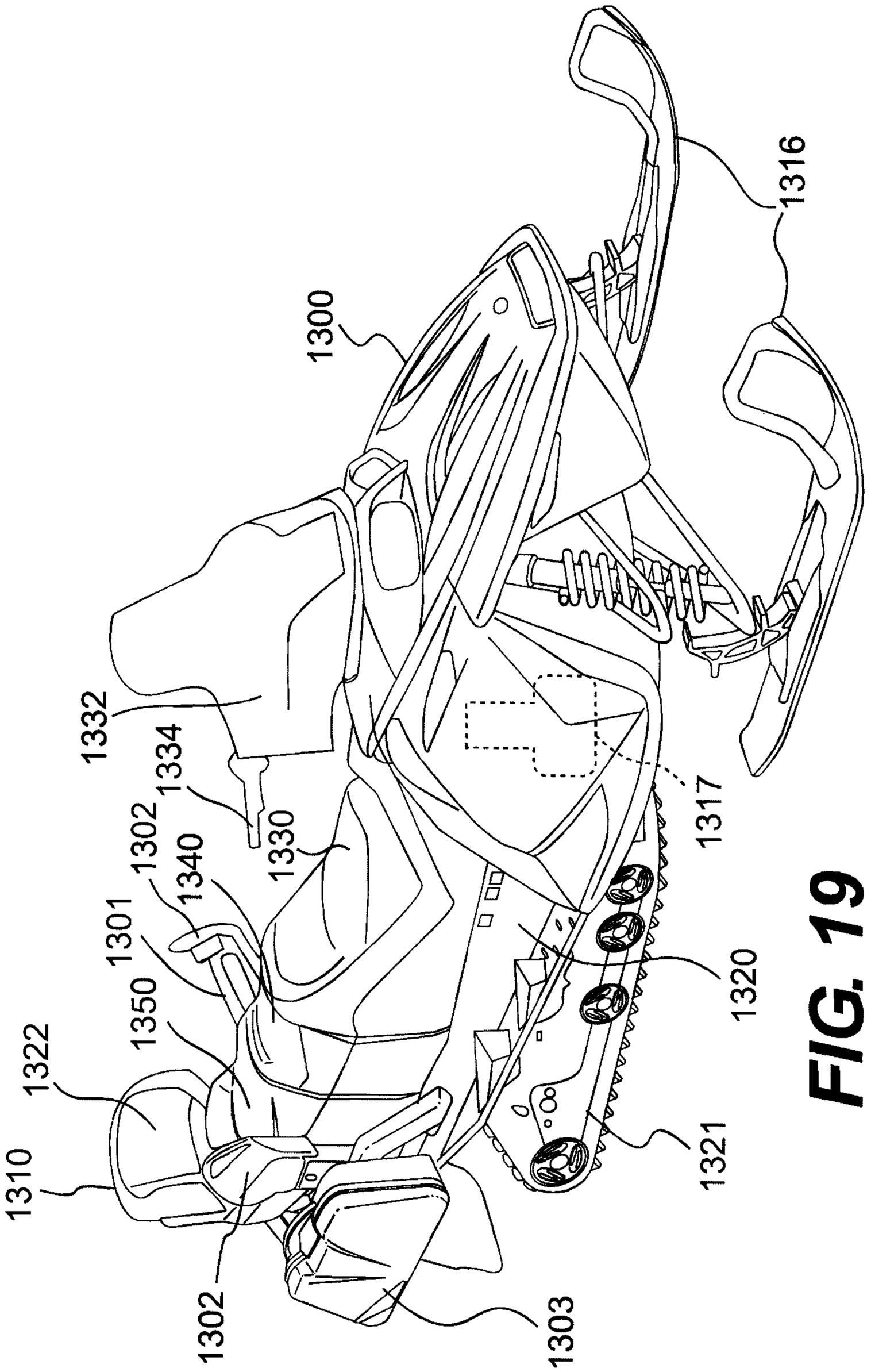
1150a
1230
1150
1240
1120
1154
1152
1150b
1140b
1140a
1190
1140
1130a
1130b
1310
1250
1130
1180
1300
1156

