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Mercure et al.

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- (54) **SKID PLATE, SECONDARY SKID PLATE, AND TRACK DRIVE PROTECTOR FOR A RECREATIONAL VEHICLE**
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- (72) Inventors: **Benjamin Mercure**, Thief River Falls, MN (US); **Peder Erickson**, Thief River Falls, MN (US); **David Vigen**, Thief River Falls, MN (US); **Benjamin Taylor Langaas**, Thief River Falls, MN (US); **Marcus Moldaschel**, Thief River Falls, MN (US)
- (21) Appl. No.: **18/090,170**
- (22) Filed: **Dec. 28, 2022**

Related U.S. Application Data

- (60) Provisional application No. 63/434,382, filed on Dec. 21, 2022, provisional application No. 63/405,121, filed on Sep. 9, 2022, provisional application No. 63/405,033, filed on Sep. 9, 2022, provisional application No. 63/405,016, filed on Sep. 9, 2022, provisional application No. 63/405,176, filed on Sep. 9, 2022, provisional application No. 63/404,992, filed on Sep. 9, 2022, provisional application No. 63/404,856, filed on Sep. 8, 2022, provisional application No. 63/404,822, filed on Sep. 8, 2022, provisional application No. 63/404,617, filed on Sep. 8, 2022, provisional application No. 63/404,731, filed on Sep. 8, 2022, provisional application No. 63/404,171, filed on

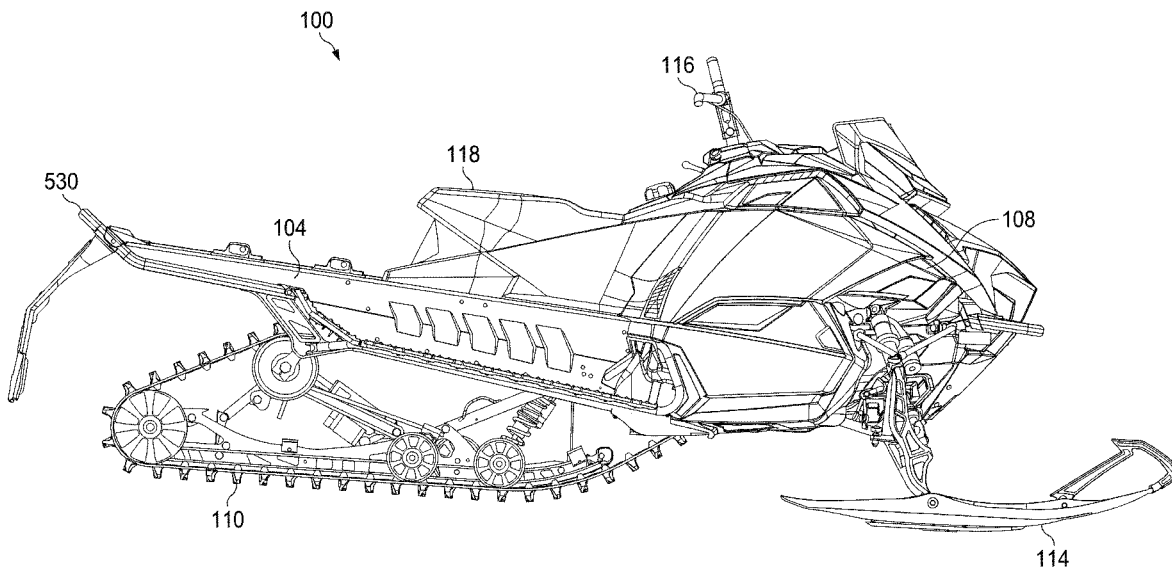
Sep. 6, 2022, provisional application No. 63/402,768, filed on Aug. 31, 2022, provisional application No. 63/400,056, filed on Aug. 23, 2022, provisional application No. 63/344,165, filed on May 20, 2022, provisional application No. 63/310,951, filed on Feb. 16, 2022, provisional application No. 63/310,983, filed on Feb. 16, 2022, provisional application No. 63/310,264, filed on Feb. 15, 2022, provisional application No. 63/310,254, filed on Feb. 15, 2022.

Publication Classification

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B62J 23/00 (2006.01)
B62M 27/02 (2006.01)
- (52) **U.S. Cl.**
CPC *B62J 23/00* (2013.01); *B62M 27/02* (2013.01); *B62M 2027/028* (2013.01)

(57) **ABSTRACT**

A recreational vehicle may include a track drive protector attached to a bottom-out protector. The track drive protector is configured to mate with the bottom-out protector. A recreational vehicle may further or alternatively include a secondary skid plate attached to the skid plate. The secondary skid plate is configured to mate with the skid plate and/or the forward frame assembly. The track drive protector and the secondary skid plate may provide additional support to the vehicle, help deflect debris away from the underside of the vehicle, and/or absorb impact forces when the vehicle strikes an object.



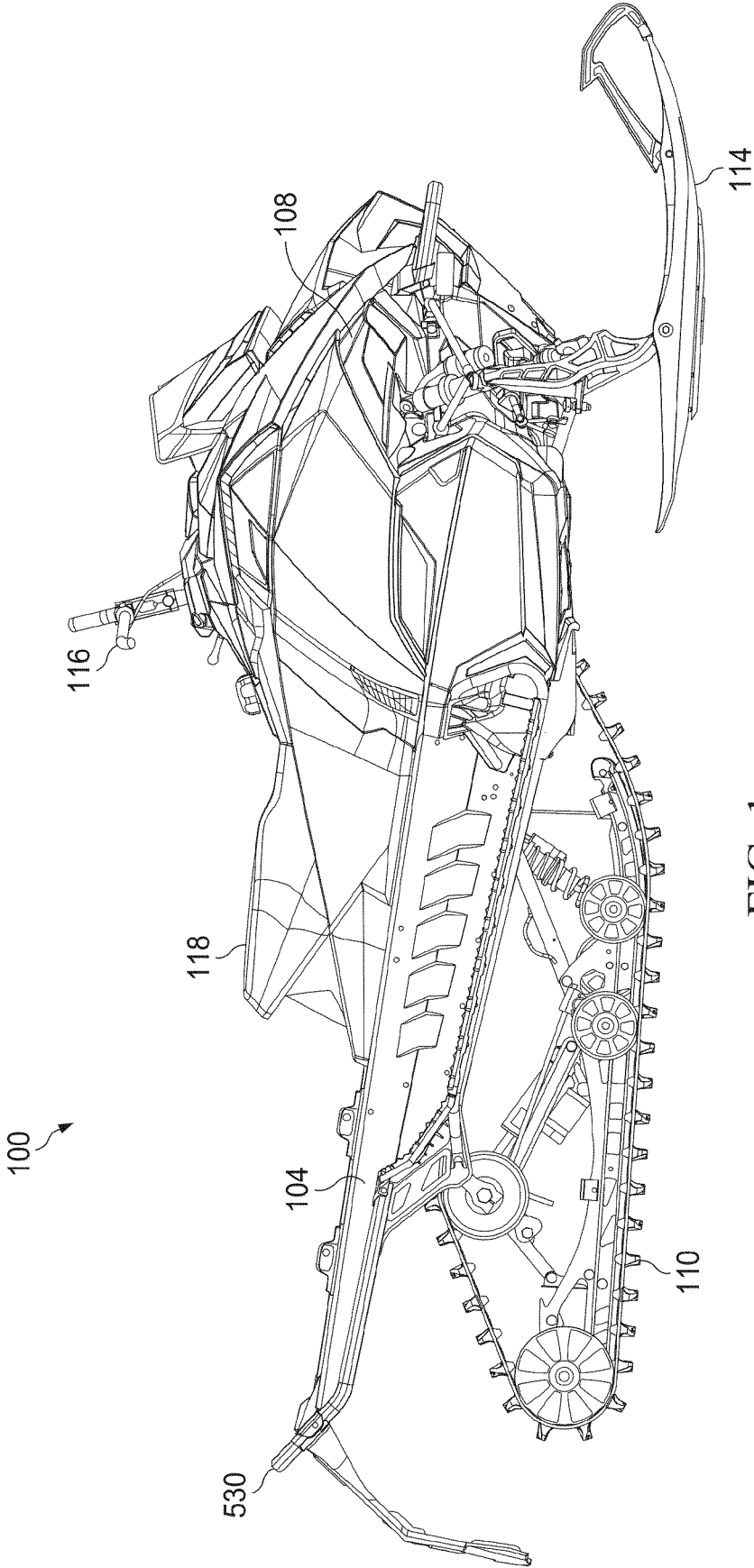


FIG. 1

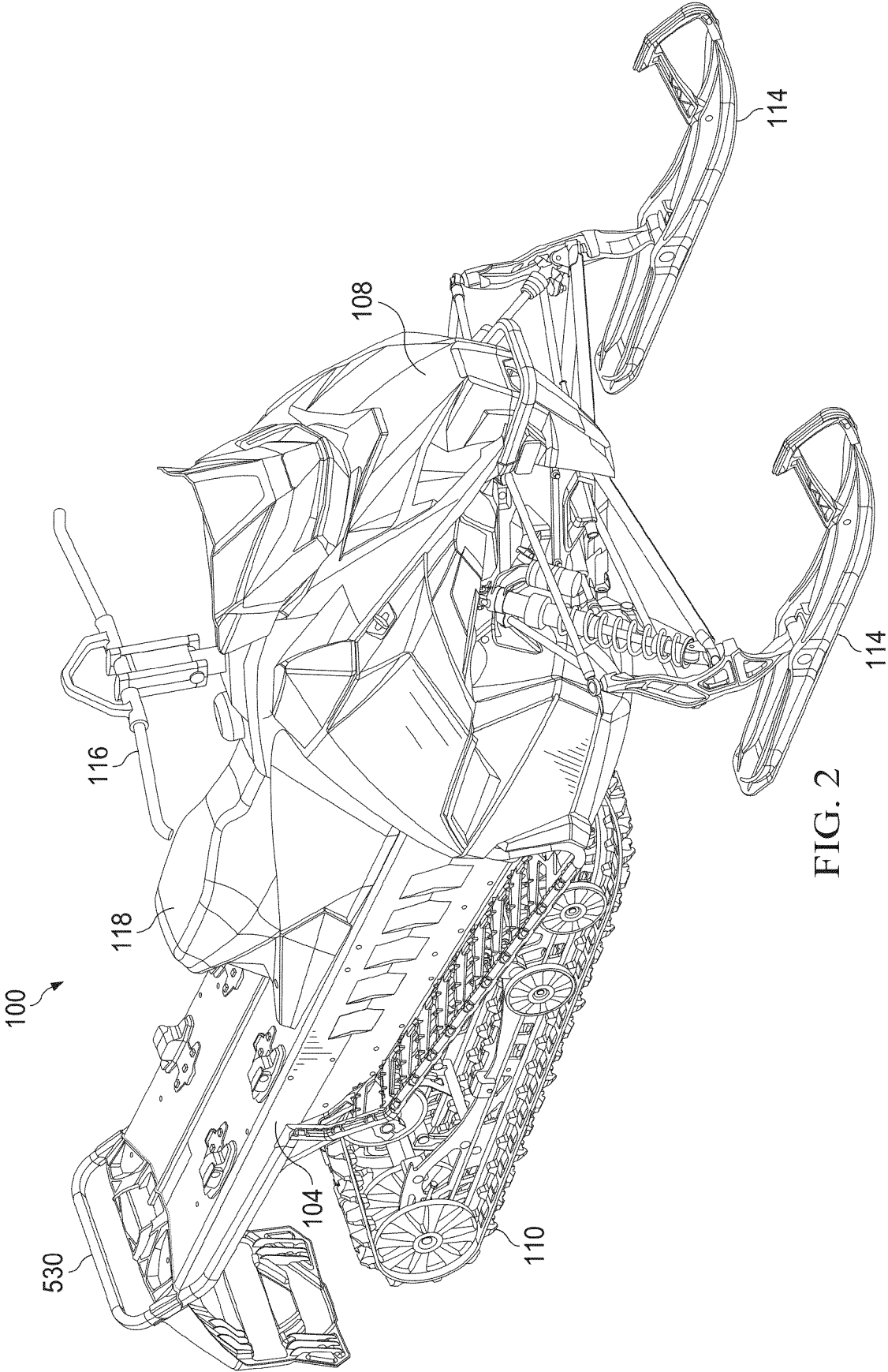


FIG. 2

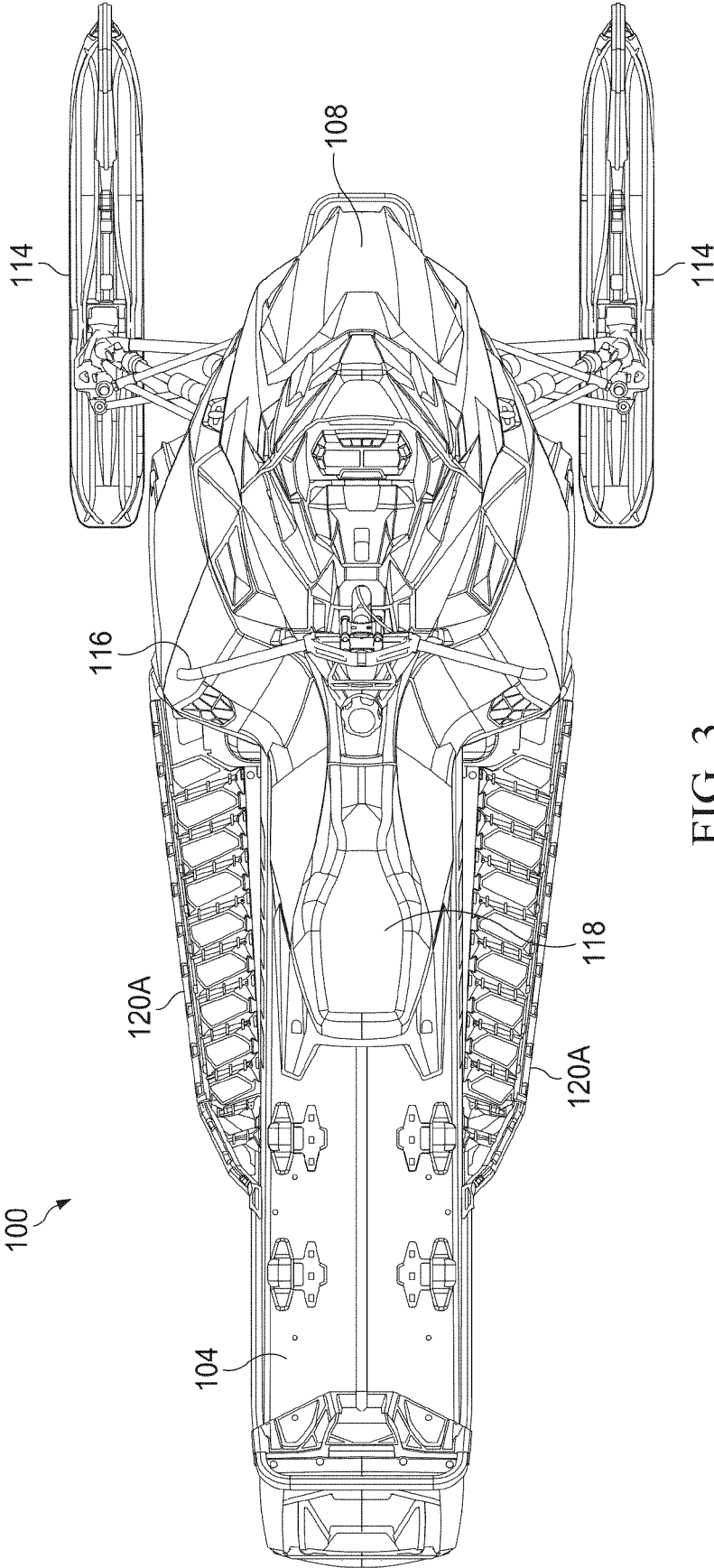


FIG. 3

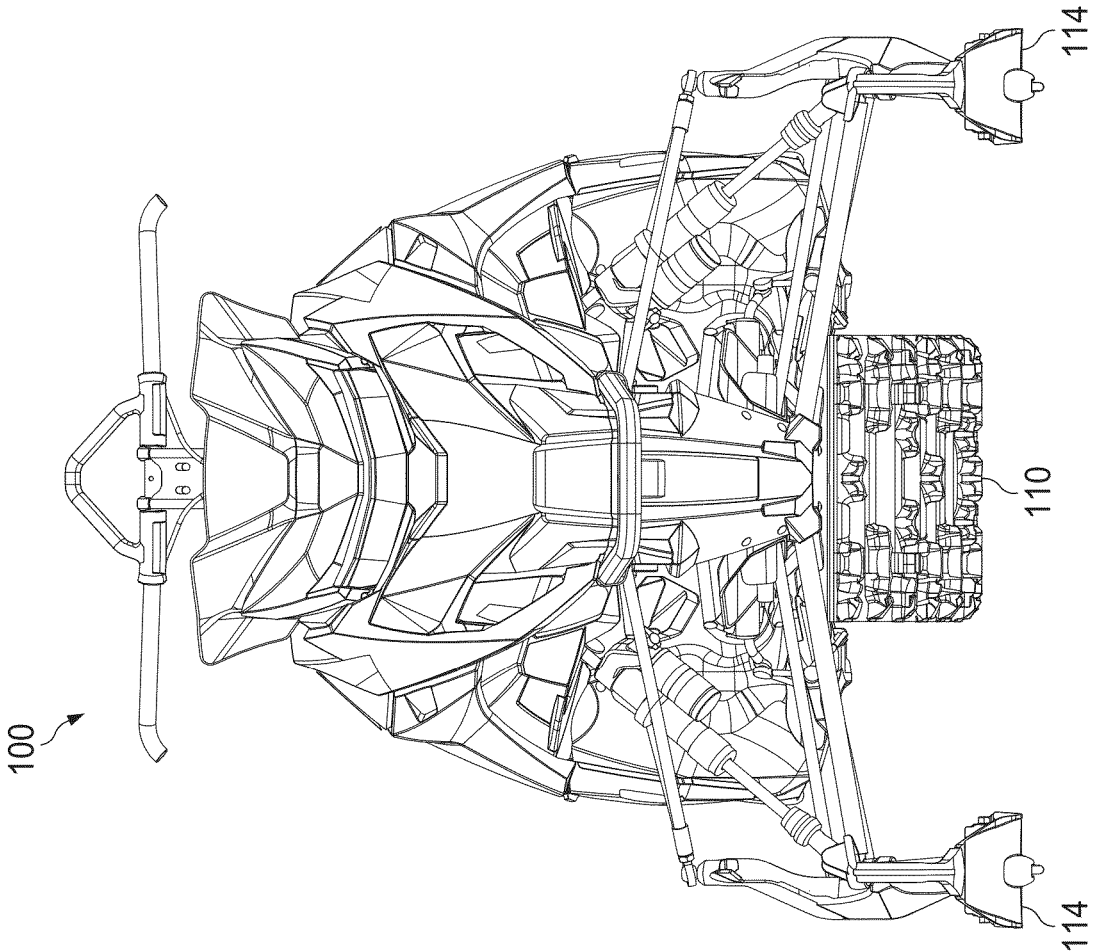


FIG. 4

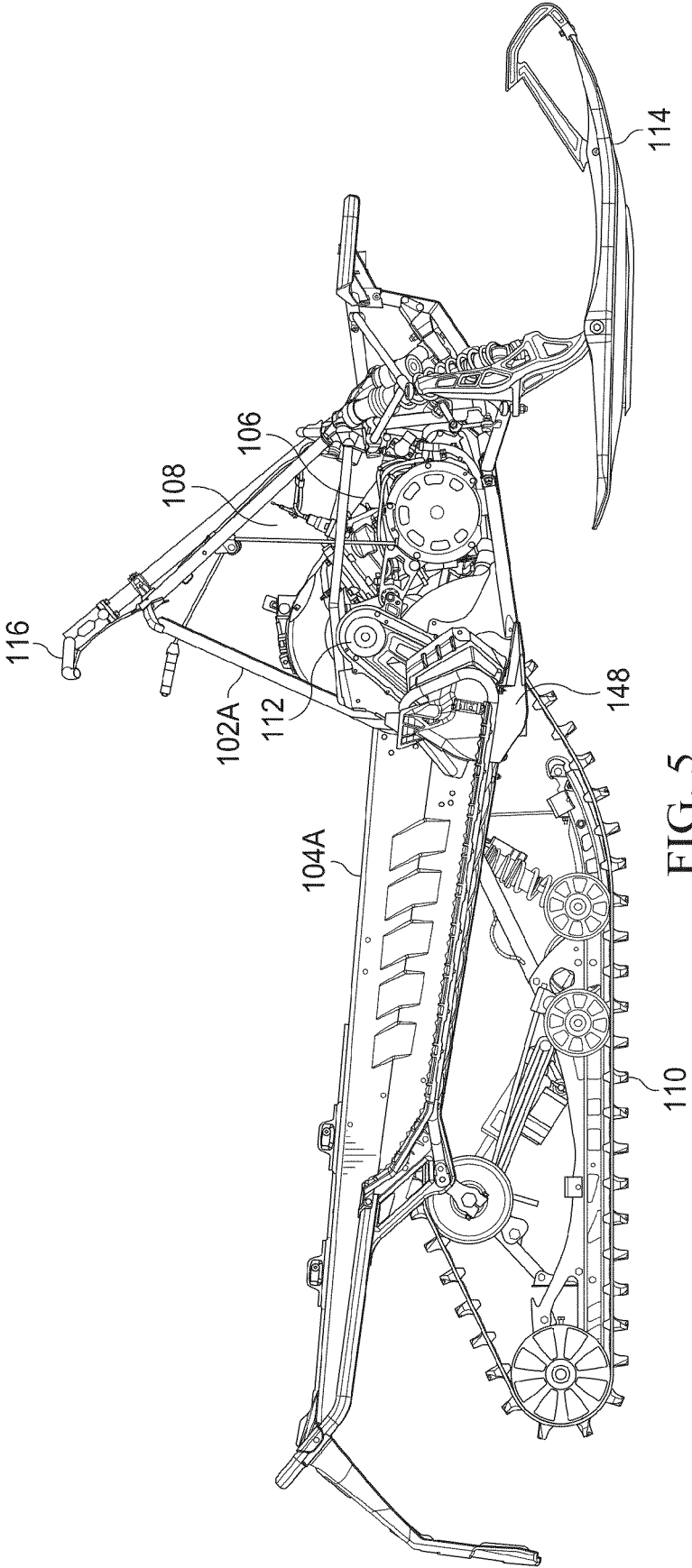


FIG. 5

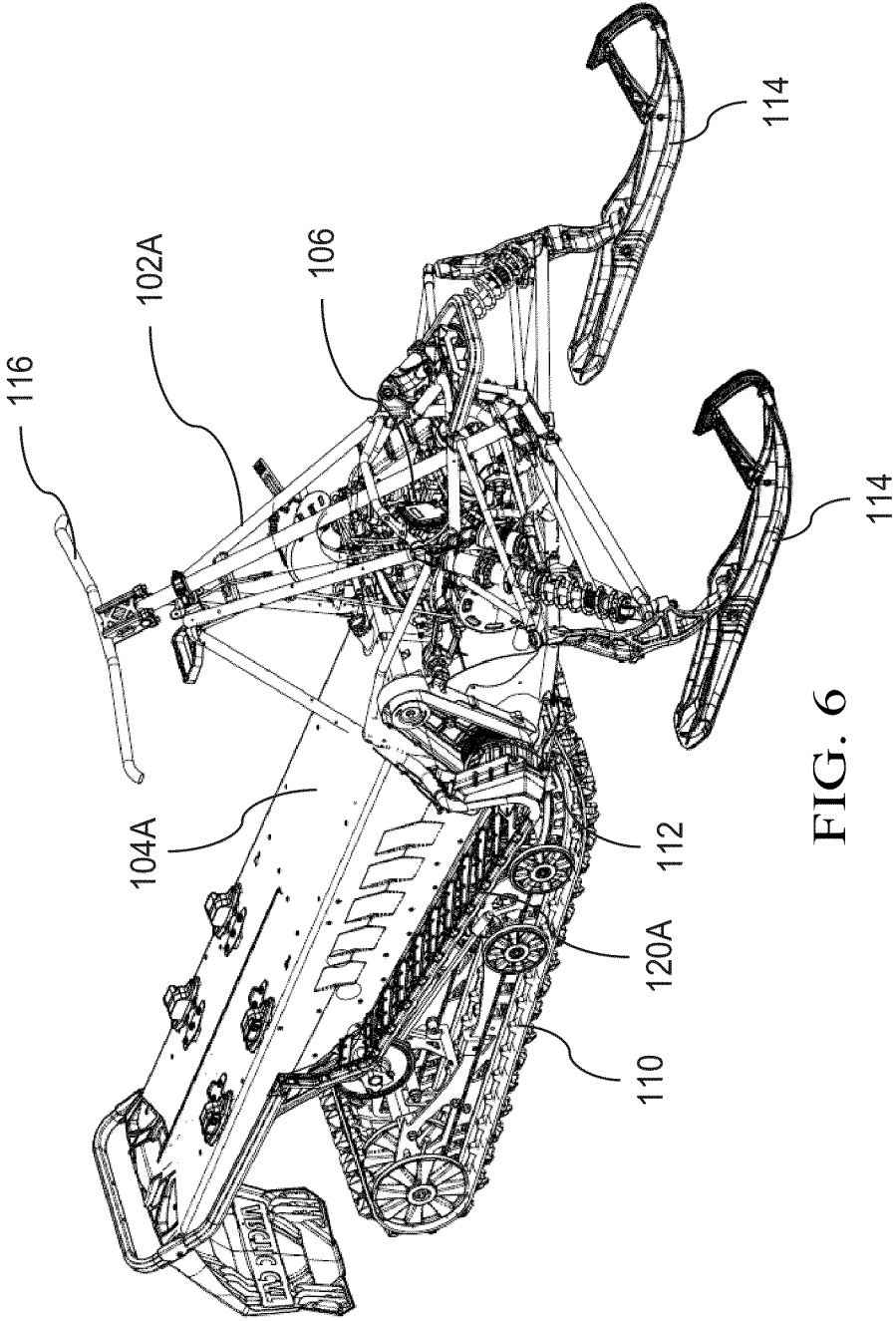


FIG. 6

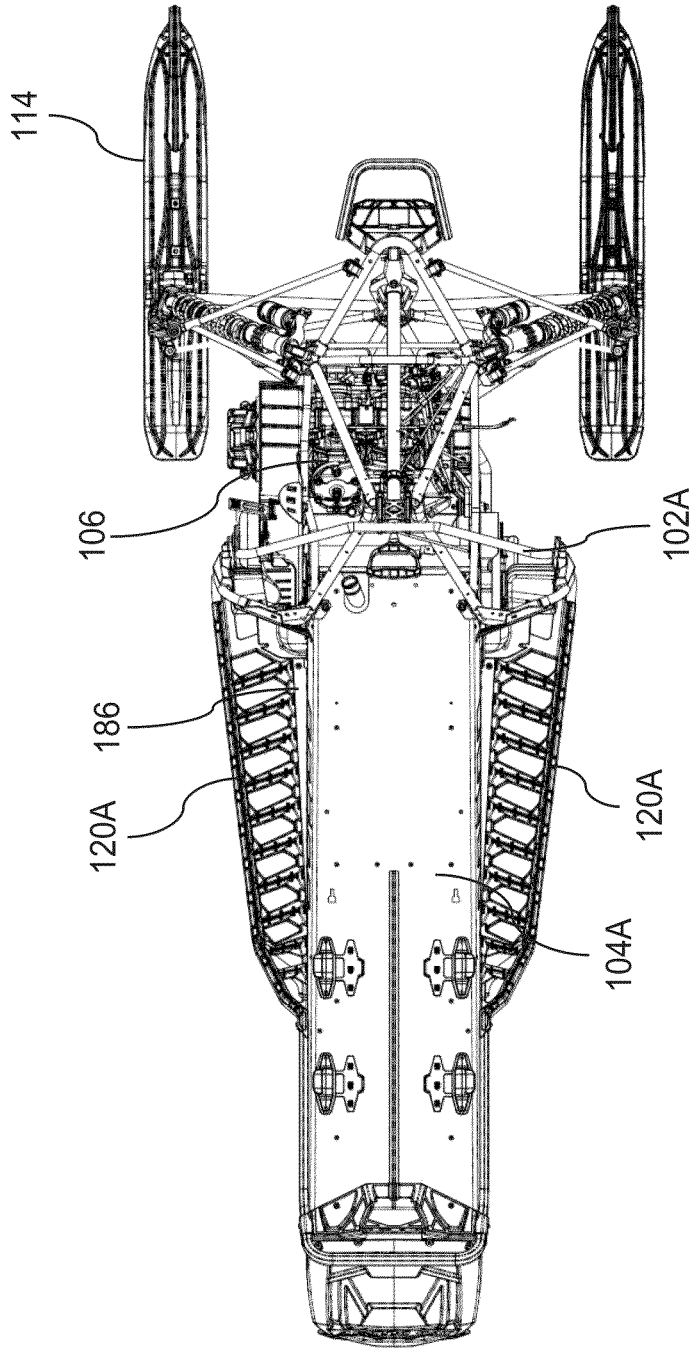


FIG. 7

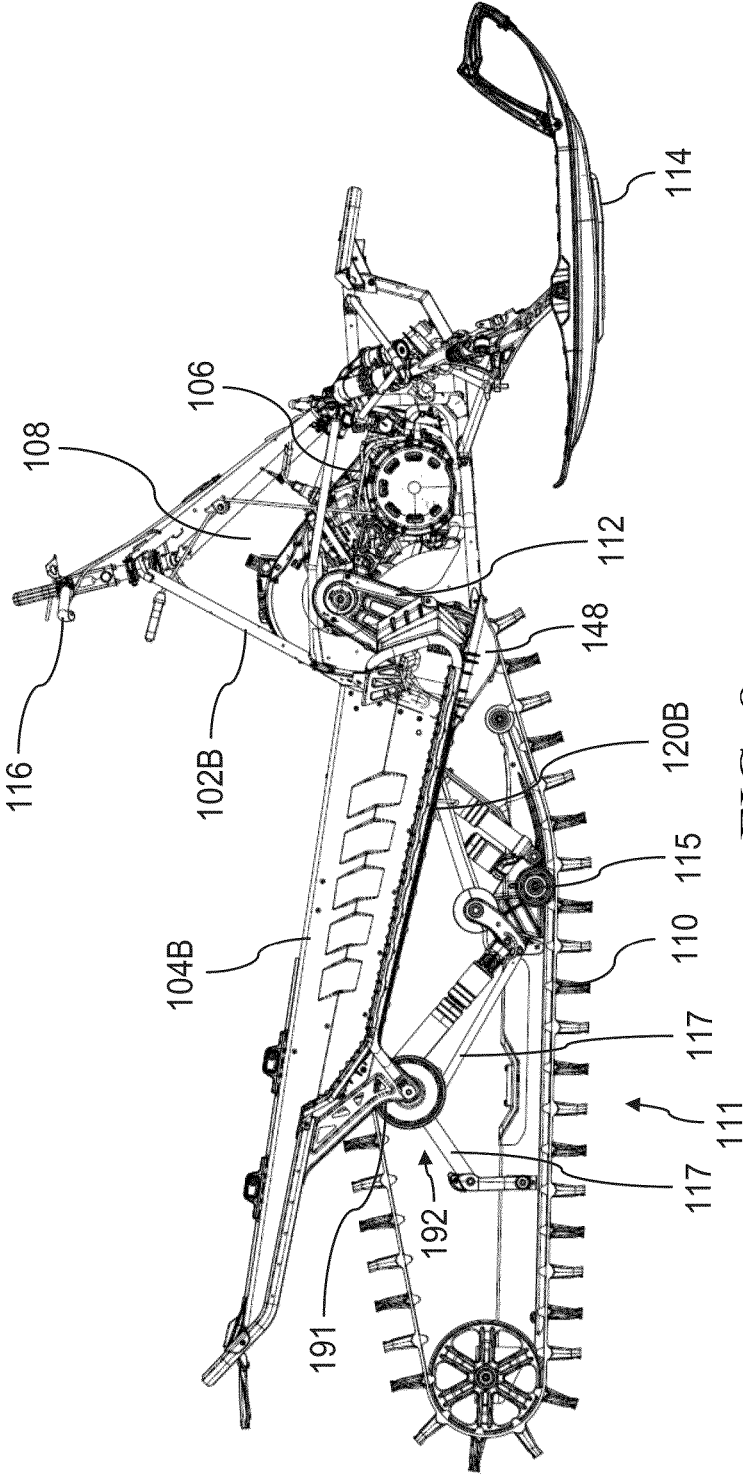


FIG. 8

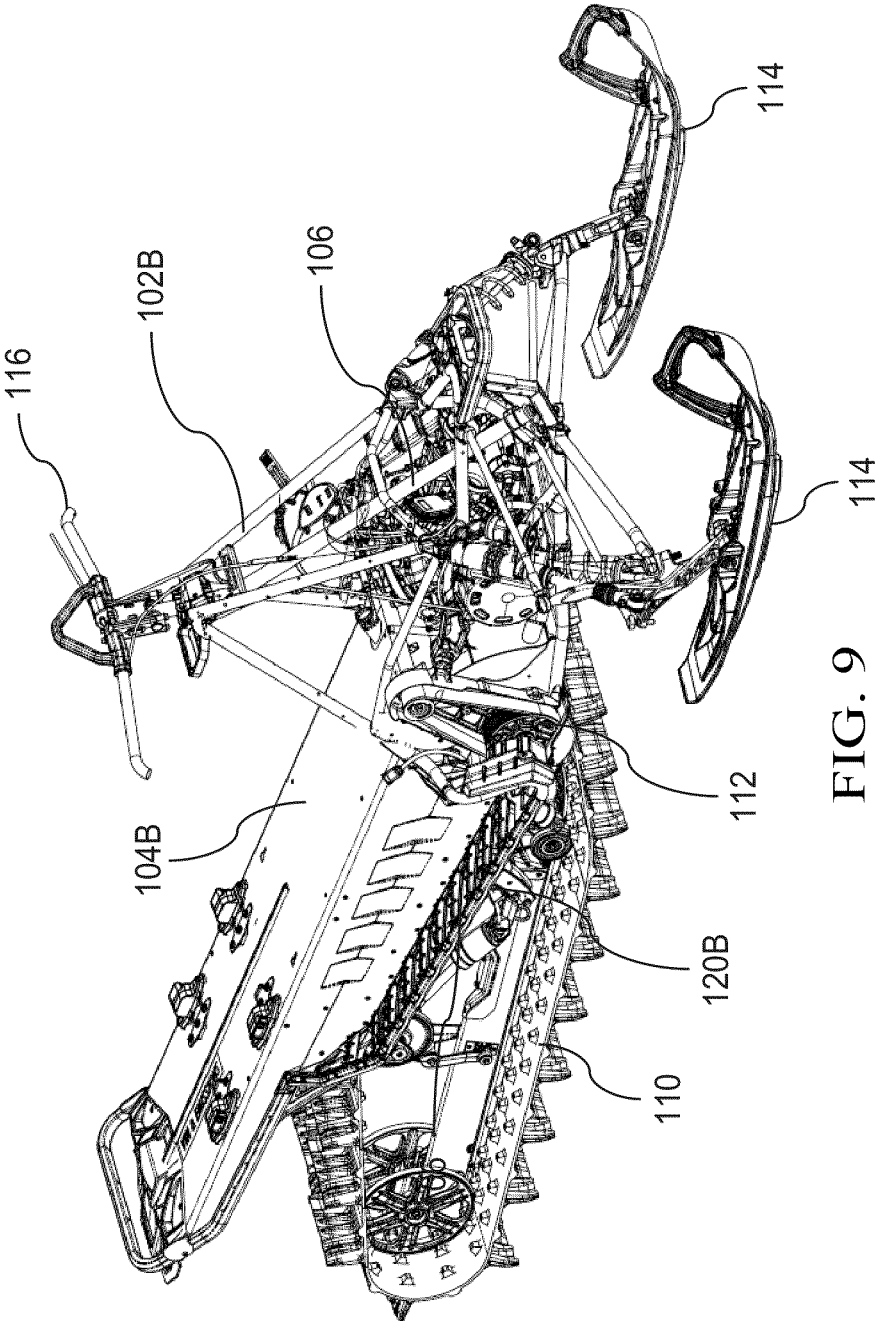


FIG. 9

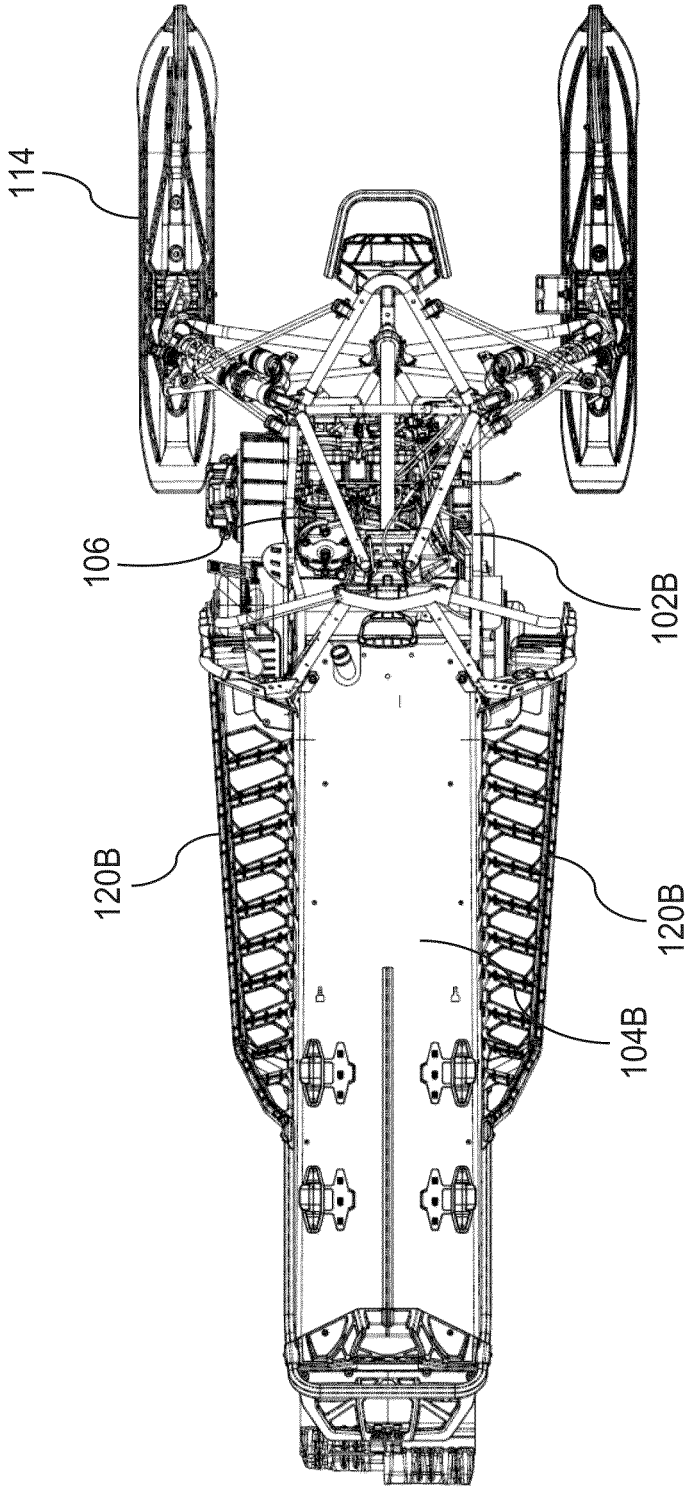


FIG. 10

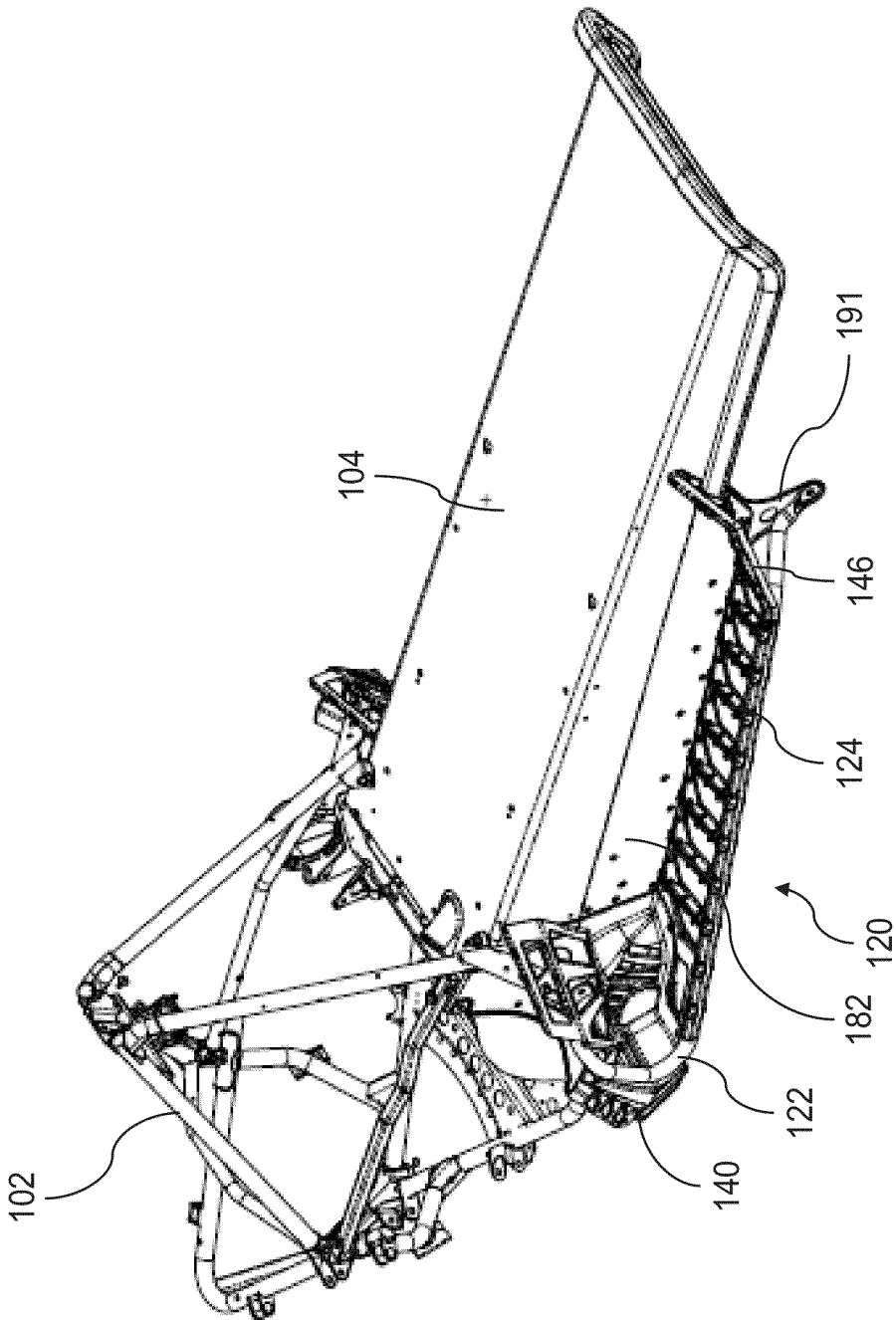


FIG. 11

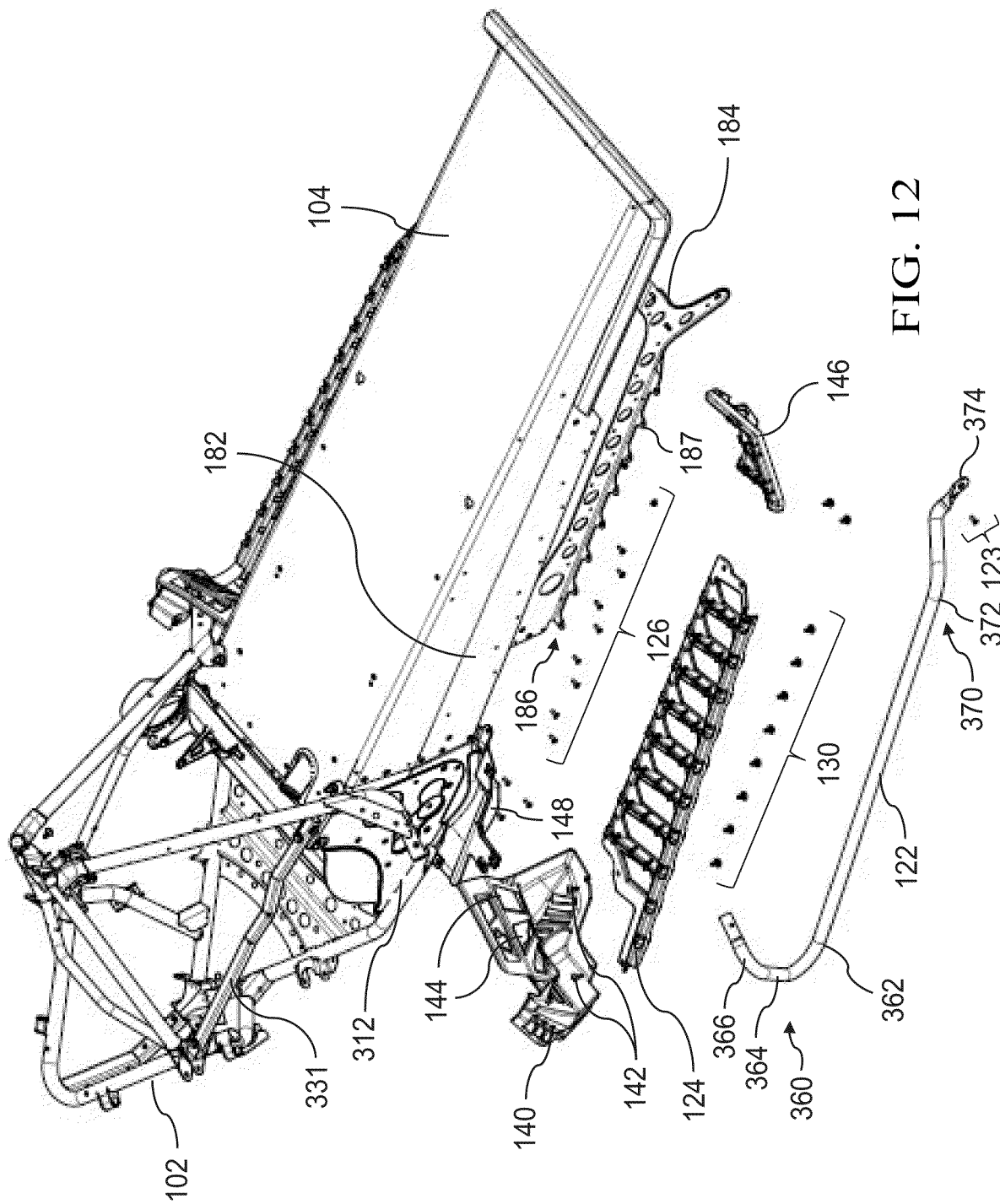


FIG. 12

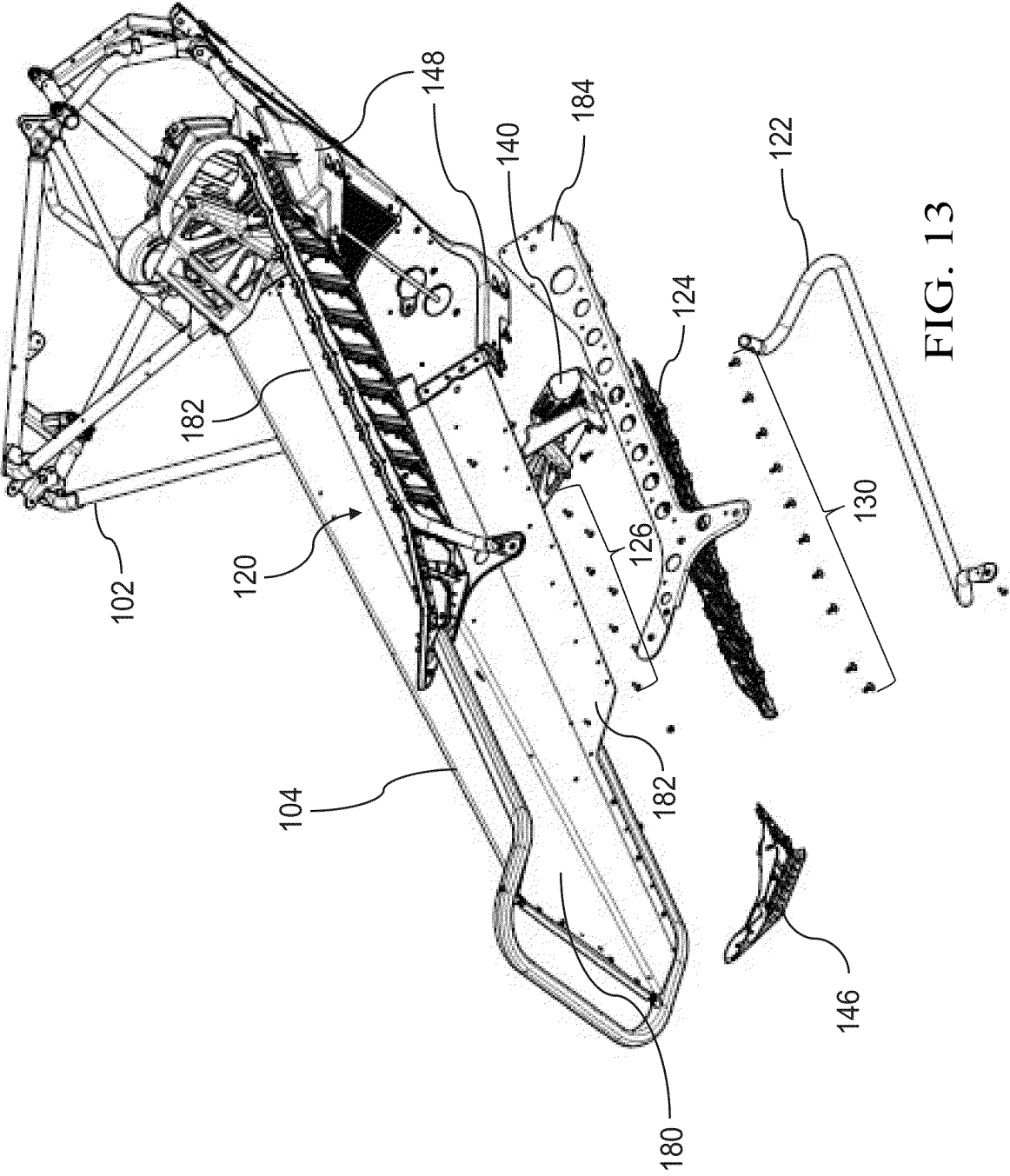


FIG. 13

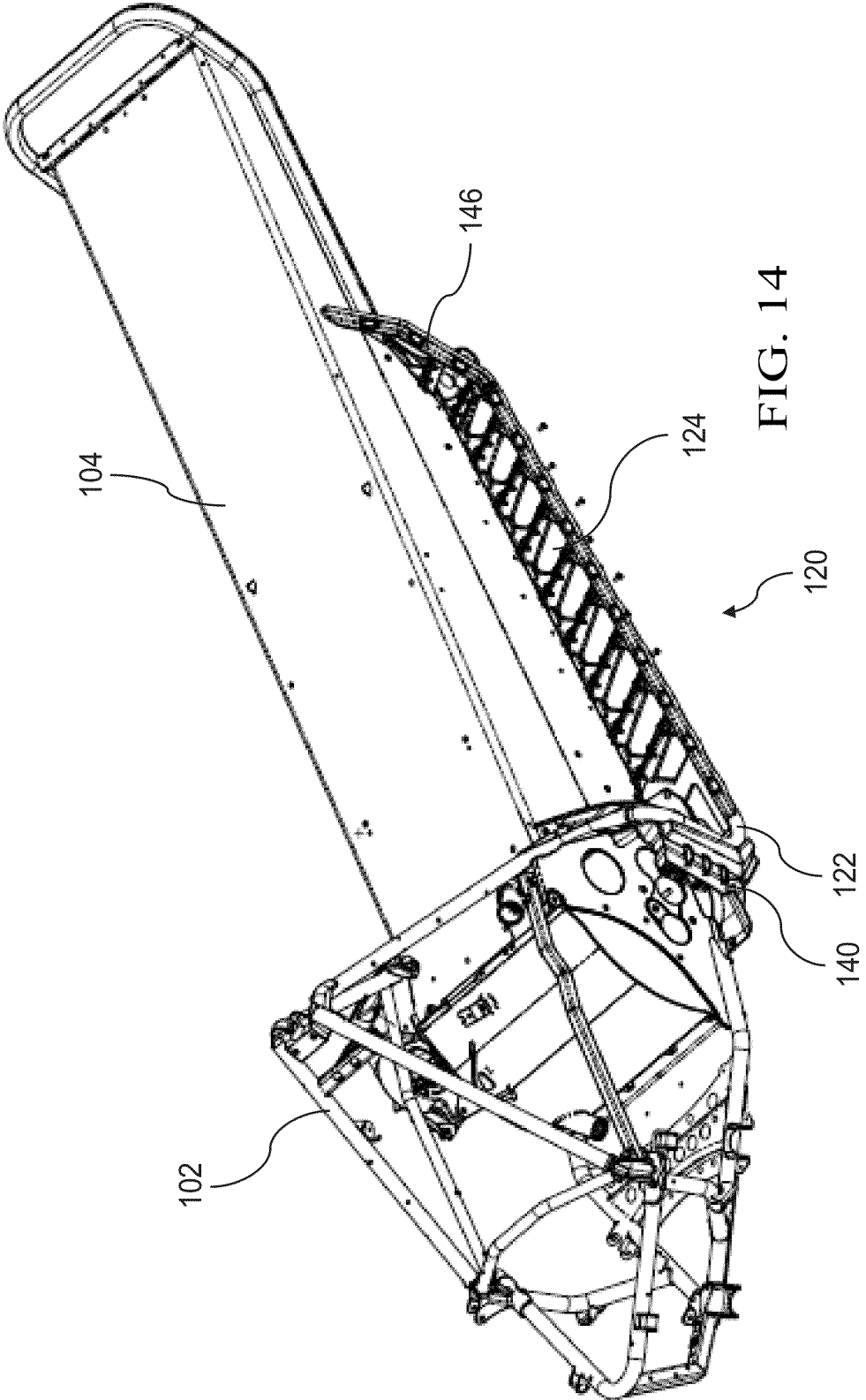


FIG. 14

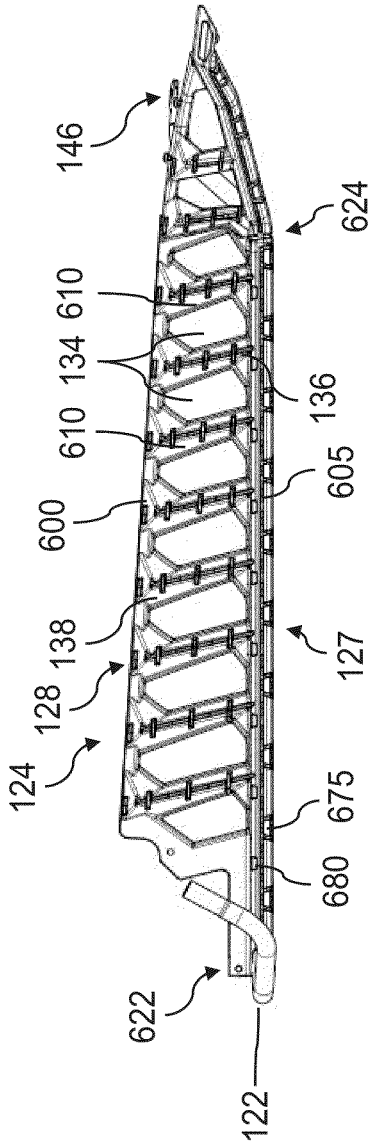


FIG. 15A

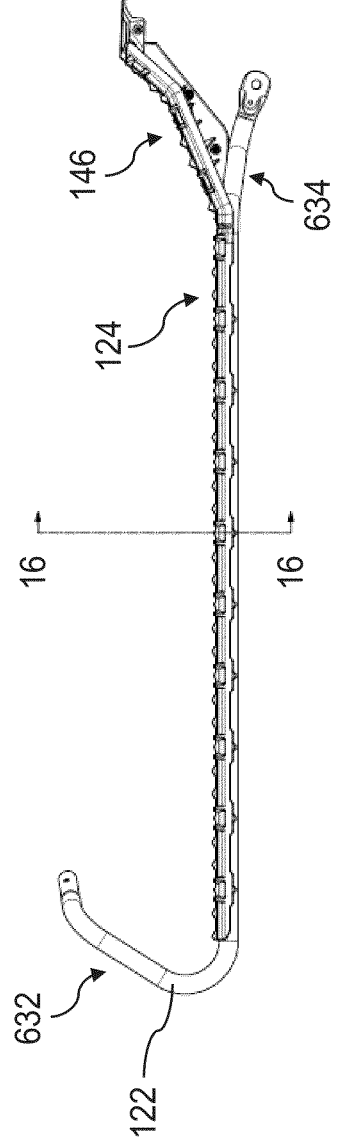


FIG. 15B

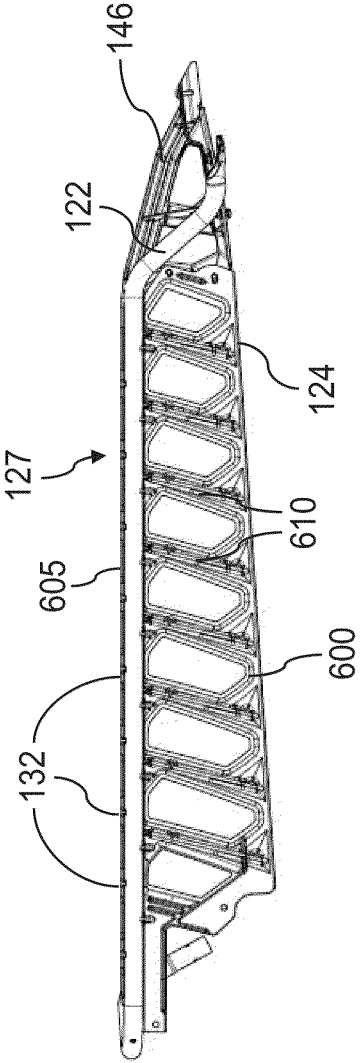


FIG. 15C

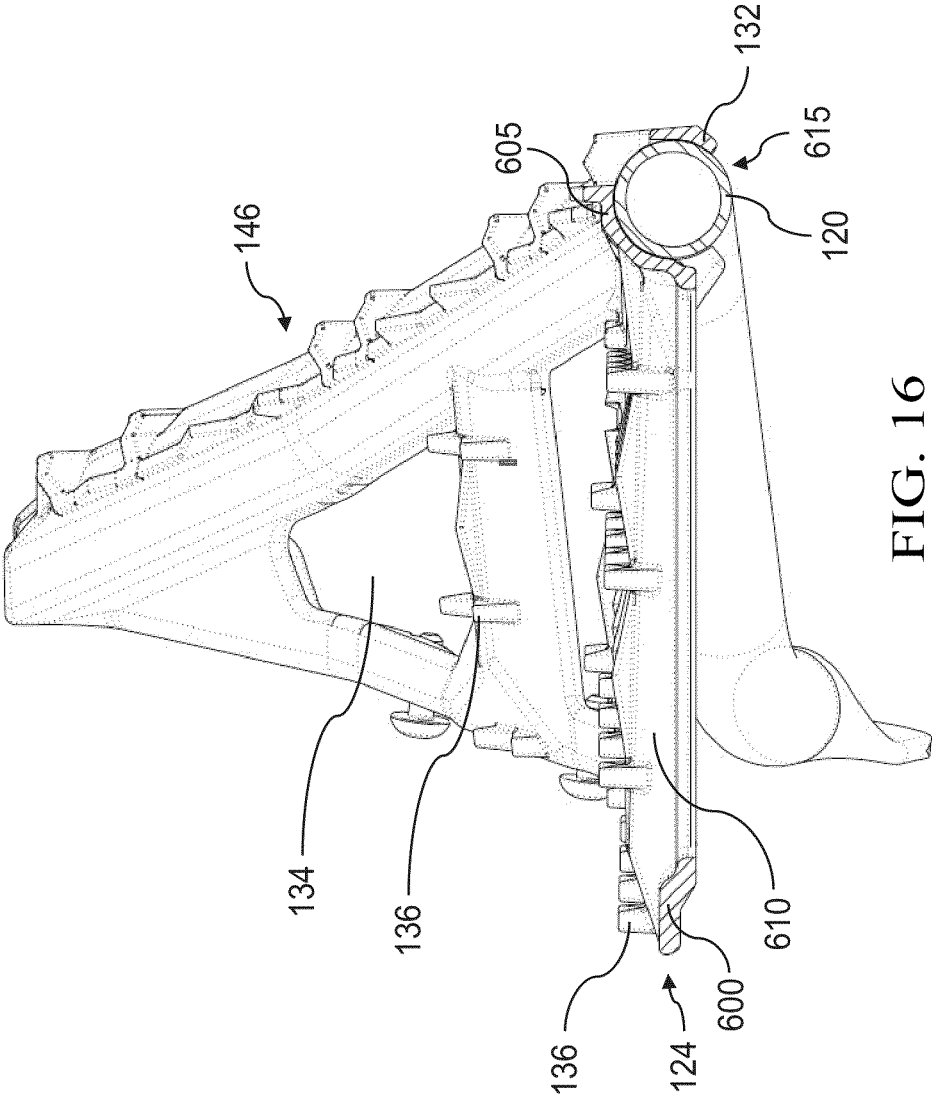


FIG. 16

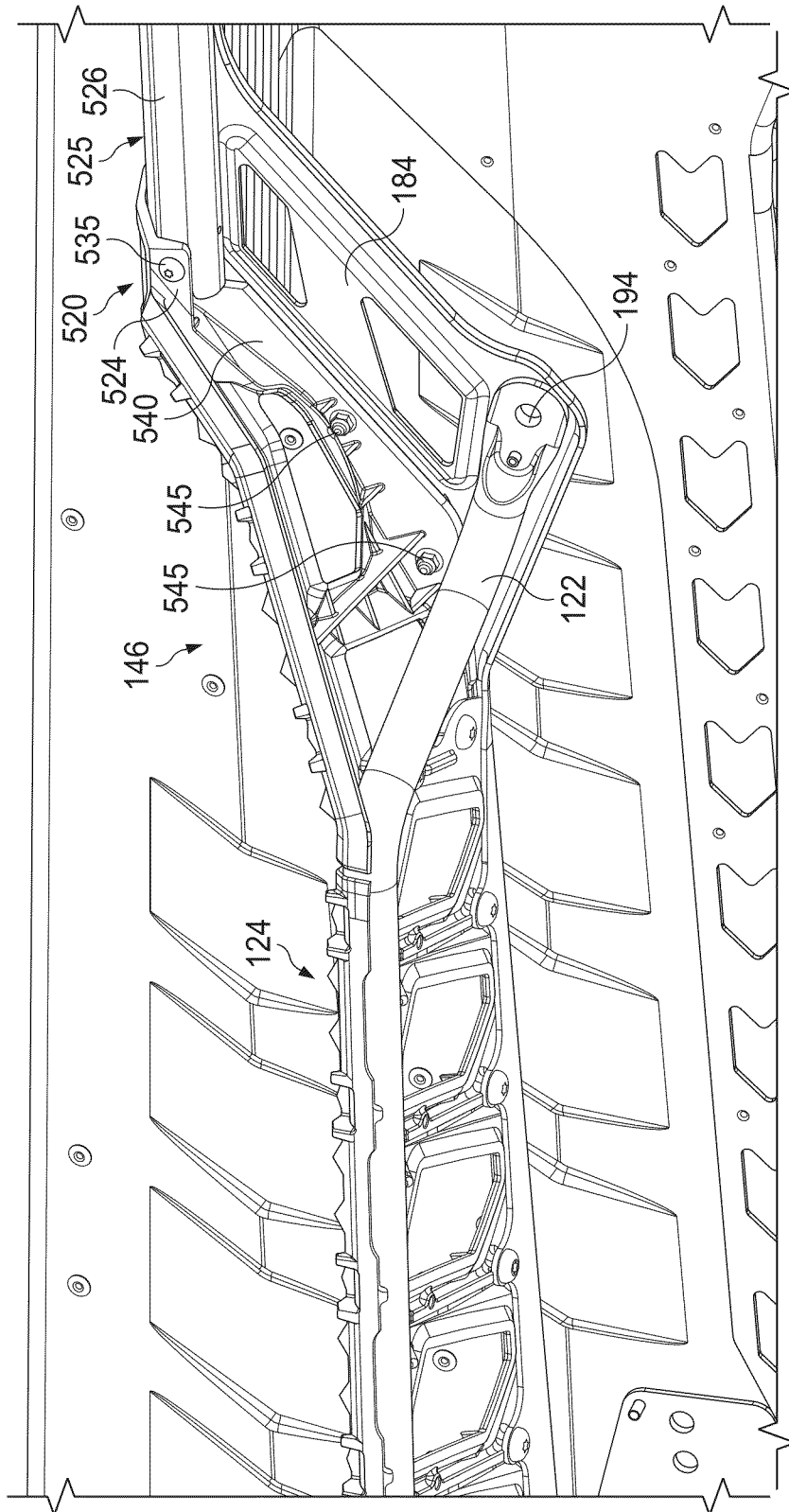


FIG. 17B

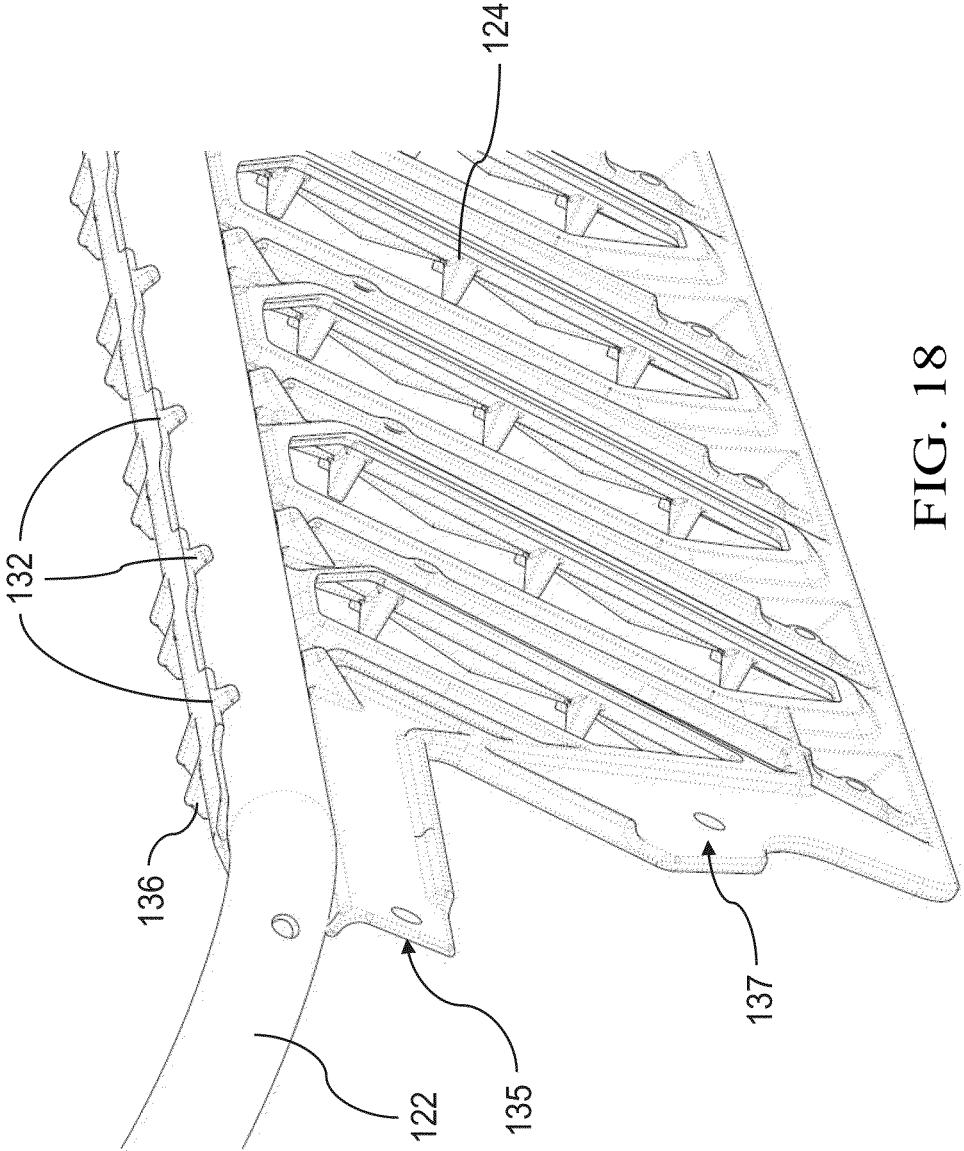
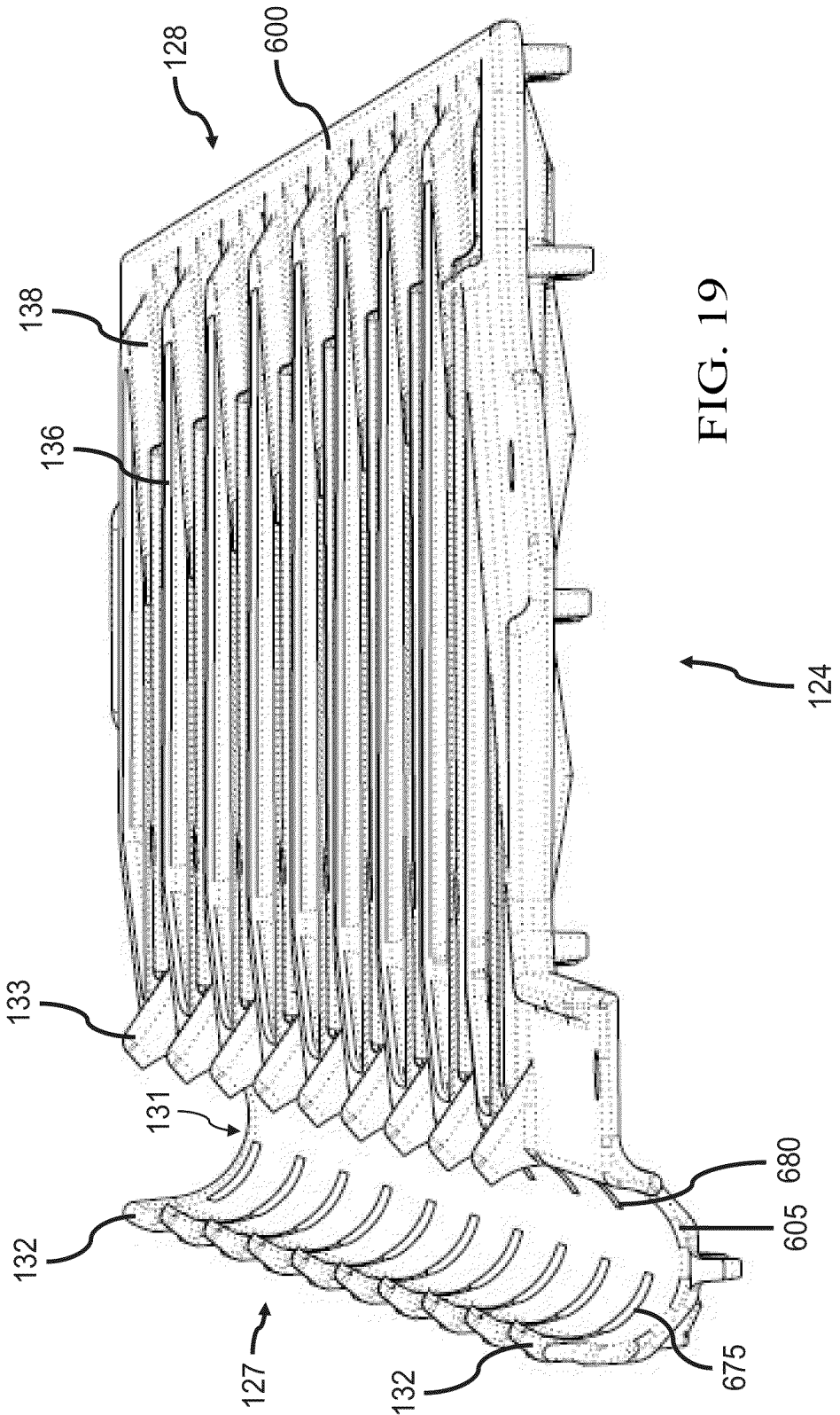


