



(22) Date de dépôt/Filing Date: 2018/03/20

(41) Mise à la disp. pub./Open to Public Insp.: 2018/09/22

(45) Date de délivrance/Issue Date: 2021/06/15

(30) Priorité/Priority: 2017/03/22 (US62/474876)

(51) Cl.Int./Int.Cl. *B62D 55/04* (2006.01),
B62D 55/07 (2006.01), *B62D 55/08* (2006.01)

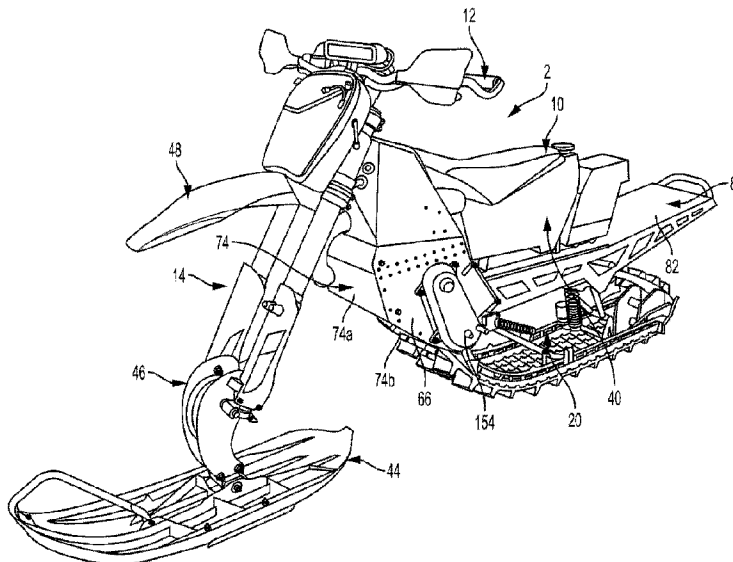
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(54) Titre : VEHICULE DE NEIGE

(54) Title: SNOW VEHICLE



(57) **Abrégé/Abstract:**

Snow vehicles, such as snowmobiles and snow bikes, are generally known. New and useful alternative designs for snow vehicles are generally desired. Accordingly, there is provided a snow vehicle converted from a dirt vehicle. The snow vehicle comprises: a vehicle frame; a powertrain comprising an engine coupled to a transmission, the transmission comprising a driveshaft; a drive coupler attached to the driveshaft; a rear suspension; a drive belt coupled to the rear suspension; a propulsion driven member supported by the vehicle frame and coupled to the drive belt, the propulsion driven member rotating about a belt drive axis; operator foot supports, wherein the belt drive axis is forward of the operator foot supports by a distance X1; and a transmission shifter positioned adjacent to one of the operator foot supports.

ABSTRACT

Snow vehicles, such as snowmobiles and snow bikes, are generally known. New and useful alternative designs for snow vehicles are generally desired. Accordingly, there is provided a snow vehicle converted from a dirt vehicle. The snow vehicle comprises: a vehicle frame; a powertrain comprising an engine coupled to a transmission, the transmission comprising a driveshaft; a drive coupler attached to the driveshaft; a rear suspension; a drive belt coupled to the rear suspension; a propulsion driven member supported by the vehicle frame and coupled to the drive belt, the propulsion driven member rotating about a belt drive axis; operator foot supports, wherein the belt drive axis is forward of the operator foot supports by a distance X_1 ; and a transmission shifter positioned adjacent to one of the operator foot supports.

SNOW VEHICLE

BACKGROUND

[0001] The present disclosure relates to snow vehicles including snowmobiles and or snow bikes.

[0002] Many types of vehicles are configured with tracks to drive in the snow. Regardless of whether the vehicle is a snowmobile or a wheeled vehicle converted to a tracked vehicle, tracked vehicles typically include a drive shaft mounted to a suspension system that supports the endless track. The drive shaft typically includes drive sprockets that engage the endless track. In the case of snow bikes, it is known to convert a motor bike by removing the front tire and replacing it with a ski, and by removing the rear tire and replacing it with a rear suspension having a drive belt.

[0003] One such snow vehicle is shown in our U.S. Patent 8,910,738. This patent discloses a conversion of a motorbike into a snow vehicle where the motorbike powertrain is utilized to power the track of the converted snow vehicle. Other such snow bikes are known from our U.S. patent applications, namely: Publication Numbers 2015/0144412; 2015/0259032; and 2016/0280331 and Application Serial Numbers 14/935,224; 14/935,265; and 15/165,862.

SUMMARY

[0004] In a first embodiment, a snow vehicle comprises a vehicle frame, the frame having an engine compartment having sidewalls; a powertrain comprising an engine coupled to a transmission, the powertrain being housed between the sidewalls; the transmission comprising a driveshaft protruding through one of the sidewalls; a drive coupler attached to the driveshaft and positioned on an opposite side of the one sidewall as said powertrain; a rear suspension; a drive belt coupled to the rear suspension; a propulsion driven member supported by the frame and coupled to the belt, the propulsion driven member rotating about a belt drive axis; a driven coupler positioned adjacent to the drive coupler and coupled to the propulsion driven member; and a linear element coupling the drive coupler and the driven coupler to drive the drive belt.

[0005] In a second embodiment, a snow vehicle comprises a vehicle frame; a powertrain comprising an engine coupled to a transmission, the transmission comprising a driveshaft; a drive coupler attached to the driveshaft; a rear suspension; a drive belt coupled to the rear suspension; a propulsion driven member supported by the frame and coupled to the belt, the propulsion driven member rotating about a belt drive axis; and operator foot supports, wherein the belt drive axis is forward of the foot supports by a distance X_1 . X_1 is approximately 5 inches.

[0005a] In a third embodiment, a snow vehicle comprises a vehicle frame; a steering system supported by the vehicle frame and having a handle bar, where the handle bar has a handle bar grip; a powertrain comprising an engine coupled to a transmission, the transmission comprising a driveshaft; a drive coupler attached to the driveshaft; a rear suspension; a drive belt coupled to the rear suspension; a propulsion driven member supported by the vehicle frame and coupled to the drive belt, the propulsion driven member rotating about a belt drive axis; operator foot supports, wherein the belt drive axis is forward of the operator foot supports by a distance X_1 ; and a transmission shifter positioned adjacent to one of the operator foot supports, wherein a distance X_6 from the handle bar grip to the front edge of the foot pegs is approximately 10 inches or is in the range of 12 to 16 inches.

BRIEF DESCRIPTION OF THE DRAWINGS

[0006] The invention will now be described in relation to the drawing figures where:

[0007] FIG. 1 is a left front perspective view of the snow vehicle as disclosed in the present disclosure;

[0008] FIG. 2 is a right rear perspective view of the snow vehicle as disclosed in the present disclosure;

[0009] FIG. 3 shows a left side view of the snow vehicle as disclosed in the present disclosure;

[0010] FIG. 4 shows a right side view of the snow vehicle as disclosed in the present disclosure;

[0011] FIG. 5 shows a rear view of the snow vehicle as disclosed in the present disclosure;

[0012] FIG. 6 is an enlarged portion of the area denoted in FIG. 5;

[0013] FIG. 7 shows a left side view of the frame;

[0014] FIG. 8 is an enlarged right side view of the front frame portion less the side panels;

- [0015]** FIG. 9 shows an underside perspective view of the frame shown in FIG. 8;
- [0016]** FIG. 10 shows a top left view of the frame with the engine cover removed;
- [0017]** FIG. 11 shows a top right view of the frame with the engine cover removed;
- [0018]** FIG. 12 shows a right perspective view of the powertrain;
- [0019]** FIG. 13 shows a left hand side of the chain casing;
- [0020]** FIG. 14 is similar to FIG. 13 with the chain casing removed;
- [0021]** FIG. 15 shows an underside perspective view of the powertrain and belt;
- [0022]** FIG 16 shows an enlarged perspective view of the powertrain of FIG. 15;
- [0023]** FIG. 17 shows an underside perspective view of the track drive mechanism;
- [0024]** FIG. 18 is a right rear perspective view of the rear suspension;
- [0025]** FIG. 19 is a left side view of the fuel tank;
- [0026]** FIG. 20 is a right rear perspective view of the fuel tank;
- [0027]** FIG. 21 is right rear perspective view showing the muffler;
- [0028]** FIG. 22 is left front perspective view showing the muffler; and
- [0029]** FIG. 23 is a left rear perspective view of the air intake system.

DETAILED DESCRIPTION OF THE EMBODIMENTS

[0030] With reference first to FIGS. 1-6, a snow vehicle is shown generally at 2 having a propulsion unit 6 (see FIG. 10), which is shown as a motorcycle engine, a frame 8, an operators seat 10, and a steering assembly 12 which includes a front fork 14. Steering assembly 12 includes handlebars 16 having handgrips 18 (FIG. 2). A rear suspension assembly 20 is shown having an upper frame portion 22 in the form of a tunnel, slide rails 24, side panels 26, control arms 28, 30, linear force elements 32 and 34 and an endless belt or drive track 36.

[0031] Other aspects of the snow bike include a fuel tank 40 positioned under the seat 10 and a muffler 42 positioned rearwardly of the seat 10. As shown in FIG. 3, a ski 44 is coupled to the front fork 14 by way of a ski bolt 45 to spindle 46 for steering snow bike 2 by way of steering assembly 12. A front fender 48 is positioned over the ski 44. With reference to FIGS. 5 and 6, the snow bike 2 further includes a head light 50, hand controls 52 and 54, and a transmission shift linkage 56. Foot supports in the form of pegs 58 are positioned on either side of snow bike for the rider's feet. Unlike the prior art mentioned above, snow bike 2 is a dedicated snow bike meaning that it has not been converted from a dirt bike or motor bike, but rather was designed solely for the function as a snow bike.

[0032] With reference now to FIGS. 7-10, frame 8 will be described in greater detail. As shown best in FIG. 7, frame 8 includes side panels 26 which couple to a center section 60 (FIG. 8) having apertures 62 which align with apertures 64 in side panels 26 (FIG. 7) to couple the side panels to the center section 60. Side panels 26 are mirror image for the left and right hand side of the tunnel 22 and include forward panel portions 66. As shown best in FIGS. 10 and 11, forward panel portions 66 define sidewalls of an engine compartment for mounting powertrain 6.

[0033] A coupling piece 68 has upper apertures 70a (FIG. 7) and lower apertures 70b (FIG. 9). Side panels 66 couple to a front panel portion 74 (FIG. 1) to form an engine compartment for enclosing the powertrain 6 as described herein. With reference now to FIGS. 9 and 13, an upper cover portion 76 is provided having fasteners 78a coupled to the upper apertures 70a (FIG. 7) and fasteners 78b (FIG. 13) coupled to the lower apertures 70b (FIG. 9). Upper cover portion 76 includes

sidewalls 76a and a front wall 76b having an aperture at 76c as described herein. As shown in FIG. 13, powertrain 6 is substantially closed by the side panels 66, front panel 74 (FIG. 1) and upper cover portion 76.

[0034] As shown best in FIG. 10, center section 60 includes slots 80 profiled for mounting objects on top of the center portion 60 as described herein. Frame 8 further includes a rear panel 82 which extends rearwardly and over track 36, as best shown in FIGS. 1 and 5. As described further herein, center section 60 is adapted for mounting of the fuel tank 40 and muffler 42 thereto.

[0035] As shown best in FIG. 12, powertrain 6 includes an engine portion 90 and an integrated transmission portion 92. In the embodiment shown, powertrain 6 is a Husqvarna 450 FC motorcycle engine. Engine 90 includes an air intake system 94 and an engine exhaust system at 96. Transmission portion 92 includes an output sprocket at 98 and a gear shift input shaft at 100. As shown in FIG. 12, transmission 92 includes a foot shifter, but this foot shifter would be removed for the snow bike as defined herein. Powertrain 6 includes engine mounts at 102, 104 and 106 (FIG. 12) and extension rods 110 can be coupled to mounts 102 (see FIGS. 10 and 11); extension rods 112 can be coupled to mounts 106 (FIG. 9) and mounts 114 (FIG. 9) can be coupled to mounts 104. A fastener 120 (FIG. 9) can be positioned through upper side panel portion 76a (FIG. 9) and into threaded engagement with extension rod 110; and fasteners 122 and 124 can be coupled to extension rods 112 and 114 respectively through panel portion 66, as best shown in FIG. 11.

[0036] With reference now to FIGS. 12-17, the belt drive will be described in greater detail. As shown best in FIGS. 12 and 16, sprocket 98 is mounted to a shaft 130 which rotates about an axis 132. As shown best in FIGS. 13 and 14, snow bike 2 includes a chain case 140 having an upper portion 142 which covers sprocket 98 and a lower portion 144 which covers a sprocket 146, as well as a chain 148 which entrains the two sprockets 98, 146. It should be understood that powertrain 6 is positioned in the engine compartment defined by side panels 66 such that shaft 130 protrudes through panel 66 and that sprockets 98, 146 and chain 148 are on the outside of panel 66. Meanwhile, sprocket 146 is positioned in the chain case cover portion 144 and drives the belt drive 150 (FIG. 17) including sprockets 152. Sprockets 152 rotate about longitudinal axis, or belt drive axis 154 (FIG. 7).

[0037] As shown best in FIG. 13, transmission shift linkage 56 has a foot treadle at 162 which couples to a link arm 164 which then couples to pull rod 166. Pull rod 166 ultimately couples with link arm 168. Link arm 168 is coupled to shaft 100 (FIG. 12). Foot control 162 includes a treadle portion 162a (FIG. 7) positioned forward of belt drive axis 154. As shaft 130 extends through side panel 66 and is coupled directly to sprocket 152, a jack shaft as is commonly used in snowmobiles is not required for the drive. This increases the mechanical efficiency and reduces the cost of the snow bike 2. Due to the elimination of a jack shaft, and as shown best in FIG. 8, a brake system 170 is shown which is coupled directly to the shaft to which sprocket 152 is coupled. Brake system 170 includes a brake disk 172 and a caliper 174.