FIG. 18


1316
1300
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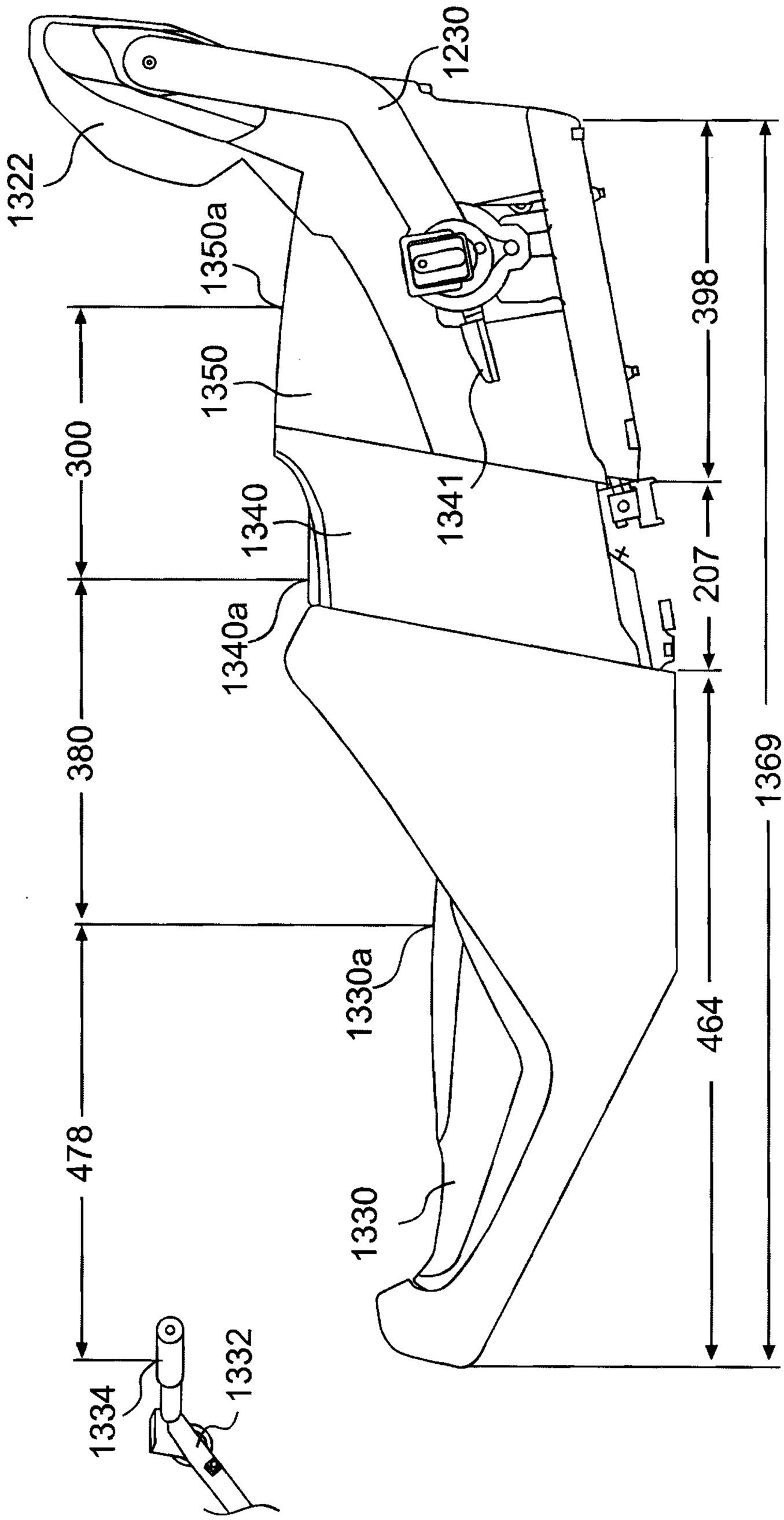
1330
1317
1301
1350
1320
1322
1310
1321
1302
1303