FIG. 18



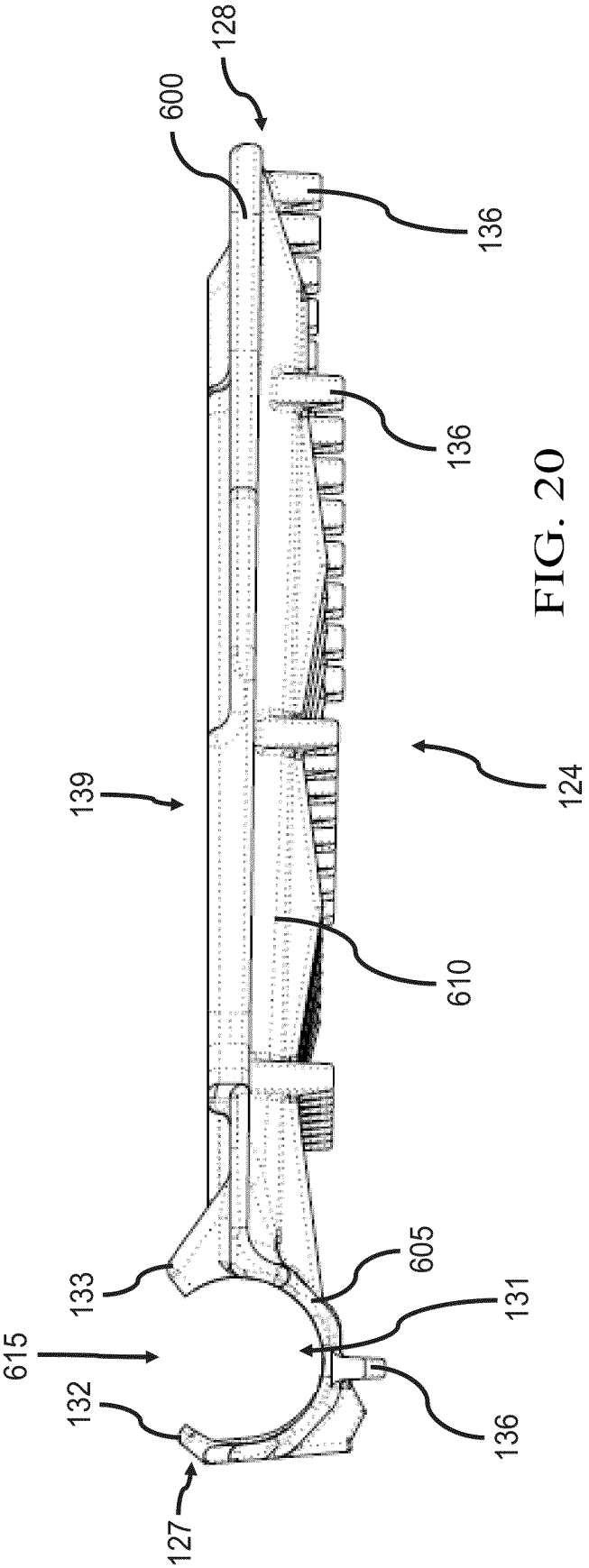


FIG. 20

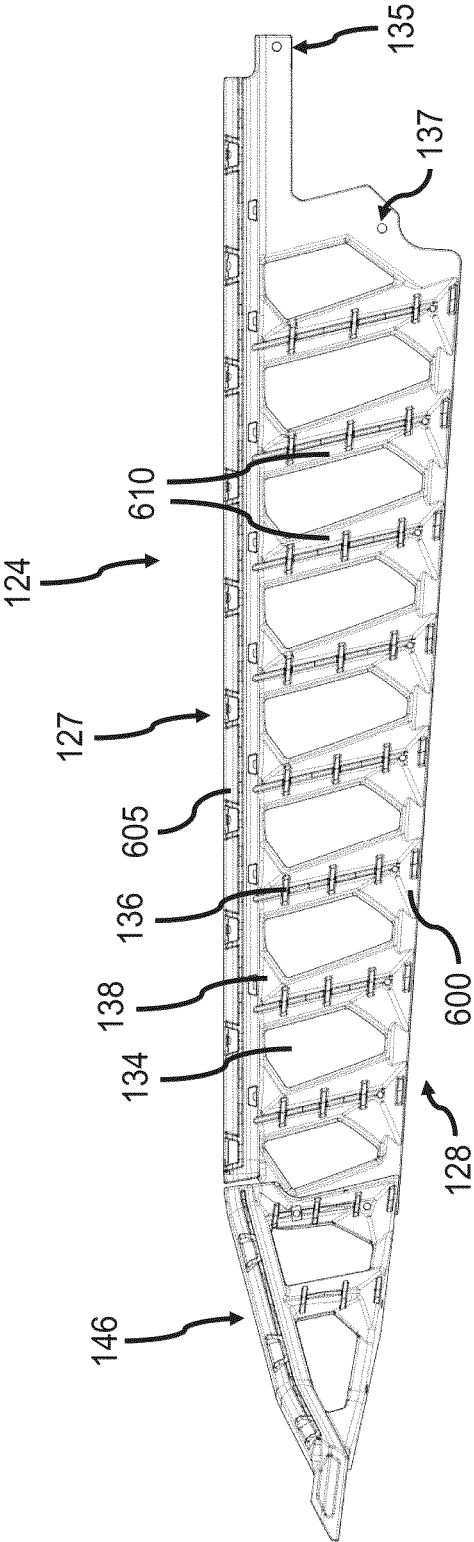


FIG. 21A

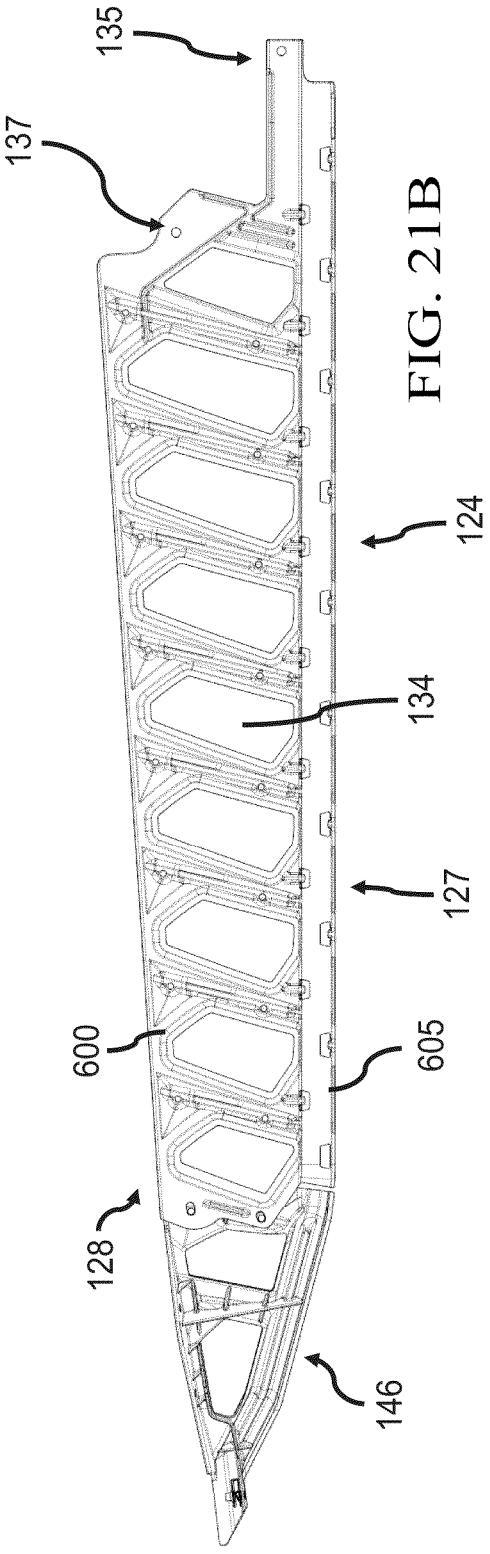


FIG. 21B

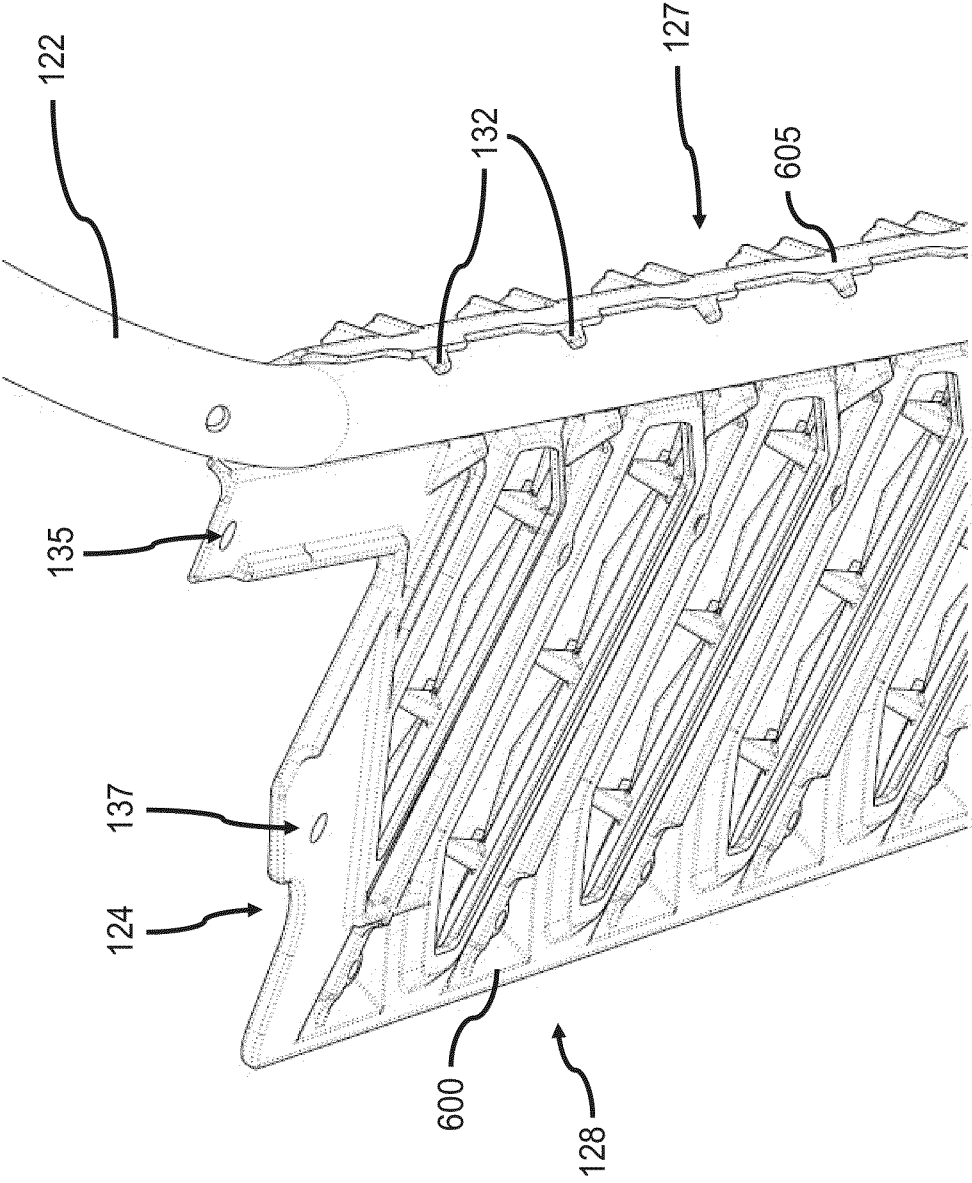


FIG. 22

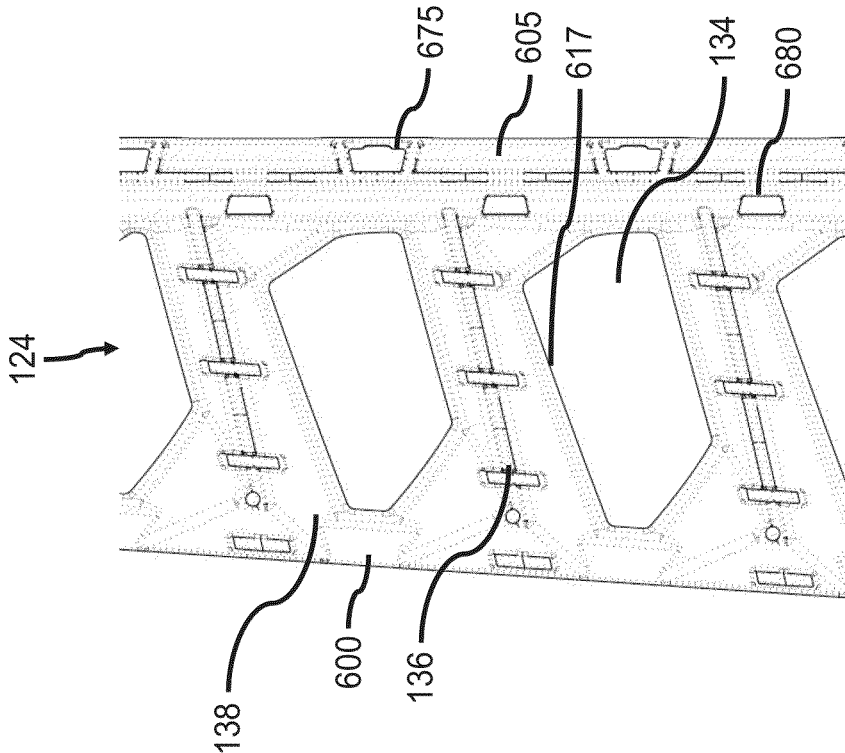


FIG. 23B

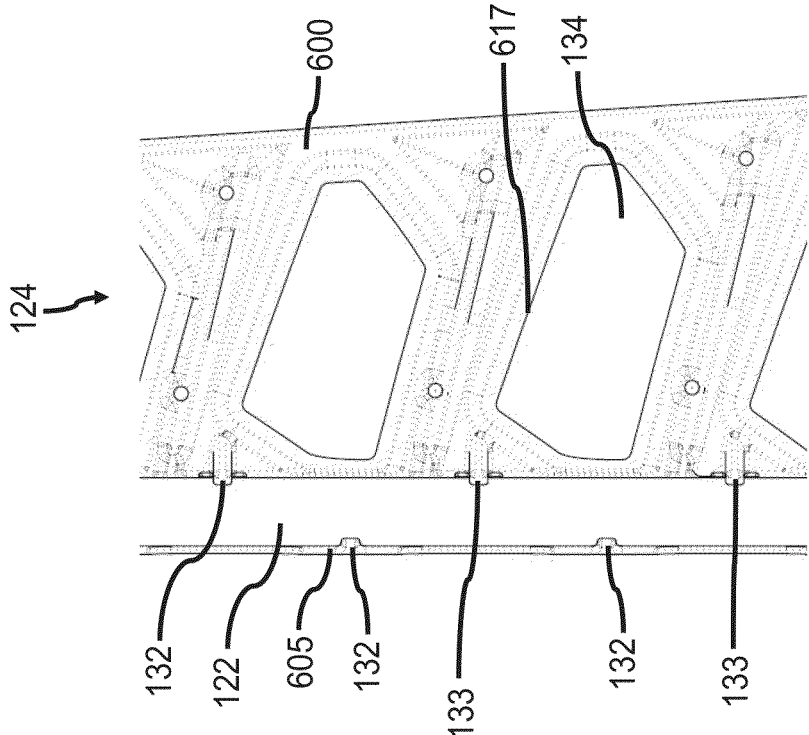


FIG. 23A

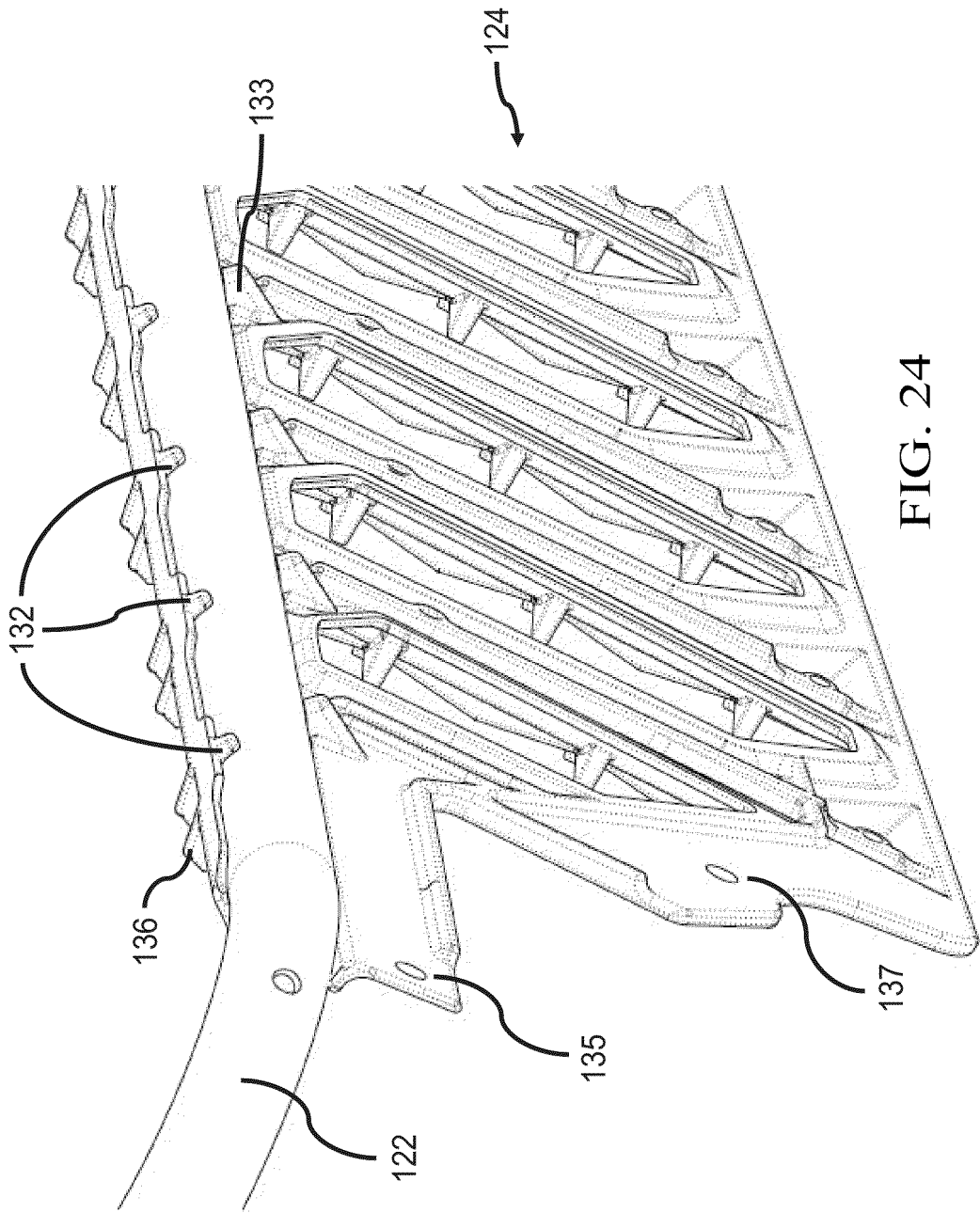


FIG. 24

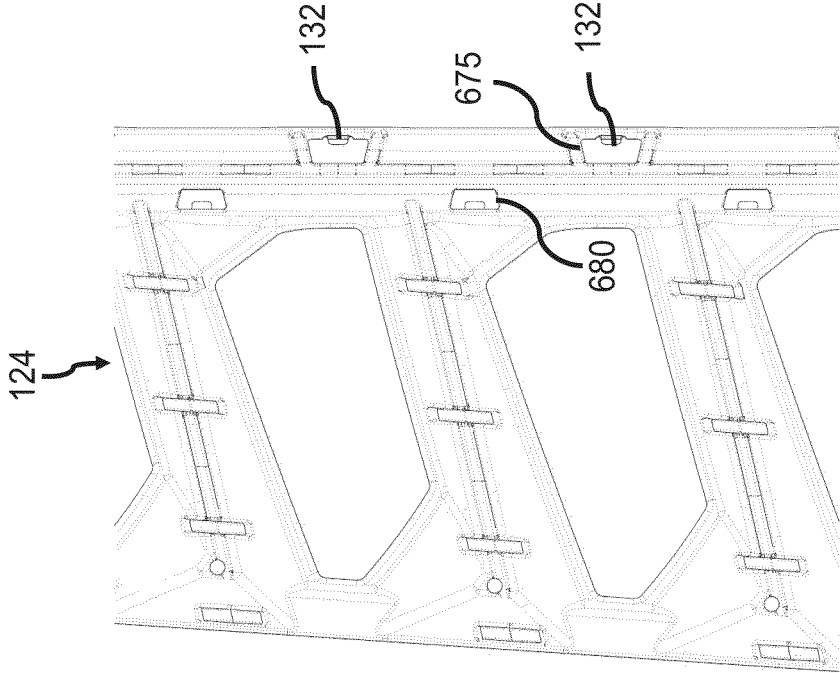


FIG. 25B

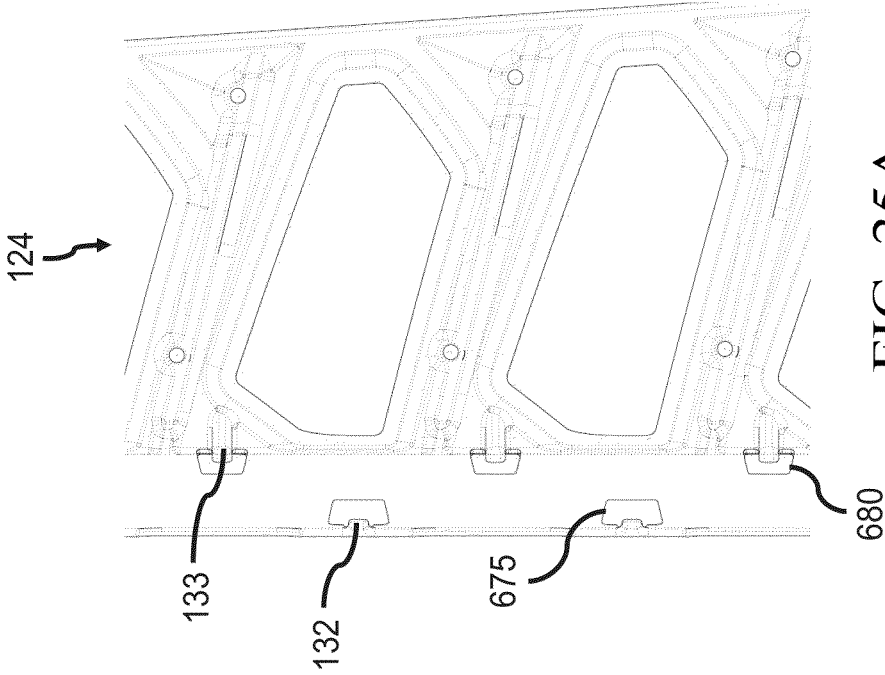


FIG. 25A

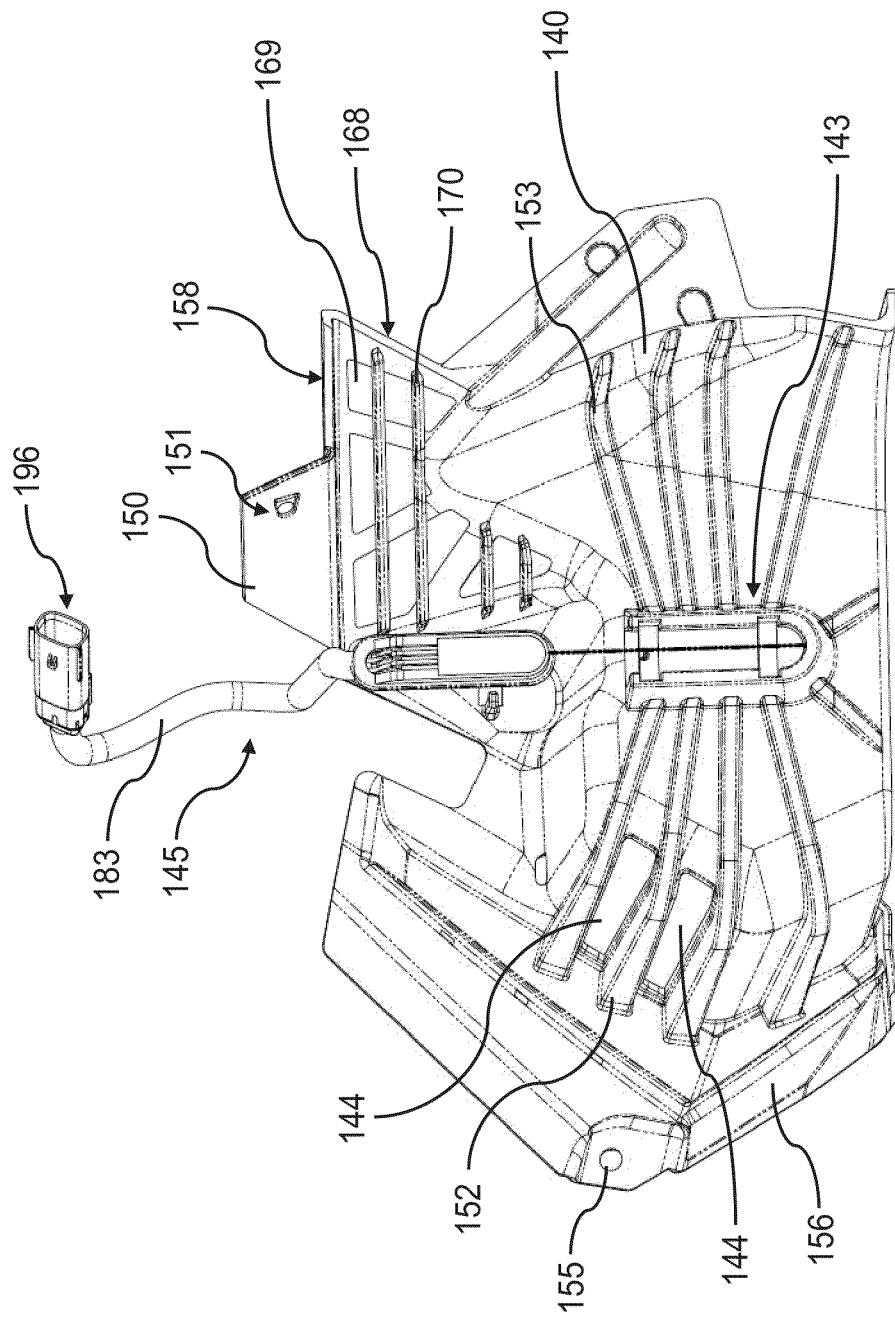


FIG. 26

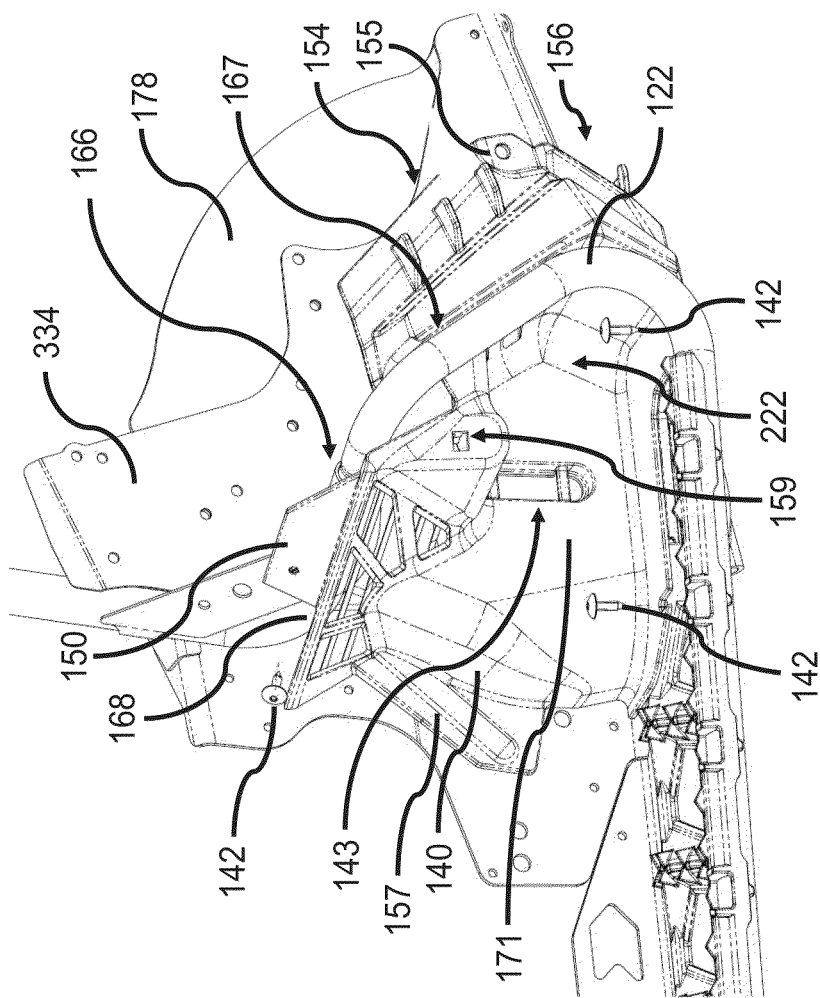


FIG. 27A

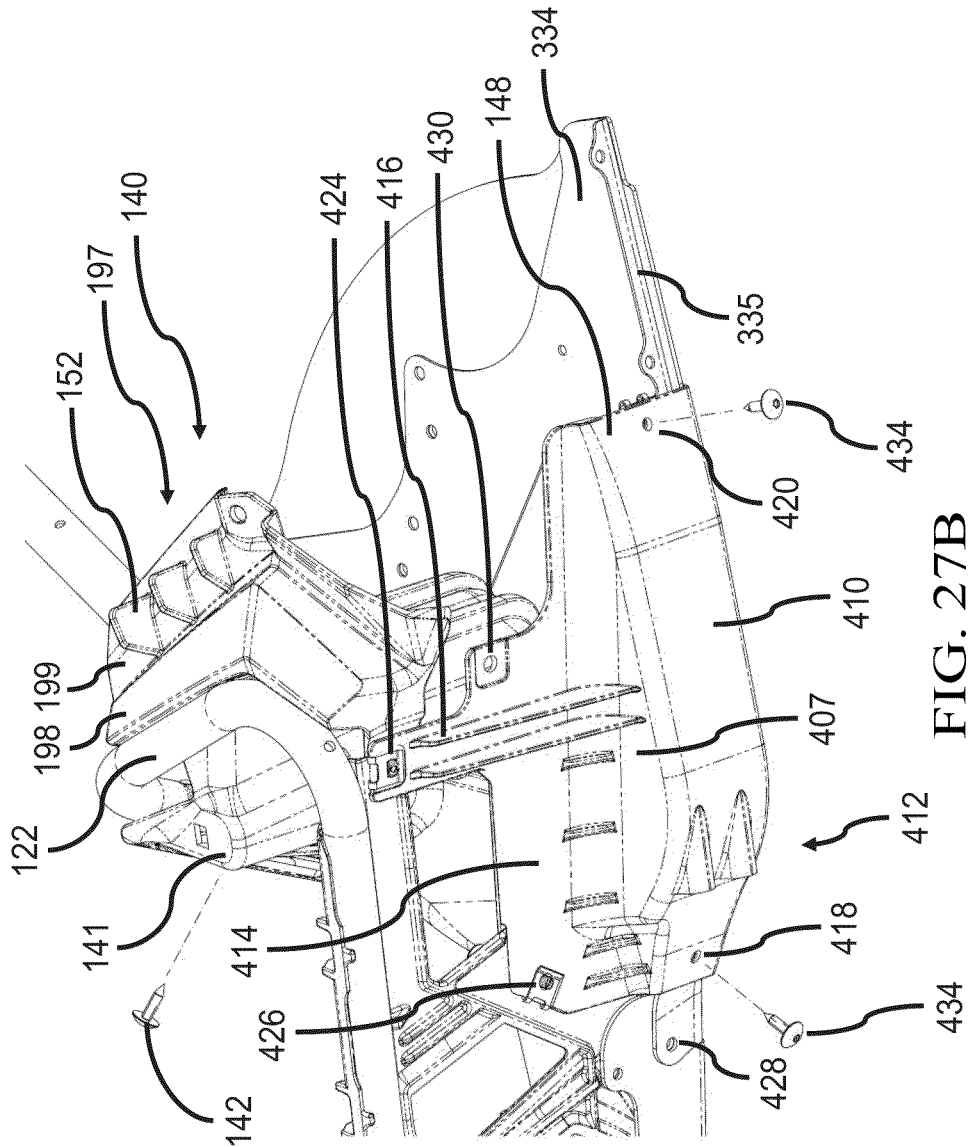


FIG. 27B

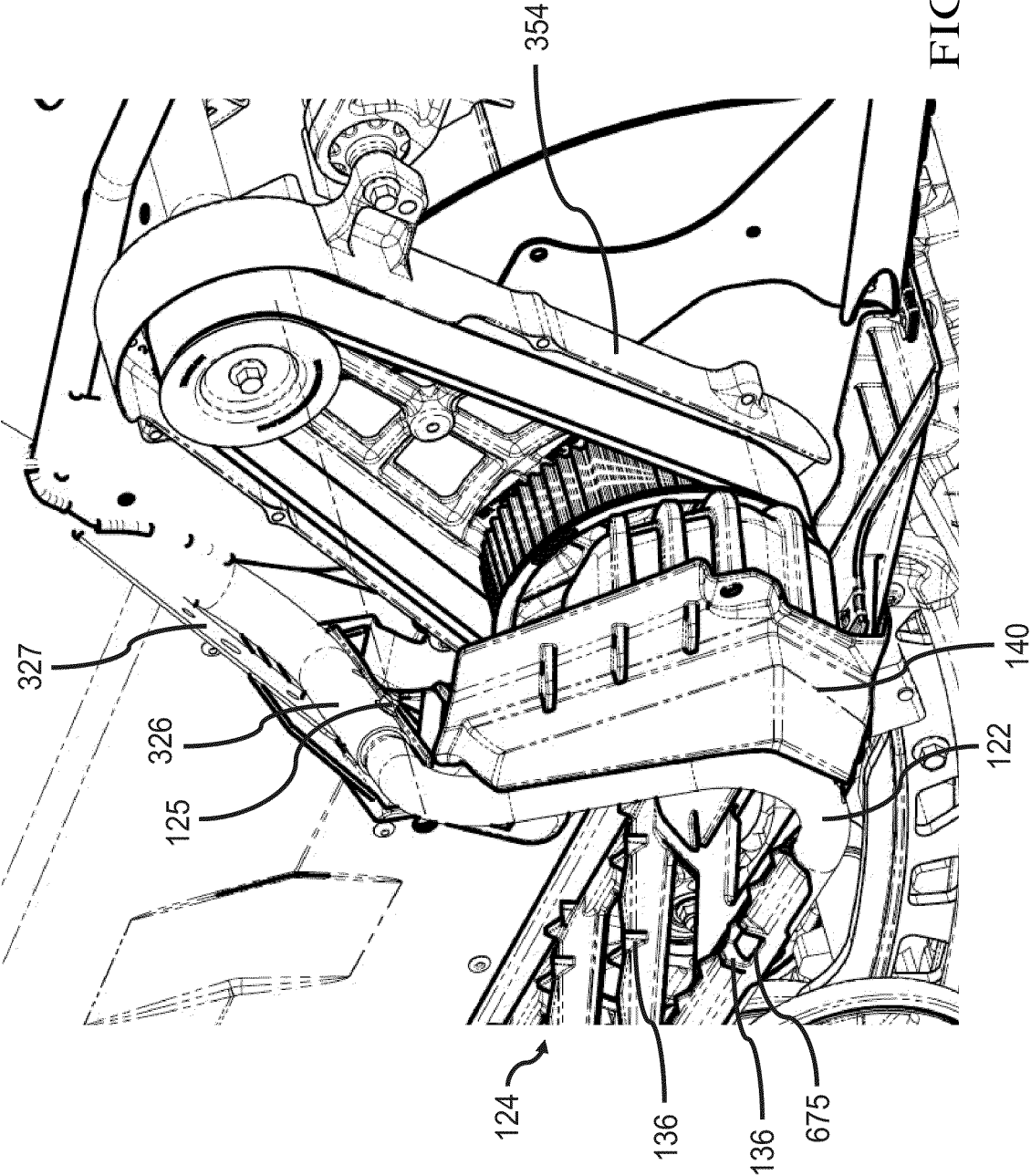


FIG. 28

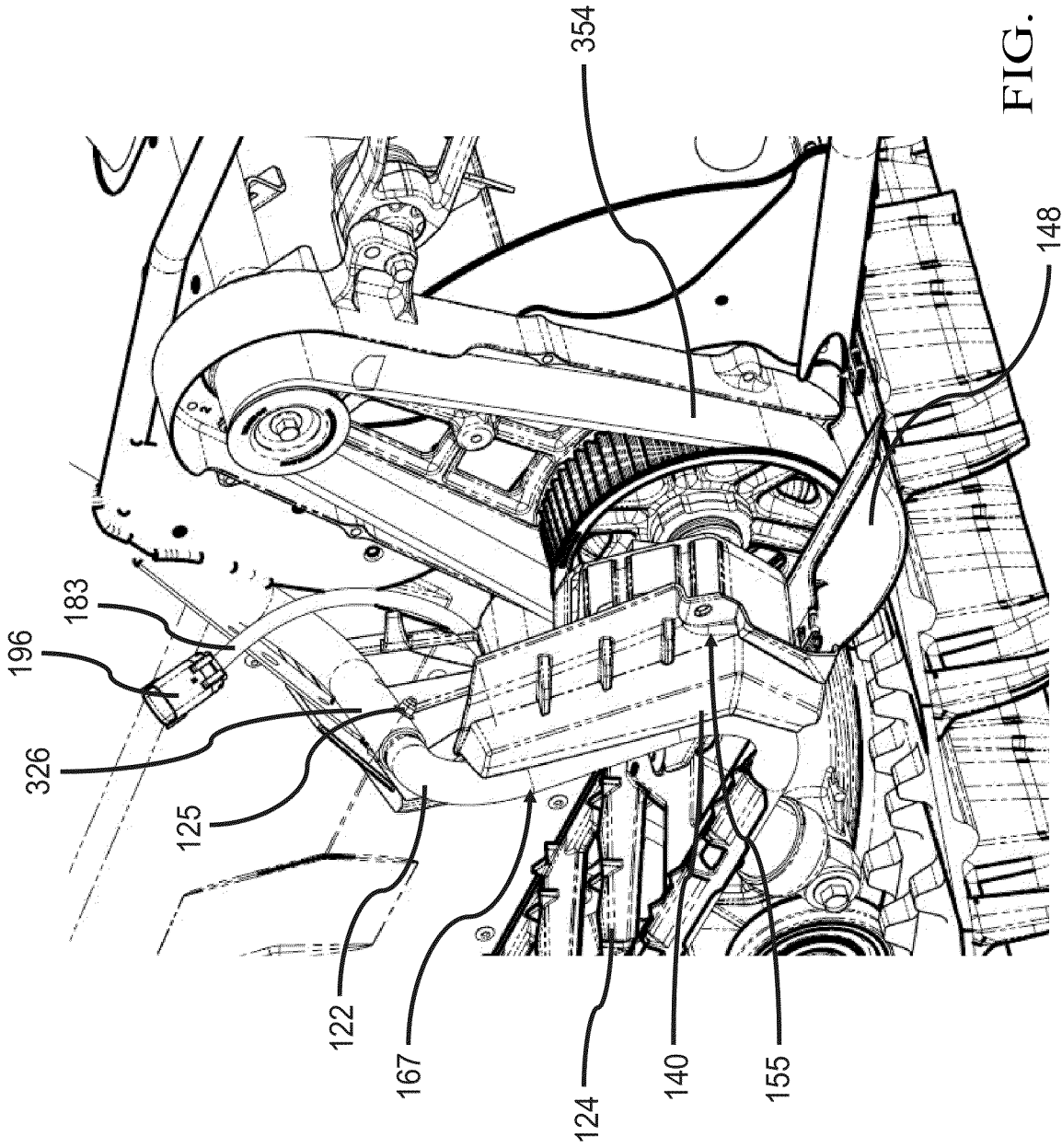


FIG. 29

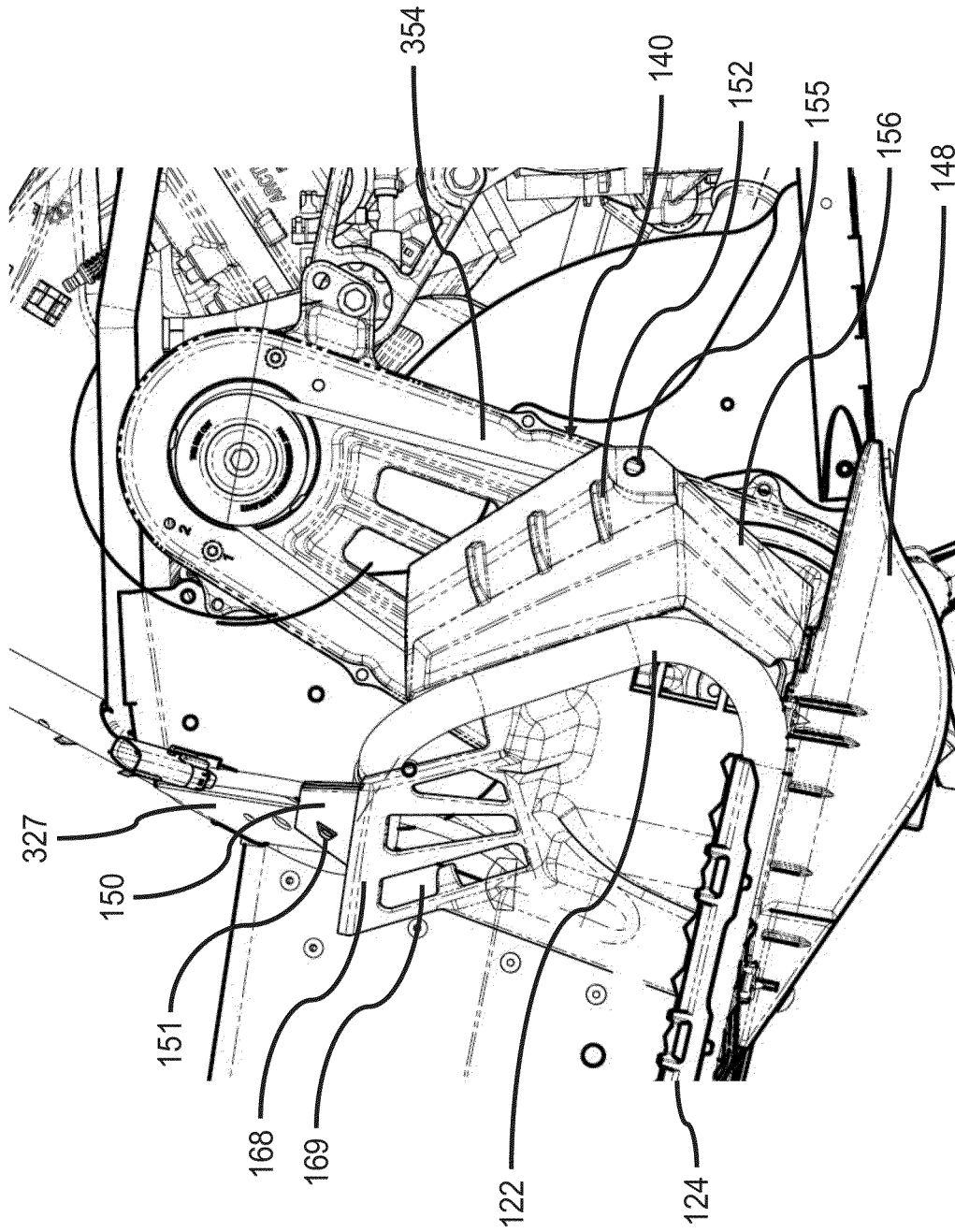


FIG. 30

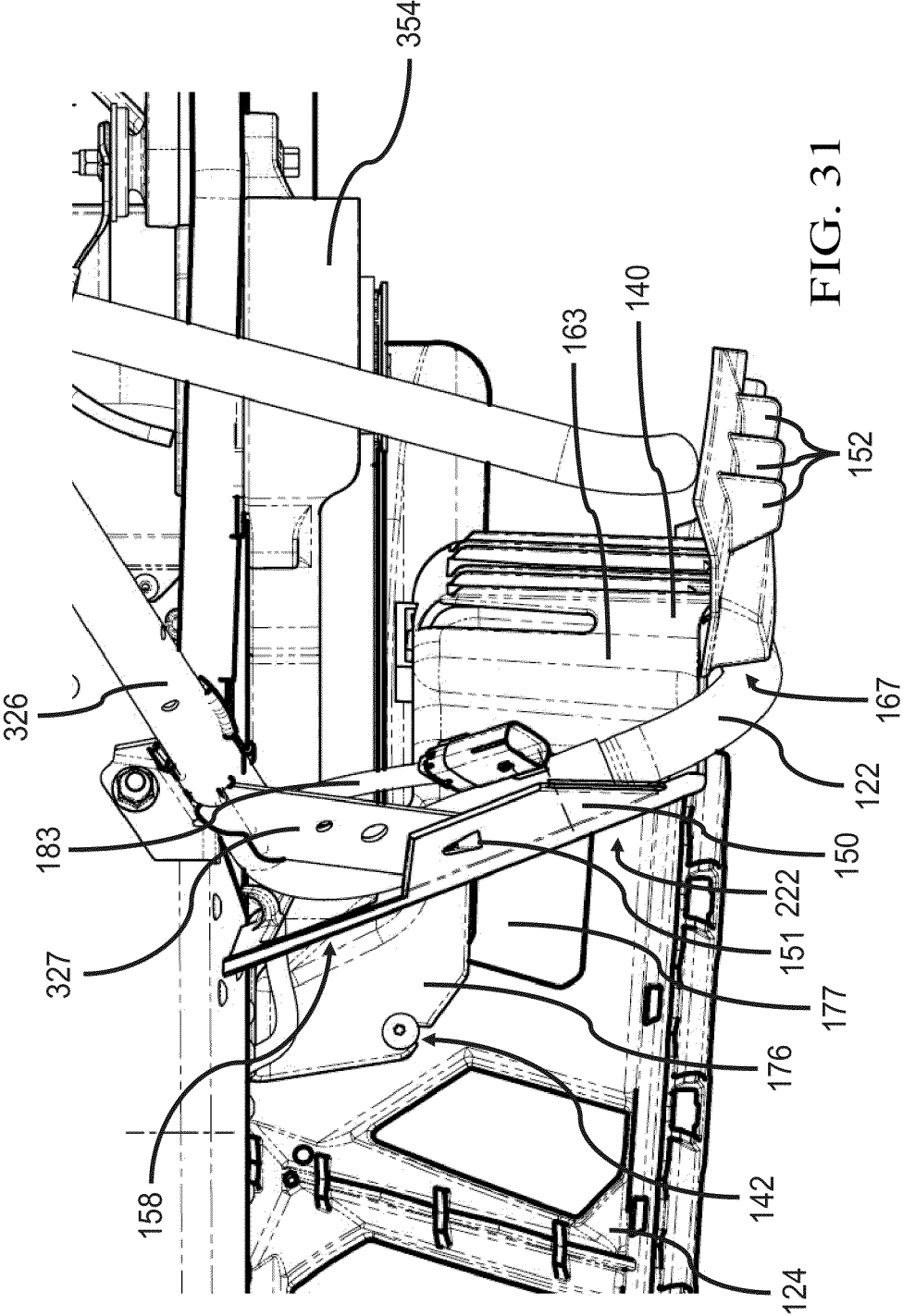


FIG. 31

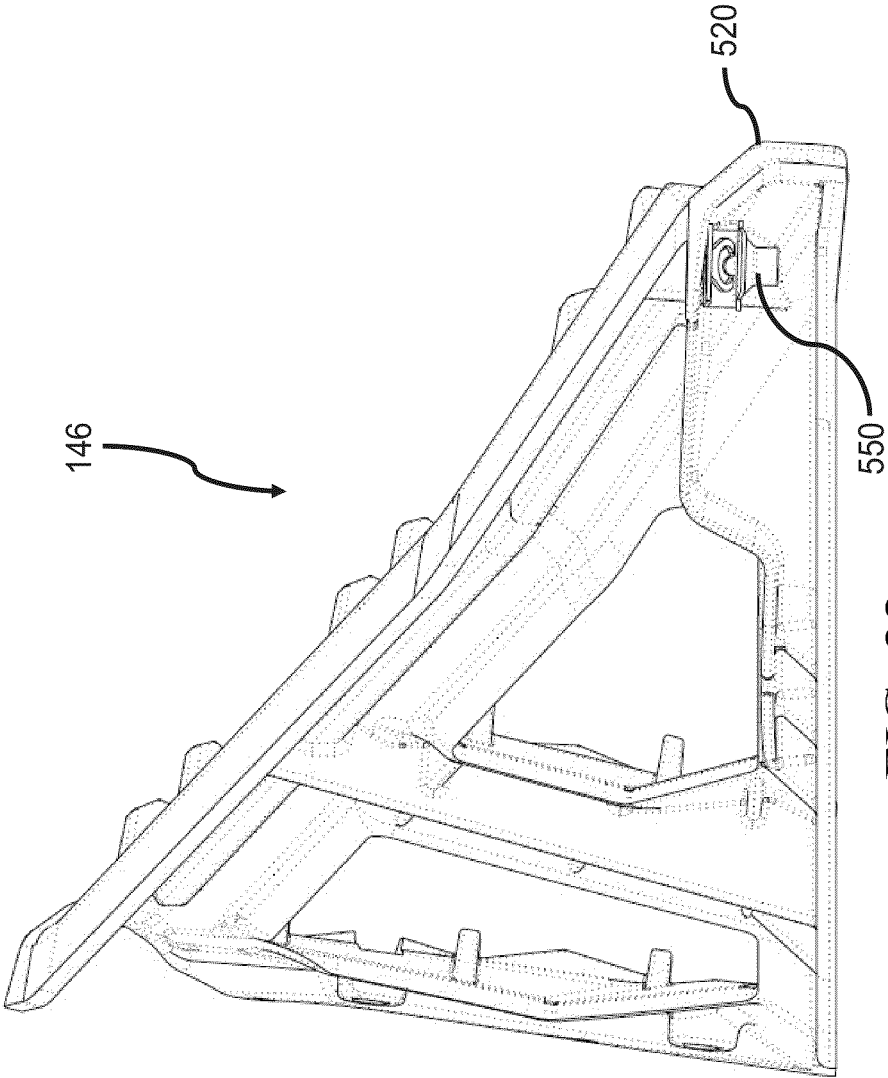


FIG. 32

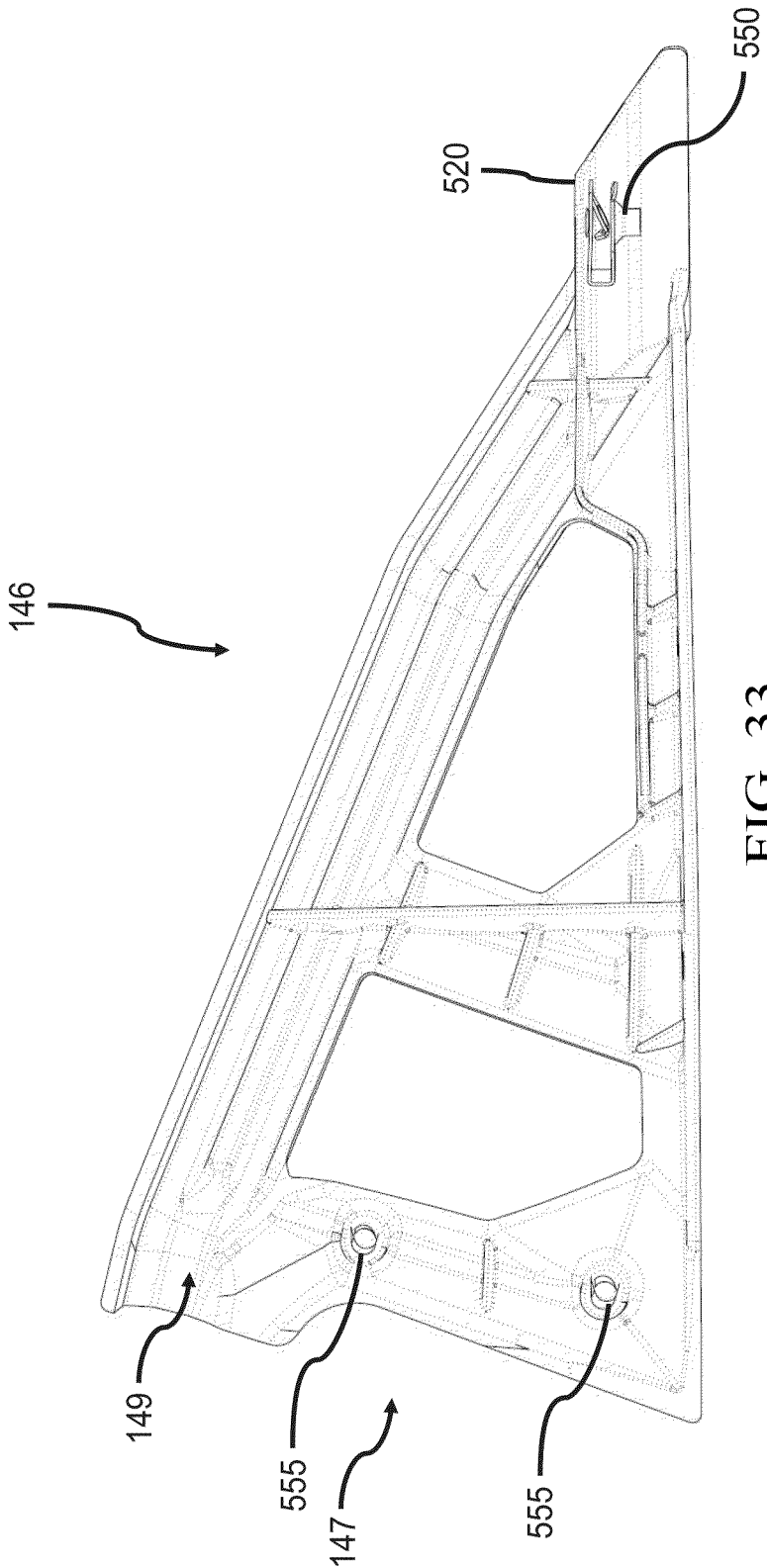


FIG. 33

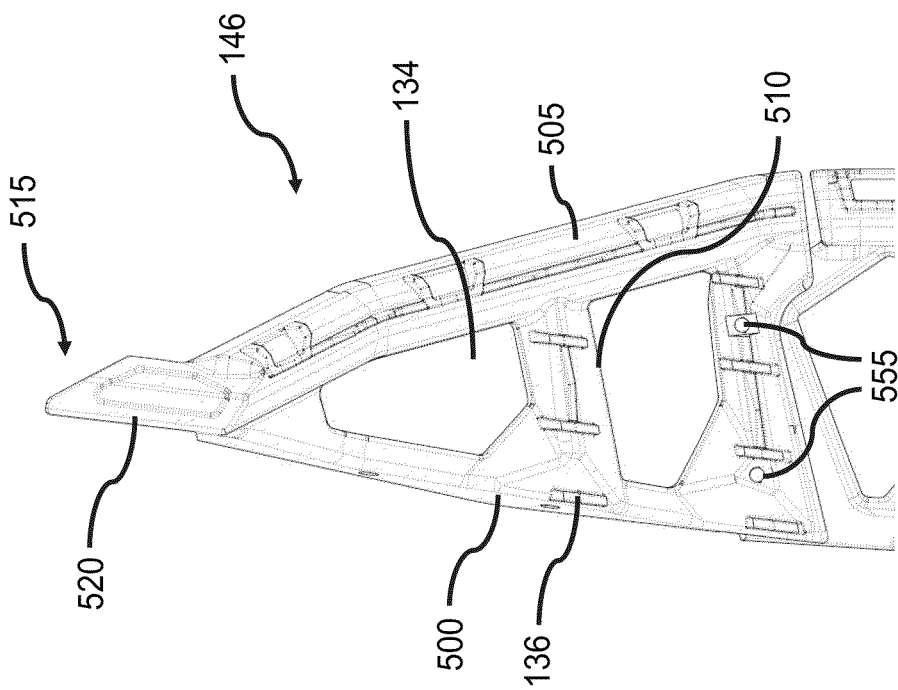


FIG. 34B

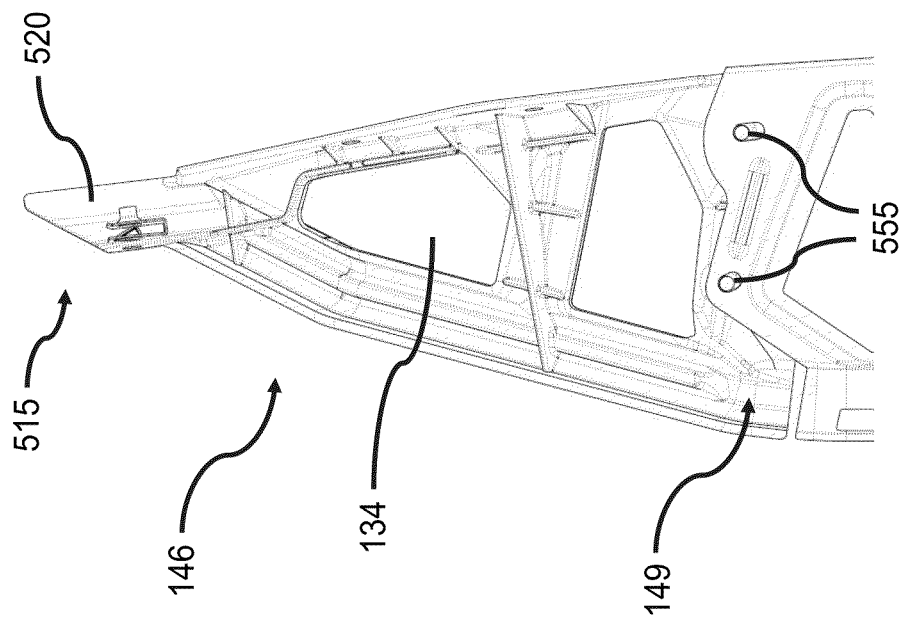


FIG. 34A

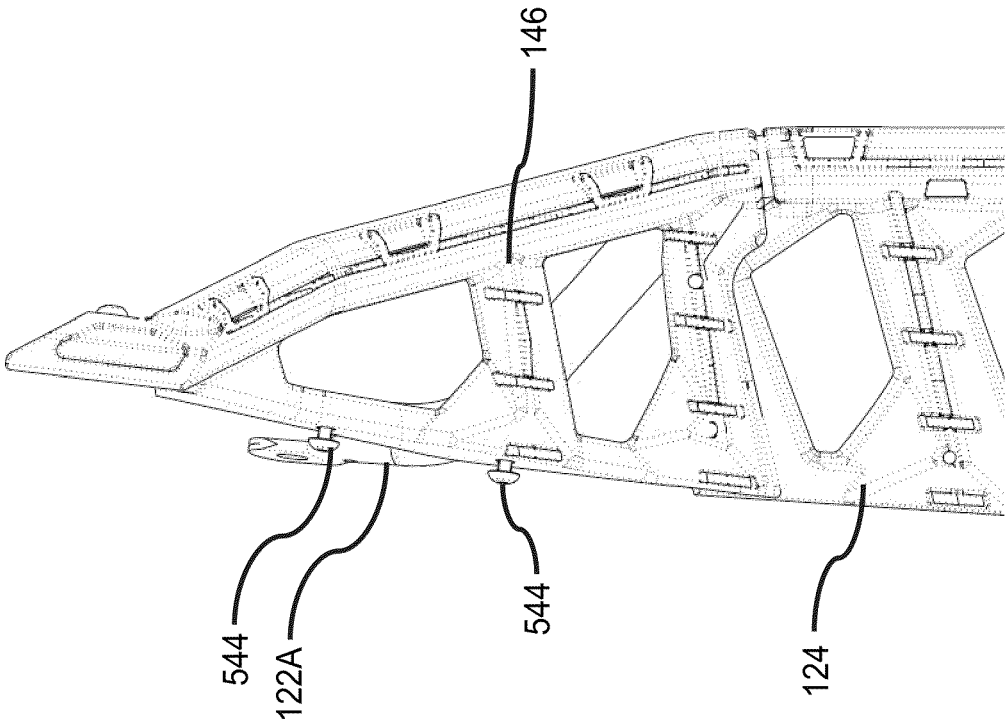


FIG. 35B

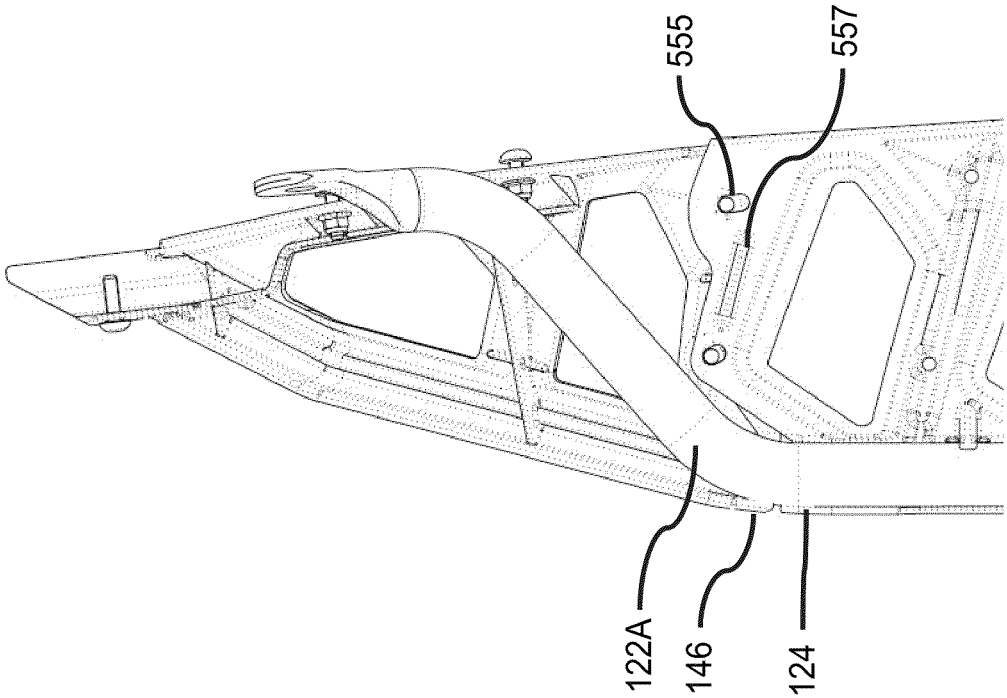


FIG. 35A

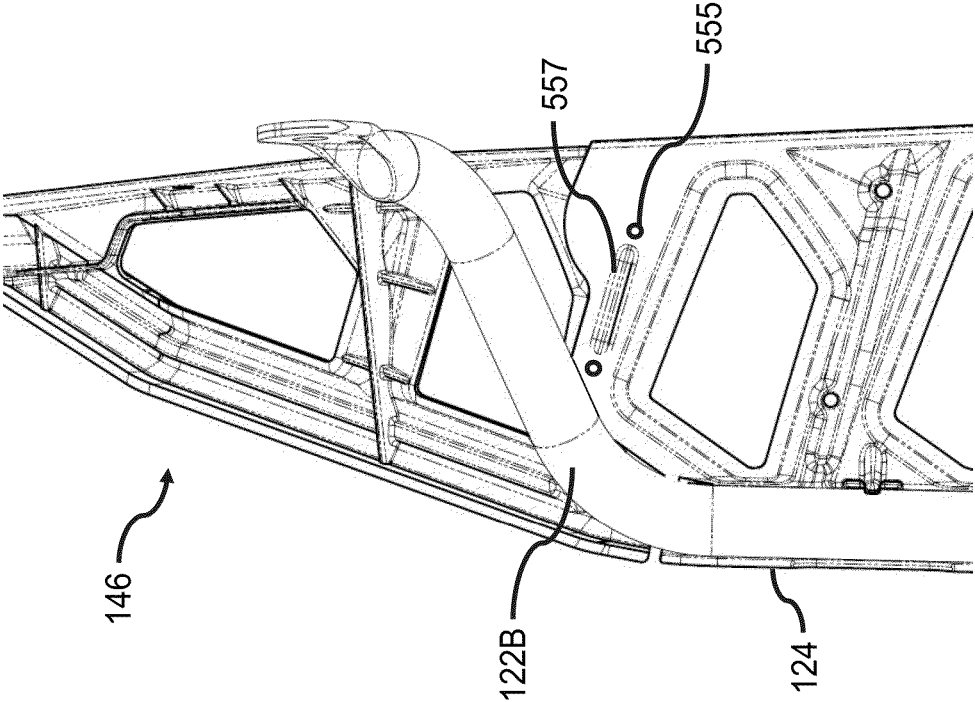
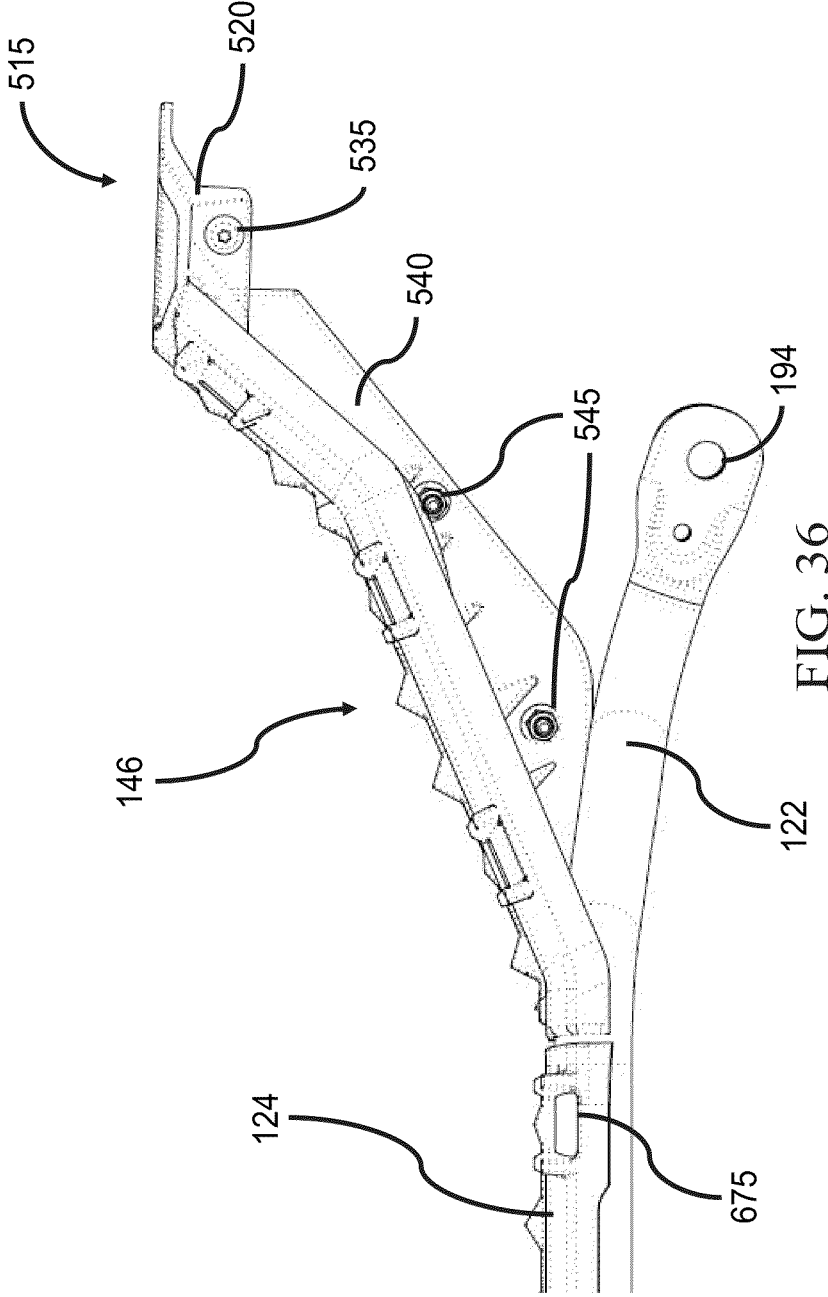


FIG. 35C



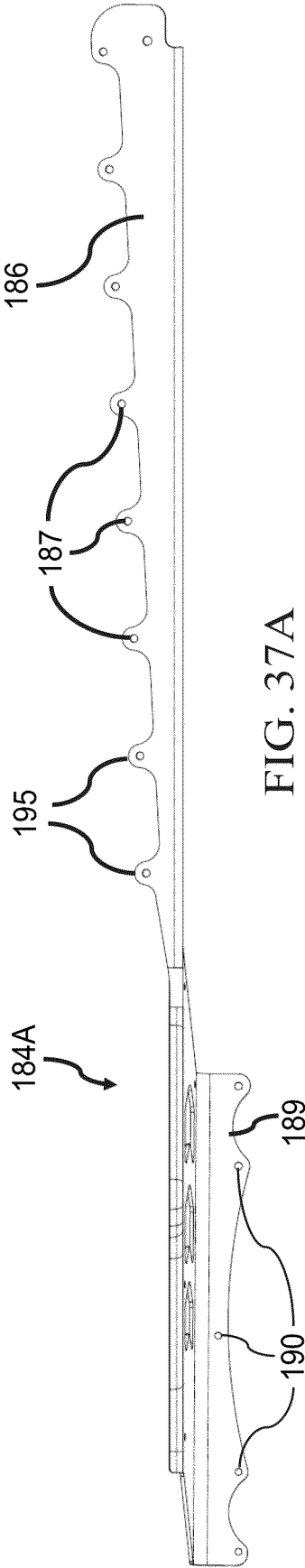


FIG. 37A

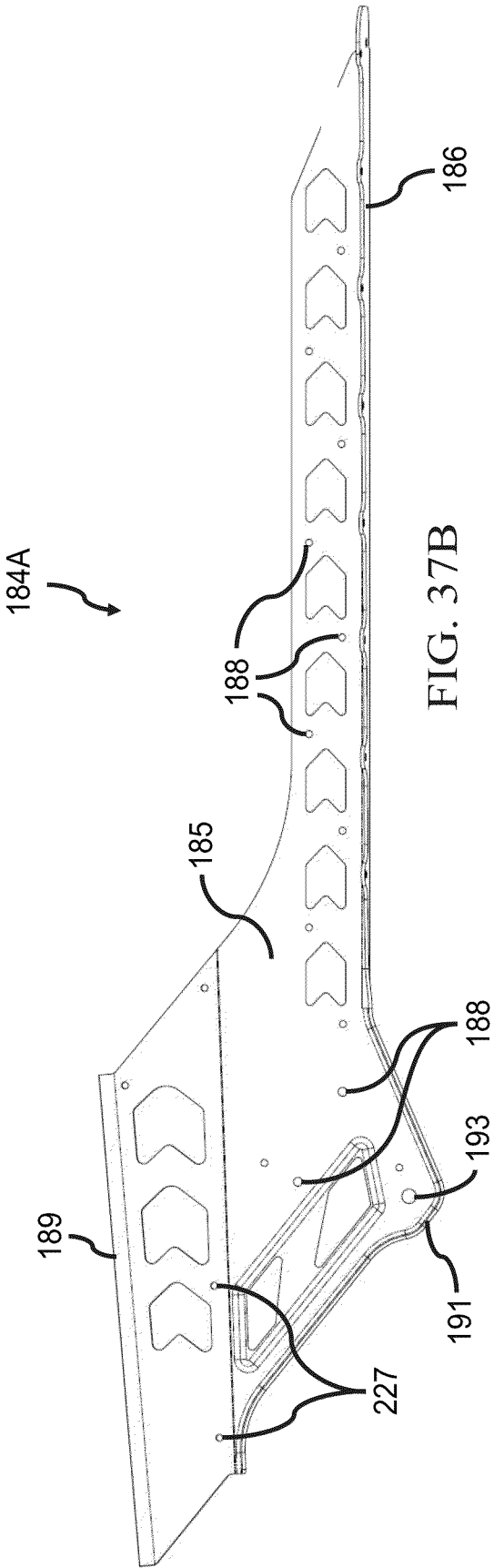


FIG. 37B

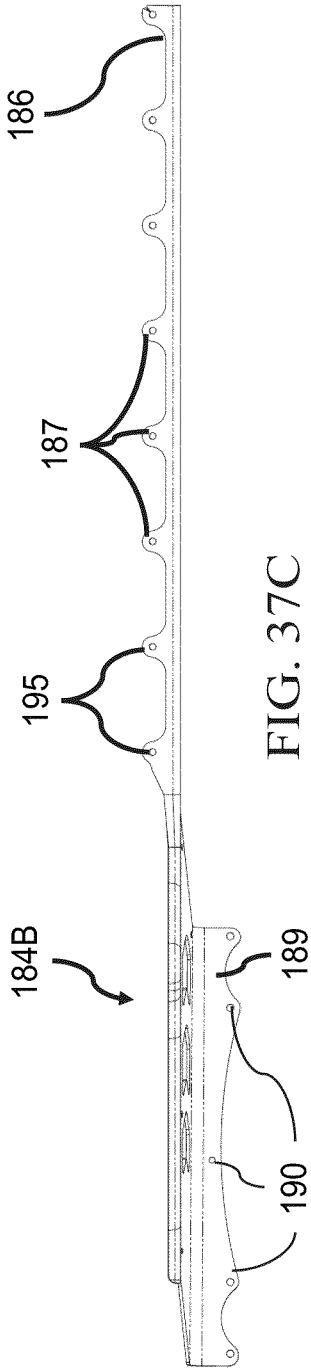


FIG. 37C

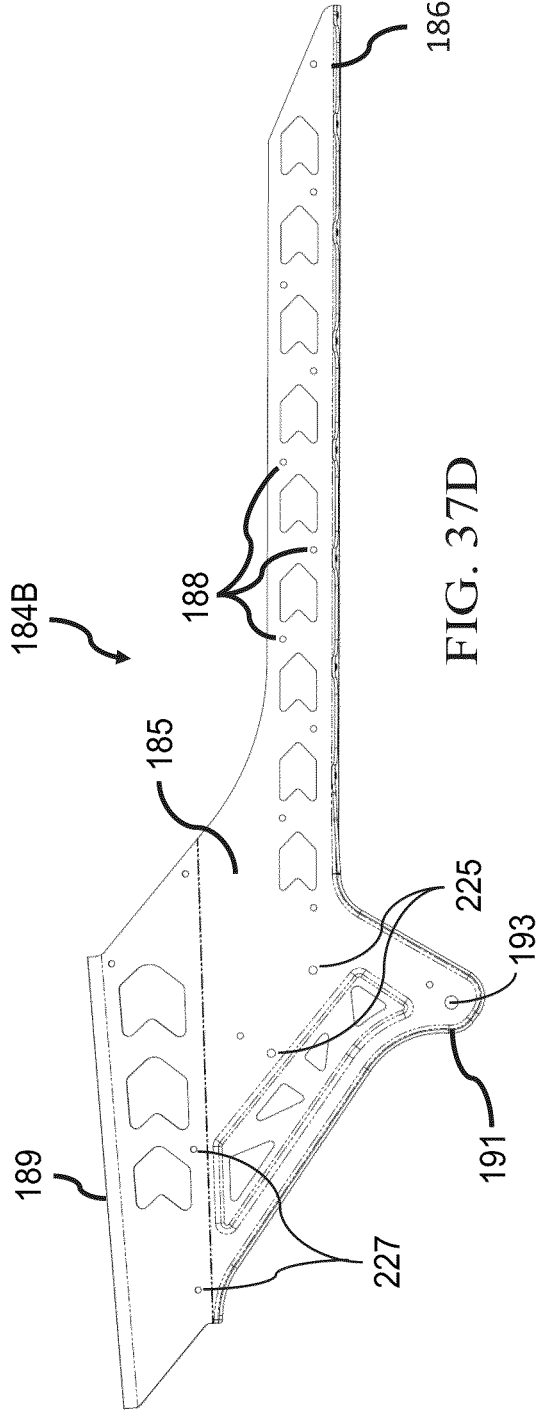


FIG. 37D

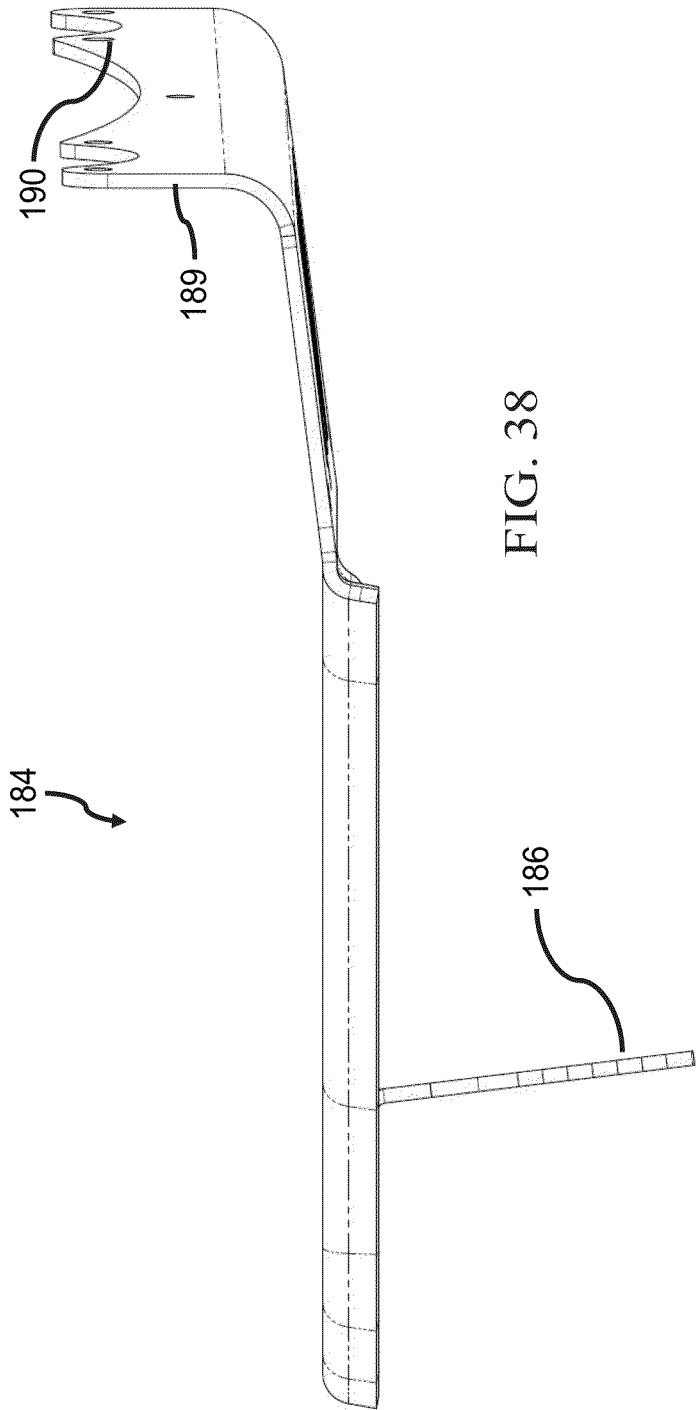


FIG. 38

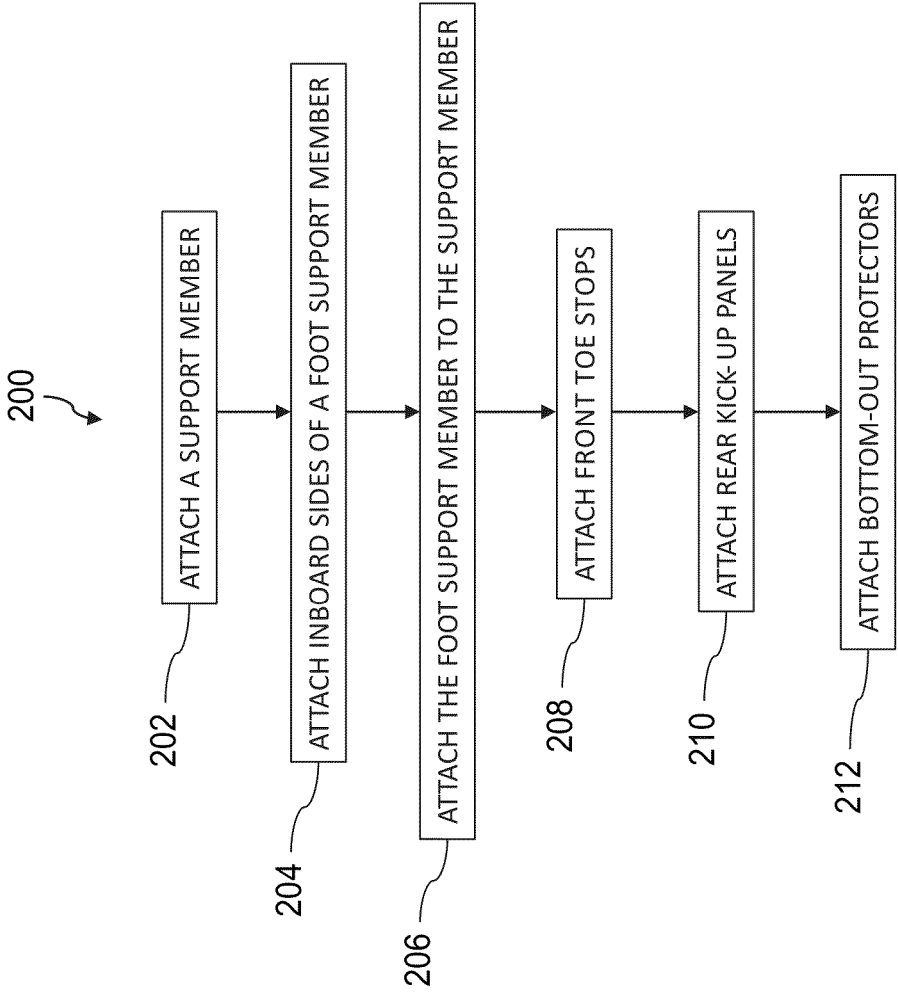
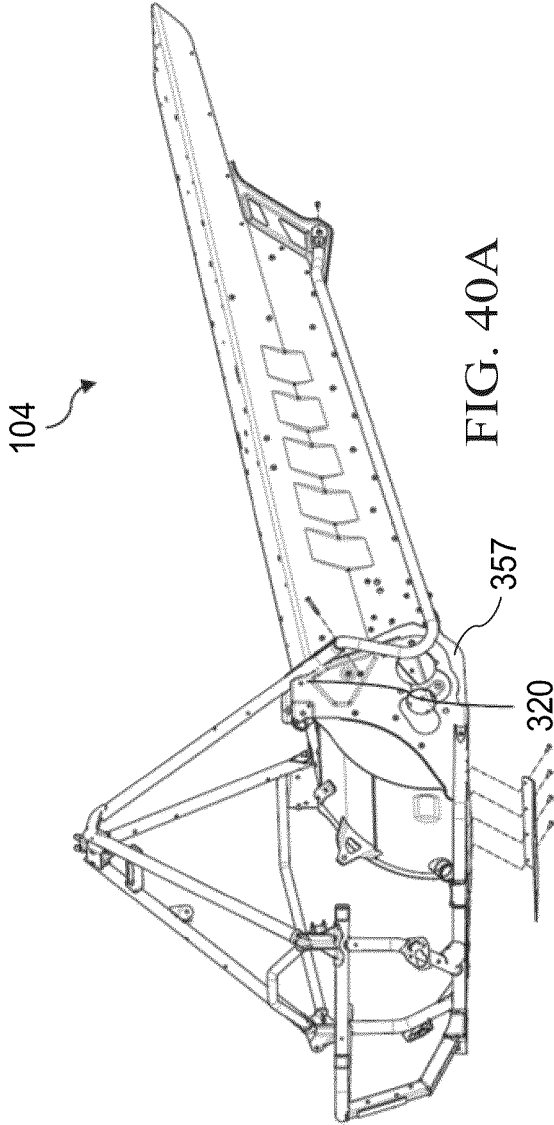


FIG. 39



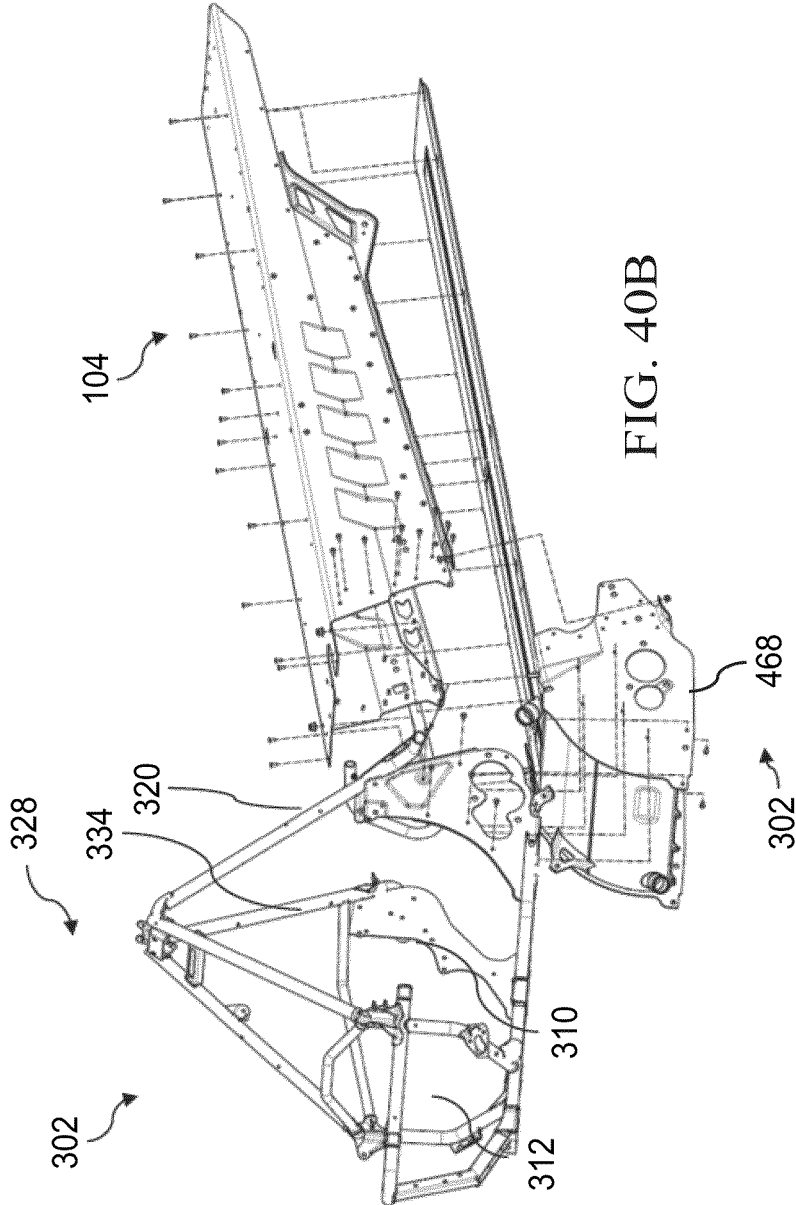
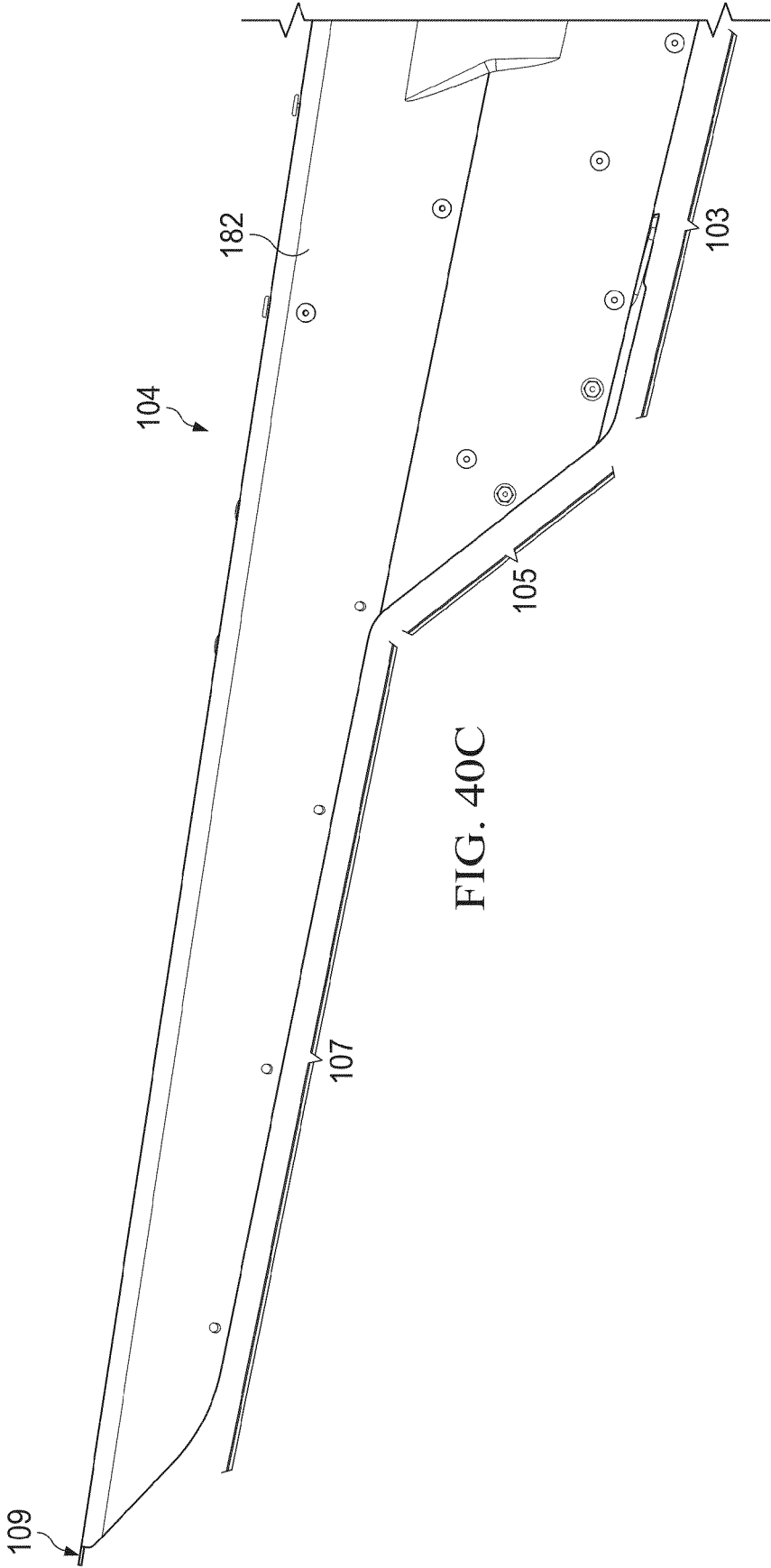


FIG. 40B



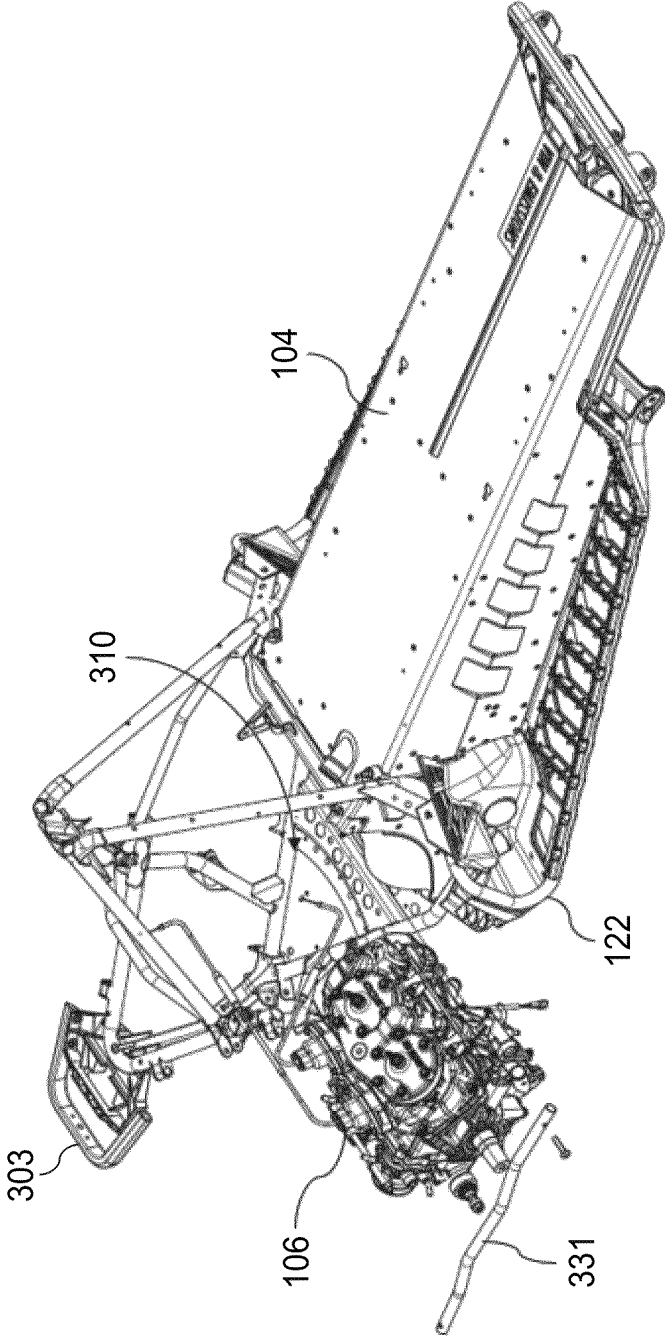


FIG. 41A

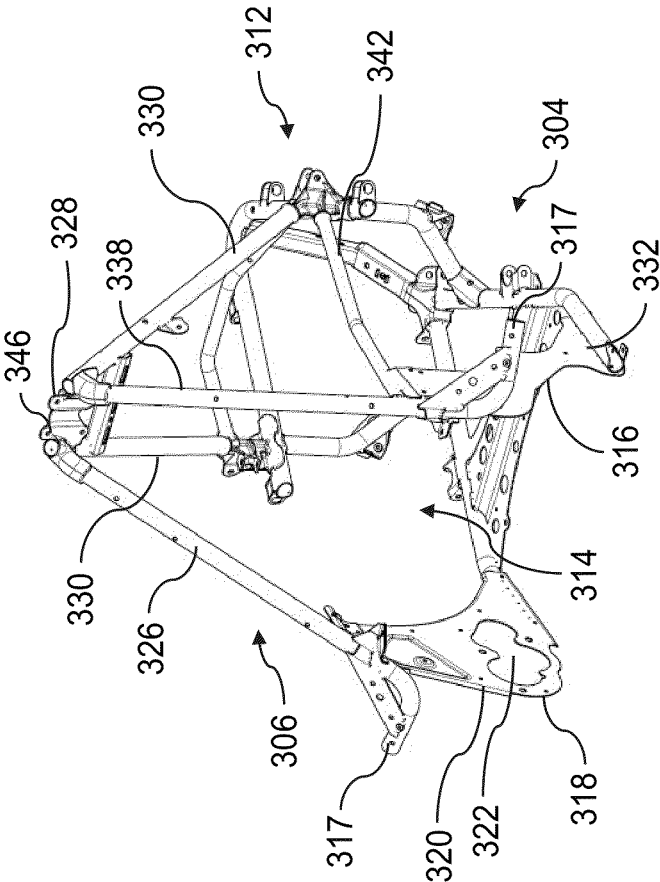


FIG. 41B

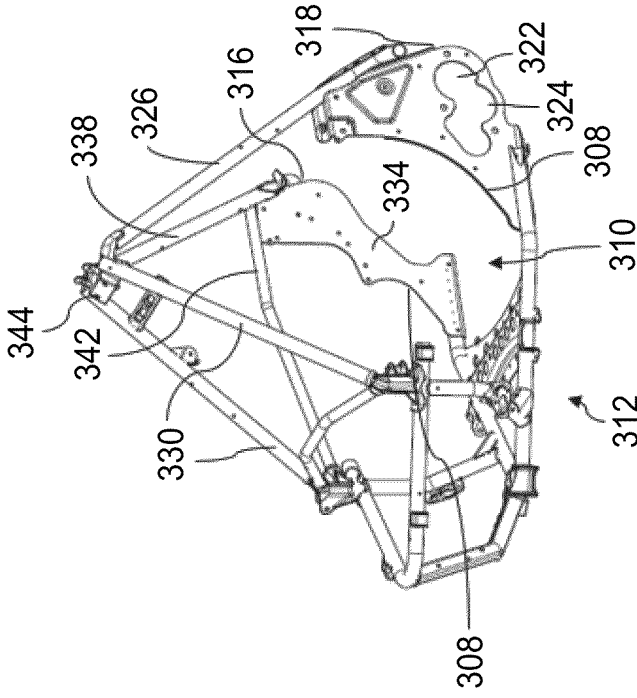


FIG. 41C

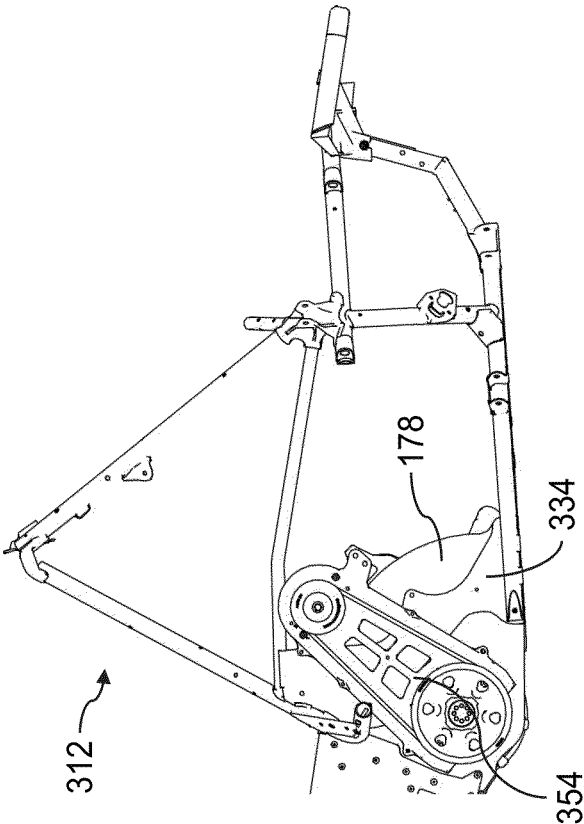


FIG. 42A

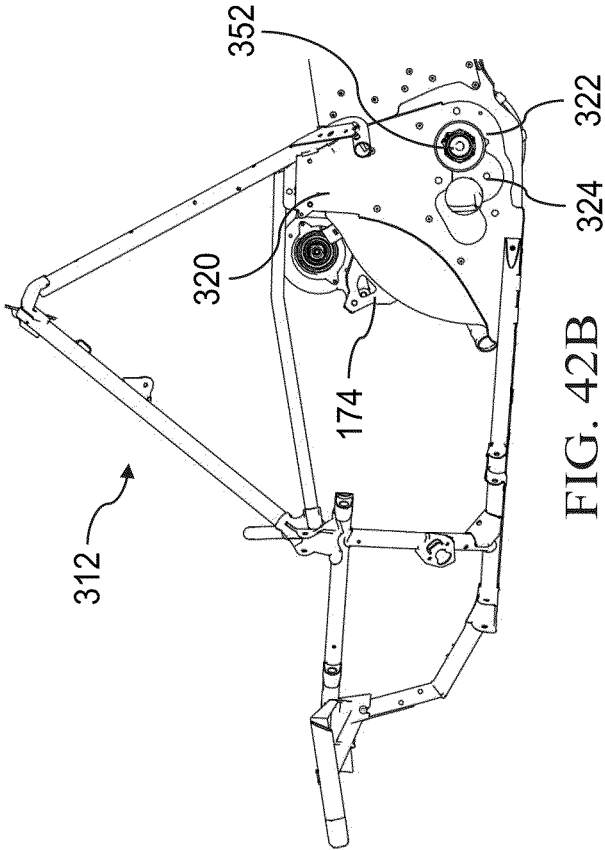


FIG. 42B

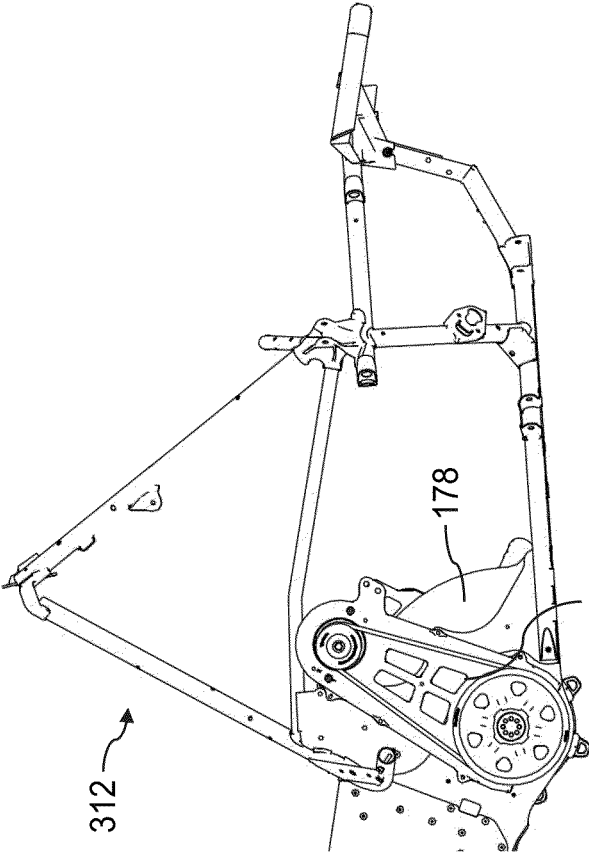


FIG. 42C

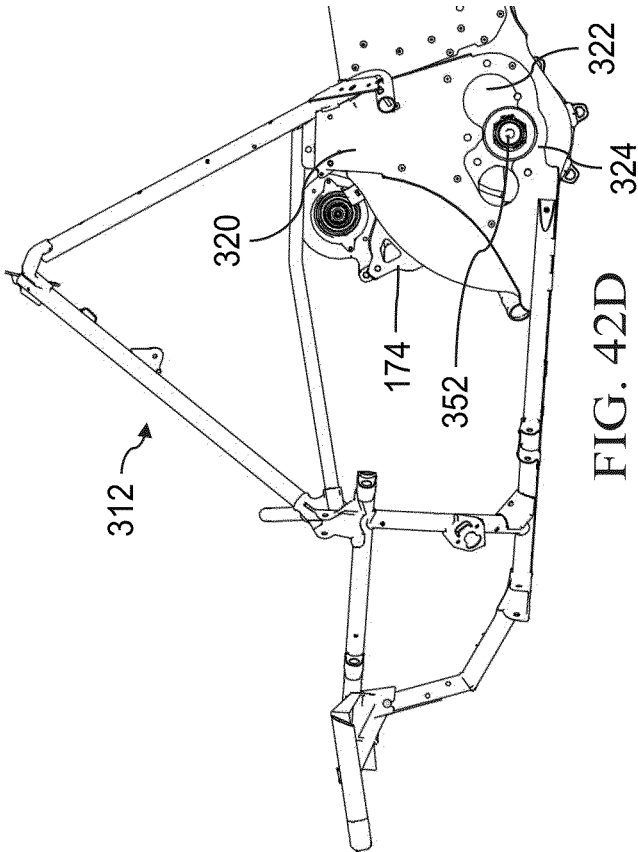


FIG. 42D

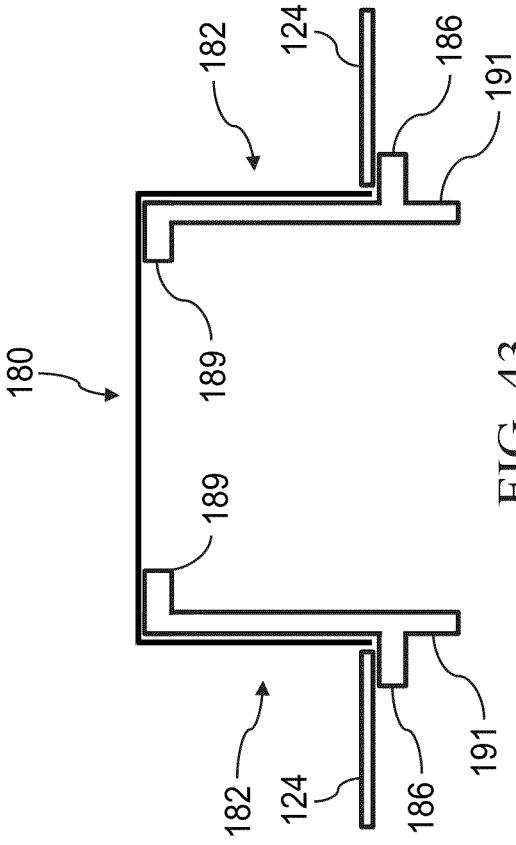


FIG. 43

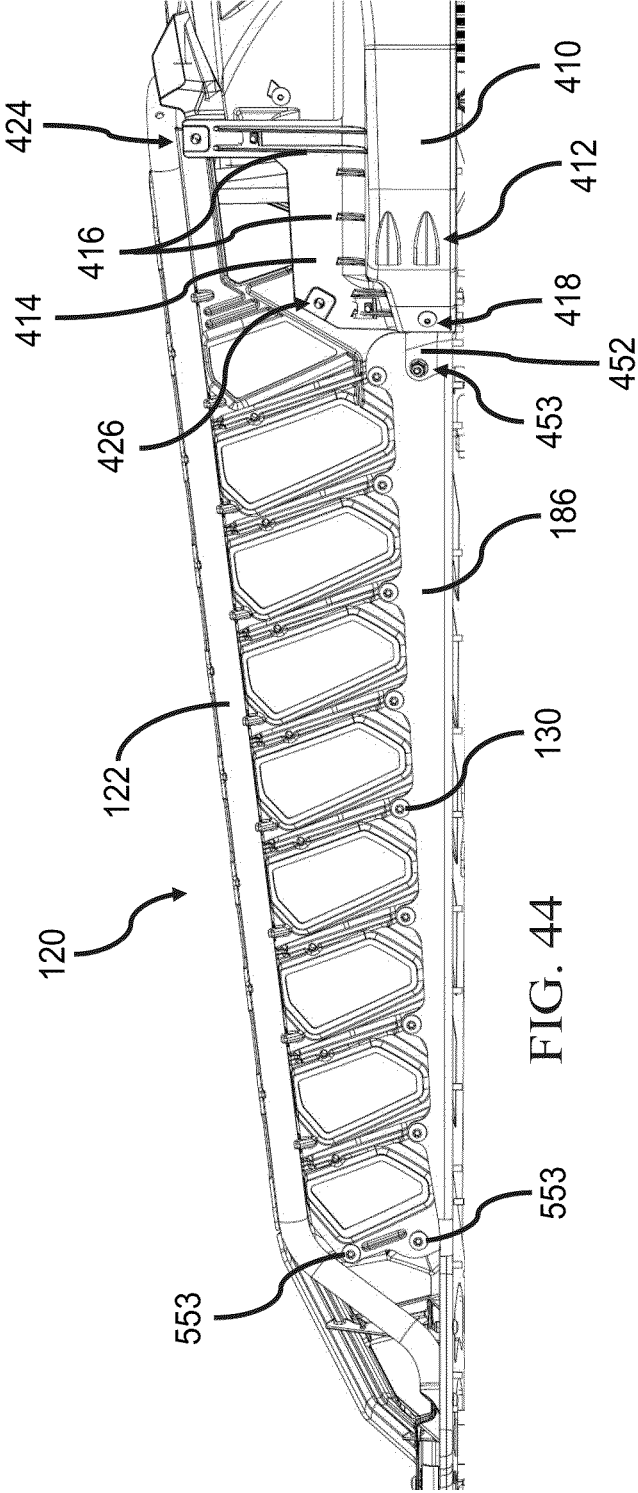


FIG. 44

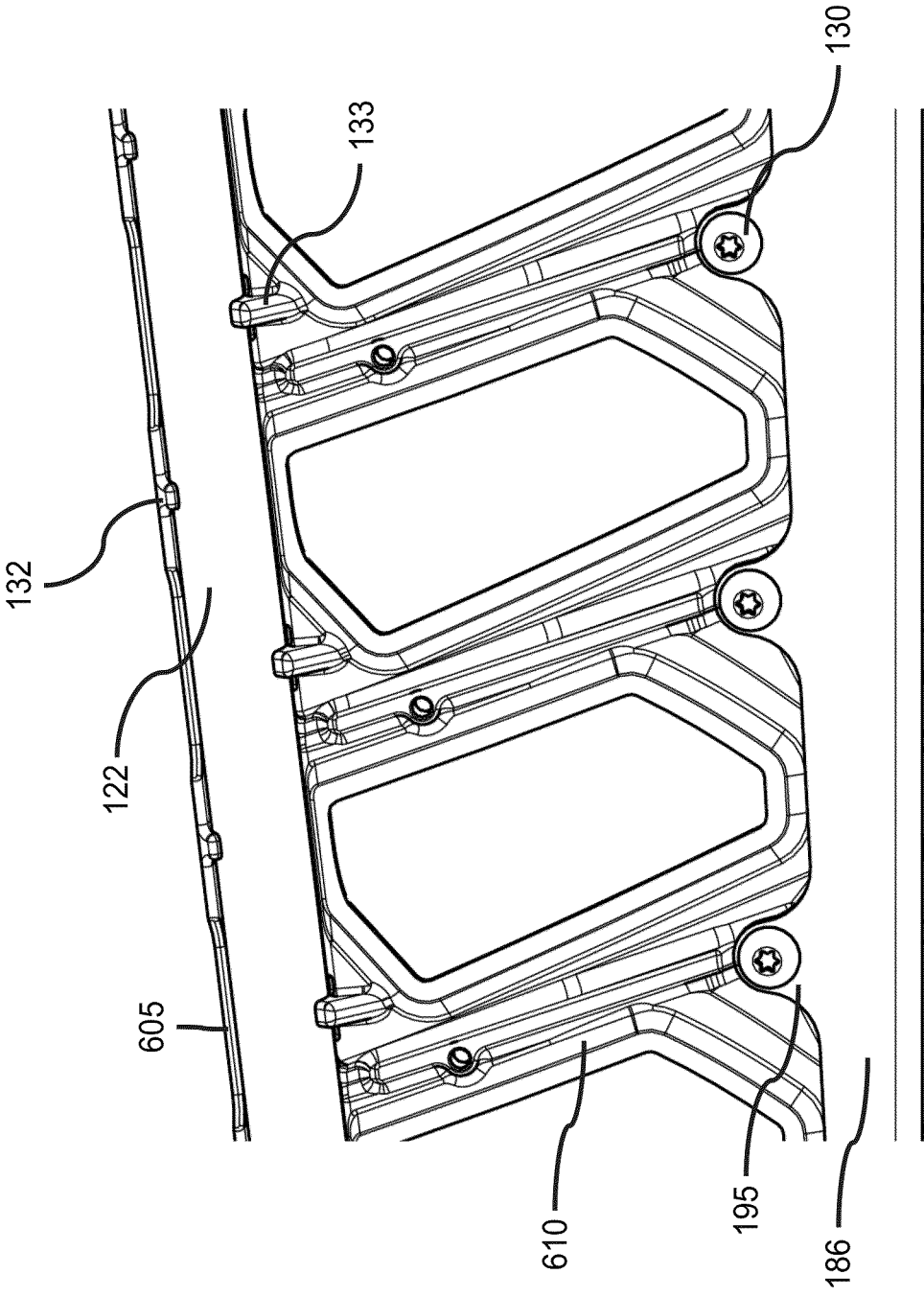


FIG. 45

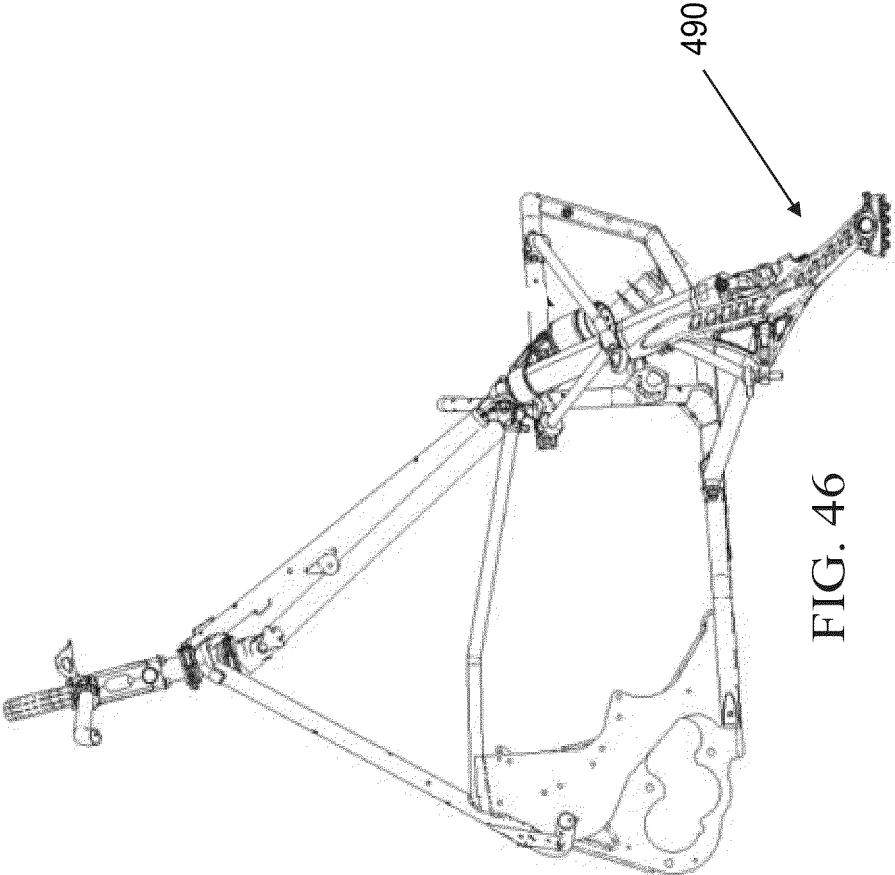


FIG. 46

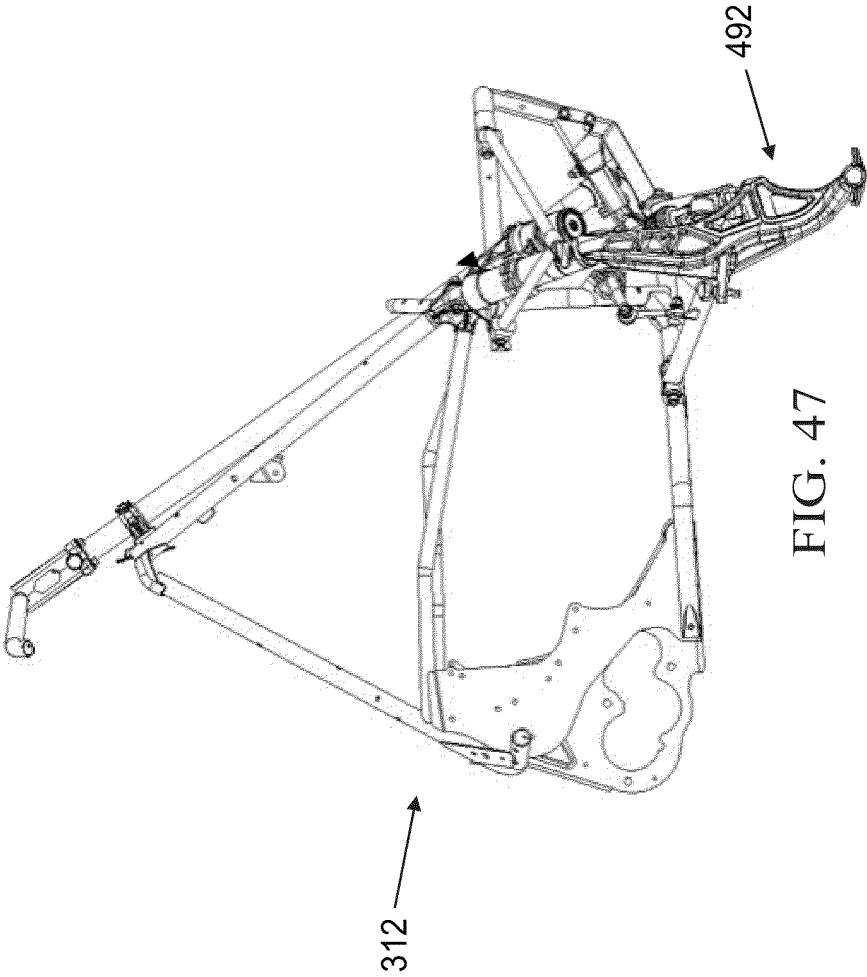
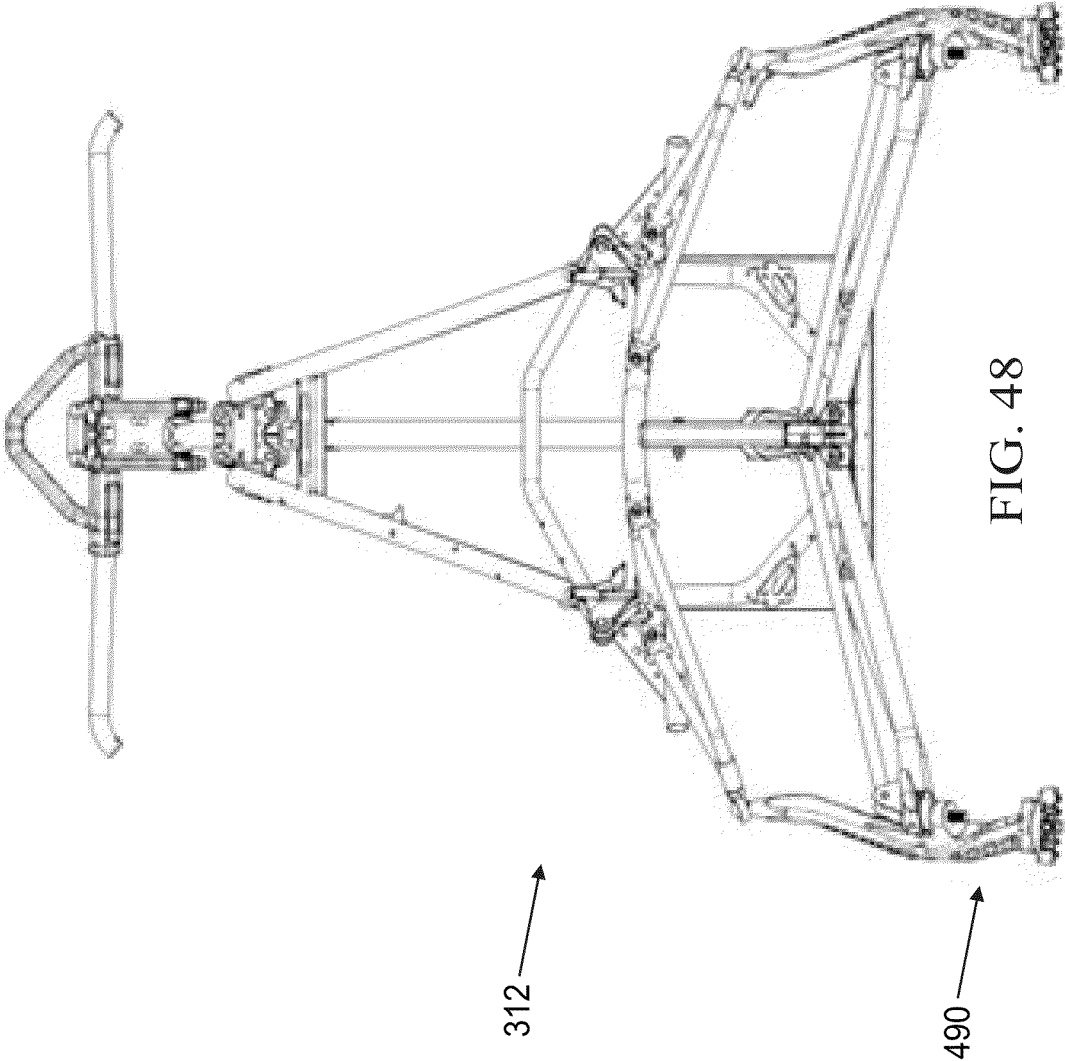