[0038] With reference now to the powertrain 6 within the frame 8, engine and transmission are forward of a rider's center of gravity (COG) position 188 as shown best in FIG. 3. Three vertical lines are shown in FIG. 3, that is vertical line 190 which extends through transmission drive axis 132 (FIG. 7); vertical line 192 which extends through belt drive axis 154 and vertical line 194 which extends through a front edge of foot pedals 58. As shown, belt drive axis 154 (at line 192) is forward of a front edge of the foot pegs 58 (at line 194) by a distance of X_1 . This means that the front of the track 36 extends forward of the rider's foot. Furthermore, the transmission drive axis 132 (FIG. 12) at line 190 is forward of line 192 by a distance X_2 . As shown, X_1 is approximately 5 inches, but could be in a range of 2 to 6 inches. As also shown, X_2 is approximately 5.5 inches, but could be in a range of 2 to 6 inches.

[0039] As shown, due to the forward position of the drive belt axis 154 as disclosed, drive belt 36 has a track length of 146 inches which is substantially longer than those normally available for snow bikes that are converted from dirt bikes. The track could be within a range from 120 to 156 inches. Also the width of track 36 is 11.5 inches and the frame 8 is between .5 and 1.5 inches wider than the track.

[0040] With reference now to FIG. 18, front control arm 28 is shown having an upper crossbar at 200 which couples to the side panels 26 by way of a fastener 202. Upper rod 200 rotates about a control arm rotational axis 204. As best shown in FIG. 4, a vertical line 212 extends through control arm rotational axis 204. Thus, control arm rotational axis 204 is within a distance X_3 of belt drive axis 154 (line 192).

In the embodiment shown, X_3 is equal to or less than 4 inches, but X_3 could be in a range of 2 inches to 10 inches. This means that the distance between the drive axis 154 and the control arm rotational axis 204 is within 4", which allows more vertical travel for the rear suspension 20.

[0041] With reference now to FIGS. 19 and 20, fuel tank 40 will be described in greater detail. As shown best in FIG. 19, fuel tank 40 includes a side wall 220, a front wall 222, a lower wall 224 which slants rearwardly, a low section 226 which could accommodate a fuel pump for powertrain 6, and a rear wall at 228. Rear wall 228 extends upwardly and rearwardly to a rear wall portion 230 which transitions into an upper wall 232 having a fuel filler cap 234. An upper wall 240 includes a generally flat portion 242, a rearwardly sloped section 244 and an upwardly sloped portion at 246. Brackets 250 and 252 are positioned on top wall 240 for mounting of seat 10 as described herein. Fuel tank 40 further comprises lower brackets 254 and 256 for mounting of the fuel tank to center section 60. As best shown in FIG. 20, brackets 254 and 256 are notched at 260 and 262 to provide access for an exhaust system as further described herein. As shown best in FIG. 19, fuel tank 40 can be coupled to center section 60 by way of fasteners 270 and 272 which are received in slots 80. The detail of slots 80 could be as disclosed in U.S. Patent 7,533,749.

[0042] As shown best in FIG. 3, a forwardmost position of the fuel tank 40 is rearward of the belt drive axis 154 (line 192). Furthermore, the rotational axis 132 of the driveshaft 130 is vertically higher than at least a portion of the fuel tank 40, namely at least portion 226. That is, as shown in FIG. 3, line 274 running through the transmission drive axis 132 (see FIG. 12) extends through the fuel tank portion 126. Also, the fuel tank is supported by the tunnel 22, and the rotational axis 132 of the driveshaft 130 is vertically higher than at least a portion of the tunnel.

[0043] With reference now to FIGS. 21 and 22, exhaust system will be described in greater detail. As shown best in FIG. 21, the exhaust system includes muffler 42 which is mounted to center portion 60 of the frame. Muffler 42 includes a lower wall 280 having brackets 282, side walls 284, front wall 286, top wall 288, rear wall 290, rearwardly extending projection 292 having exhaust tubes at 294. An inlet tube is provided at 296 for receiving the exhaust through exhaust hose 300 which is coupled to an exhaust manifold at 302 (FIG. 22). Exhaust manifold 302 includes an

inlet portion at 304 which couples to exhaust port 96 (FIG. 12) and an outlet portion 306 which couples to an inlet portion 308 of hose 300. An outlet portion 310 of hose 300 couples to the inlet portion 296 of muffler 42. As best shown in FIG. 21, hose 300 tucks into the notched portions 260 and 262 (FIG. 20) of brackets 254 and 256. Muffler 42 is coupled to the center section 60 by way of brackets 282 much the same way as the fuel tank 40 as described above.

[0044] With reference again to FIG. 19, seat 10 couples to the top of the fuel tank 40 and particularly to brackets 250 and 252. As shown, seat 10 conforms to the tank surfaces 244 and 246 such that the seat is nested against the tank 10.

[0045] As shown in FIG. 23, an air intake system 320 is provided including a filter 322 positioned under the seat 10 and rearward of the cover portion 76a. Air intake system would be connected to the air intake port 94 (FIG. 12). Alternatively, an airbox can be provided in the cover 76 through an opening 340, as shown in FIG. 6.

[0046] With reference again to FIG. 1, ski 44 is comprised of a single ski and could be as wide, or wider than the belt 36, as more fully disclosed in our U.S. patent application serial number 15/449,467, filed March 3, 2017. Alternatively, ski could include multiple skis as more fully disclosed in our U.S. patent application serial number 15/165,862, filed May 26, 2016.

[0047] With reference to FIG. 1, the design of the snow bike also prevents deep snow from contacting the belt paddles. As shown, the front panel portion includes an upper panel portion 74a and a lower portion 74b. The belt drive axis 154 is above the lower edge of panel portion 74b, thus the snow does not contact the upper paddles of belt 36 adding a reverse torque to the belt drive.

[0048] With reference now to FIG. 11, a cooling system 330 includes first and second hoses 332 and 334 (FIG. 10) which circulate cooling water through internal channels 336, 338 (FIG. 11), to make a U-shaped flow pattern in and out of the center section 60 to cool engine 90. This cooling function is more thoroughly described in our U.S. Patent 7,353,898.

[0049] Thus the snow bike 2 of the present disclosure has numerous advantages over prior snow bikes. First, and as best shown in FIG. 3, the rider position at 188 is over the track 36, not over the ski 44. This provides better weight distribution for the ski bike 2. Furthermore, due to the dedicated design of the snow bike, the overall weight is significantly lower than a snow bike that has been converted from a dirt bike. Weight reduction is also achieved through the elimination of the jackshaft of prior designs which eliminates that weight of the jackshaft, another chain and the bearings associated with the jackshaft.

[0050] Also as mentioned above, due to the fact that the belt drive axis 154 is forward of the foot pegs 58, the track 36 can be lengthened to a 146" track. This provides significantly improved traction to the snow bike 2. Also as mentioned above, the suspension has improved the travel from 9 inches on a typical snow bike to 12 inches on the present design. This has been accomplished by the lengthened front control arm 28 as described herein and the location of the axis of rotation 204 of the front control arm (FIG. 4) relative to the belt drive axis 154. Normally, a snow vehicle with 12" of suspension travel will not climb mountains, but with the present design and the length of the track, this vehicle is able to climb mountains.

[0051] Also to have proper weight distribution between the ski 44 and the belt 36, a distance is provided between the ski bolt 45 and the belt drive axis 154, and is shown in FIG. 3 as X_4 . As shown, X_4 is approximately 34 inches, but could be in a range of 32 to 38 inches. Also, a distance X_5 (FIG. 3) from the handle bar grip 18 to the belt drive axis is 10 inches but could be in the range of 8 to 14 inches. Furthermore a distance X_6 from the handle bar grip 18 to the front edge of the foot pegs 58 is 10 inches but could be in the range of 12 to 16 inches.

[0052] Furthermore, as mentioned above, the engine has been moved forward and up from prior snow bikes. As shown in FIG. 3, a vertical distance Y as measured from the ground to the transmission drive axis 132 is shown to be 28 inches, but could be in a range of 24 to 30 inches, and as mentioned before is in front of the foot pegs by a distance X_1 .

[0053] As shown herein, the substantial majority of the components are shown as aluminum fabrications, but it should be understood that the components such as

the fuel tank 44, cover 76, and others could be formed from a plastic material. Furthermore, the foot supports are shown herein as foot pegs 58, but a running board could be provided, similar to a snowmobile running board, such as that shown in U.S. Patents 9,446,810 or 8,919,477.

[0054] While this invention has been described as having an exemplary design, the present invention may be further modified within the spirit and scope of this disclosure. This application is therefore intended to cover any variations, uses, or adaptations of the invention using its general principles. Further, this application is intended to cover such departures from the present disclosure as come within known or customary practice in the art to which this invention pertains.

What is claimed is:

1. A snow vehicle comprising:
 - a vehicle frame;
 - a steering system supported by the vehicle frame and having a handle bar, where the handle bar has a handle bar grip;
 - a powertrain comprising an engine coupled to a transmission, the transmission comprising a driveshaft;
 - a drive coupler attached to the driveshaft;
 - a rear suspension;
 - a drive belt coupled to the rear suspension;
 - a propulsion driven member supported by the vehicle frame and coupled to the drive belt, the propulsion driven member rotating about a belt drive axis;
 - operator foot supports, wherein the belt drive axis is forward of the operator foot supports by a distance X_1 ; and
 - a transmission shifter positioned adjacent to one of the operator foot supports, wherein a distance X_6 from the handle bar grip to the front edge of the foot pegs is approximately 10 inches or is in the range of 12 to 16 inches.
2. The snow vehicle of claim 1, wherein X_1 is in a range between 2 and 6 inches.
3. The snow vehicle of claim 2, wherein X_1 is approximately 5 inches.
4. The snow vehicle of claim 1, wherein a rotational axis of the driveshaft is forward of the belt drive axis by a distance X_2 .
5. The snow vehicle of claim 4, wherein X_2 is in a range between 2 and 6 inches.
6. The snow vehicle of claim 5, wherein X_2 is approximately 5.5 inches.

7. The snow vehicle of any one of claims 1 to 3, further comprising:
a driven coupler positioned adjacent to the drive coupler and coupled to the propulsion driven member; and
a linear element coupling the drive coupler and the driven coupler to drive the drive belt.
8. The snow vehicle of claim 7, wherein the vehicle frame has an engine compartment having sidewalls, the powertrain being housed between the sidewalls.
9. The snow vehicle of claim 8, wherein the driveshaft protrudes through one of the sidewalls and is positioned on an opposite side of the one sidewall as said powertrain.
10. The snow vehicle of claim 8 or 9, wherein the vehicle frame includes side panels coupled to a center section.
11. The snow vehicle of claim 10, wherein the sidewalls are formed on front panel portions of the side panels and define the engine compartment.
12. The snow vehicle of any one of claims 7 to 11, wherein the drive coupler and the driven couplers are sprockets, and the linear element is a chain.
13. The snow vehicle of claim 12, further comprising a chain case cover positioned over the chain.
14. The snow vehicle of claim 11, wherein the frame includes a cover portion coupled to the front panel portions.
15. The snow vehicle of claim 14, wherein the cover portion and the side panels substantially enclose the powertrain.

16. The snow vehicle of claim 10 or 11, further comprising a fuel tank supported by the center section.
17. The snow vehicle of claim 16, wherein a forwardmost position of the fuel tank is rearward of the belt drive axis.
18. The snow vehicle of claim 16 or 17, wherein the center section and the side panels define a tunnel and a rotational axis of the driveshaft is above at least a portion of the tunnel.
19. The snow vehicle of claim 10 or 11, wherein the operator foot supports comprise foot pegs coupled to the side panels.
20. The snow vehicle of any one of claims 1 to 19, wherein the transmission shifter includes a foot treadle portion, positioned forward of the belt drive axis.
21. The snow vehicle of any one of claims 1 to 20, wherein the drive belt has a belt length of over 140 inches.
22. The snow vehicle of claim 21, wherein the belt length is 146 inches.