FIG. 19


1230
1322
1350a
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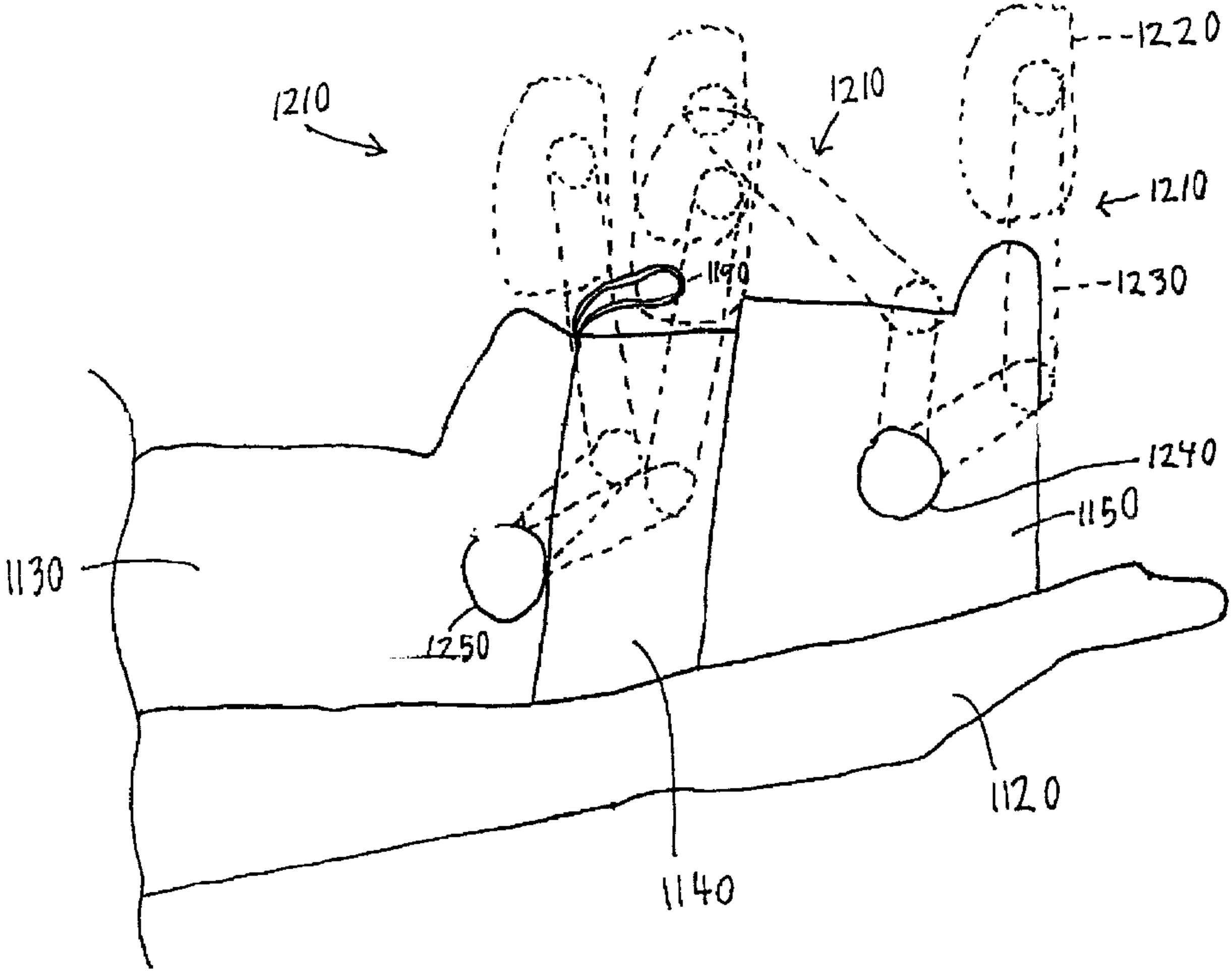
1340
1340a
1341
1330a
1330
1332
1334
300
380
478
398
207
464
1369

FIG. 20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