FIG. 47



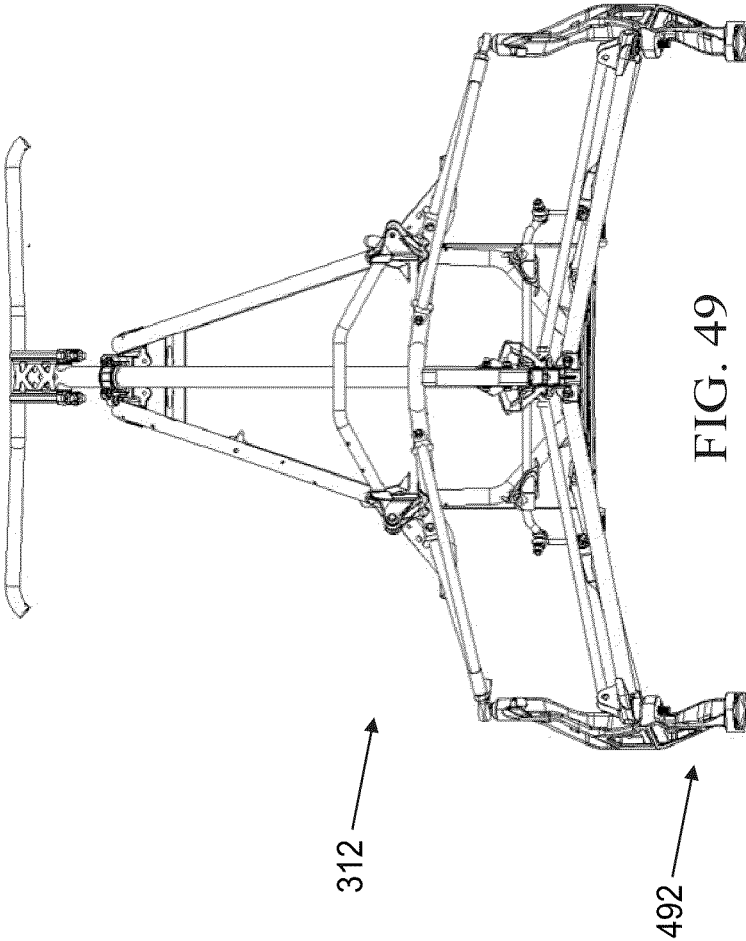


FIG. 49

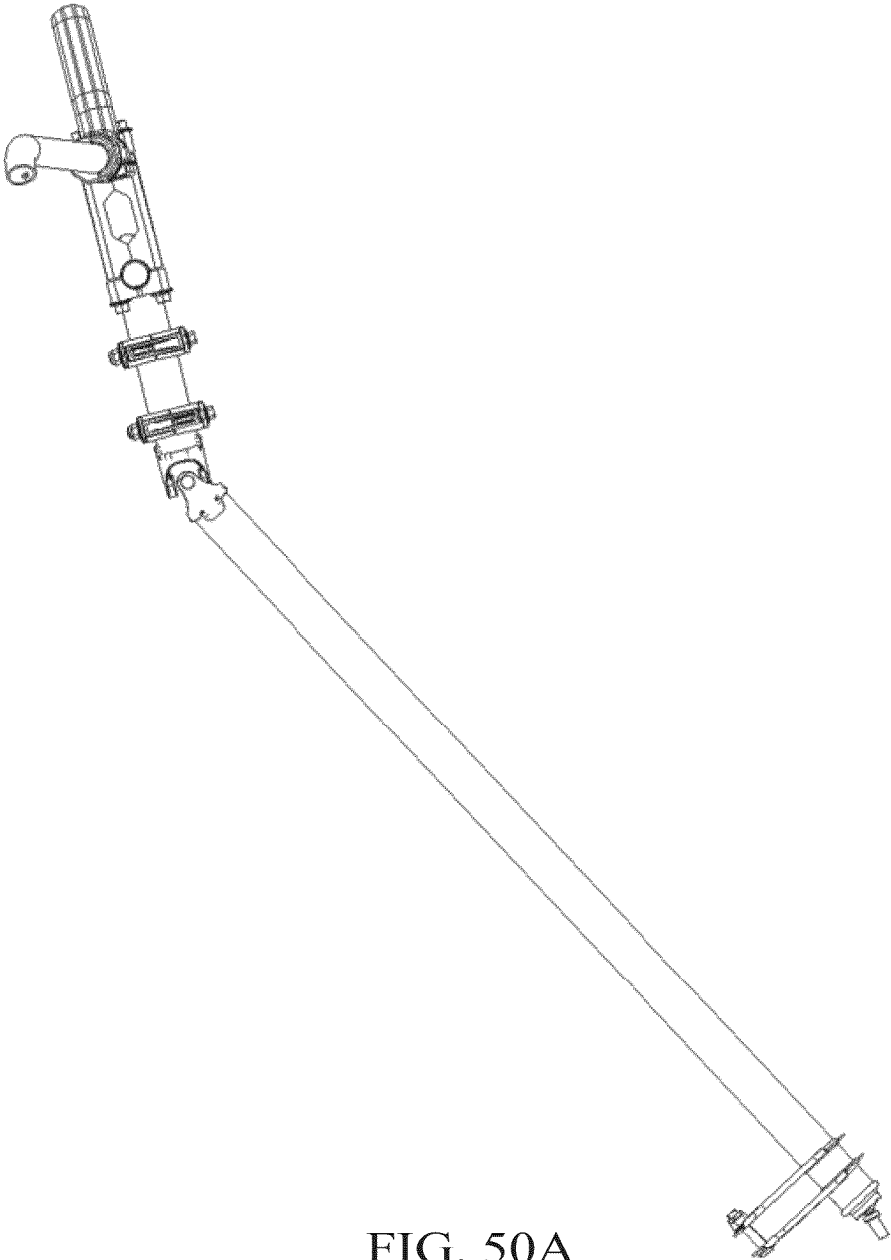


FIG. 50A

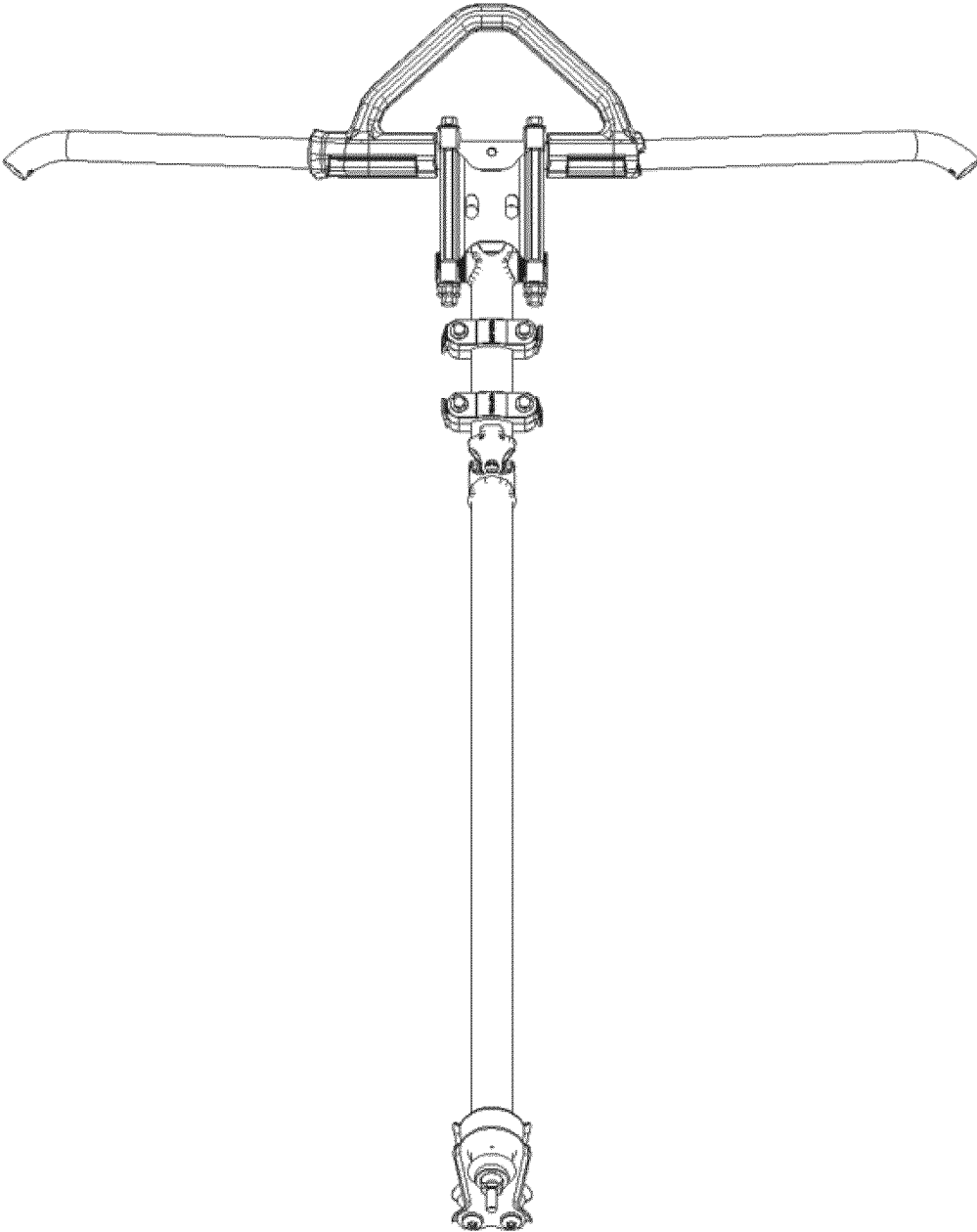
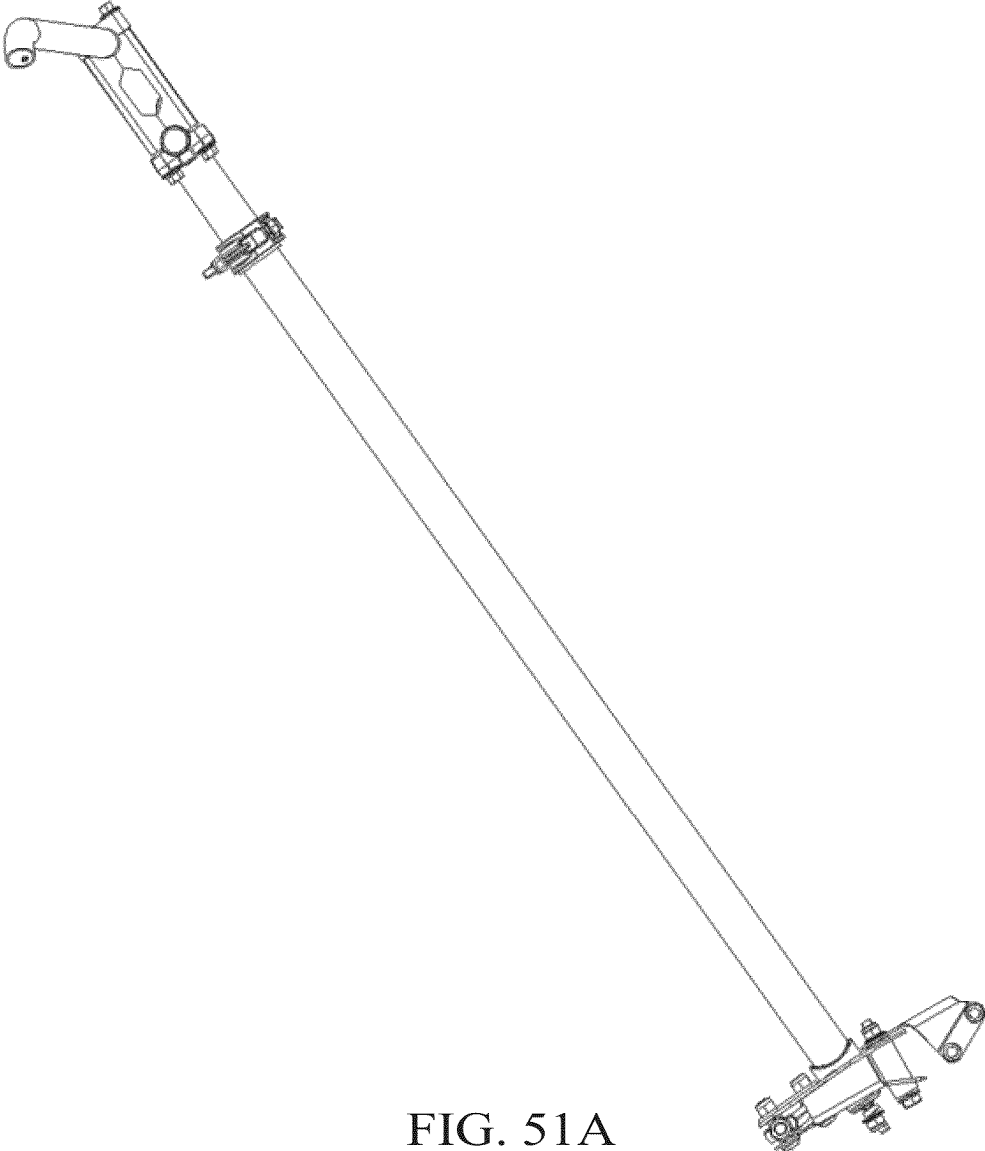


FIG. 50B



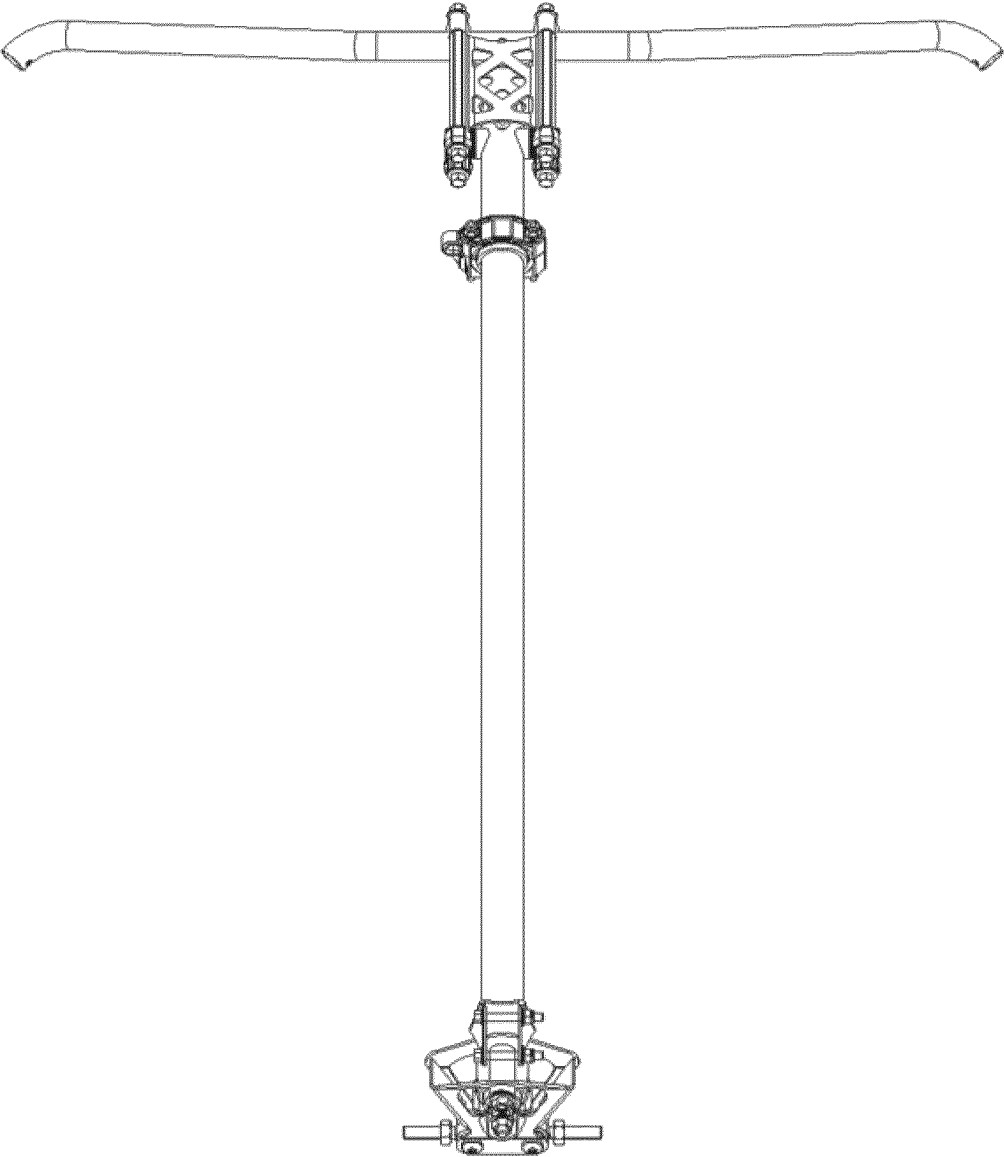
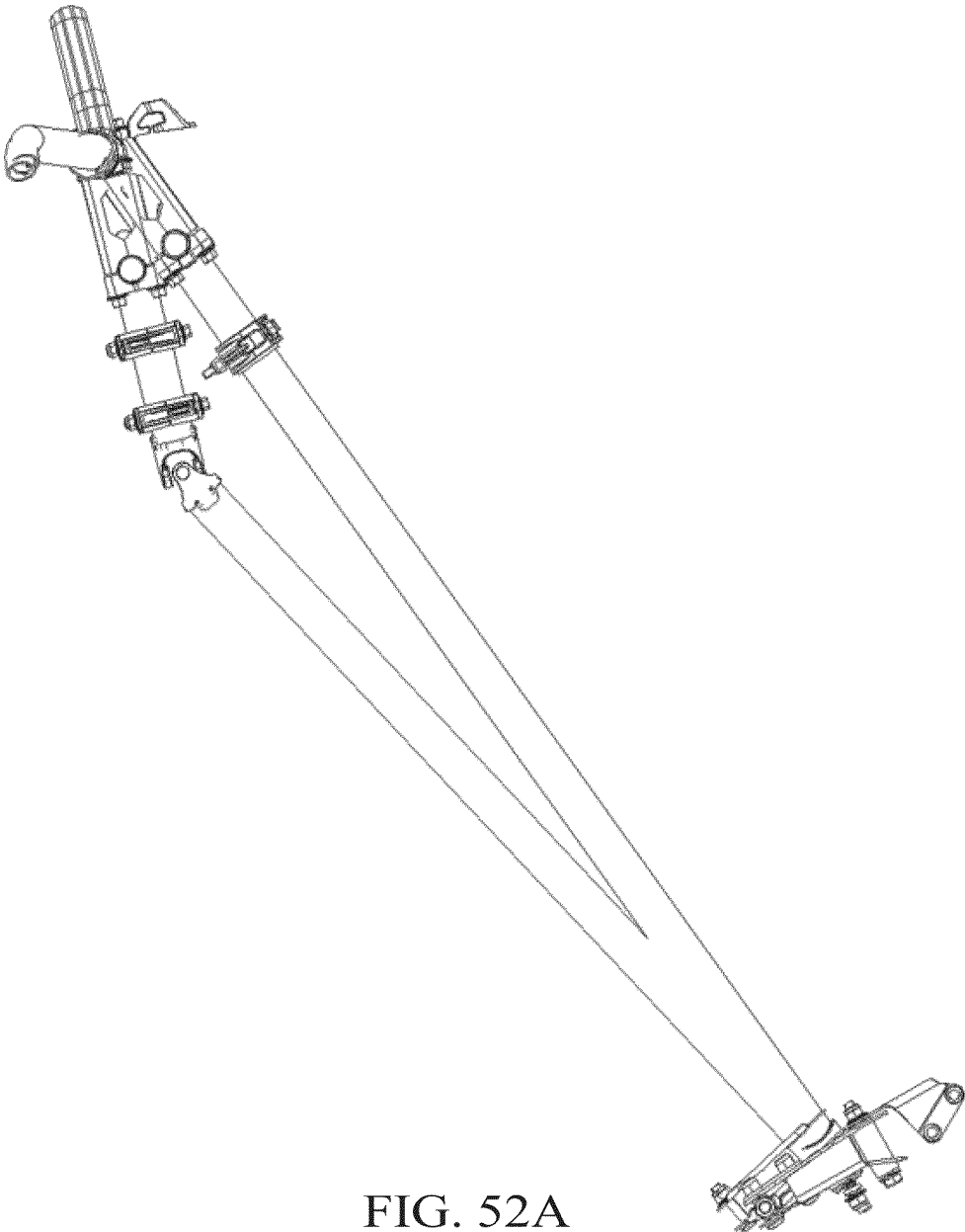