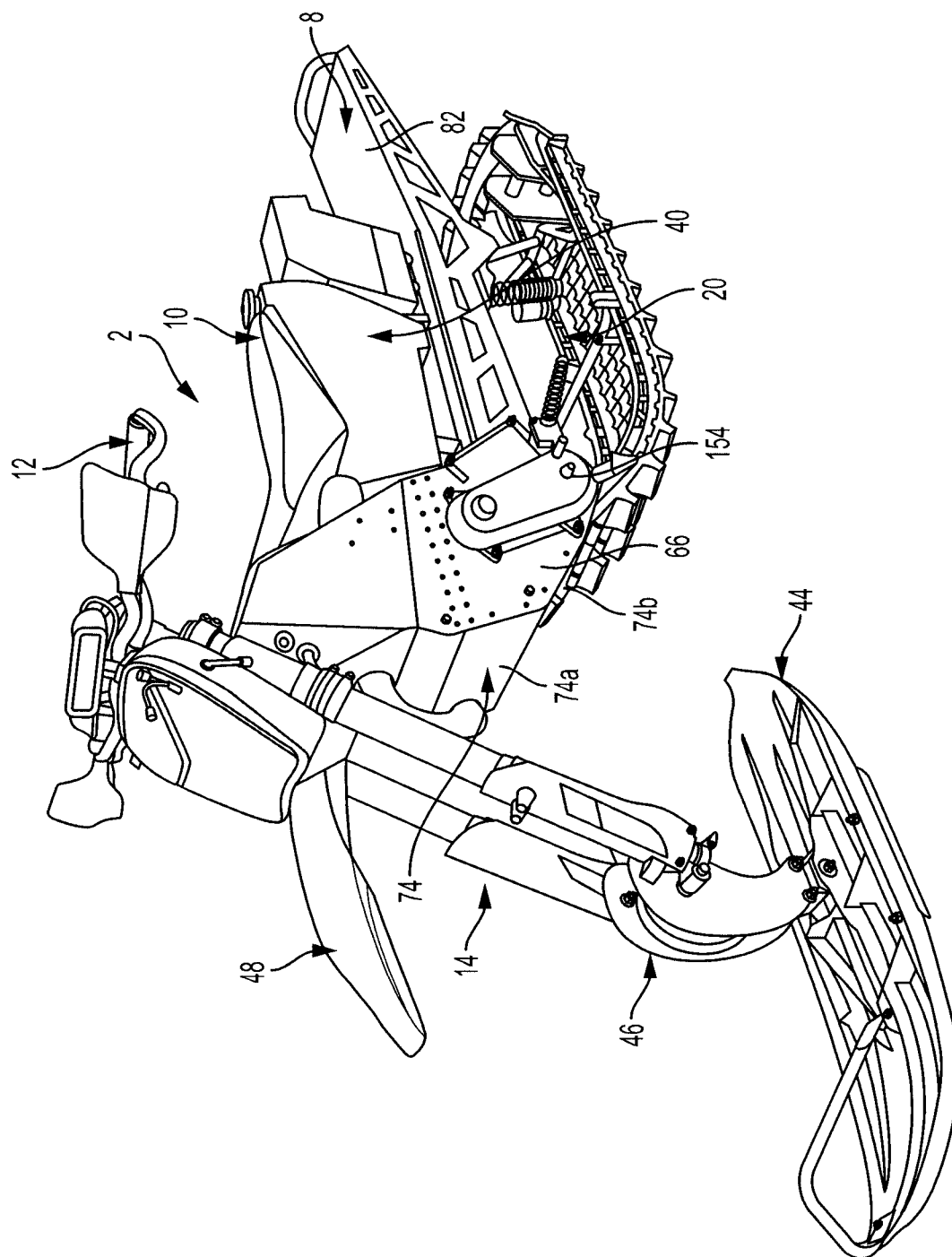


FIG. 1

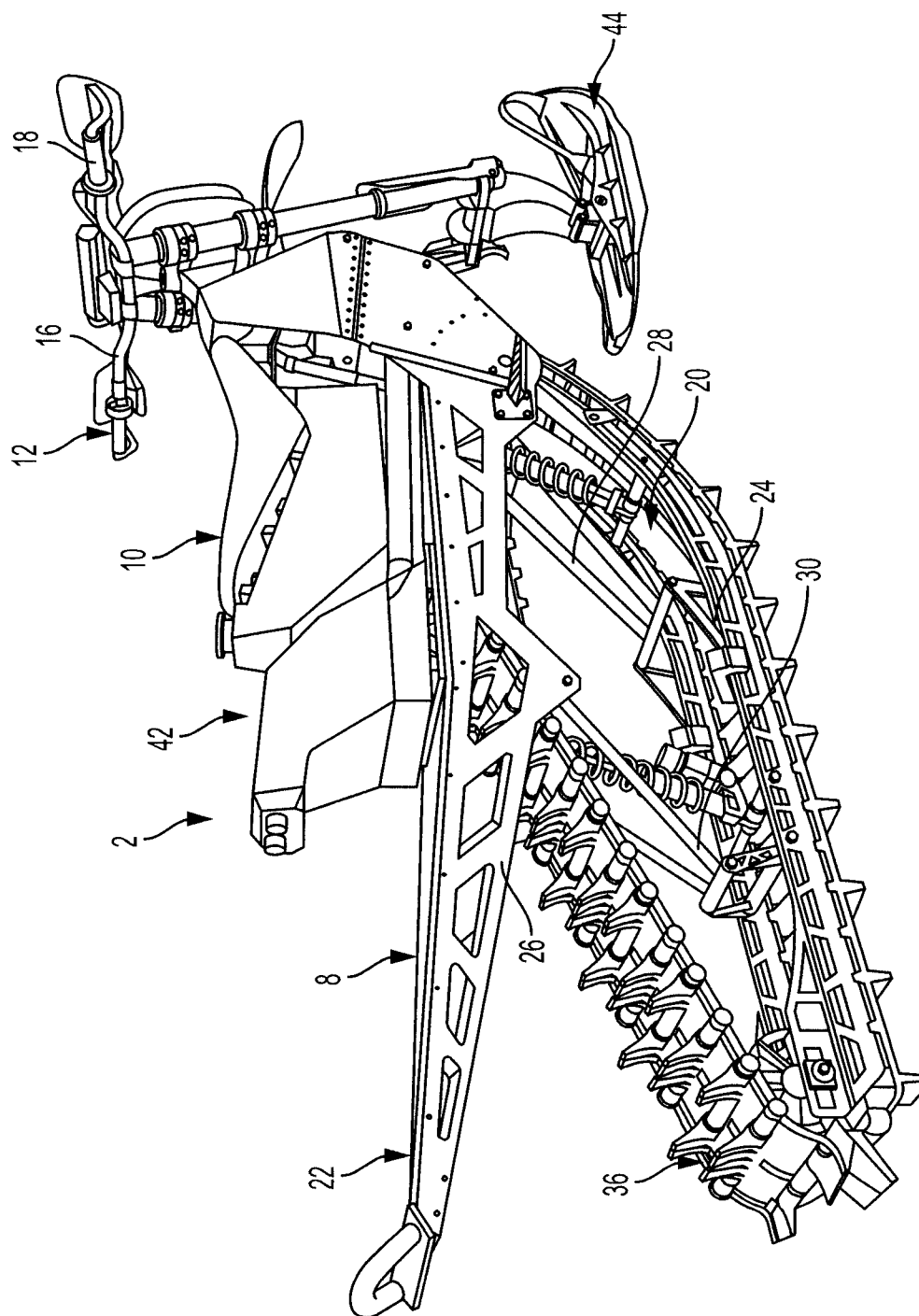
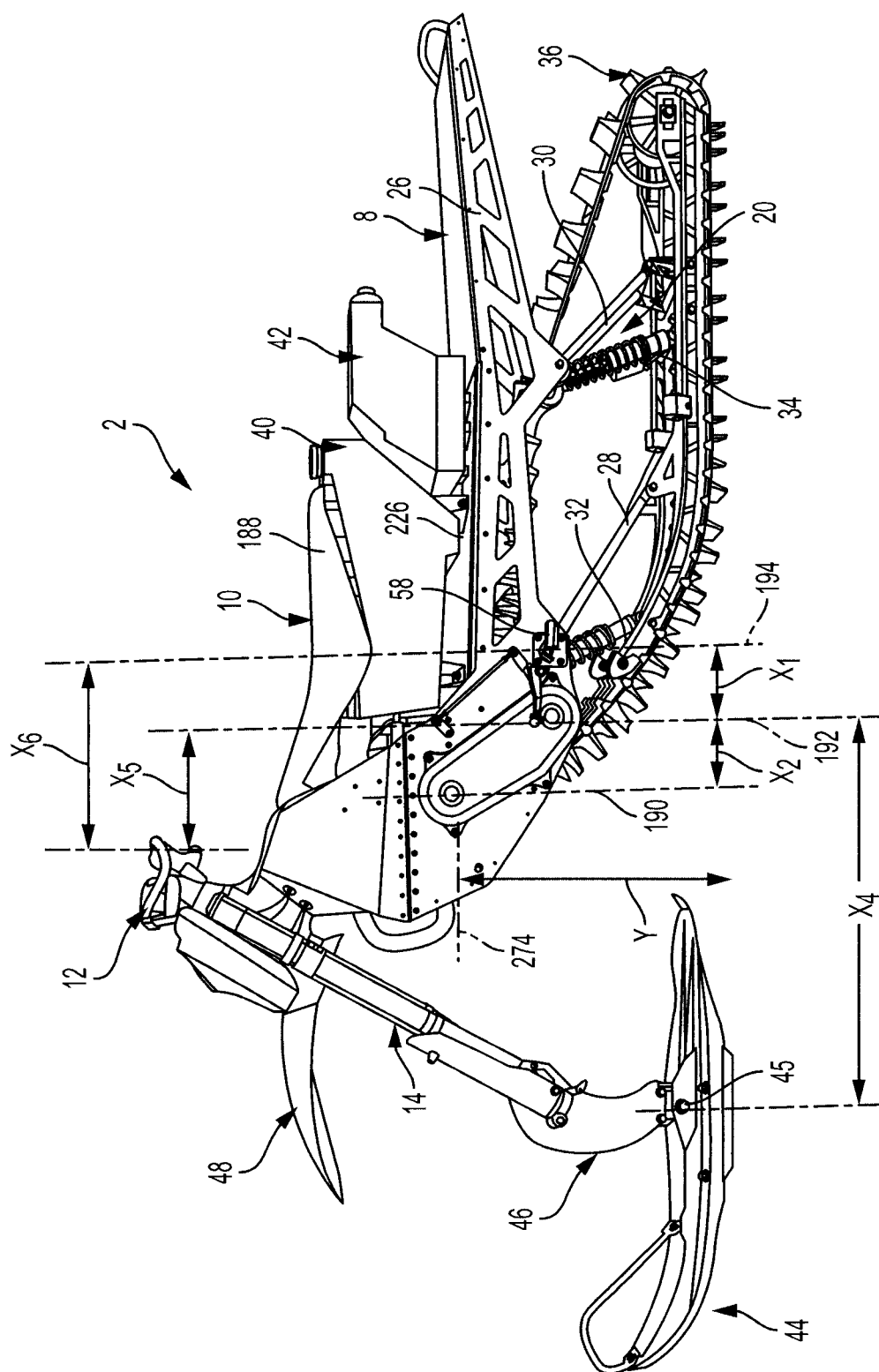


FIG. 2



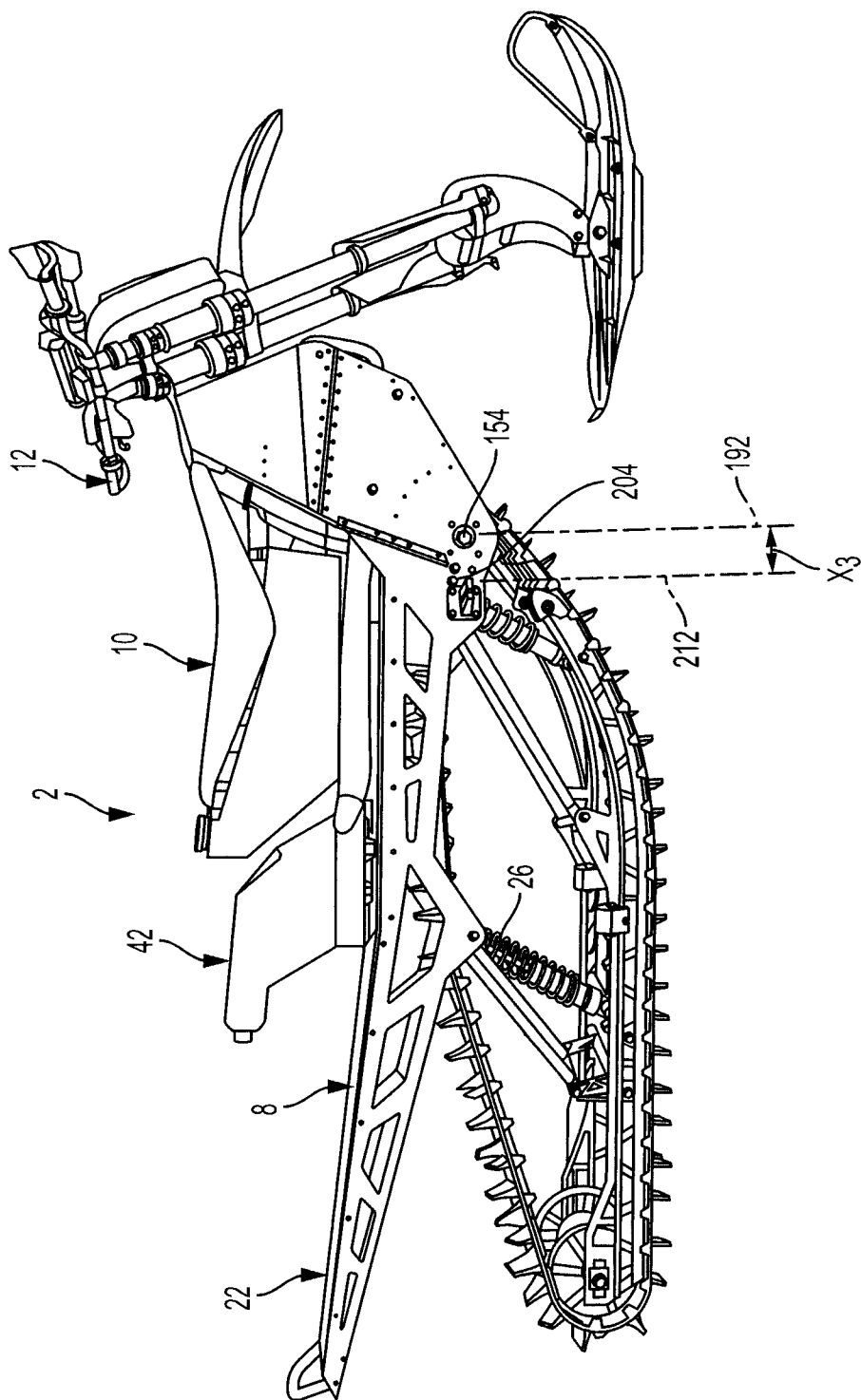


FIG. 4

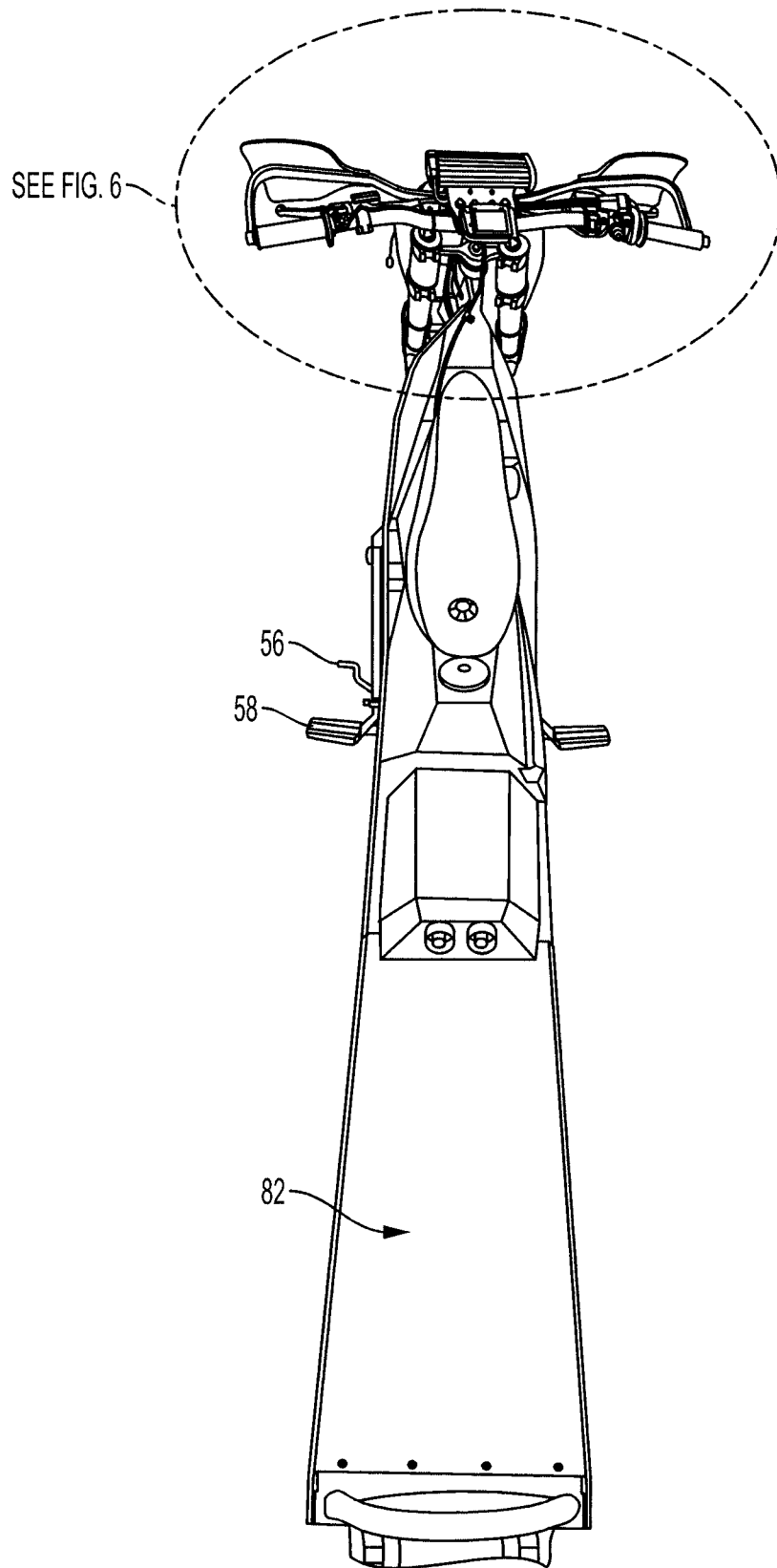


FIG. 5

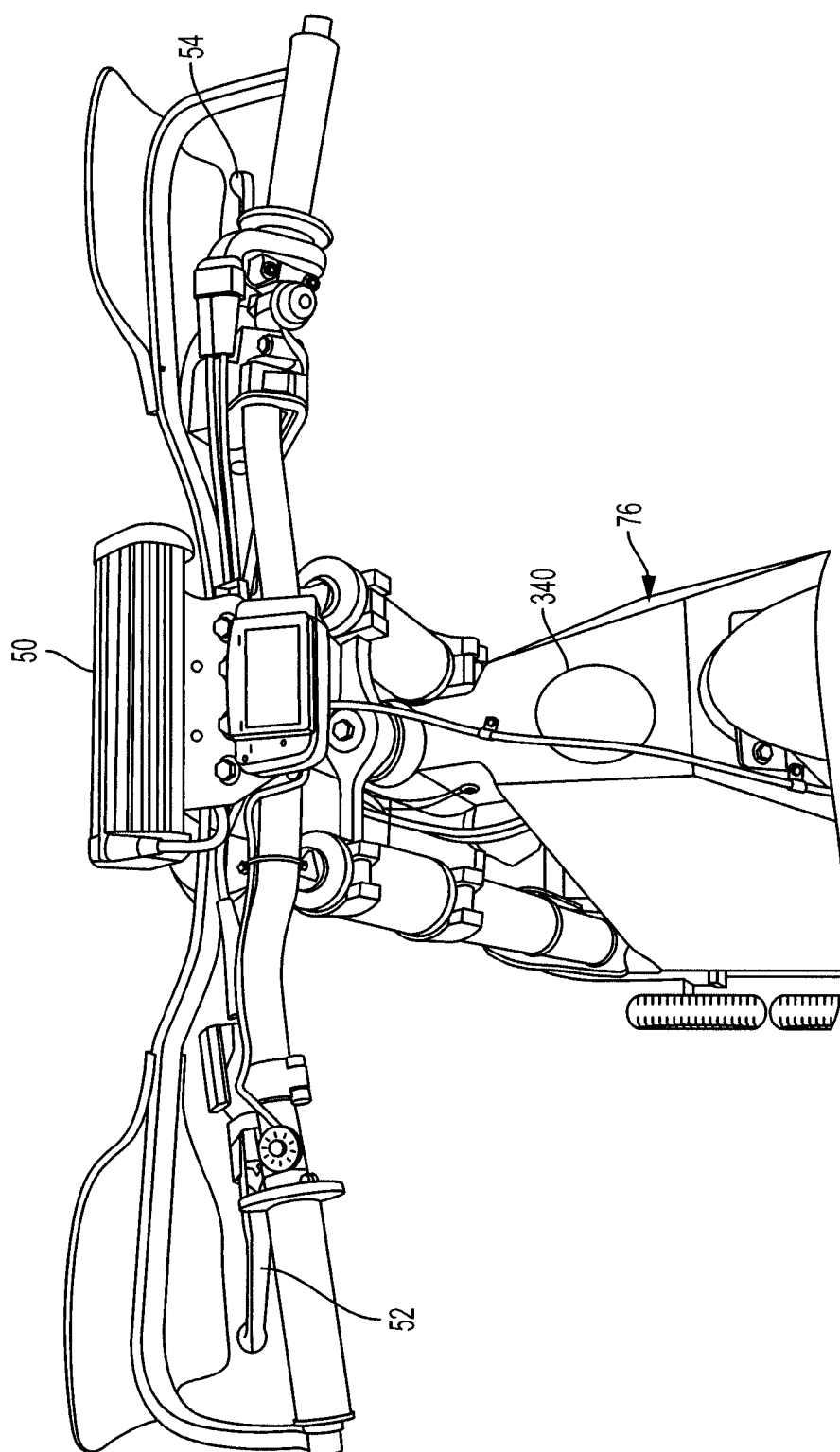
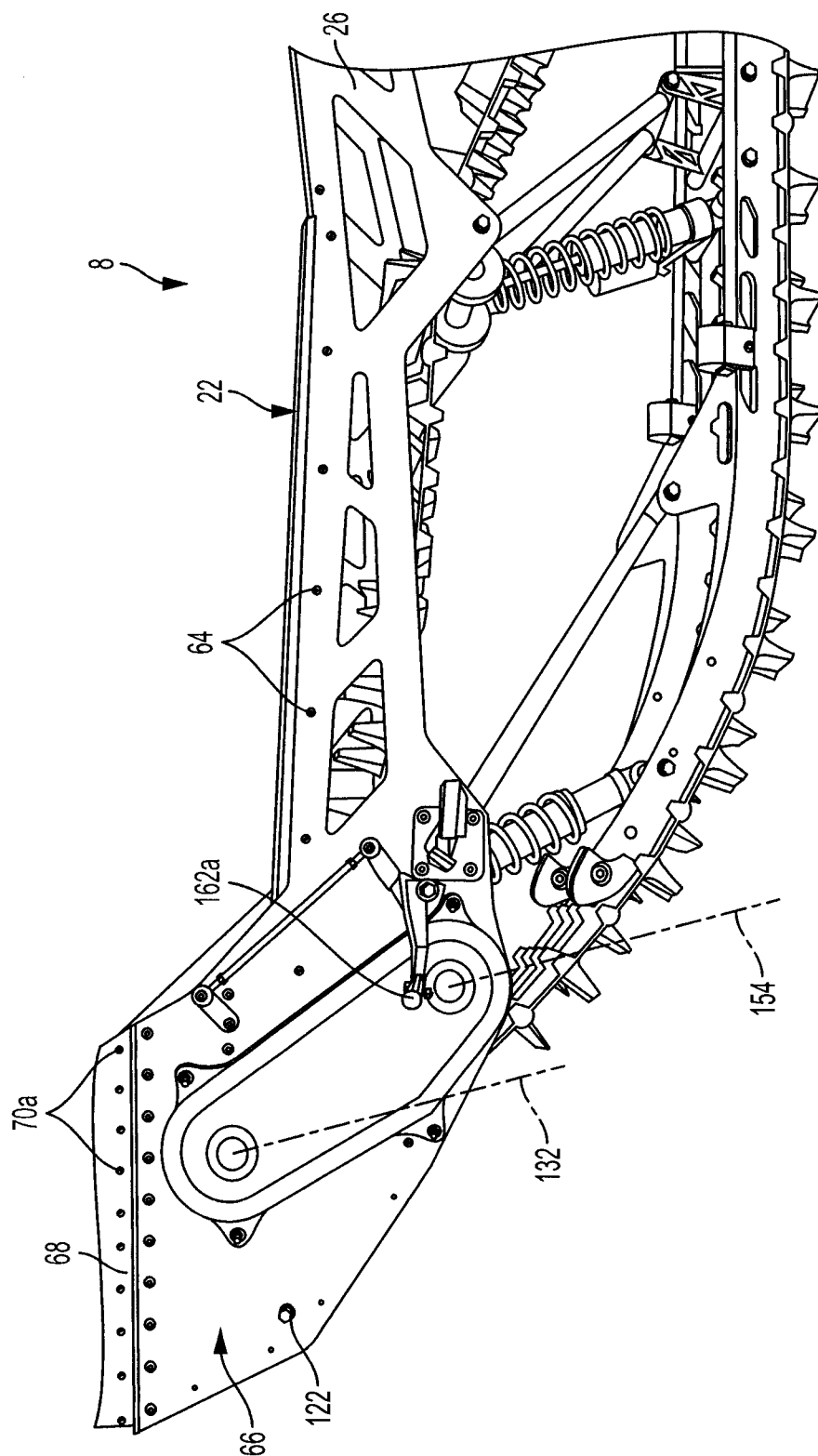