FIG. 51B



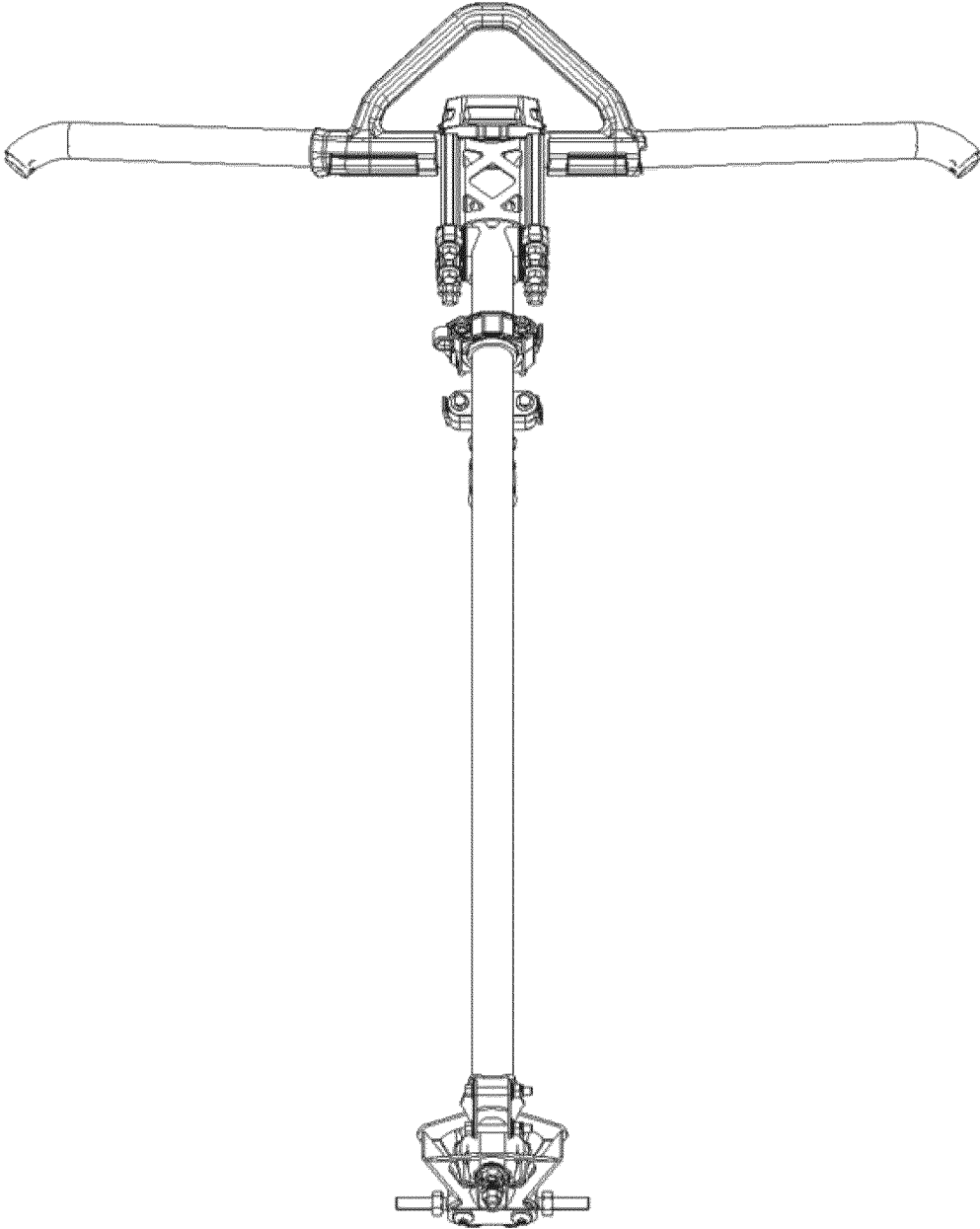


FIG. 52B

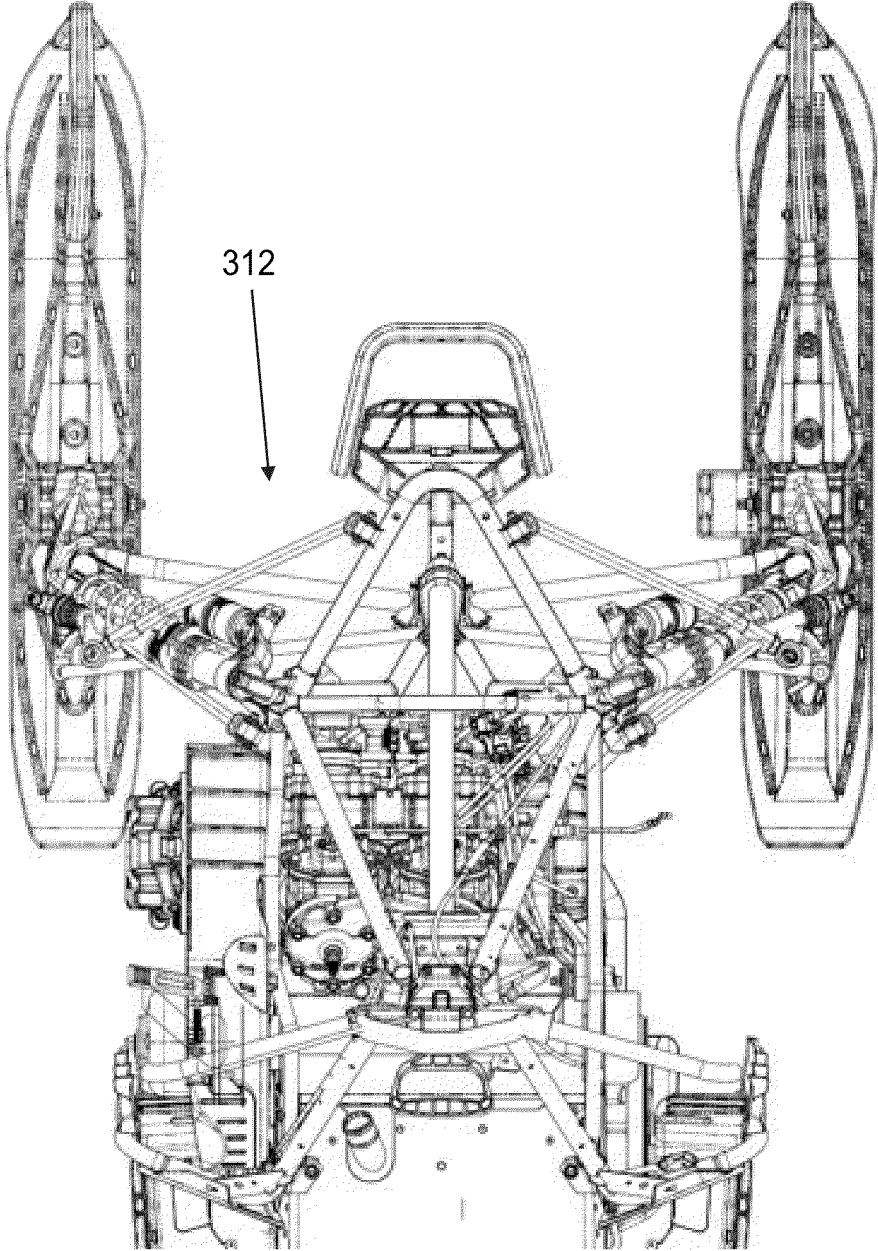


FIG. 53

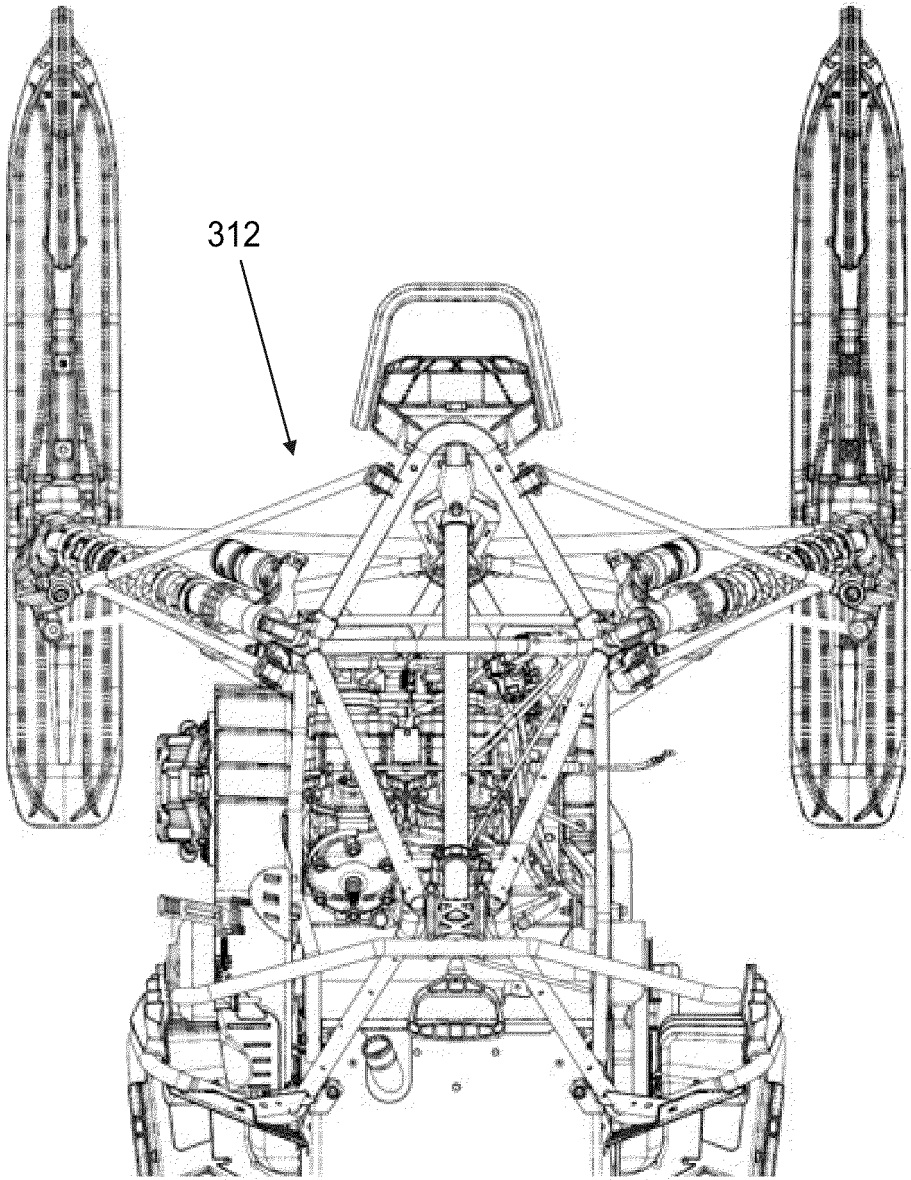


FIG. 54

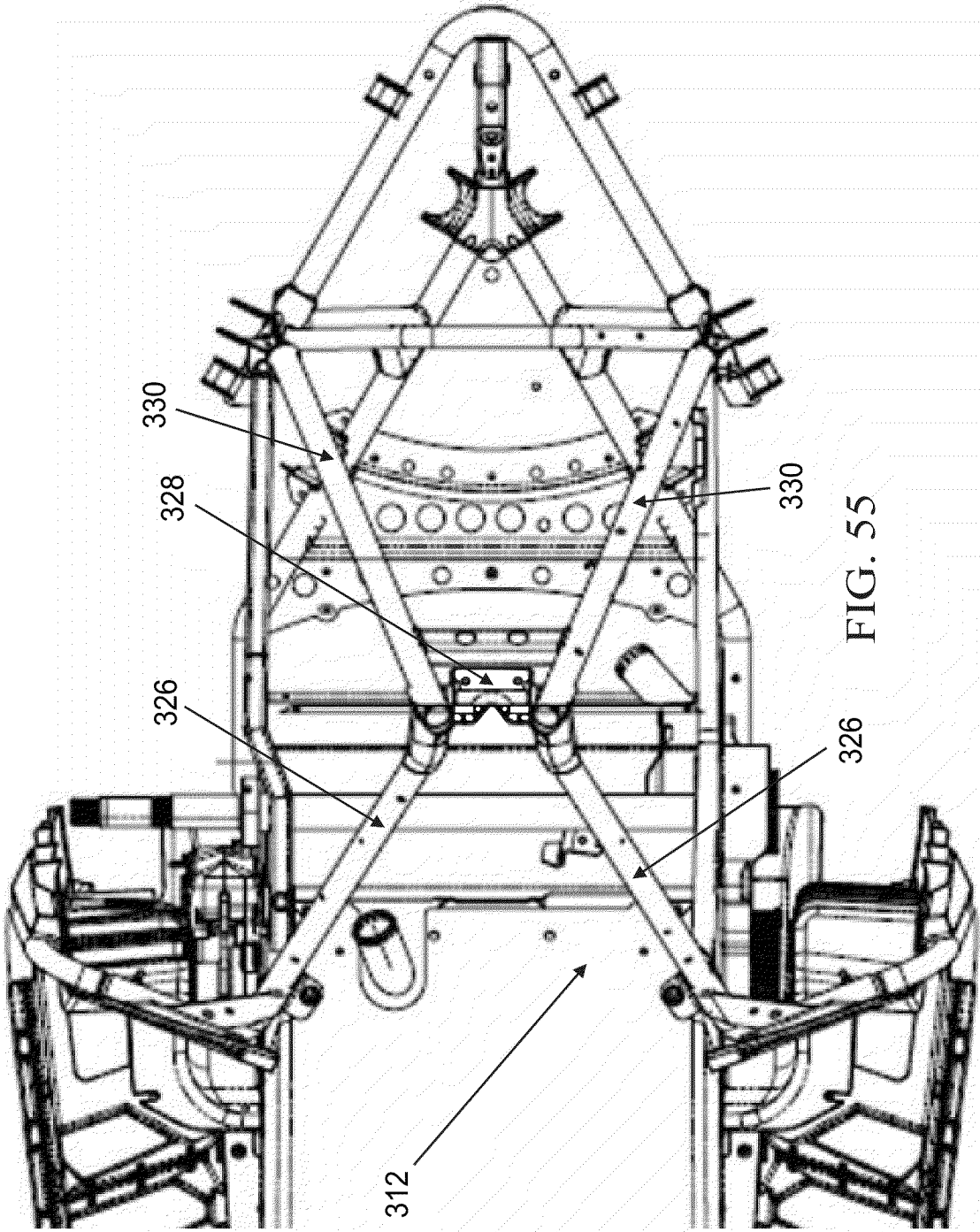


FIG. 55

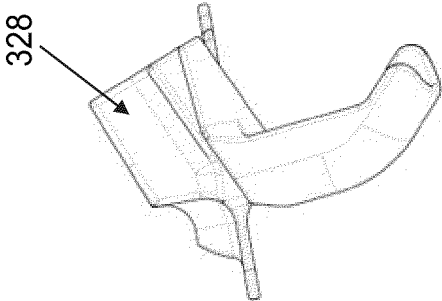


FIG. 56B

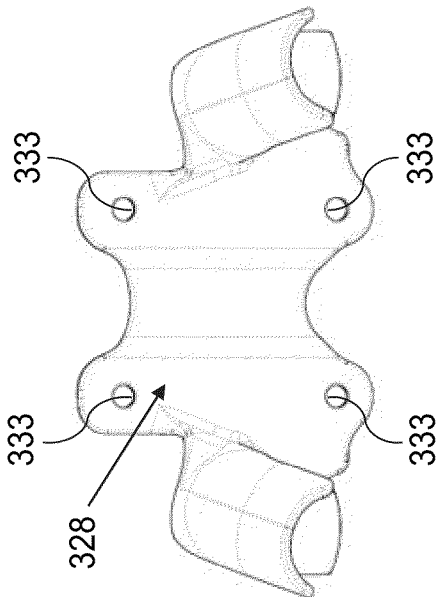


FIG. 56C

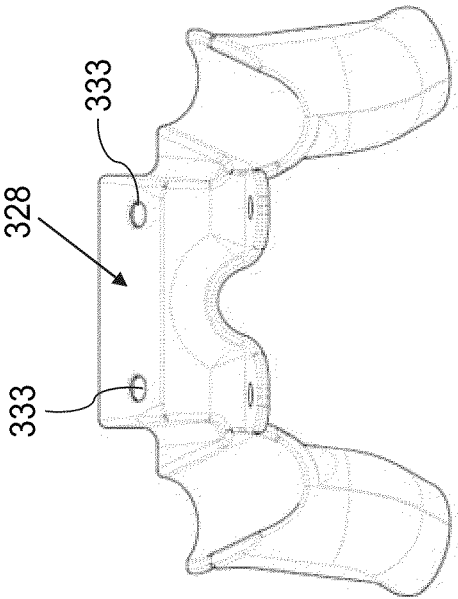


FIG. 56A

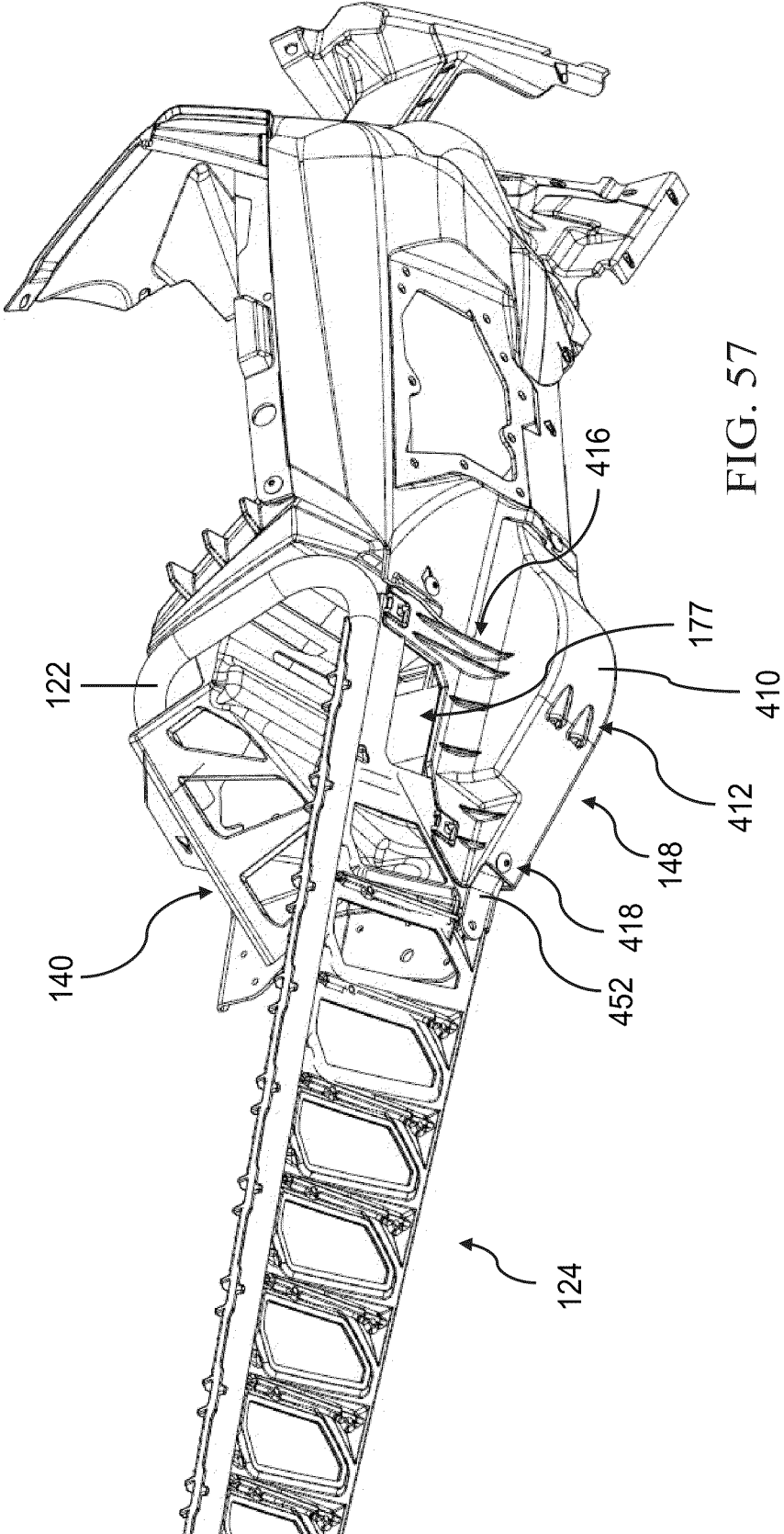


FIG. 57

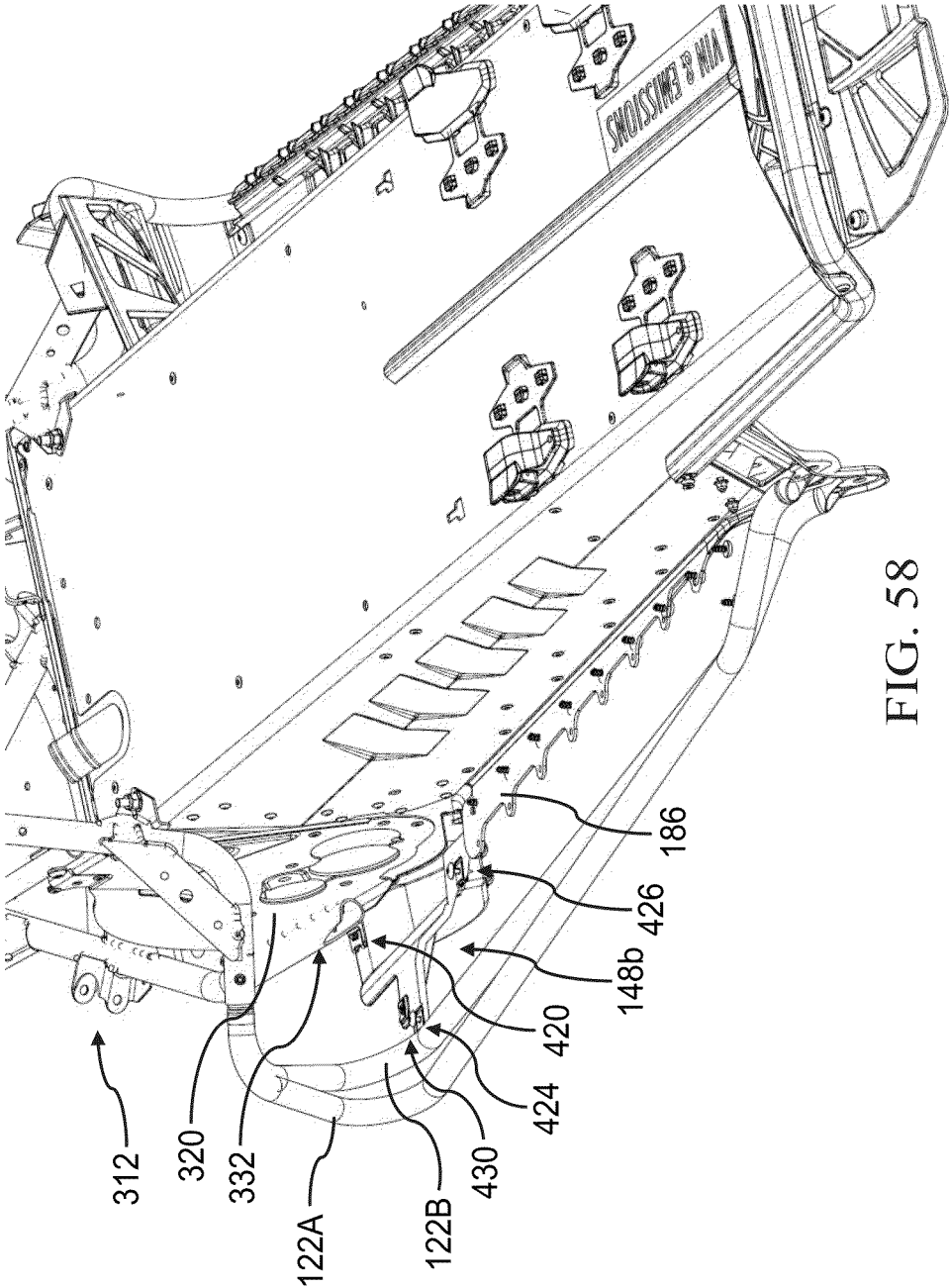


FIG. 58

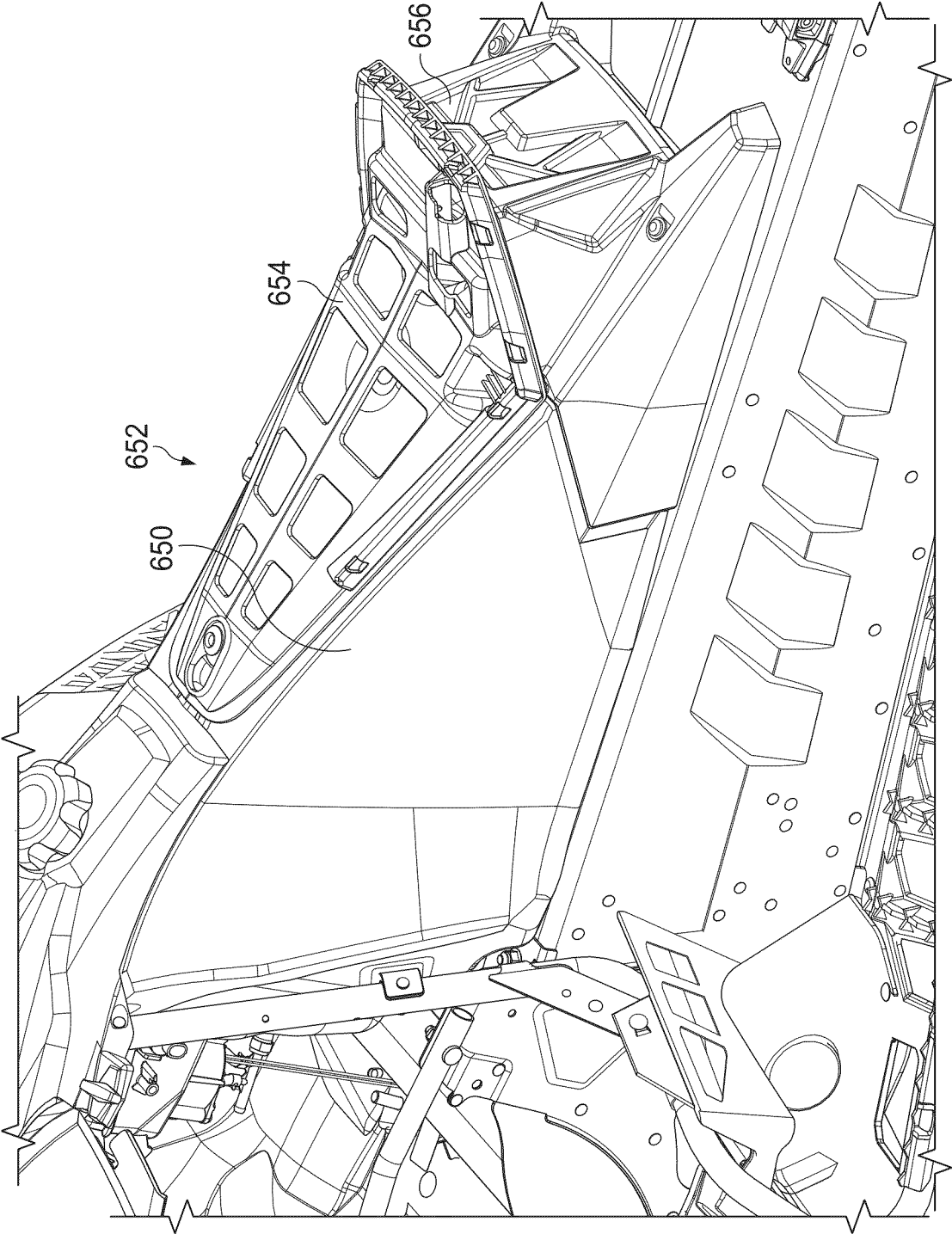


FIG. 59

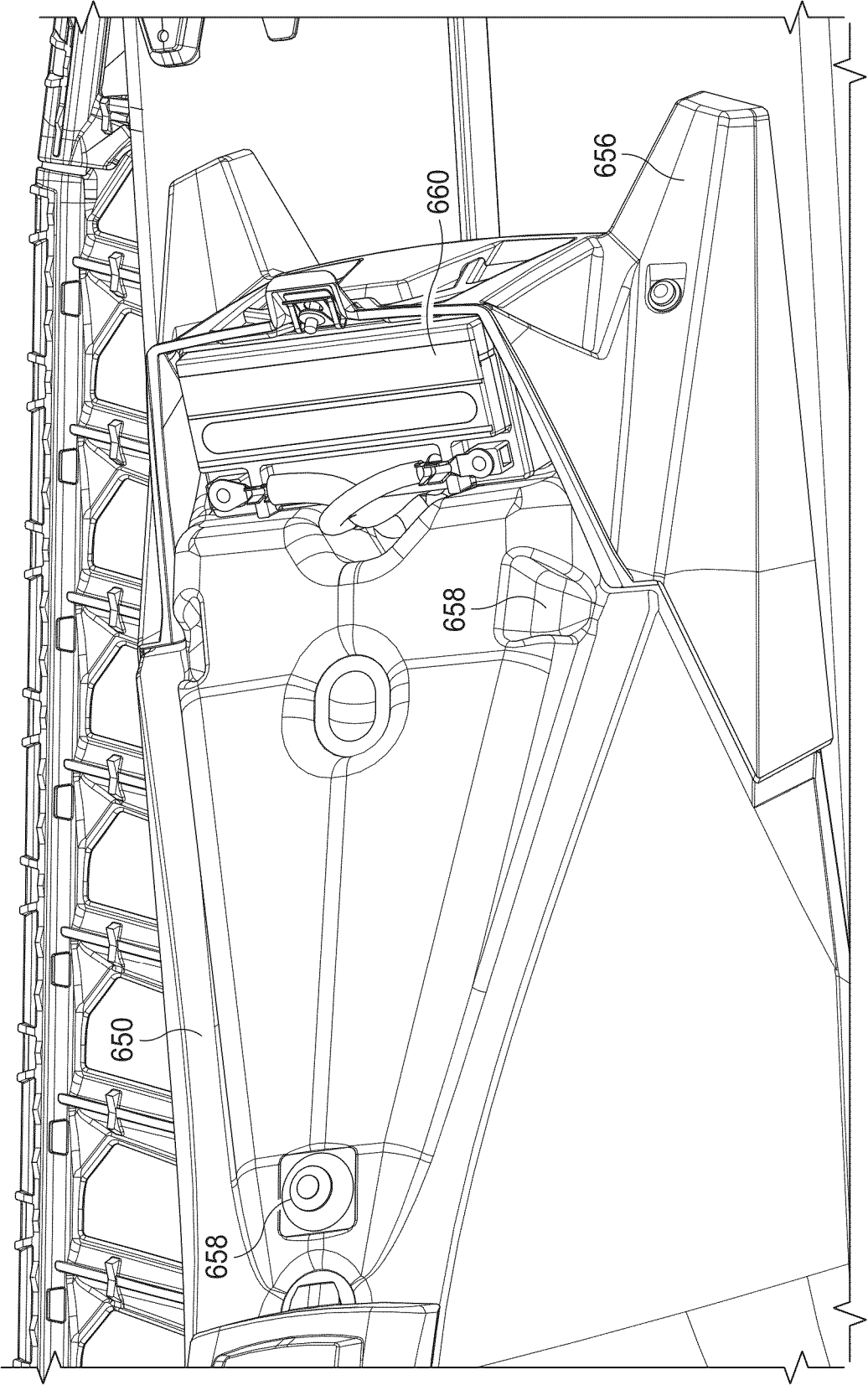


FIG. 60

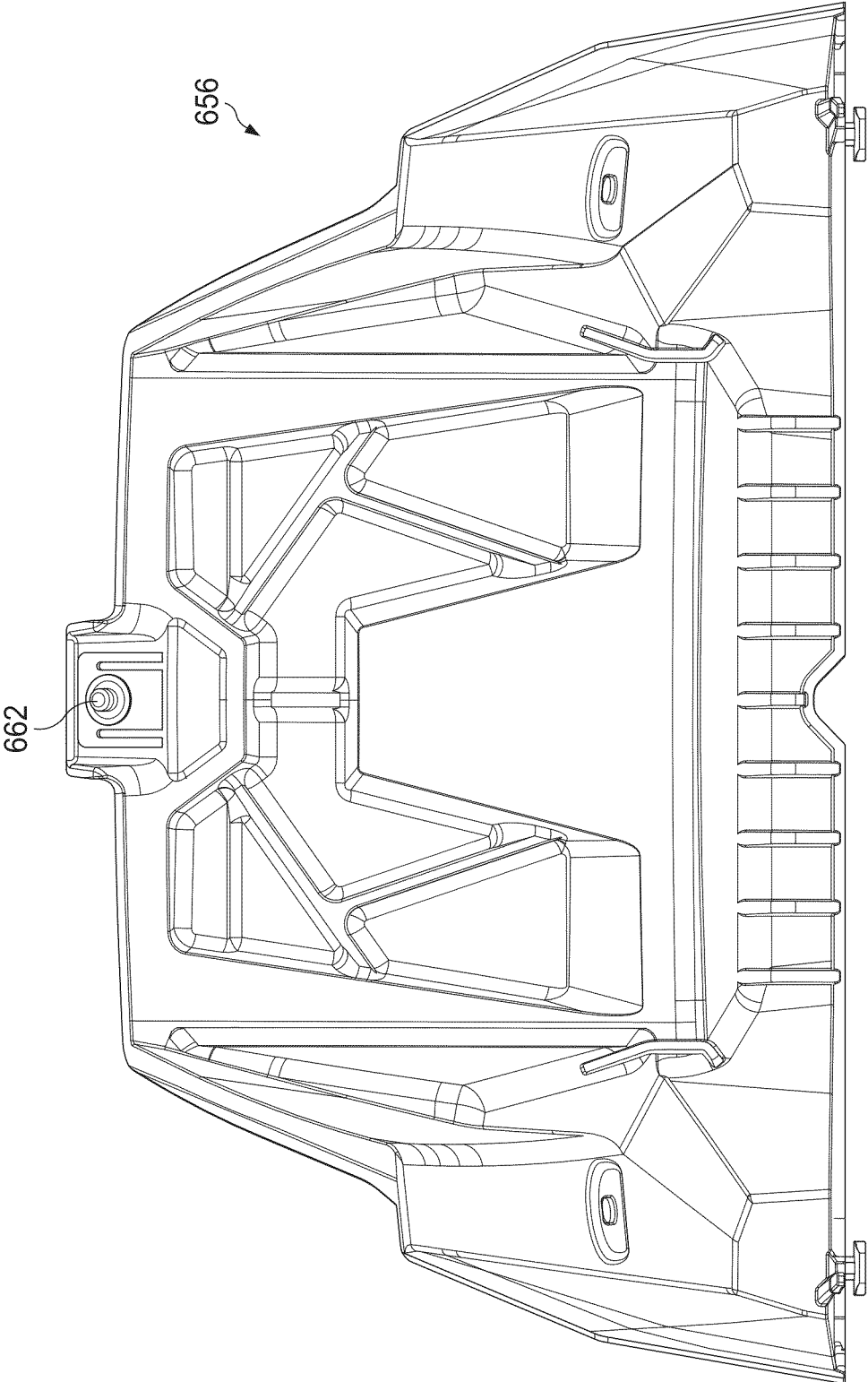


FIG. 61

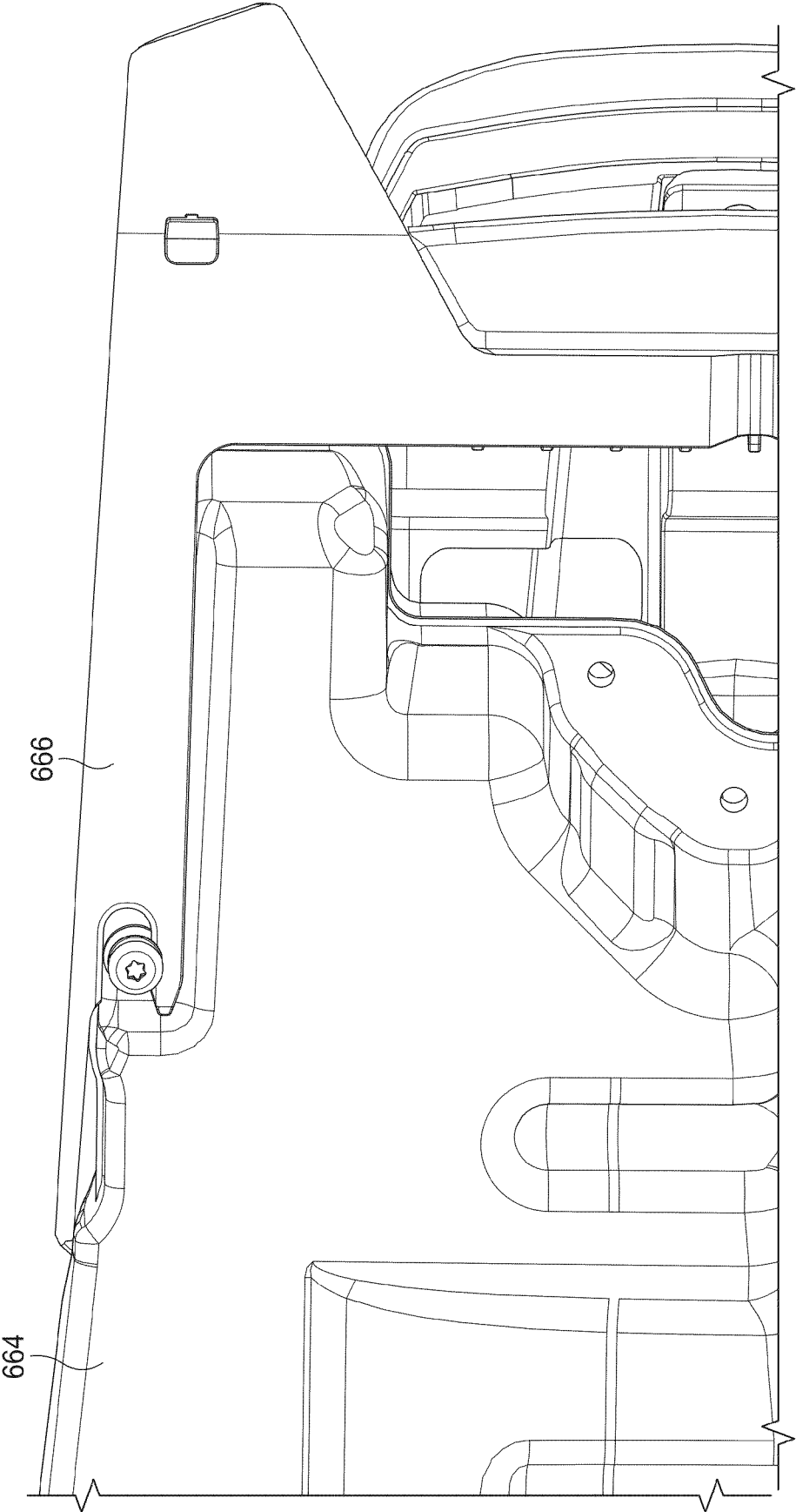


FIG. 62

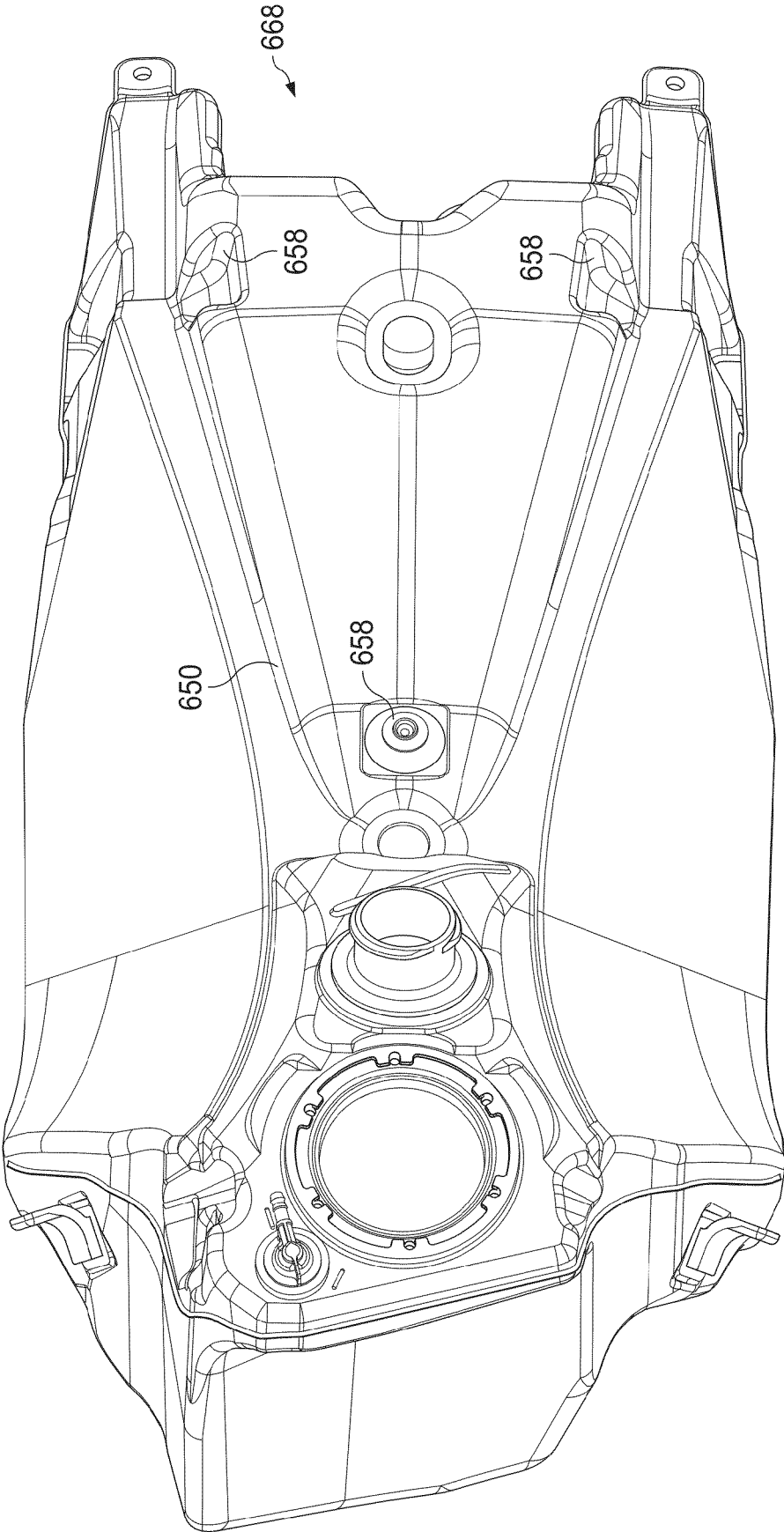


FIG. 63

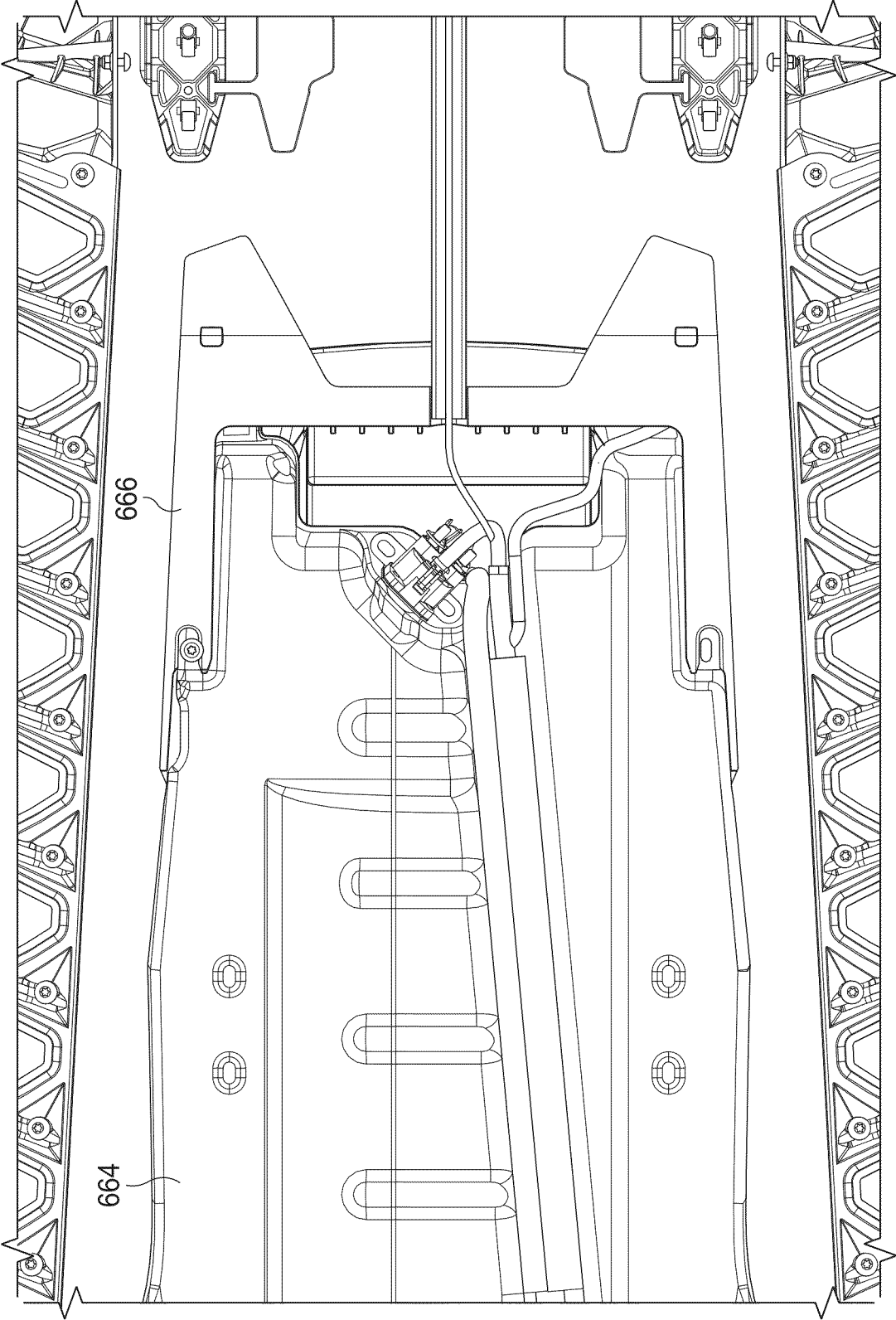


FIG. 64

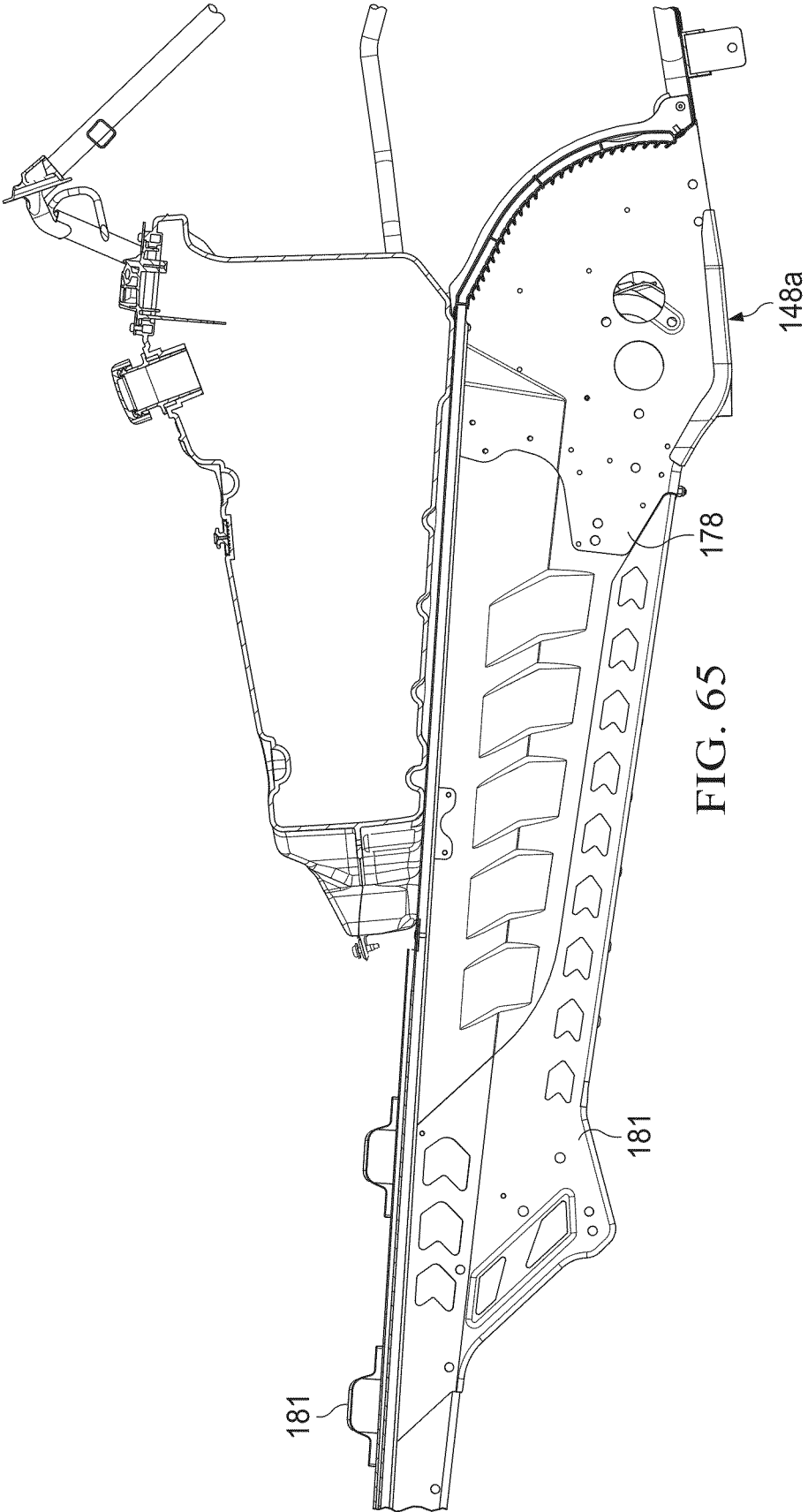


FIG. 65

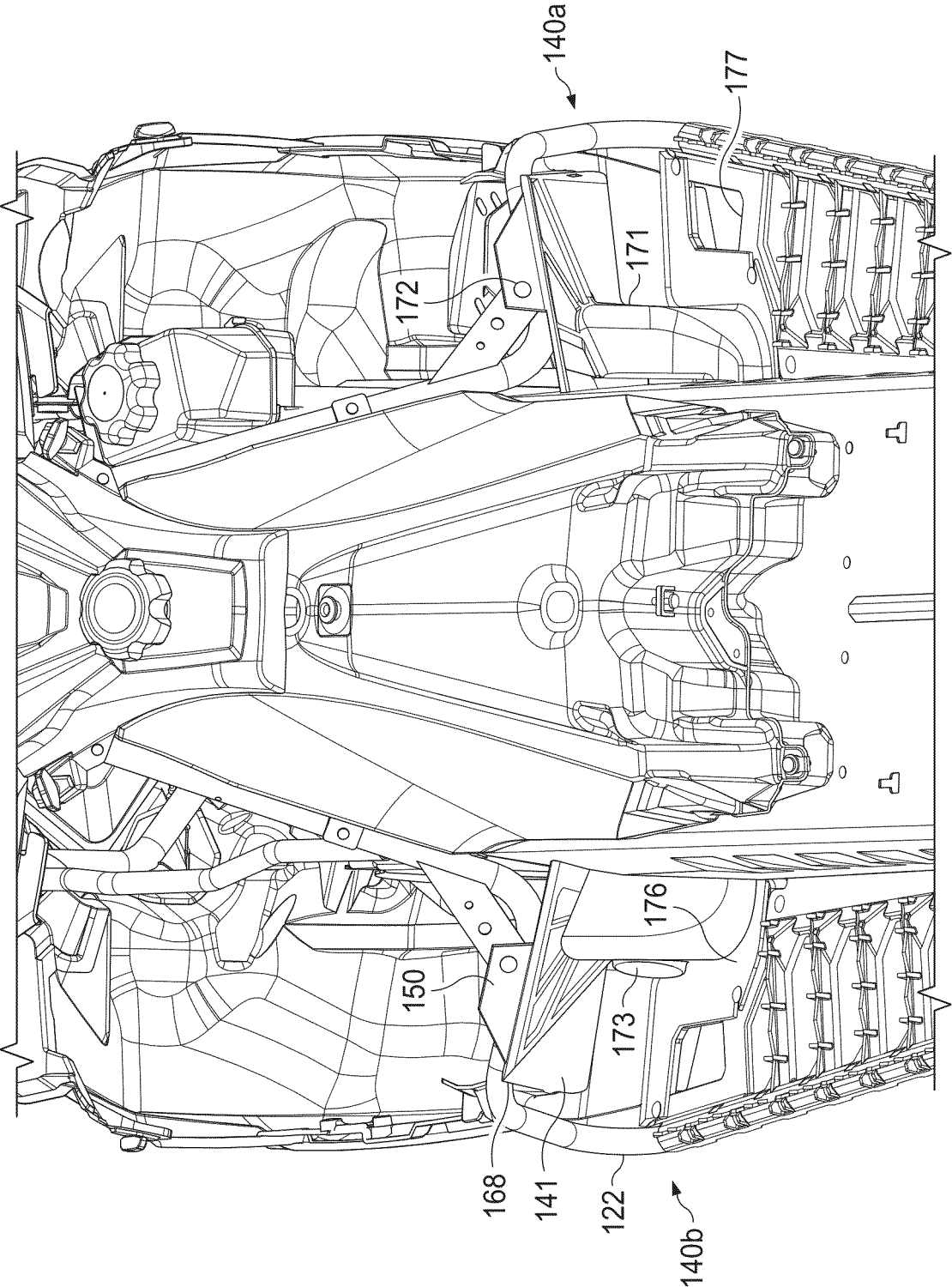


FIG. 66

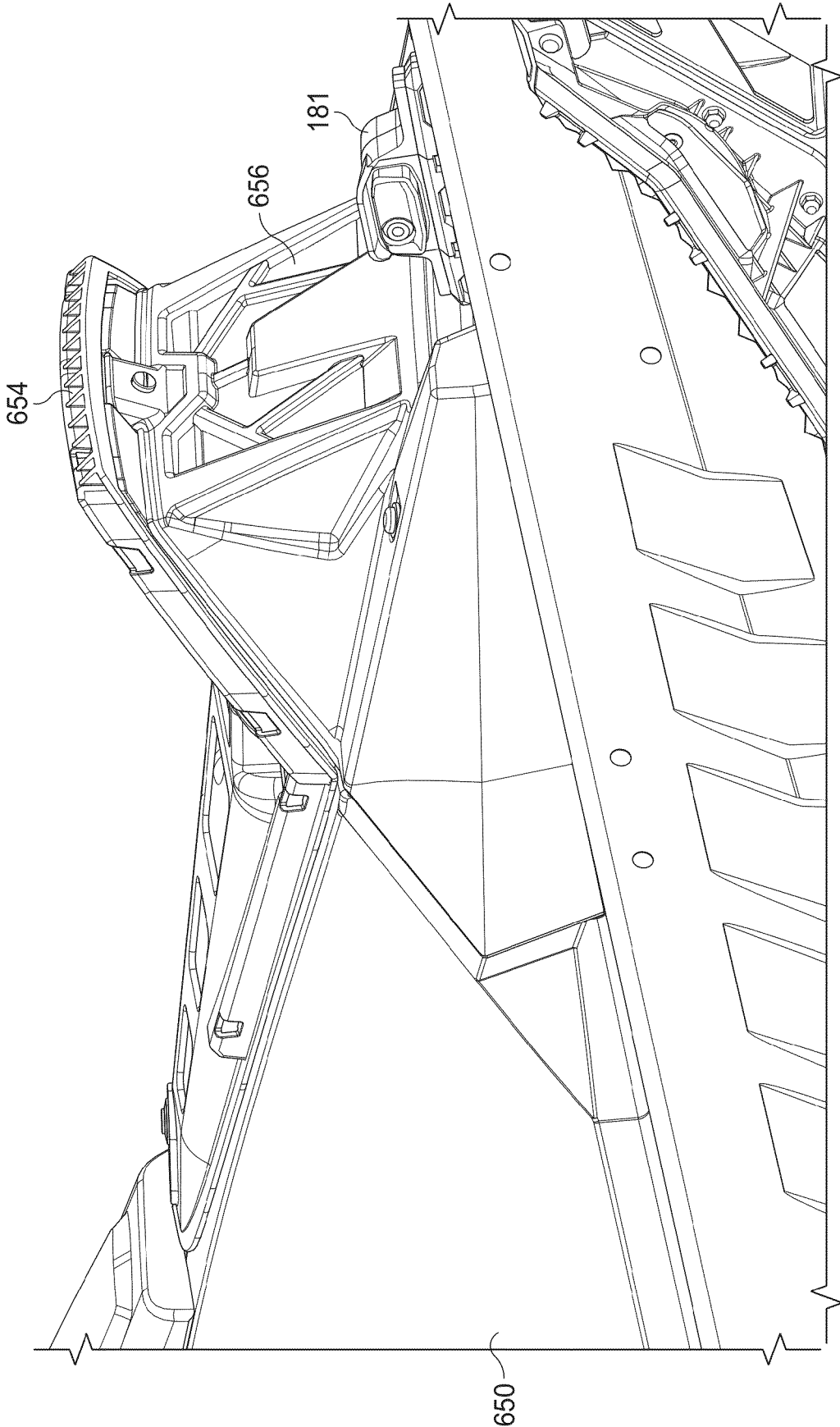


FIG. 67

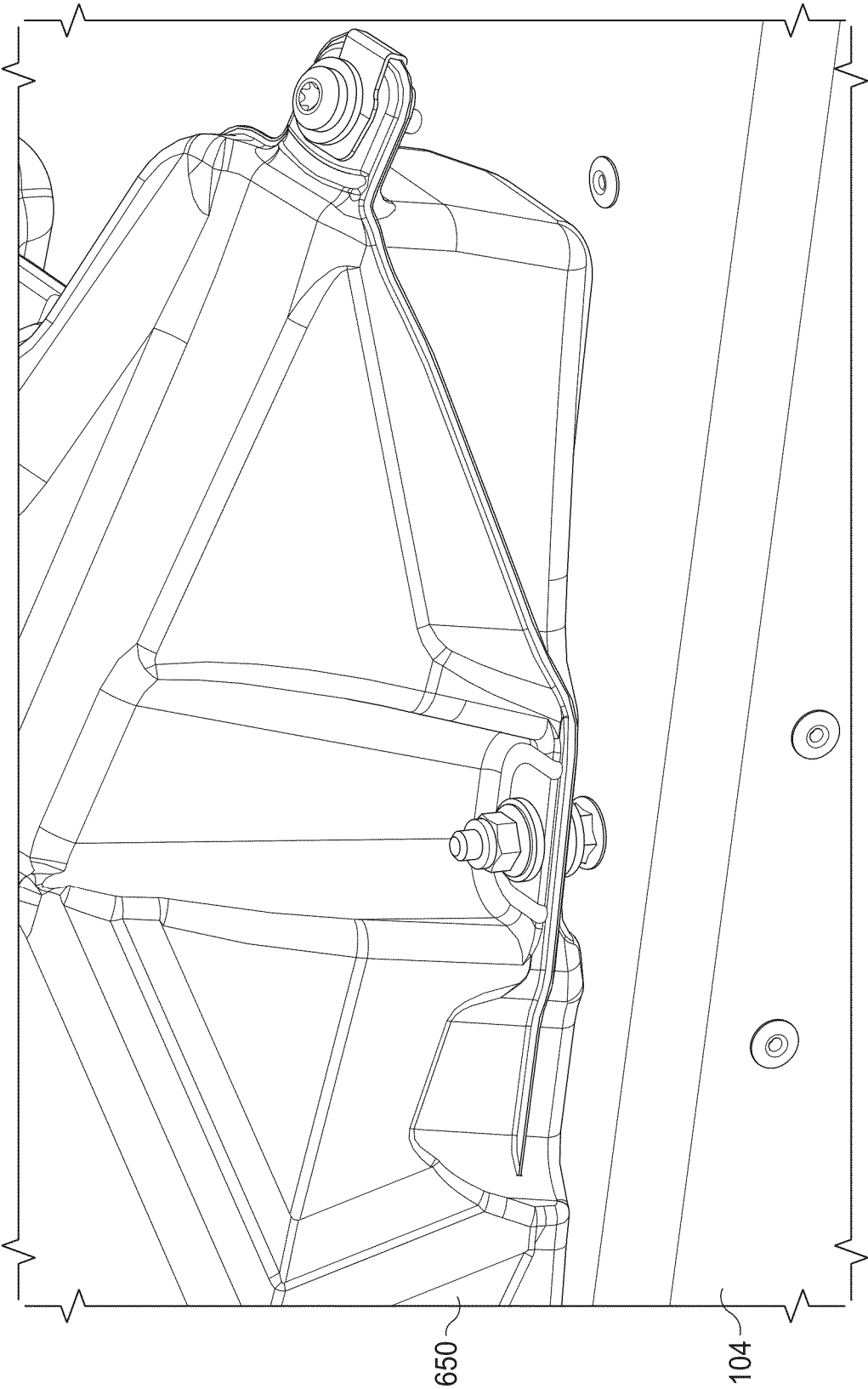


FIG. 68

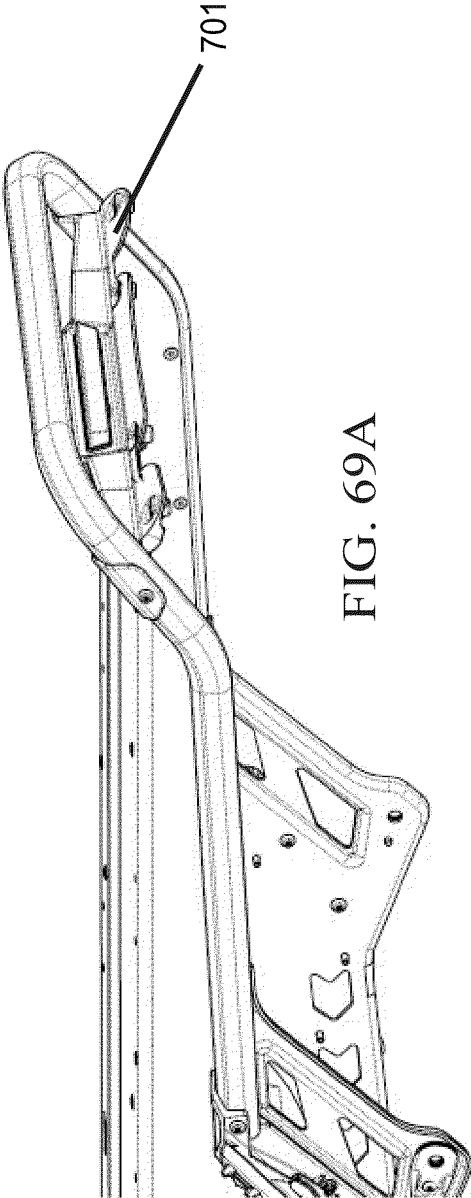


FIG. 69A

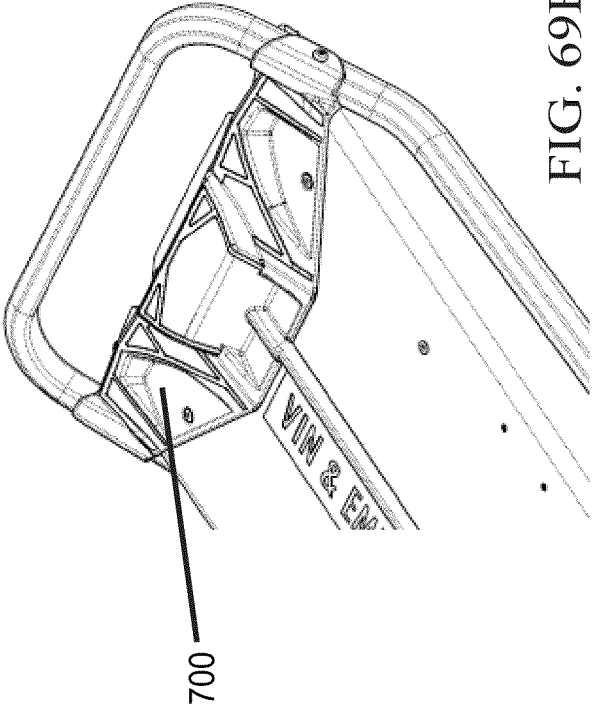


FIG. 69B

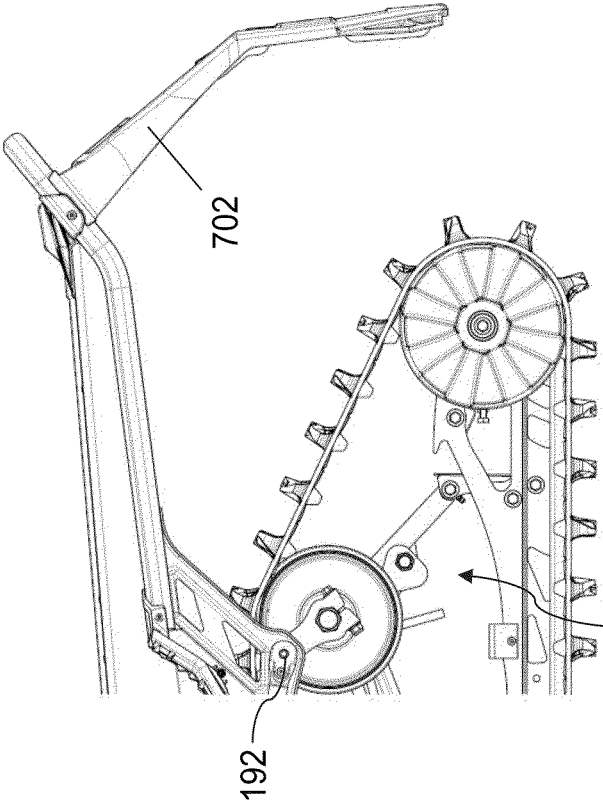


FIG. 70A

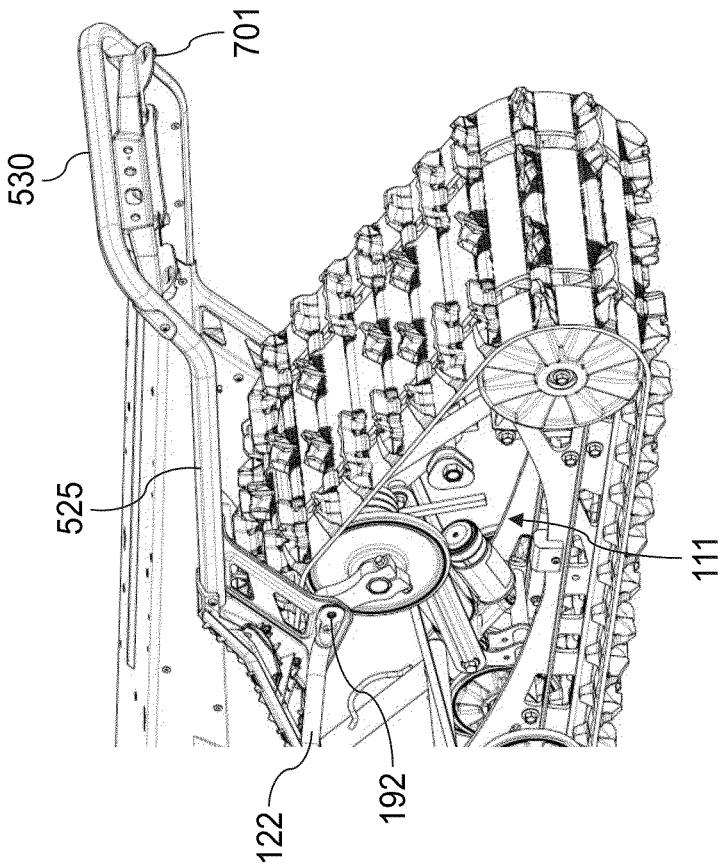


FIG. 70B

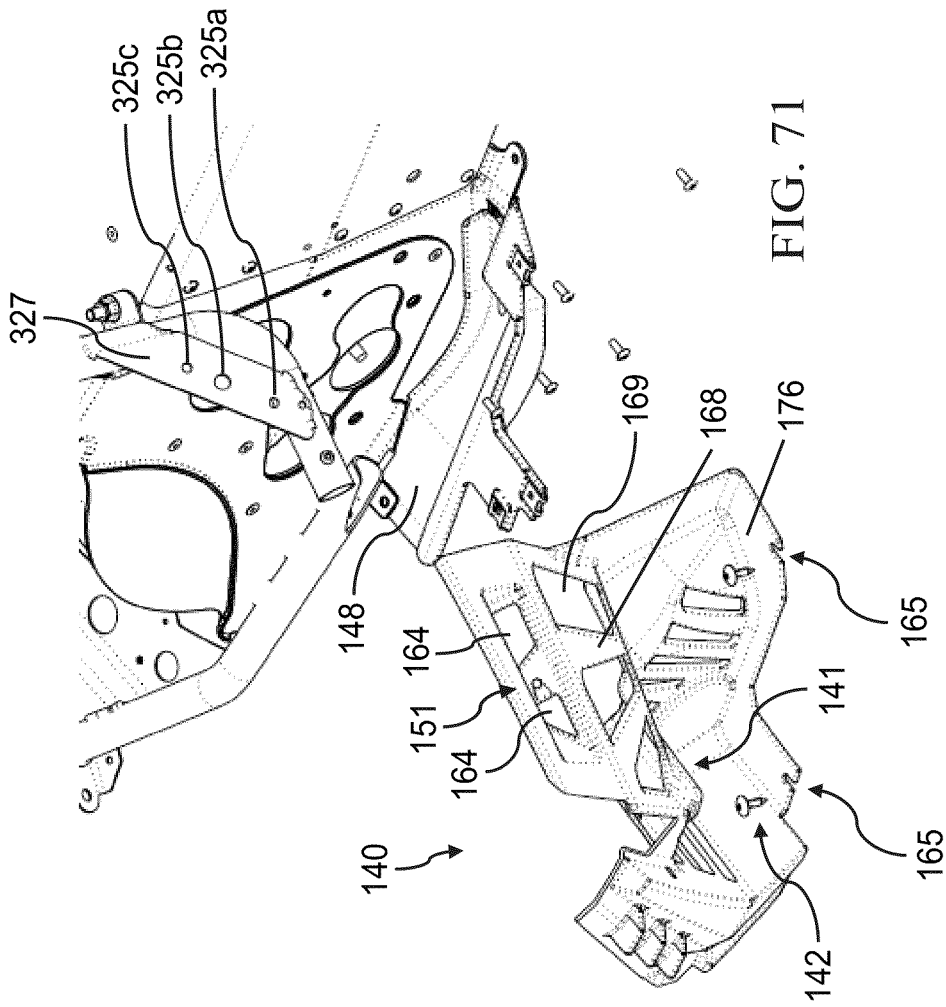


FIG. 71

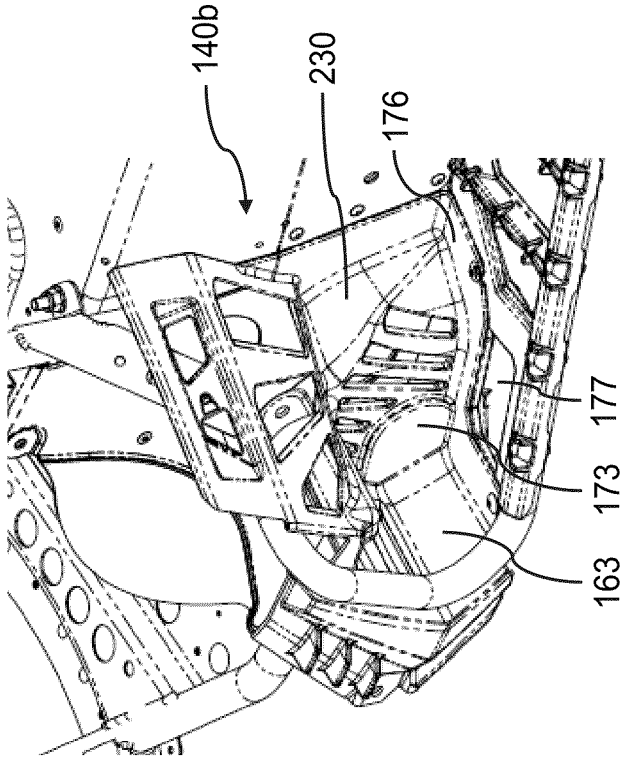


FIG. 72

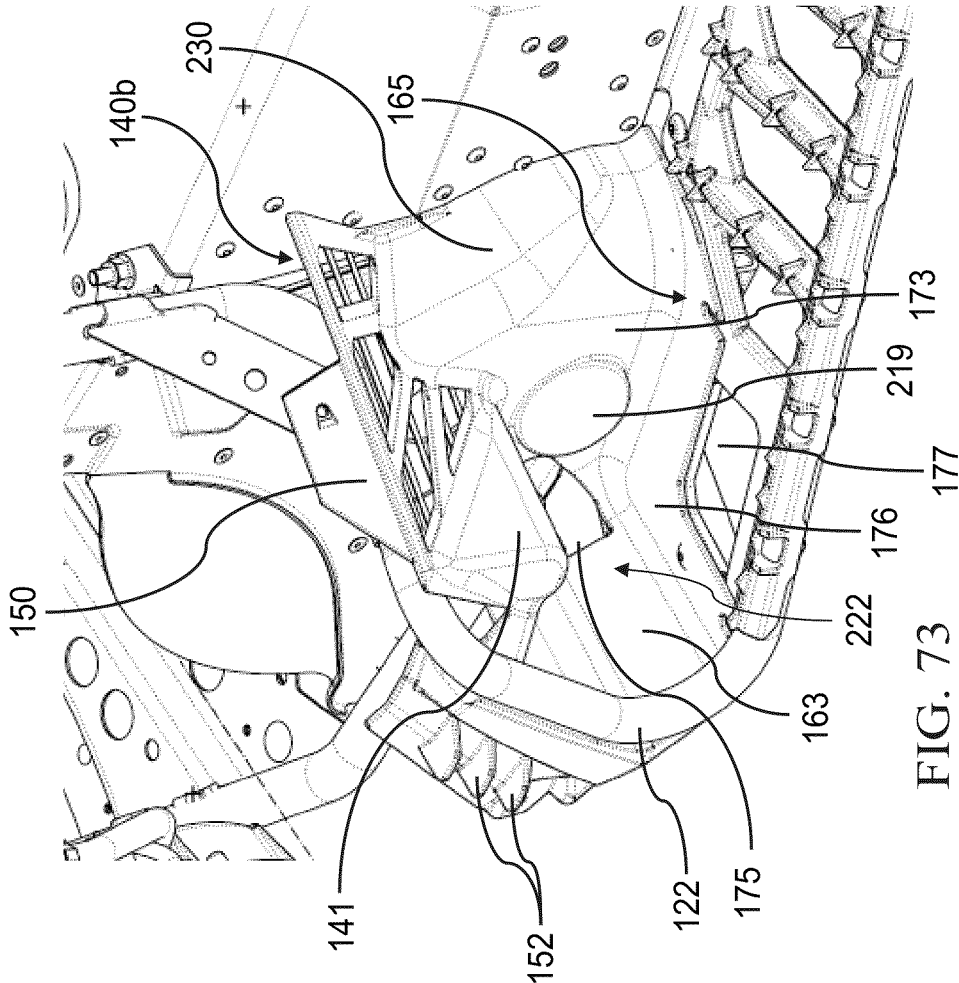


FIG. 73

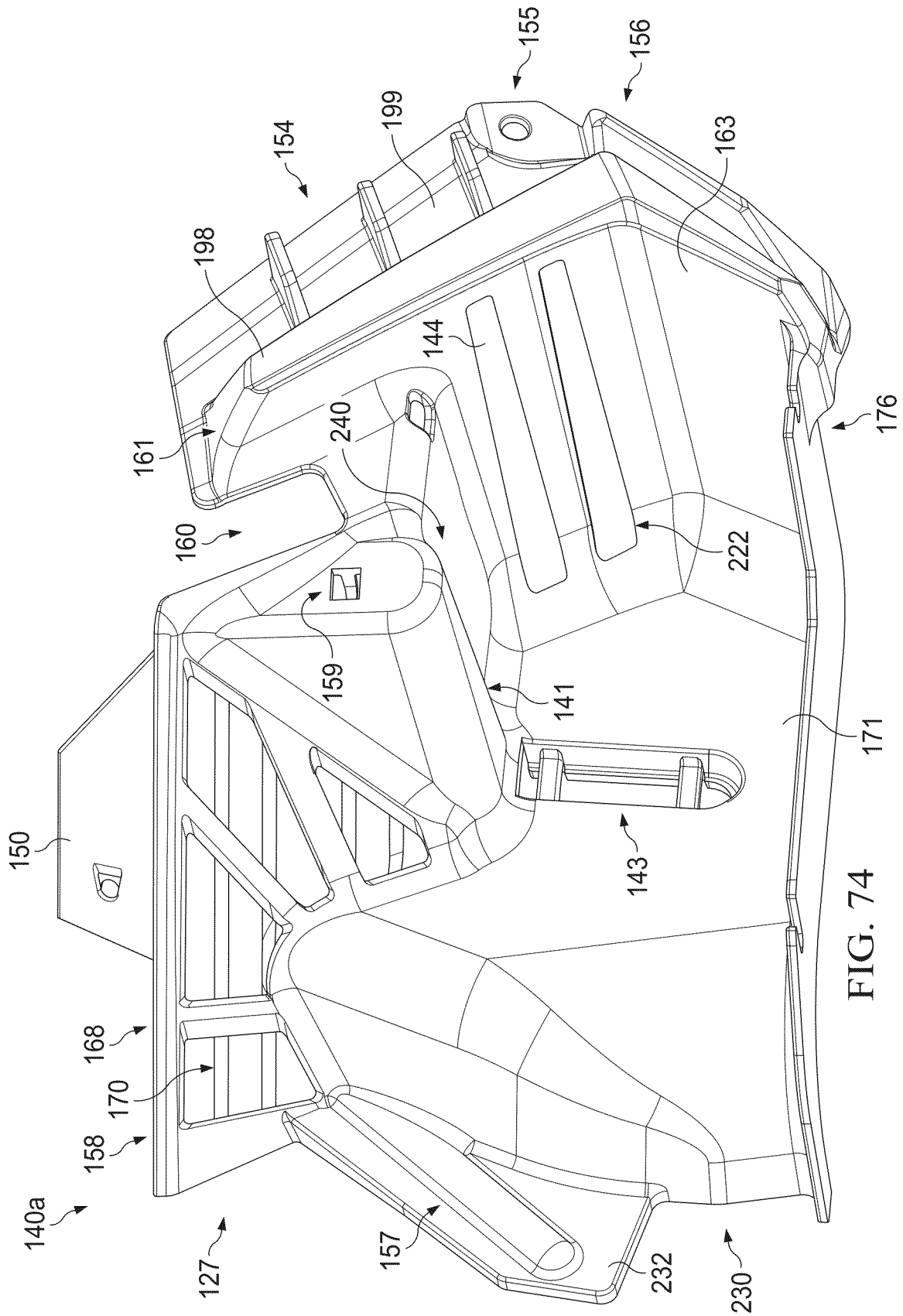


FIG. 74

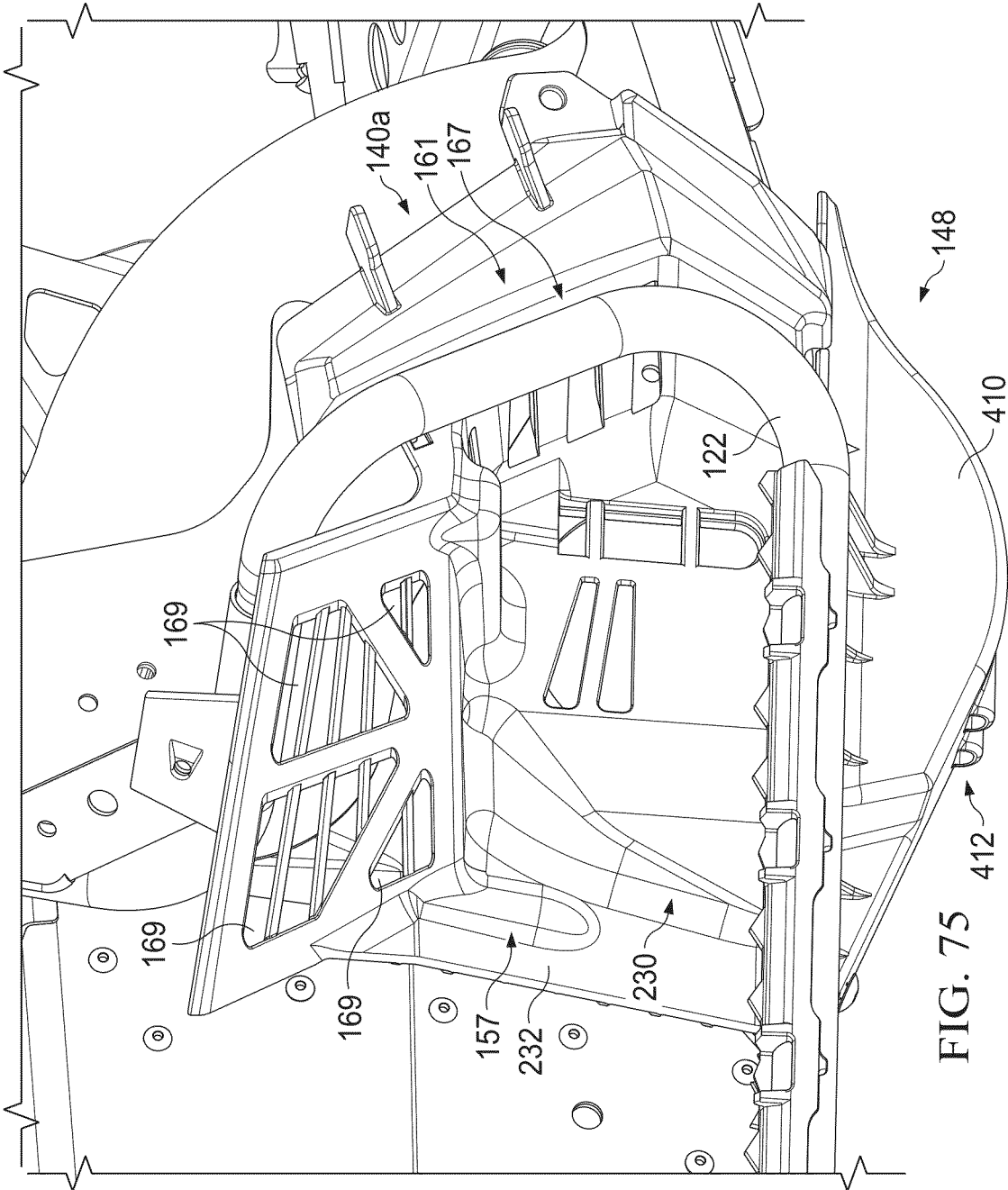


FIG. 75

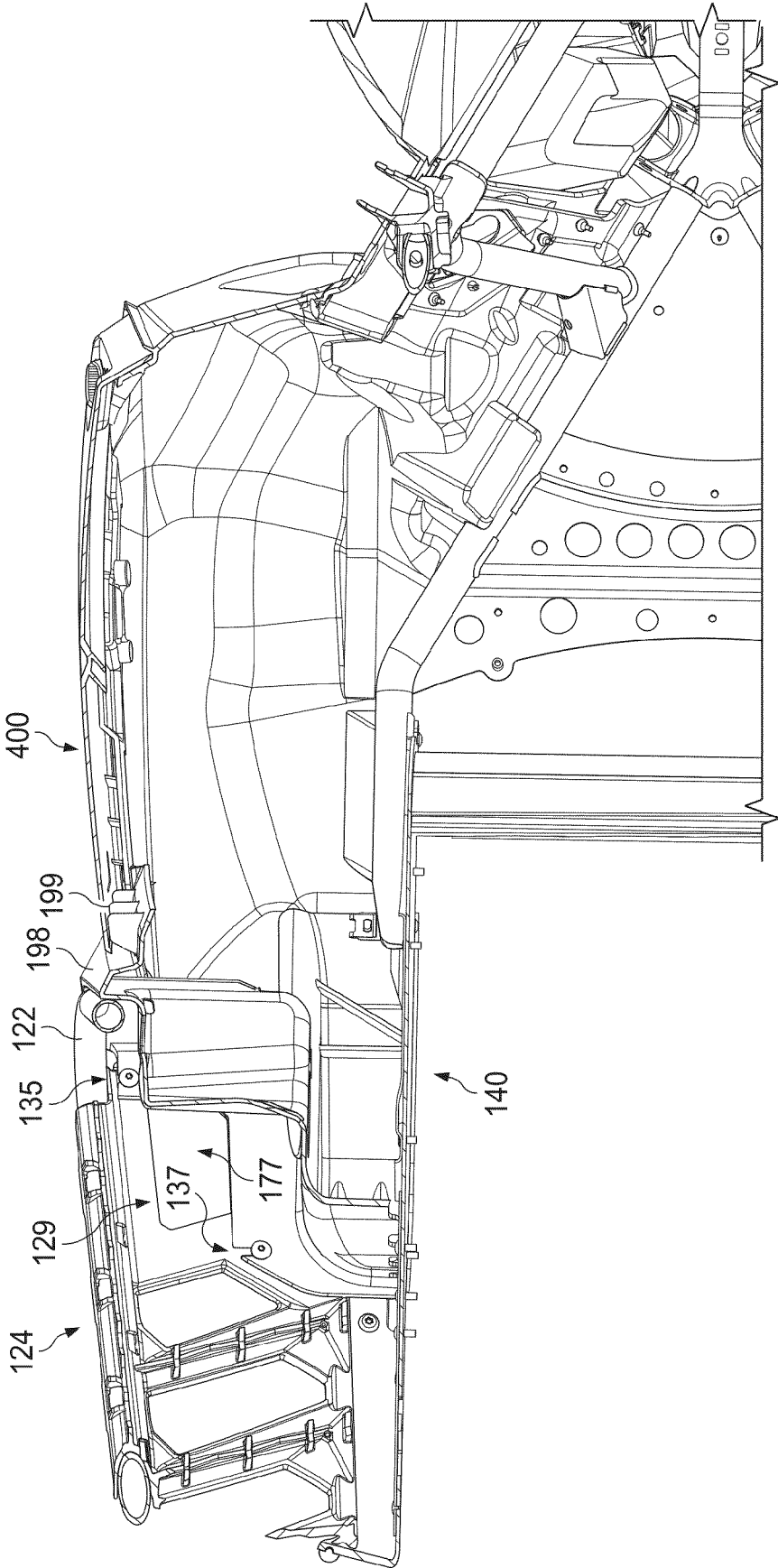


FIG. 76

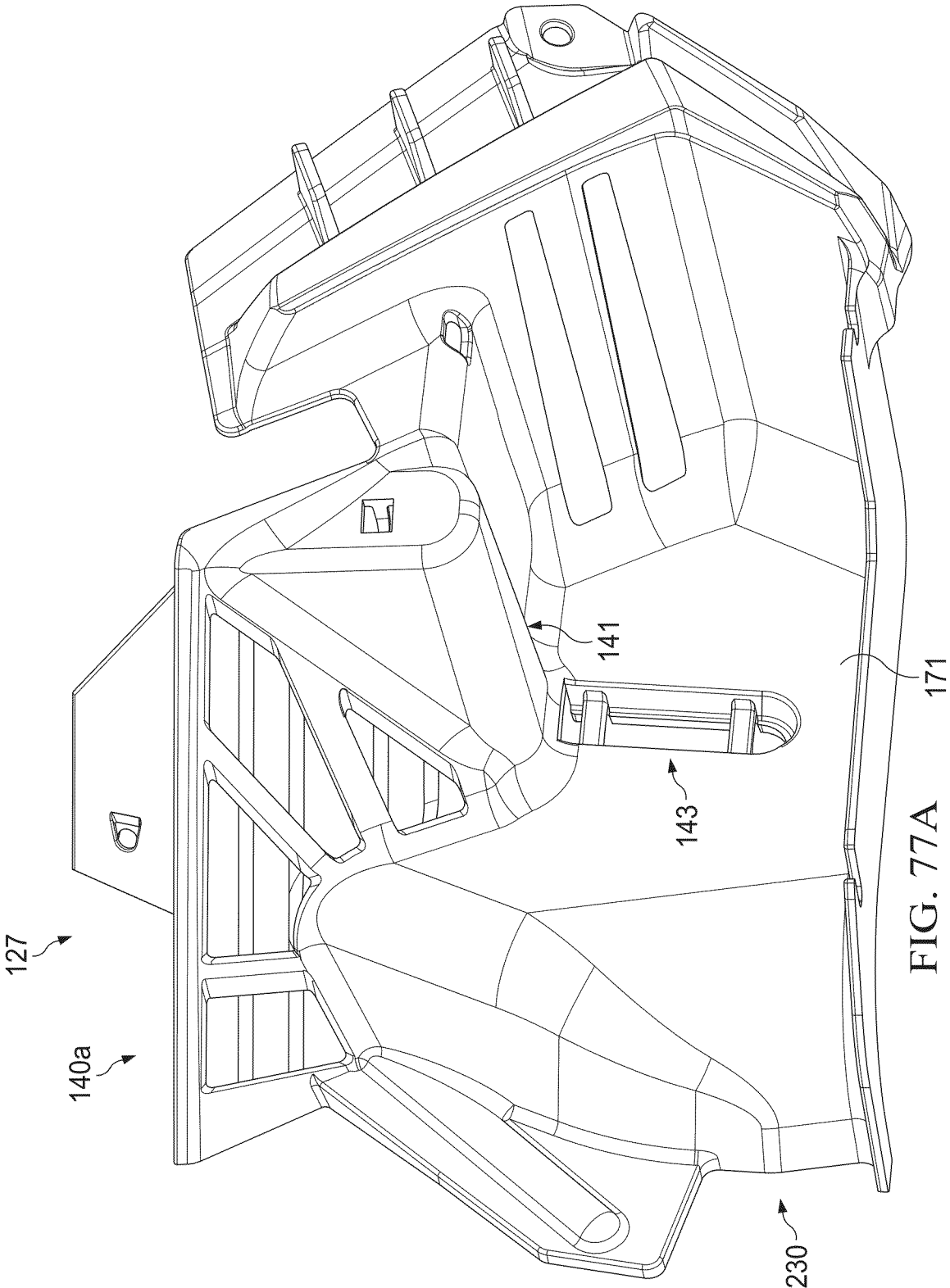


FIG. 77A

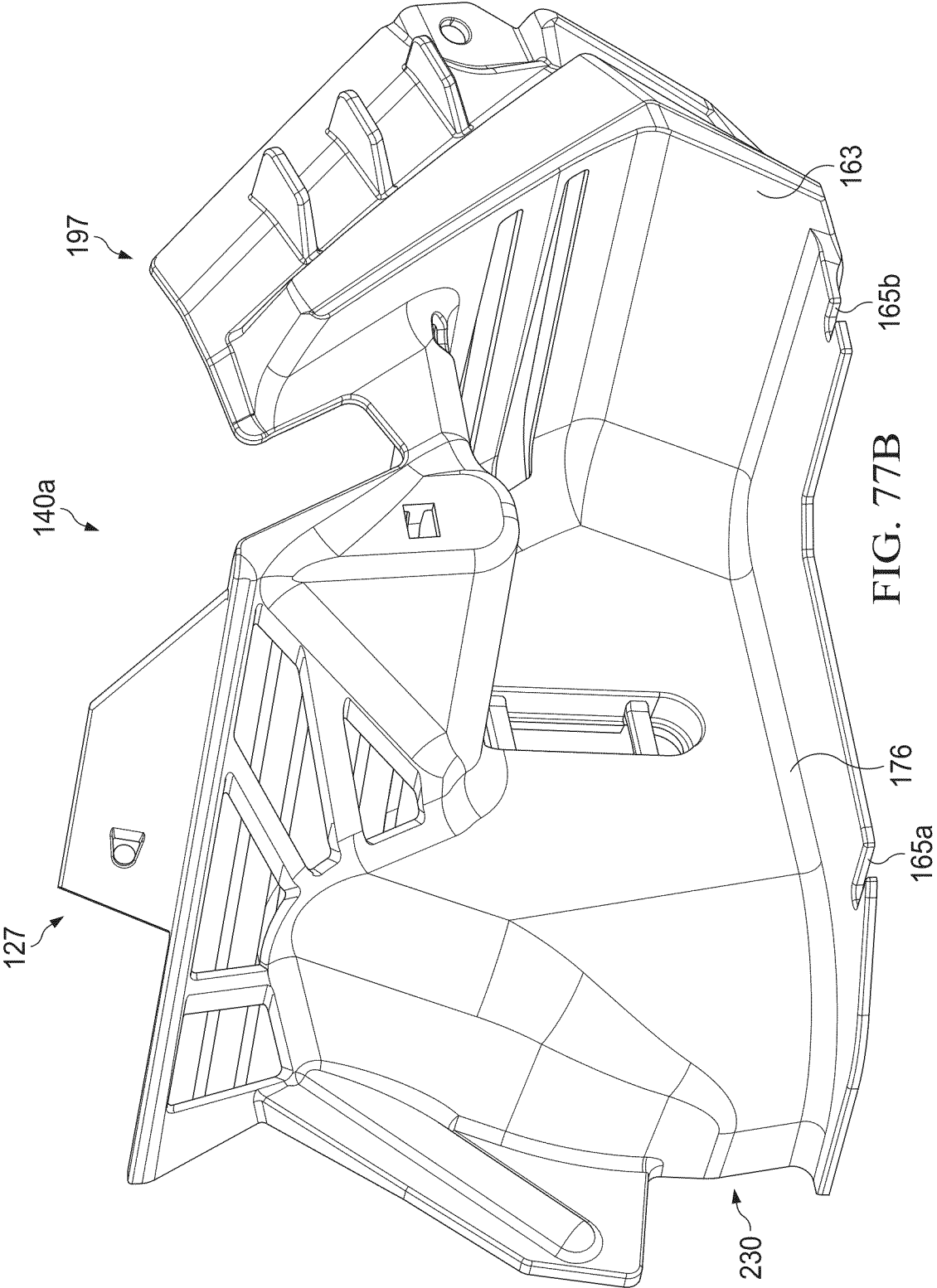


FIG. 77B

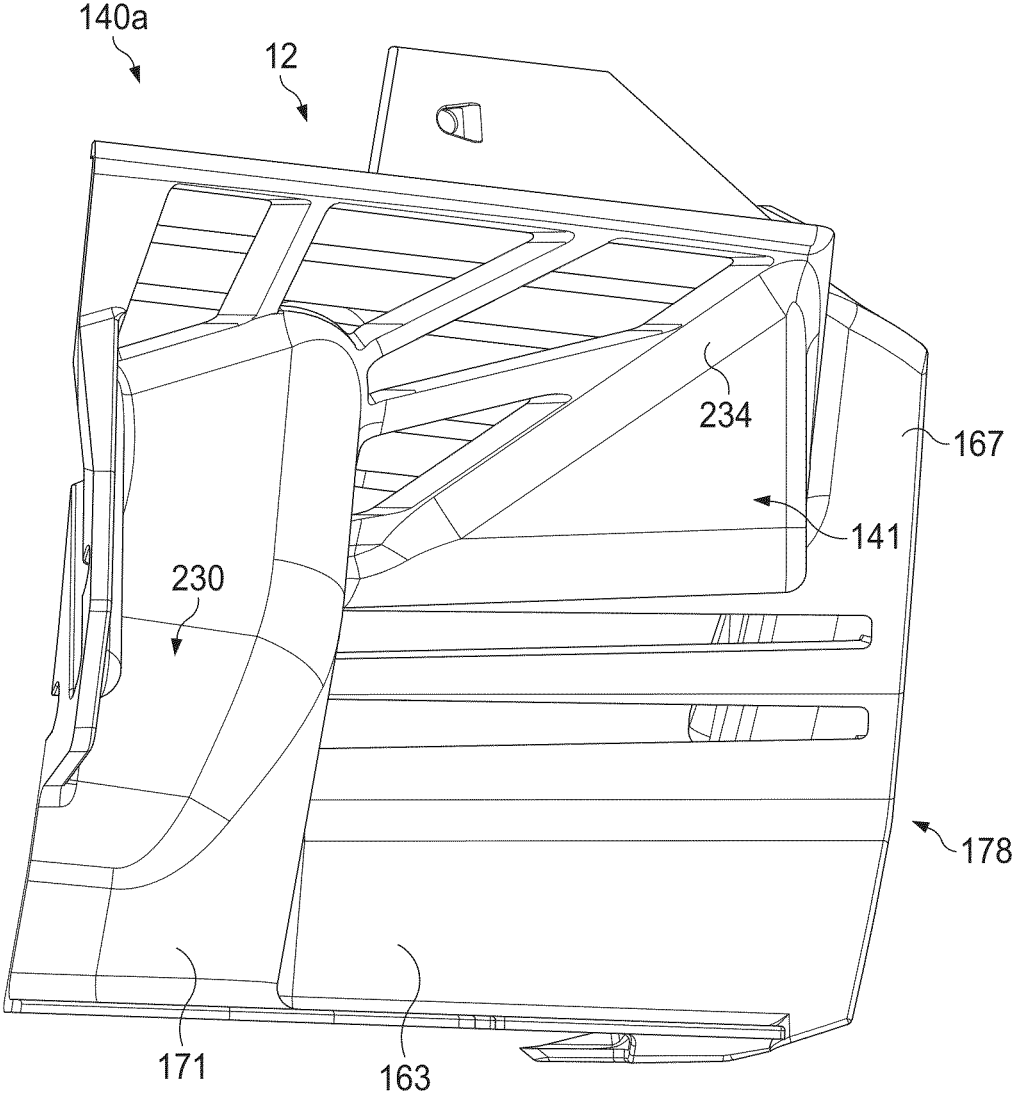


FIG. 78A

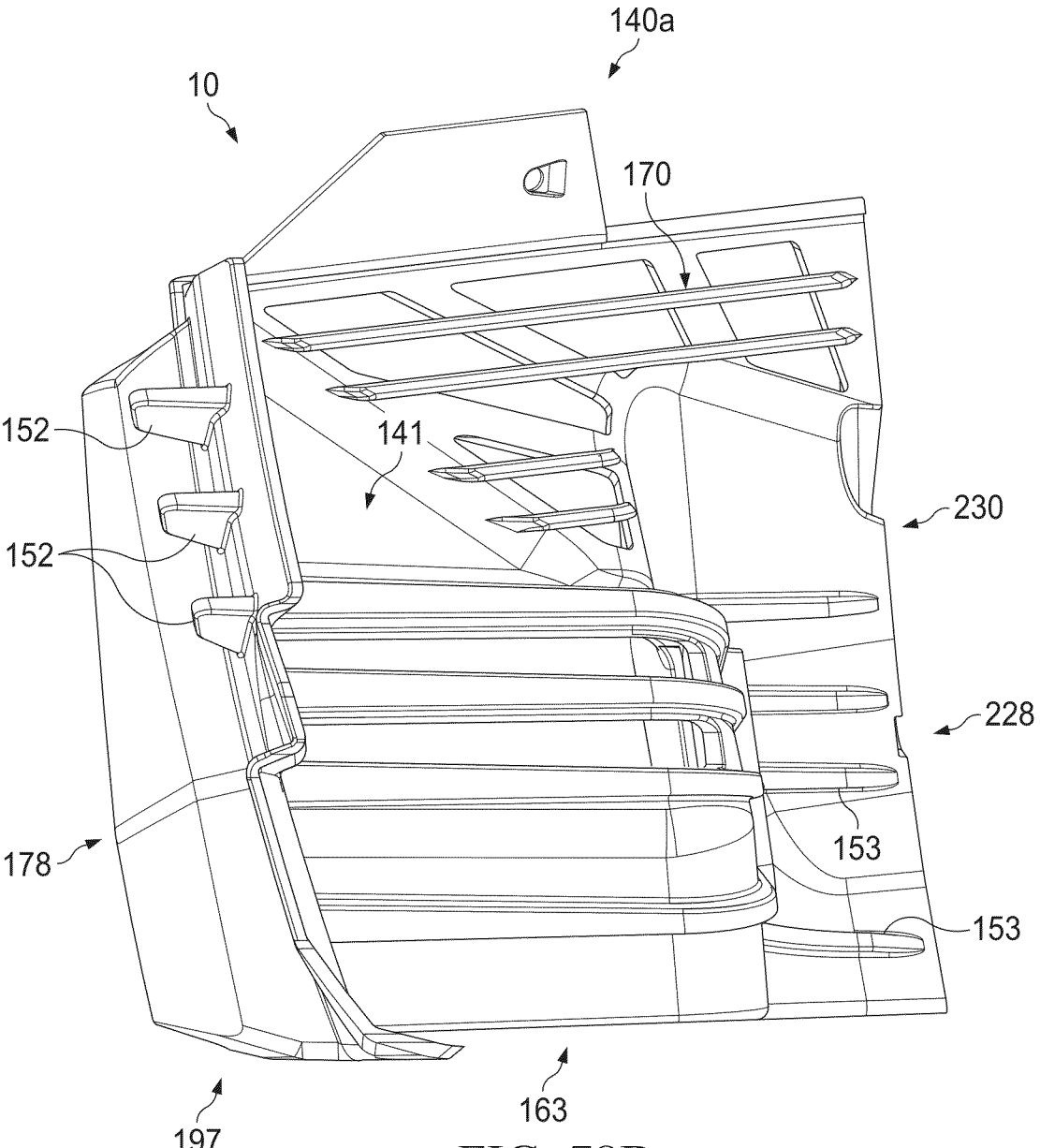


FIG. 78B

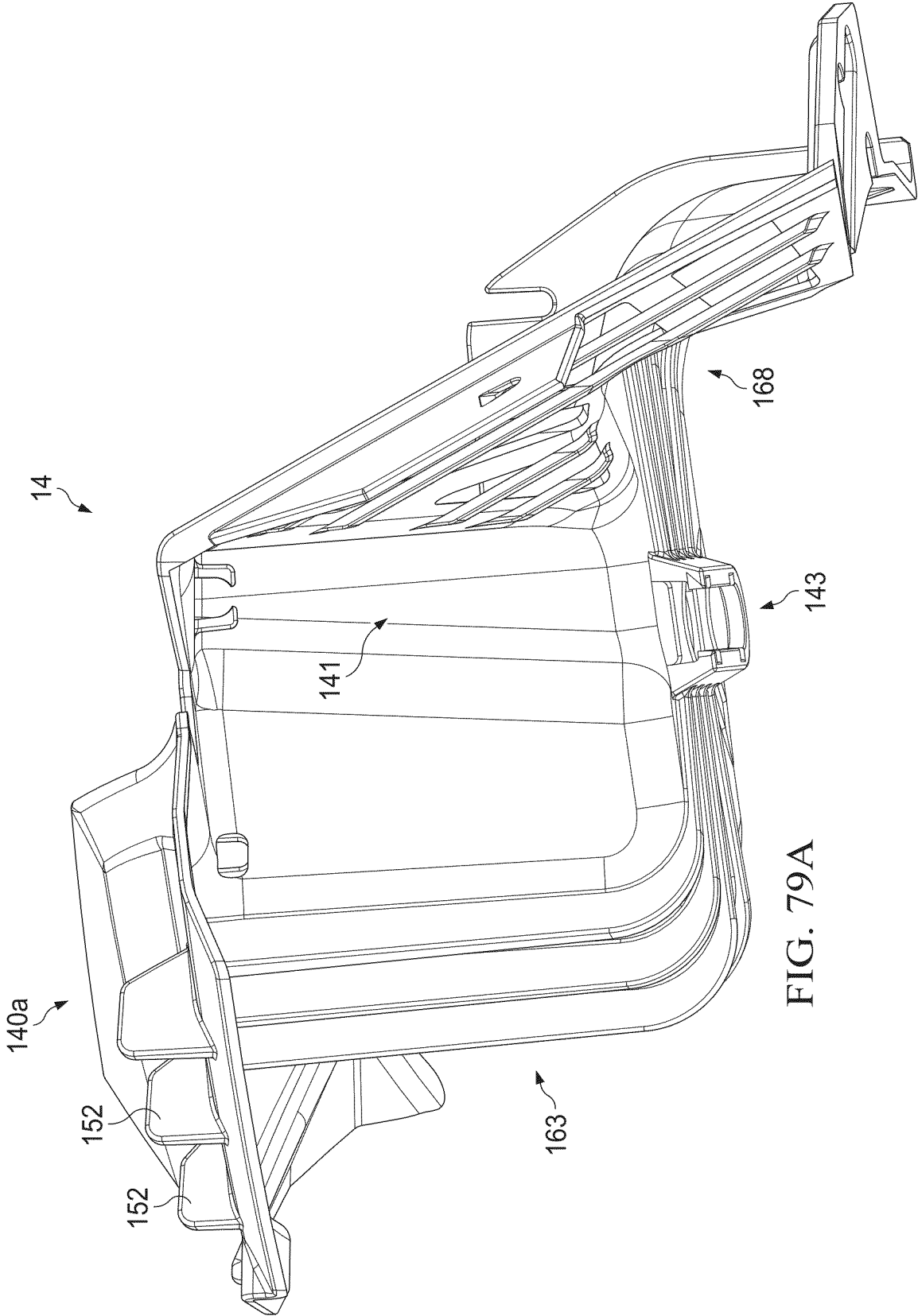
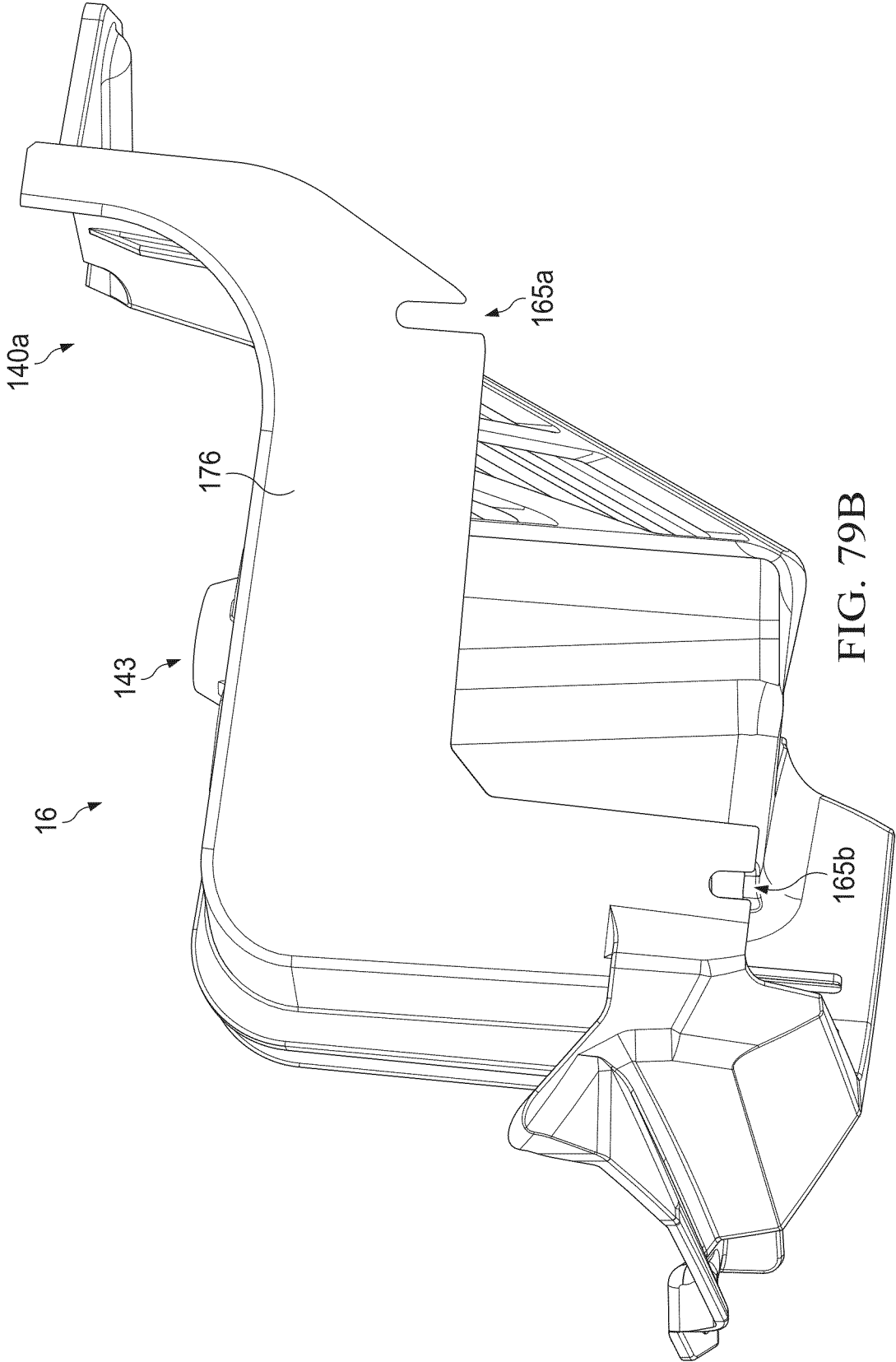