FIG. 6



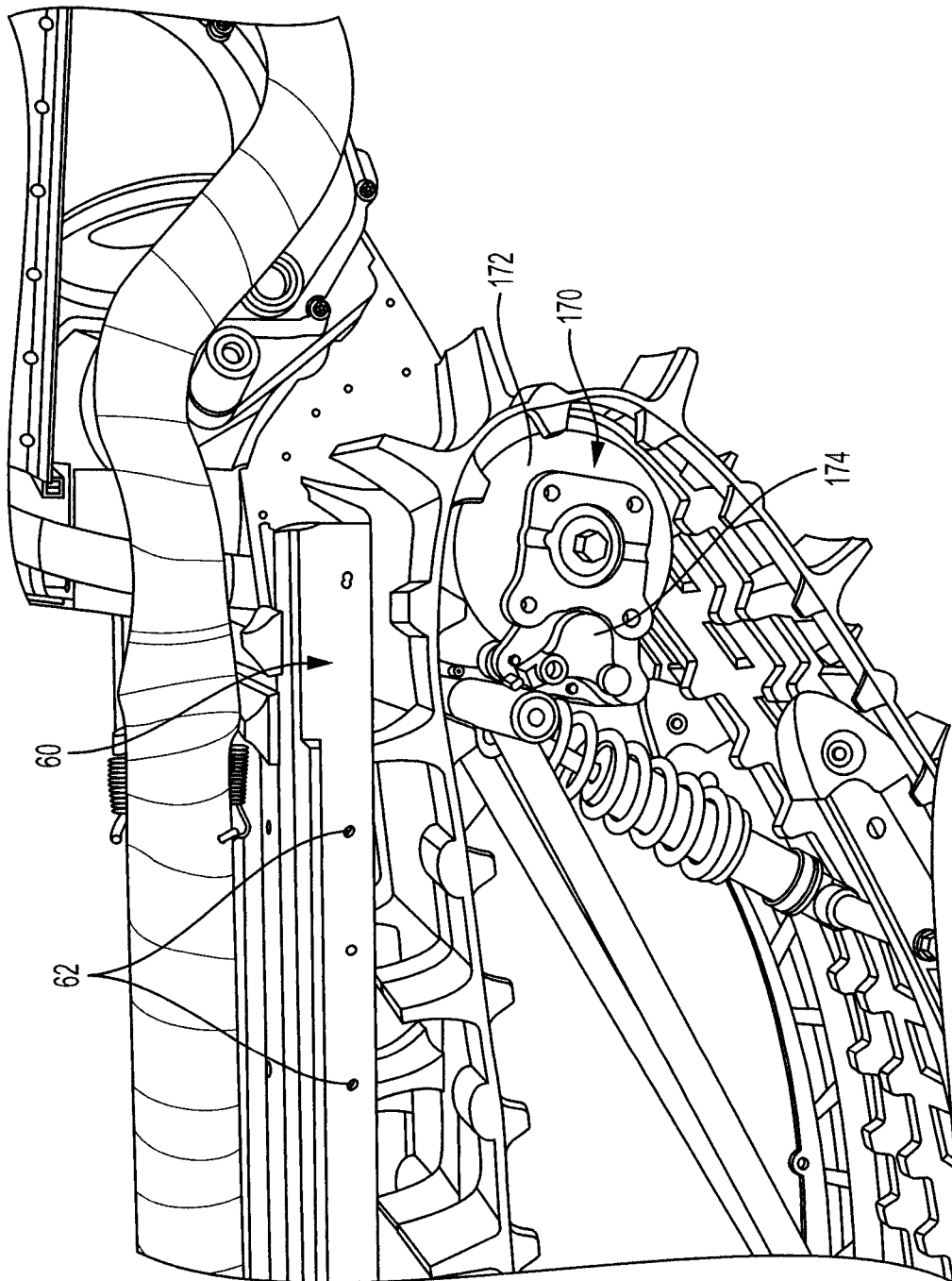


FIG. 8

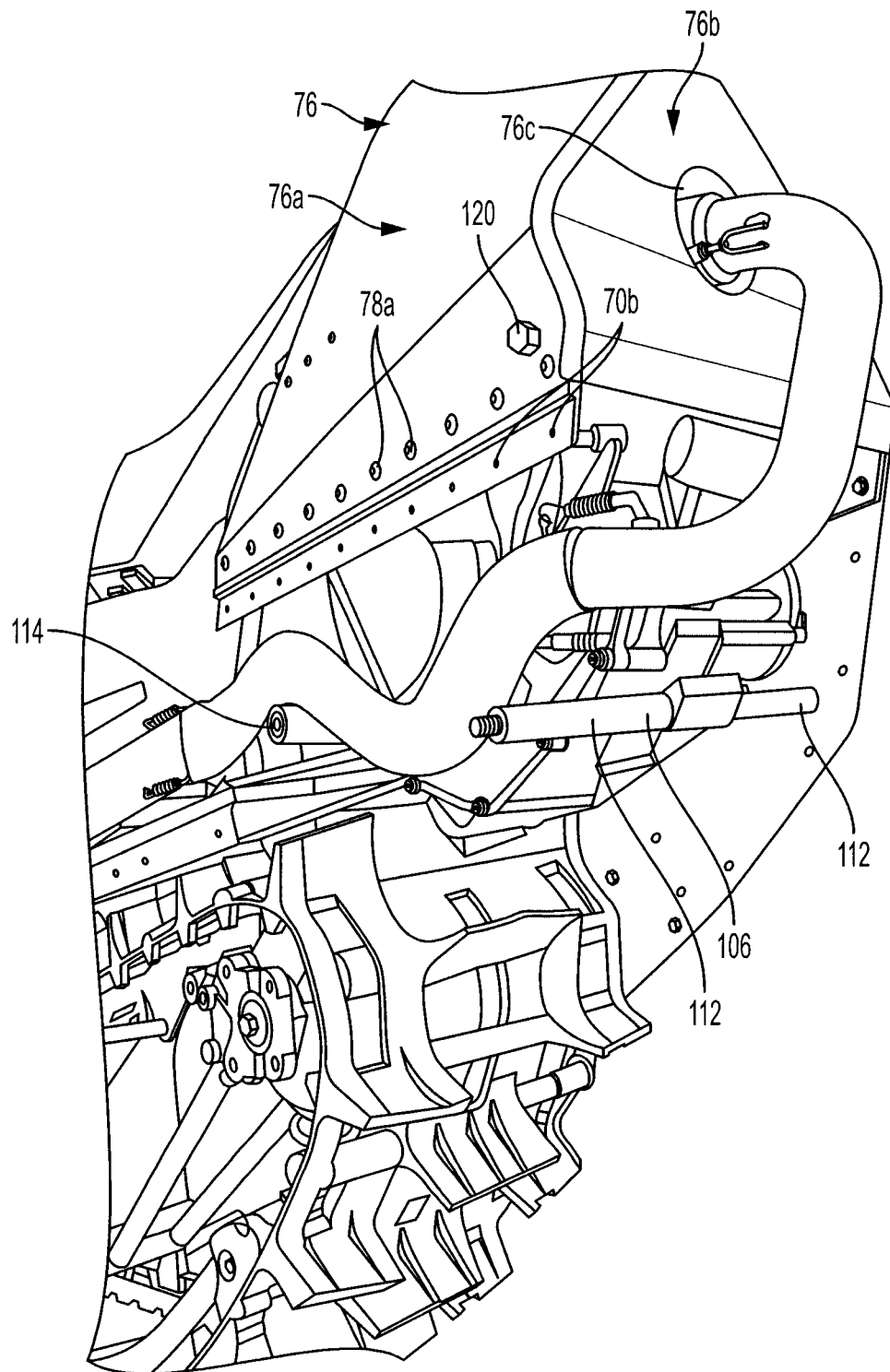


FIG. 9

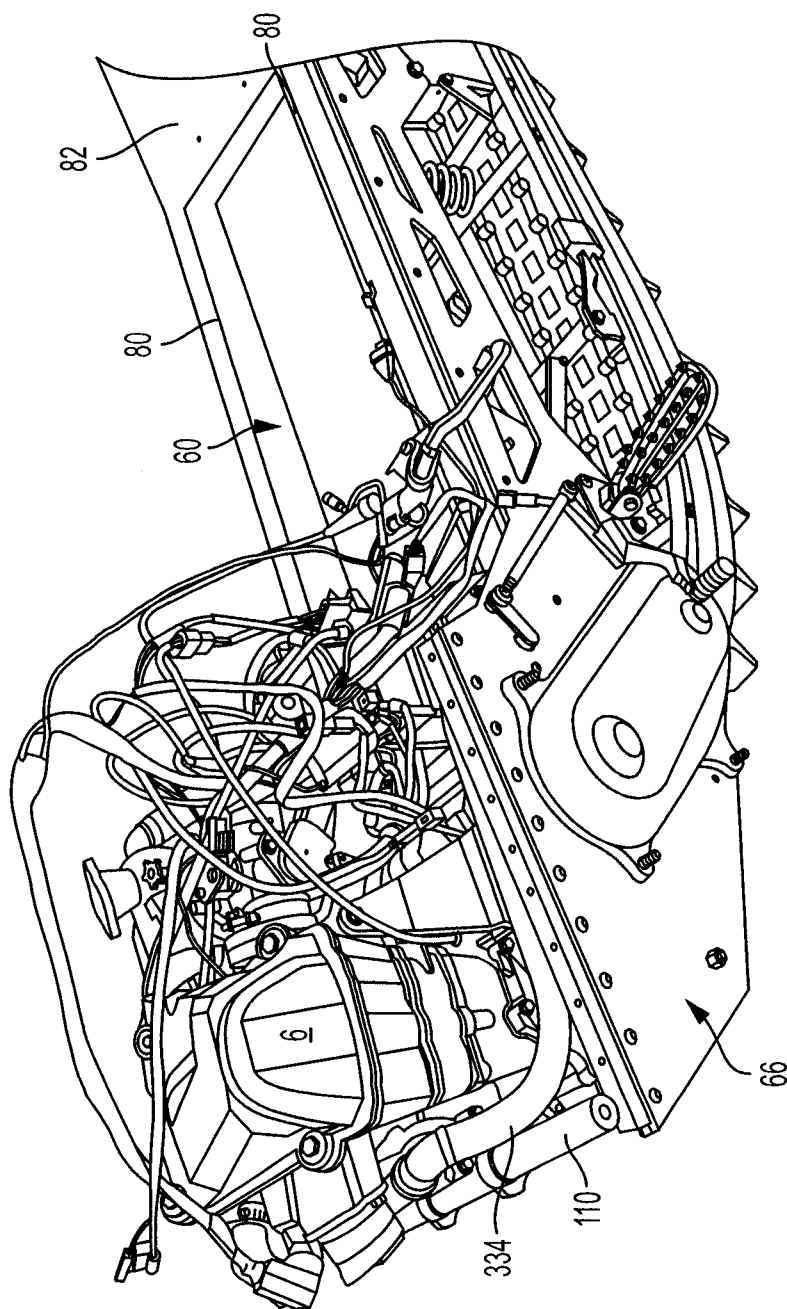


FIG. 10

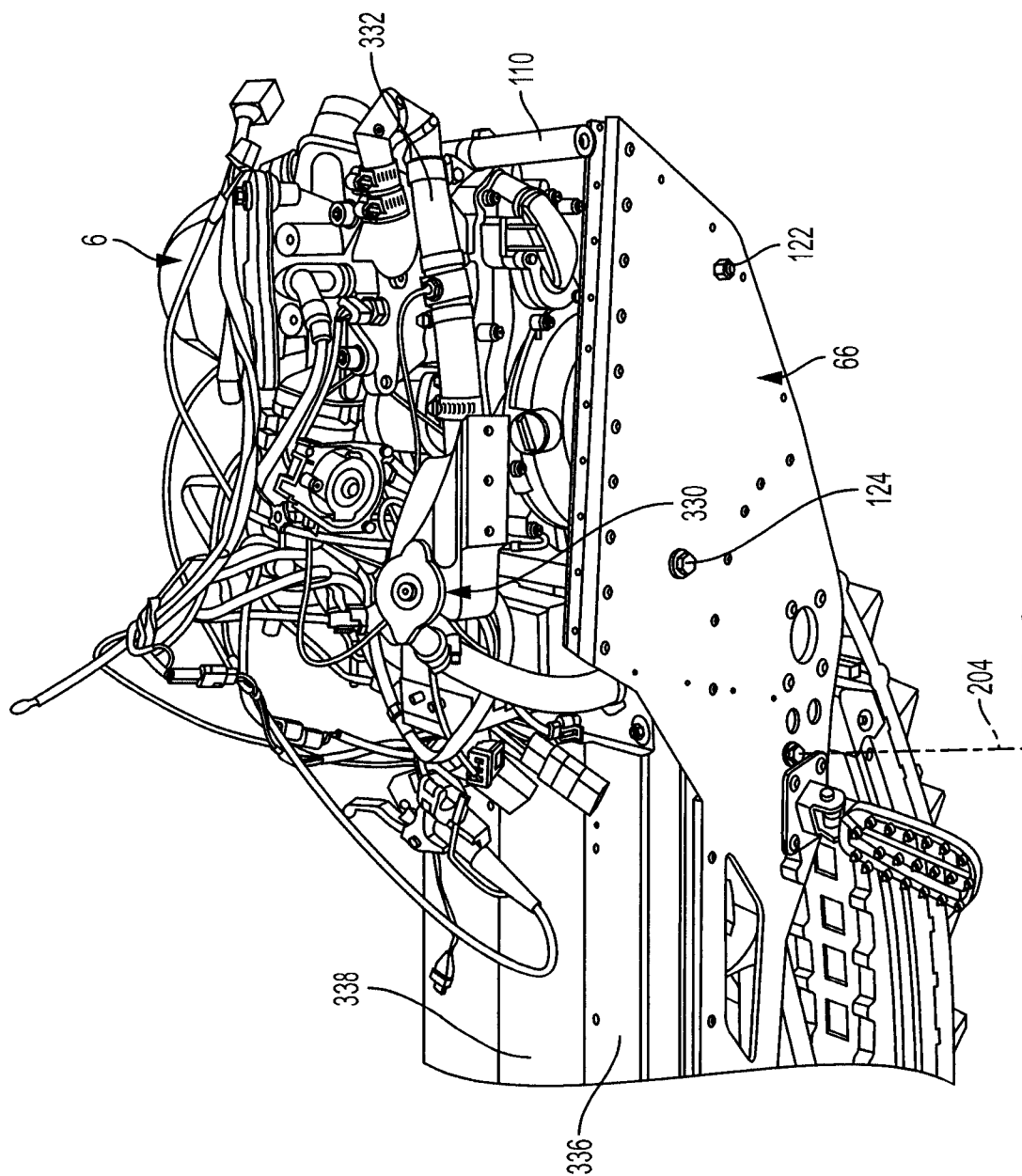


FIG. 11

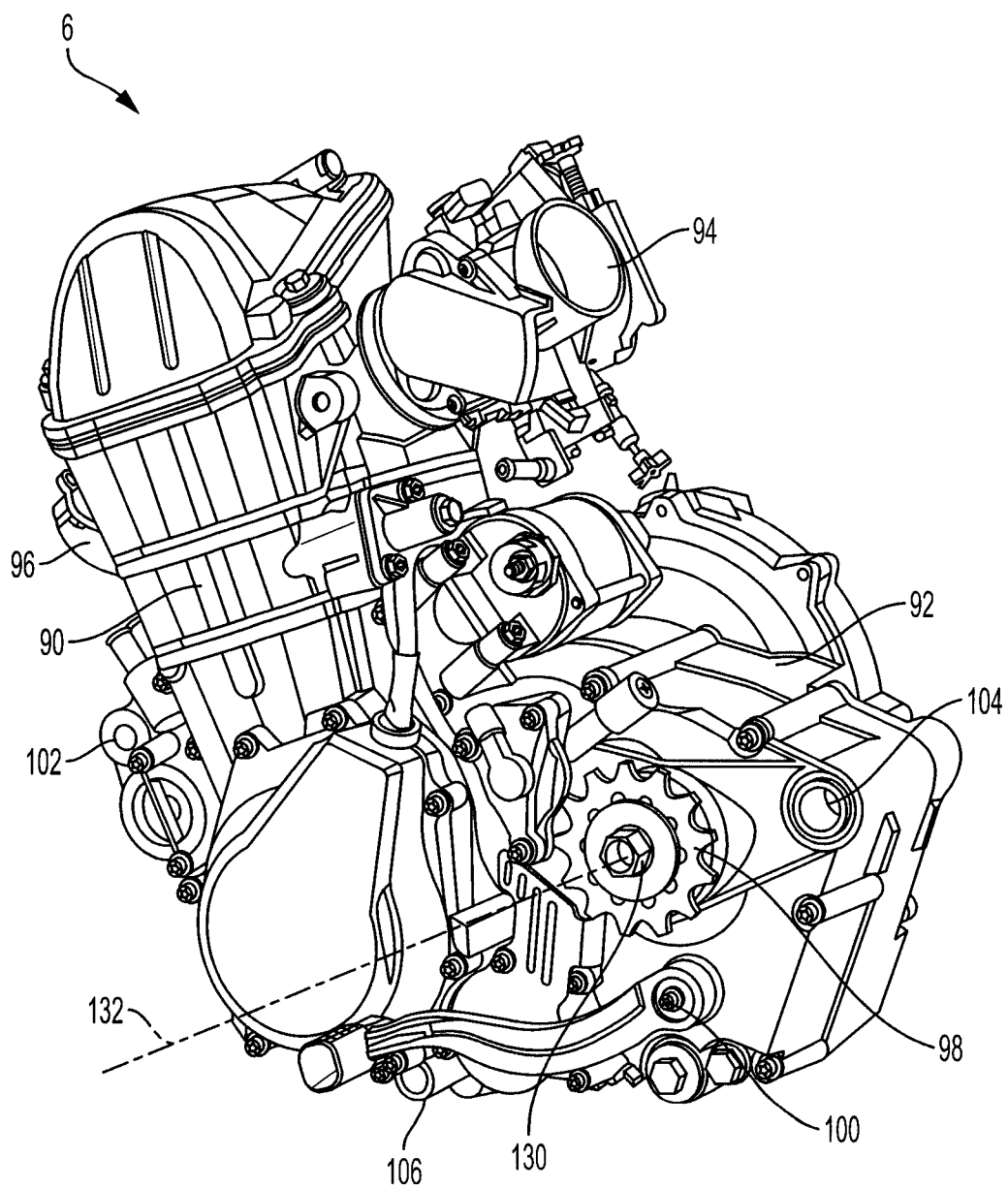


FIG. 12

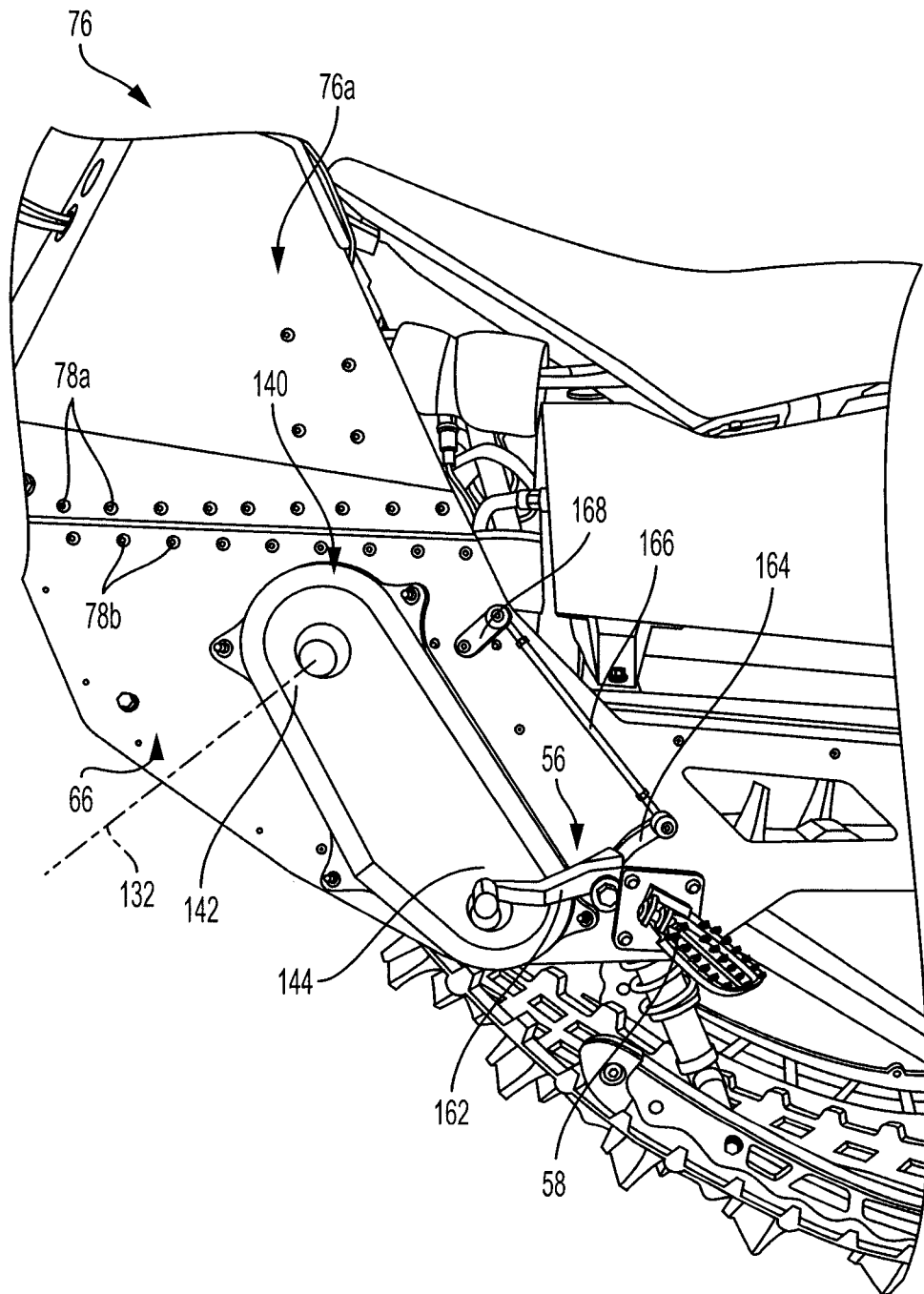


FIG. 13

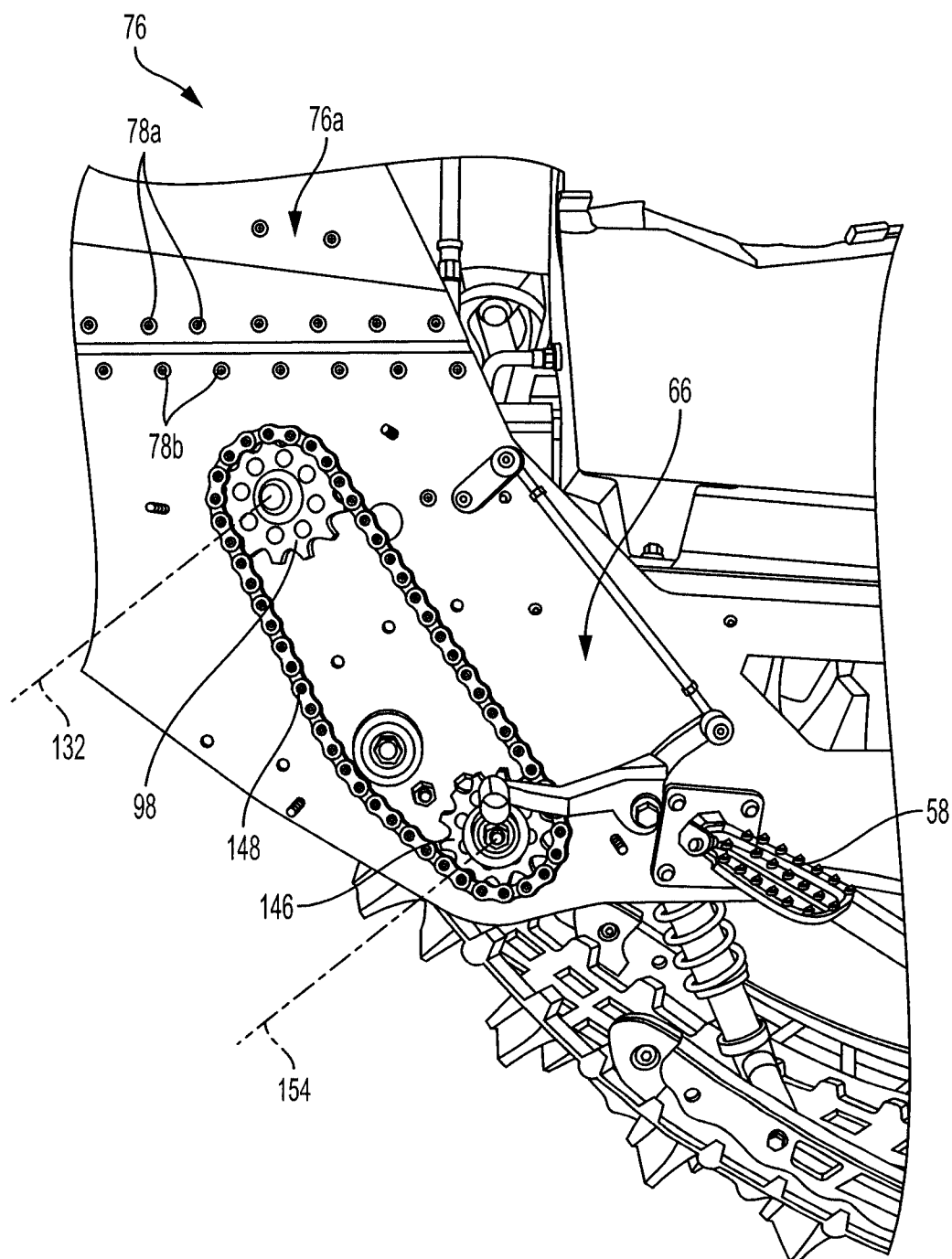


FIG. 14

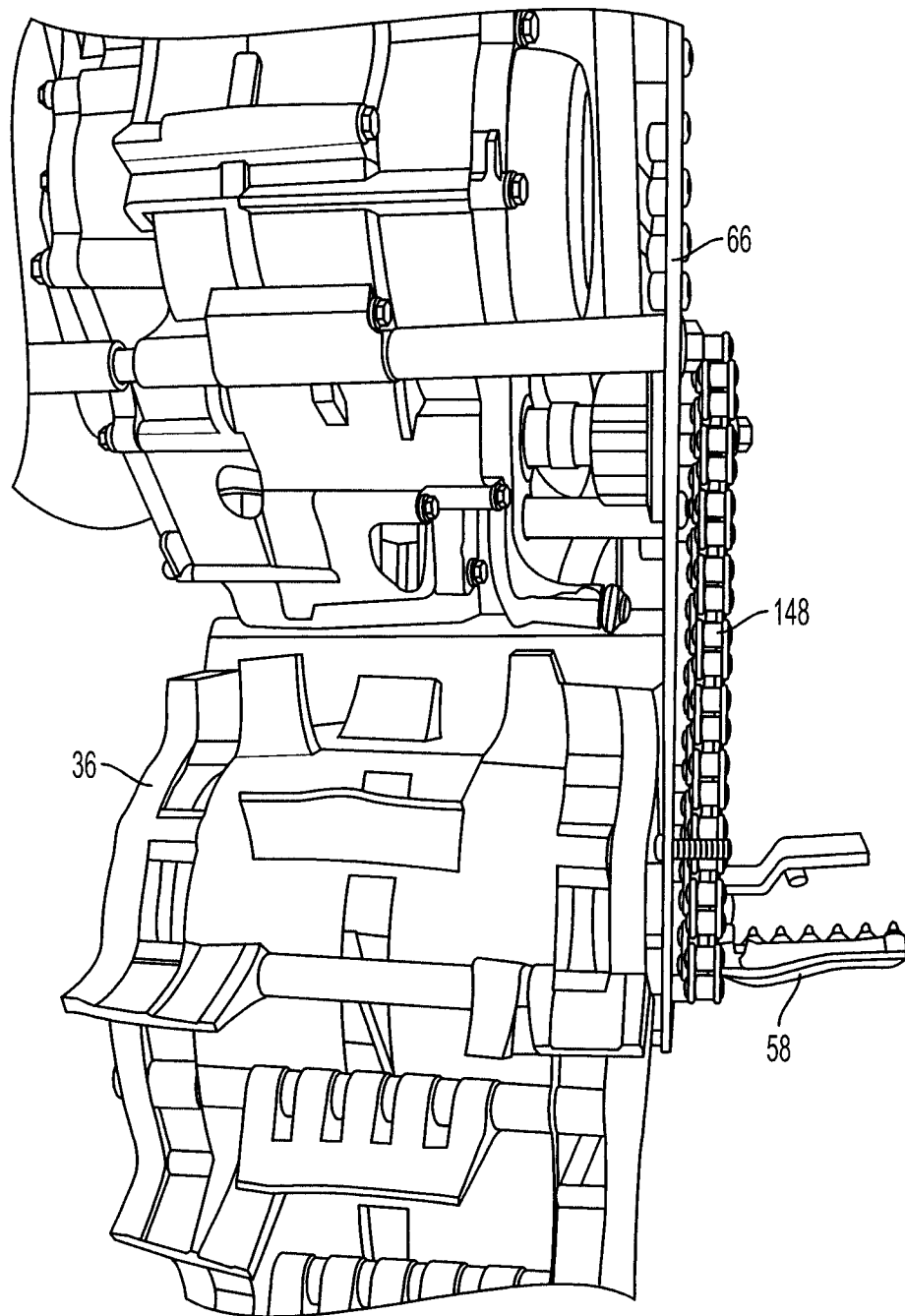


FIG. 15