FIG. 79A



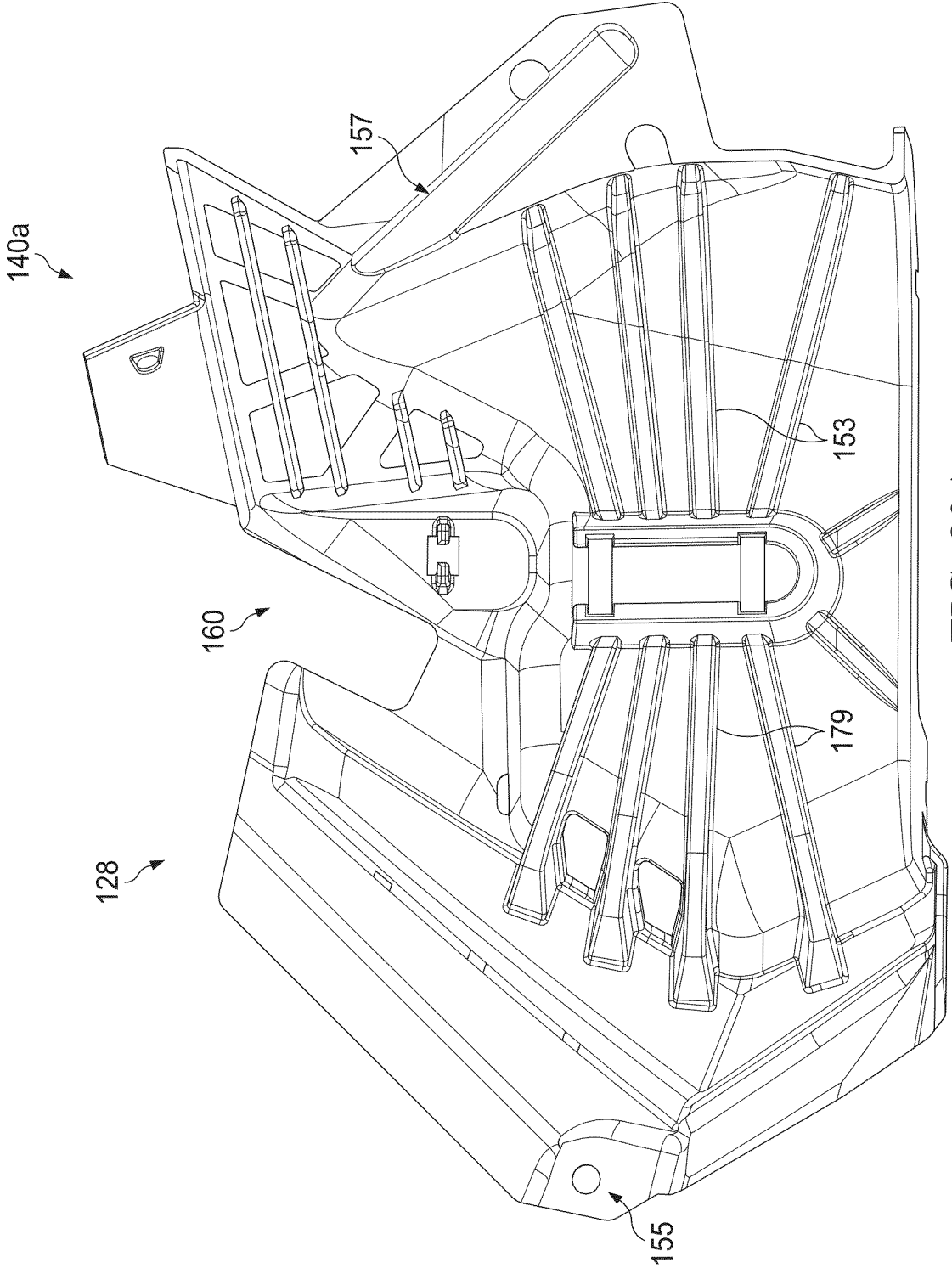


FIG. 80A

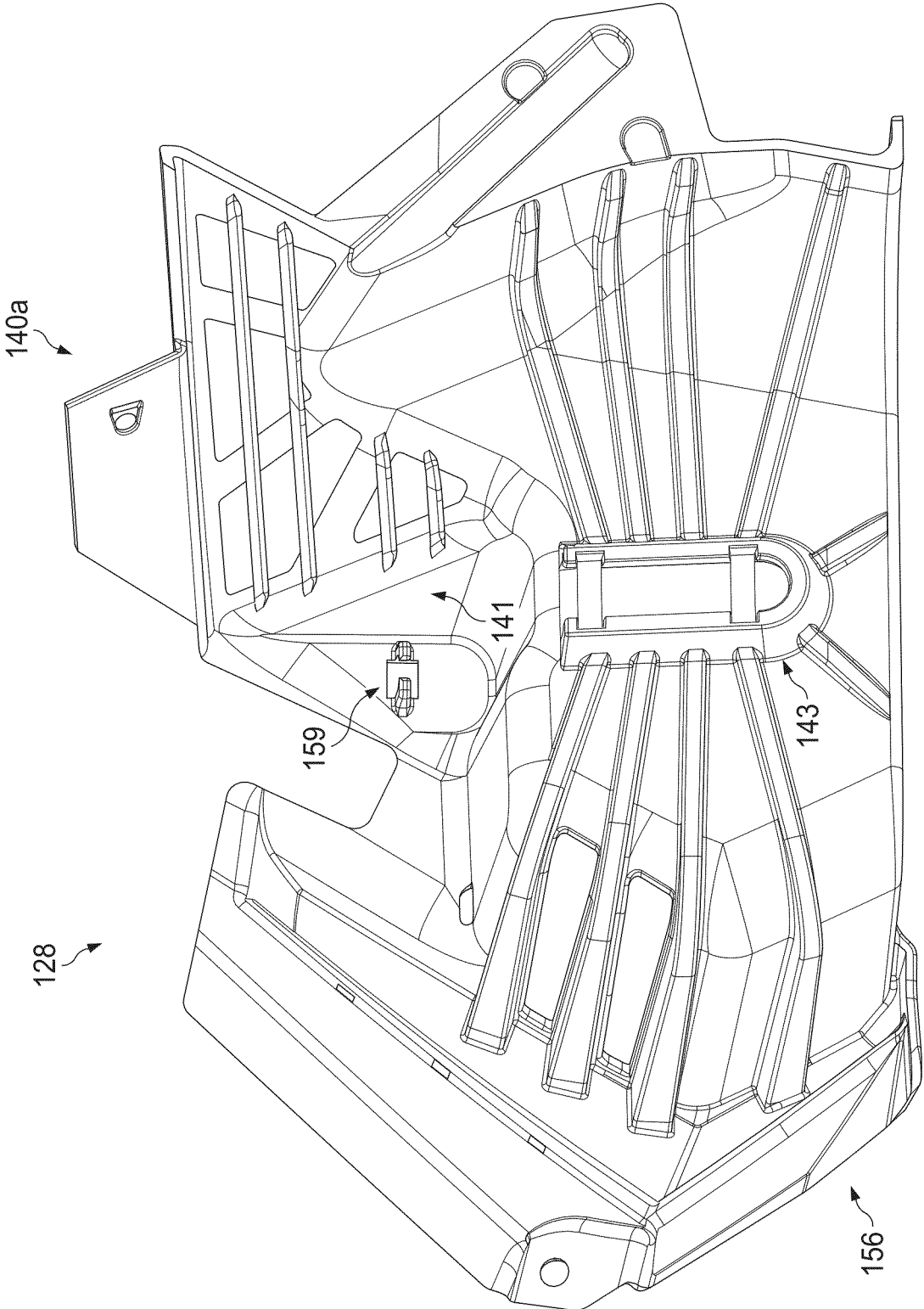


FIG. 80B

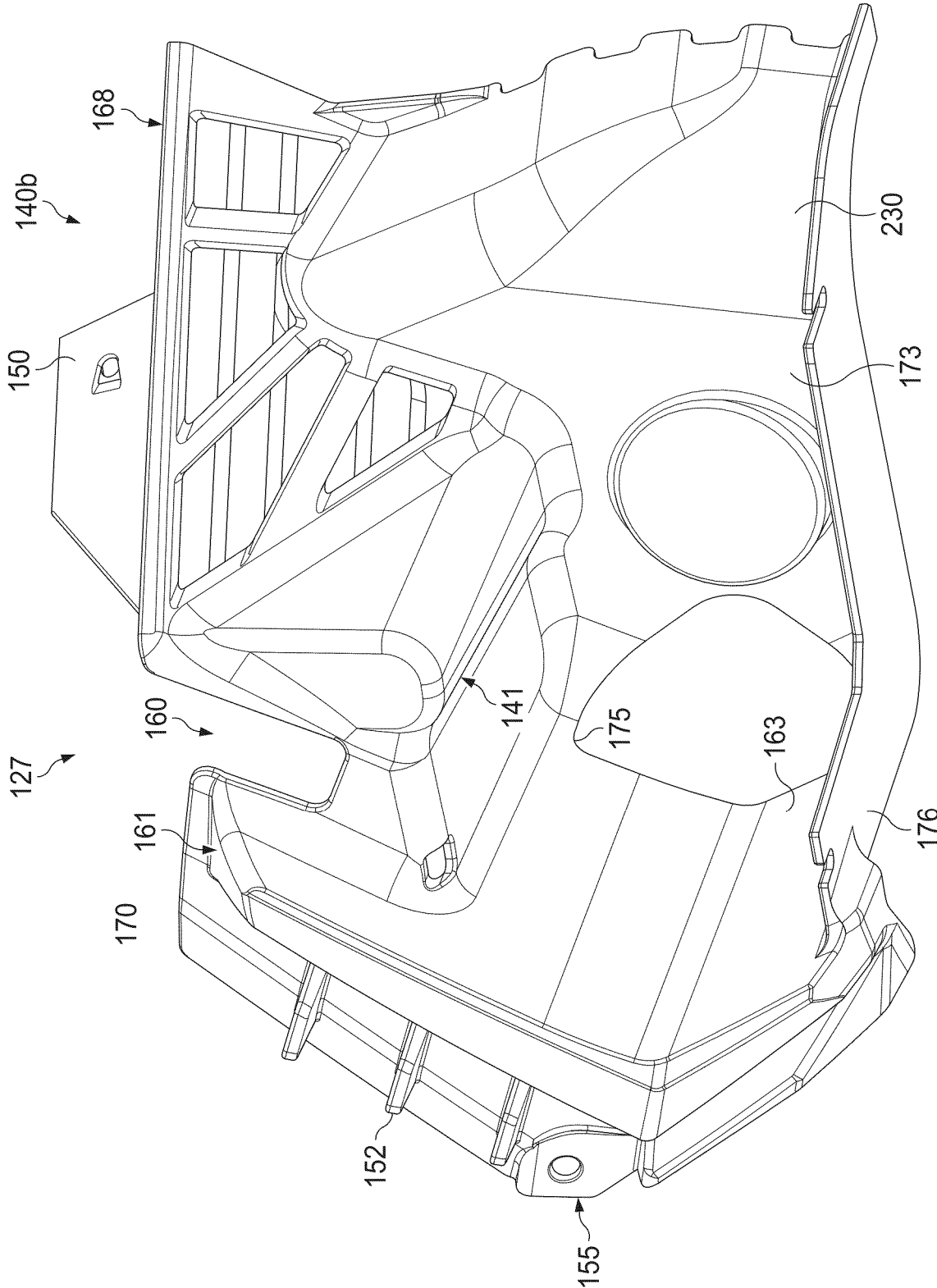


FIG. 81A

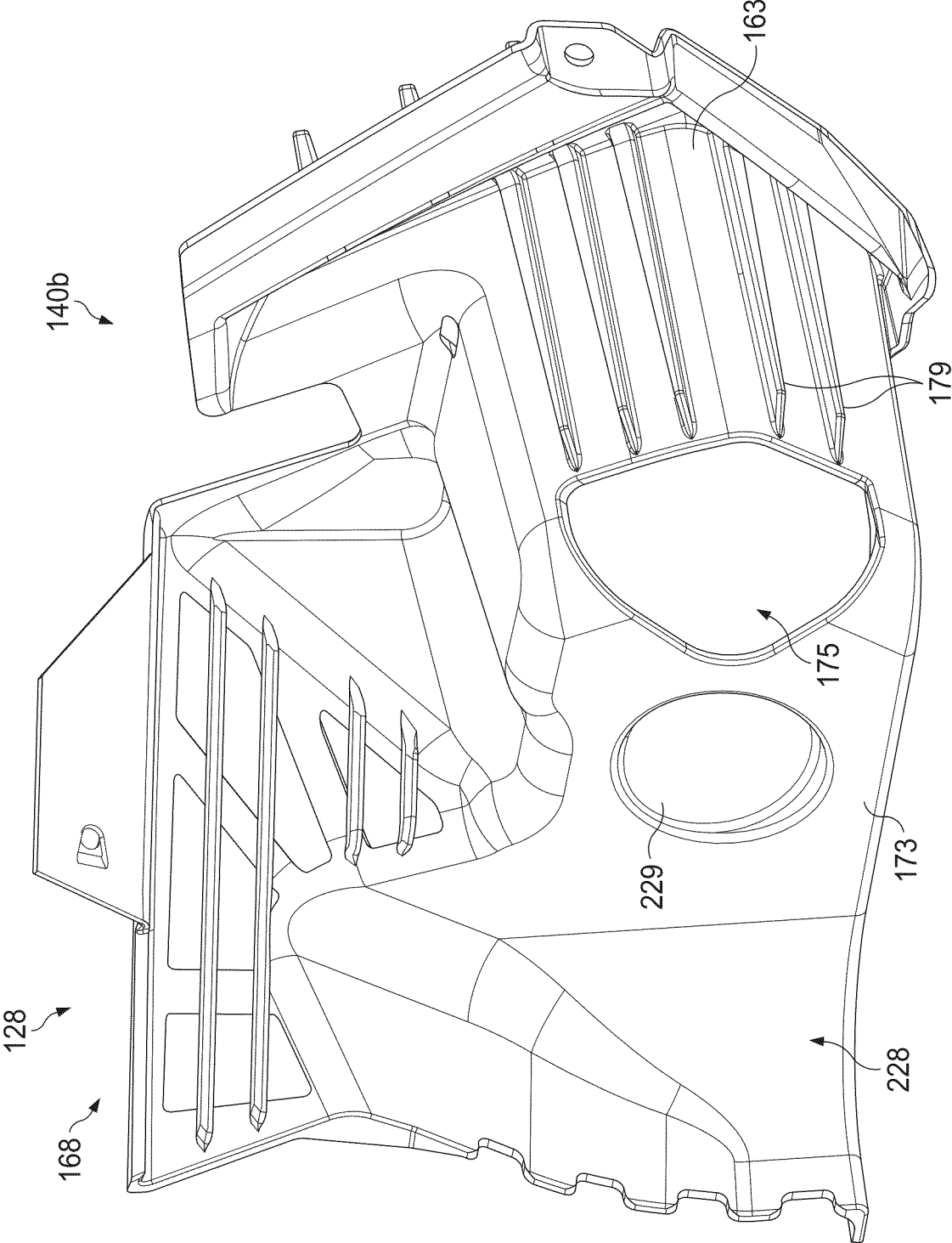


FIG. 81B

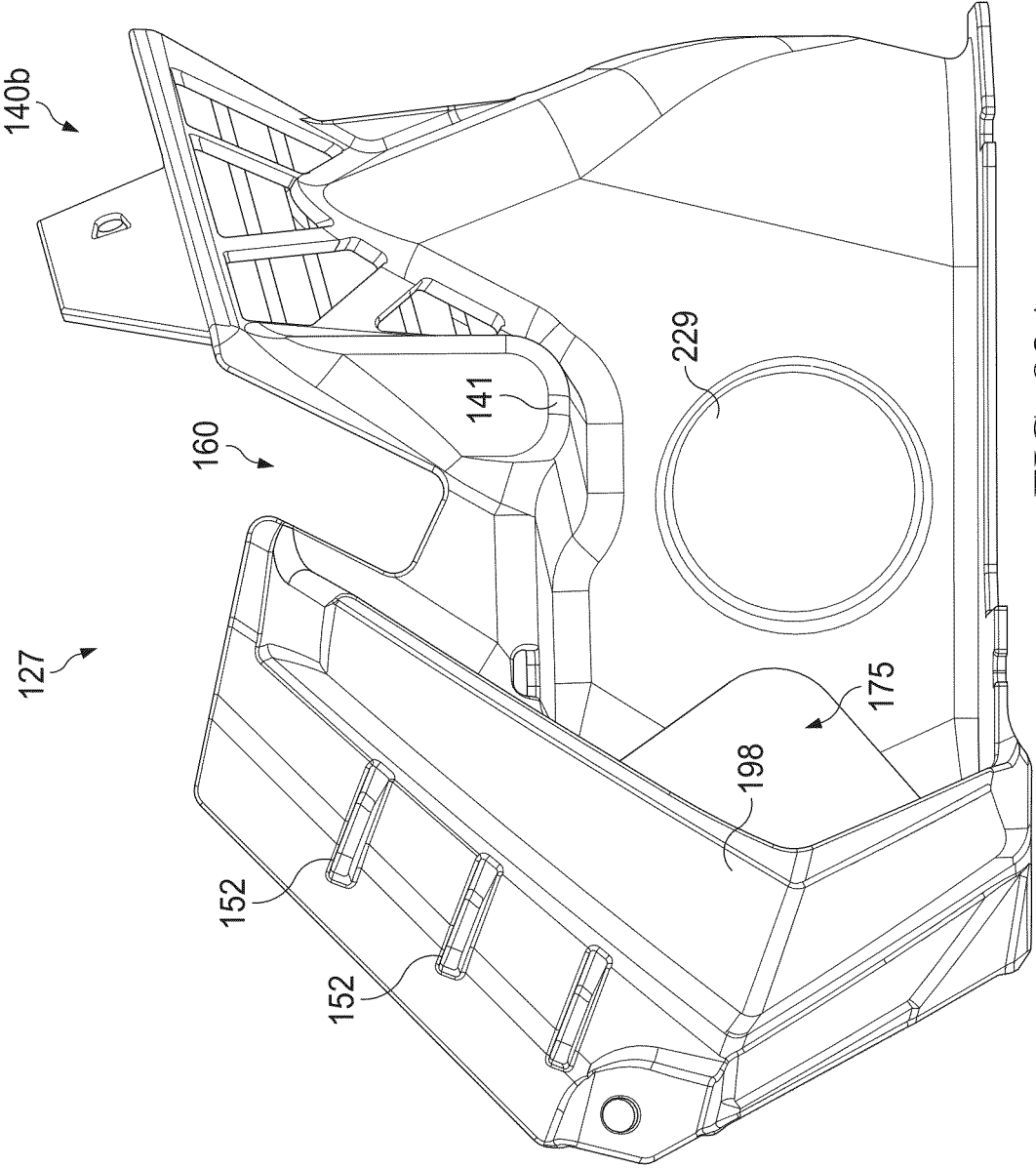


FIG. 82A

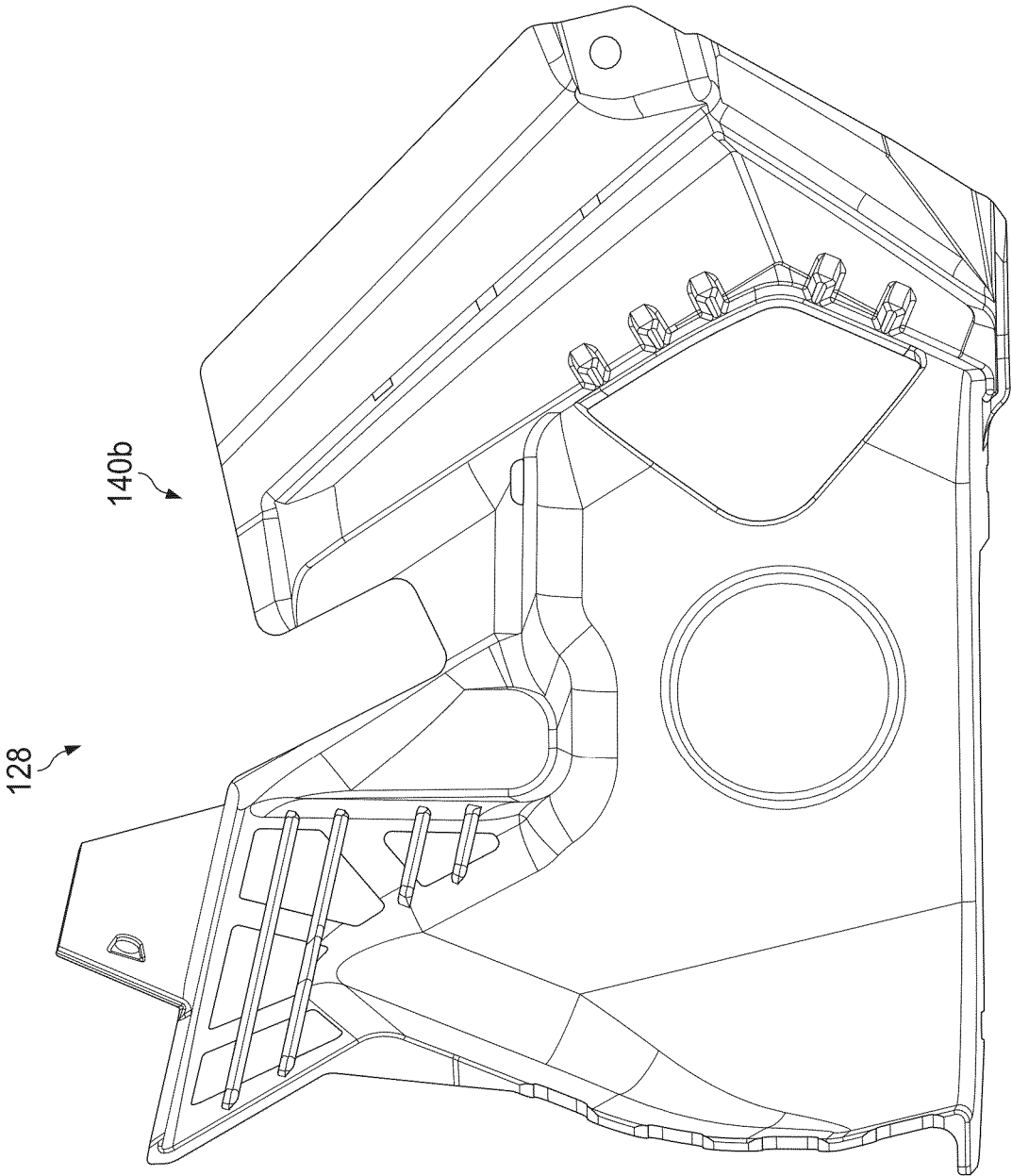


FIG. 82B

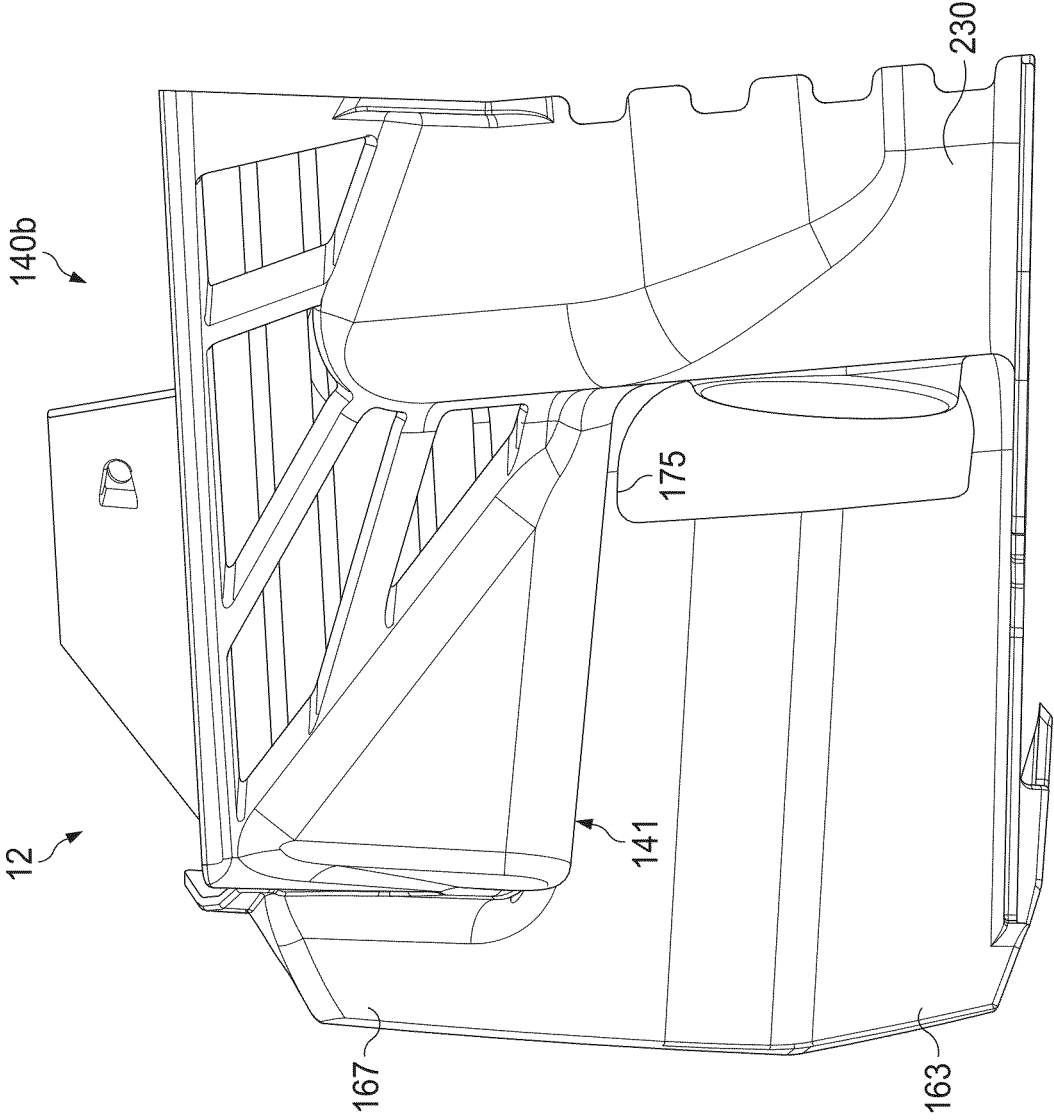


FIG. 83A

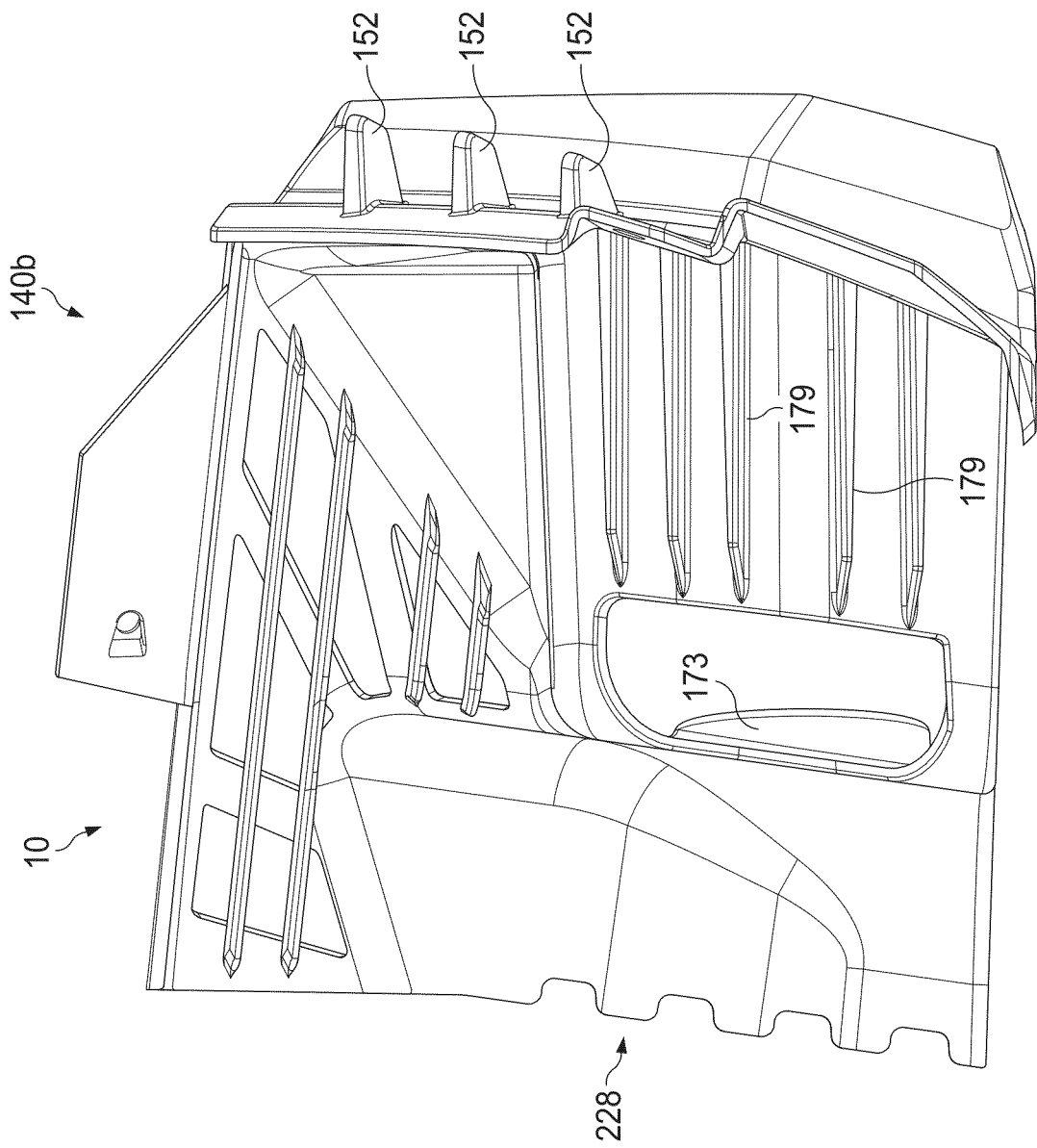


FIG. 83B

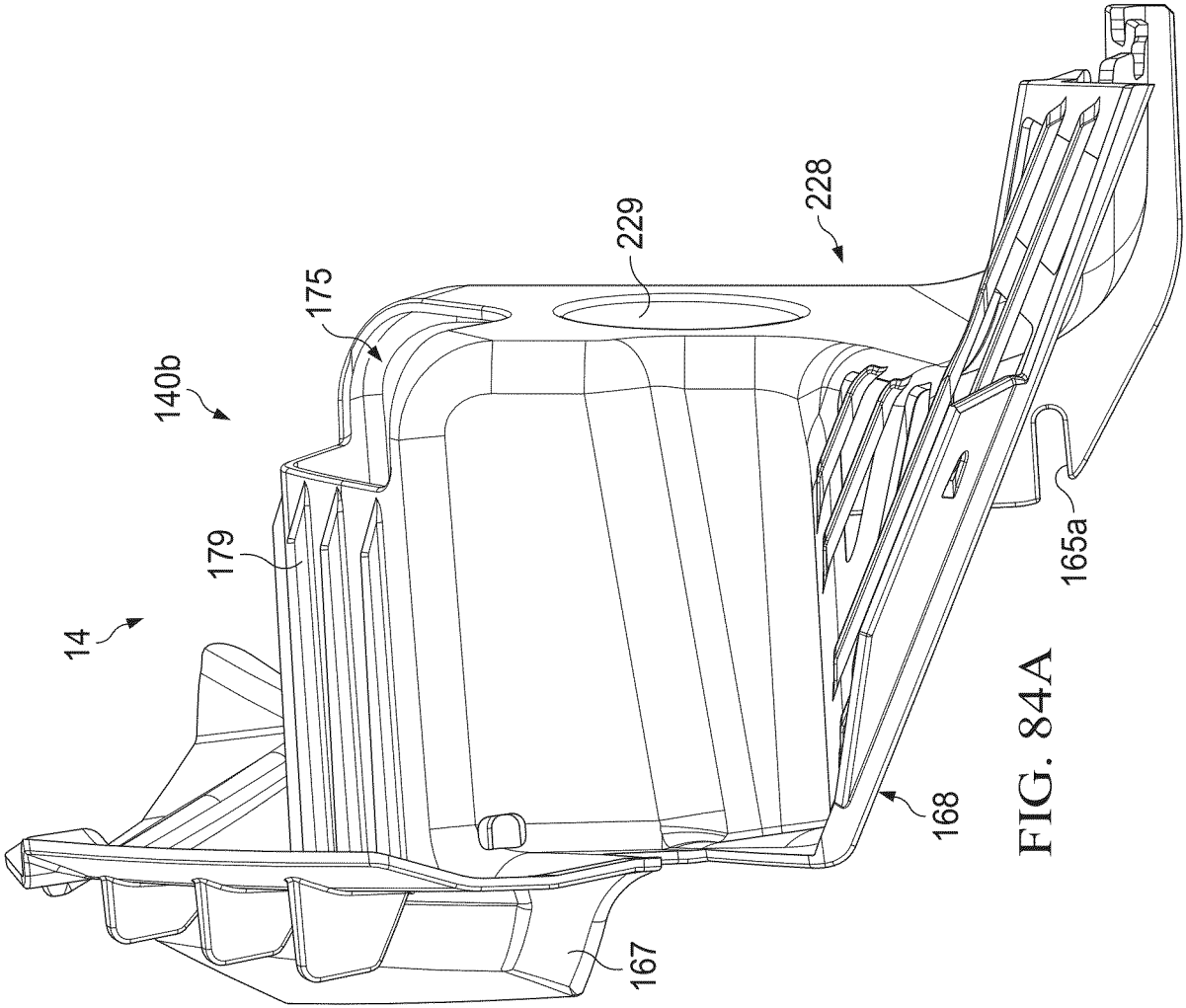


FIG. 84A

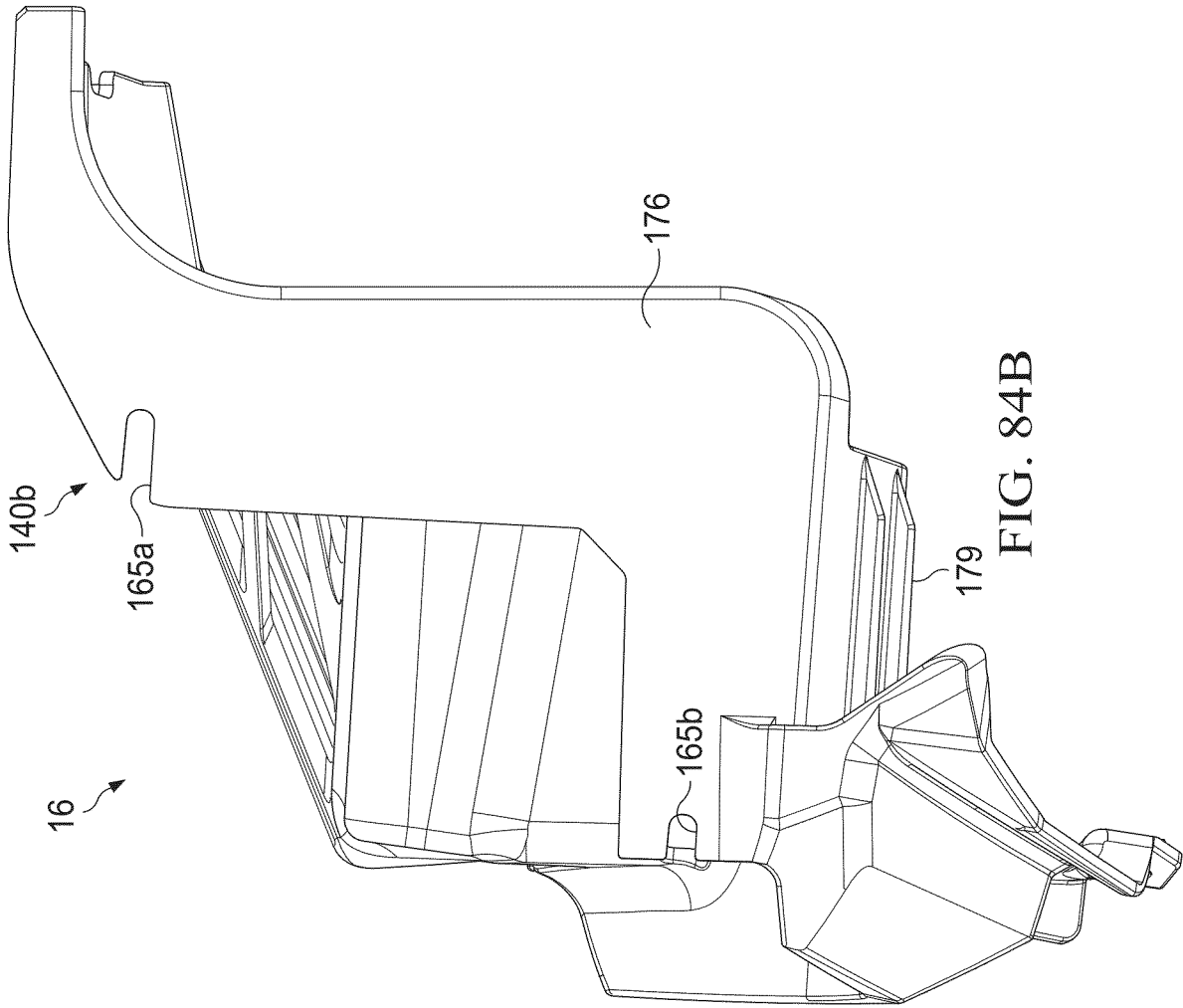


FIG. 84B

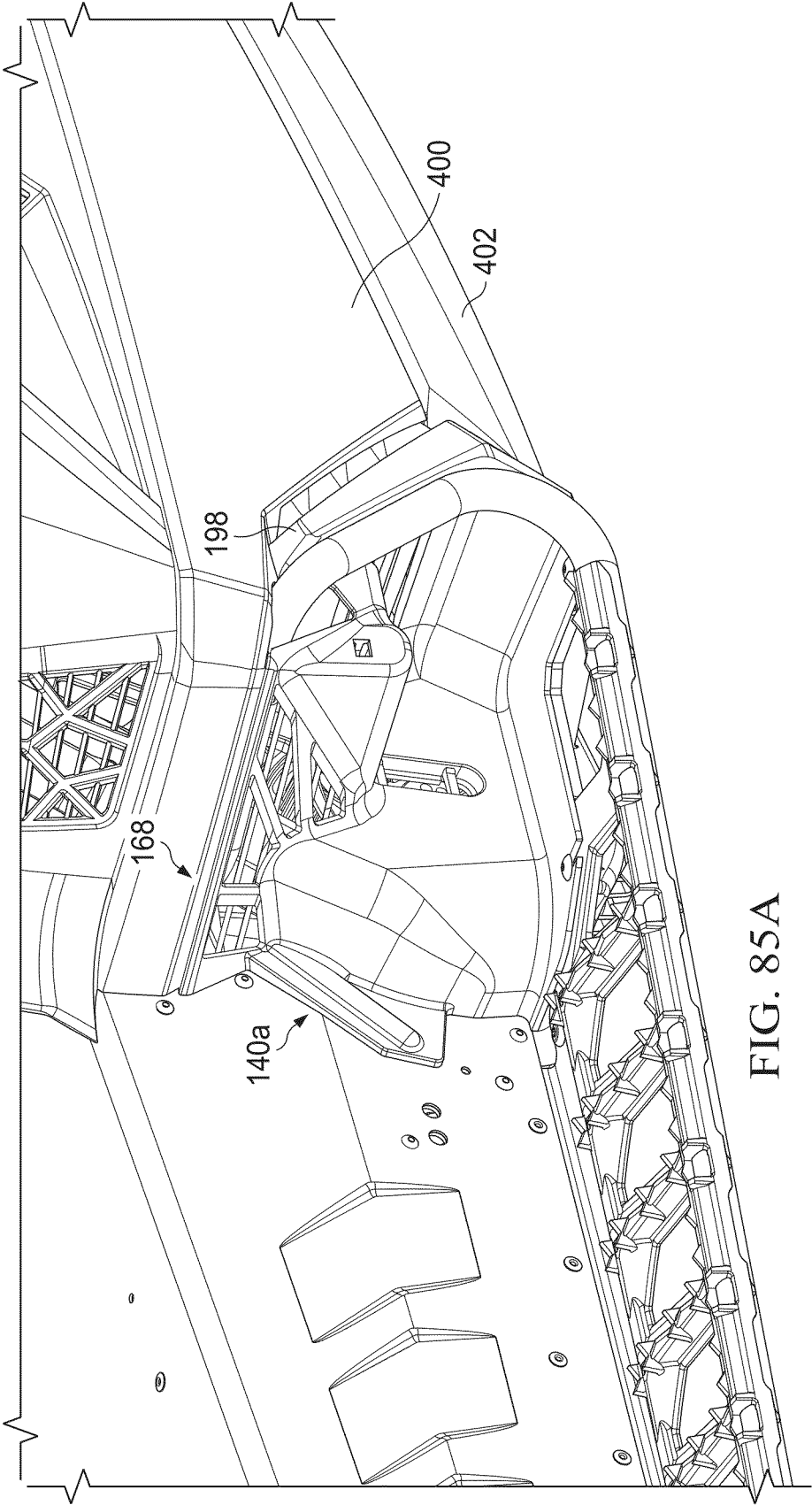


FIG. 85A

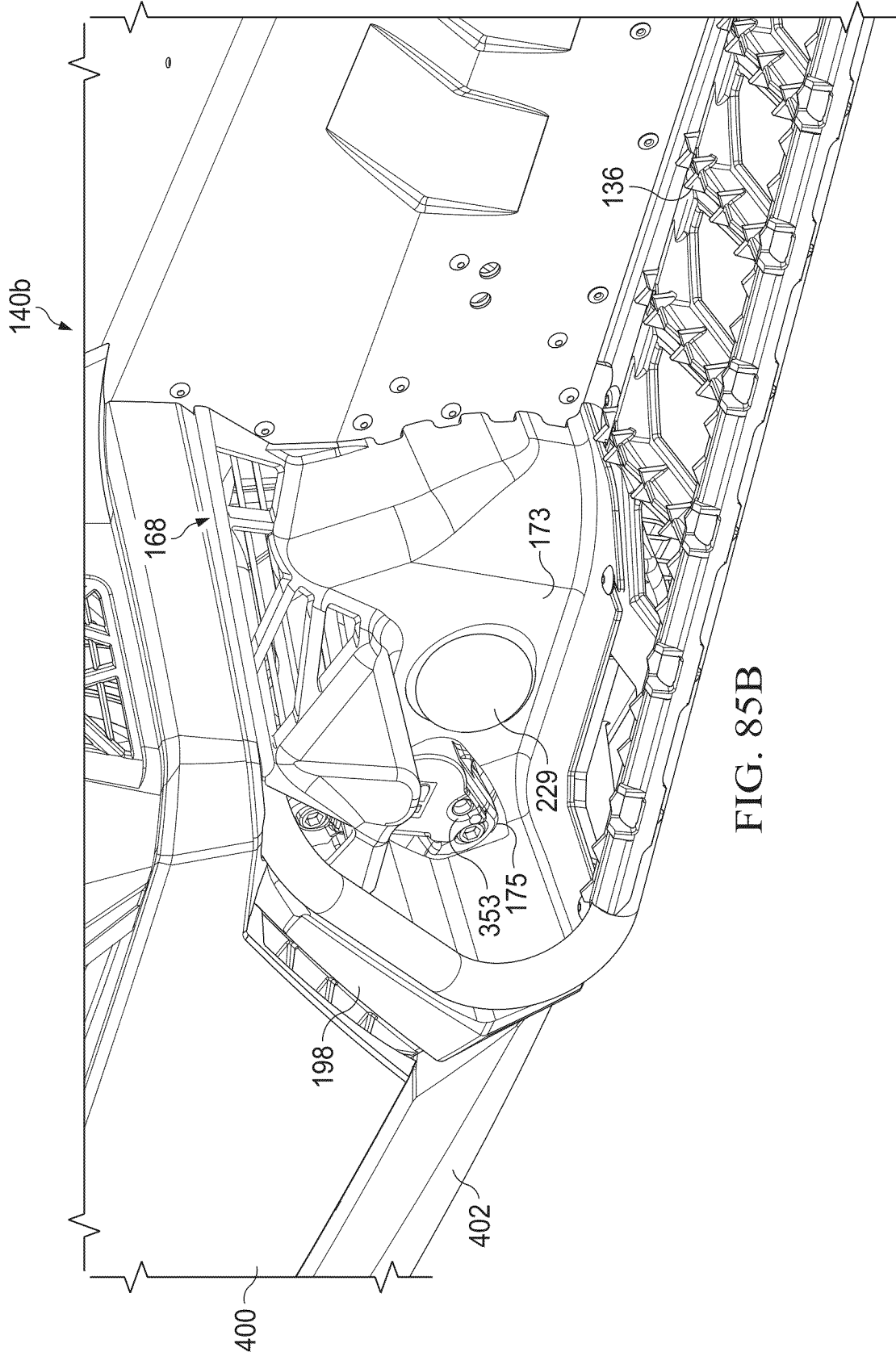


FIG. 85B

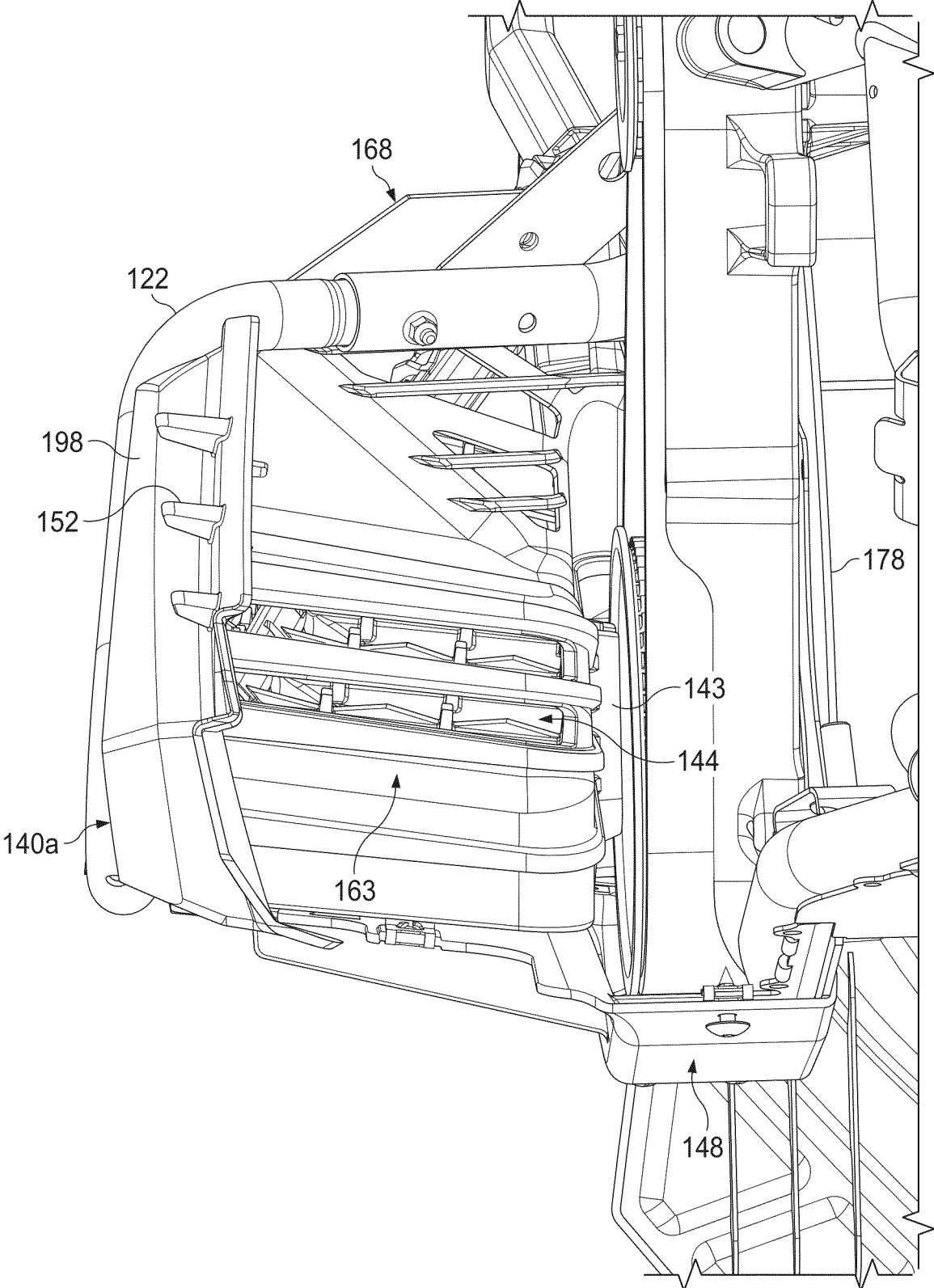


FIG. 86A

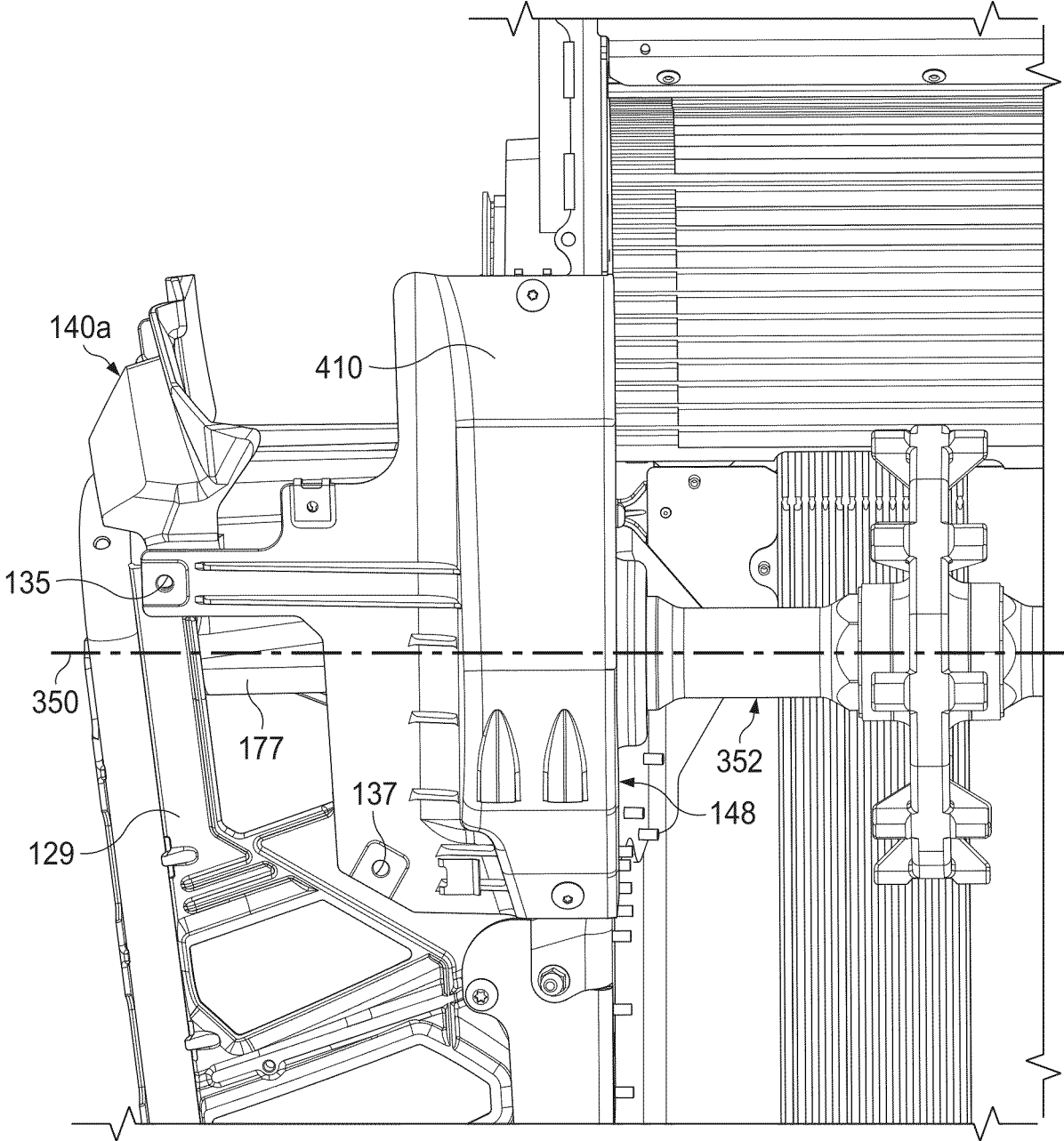


FIG. 86B

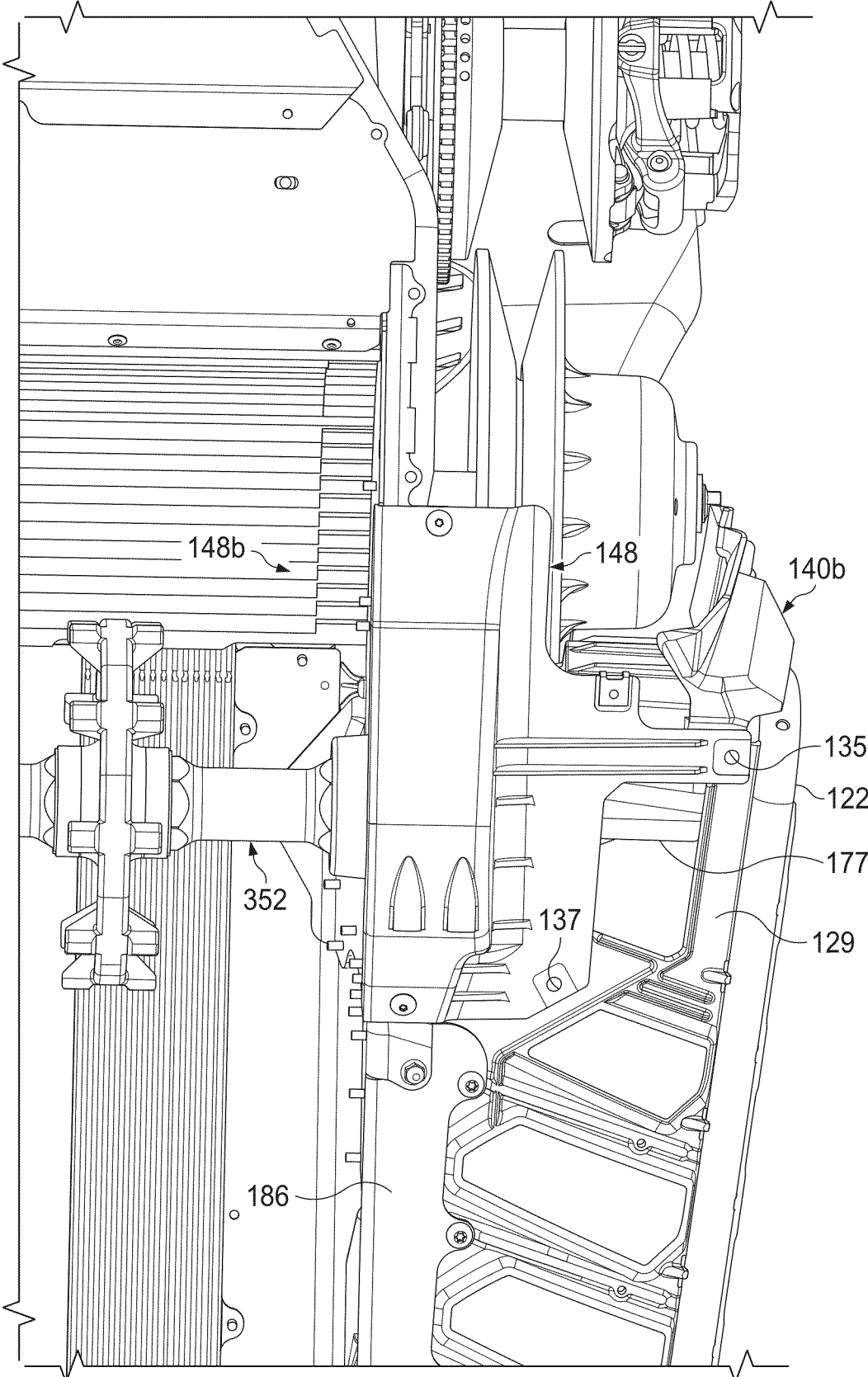


FIG. 87A

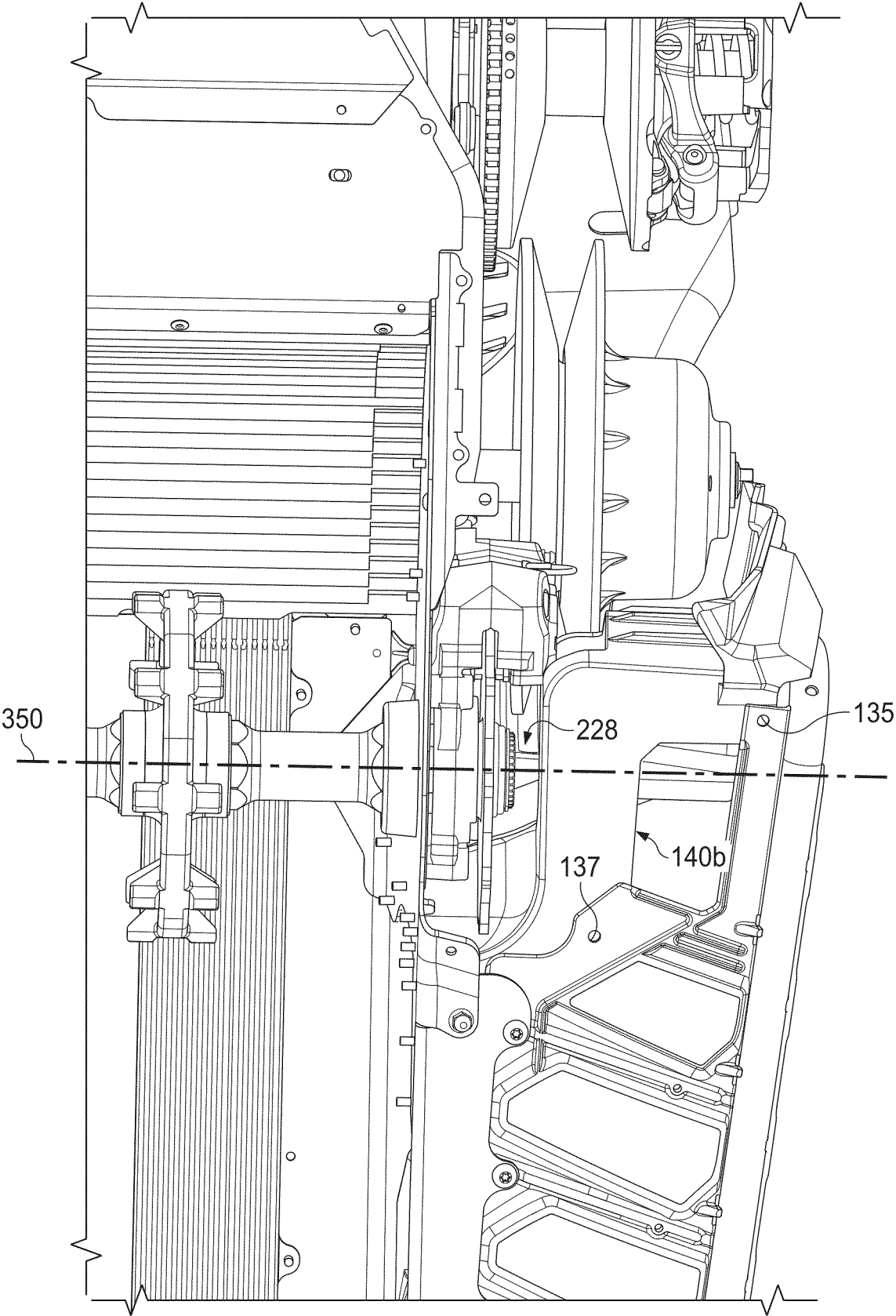


FIG. 87B

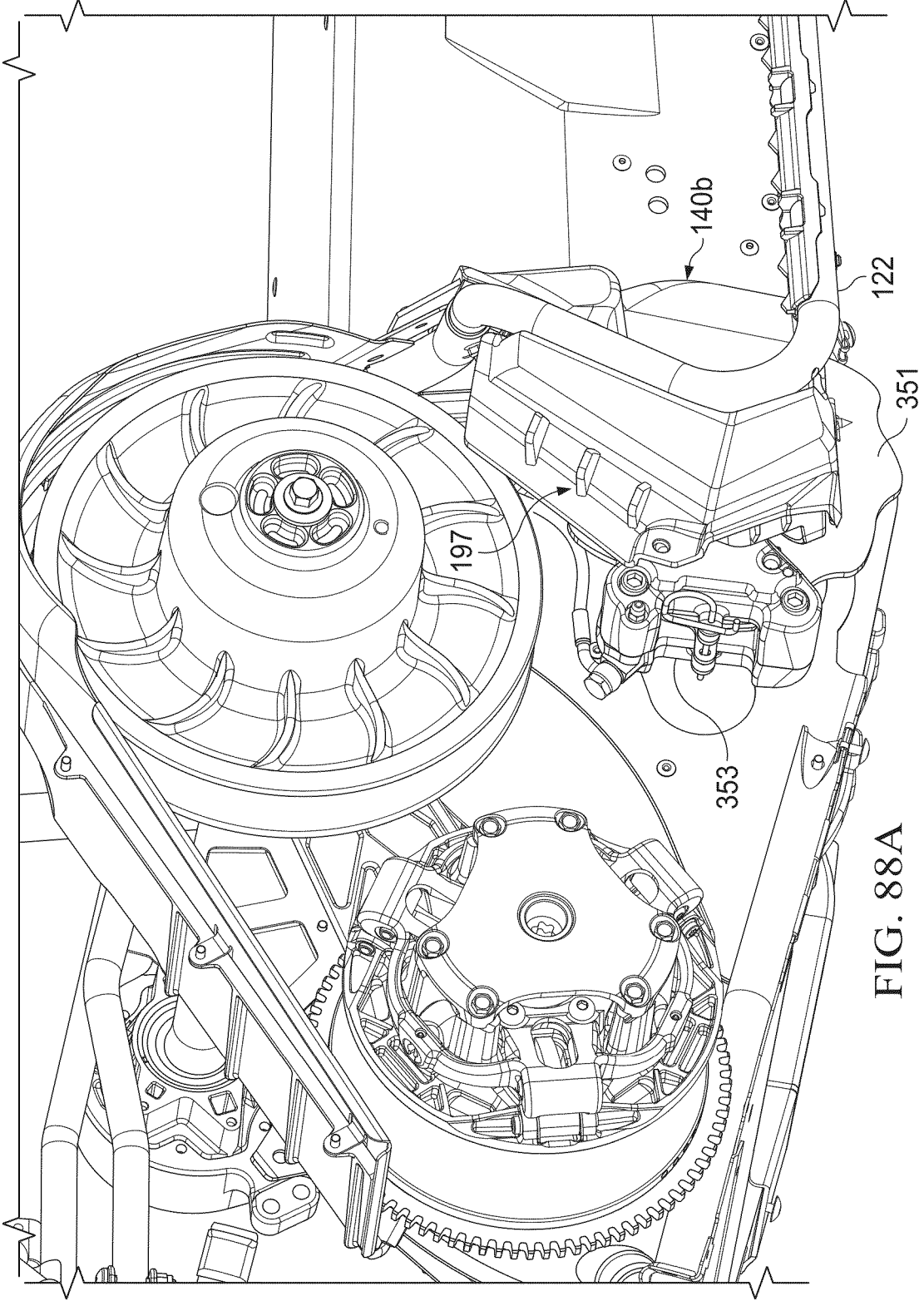


FIG. 88A

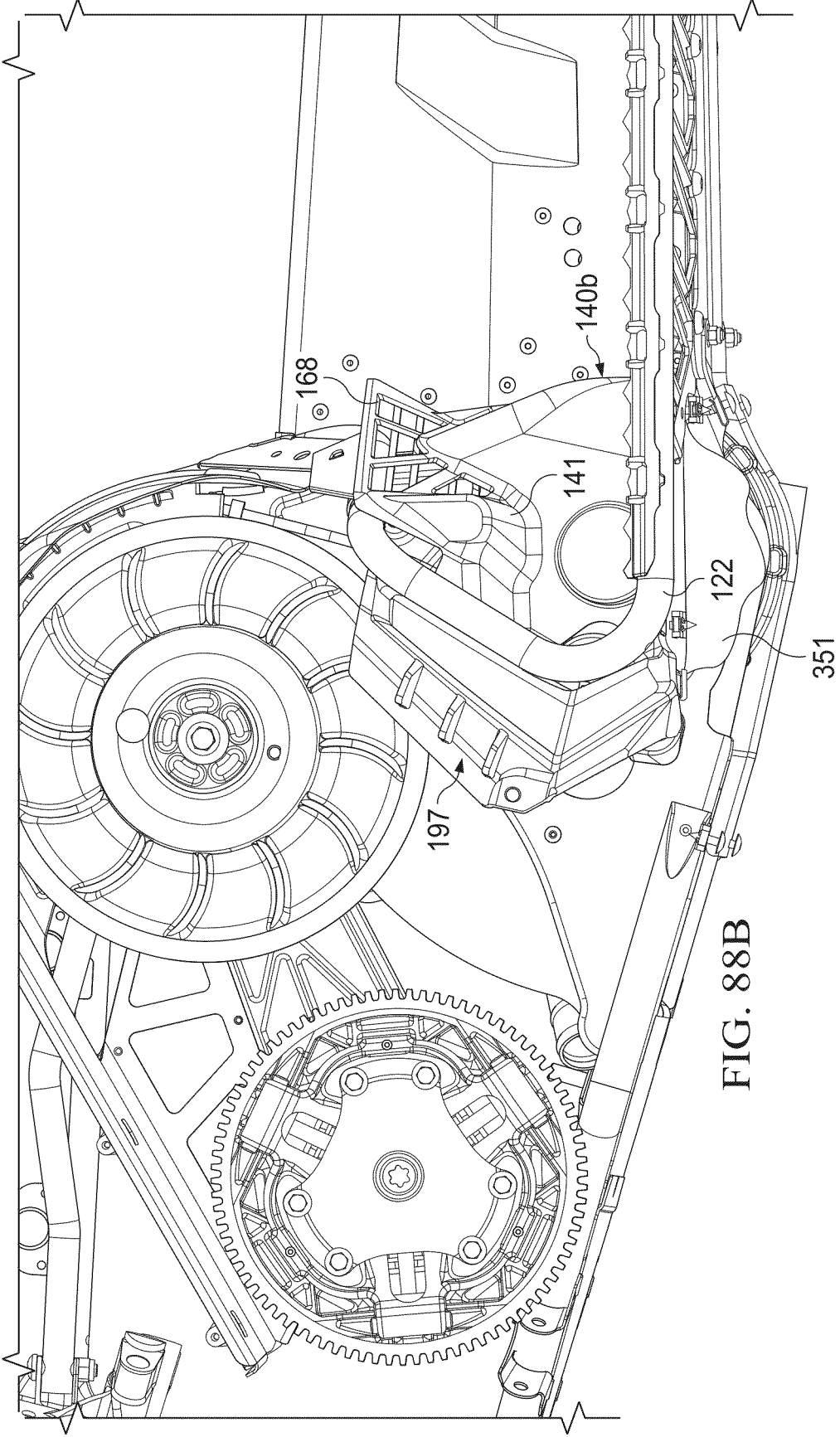


FIG. 88B

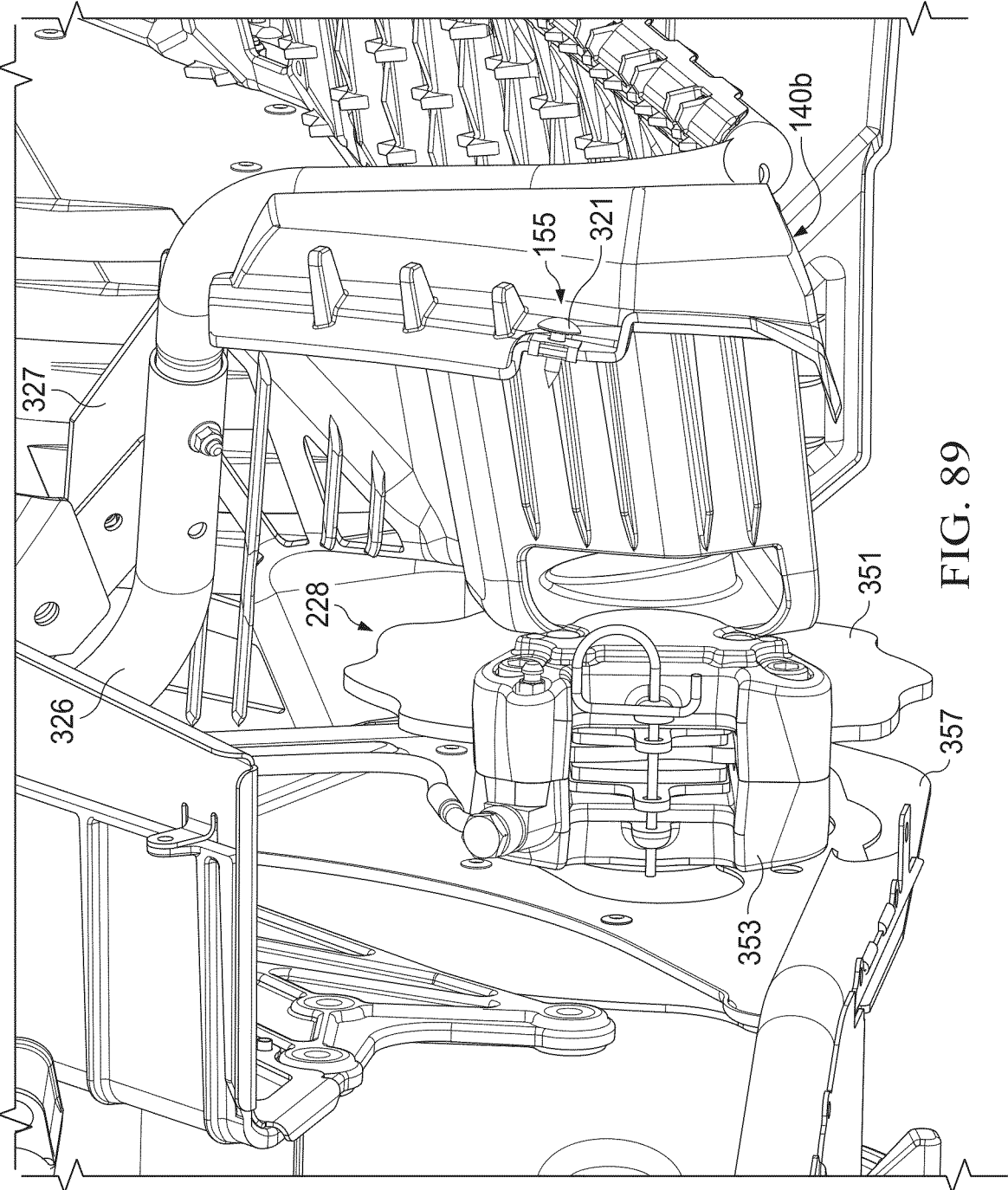


FIG. 89

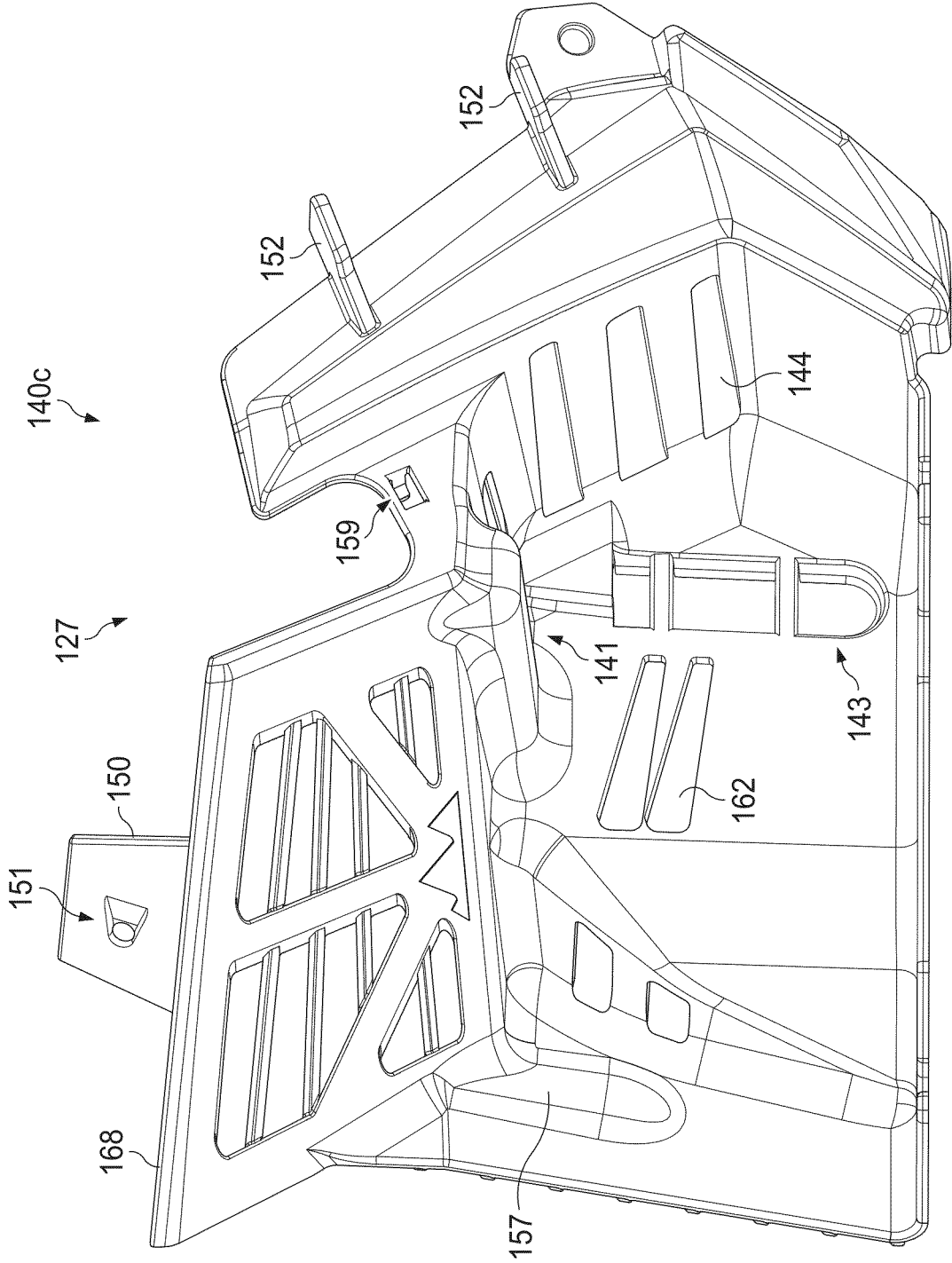


FIG. 90A

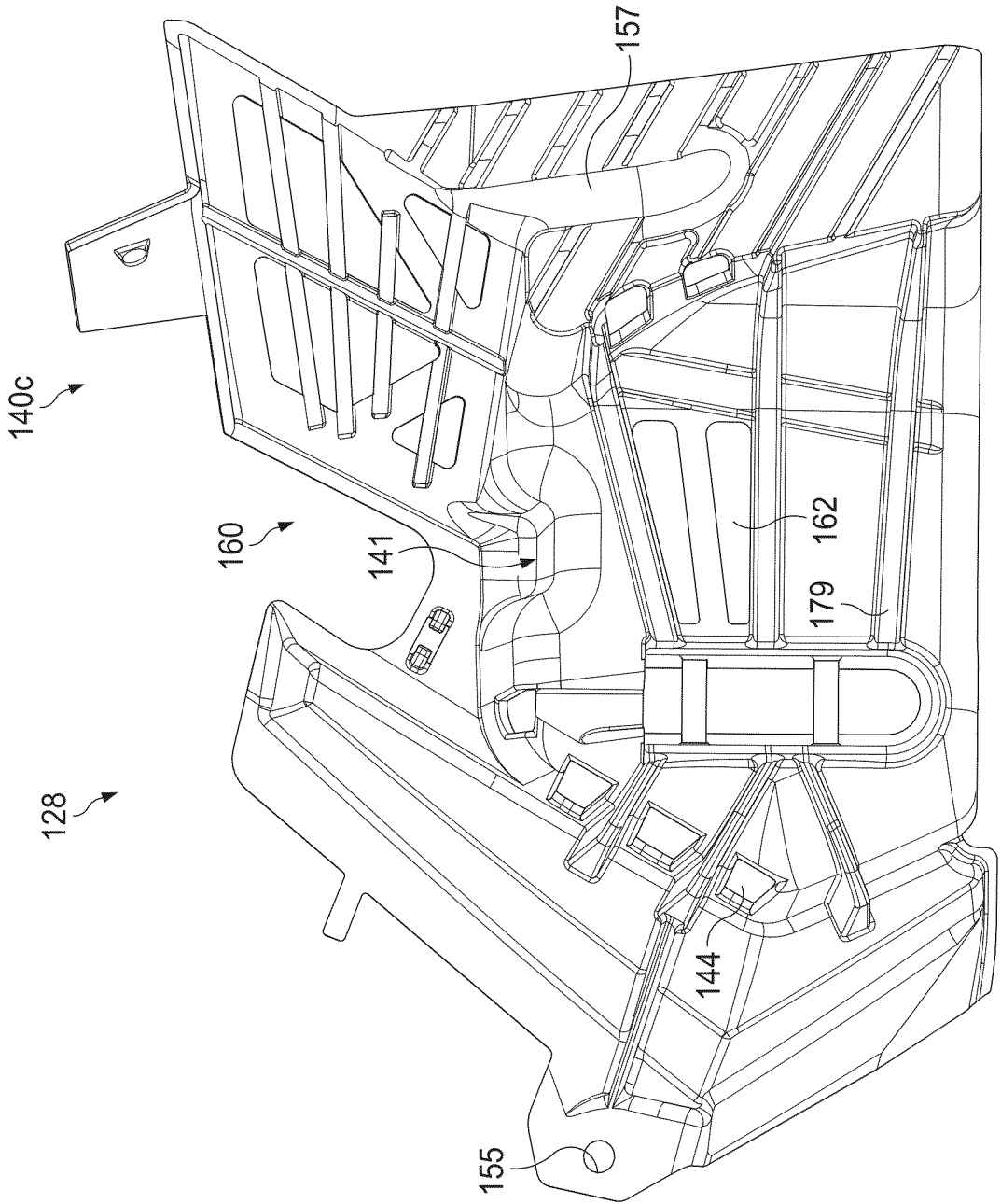


FIG. 90B

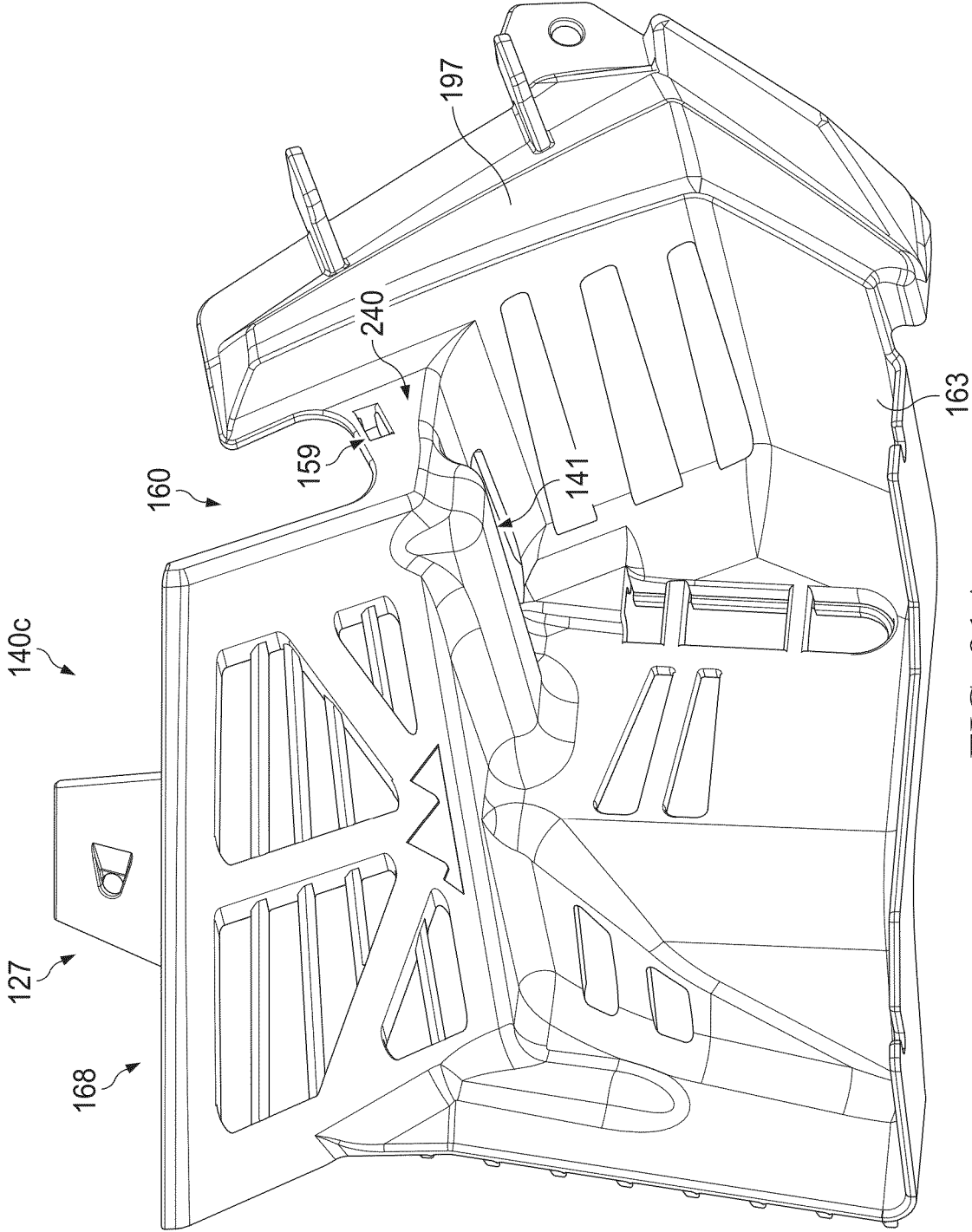


FIG. 91A

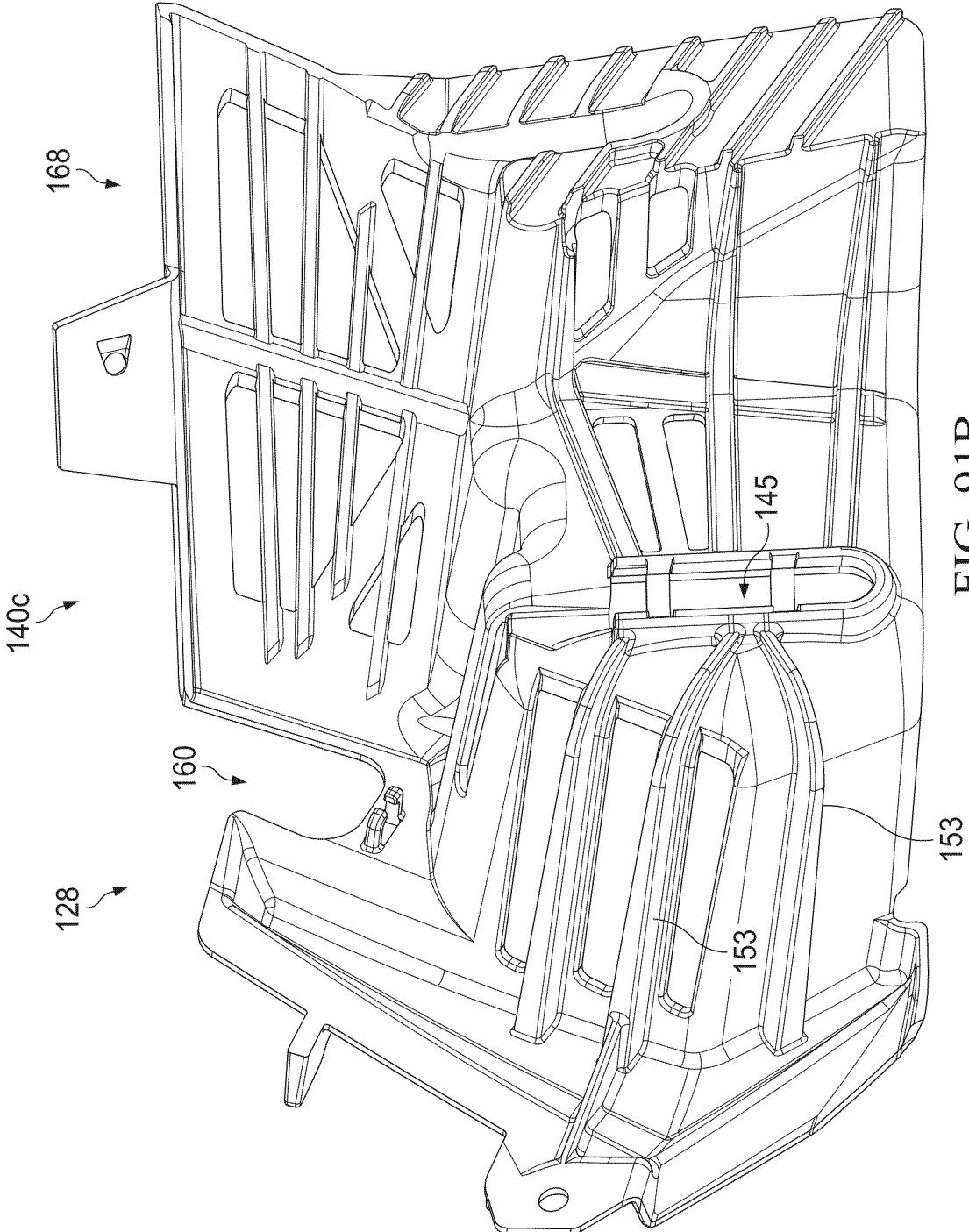


FIG. 91B

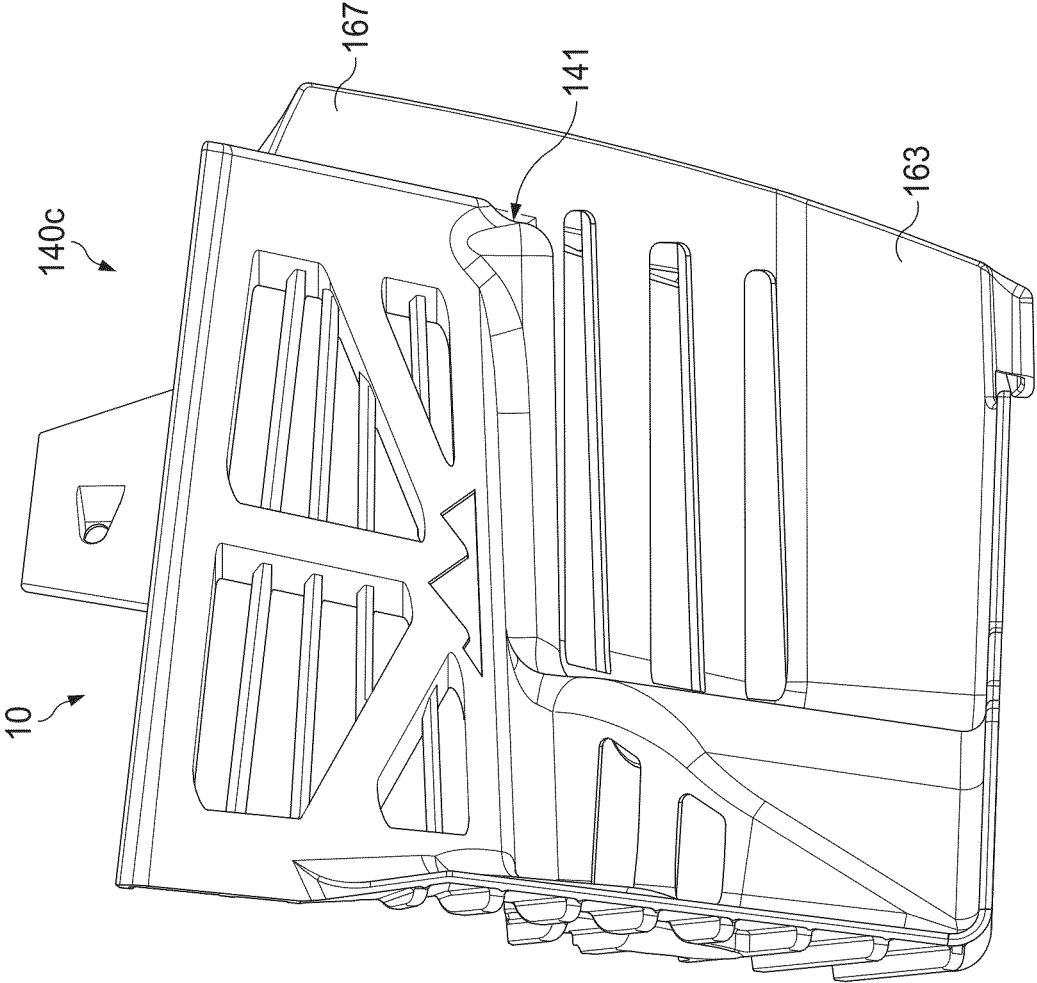


FIG. 92A

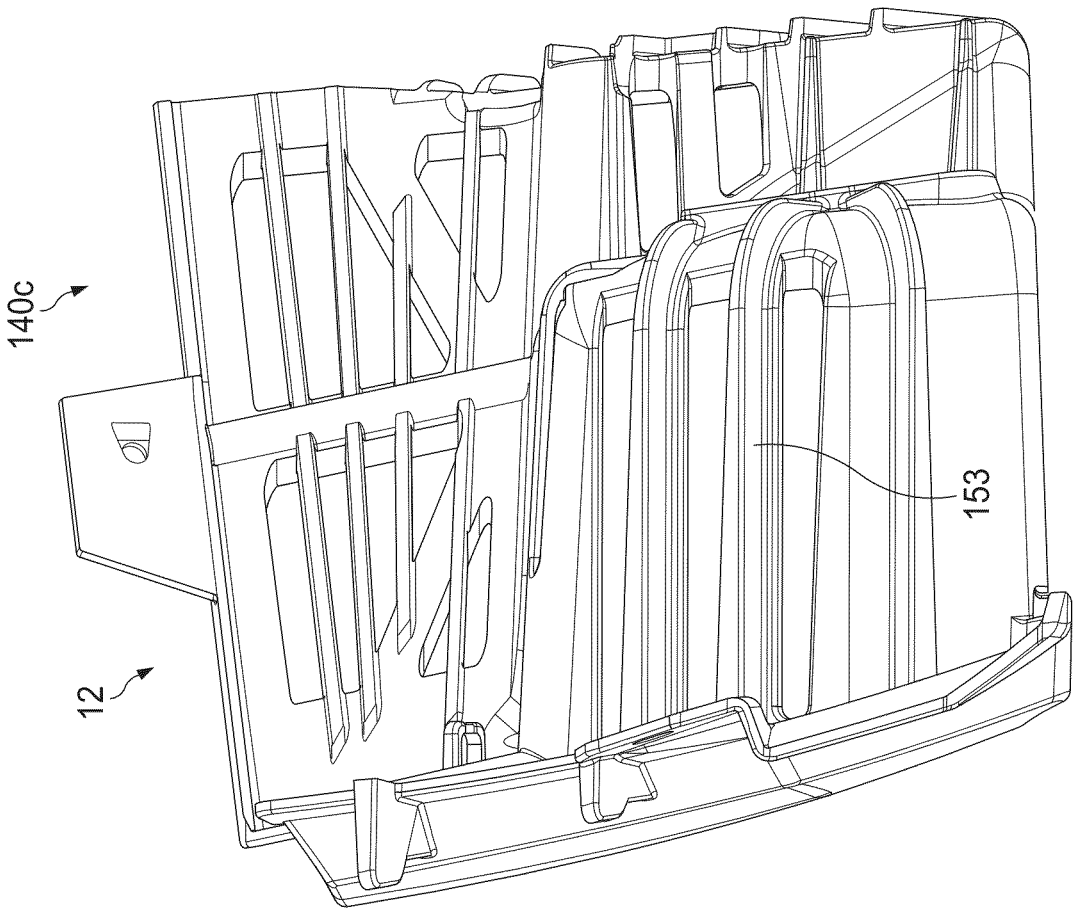


FIG. 92B

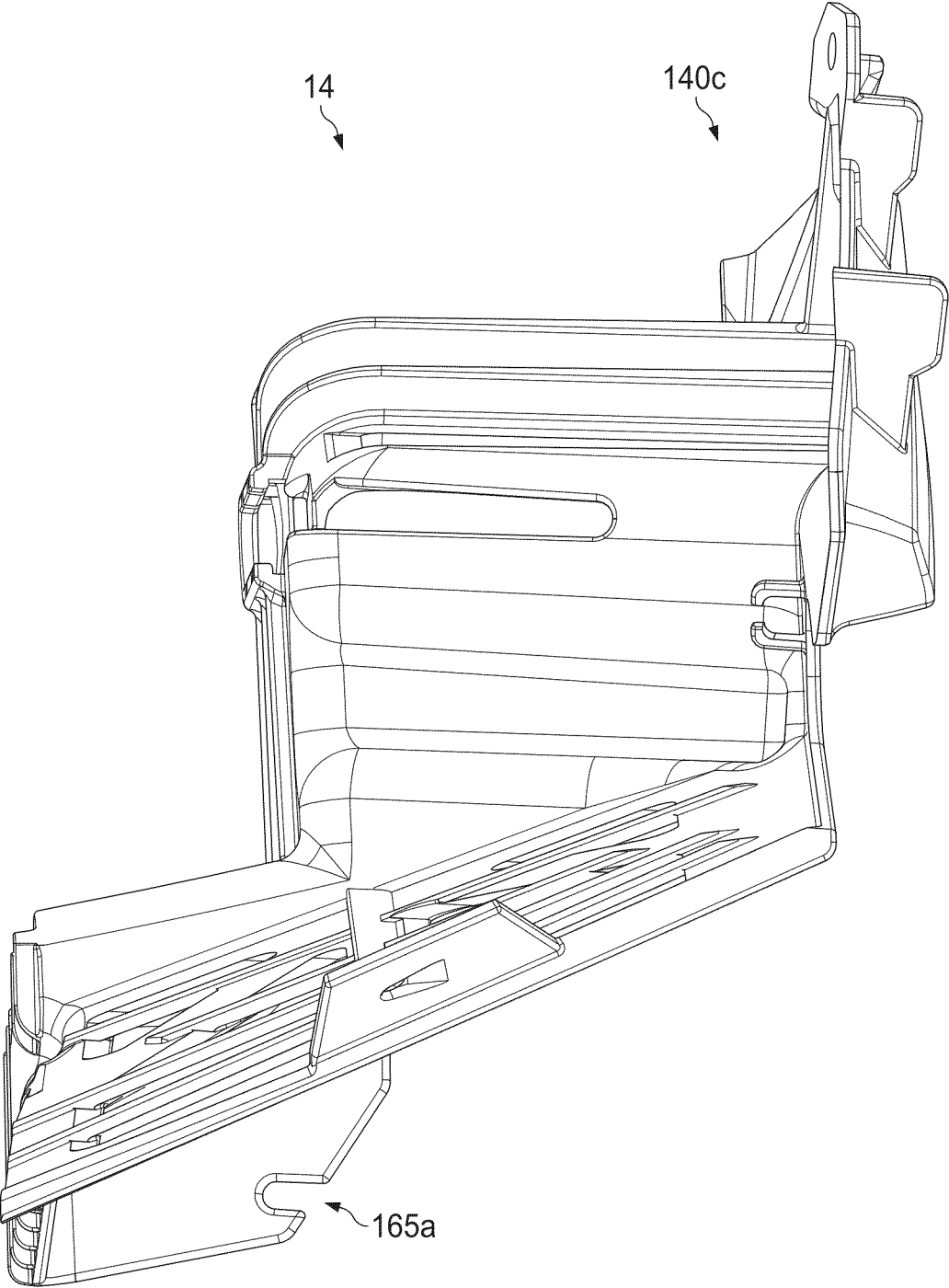


FIG. 93A

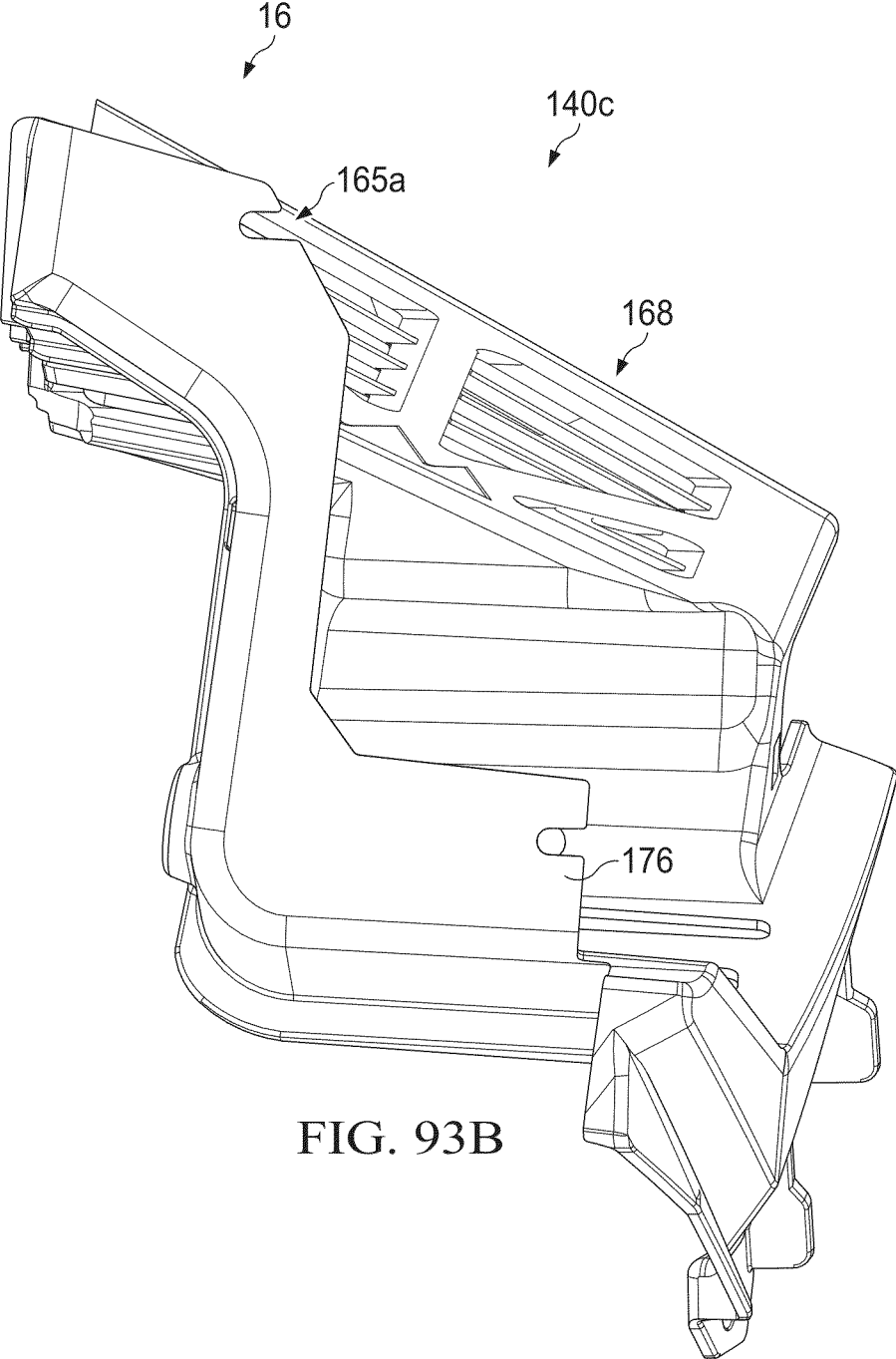


FIG. 93B

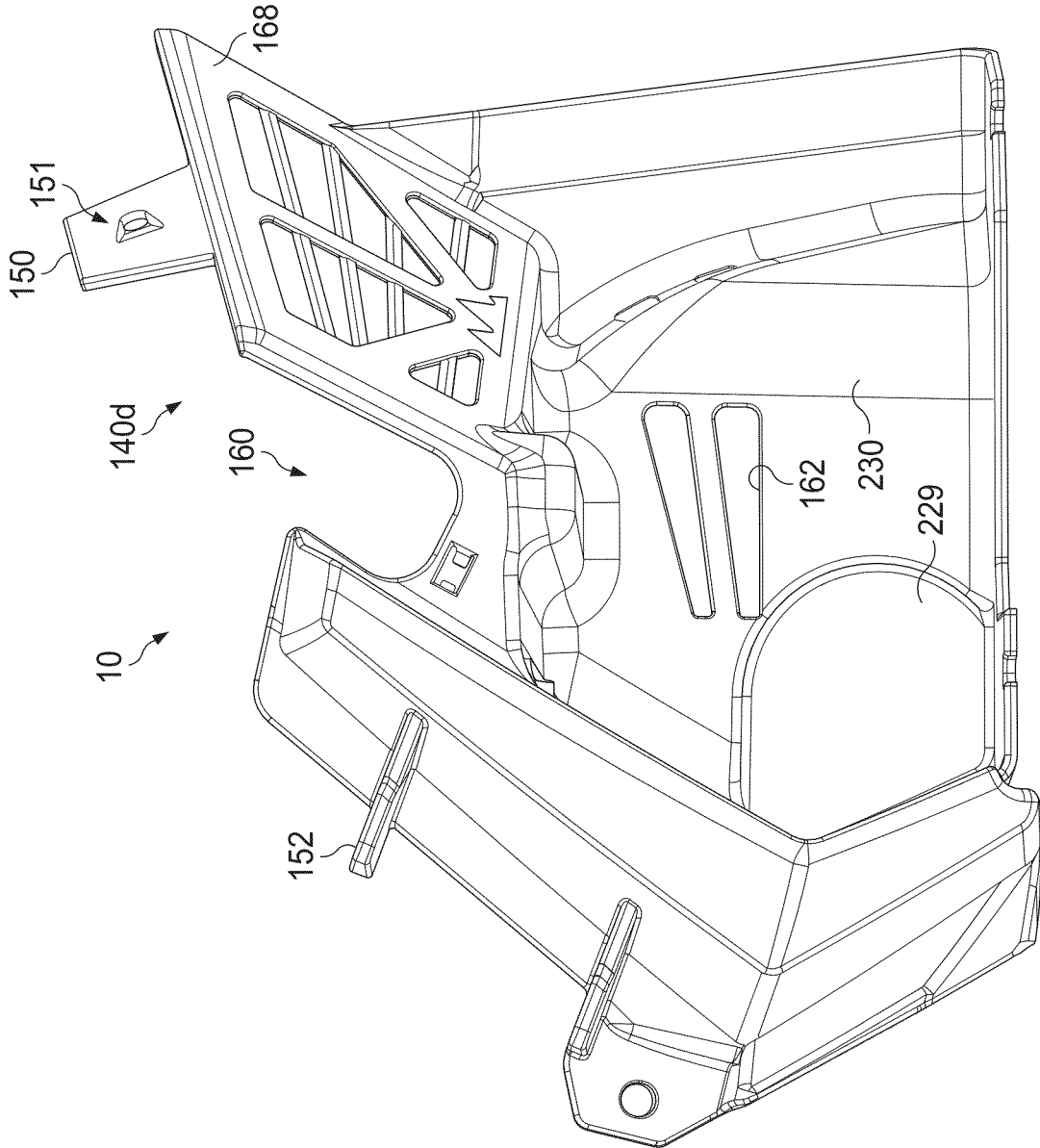


FIG. 94A

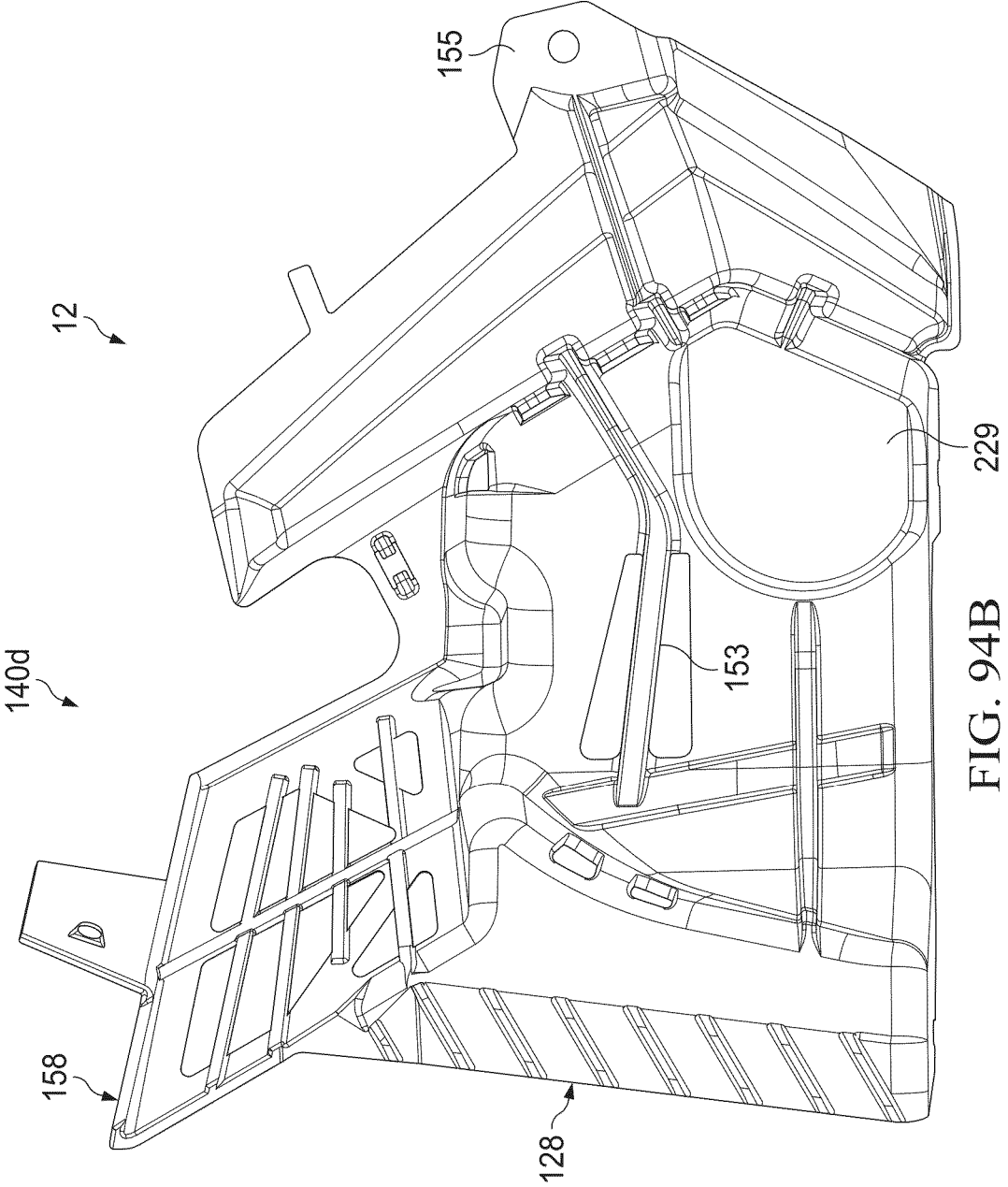


FIG. 94B

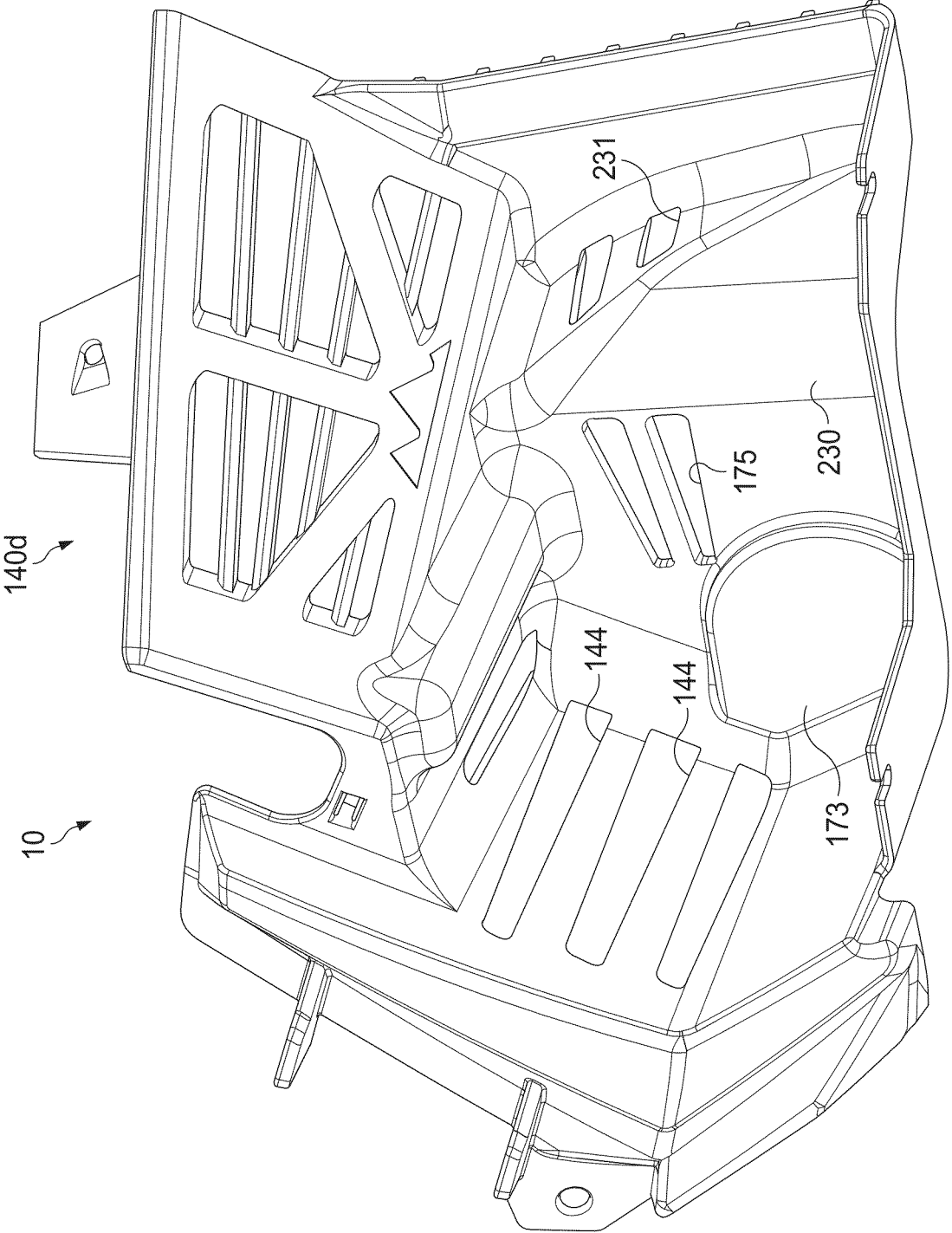


FIG. 95A

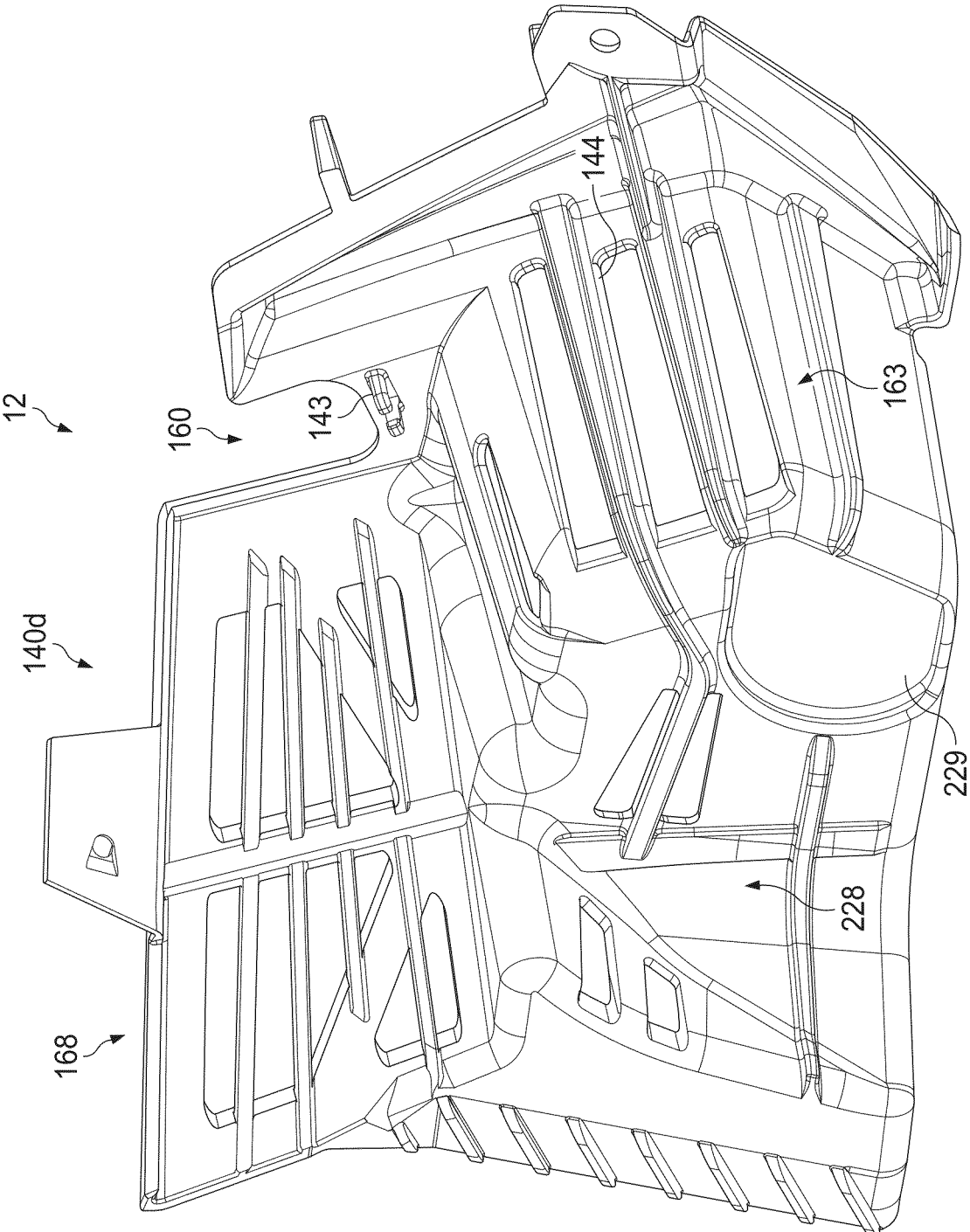


FIG. 95B

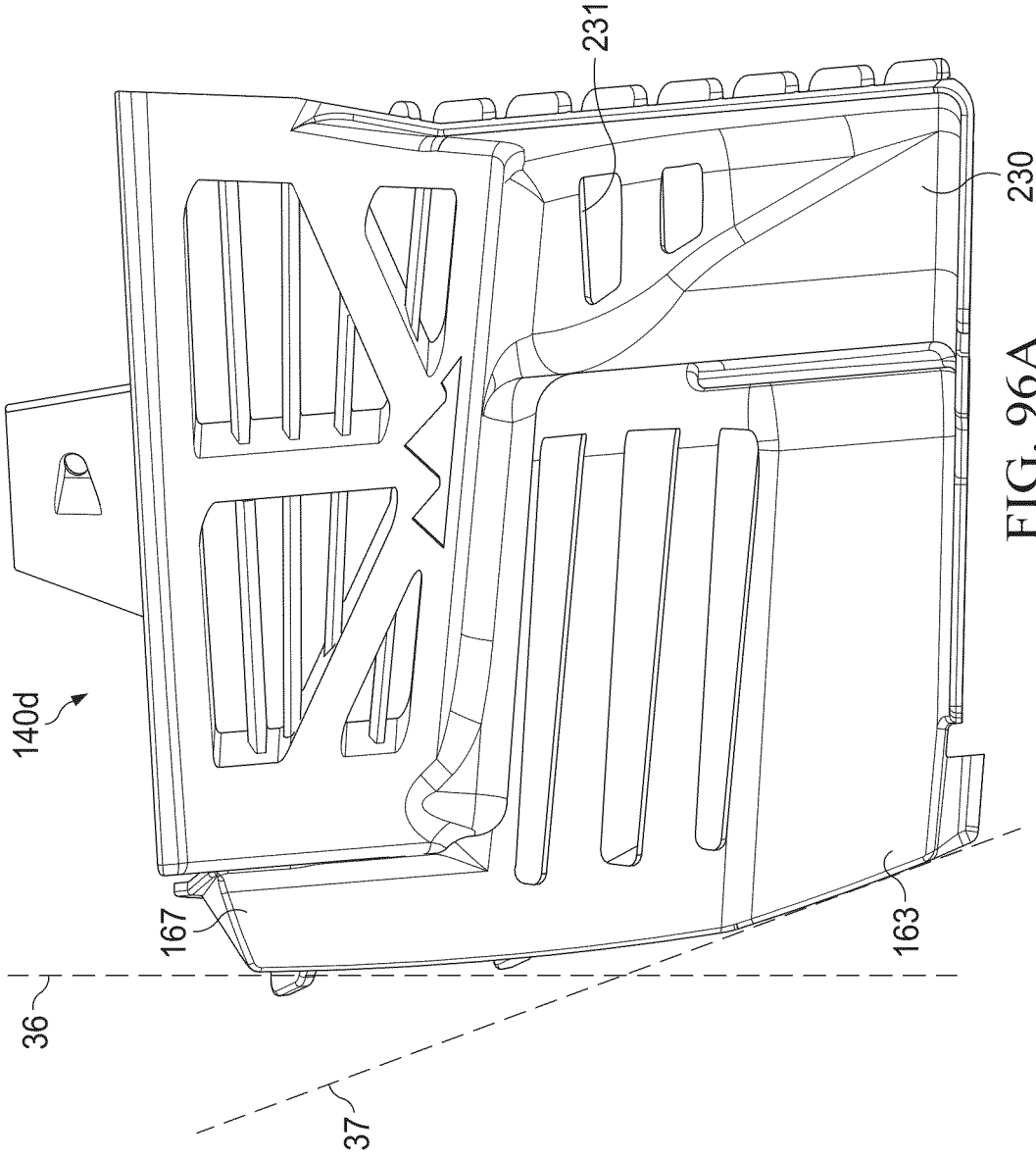


FIG. 96A 230

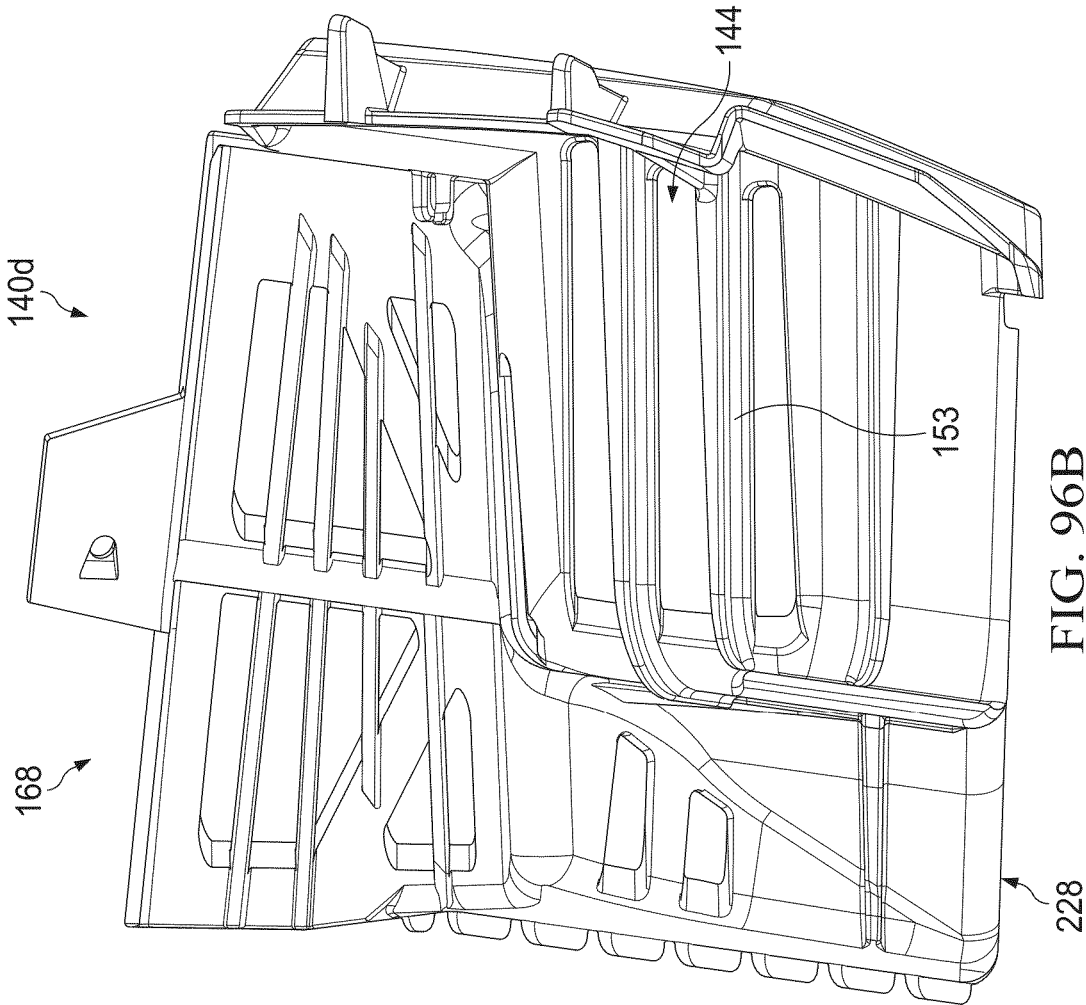


FIG. 96B

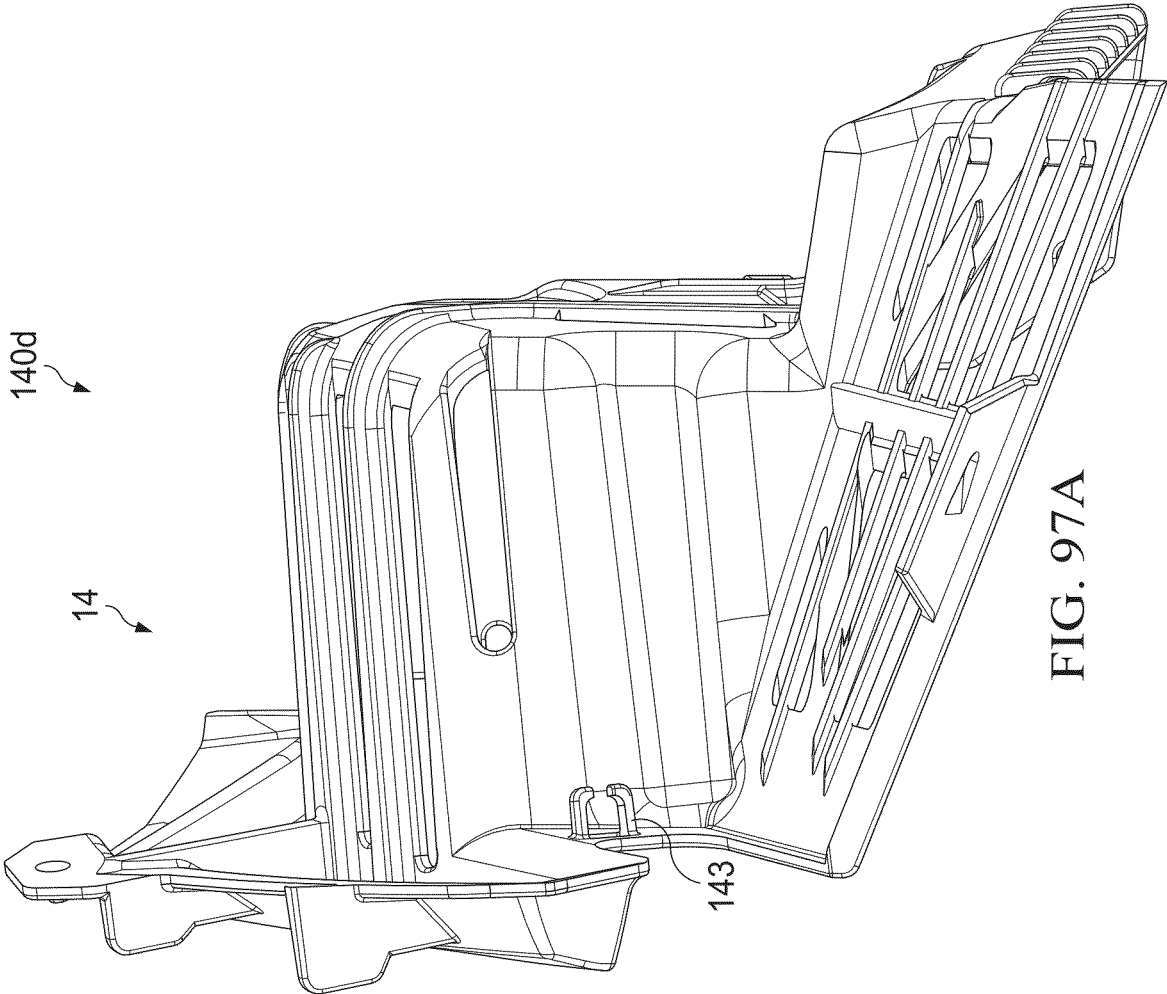


FIG. 97A

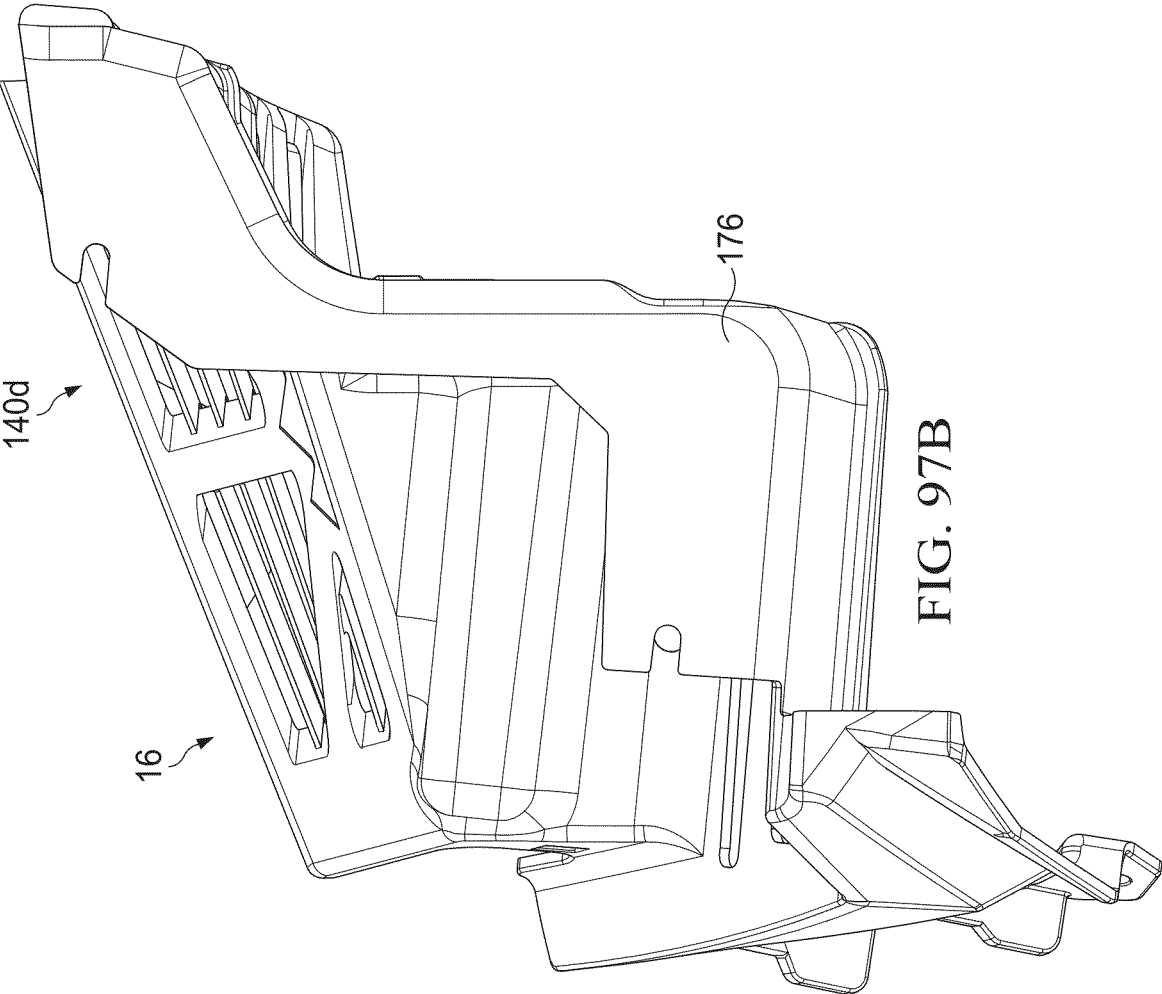


FIG. 97B

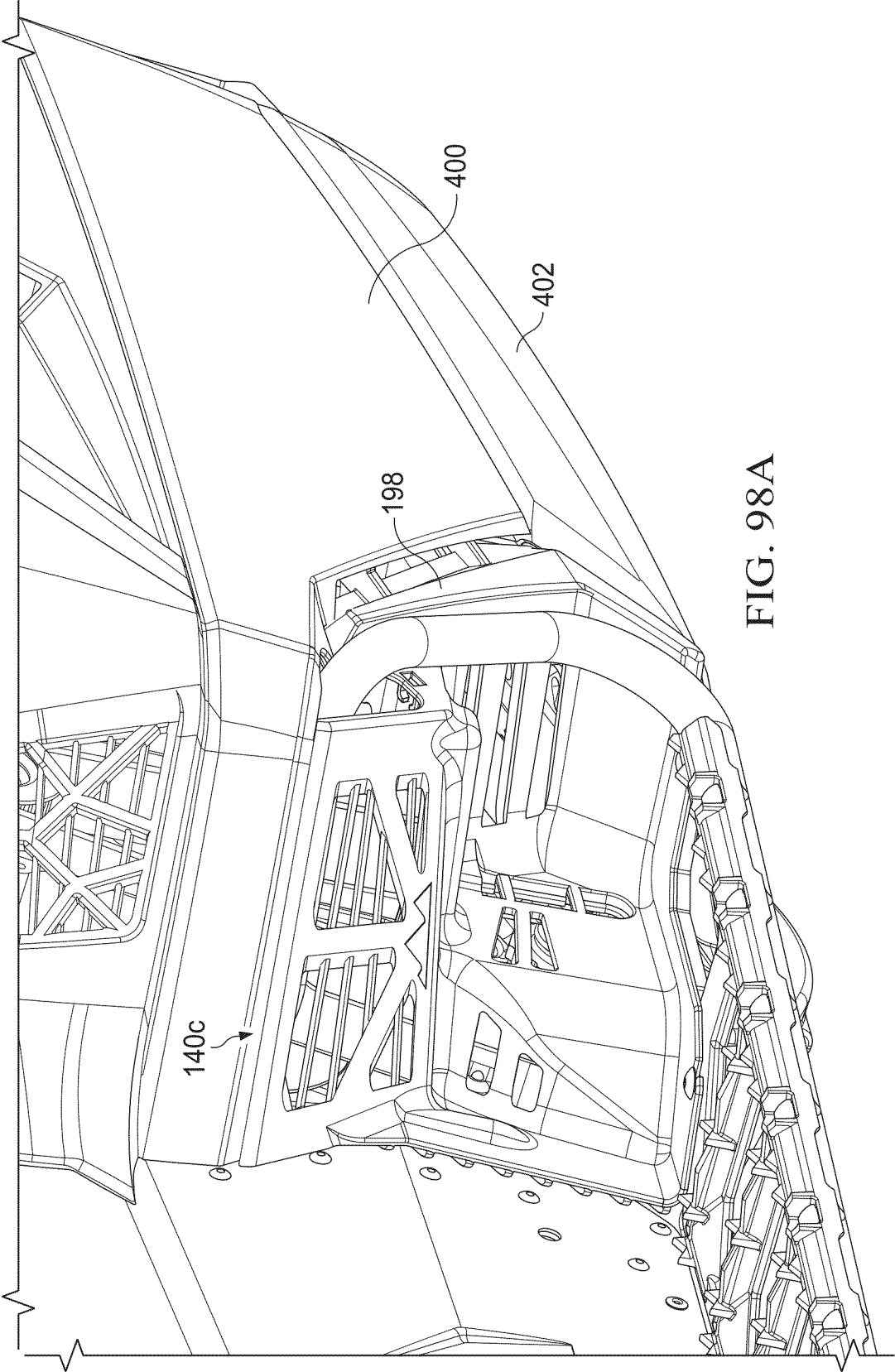


FIG. 98A

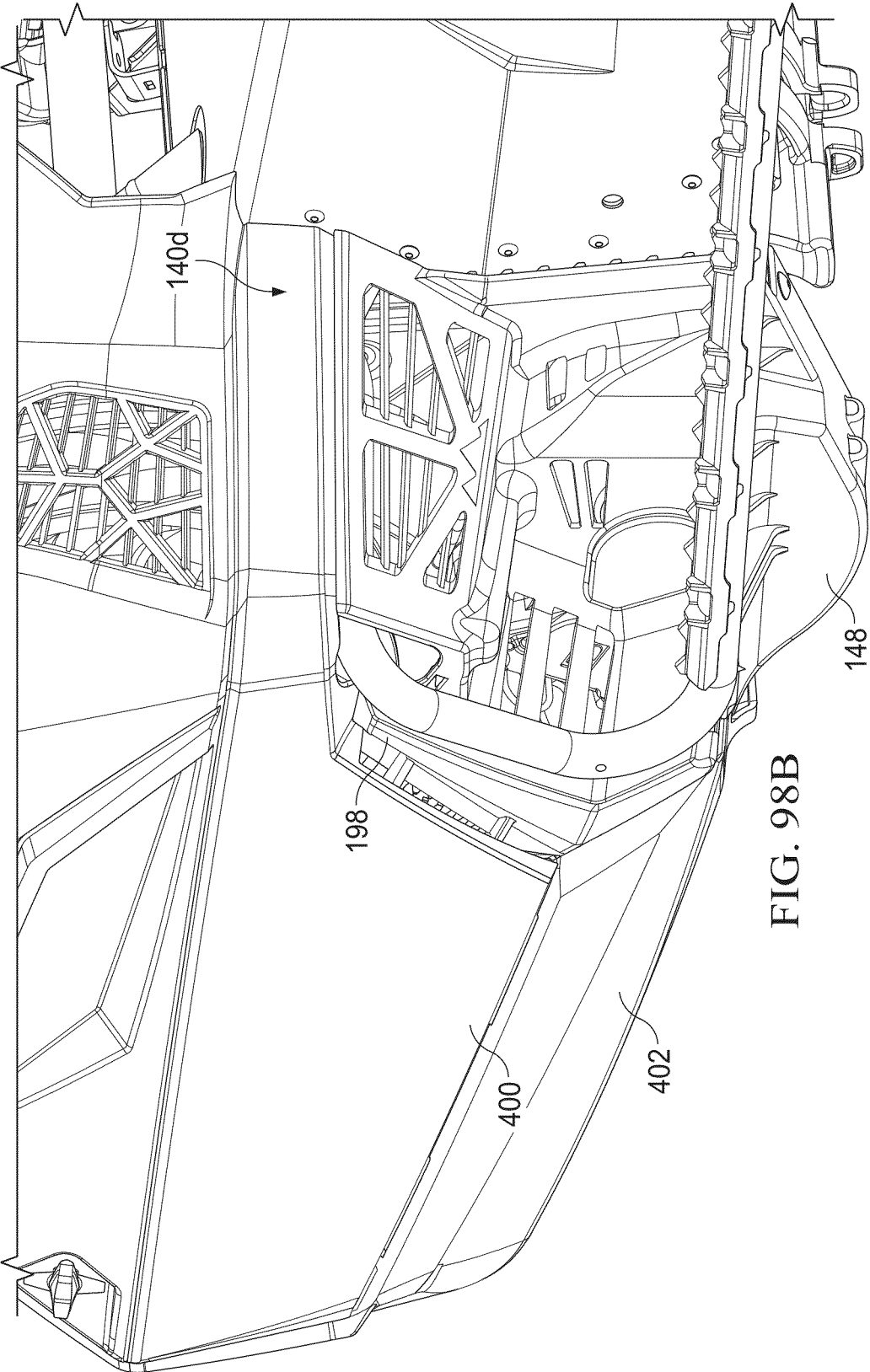


FIG. 98B

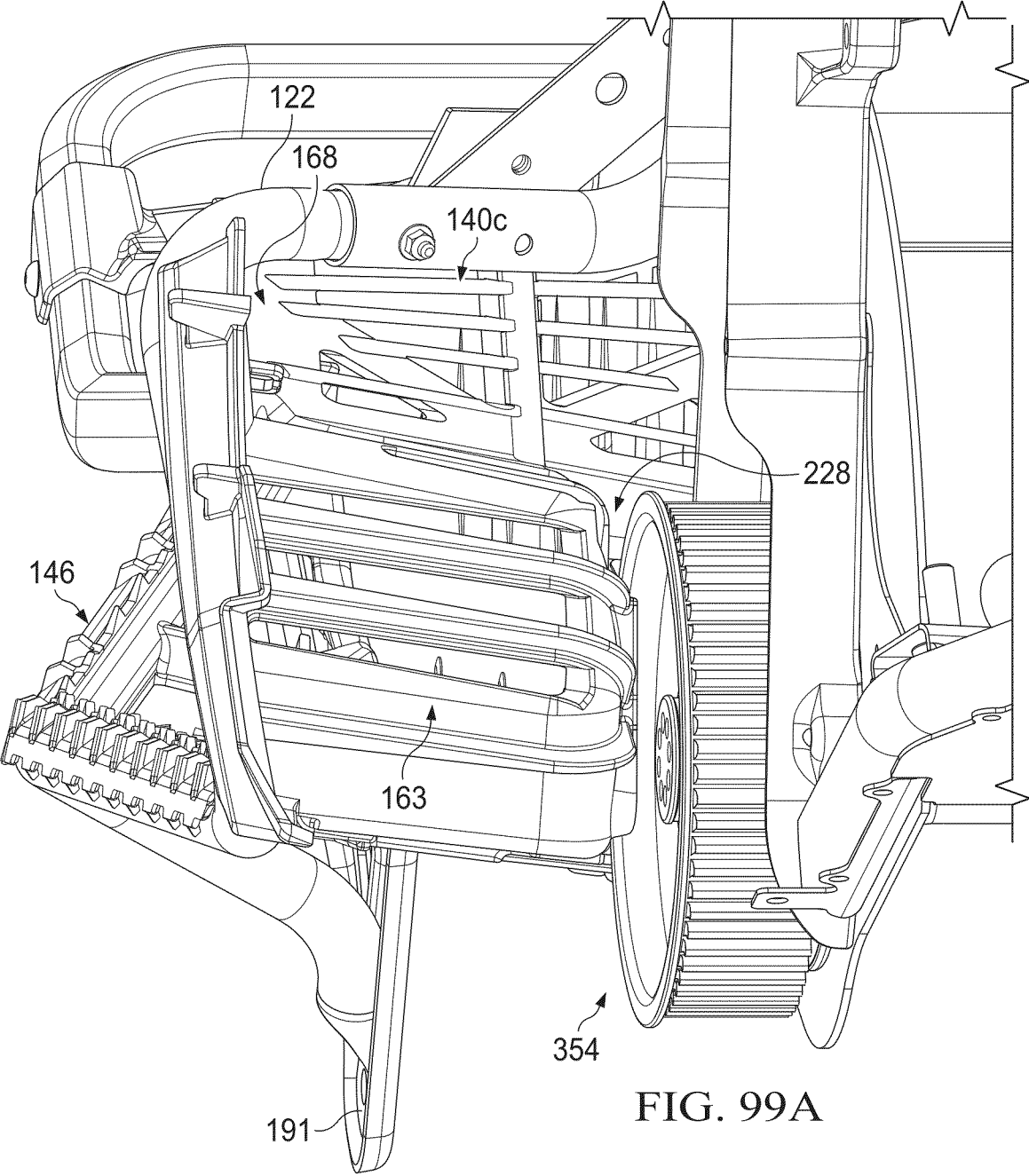


FIG. 99A

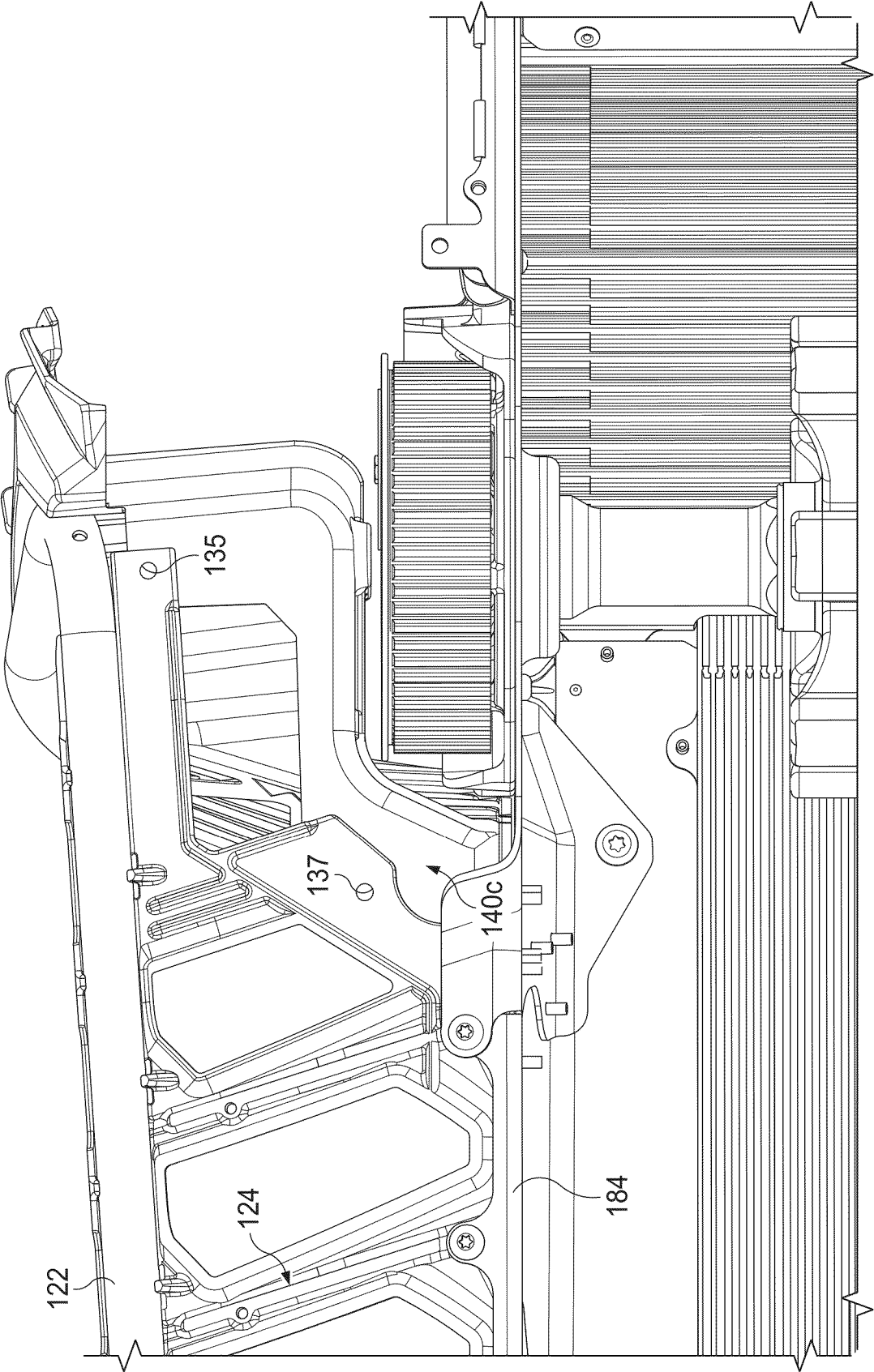


FIG. 99B

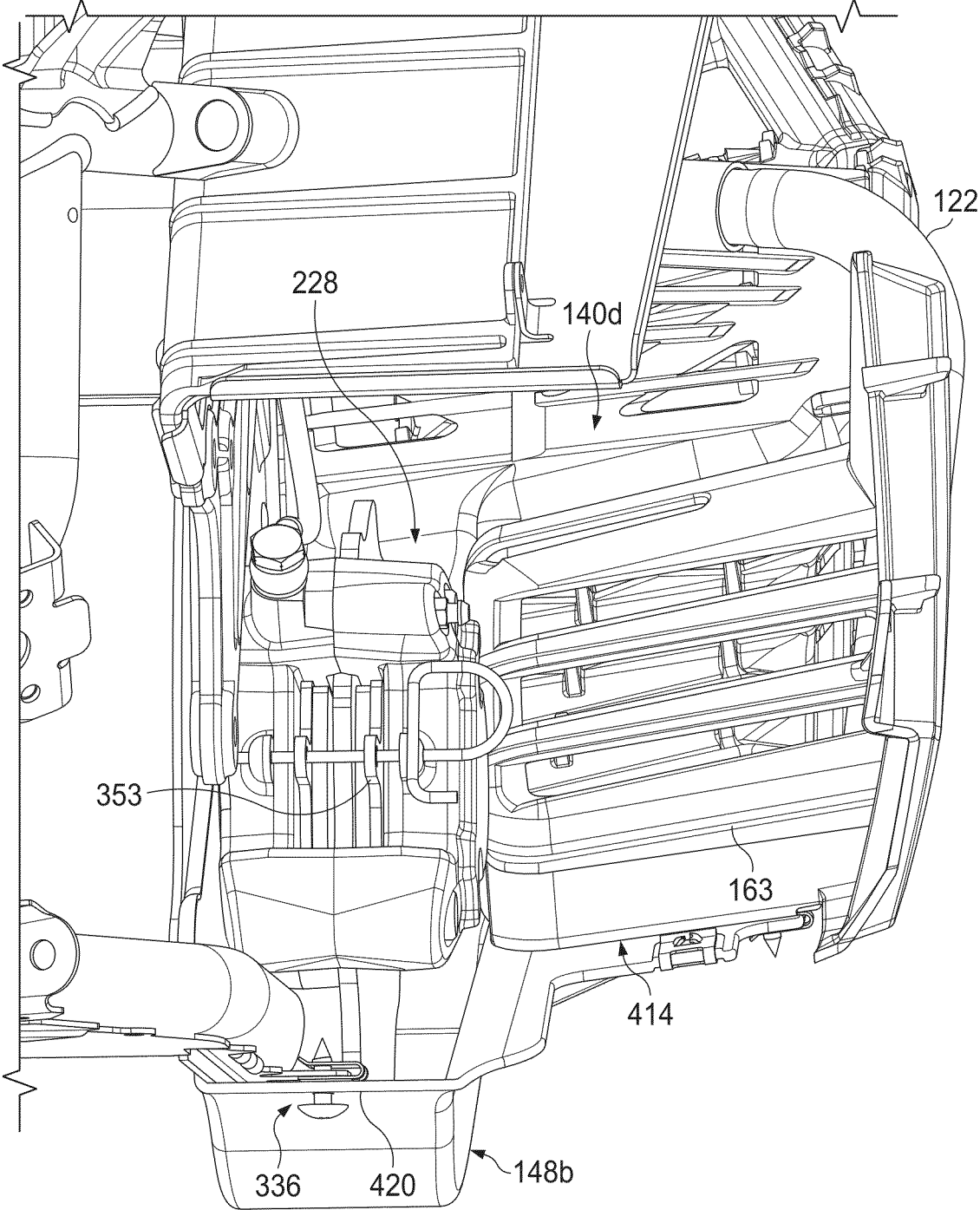


FIG. 100A

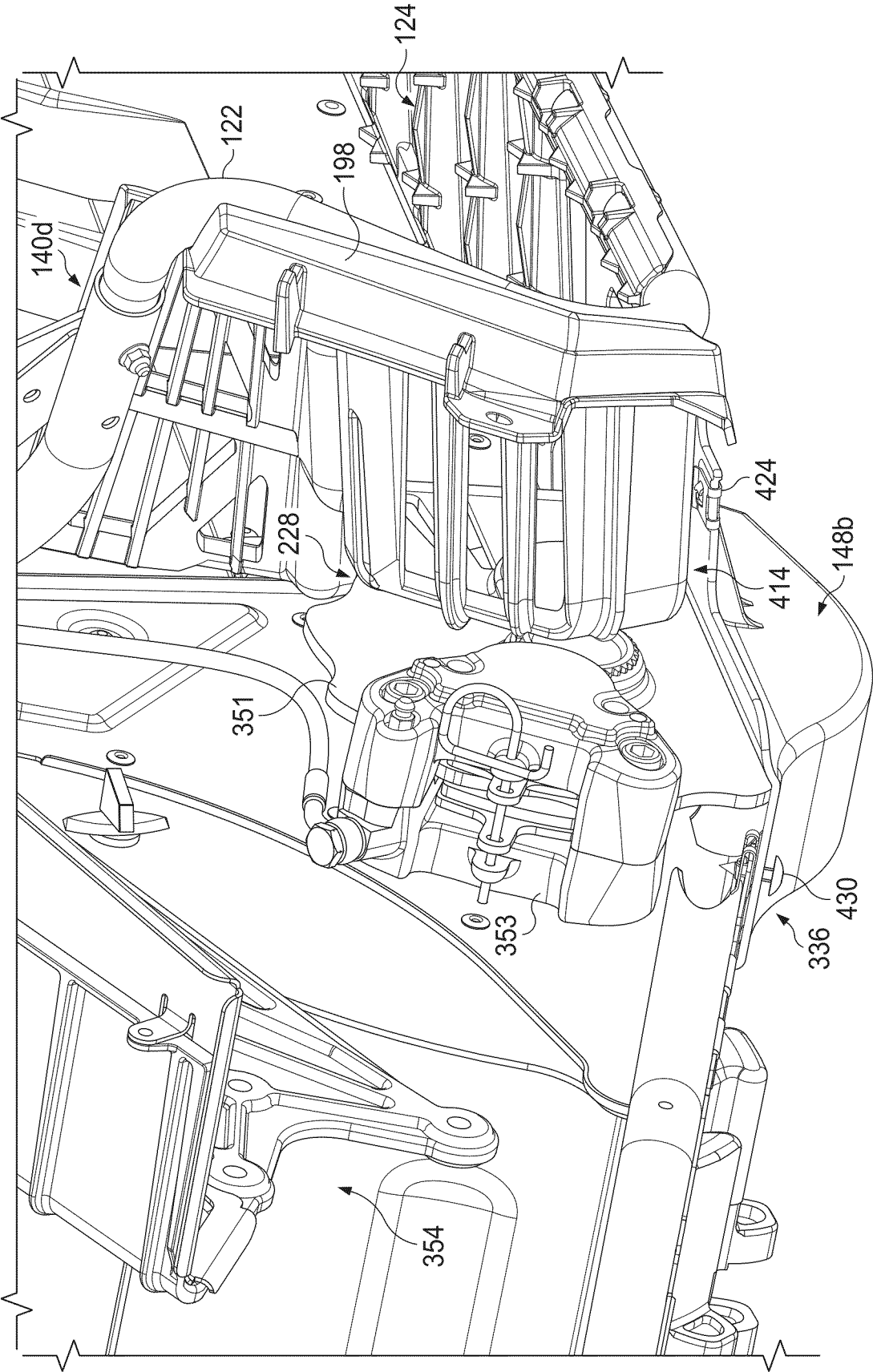


FIG. 100B

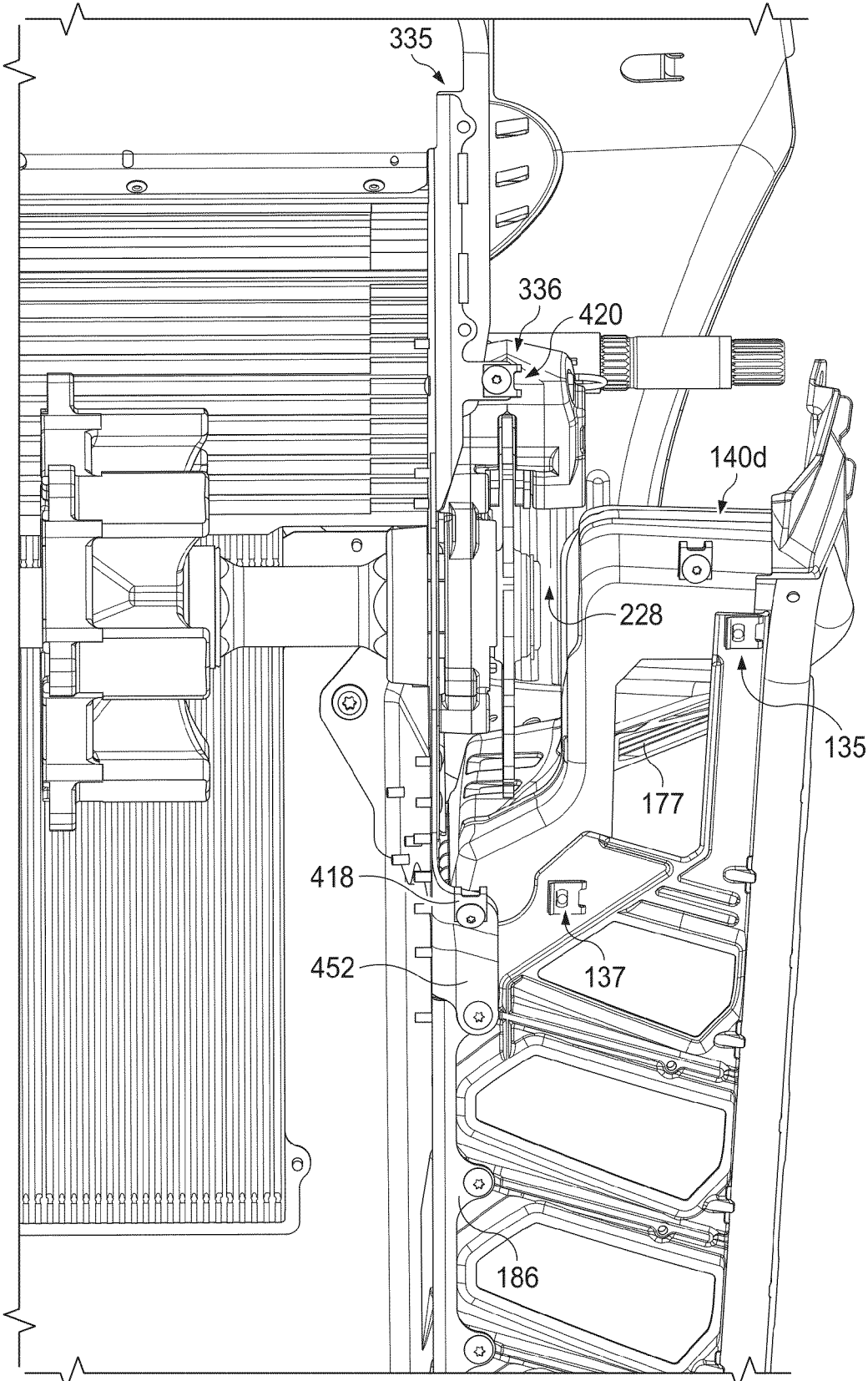


FIG. 101

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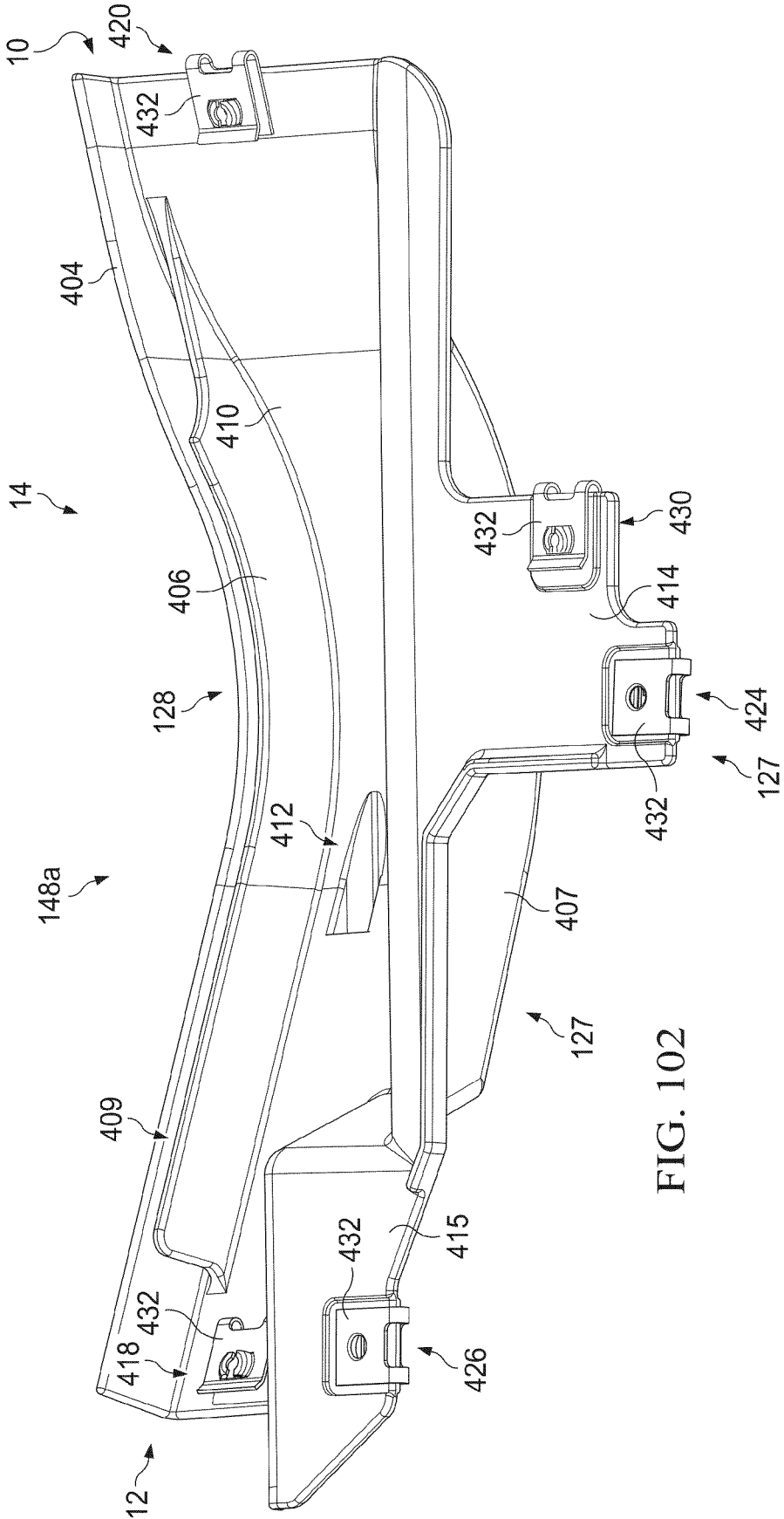


FIG. 102

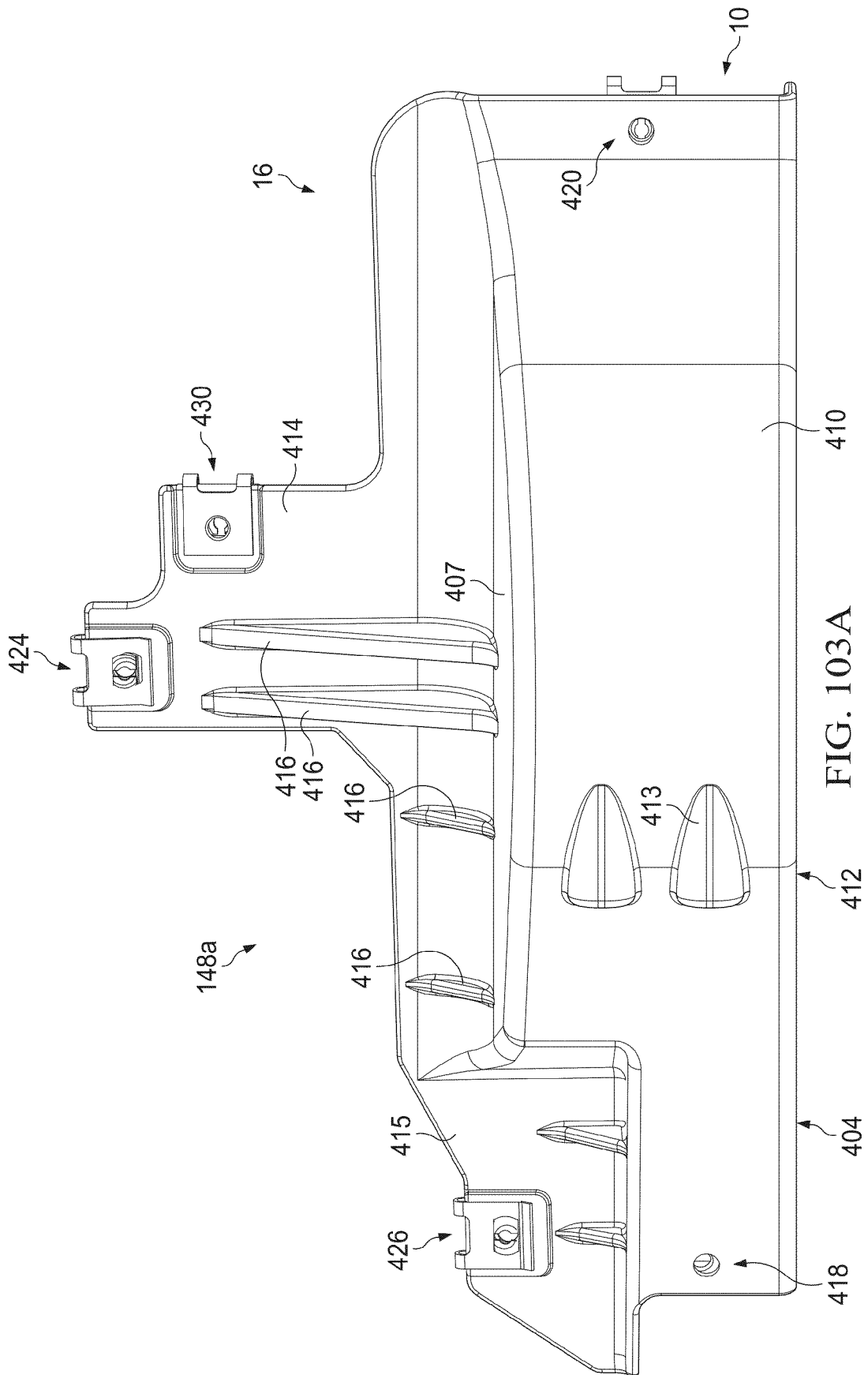


FIG. 103A

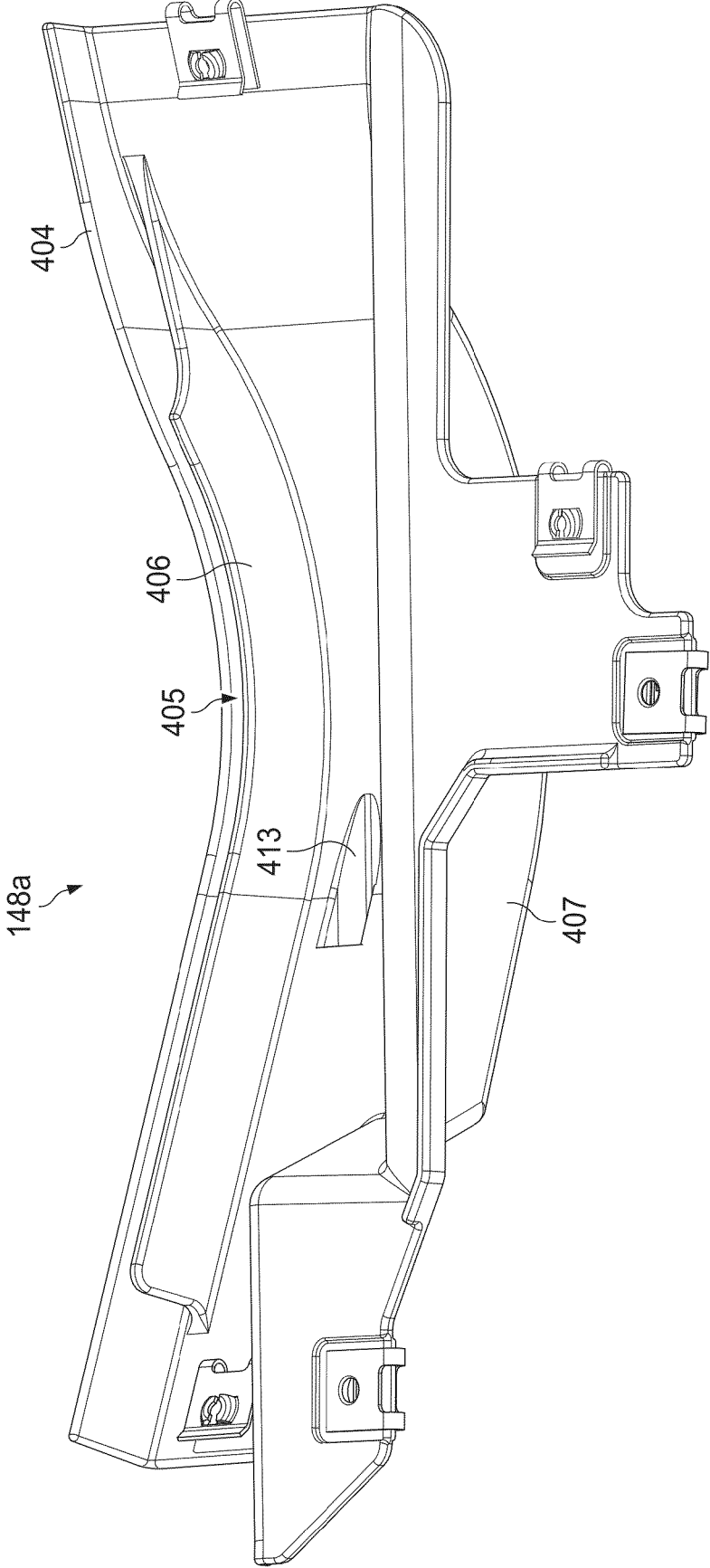


FIG. 103B

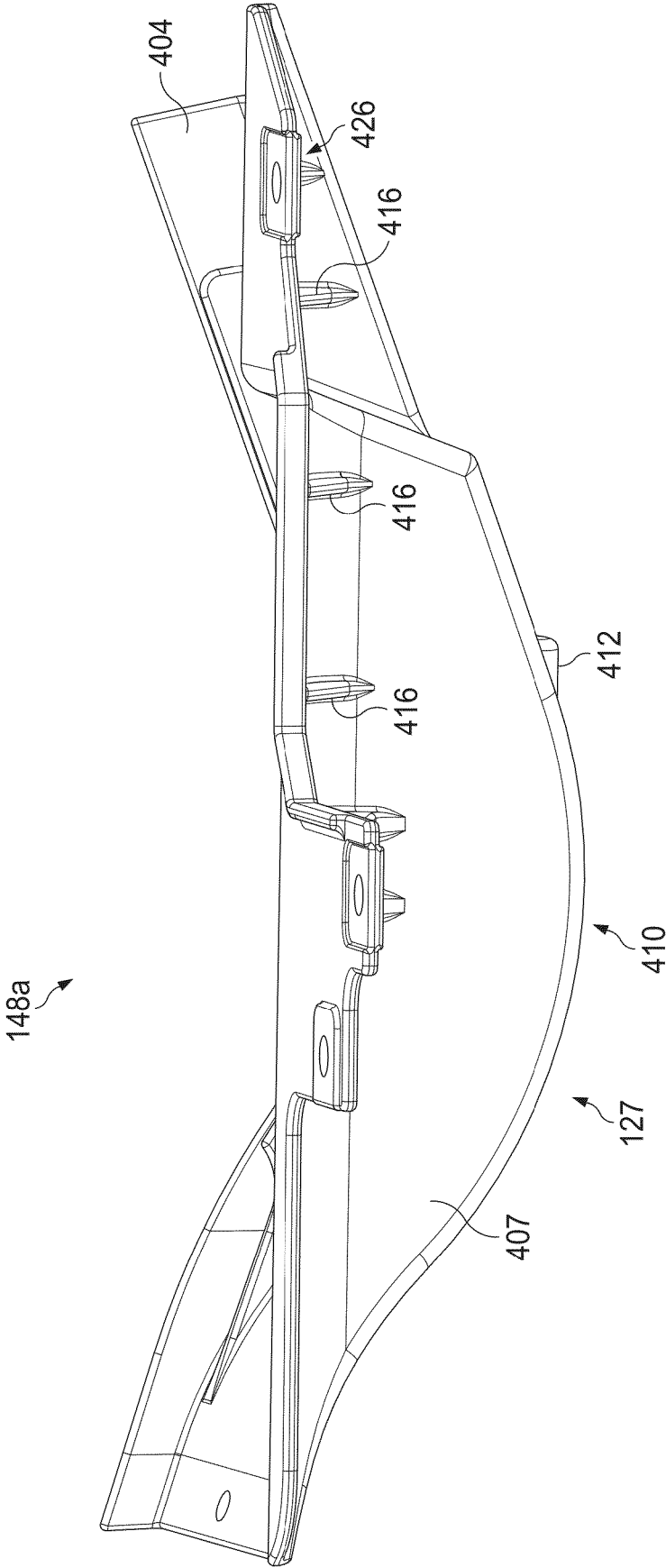


FIG. 104A

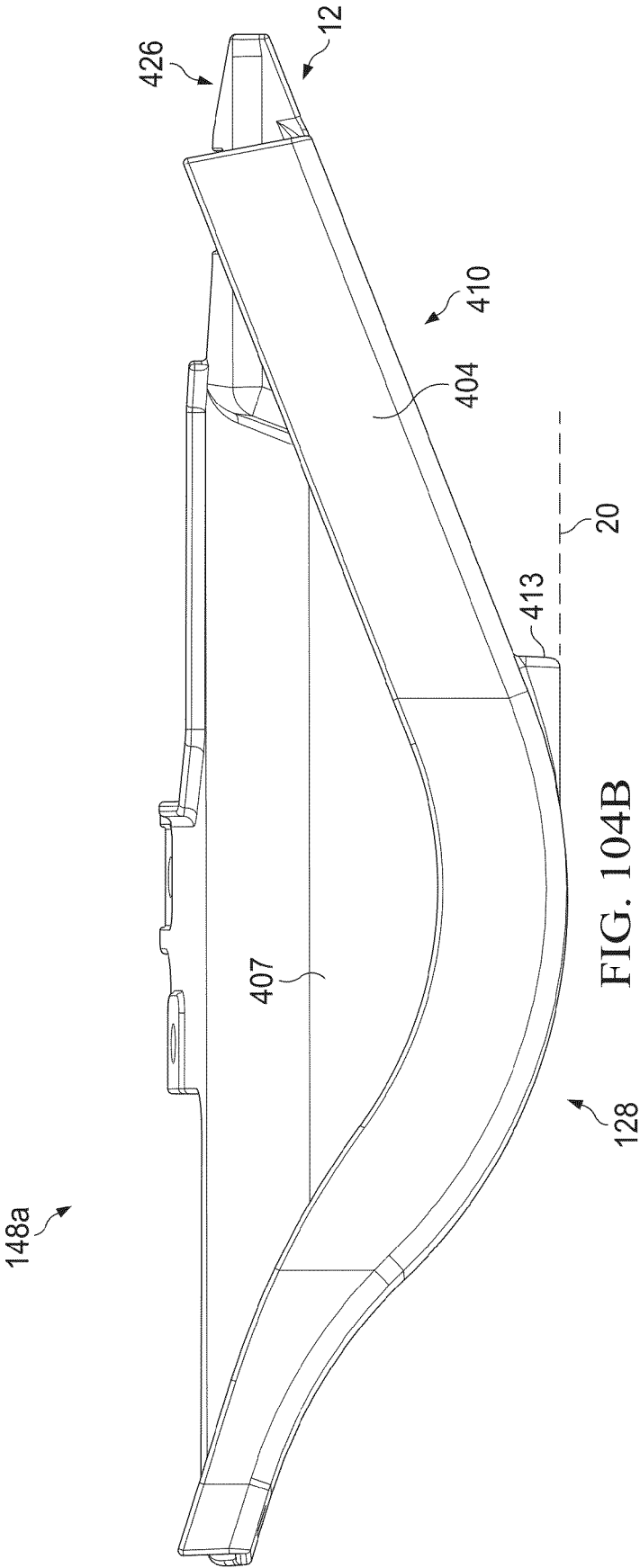
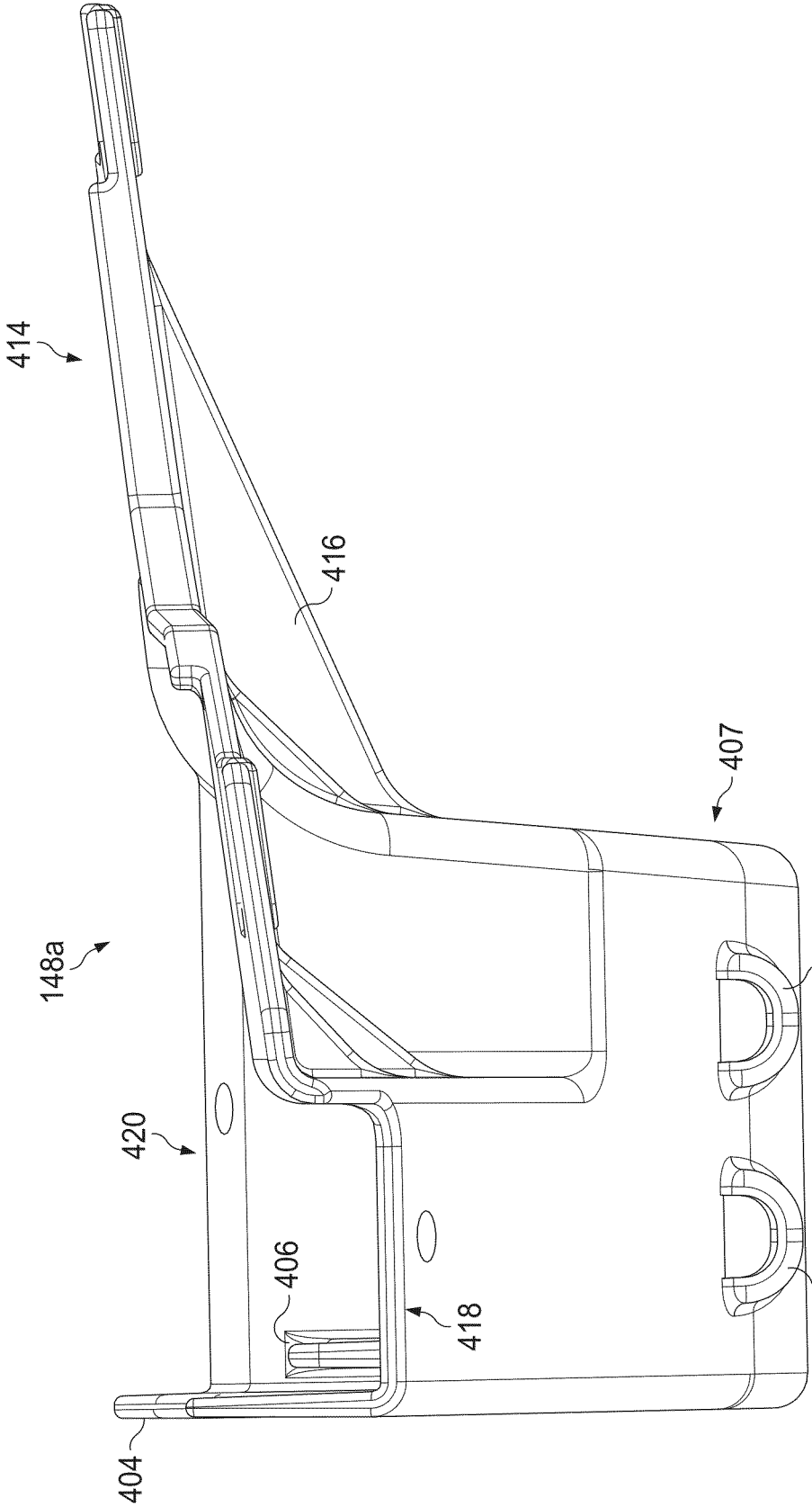


FIG. 104B



412 FIG. 105A

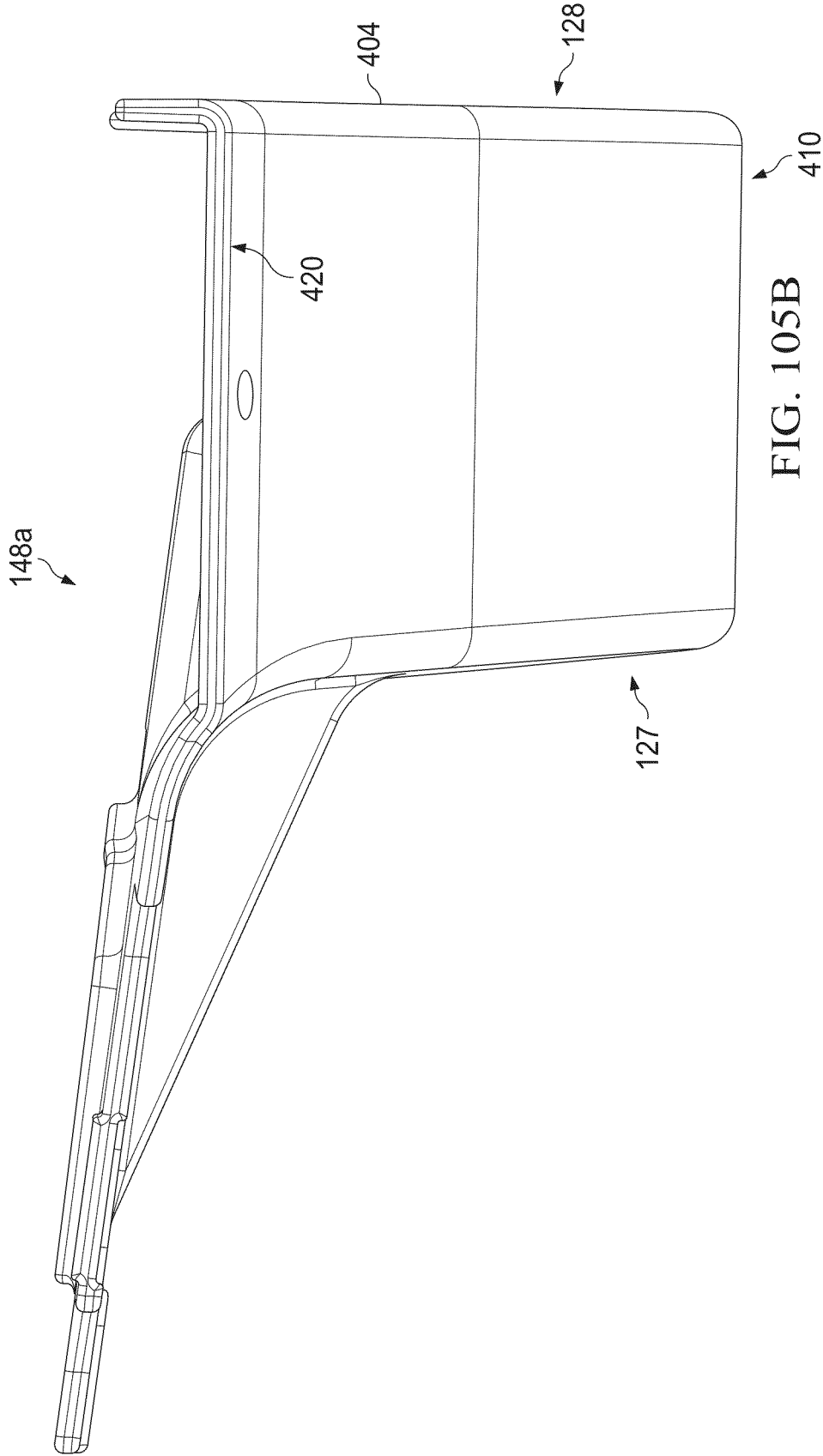


FIG. 105B

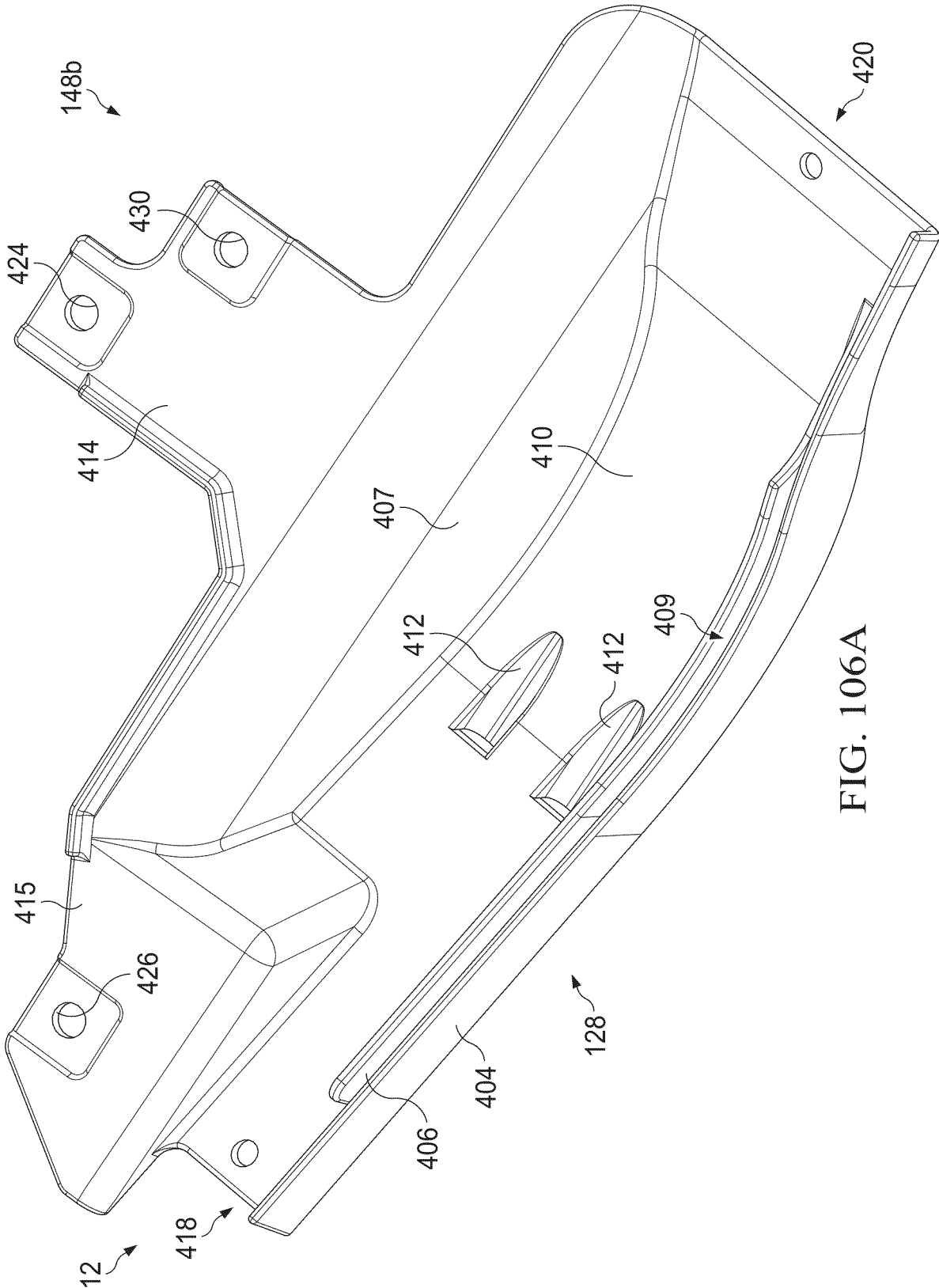


FIG. 106A

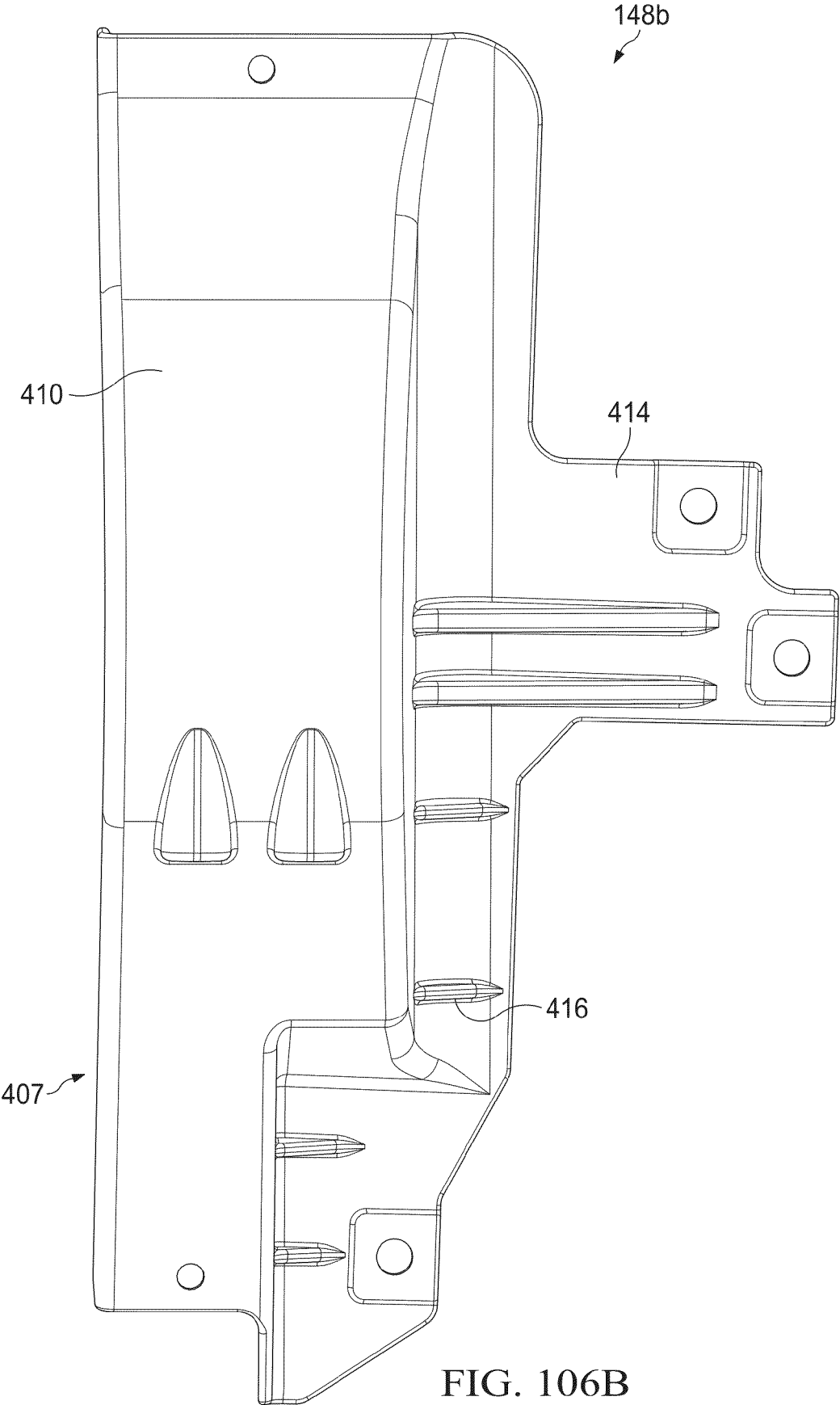


FIG. 106B

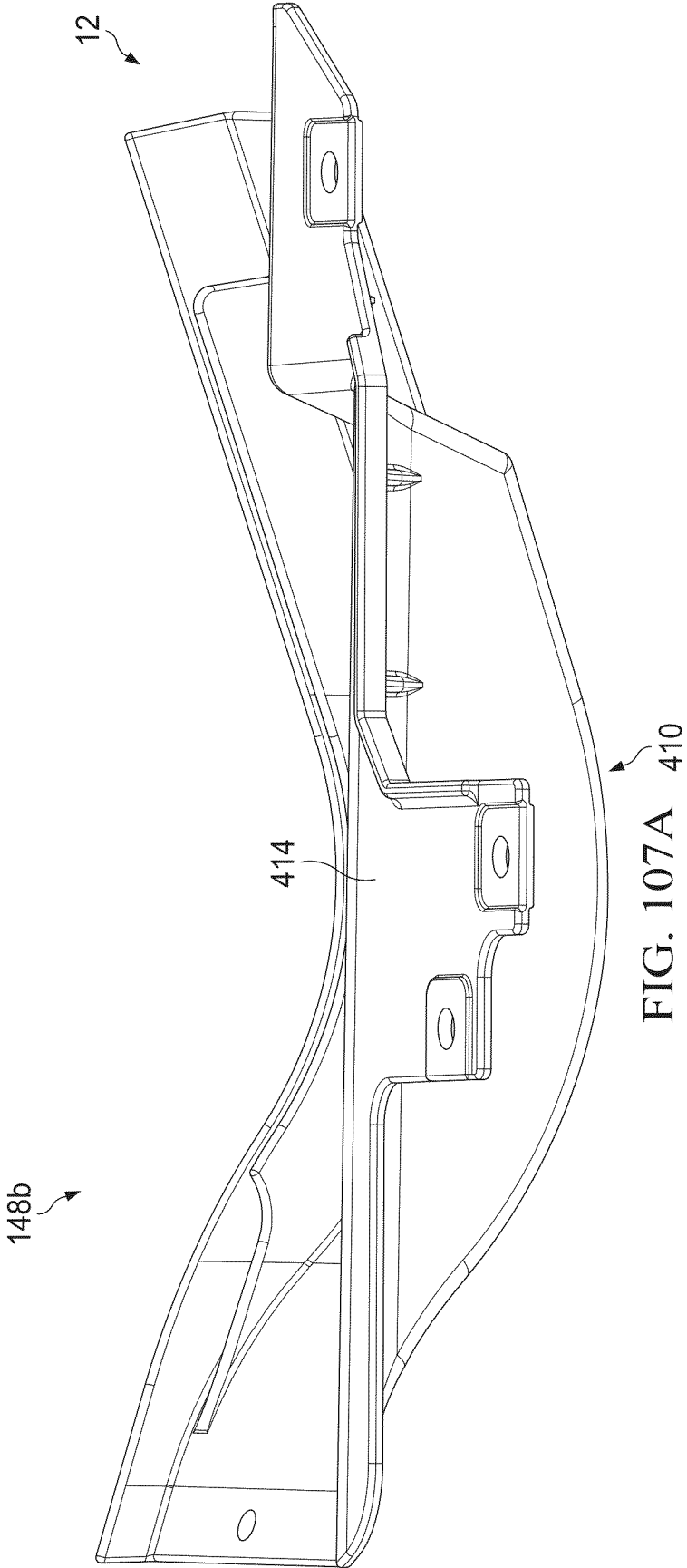


FIG. 107A 410

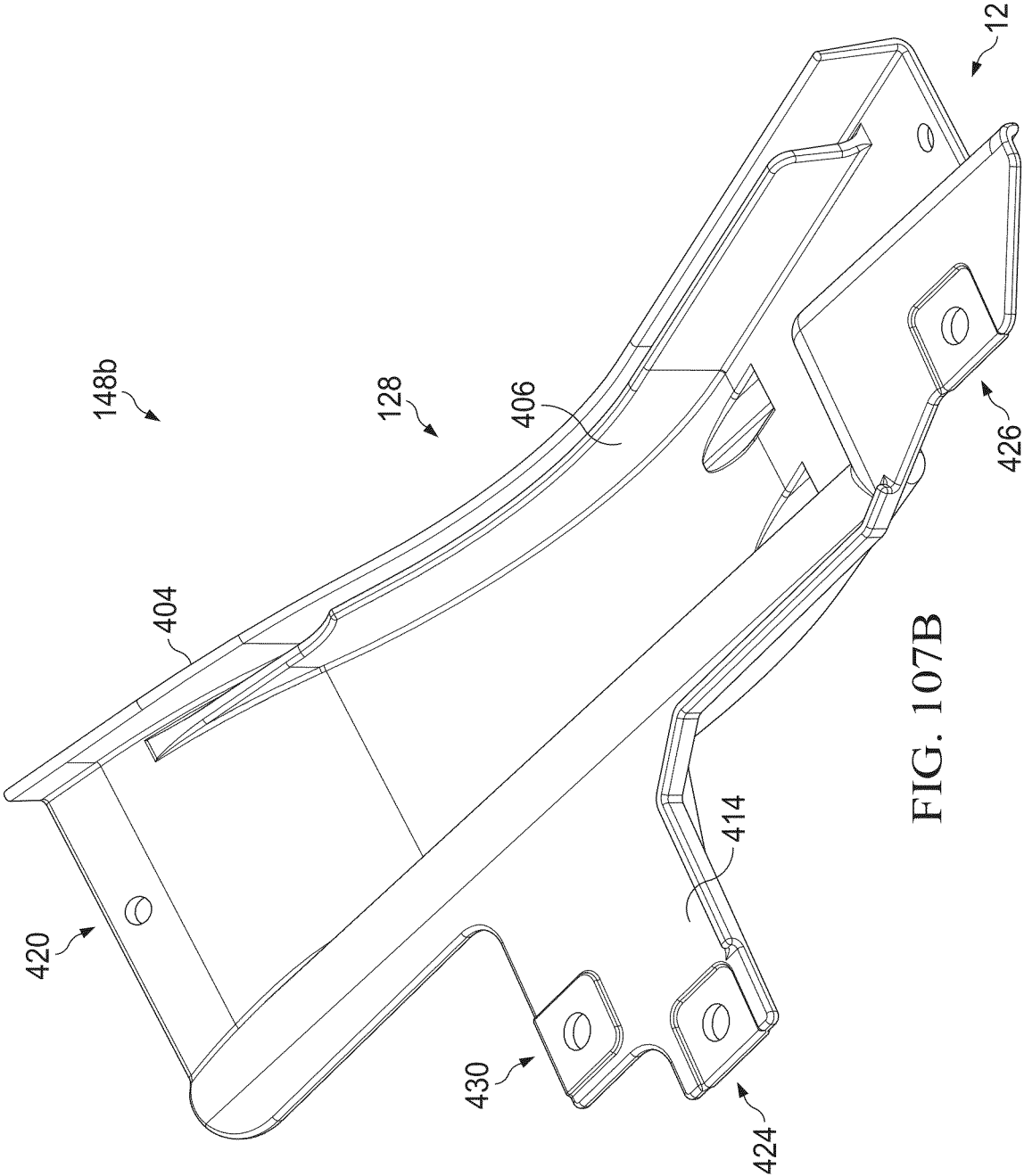
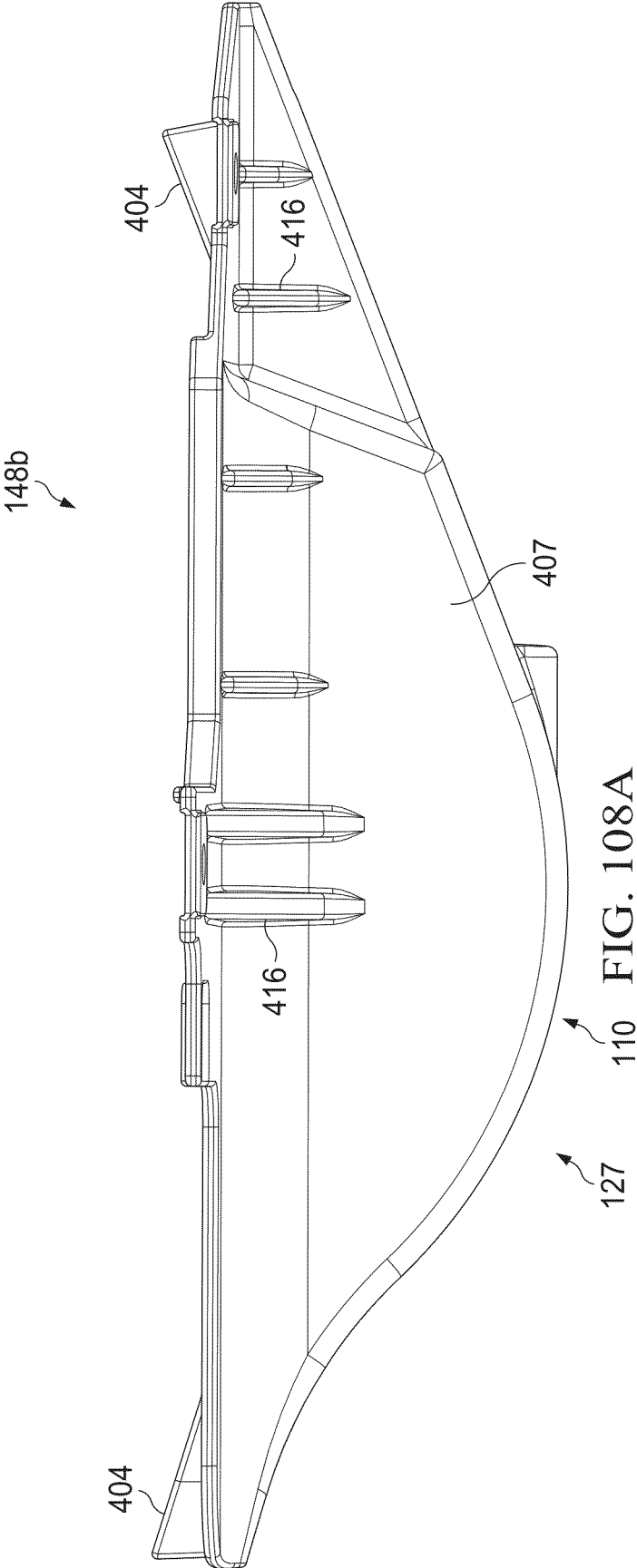
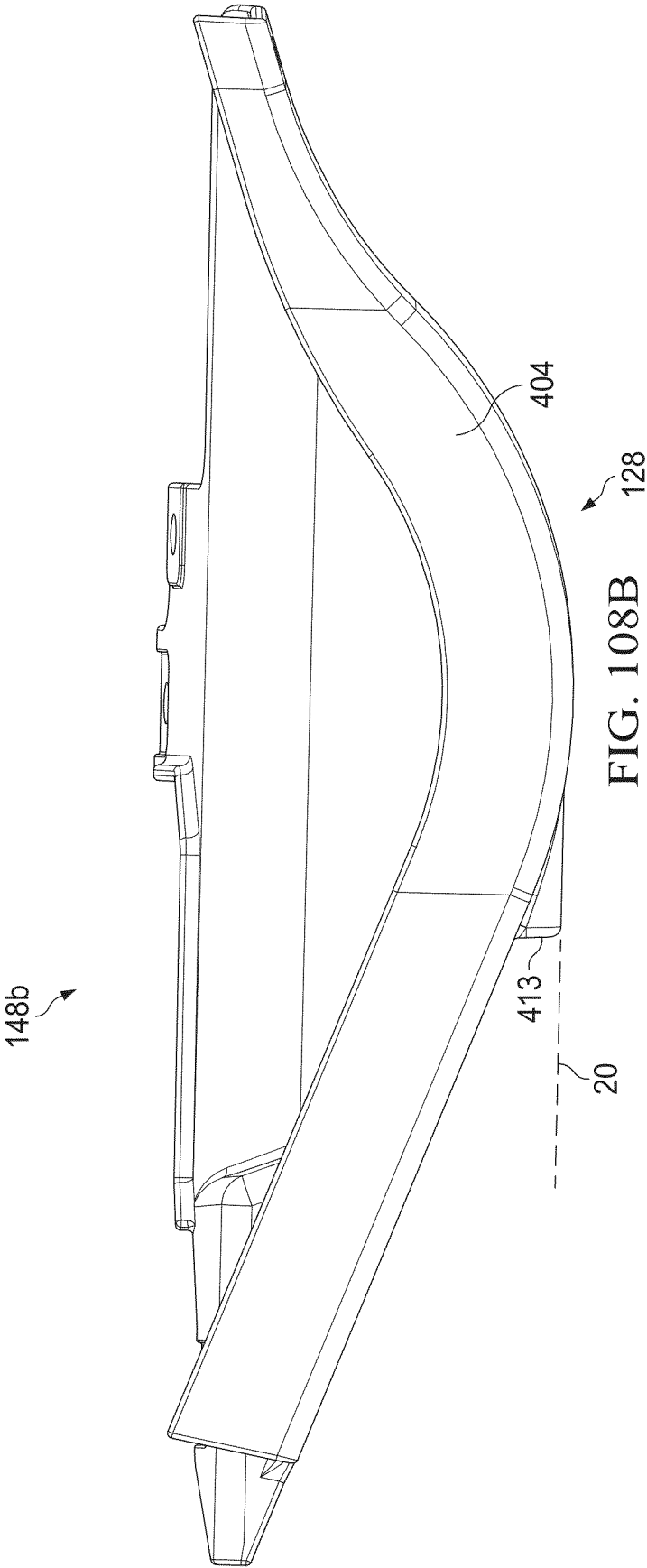


FIG. 107B



110 FIG. 108A



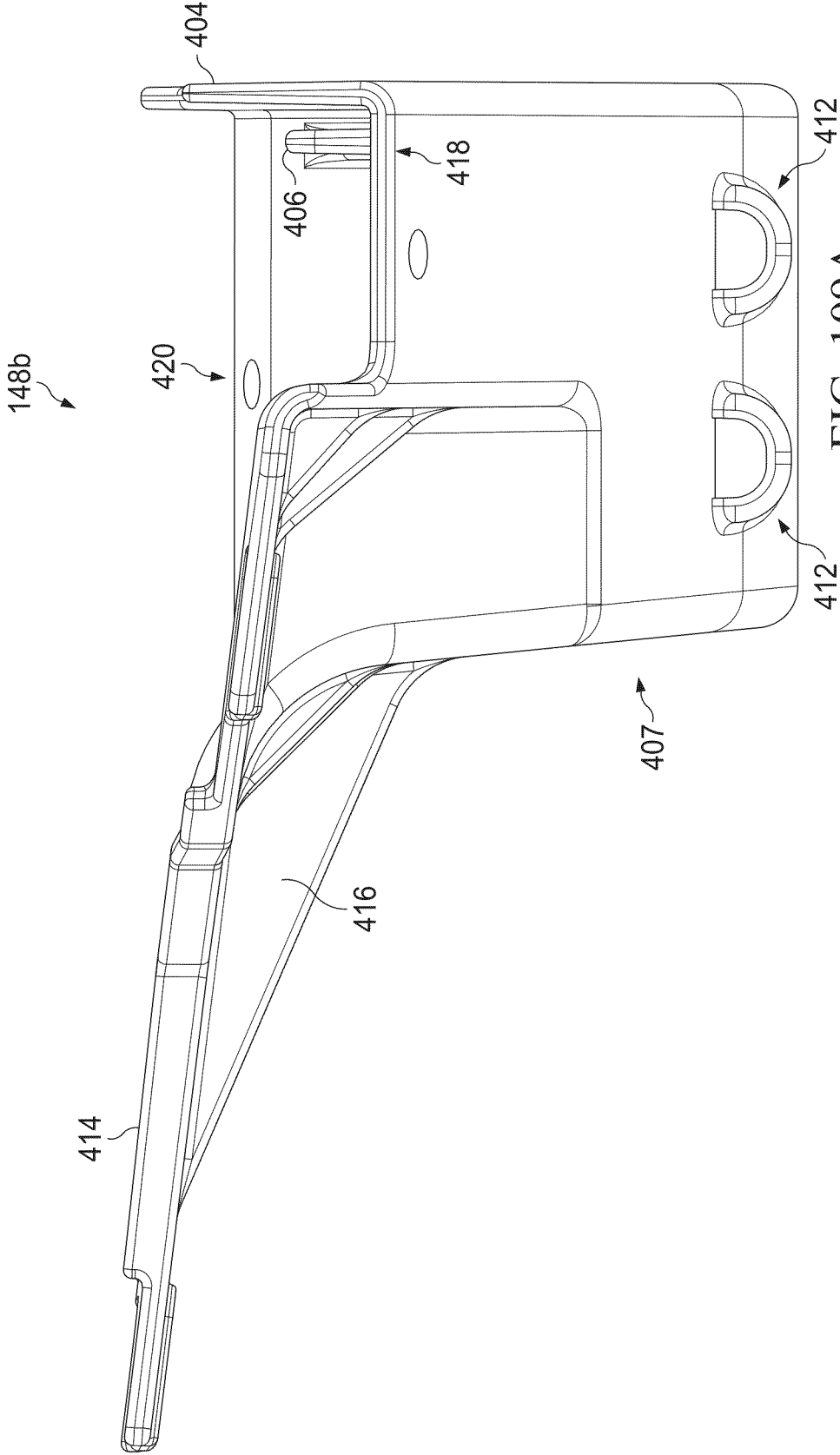
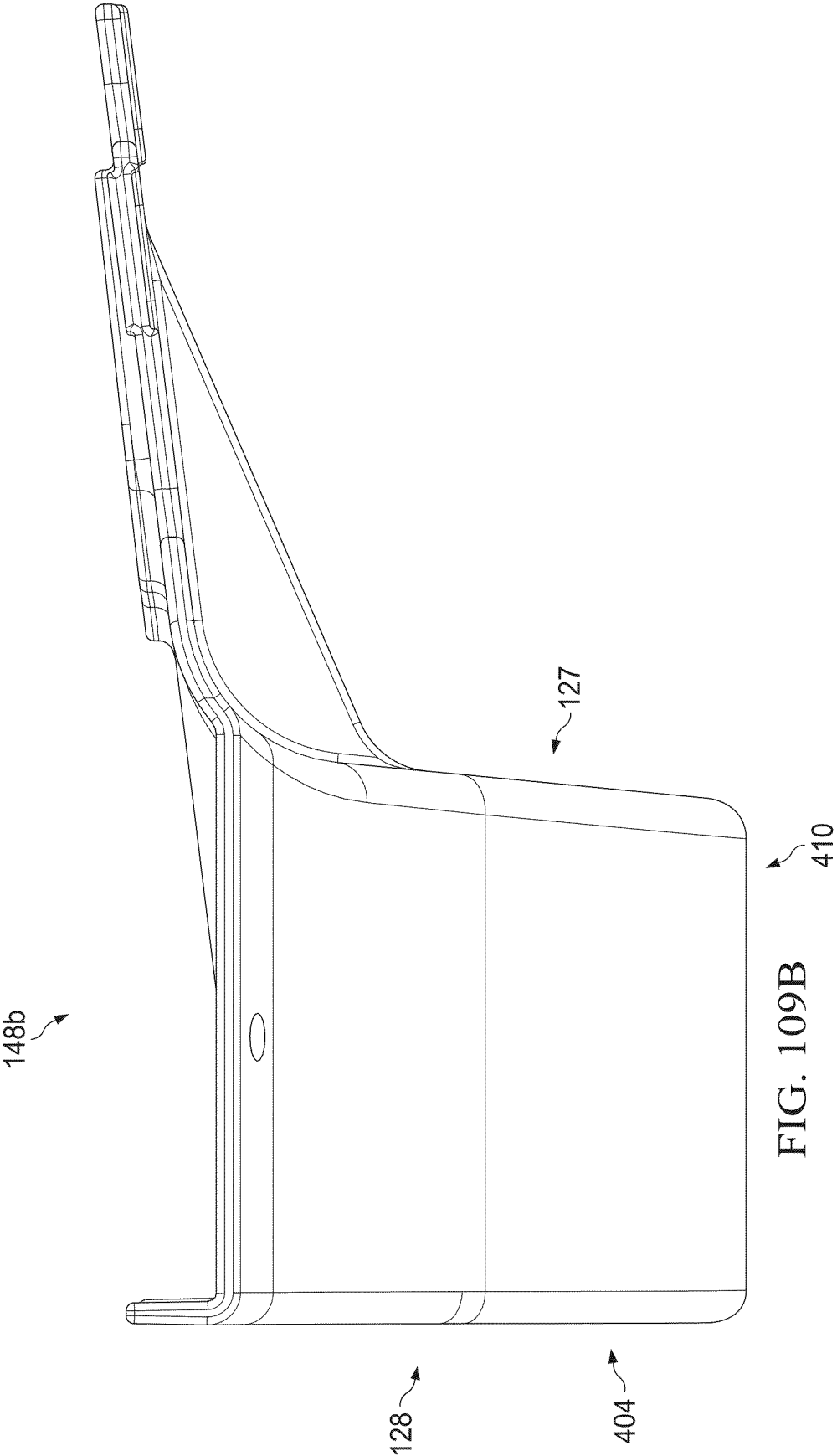


FIG. 109A



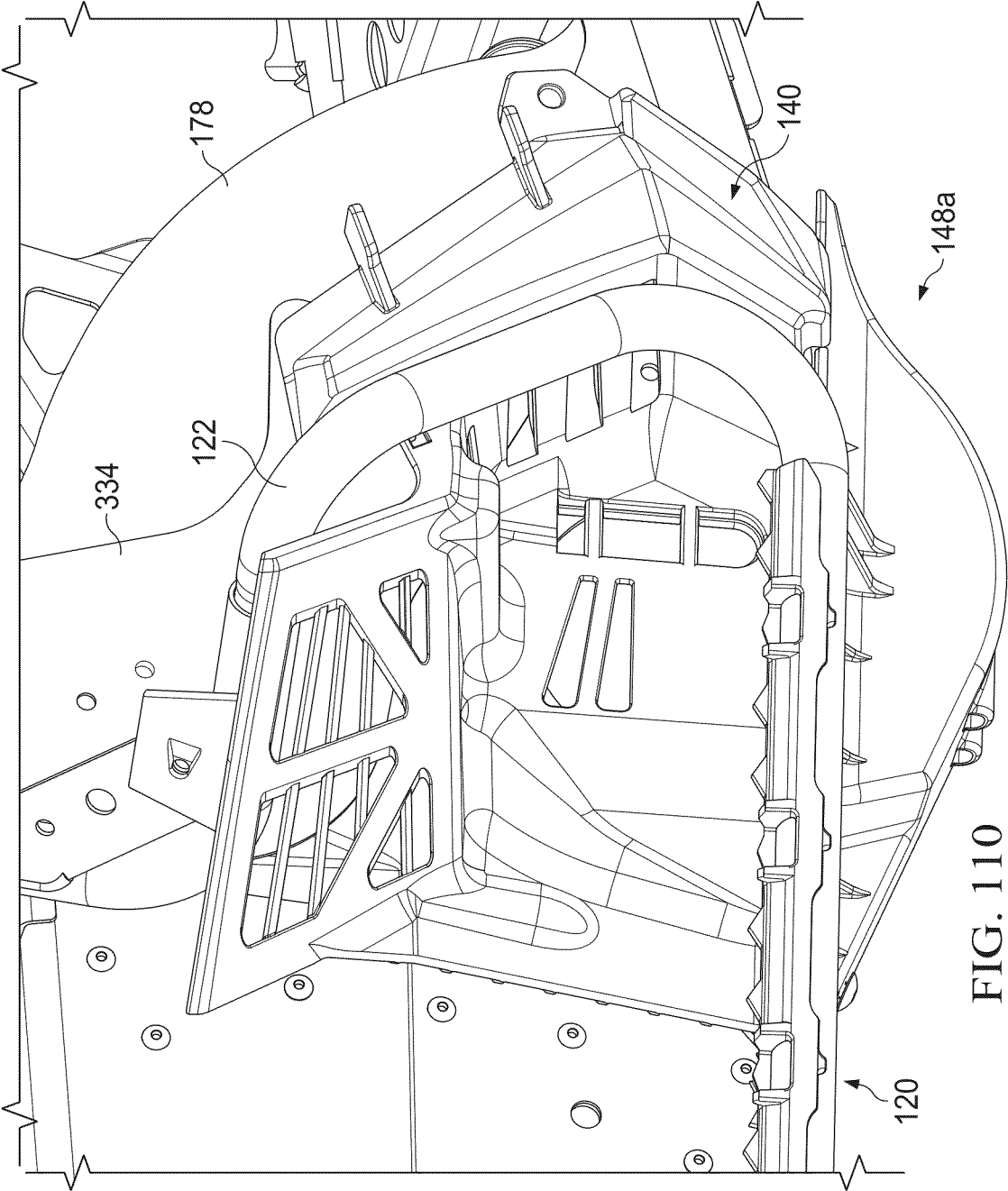
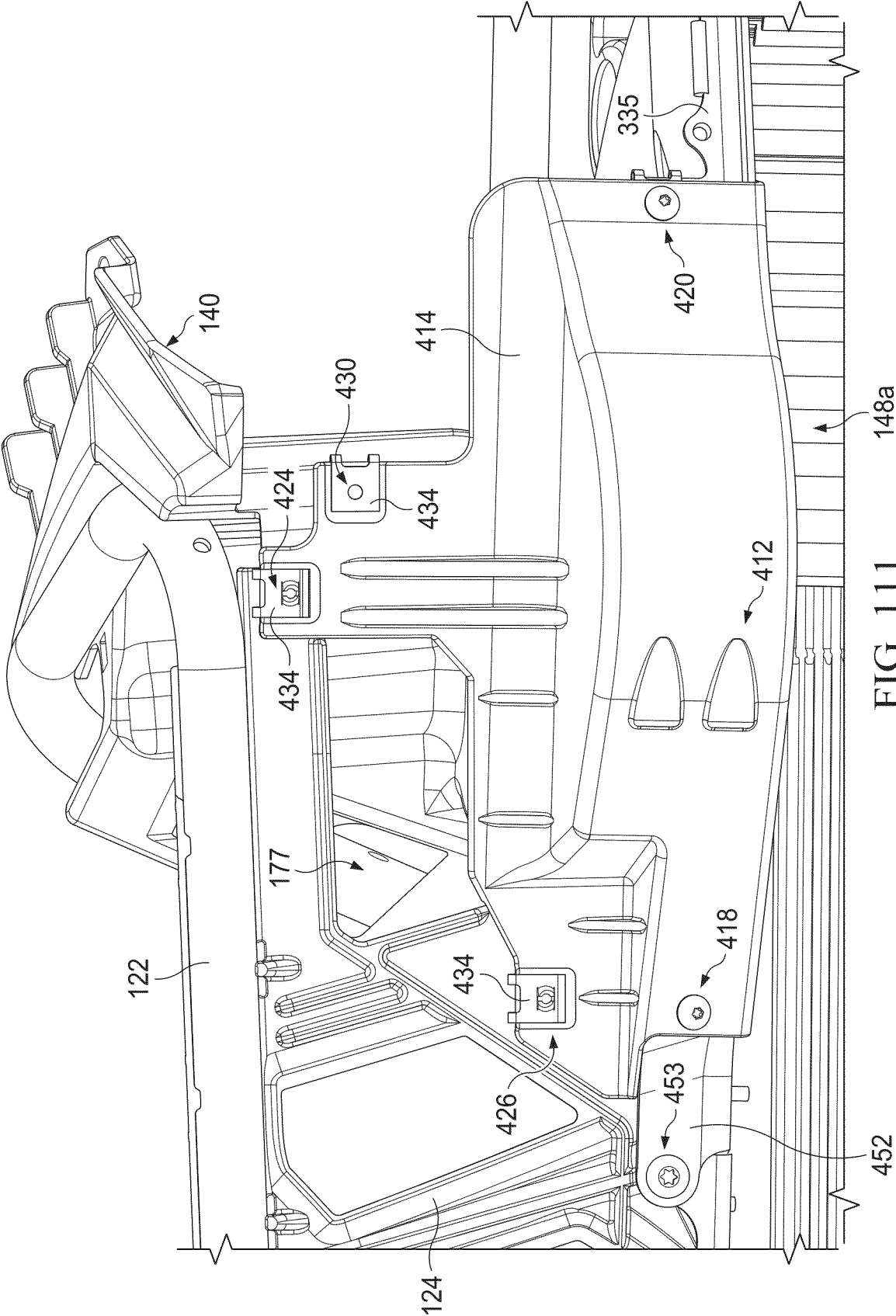


FIG. 110



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FIG. 111

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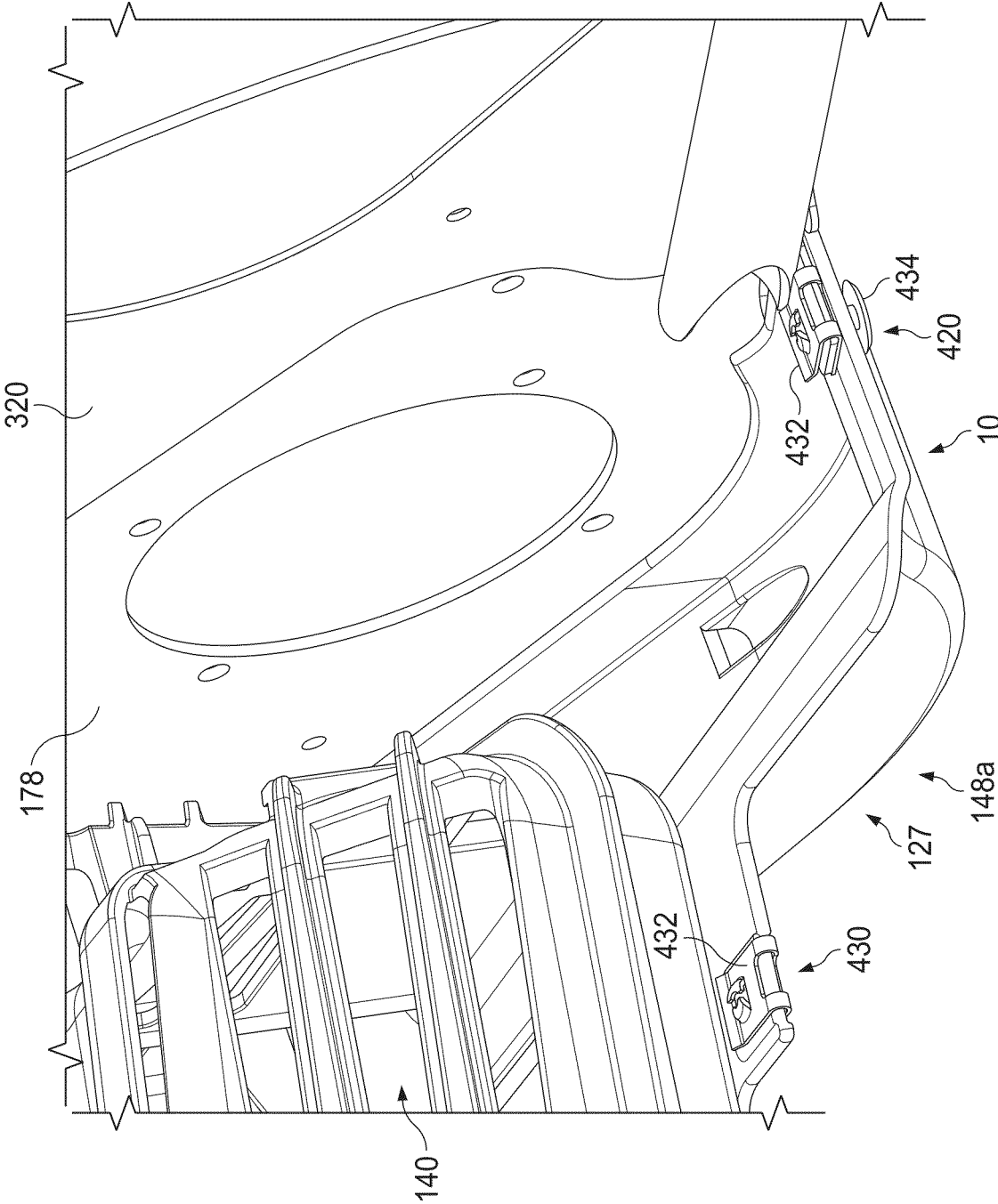


FIG. 112

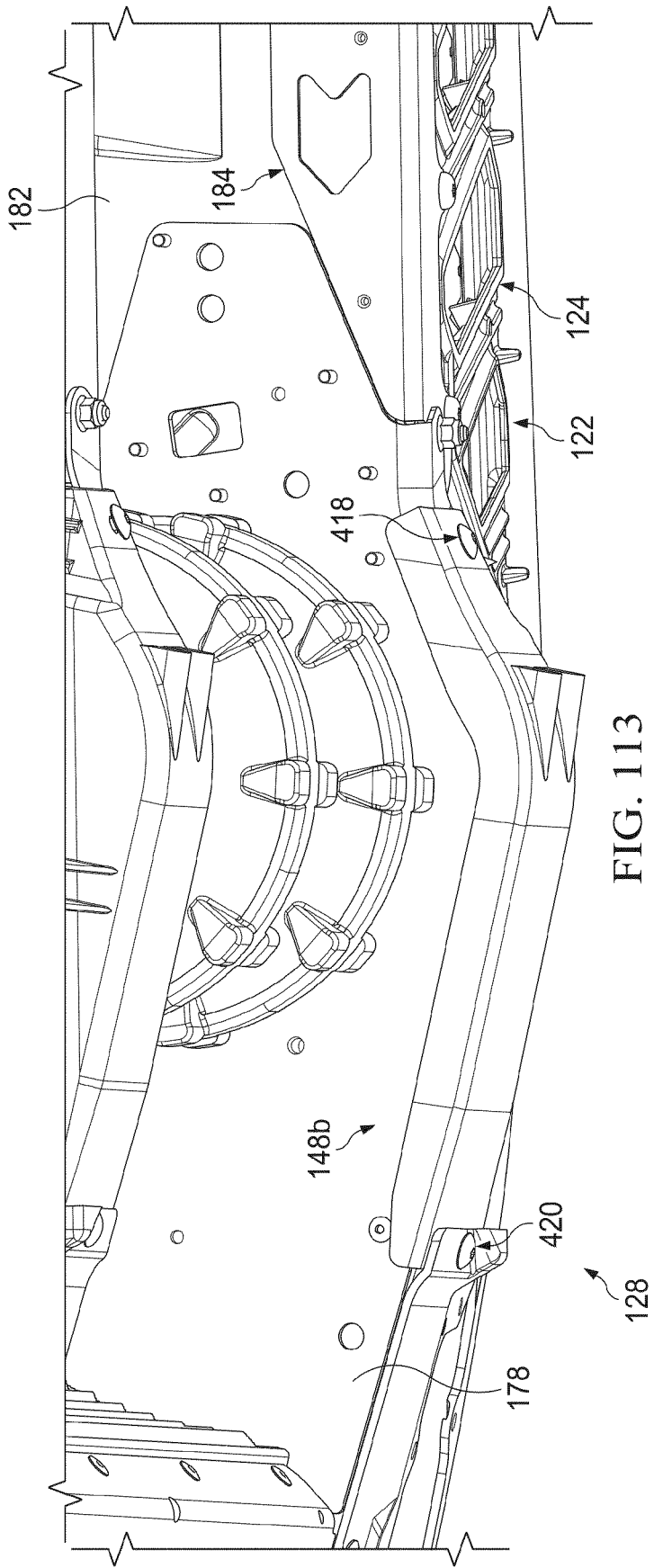


FIG. 113

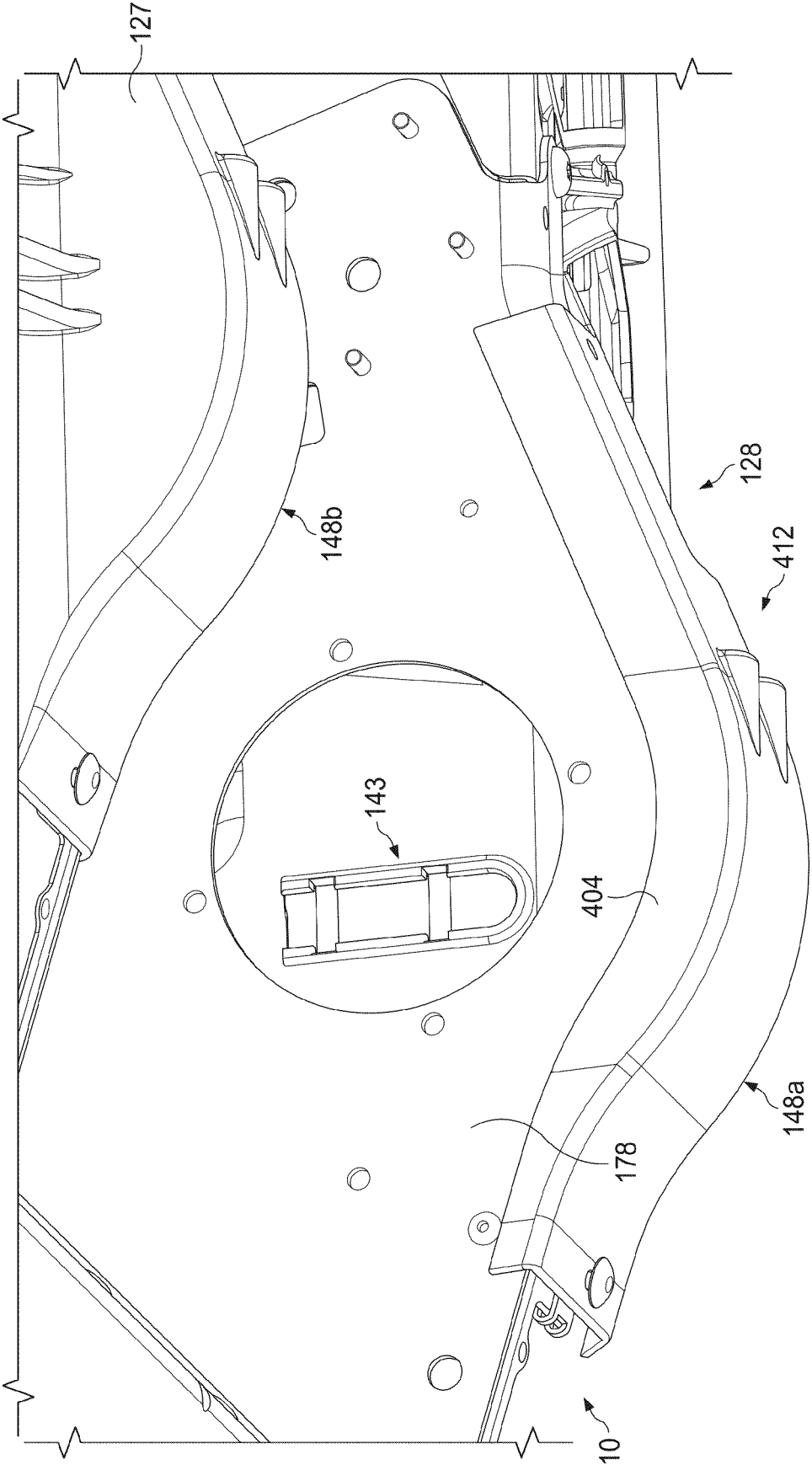


FIG. 114

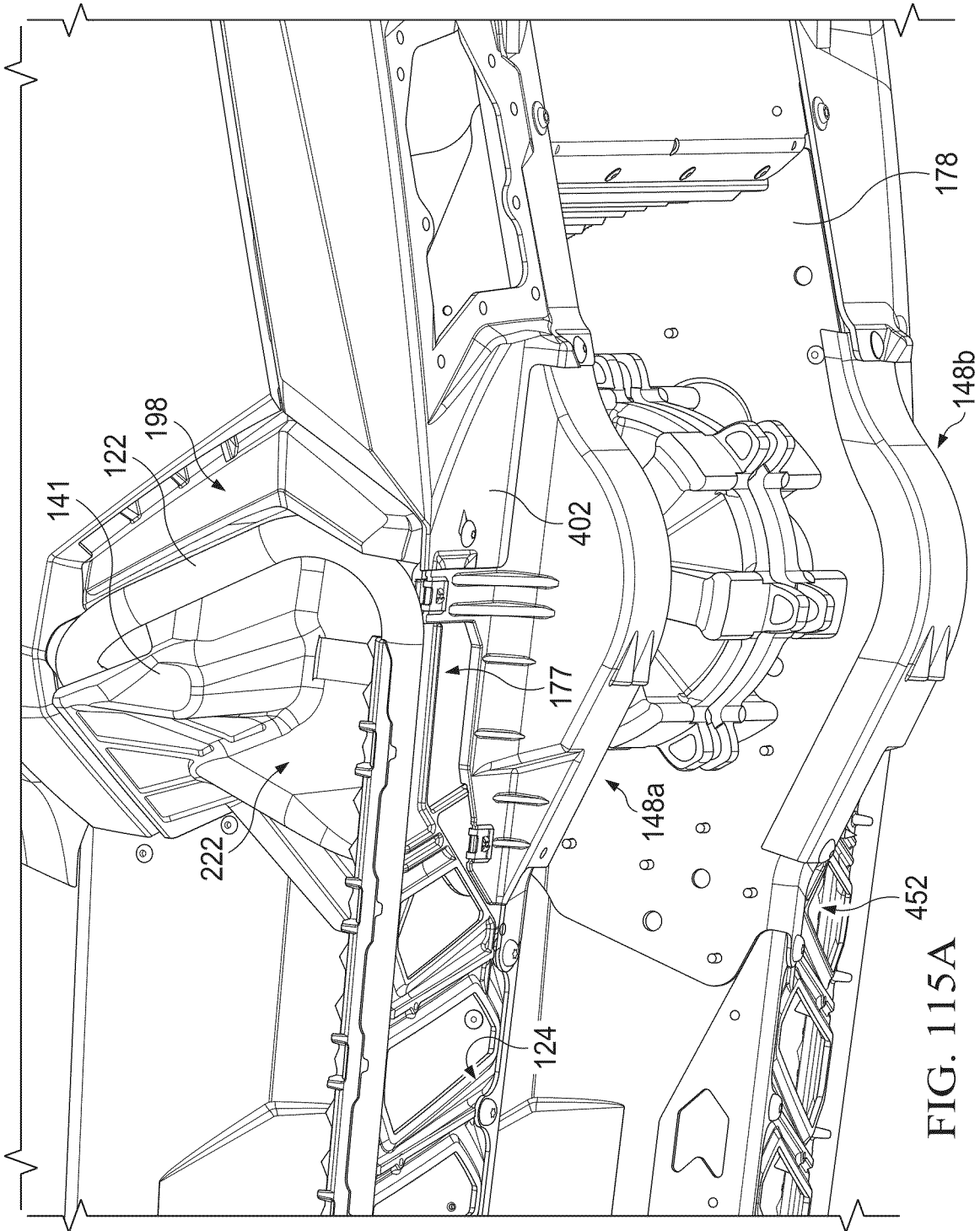


FIG. 115A

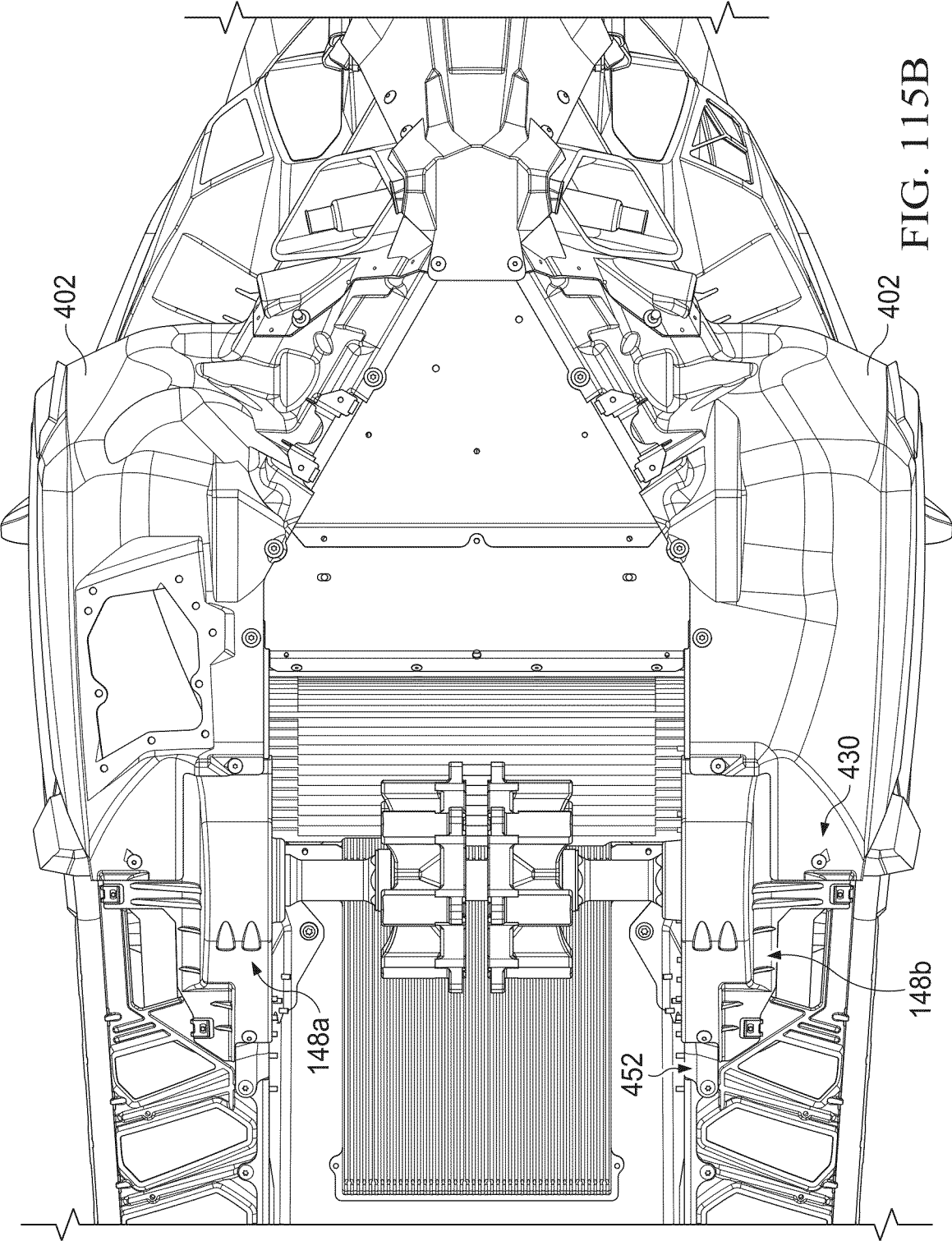
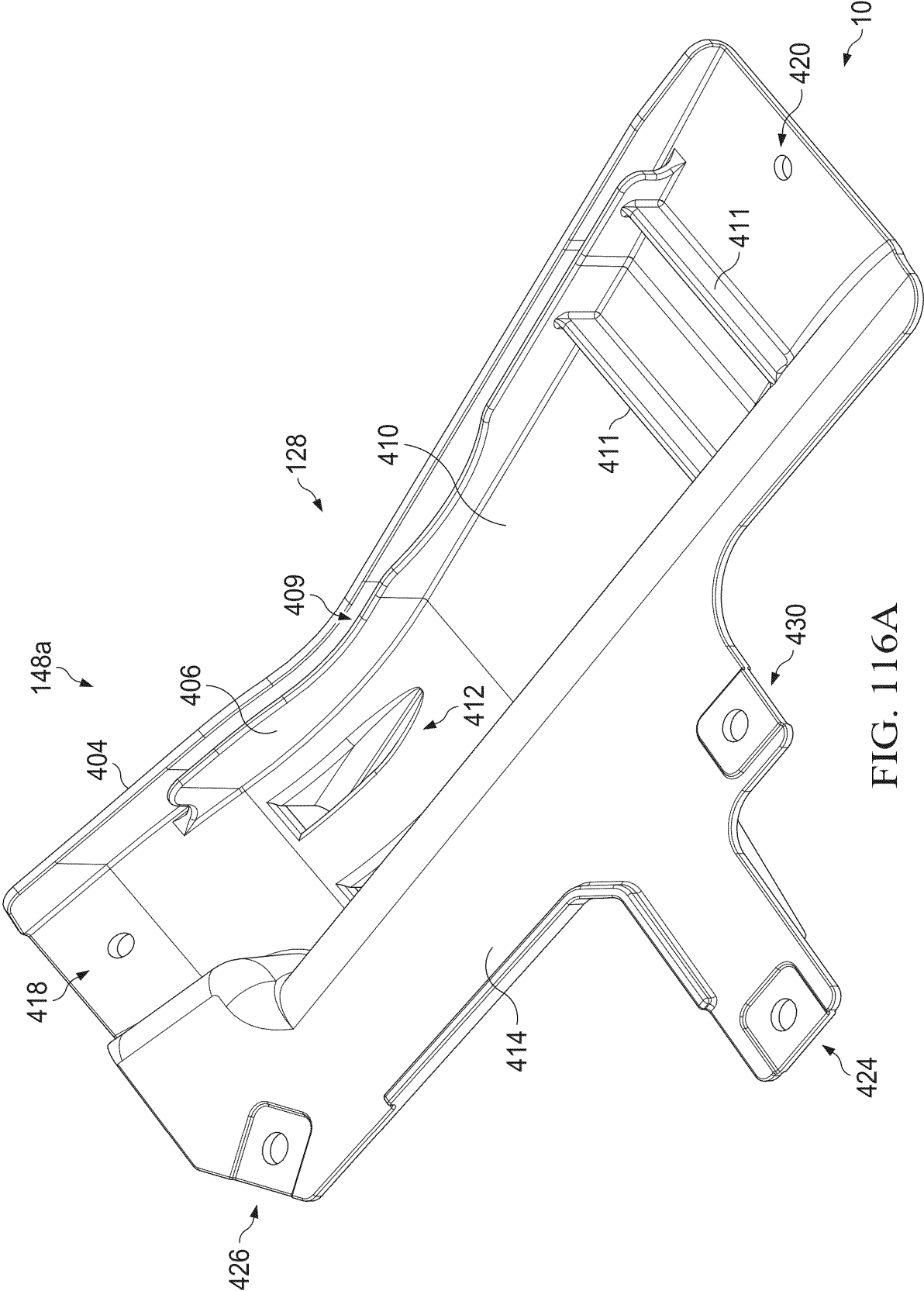


FIG. 115B



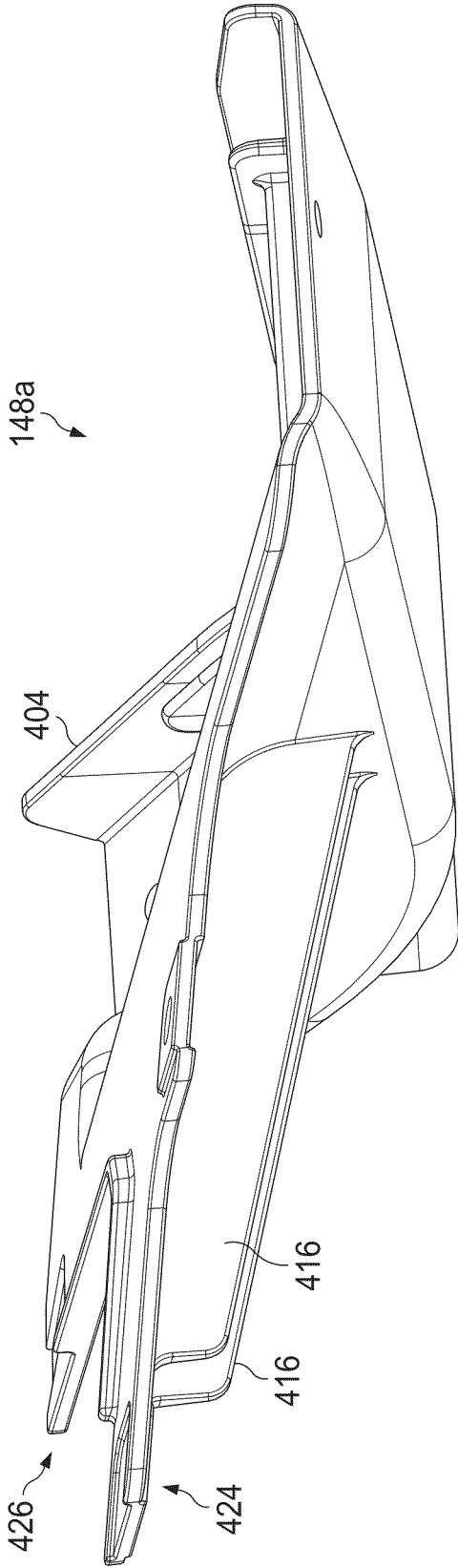


FIG. 116B

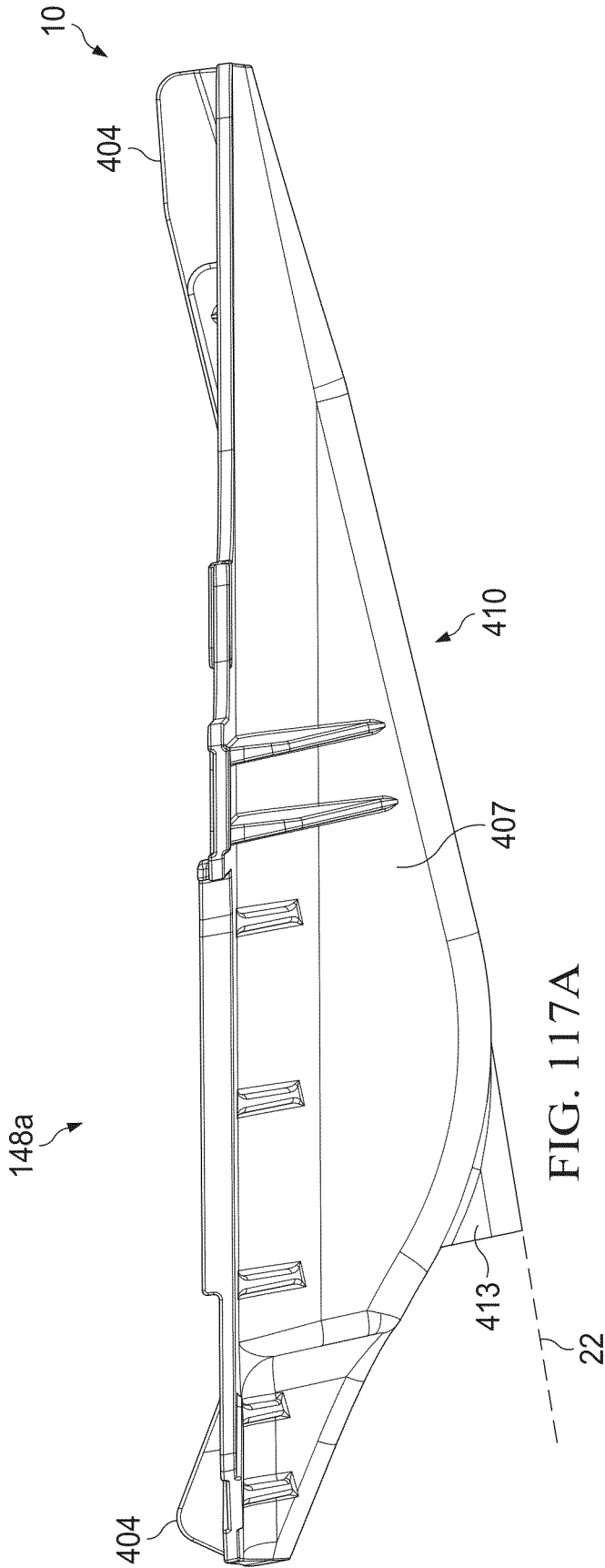


FIG. 117A

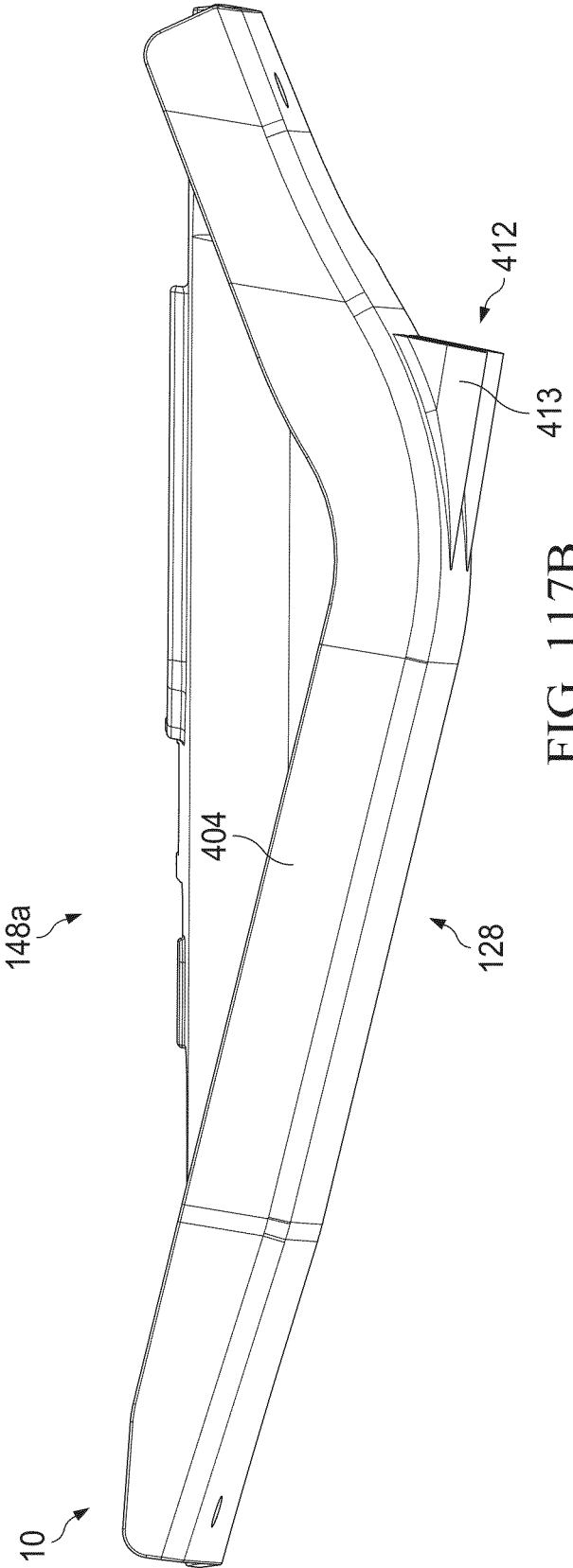


FIG. 117B

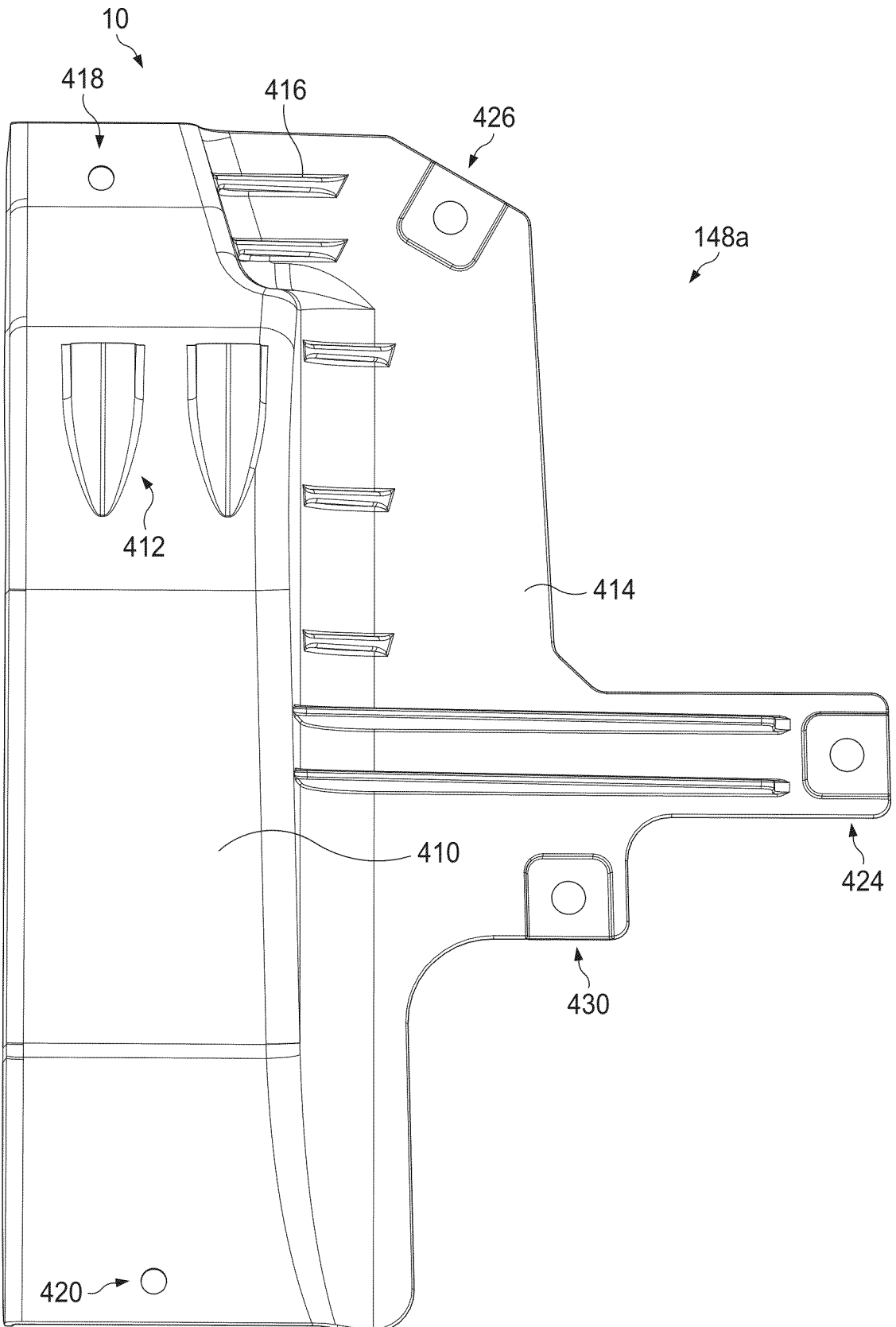


FIG. 118

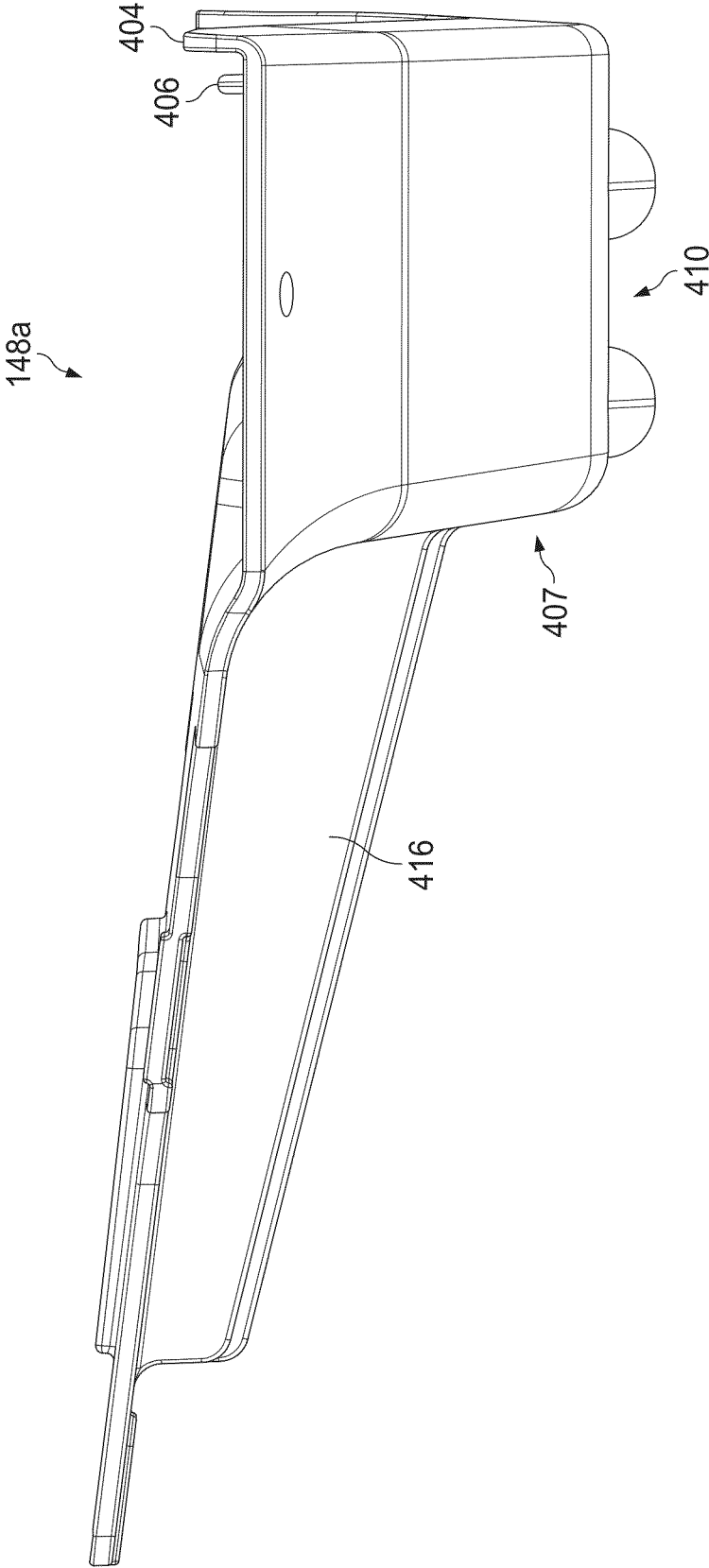
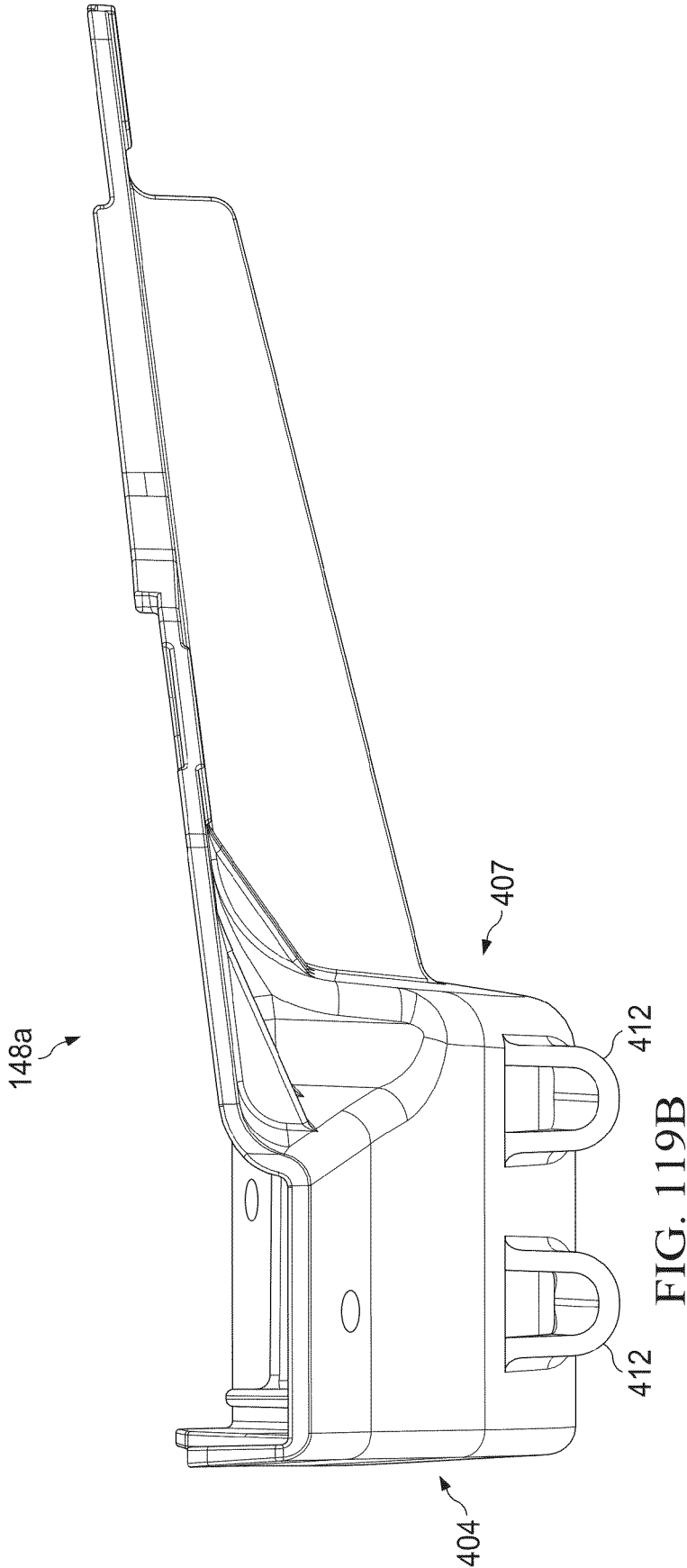