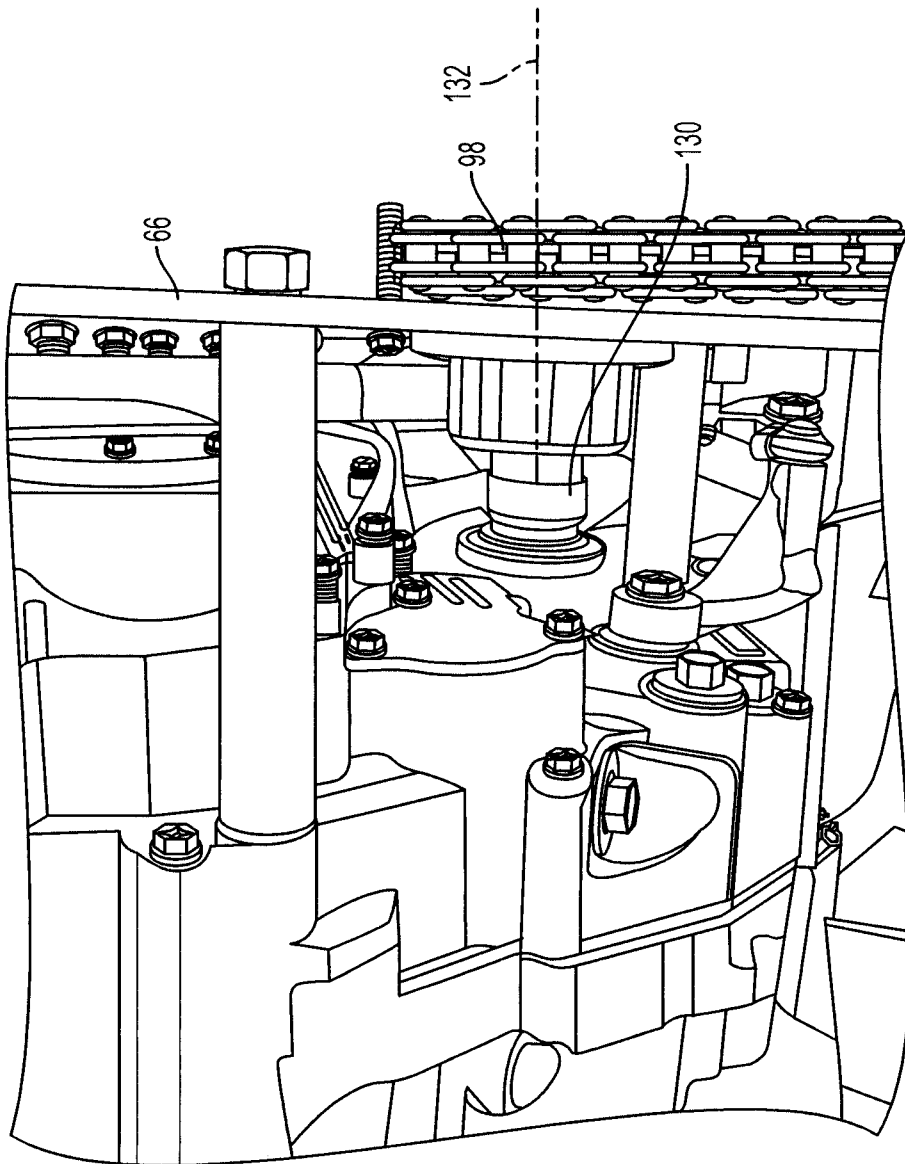


FIG. 16

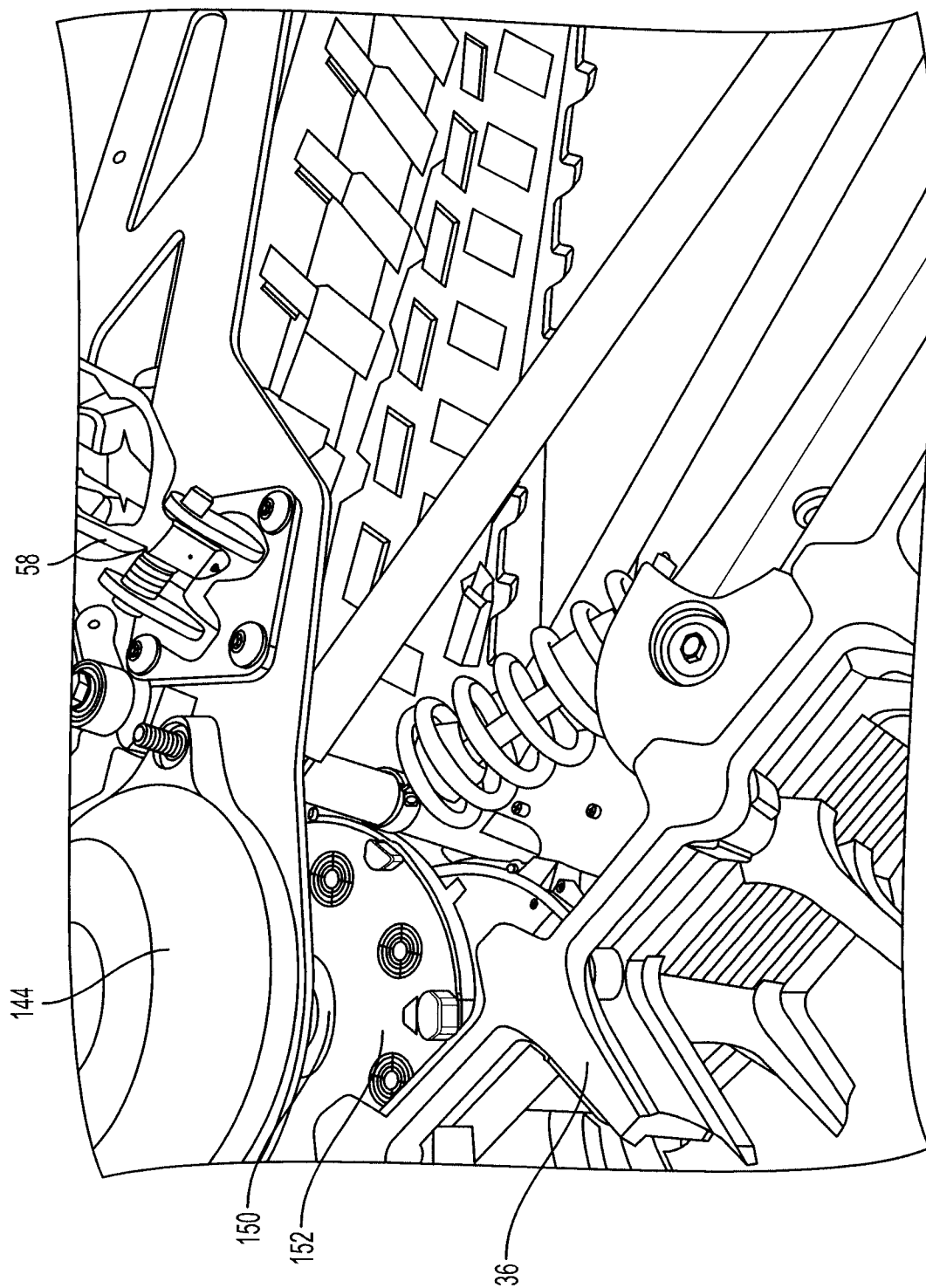


FIG. 17

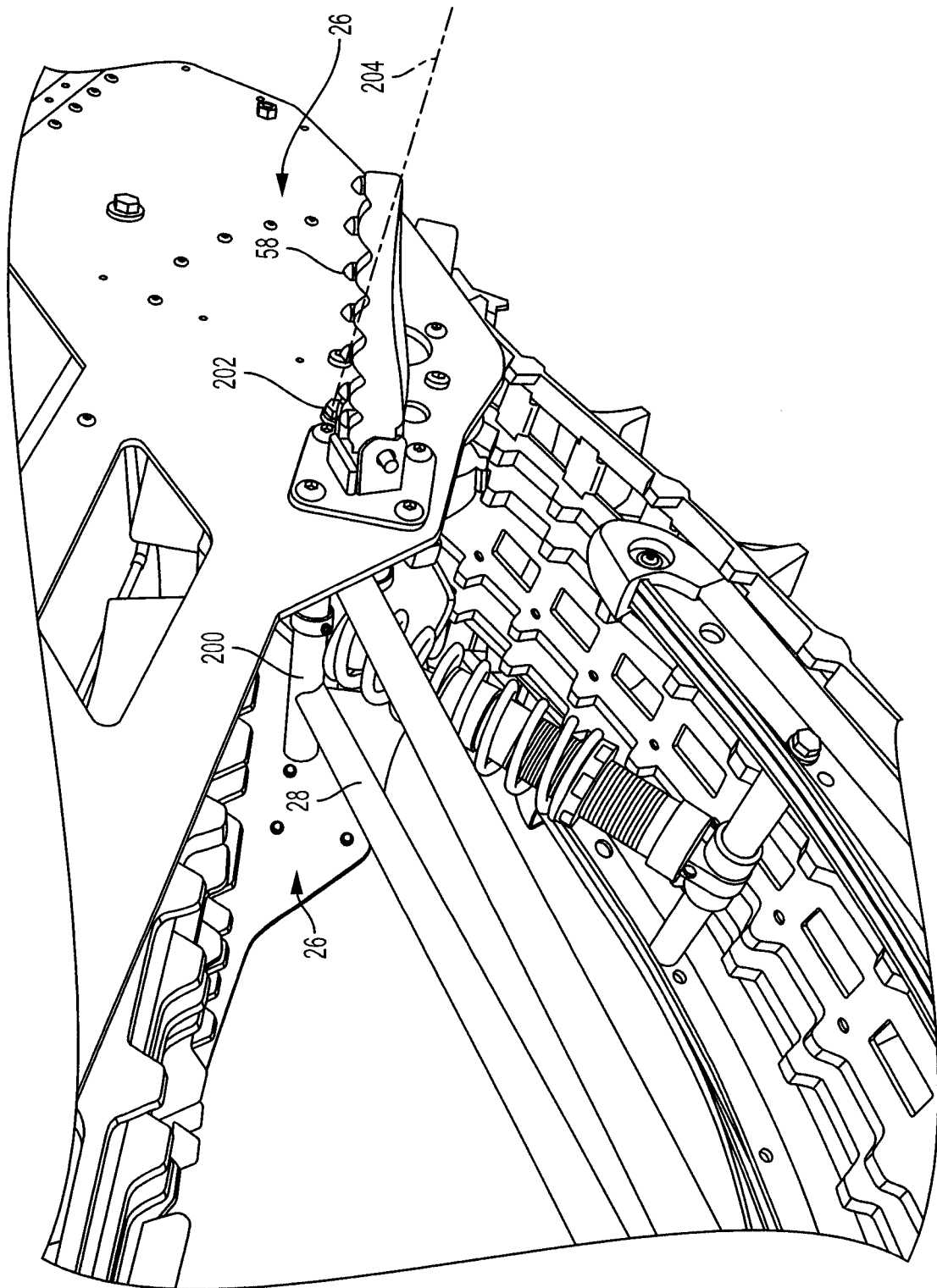


FIG. 18

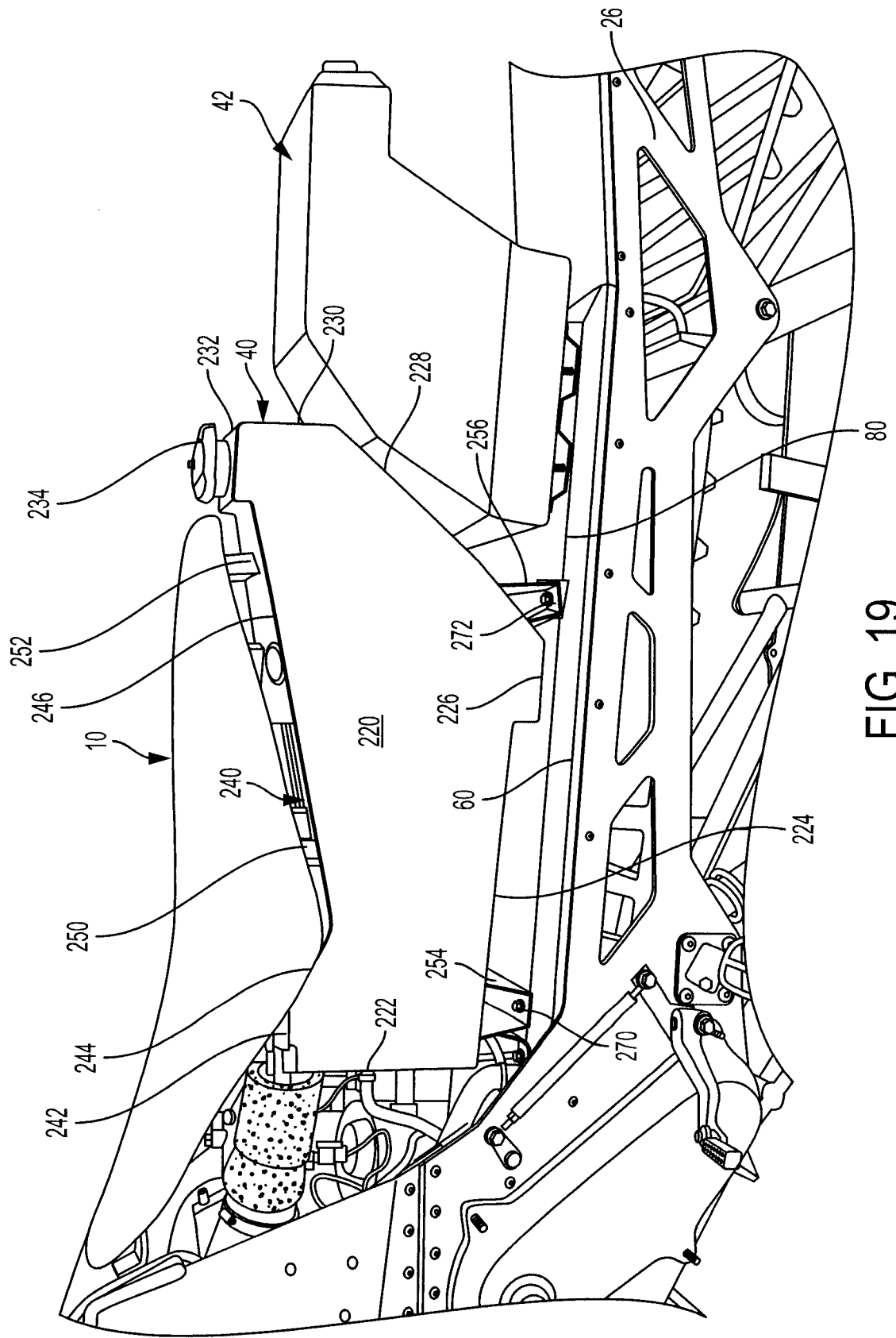


FIG. 19

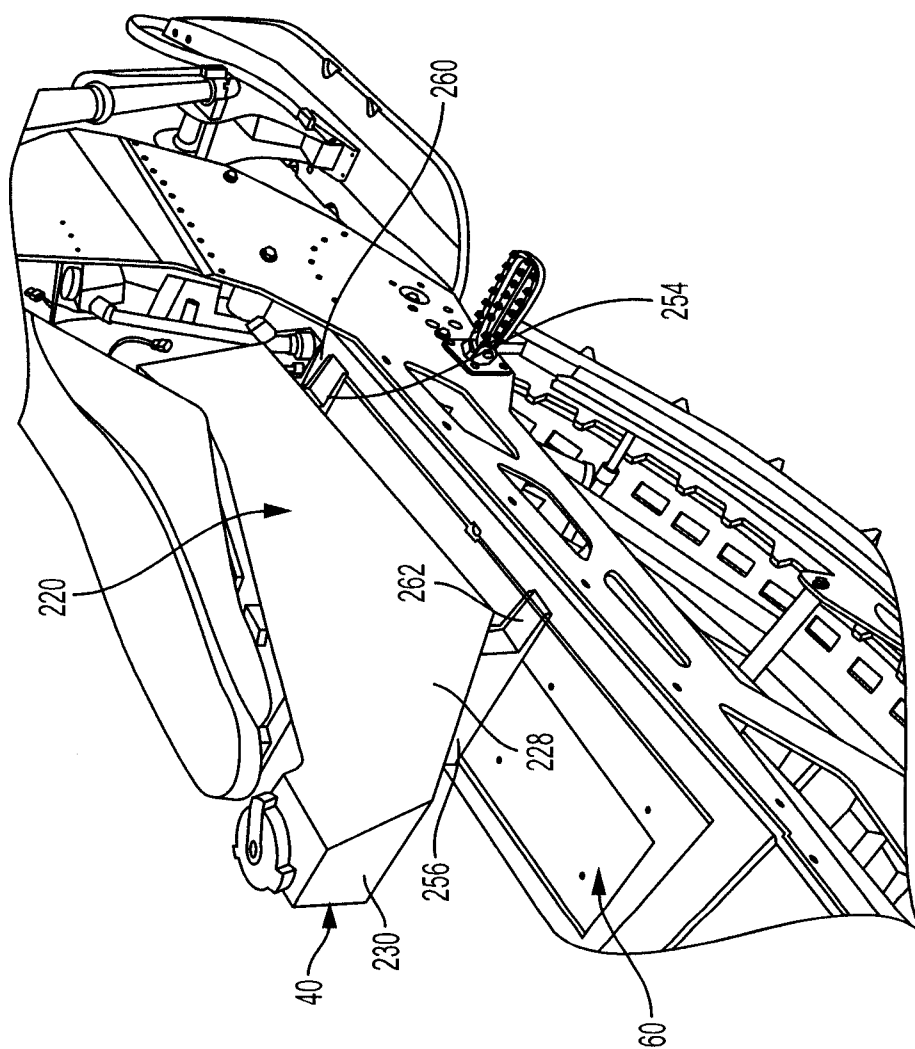


FIG. 20

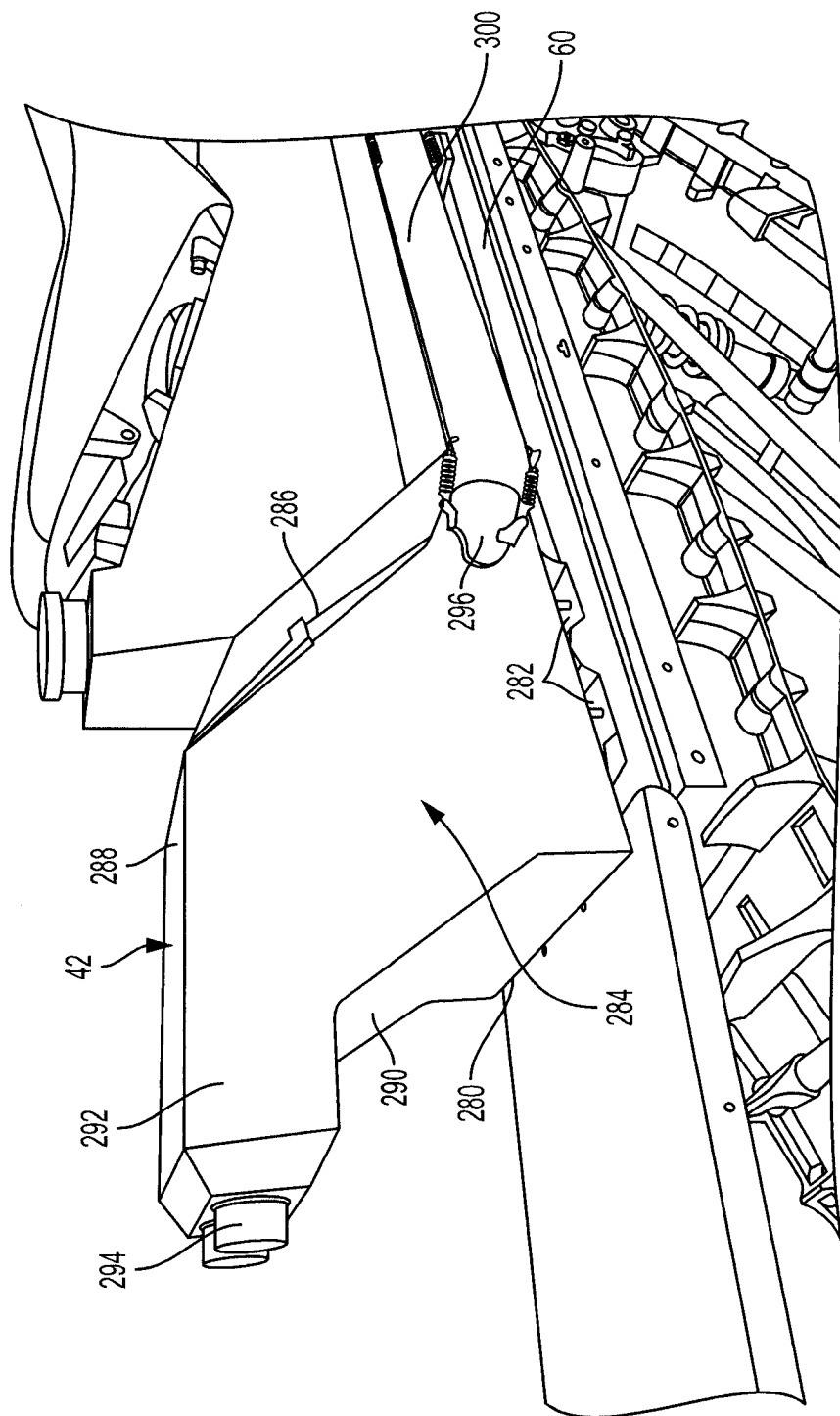


FIG. 21

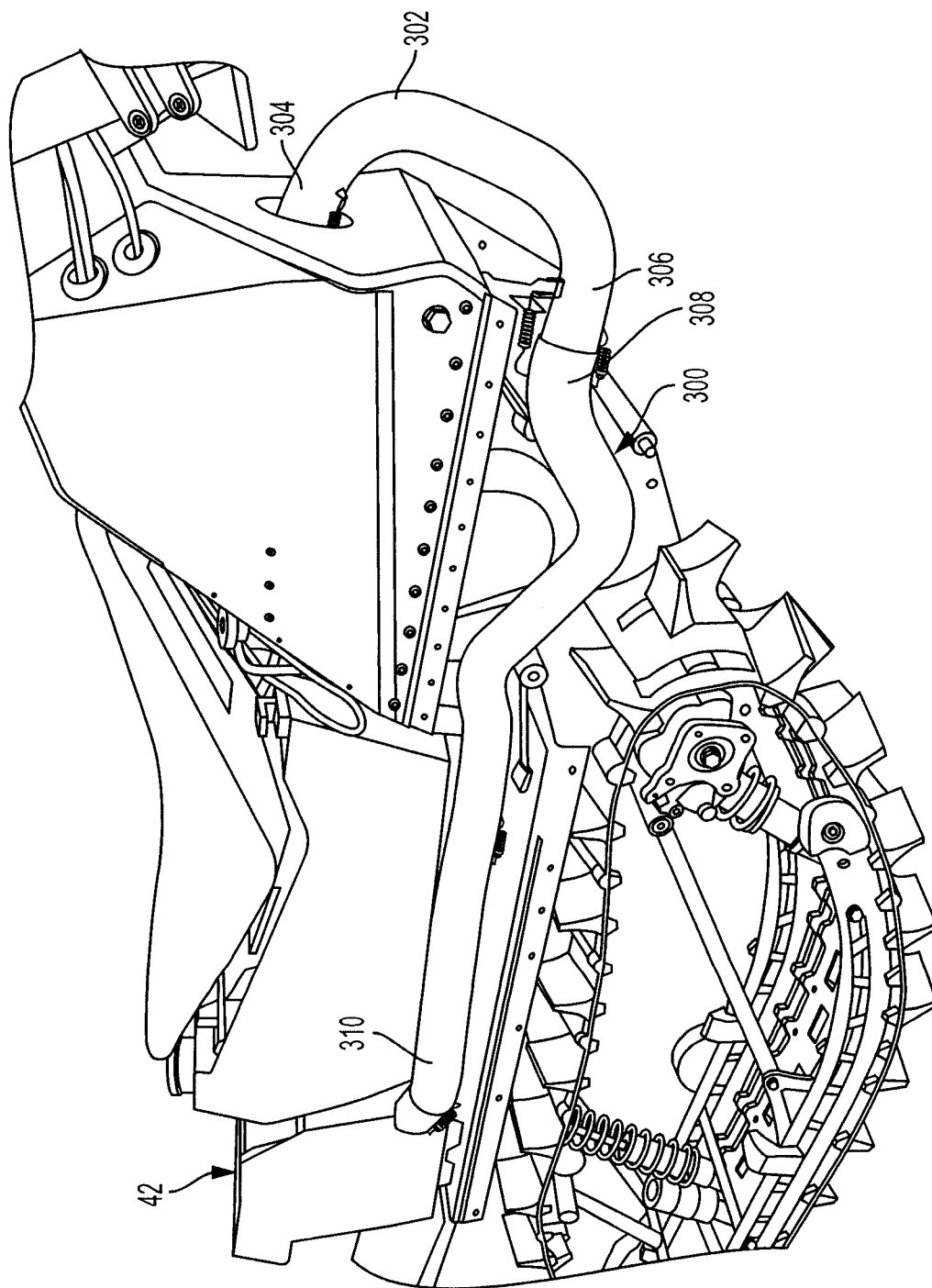


FIG. 22

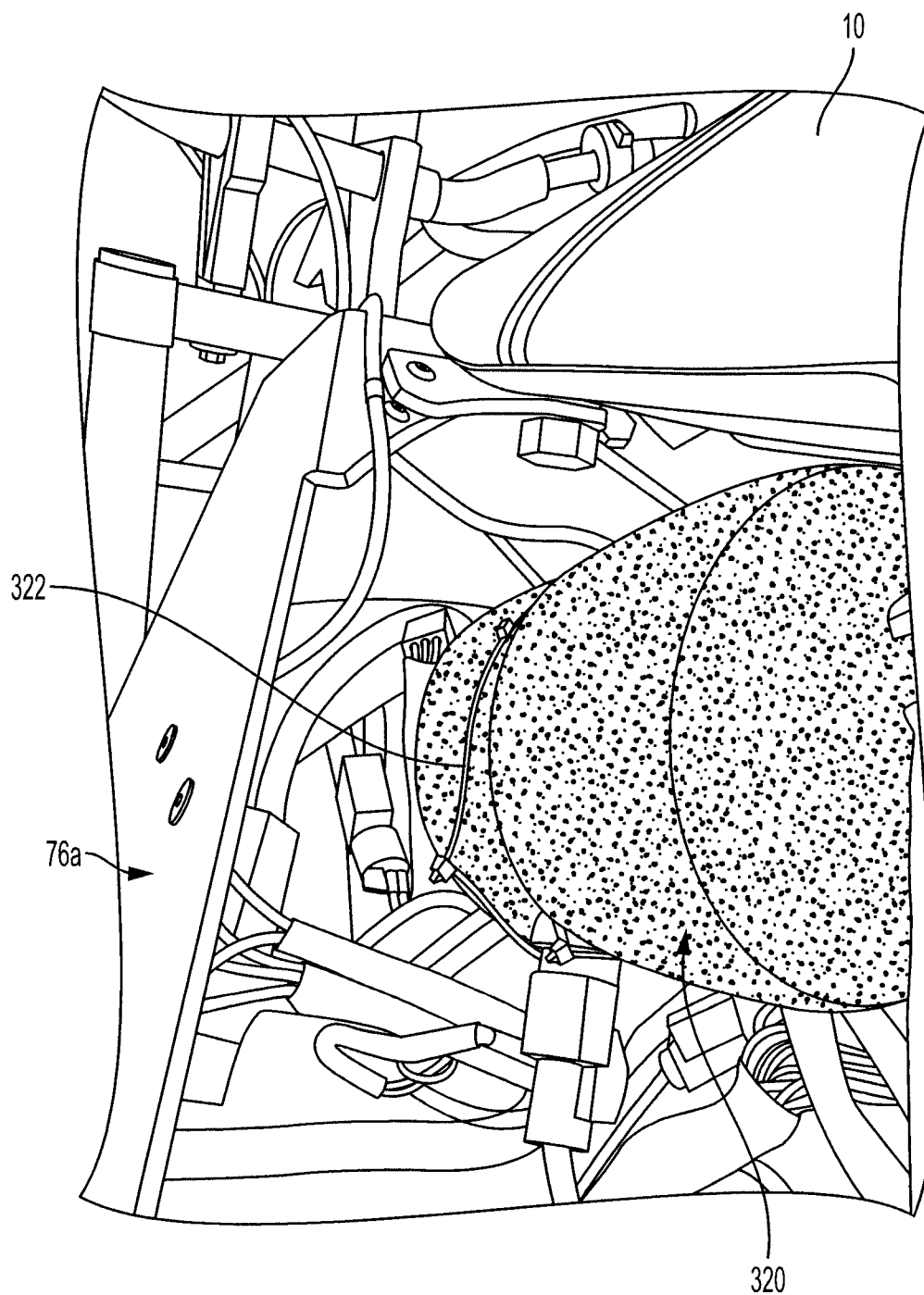


FIG. 23