FIG. 119A



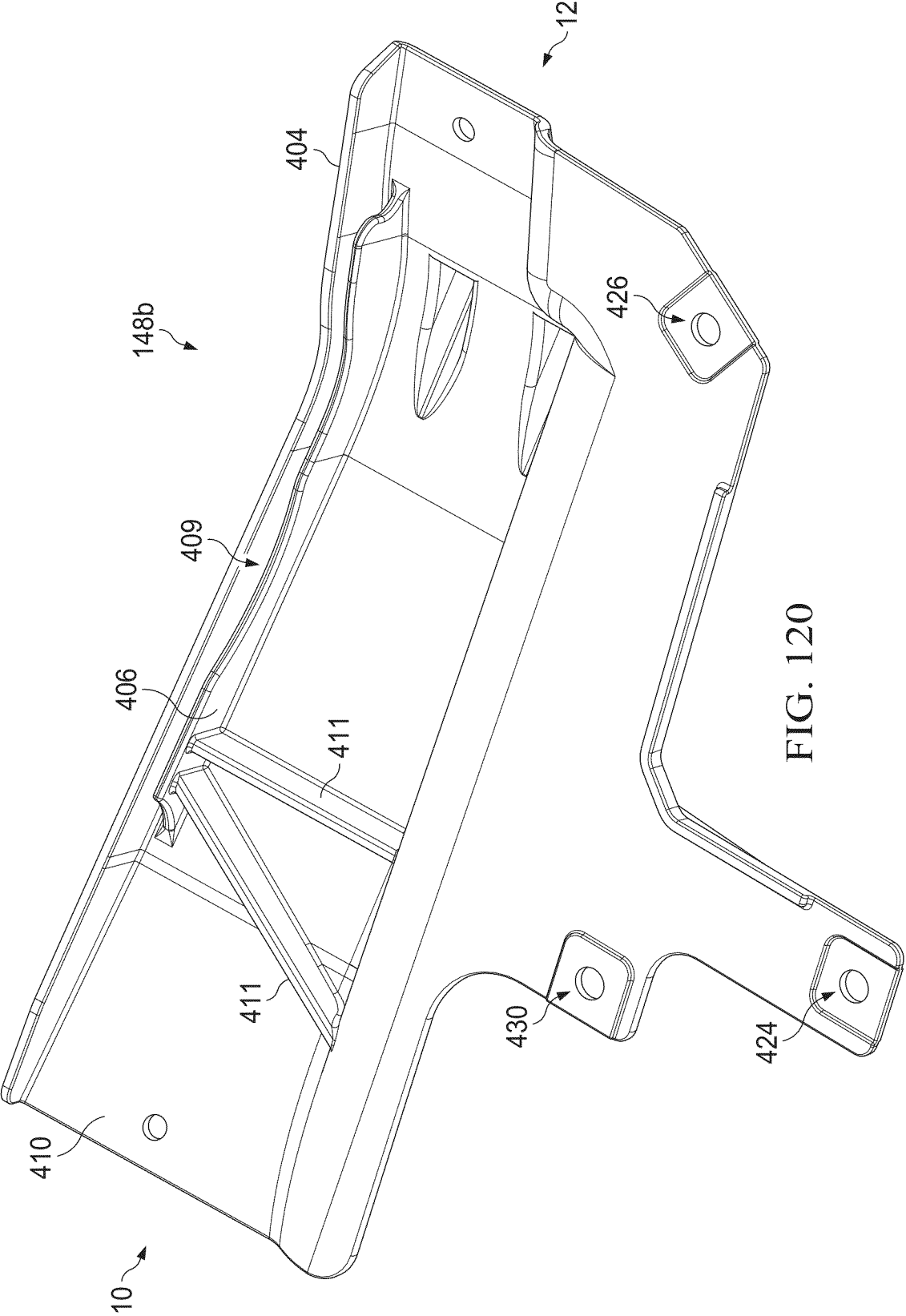


FIG. 120

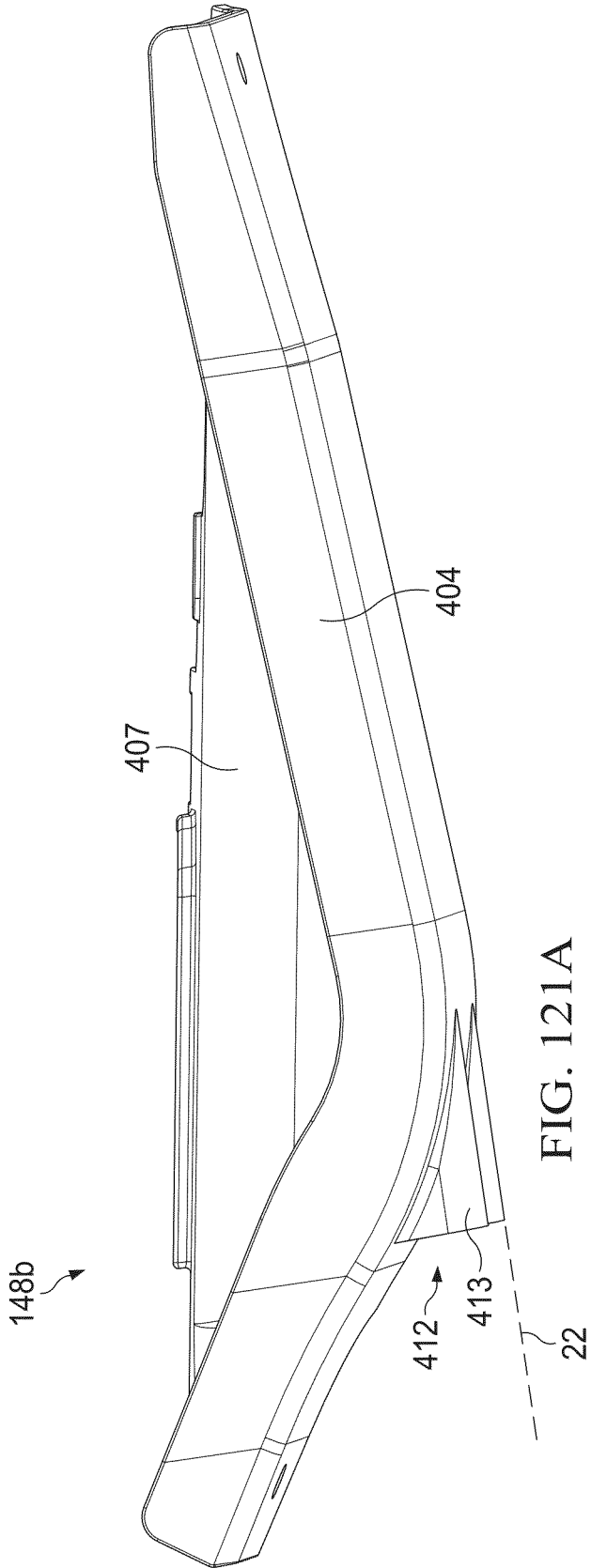


FIG. 121A

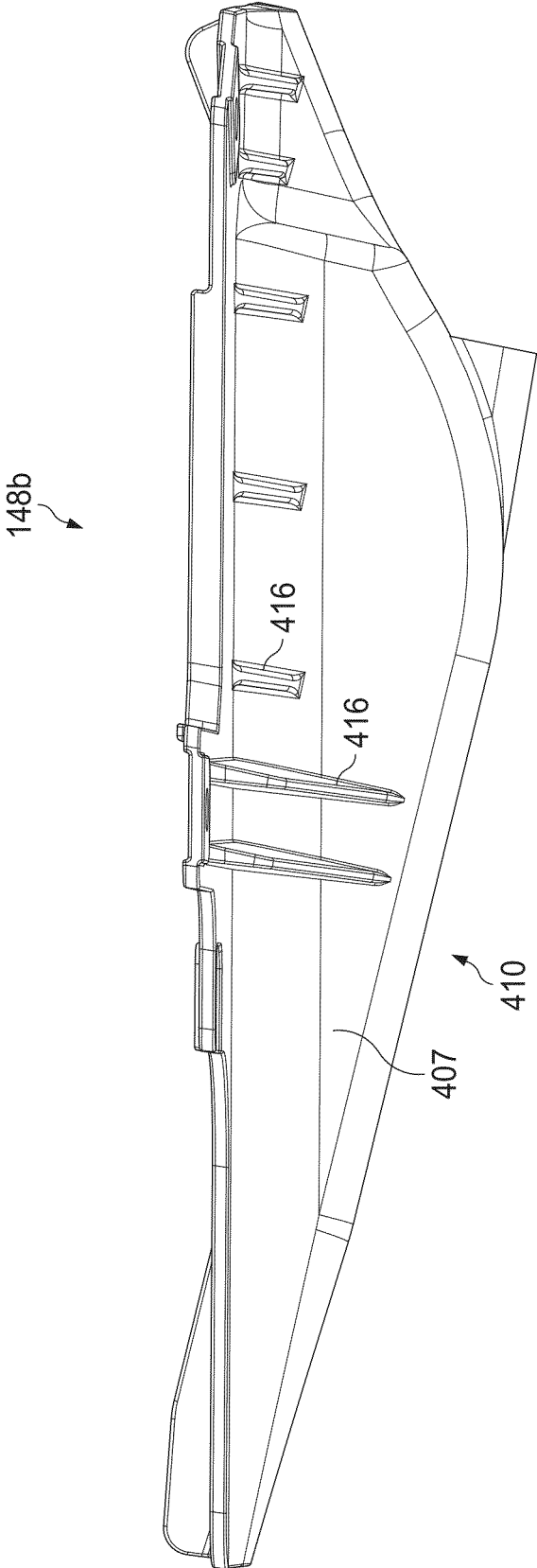


FIG. 121B

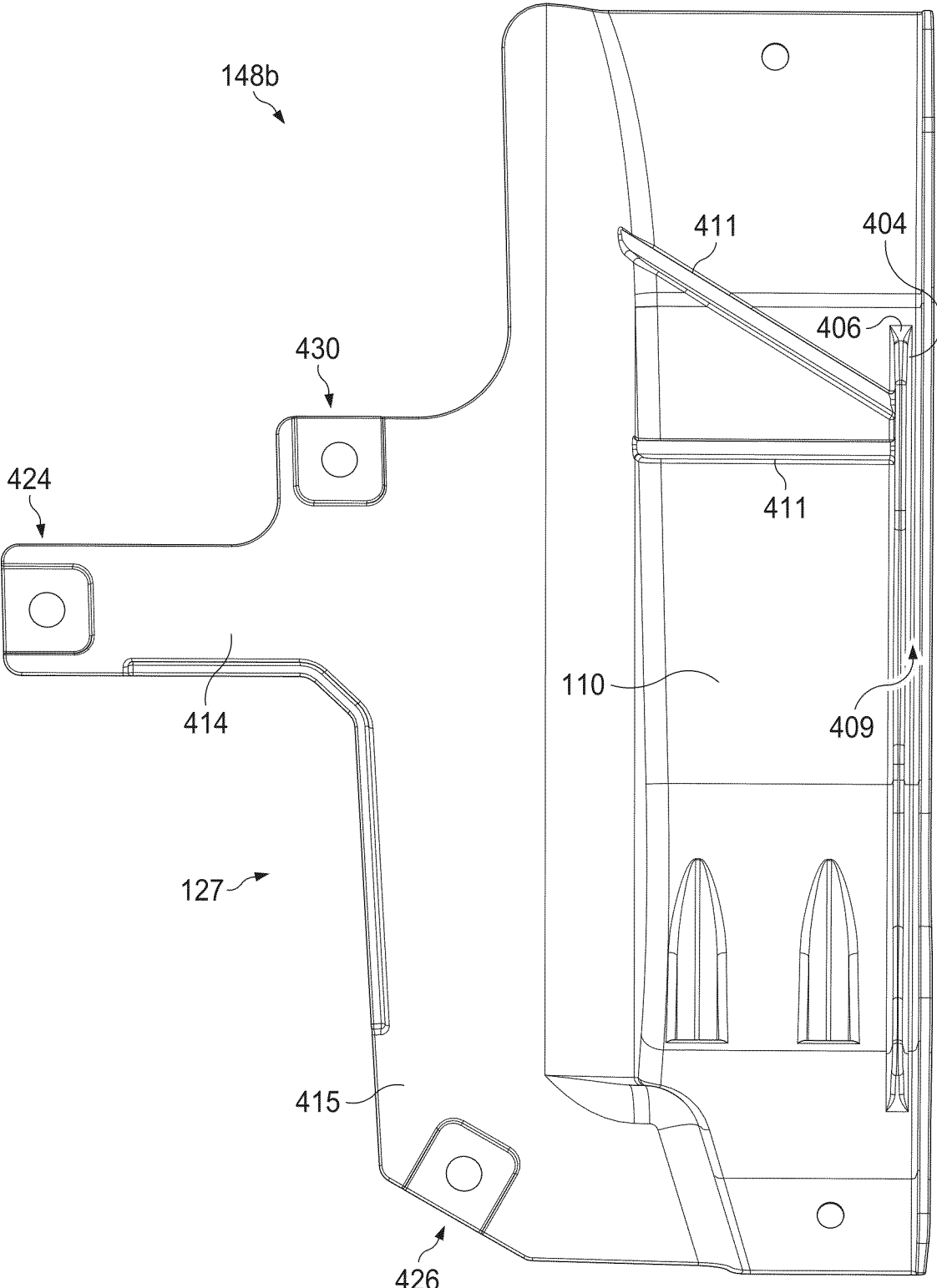


FIG. 122A

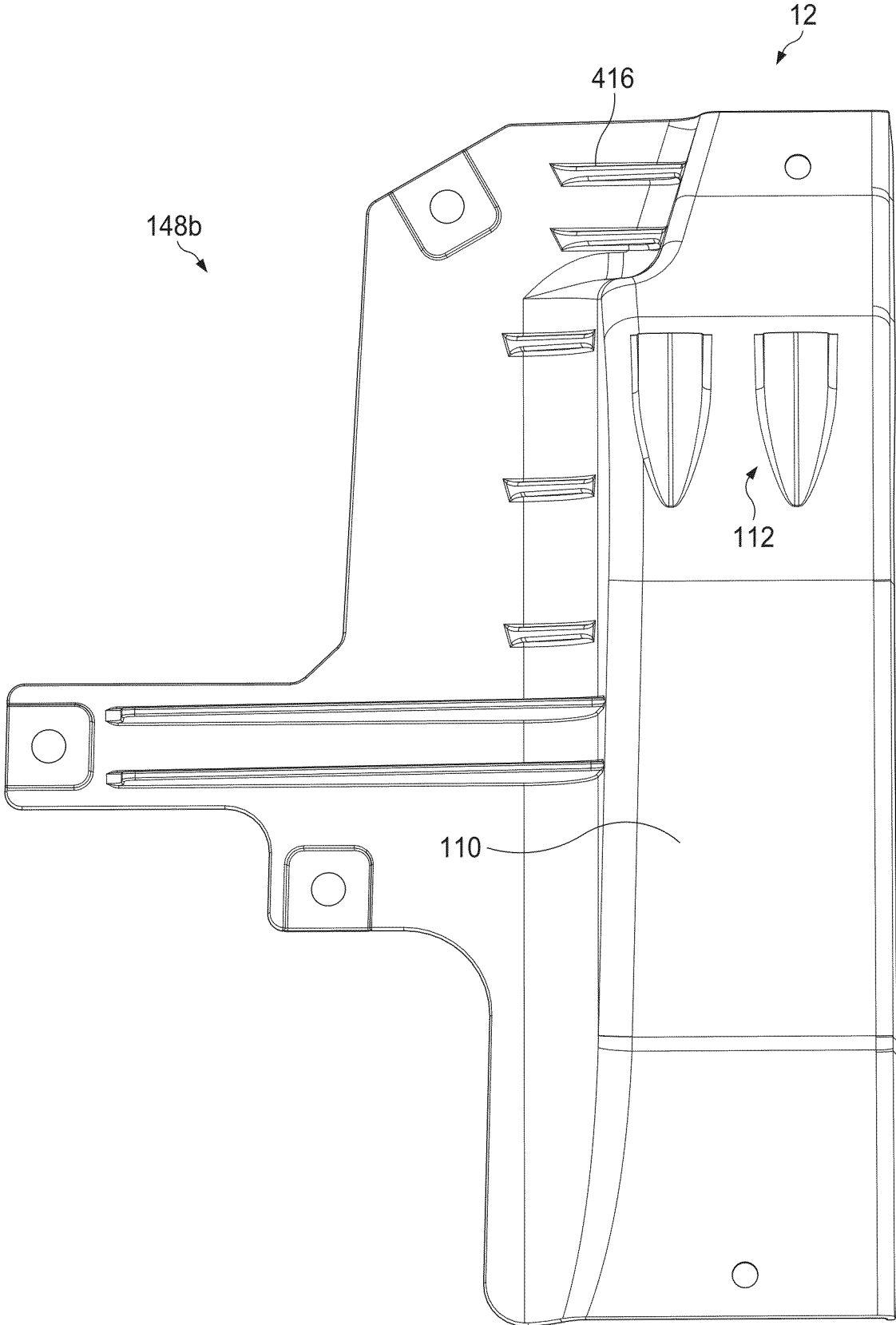


FIG. 122B

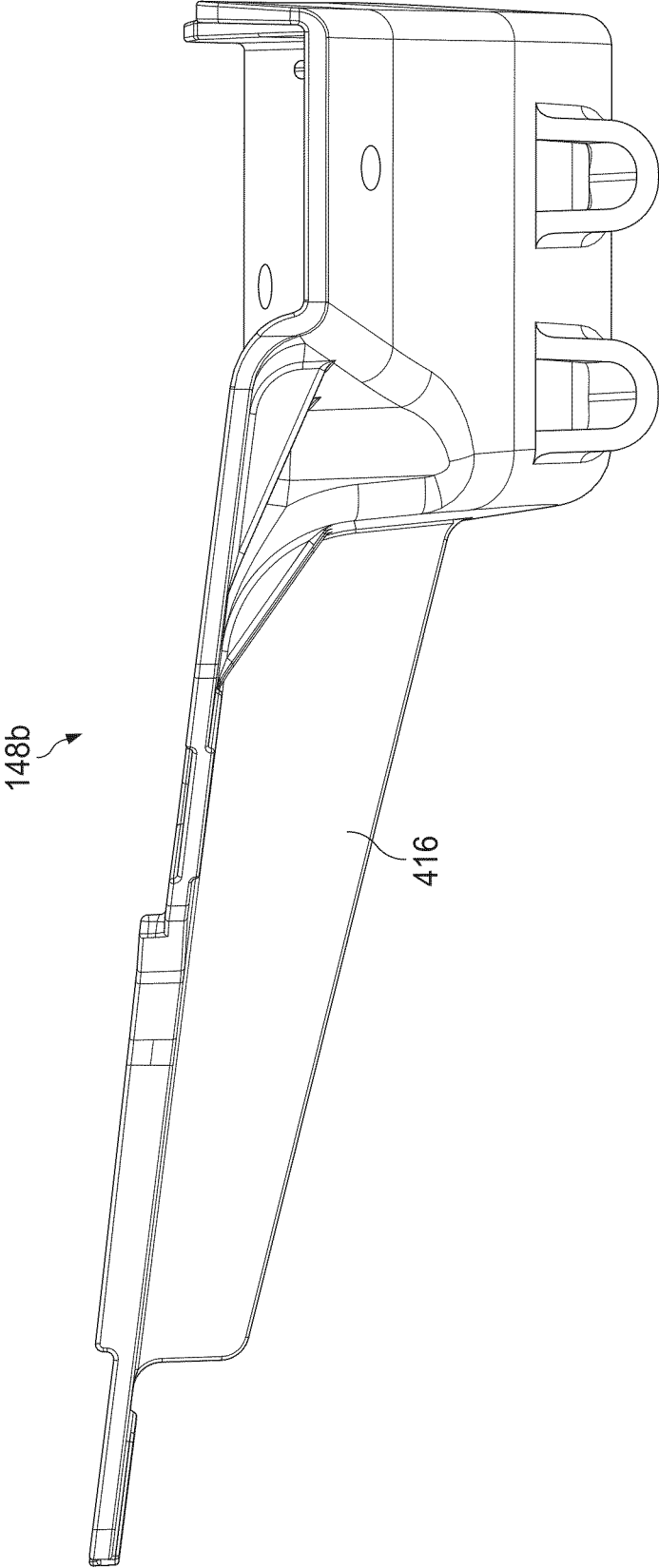


FIG. 123A

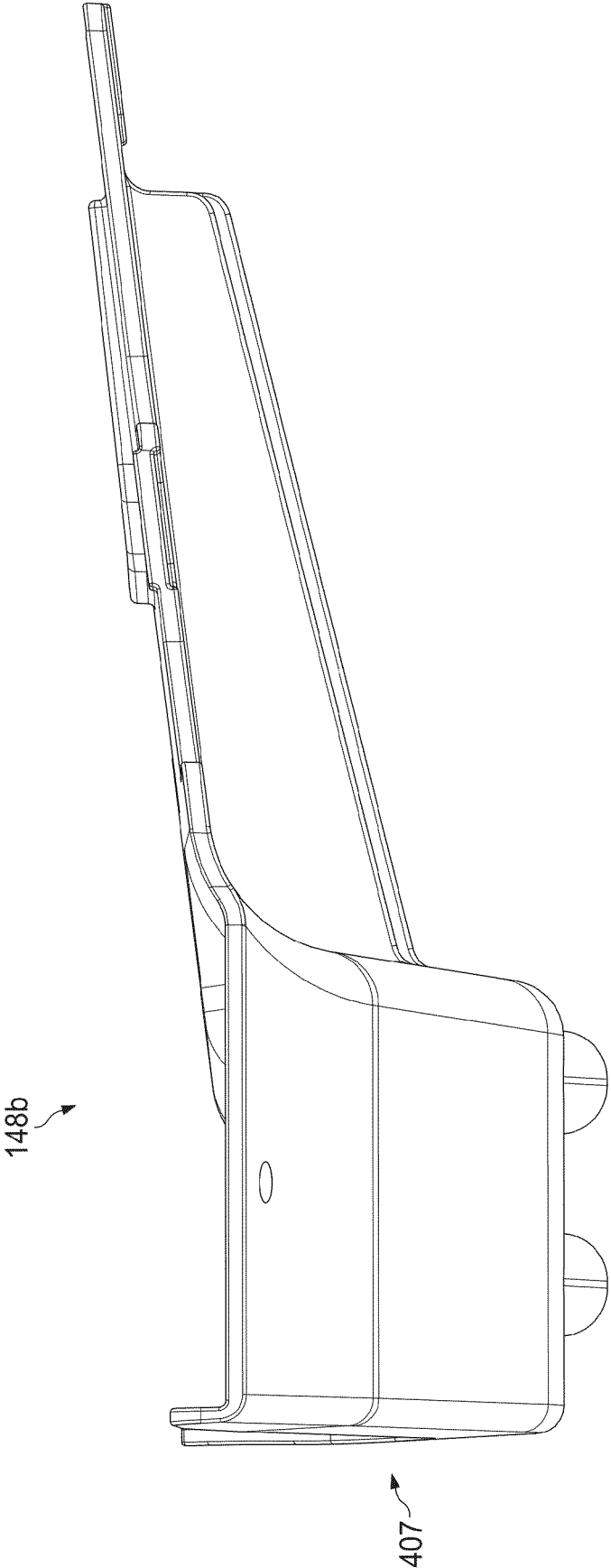


FIG. 123B

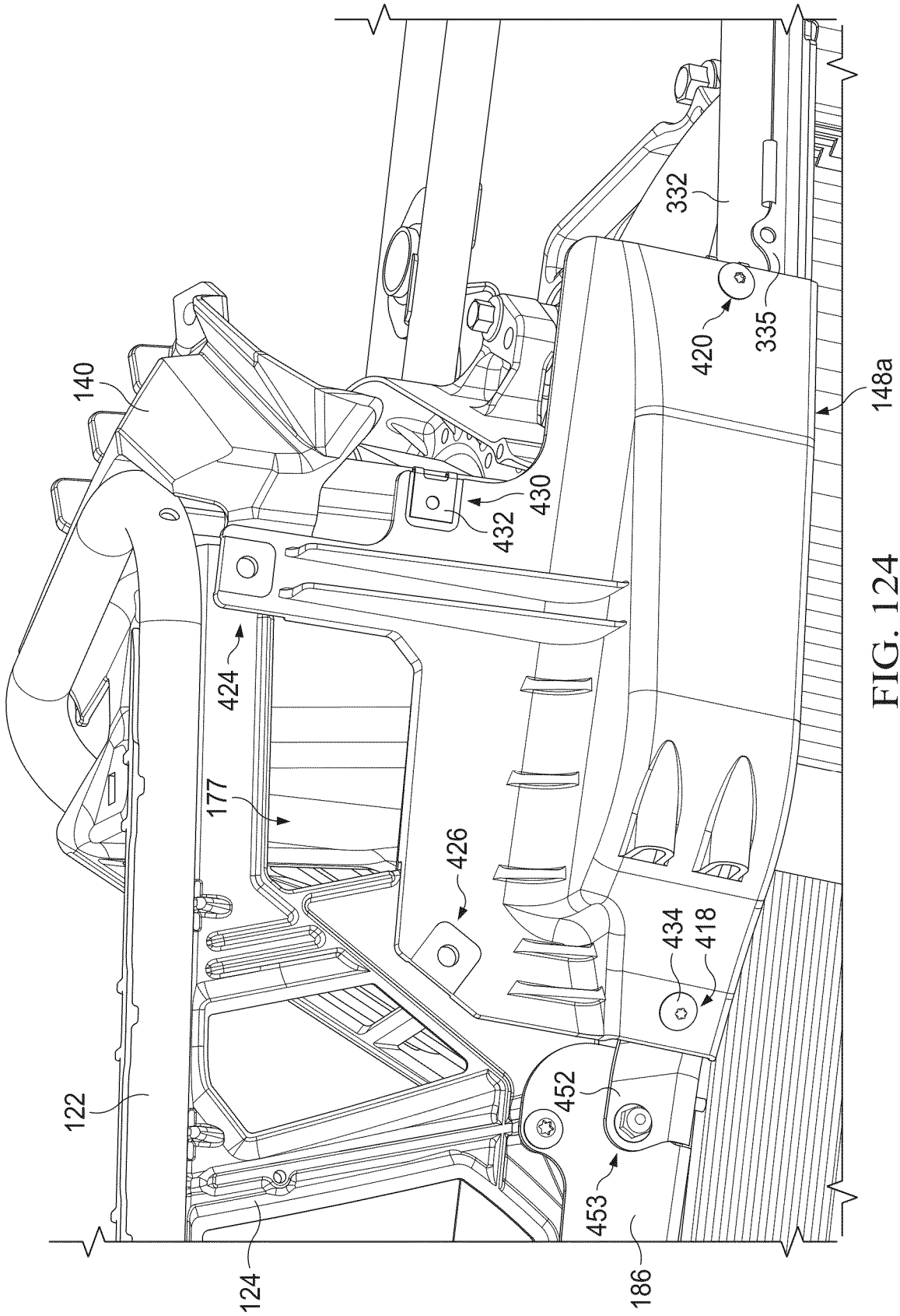


FIG. 124

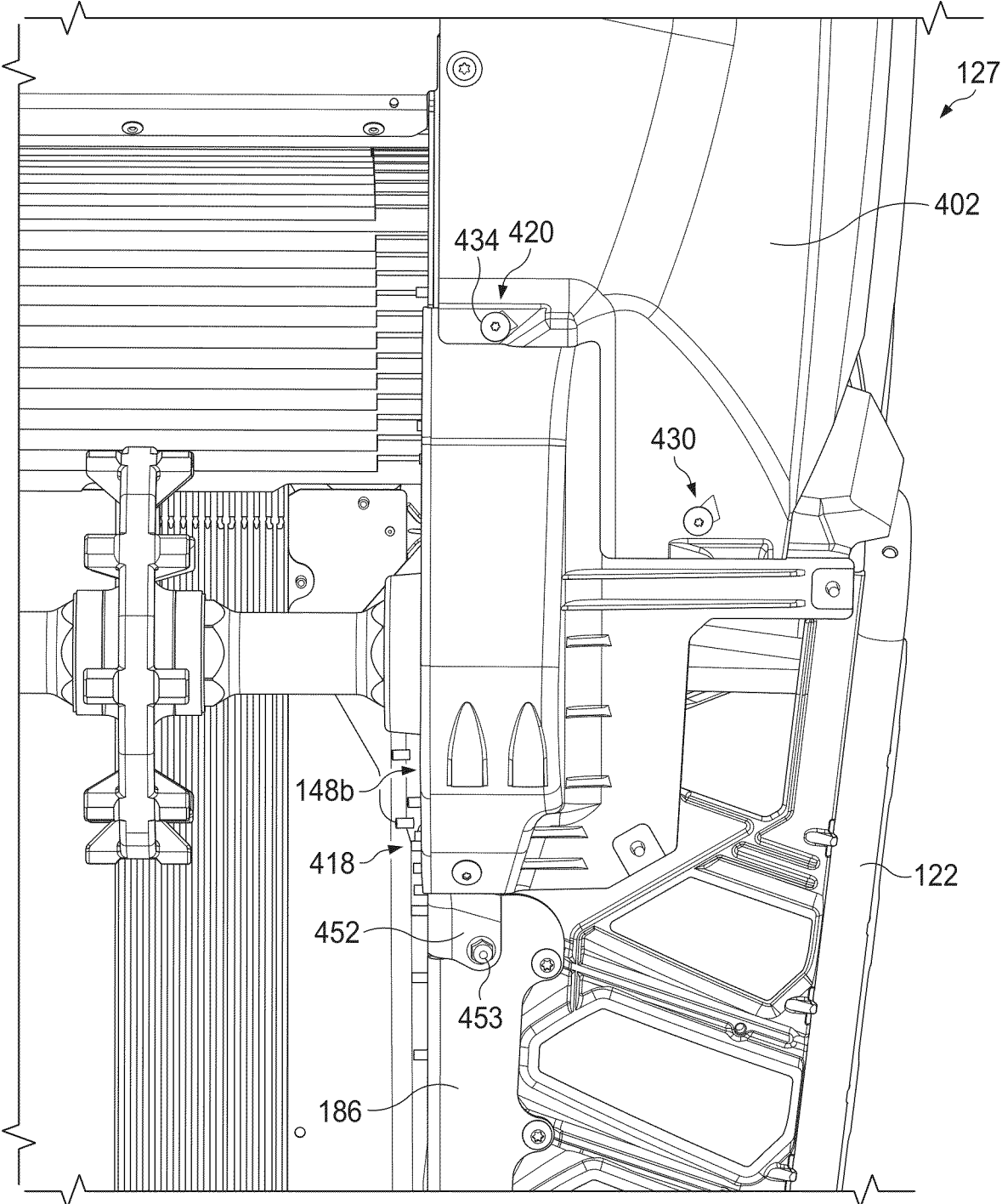


FIG. 125

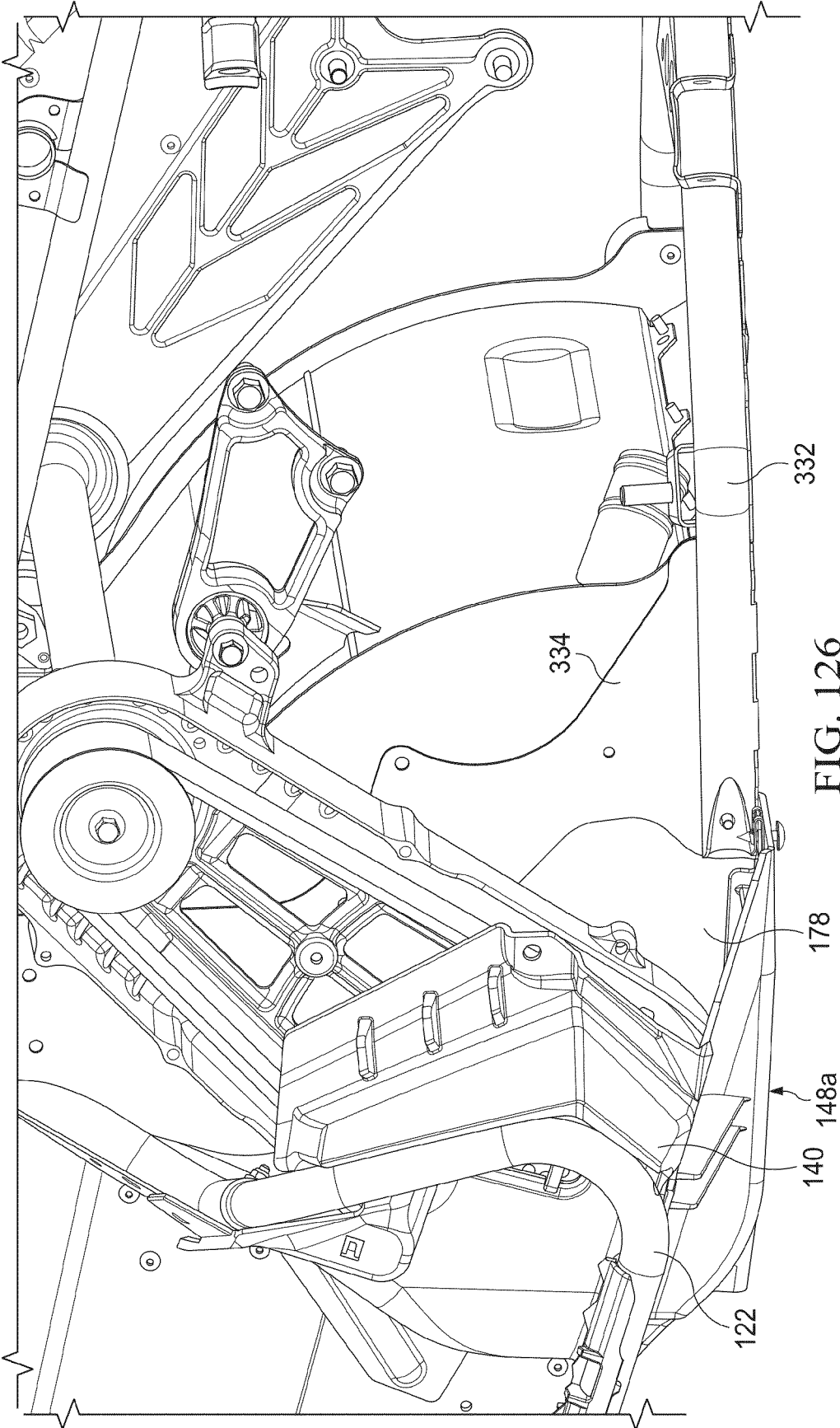


FIG. 126

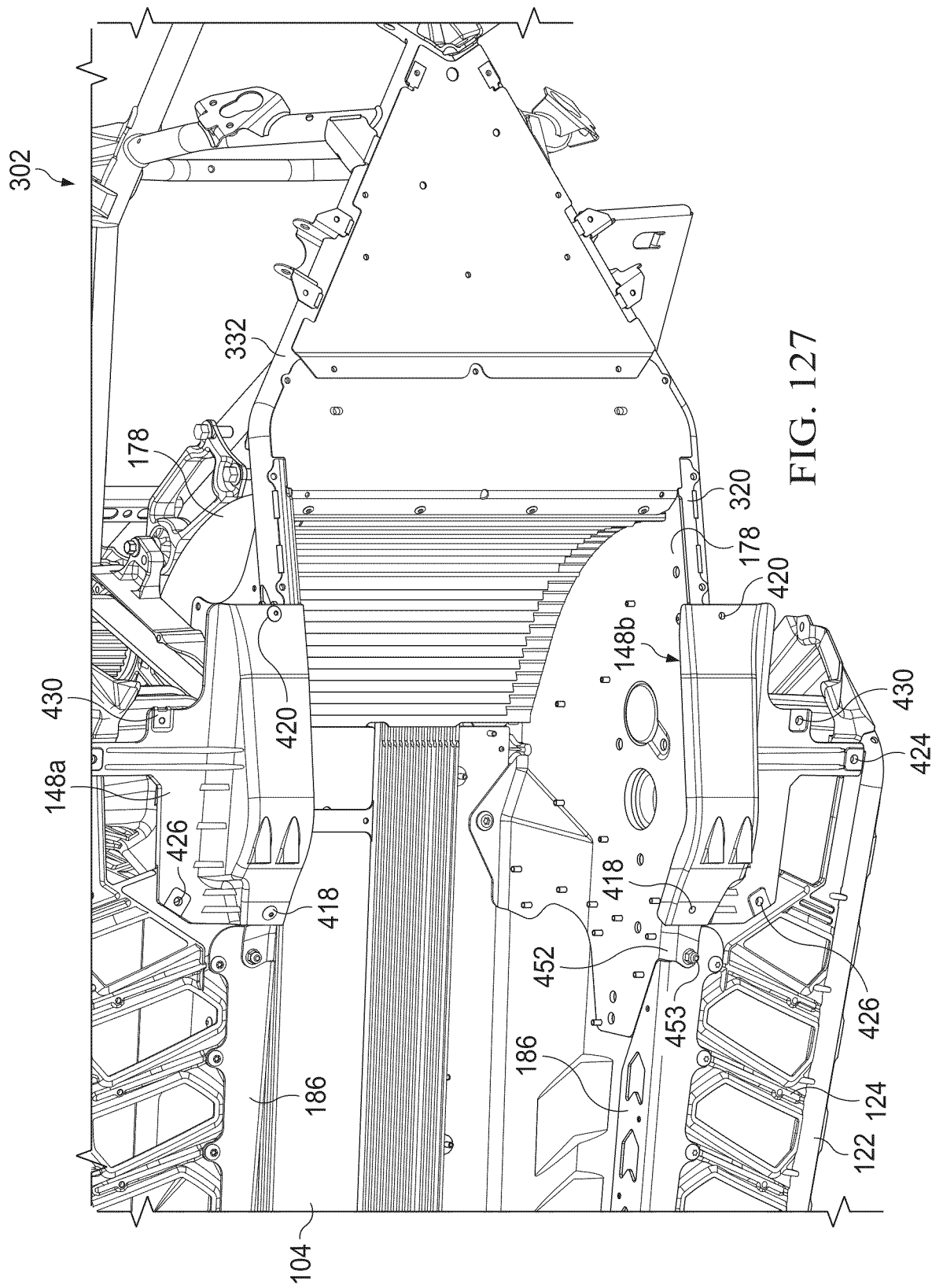


FIG. 127

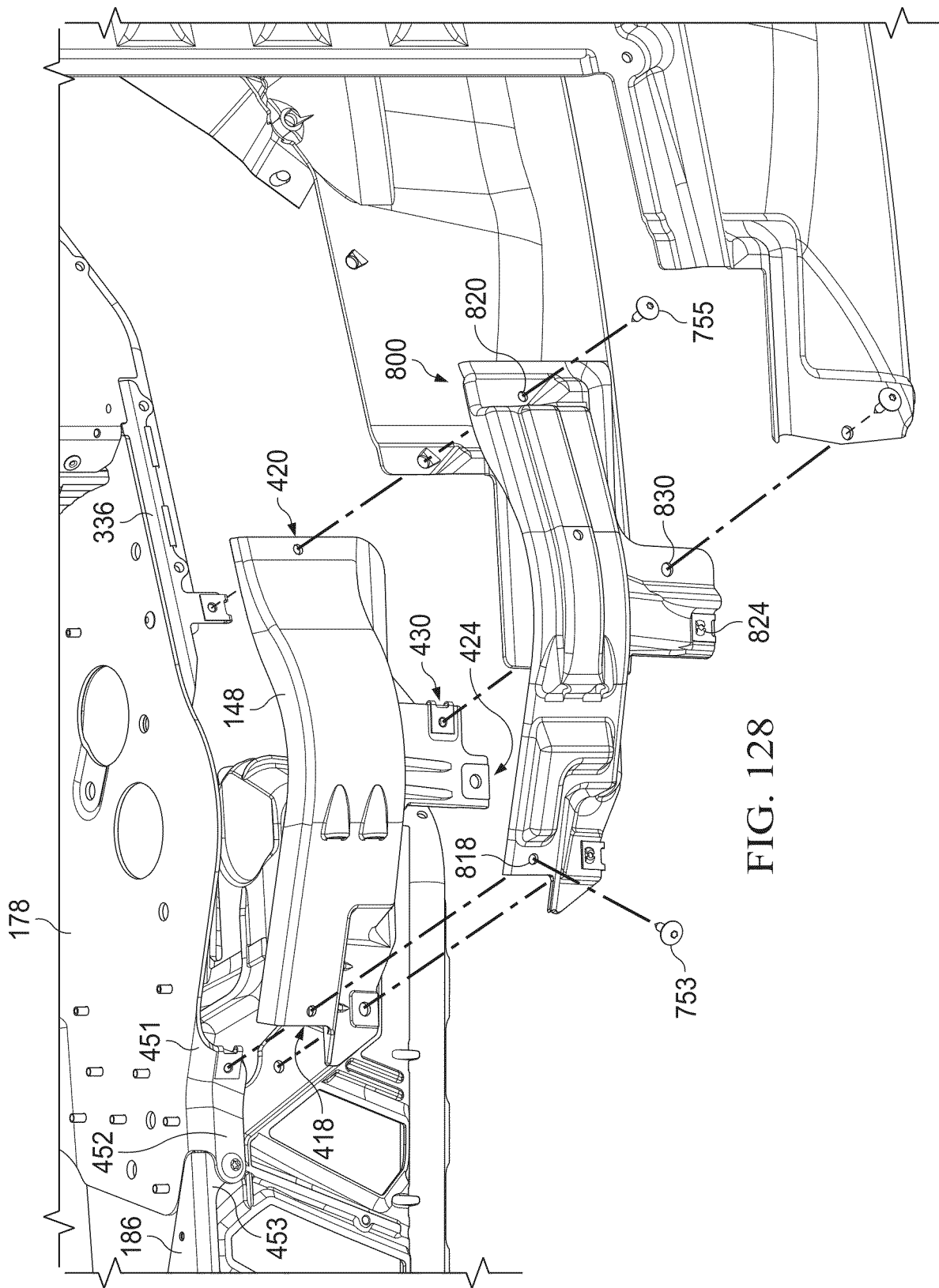


FIG. 128

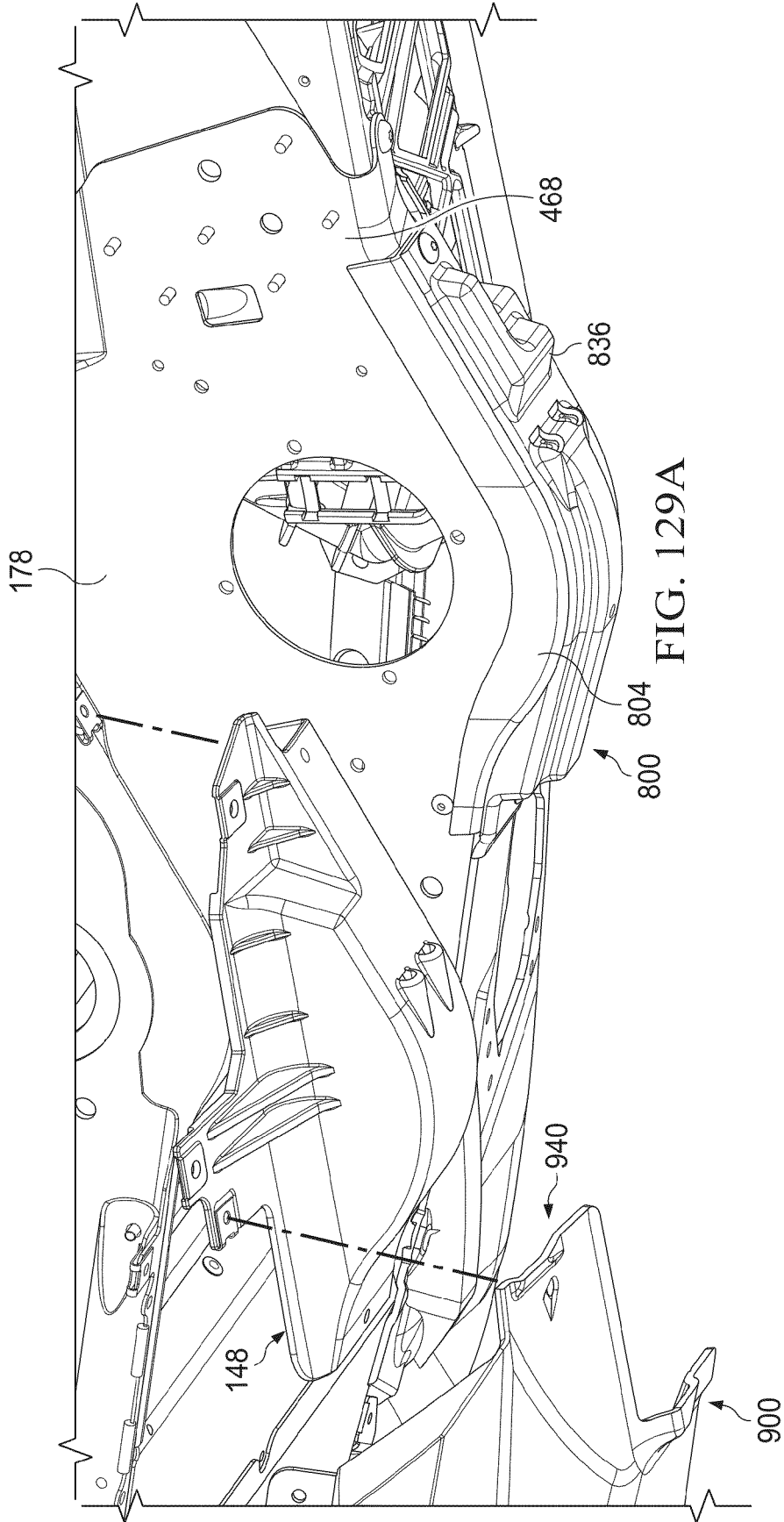


FIG. 129A

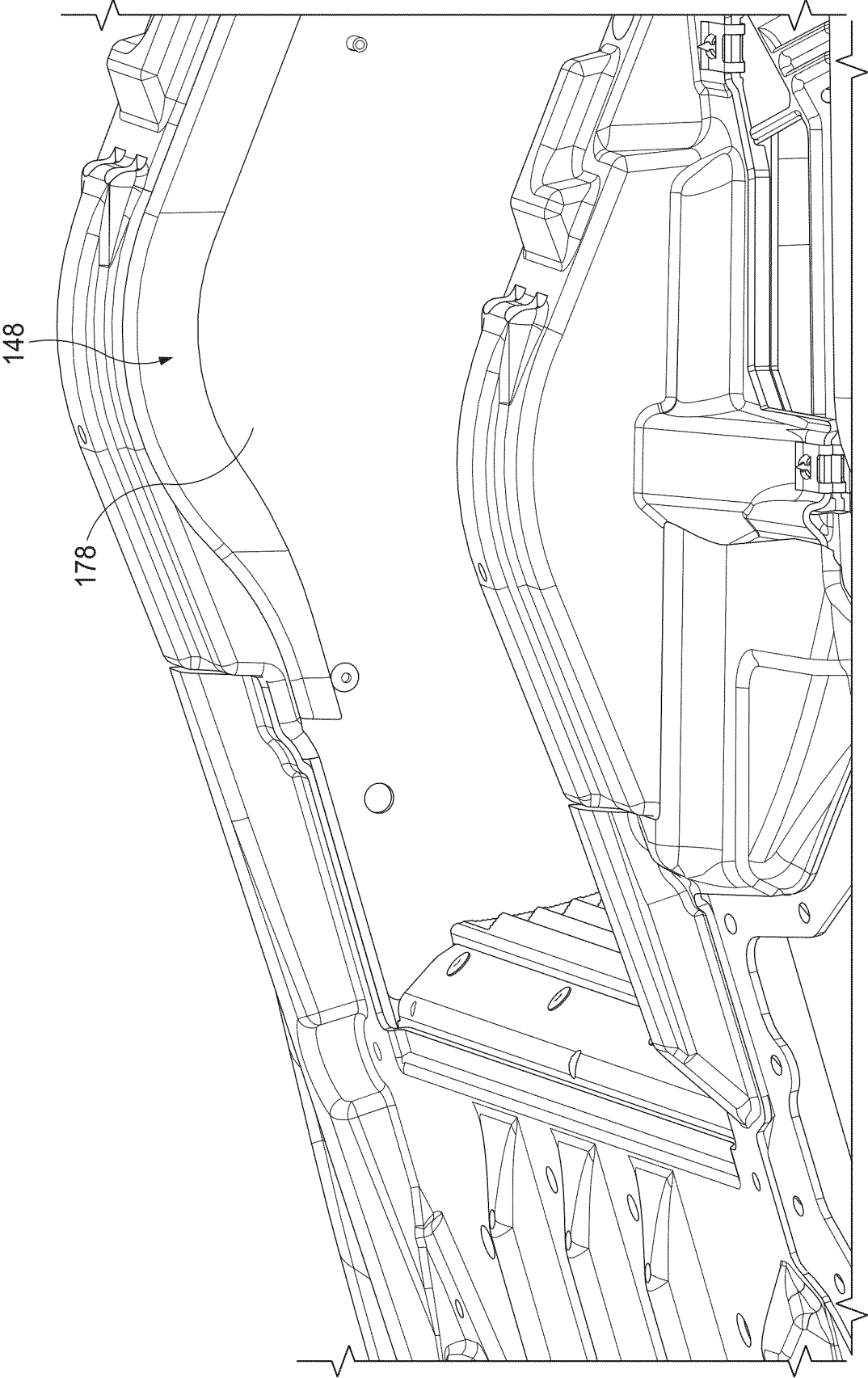
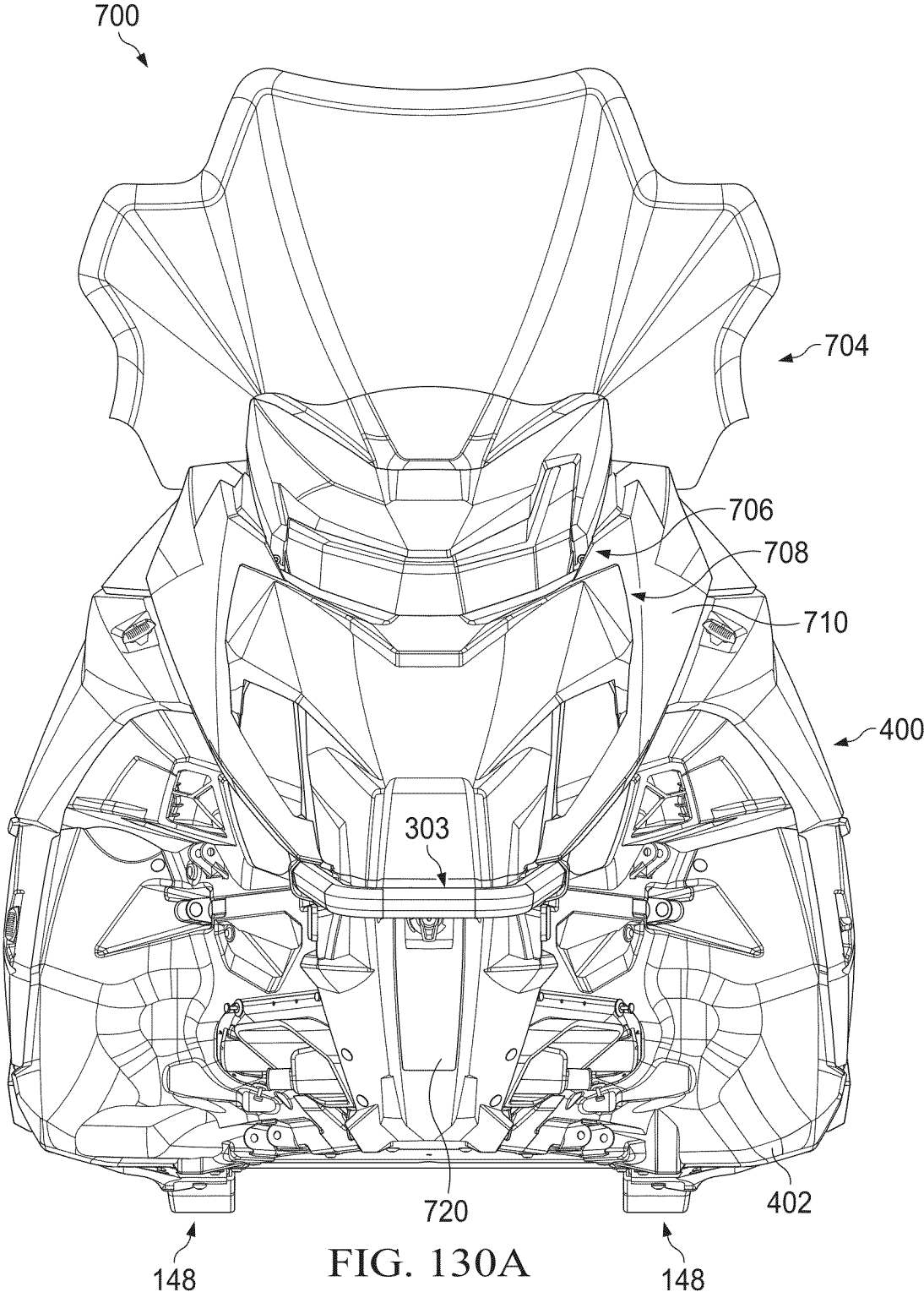


FIG. 129B



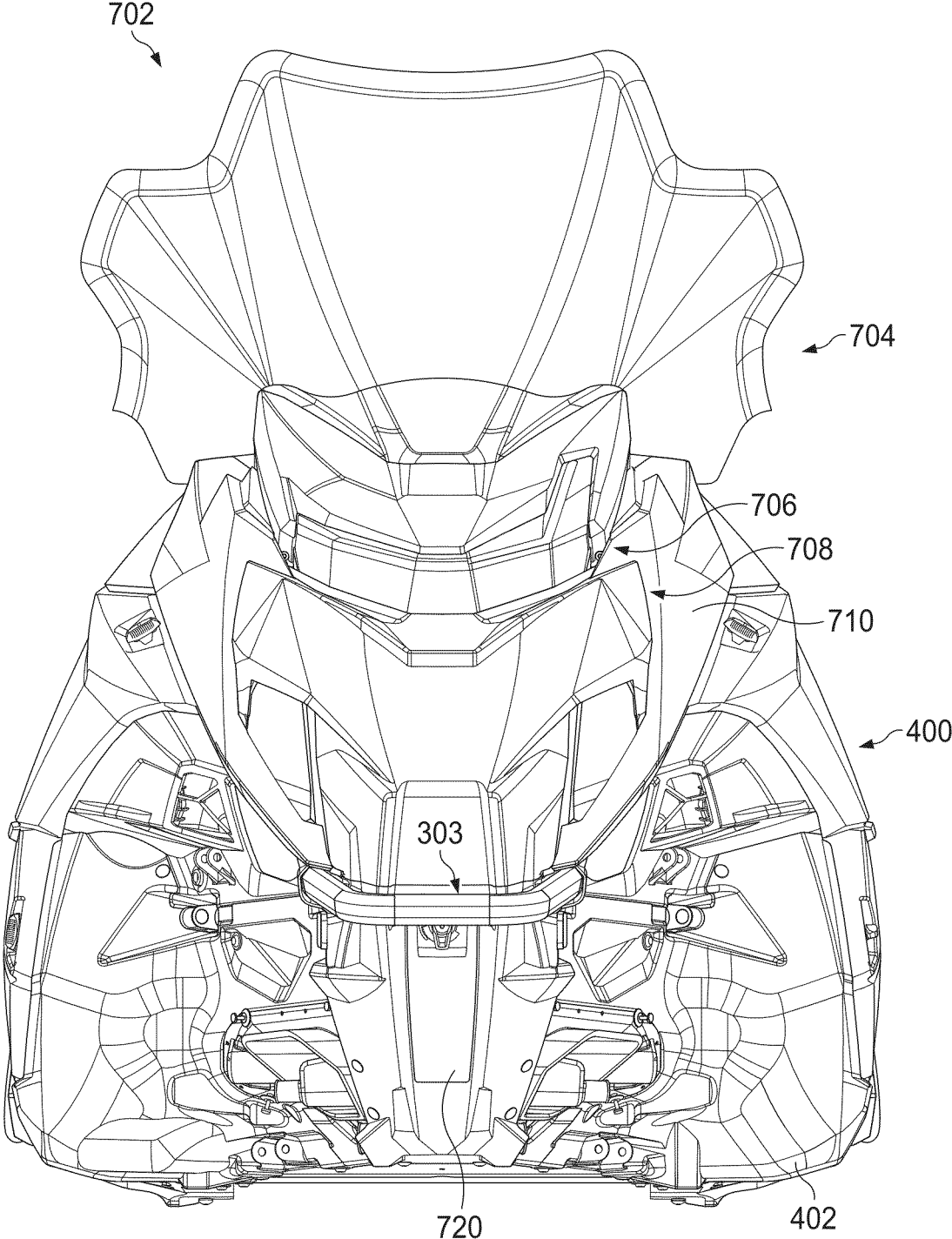


FIG. 130B

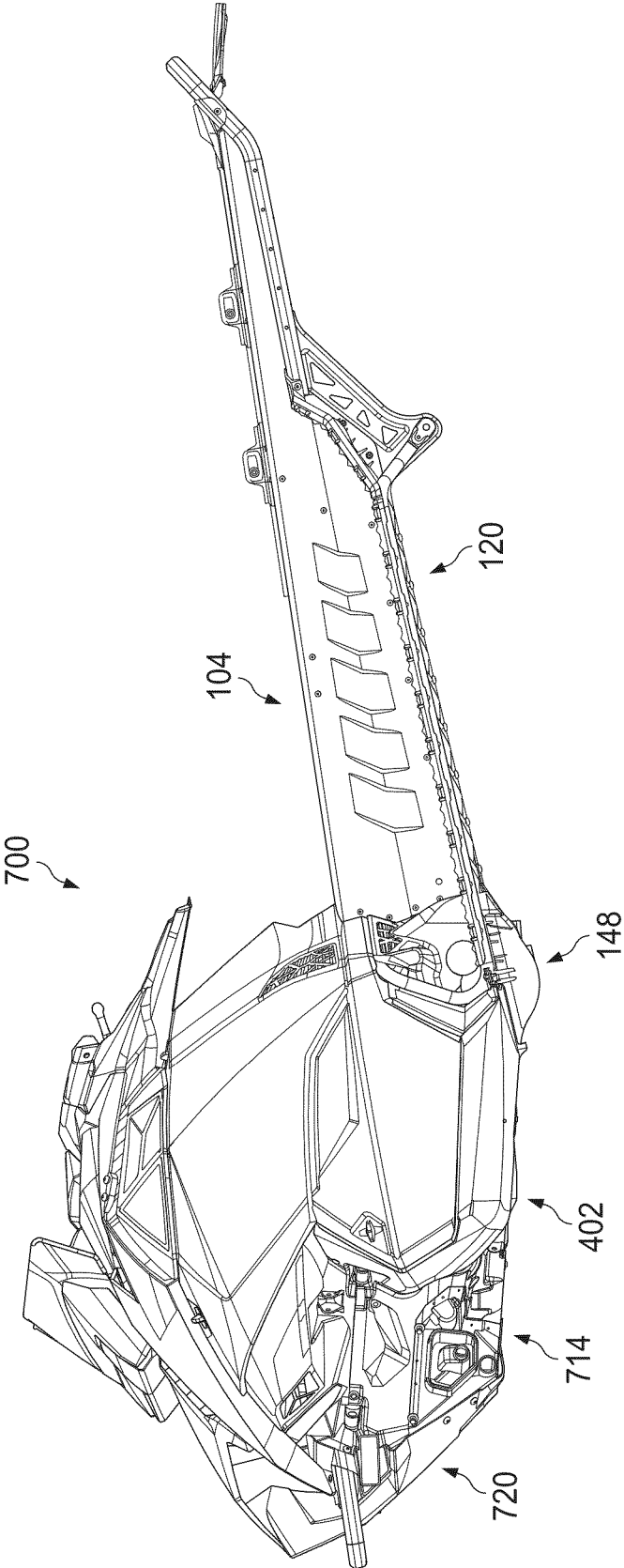


FIG. 131A

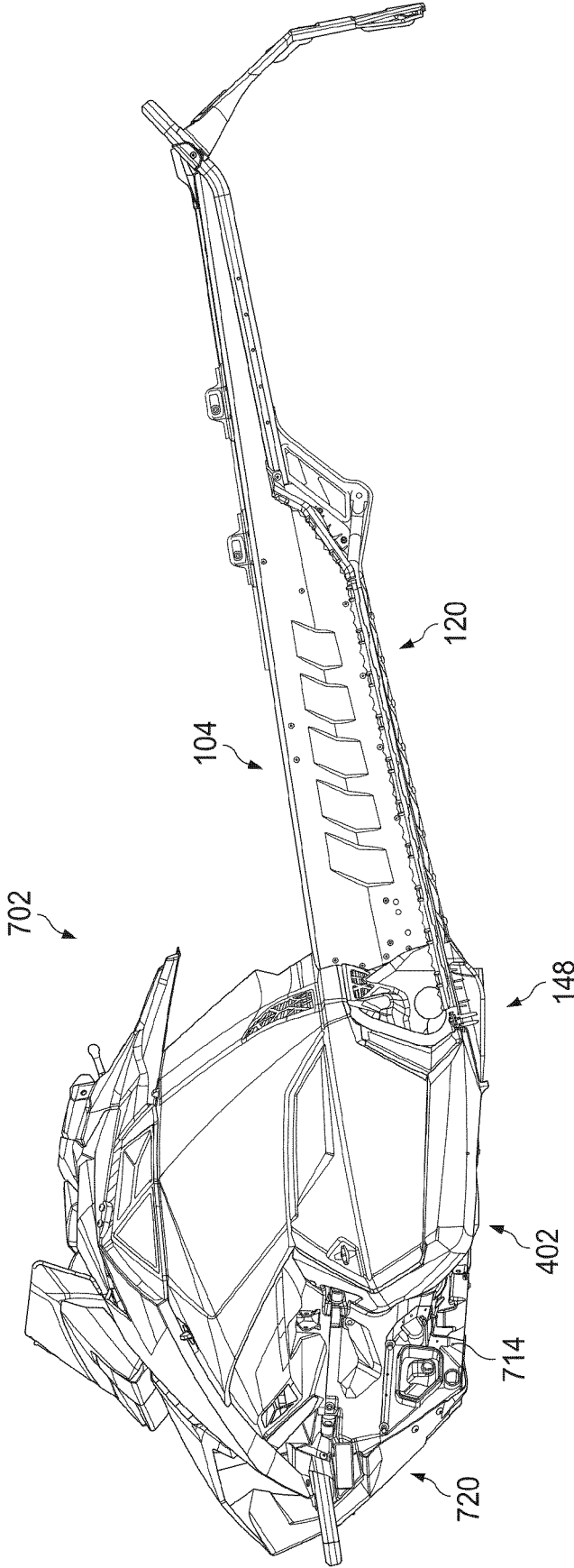


FIG. 131B

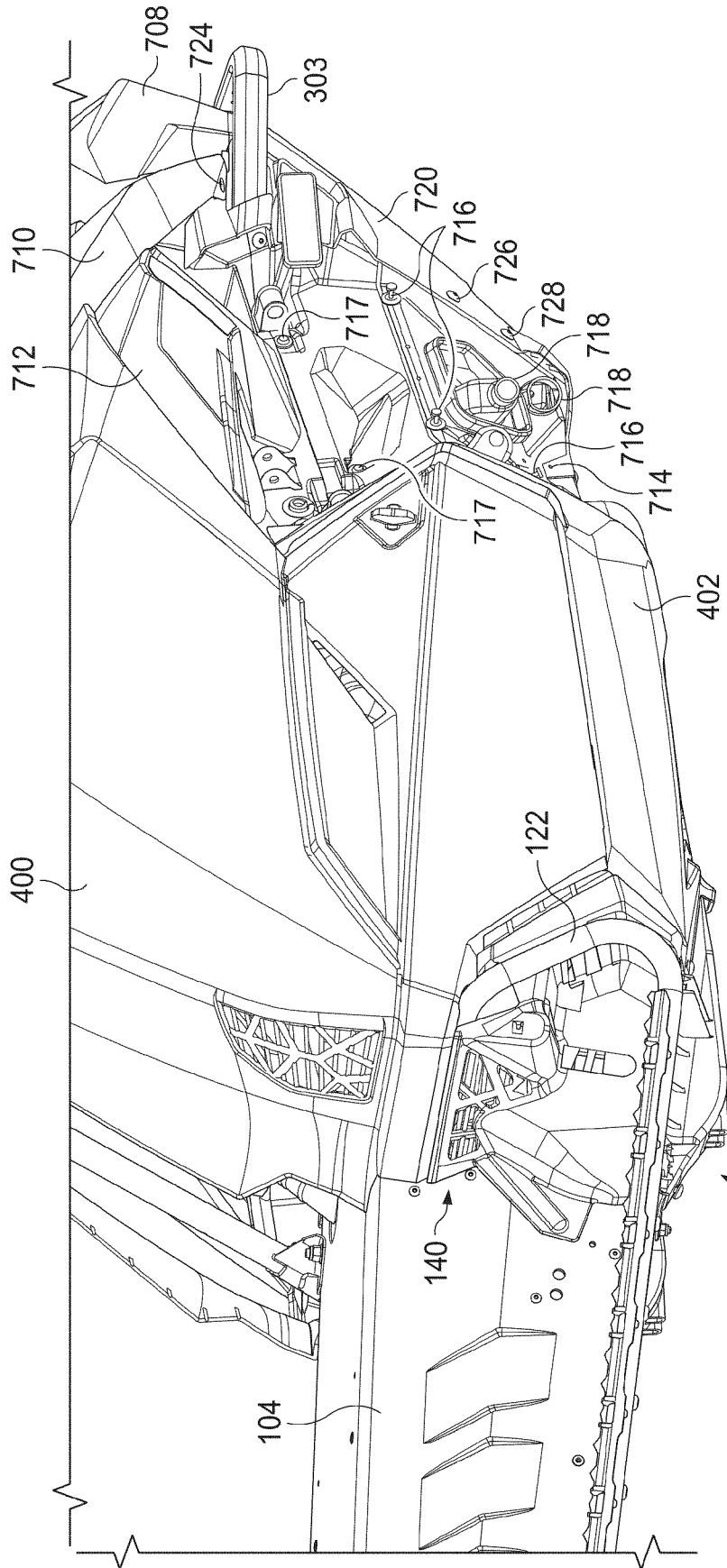


FIG. 132

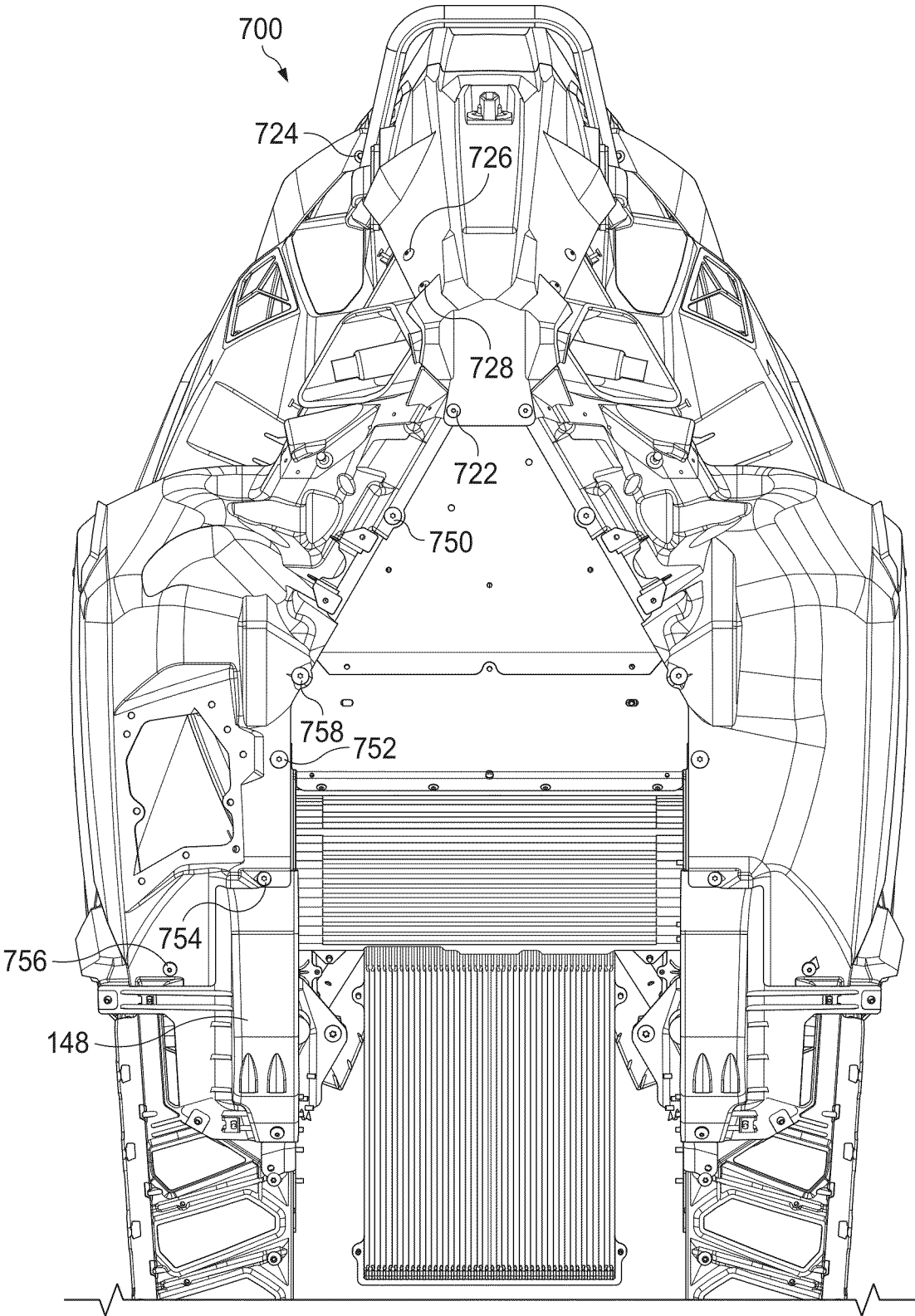


FIG. 133A

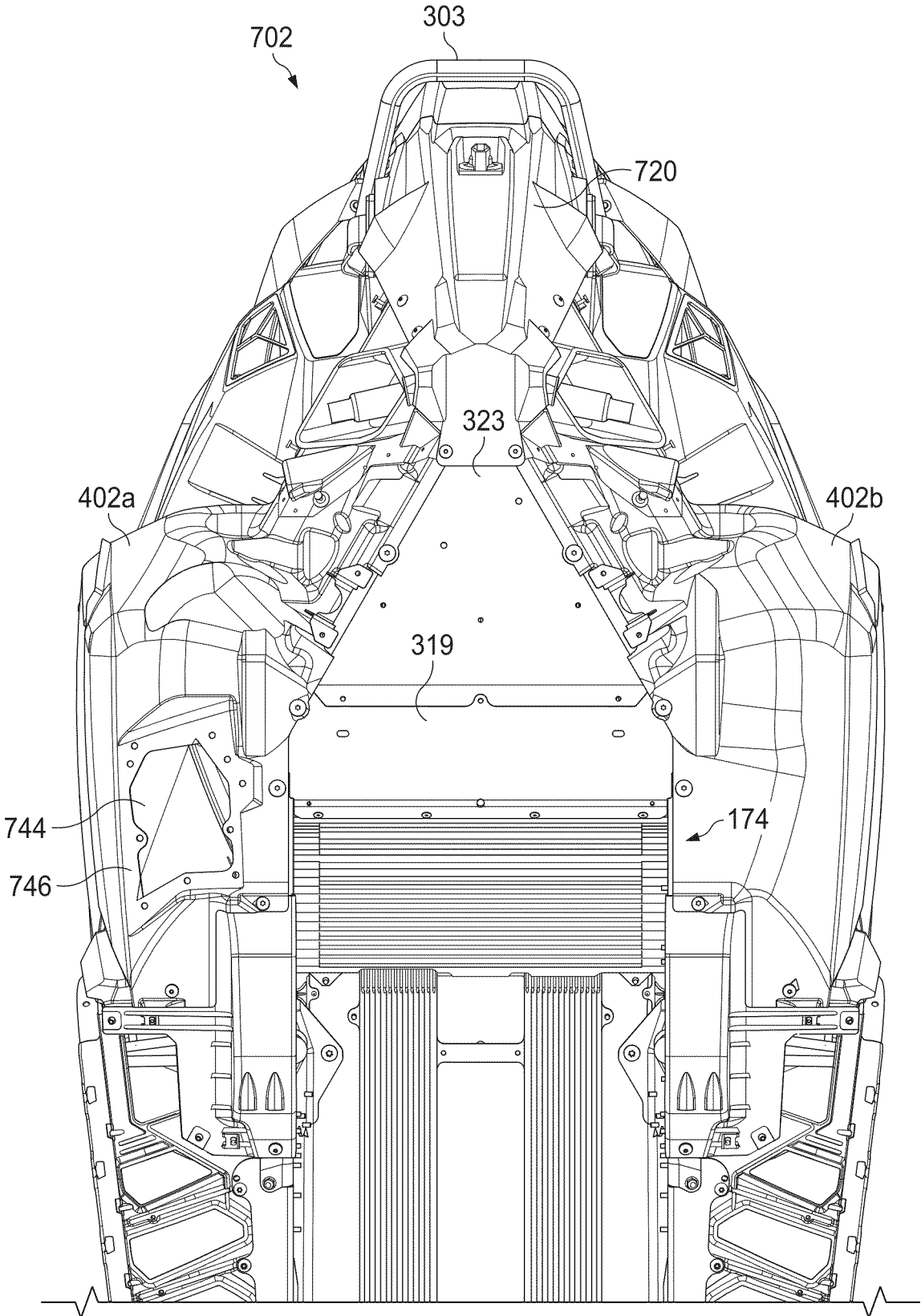


FIG. 133B

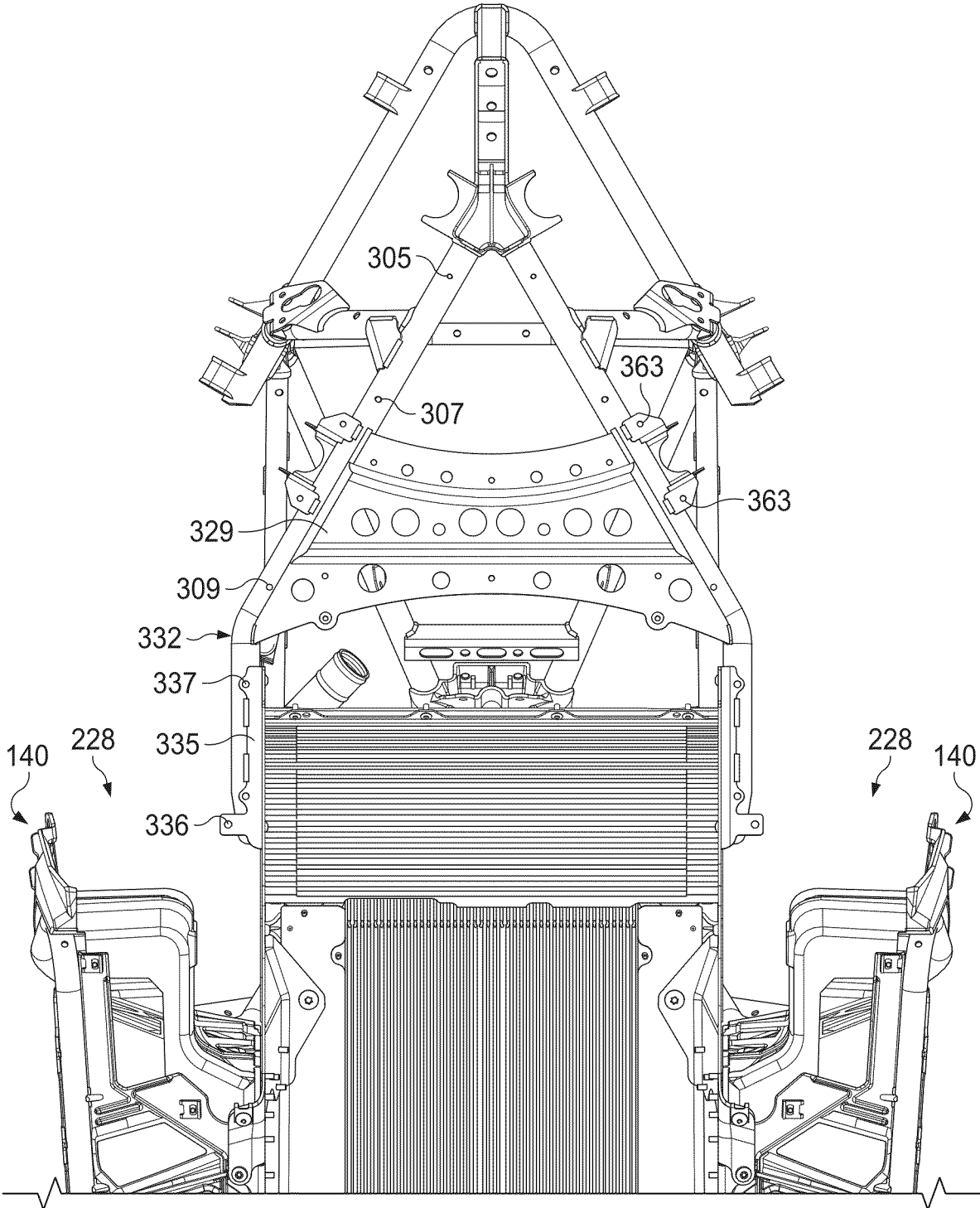


FIG. 134

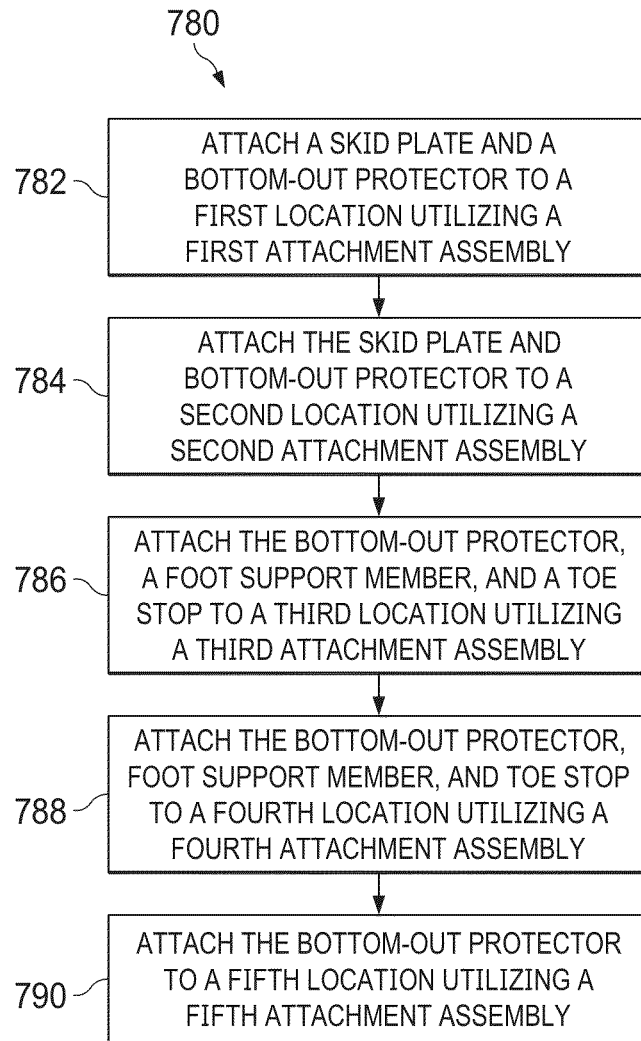


FIG. 135

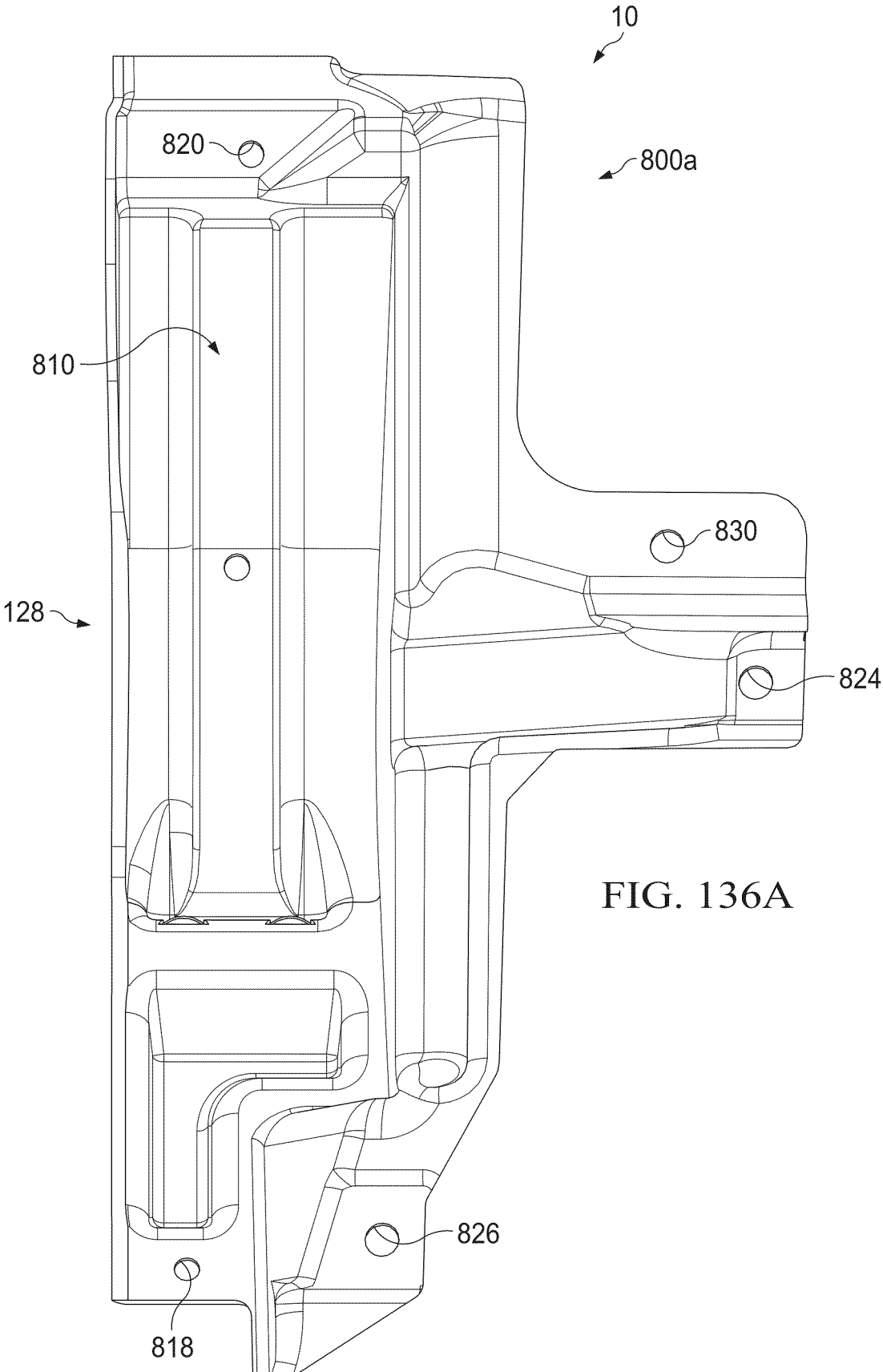


FIG. 136A

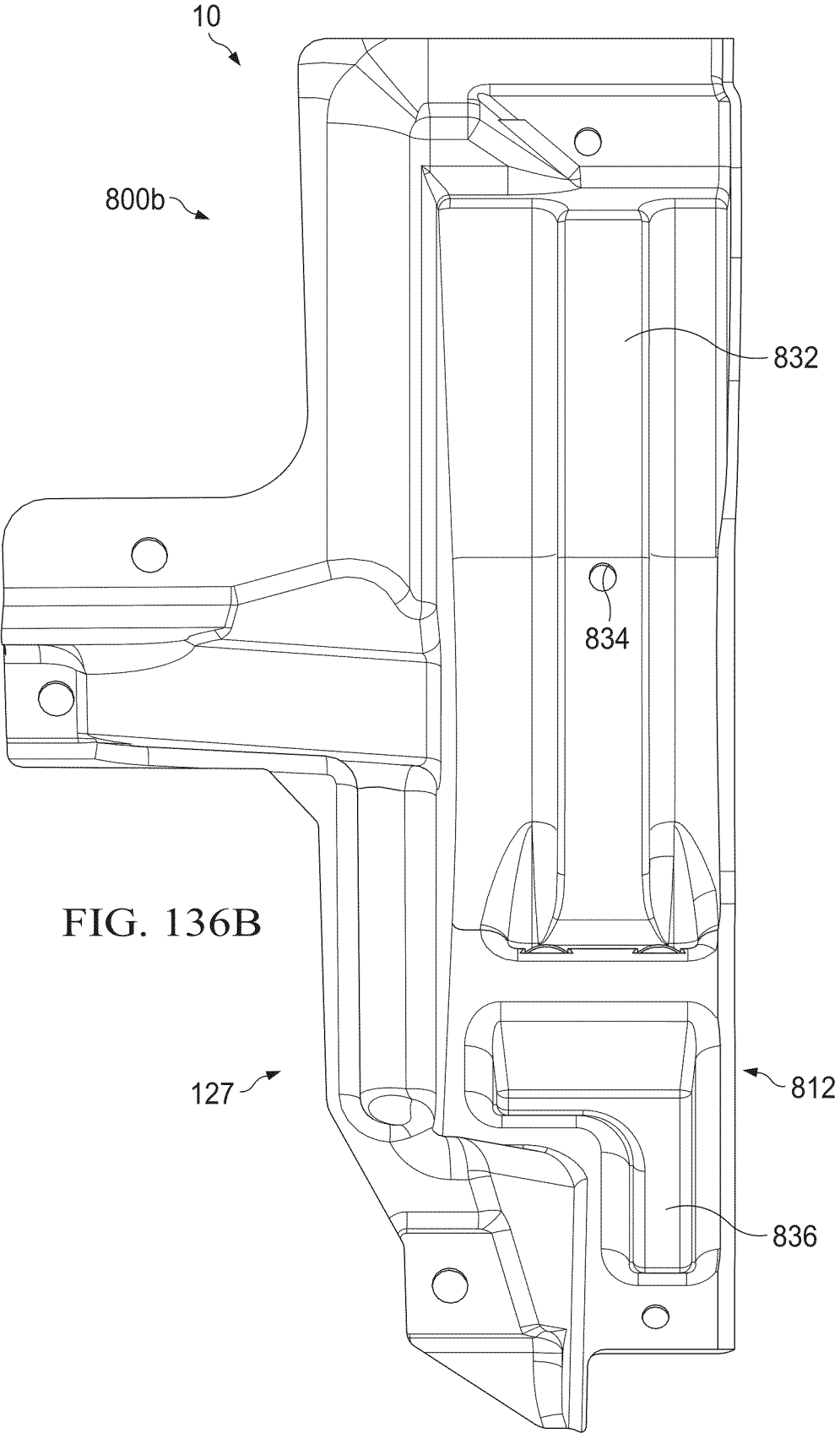


FIG. 136B

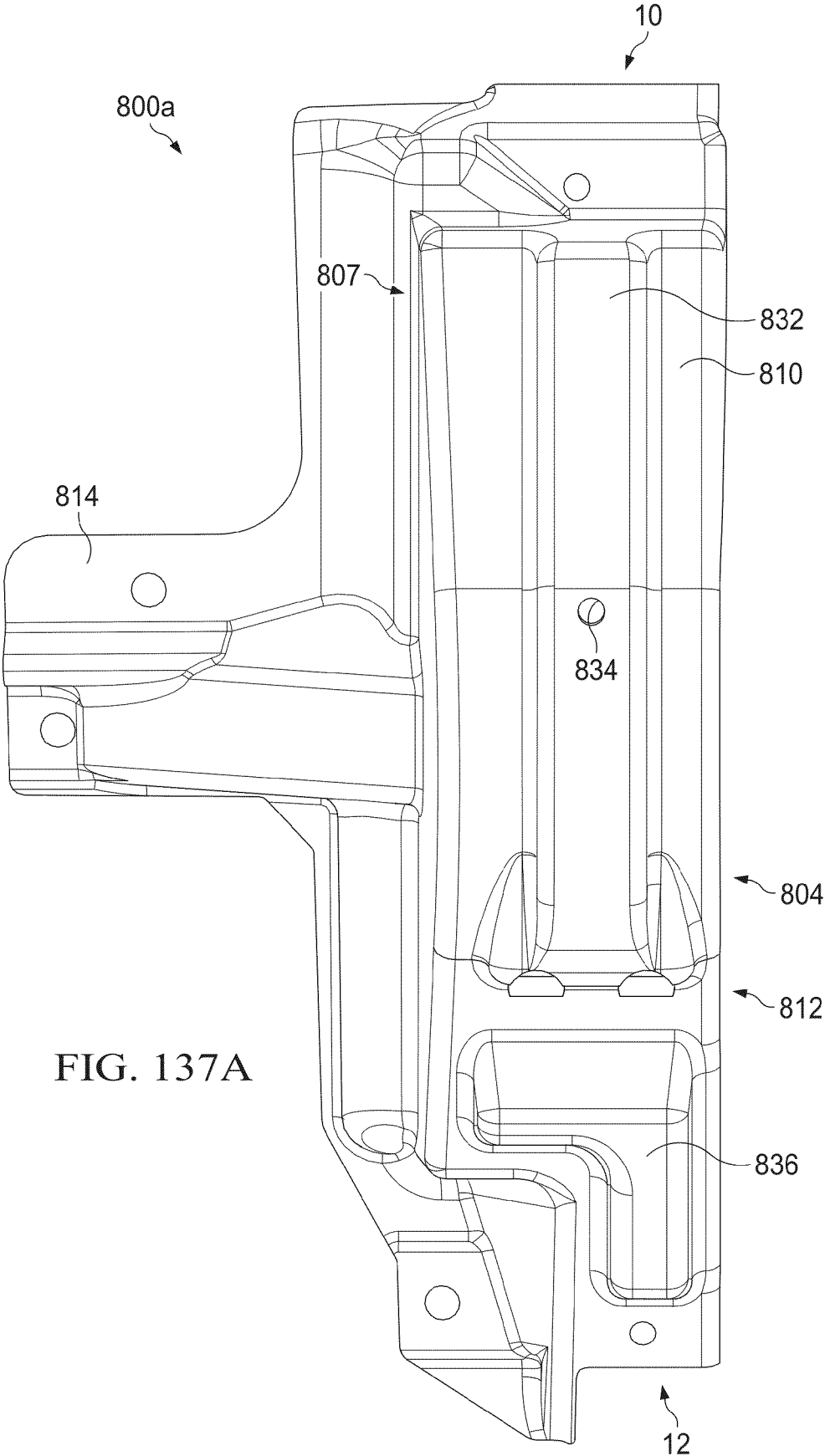


FIG. 137A

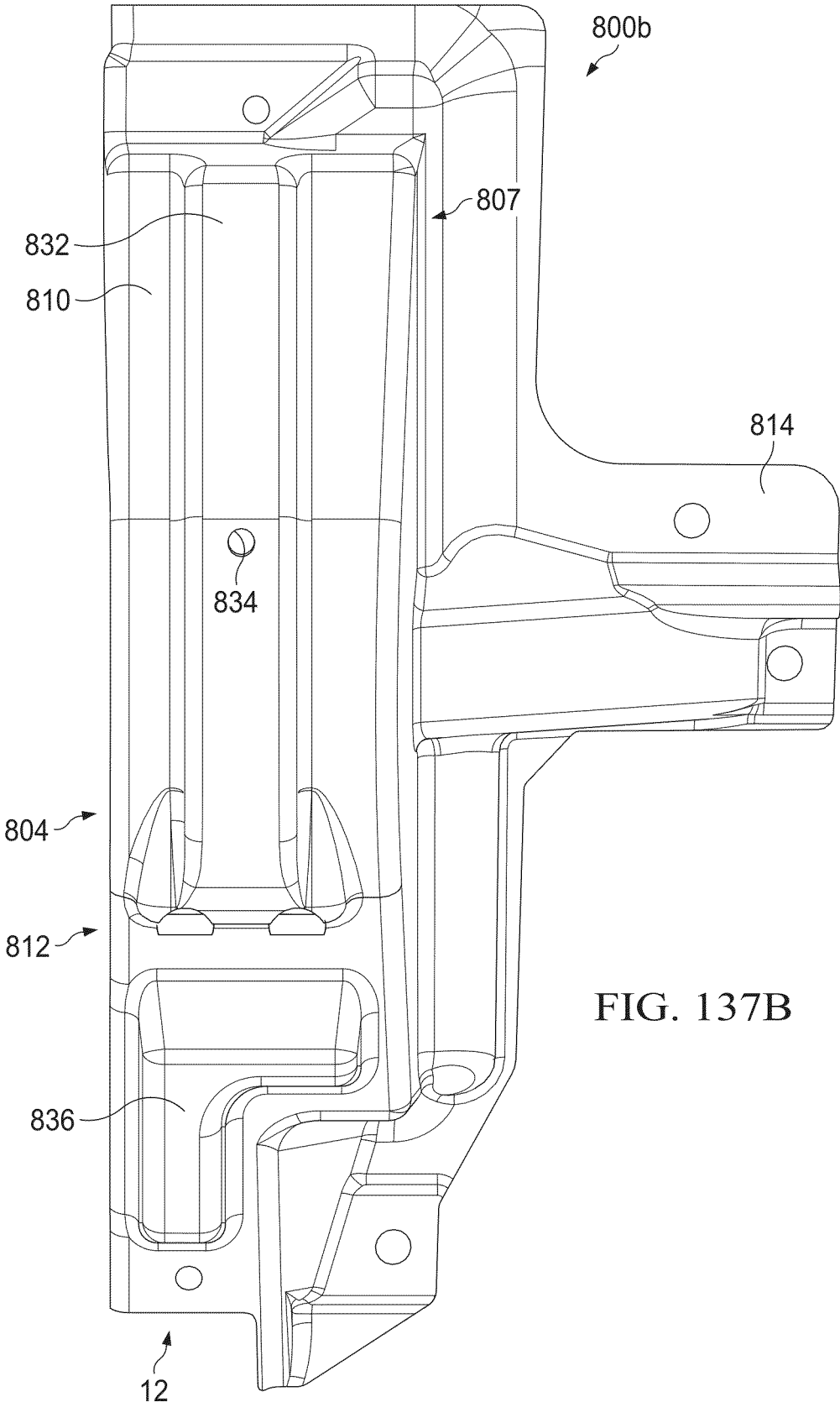


FIG. 137B

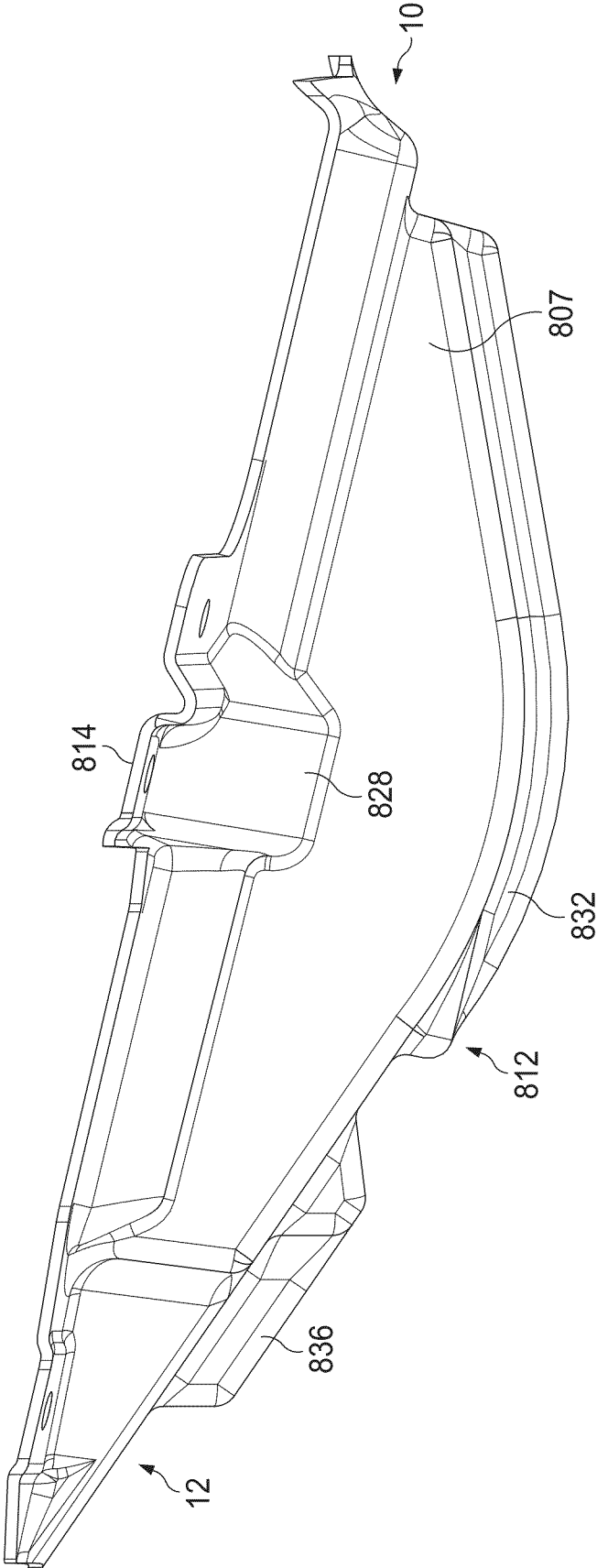


FIG. 138A

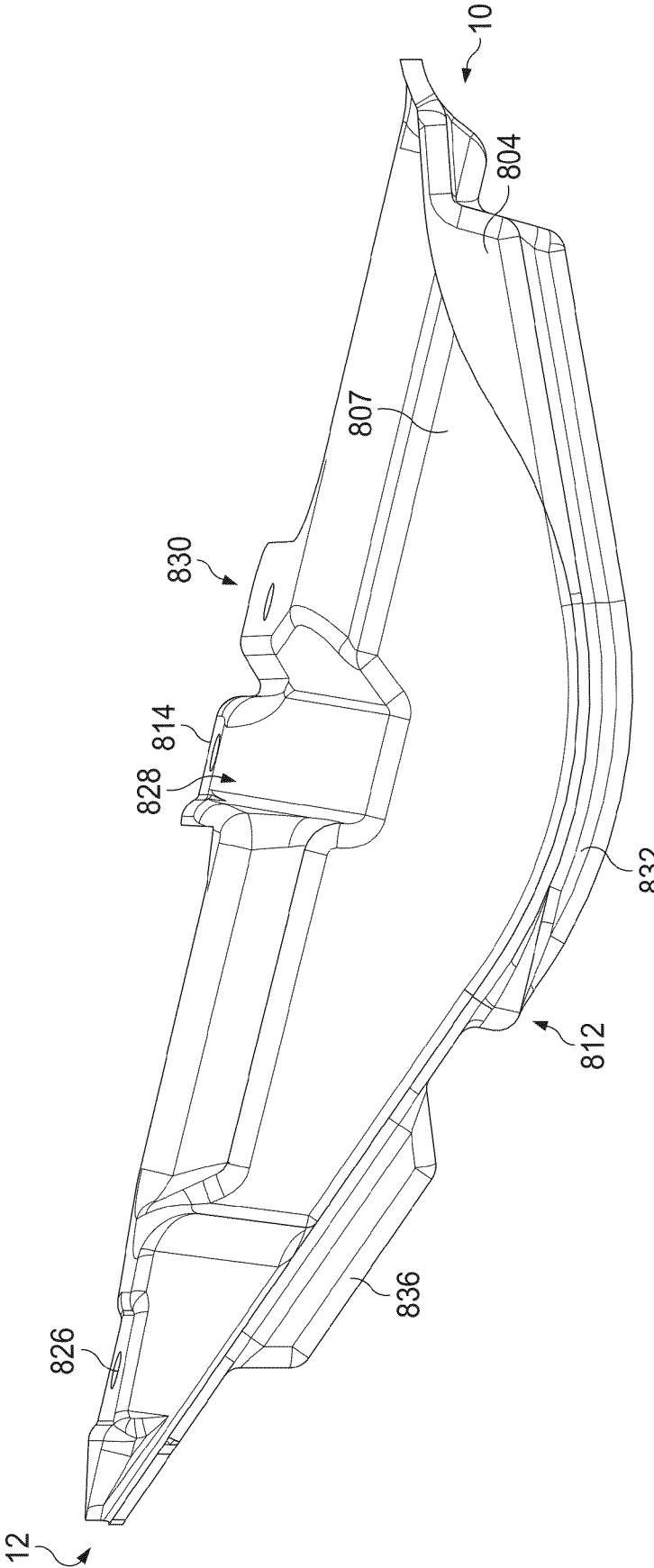
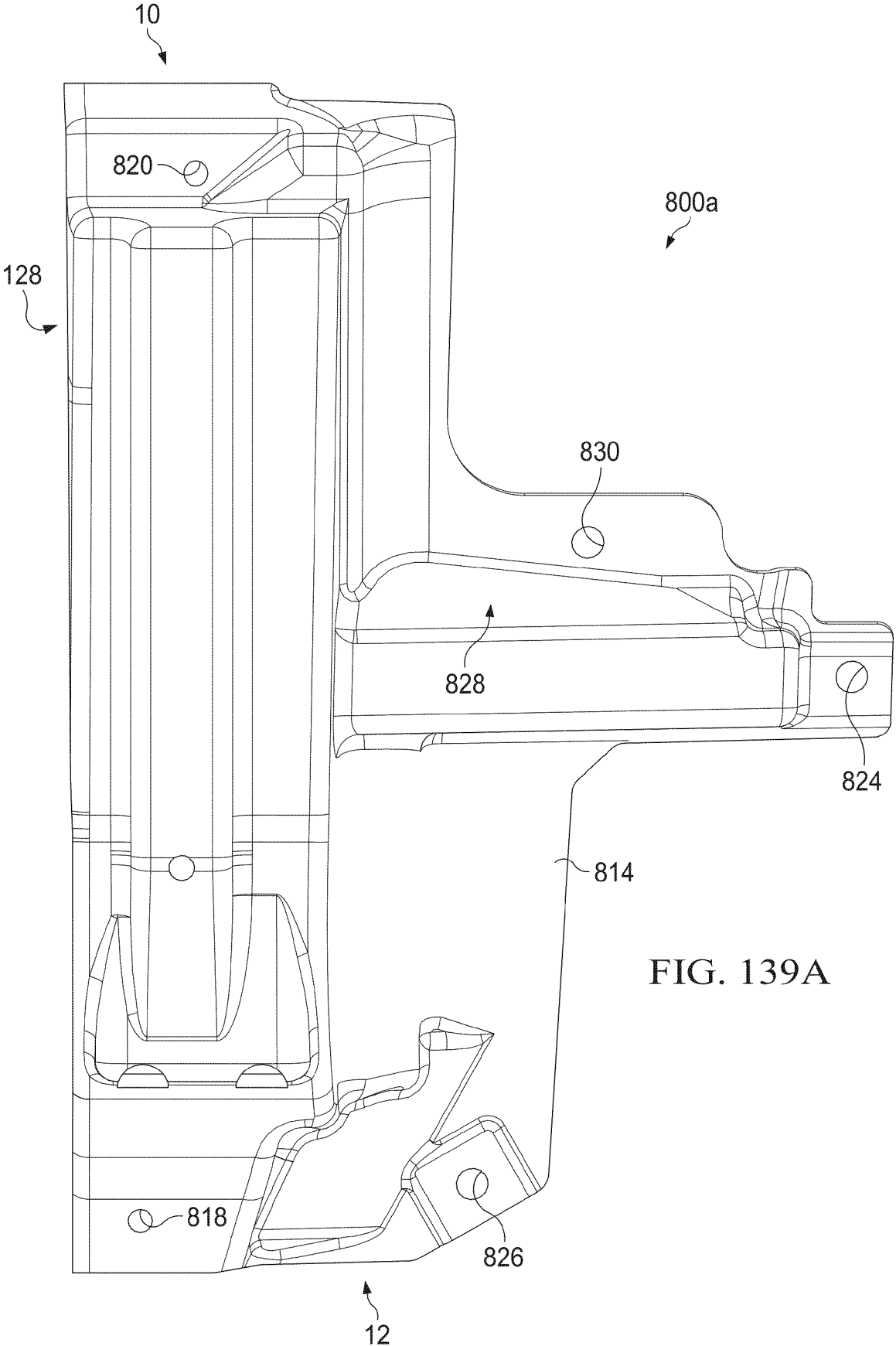


FIG. 138B



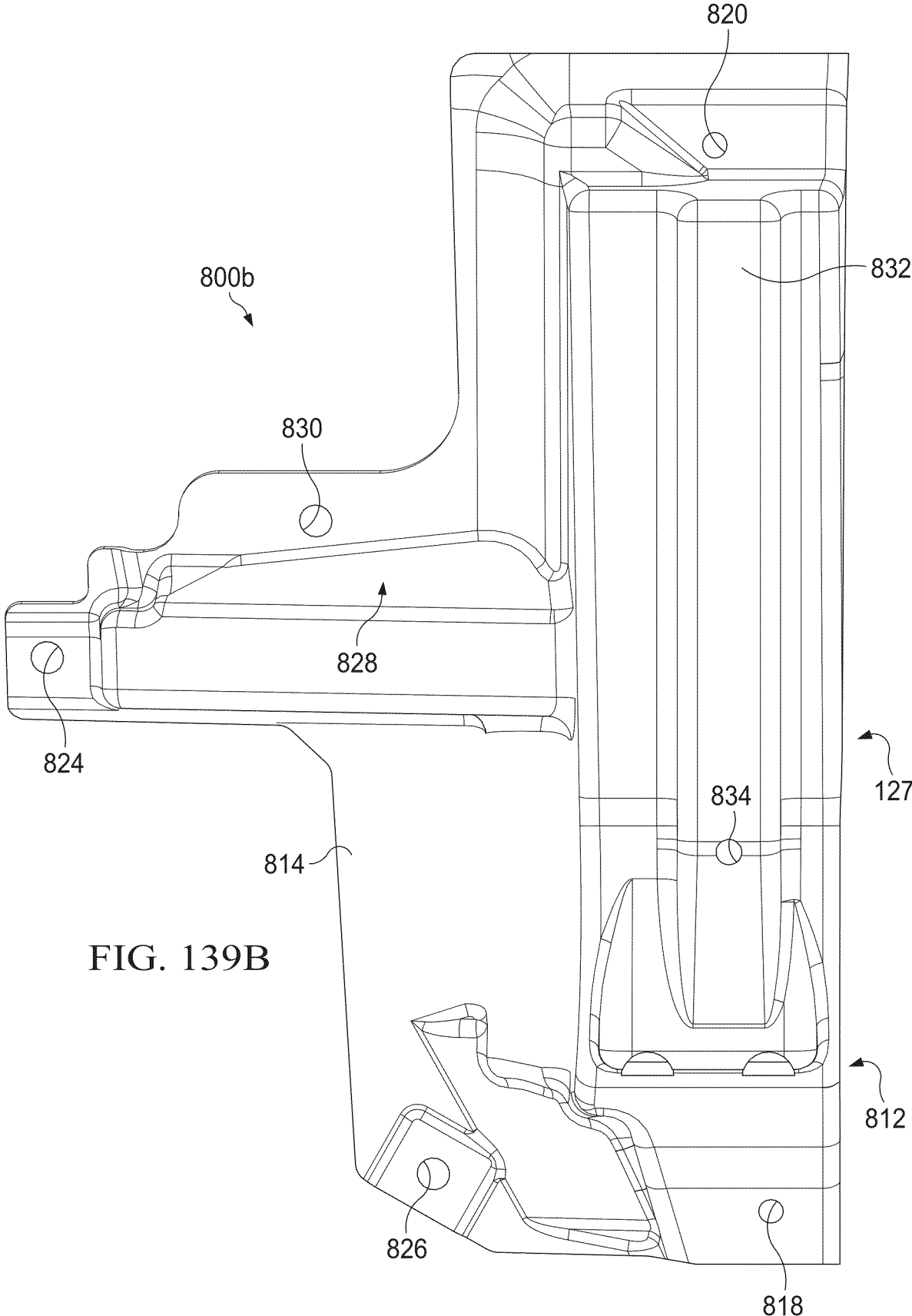


FIG. 139B

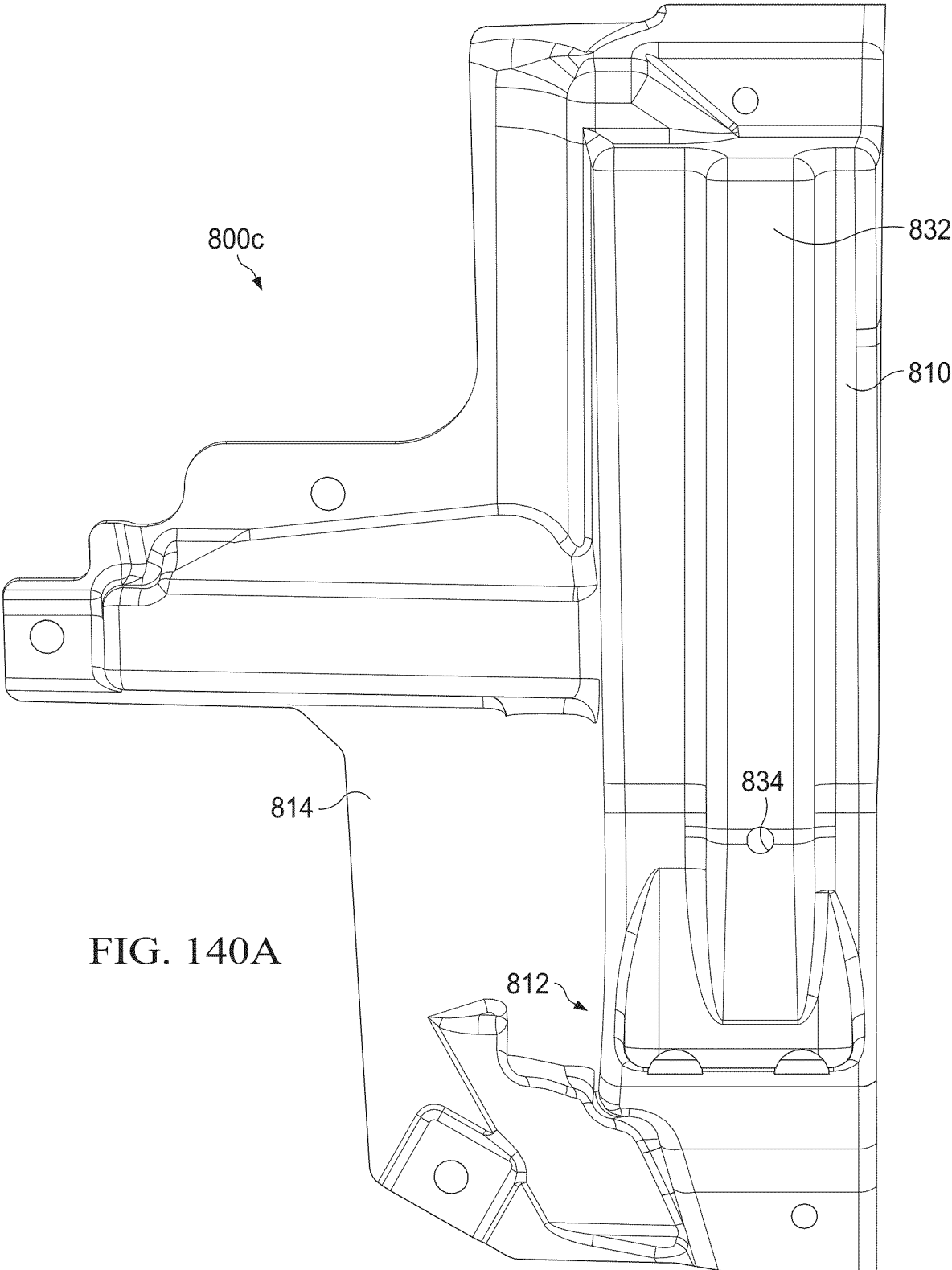
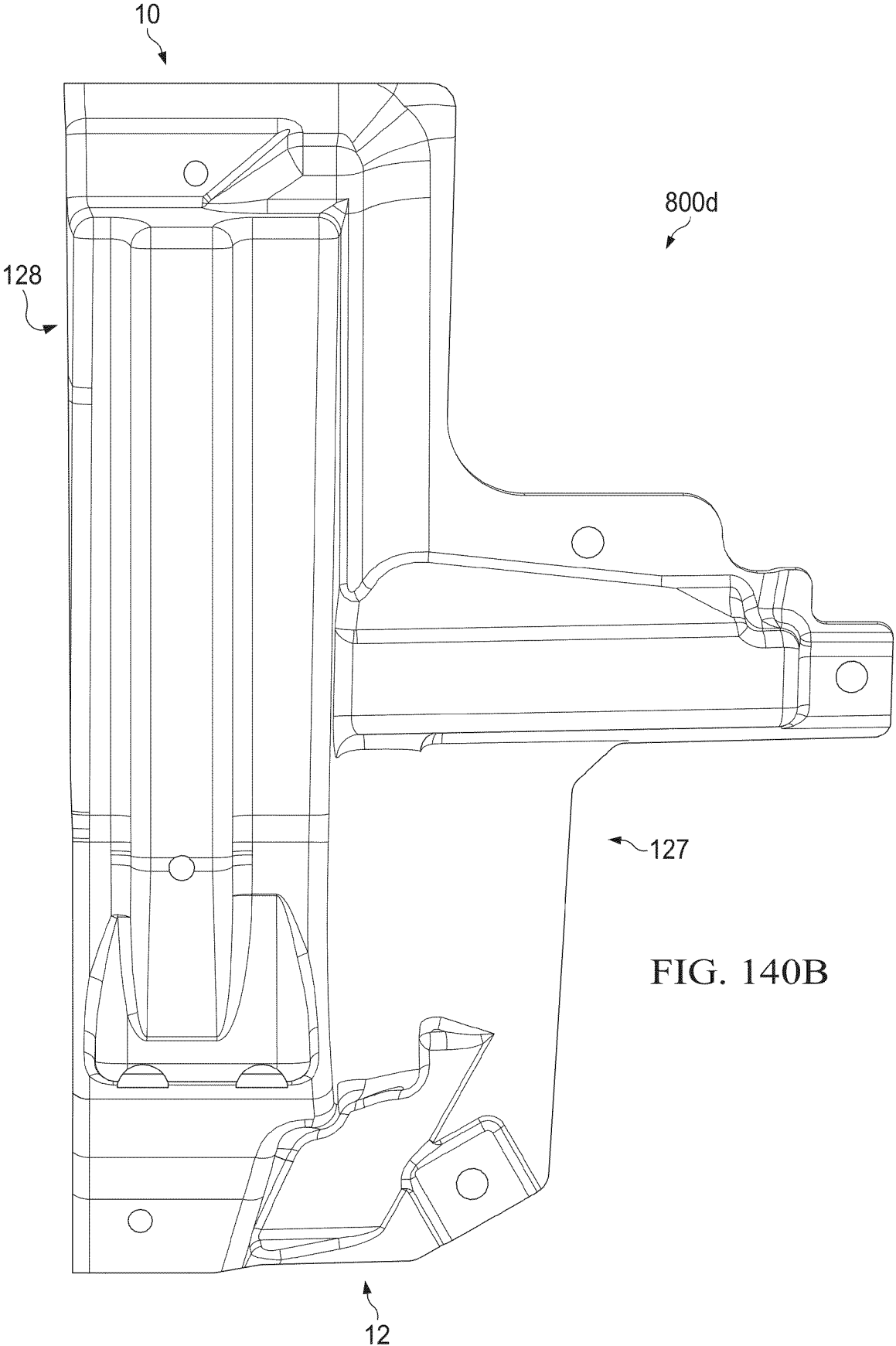


FIG. 140A



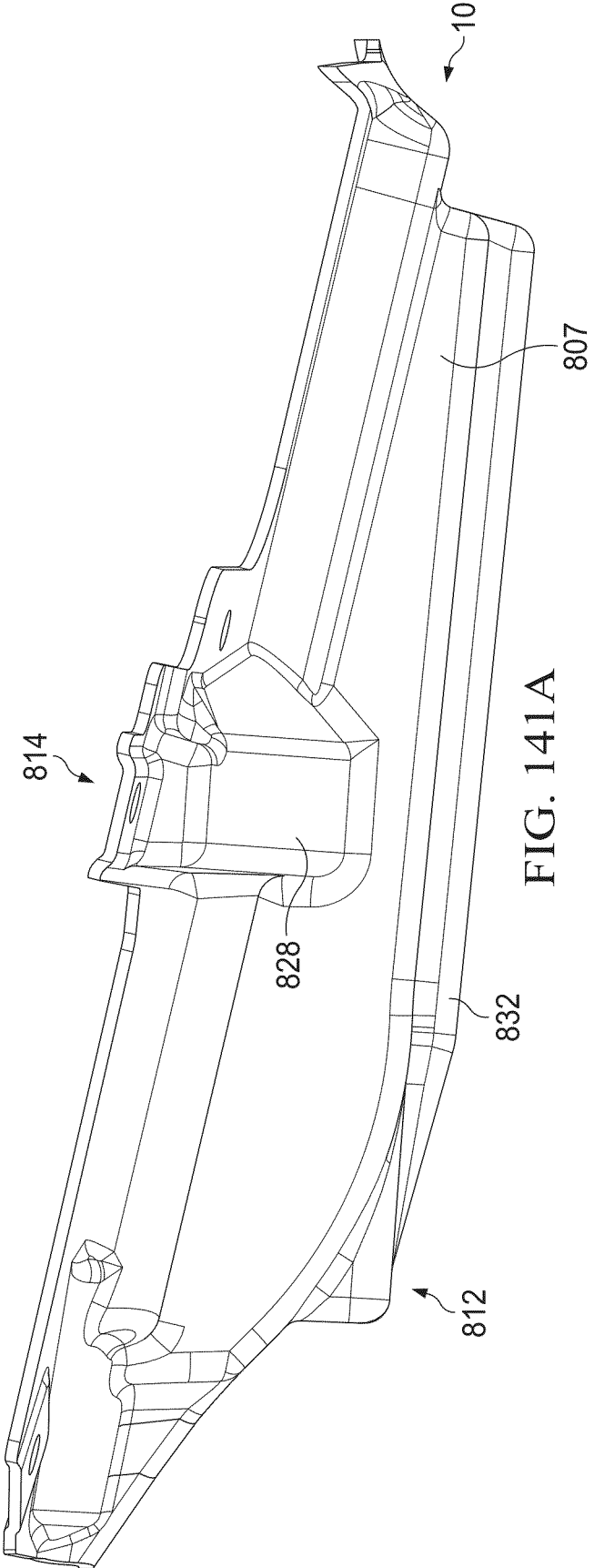


FIG. 141A

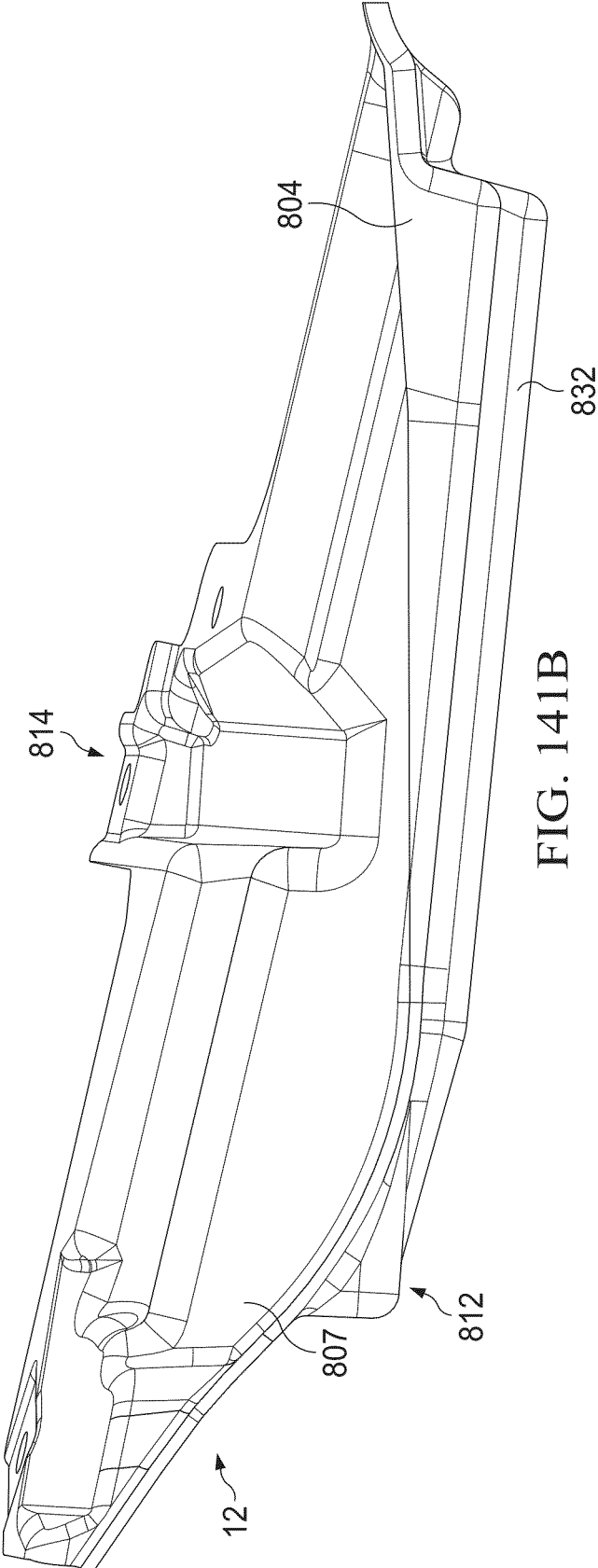
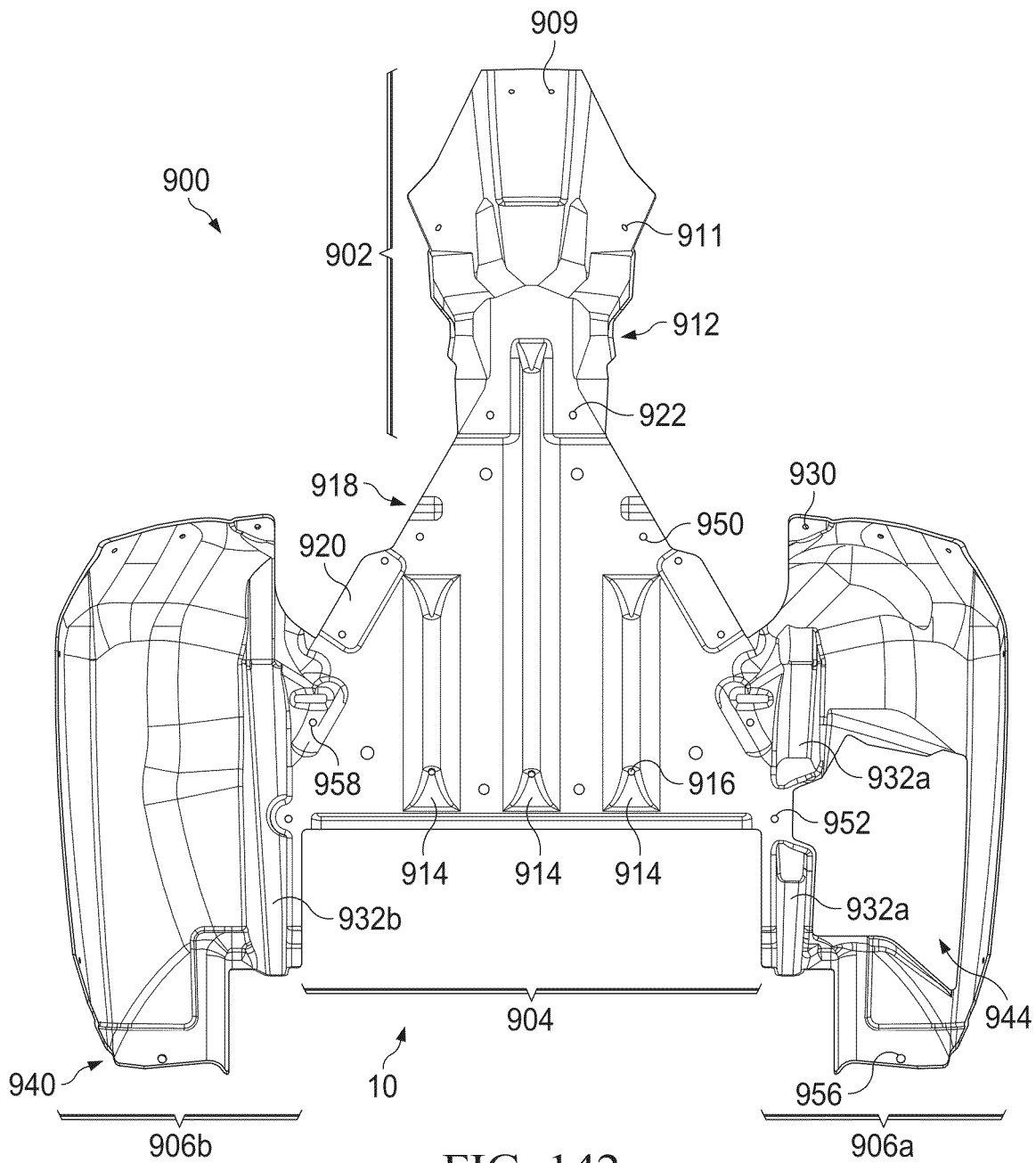


FIG. 141B



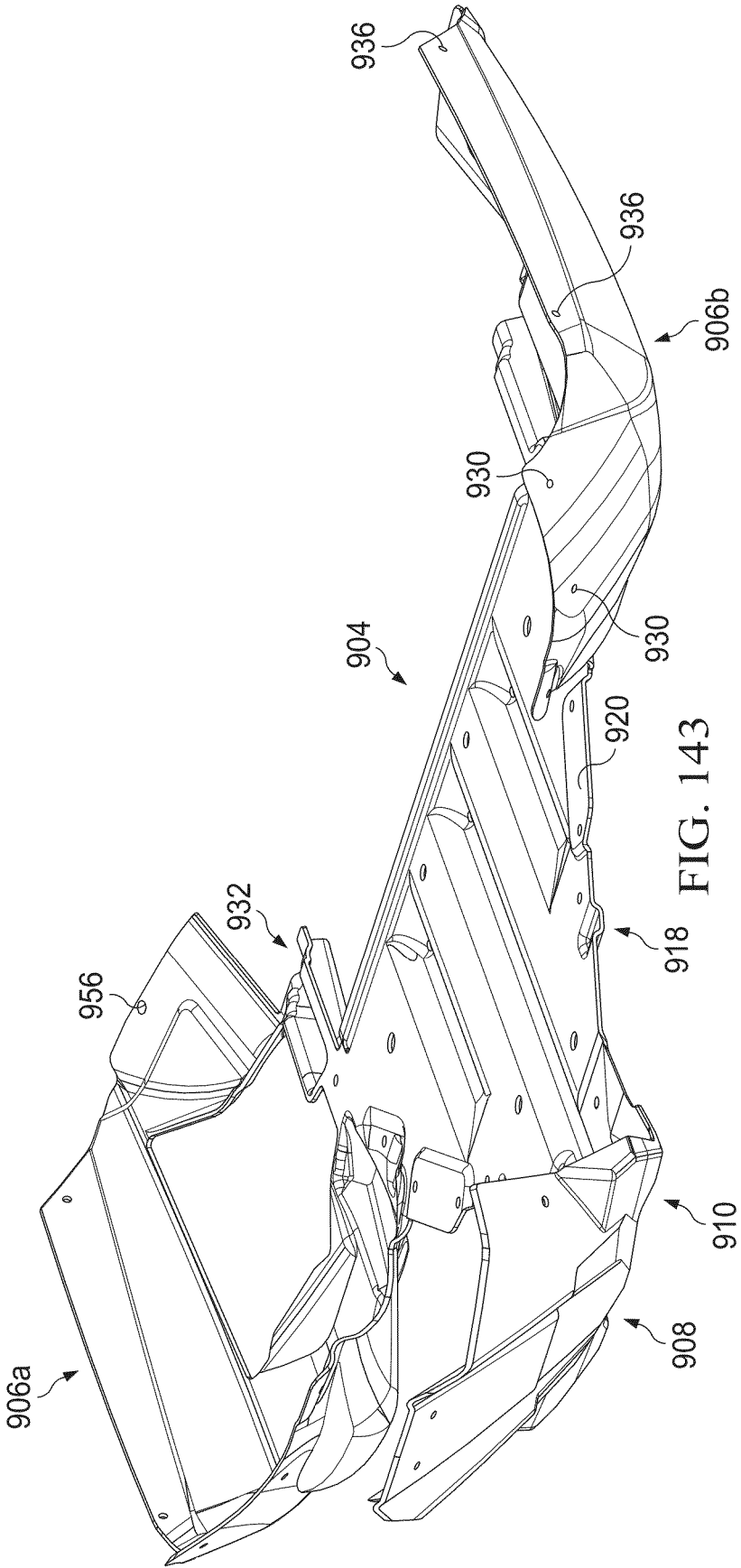


FIG. 143

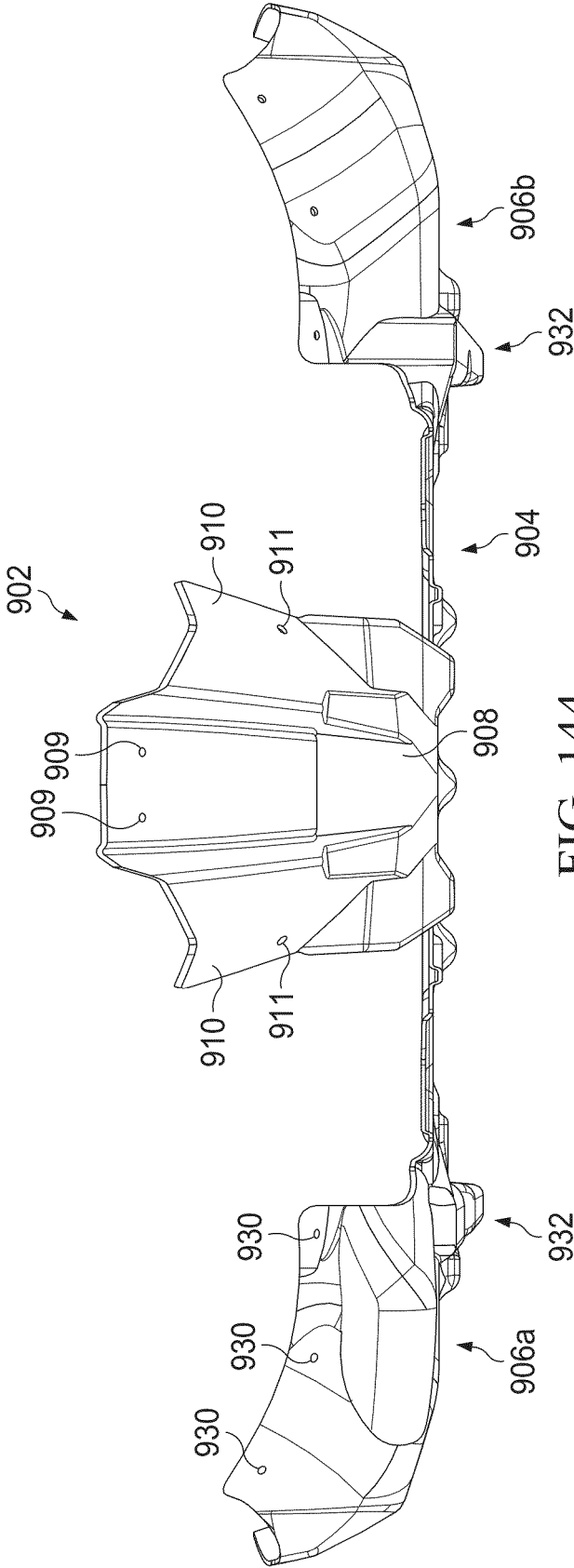


FIG. 144

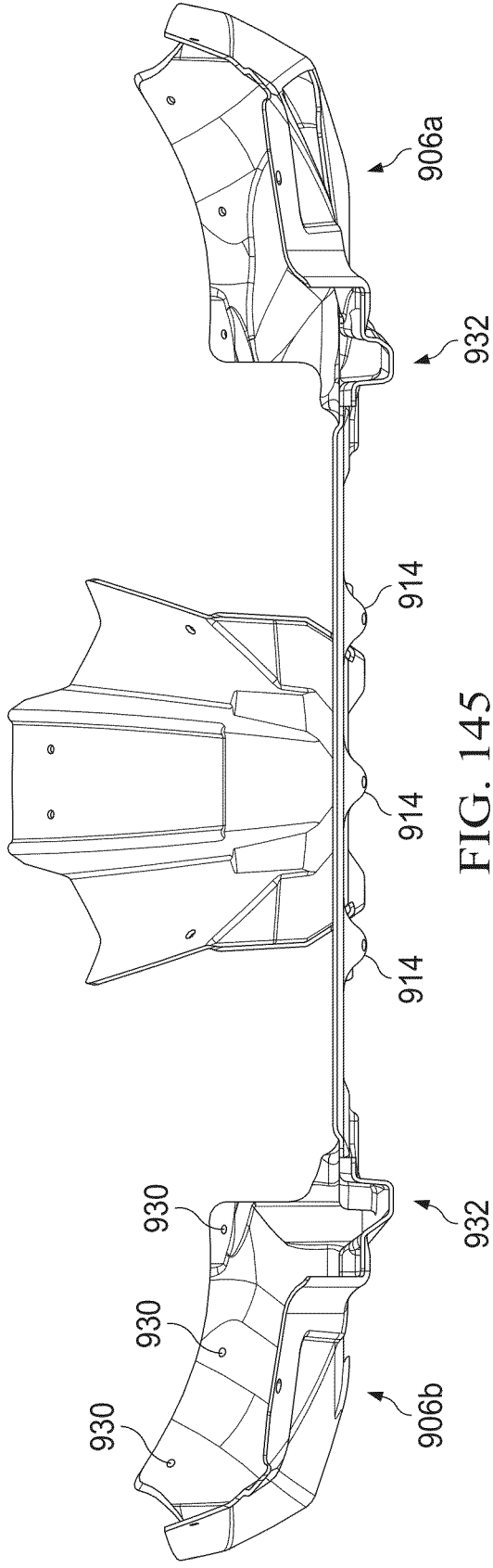


FIG. 145

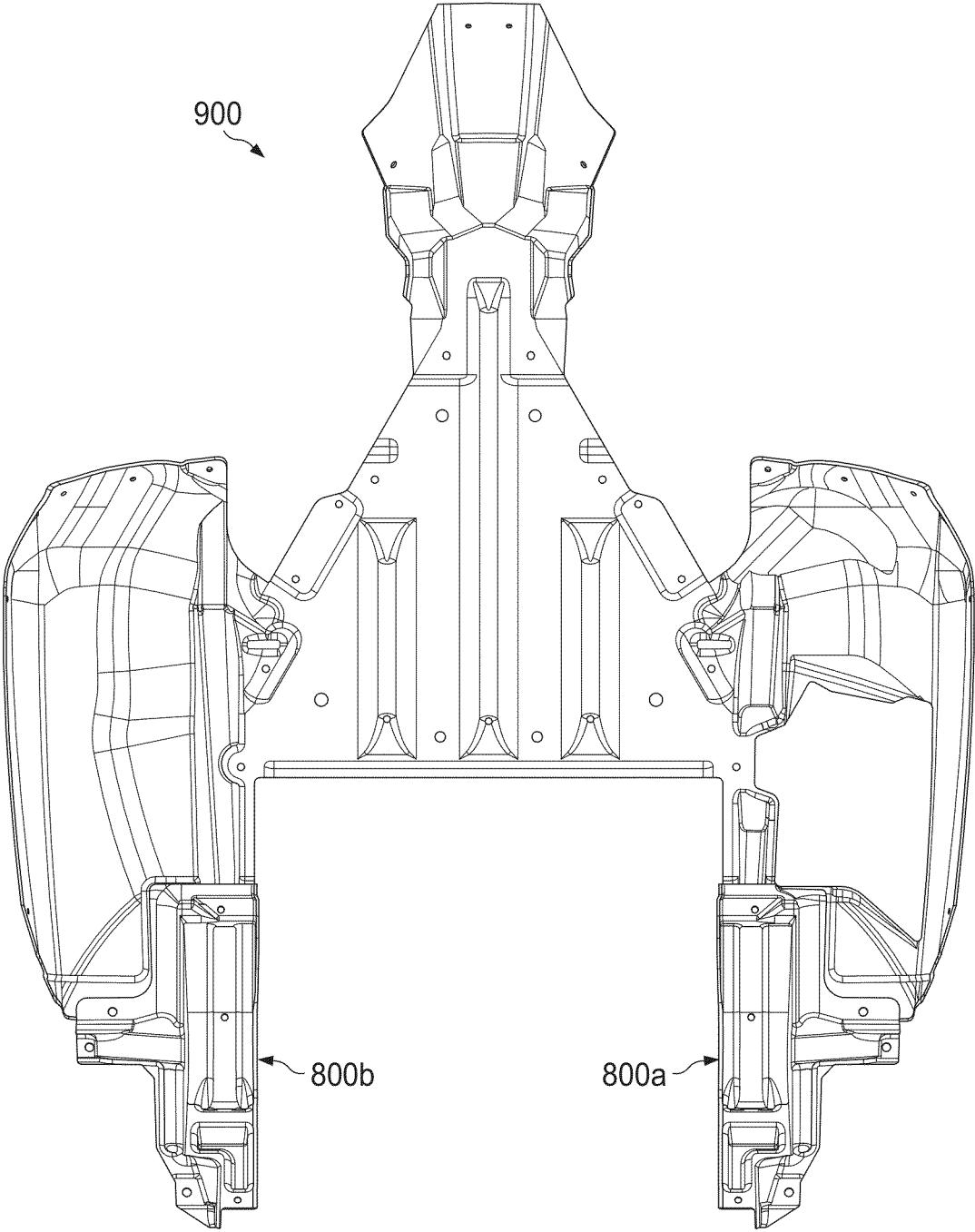


FIG. 146A

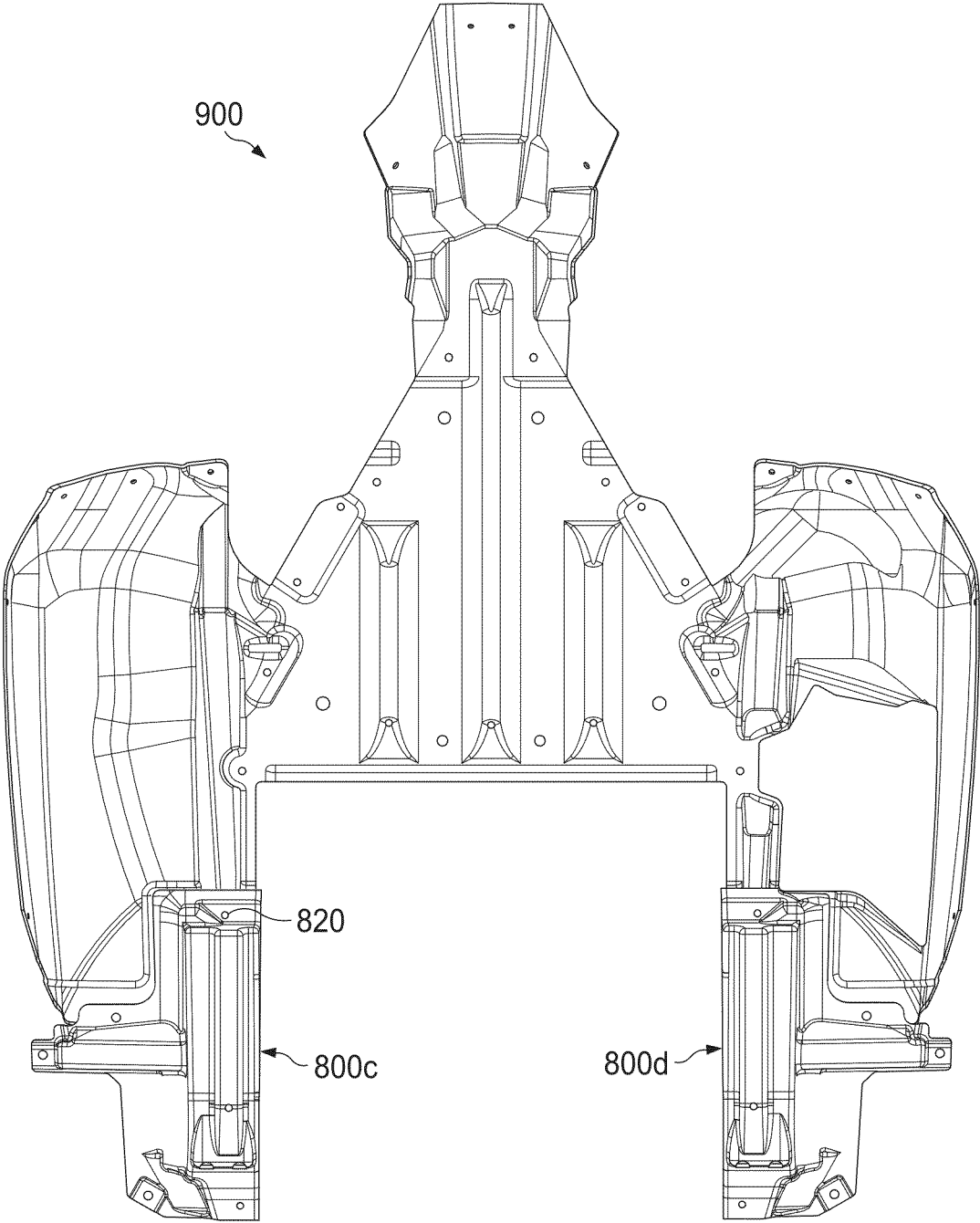


FIG. 146B

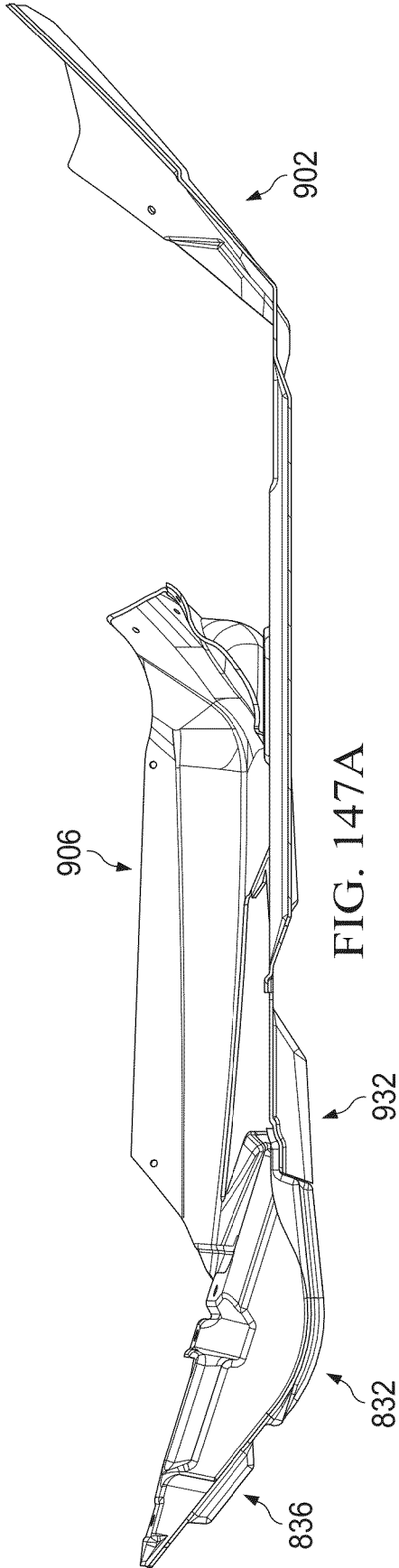


FIG. 147A

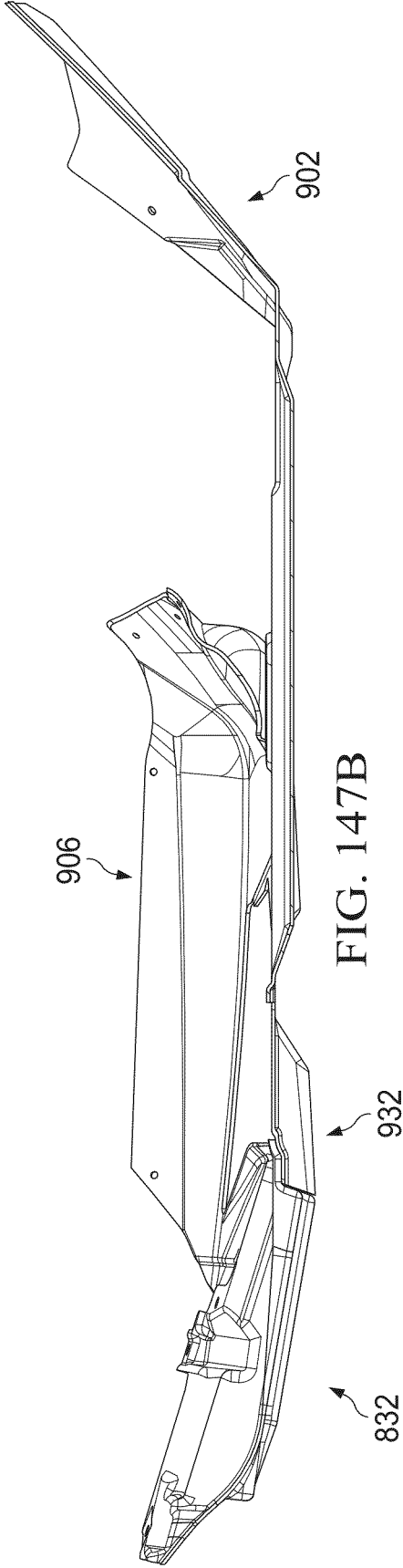


FIG. 147B

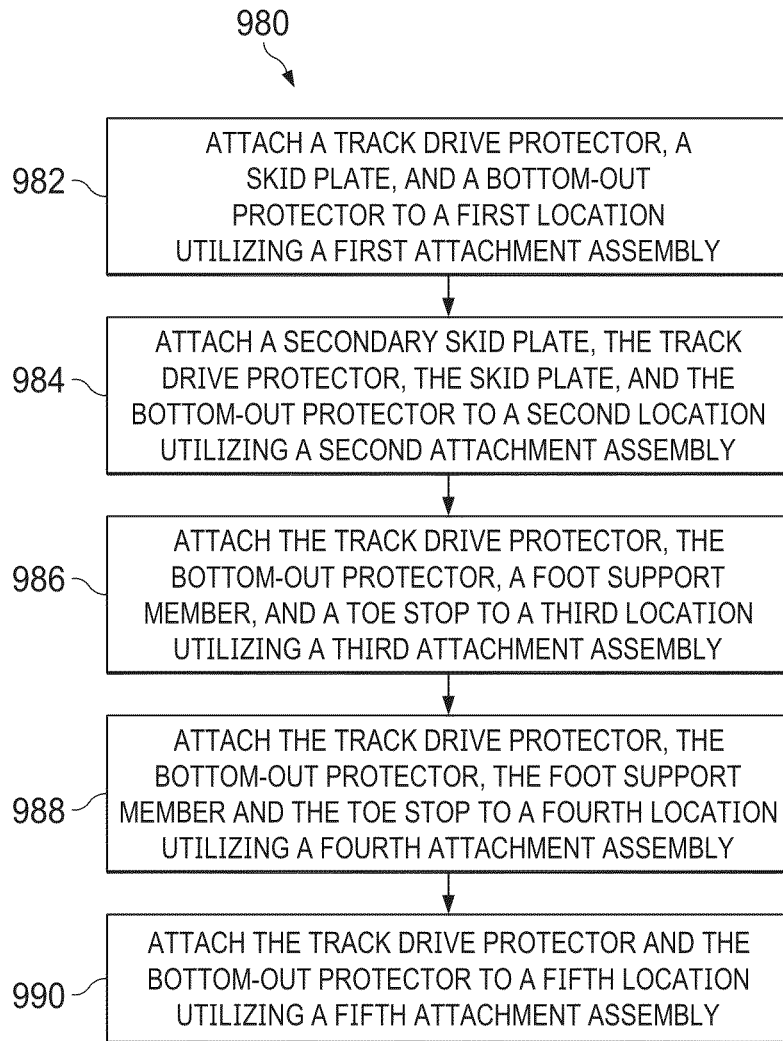


FIG. 148

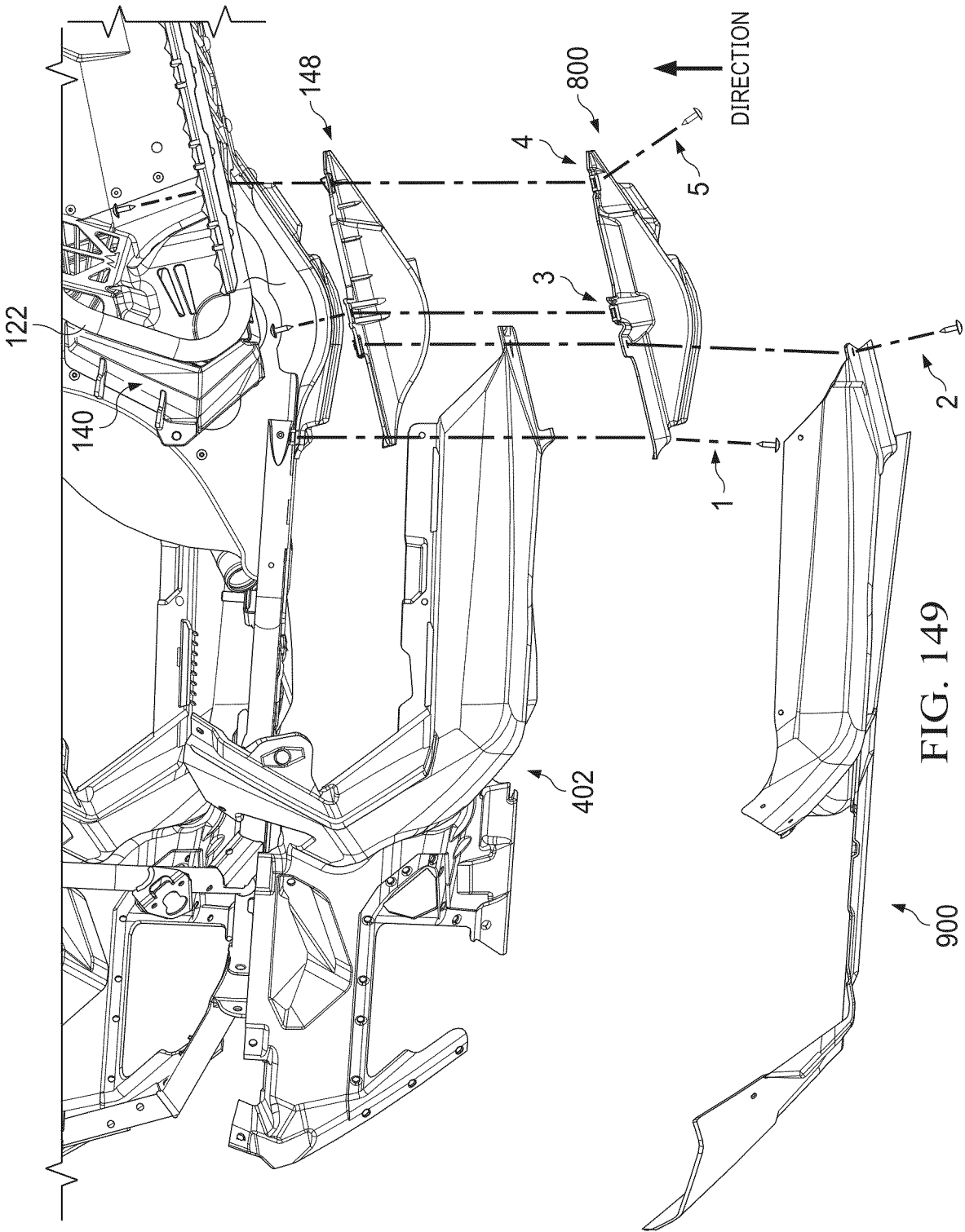


FIG. 149

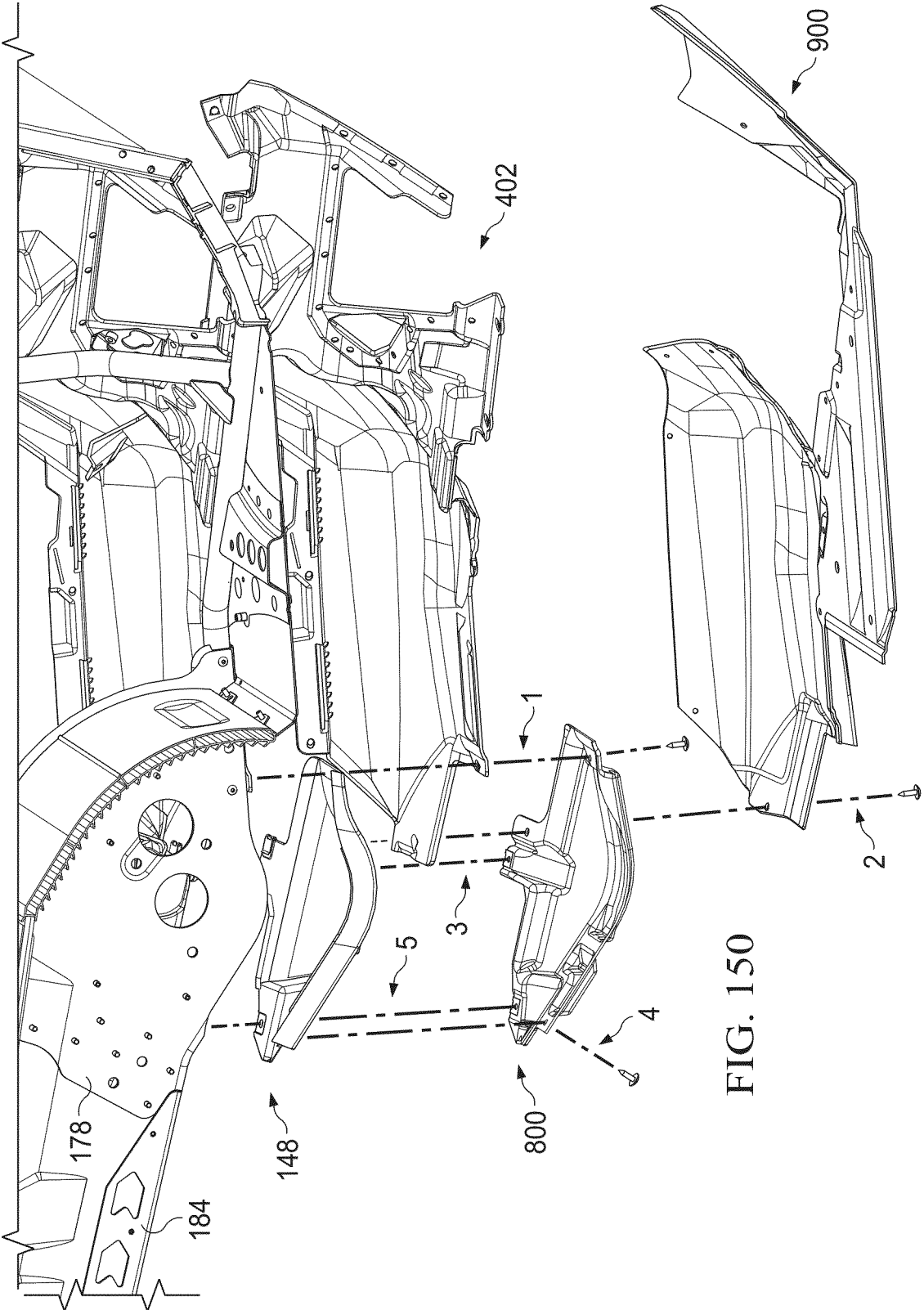


FIG. 150

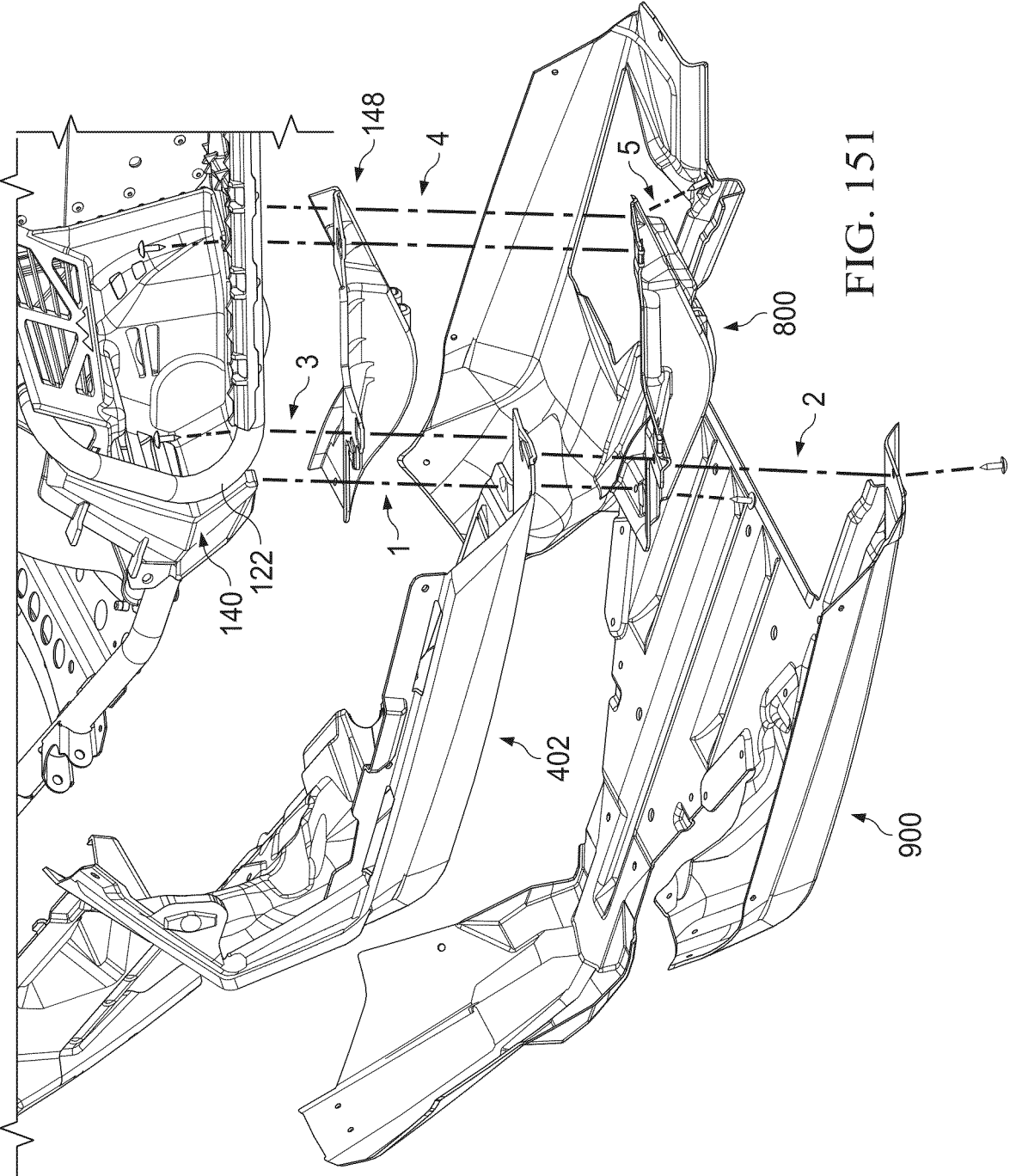


FIG. 151

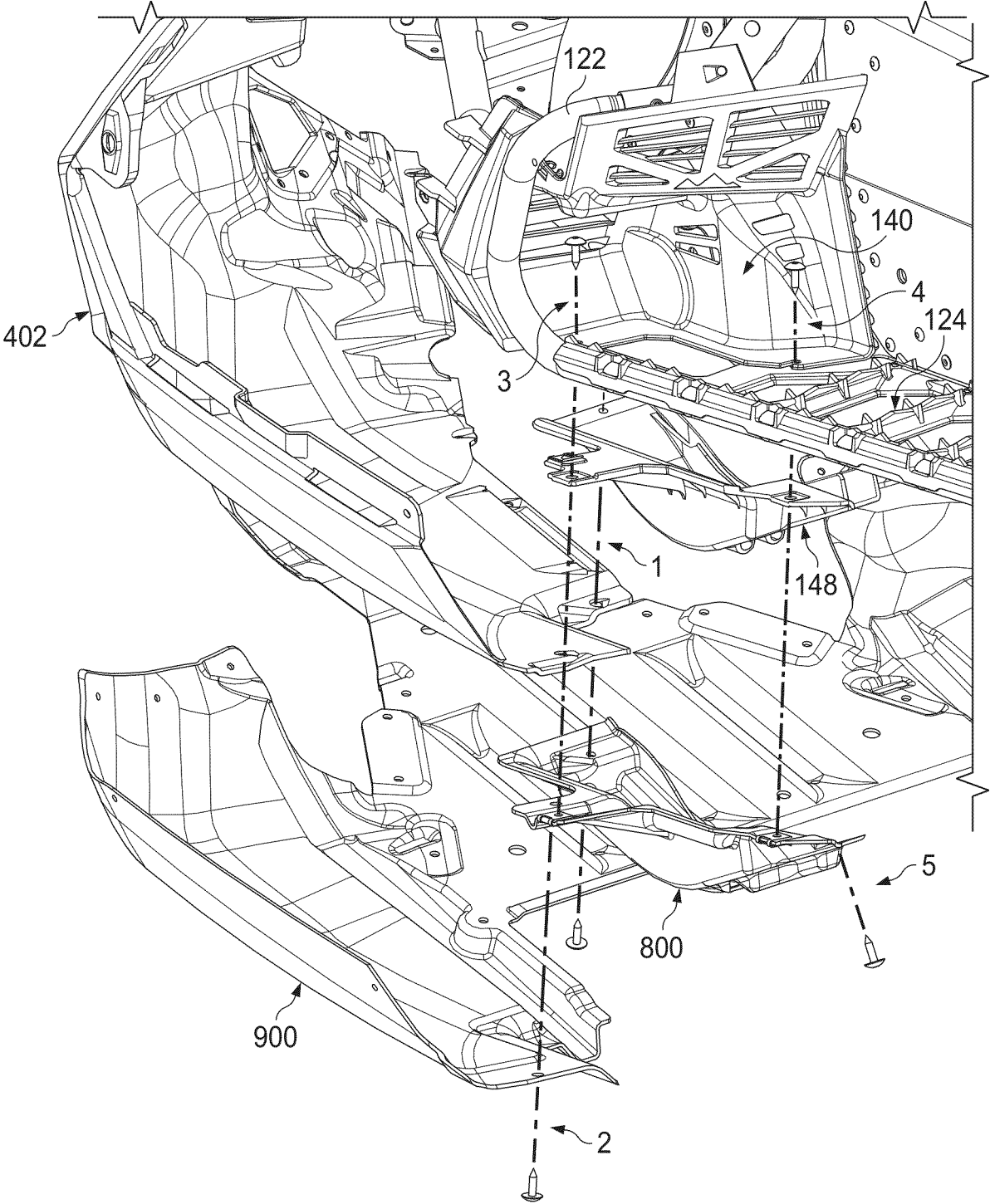


FIG. 152

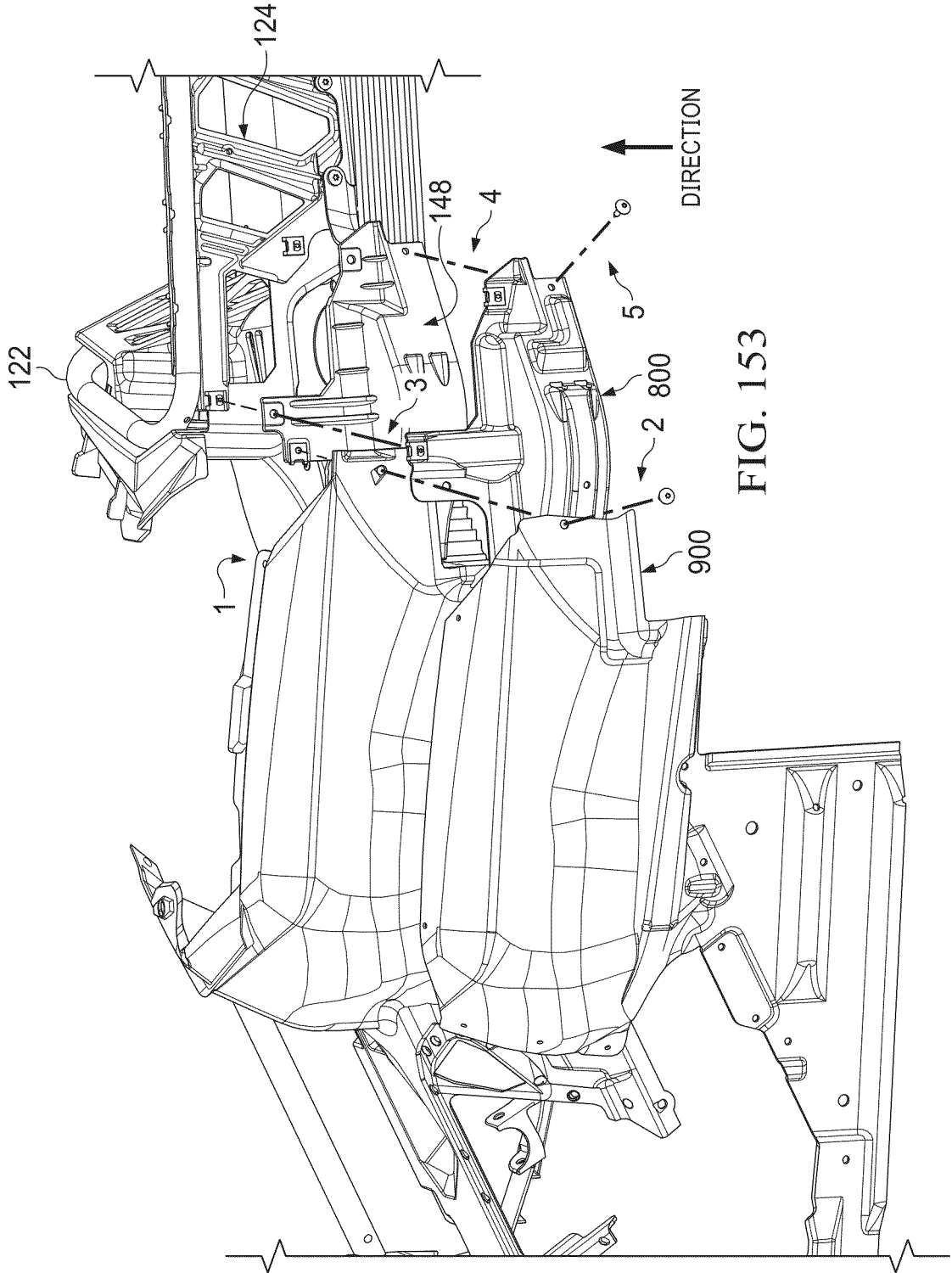


FIG. 153

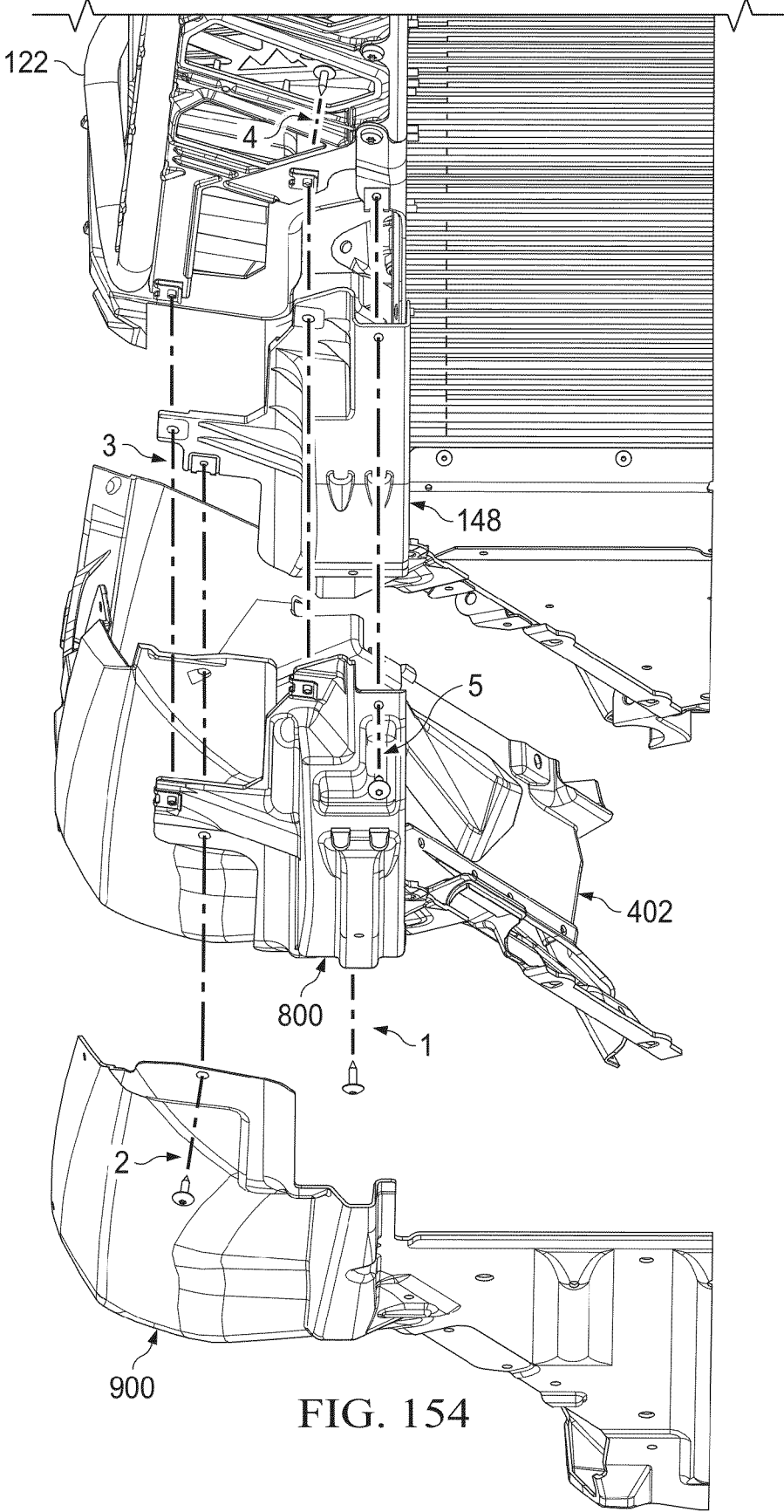


FIG. 154

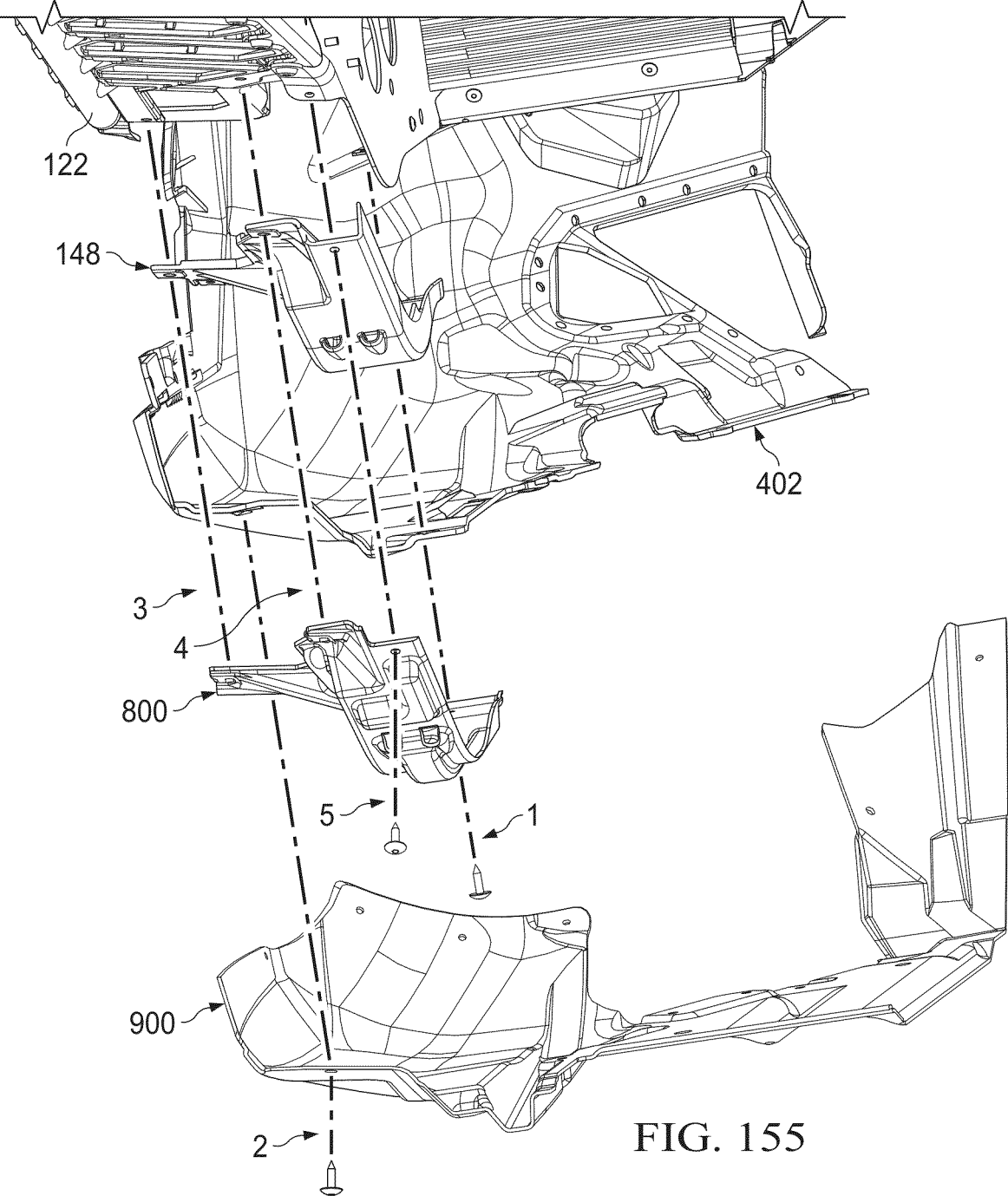


FIG. 155

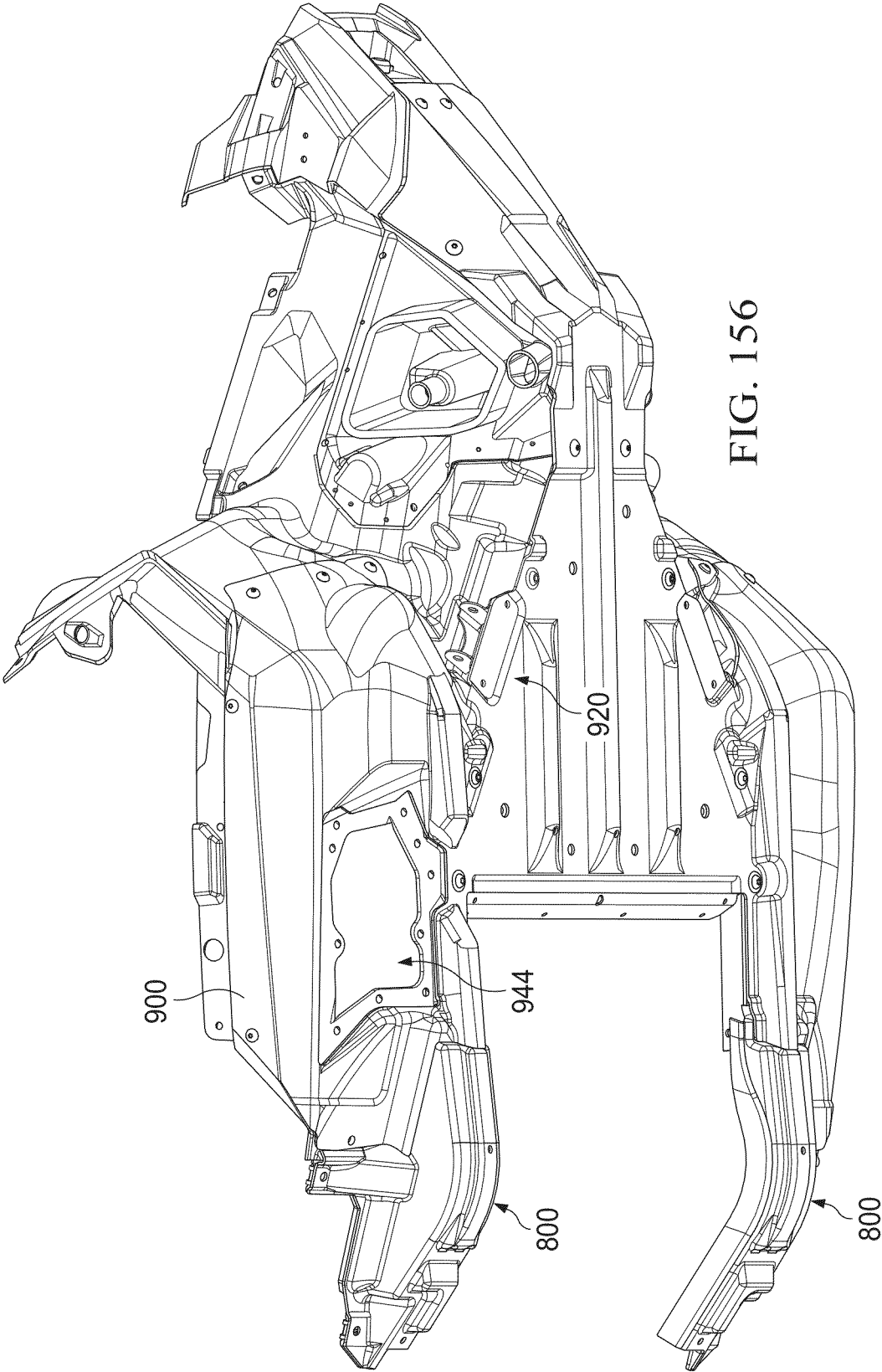


FIG. 156

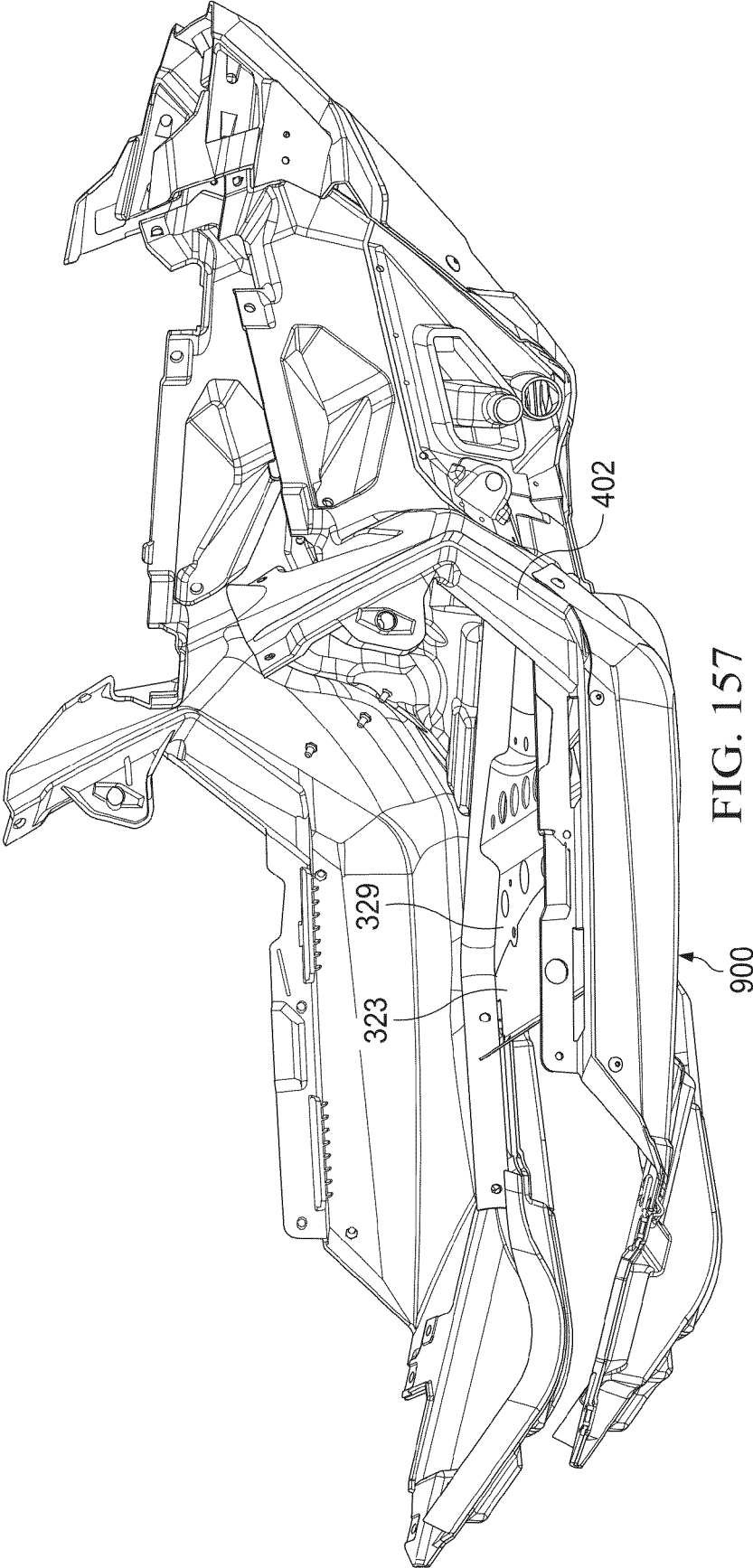


FIG. 157

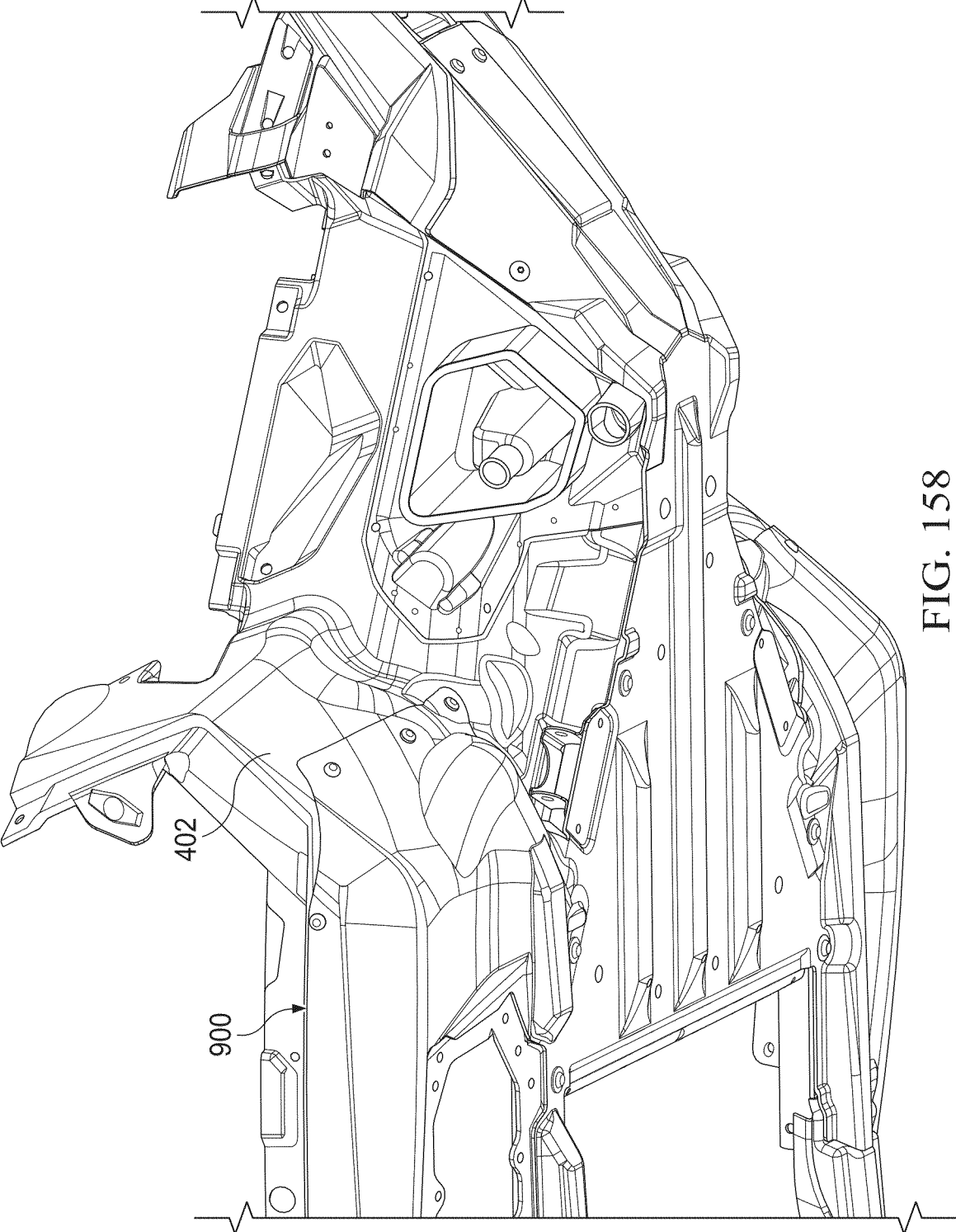


FIG. 158

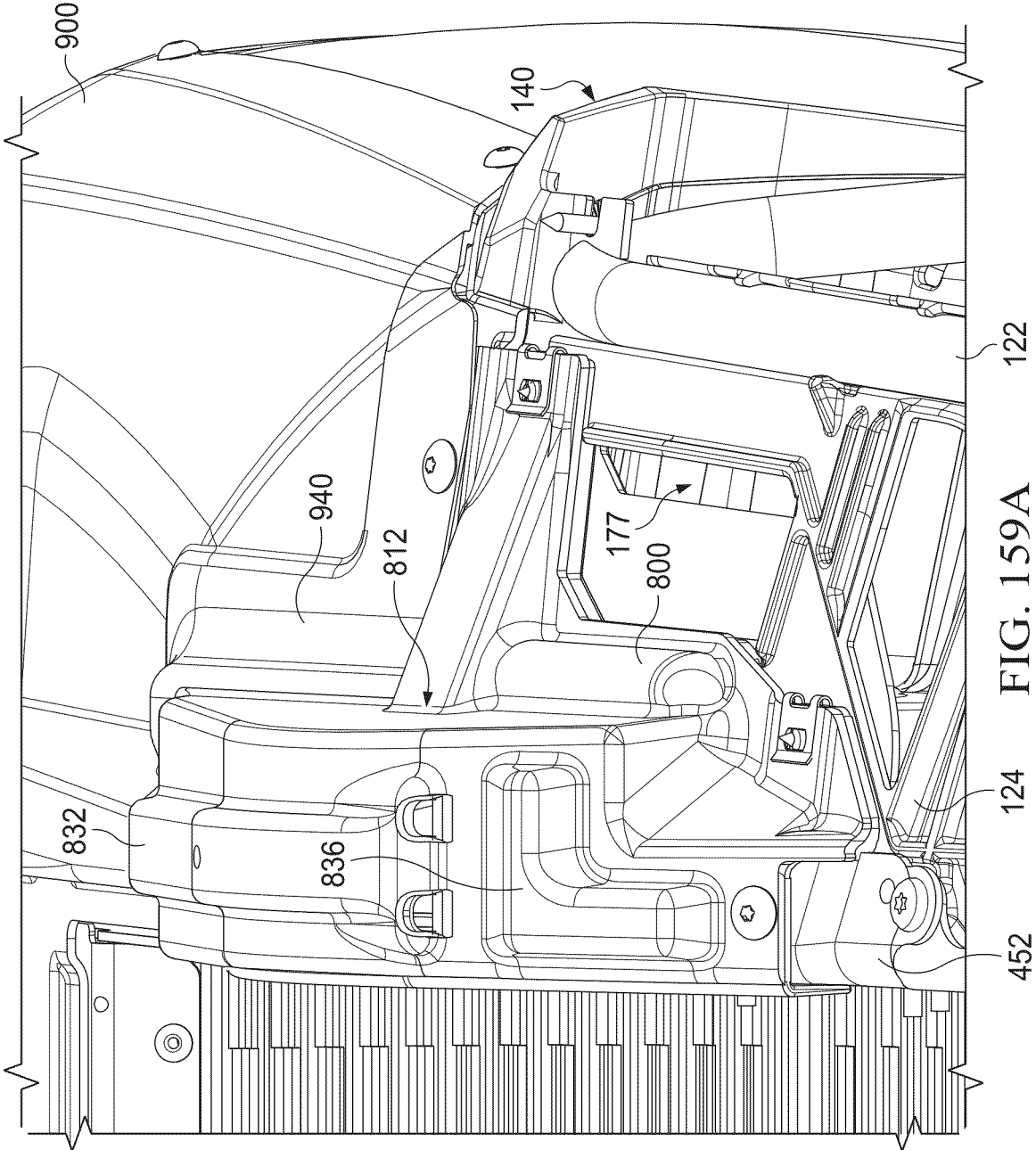


FIG. 159A

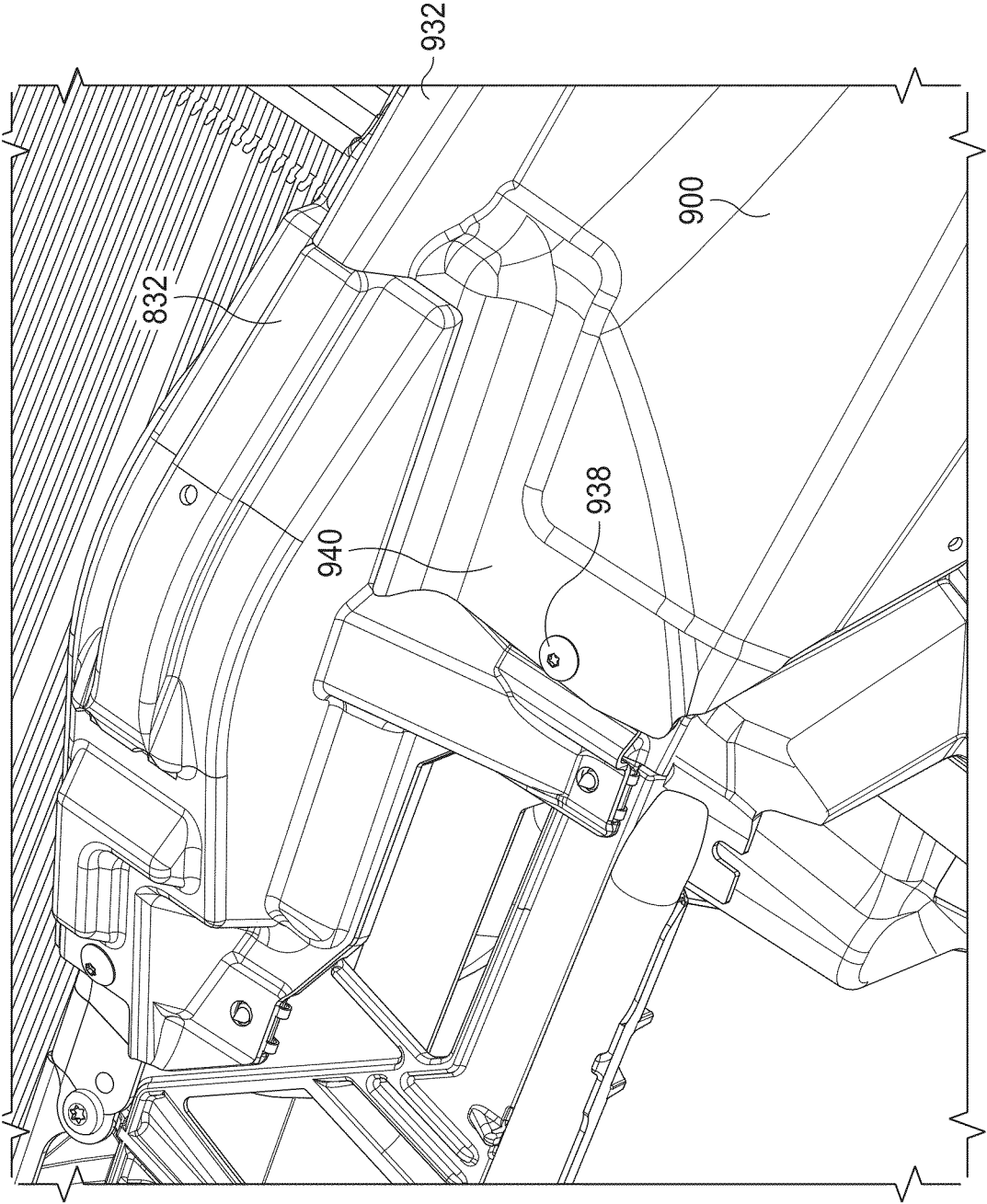


FIG. 159B

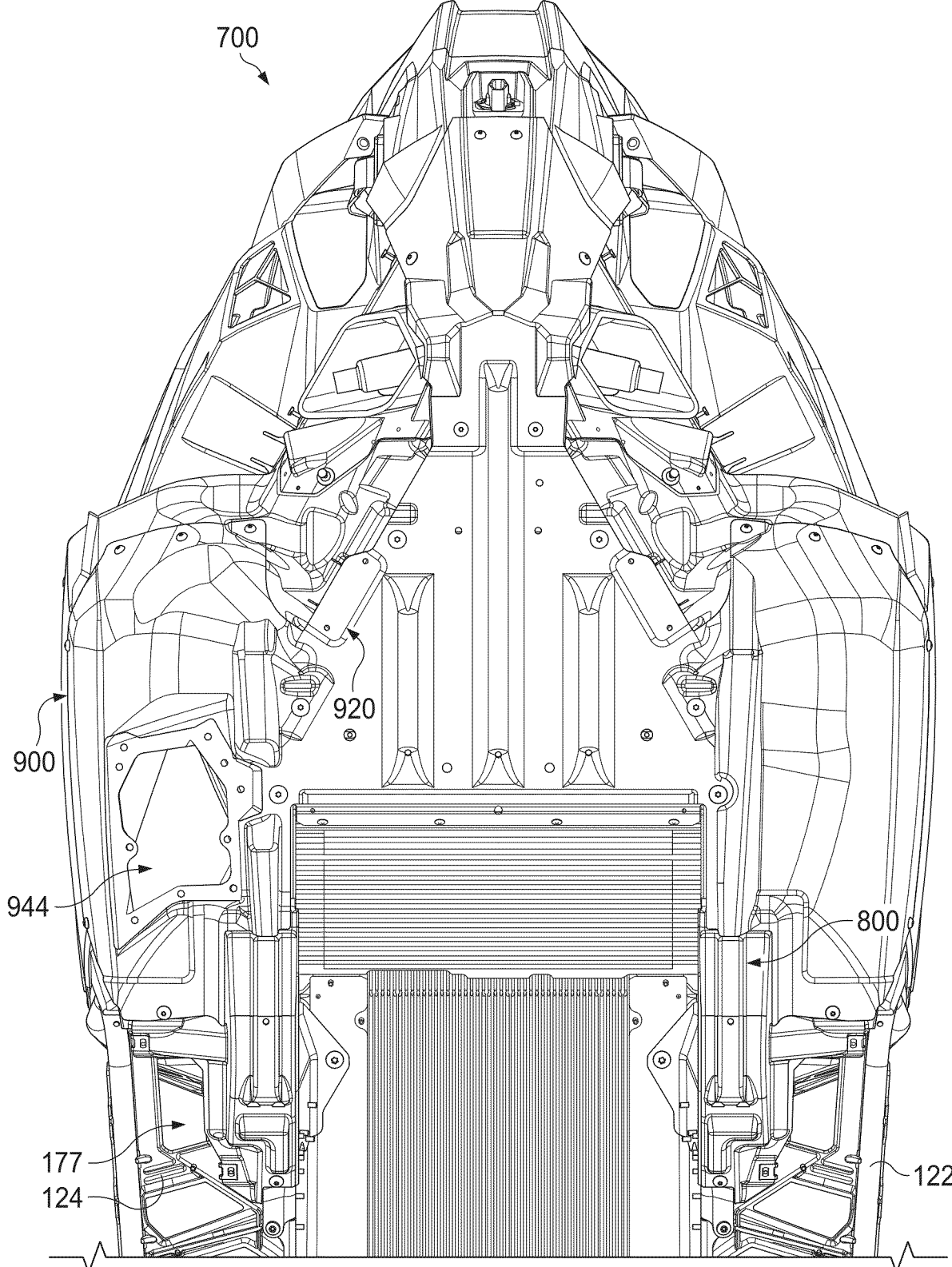


FIG. 160A

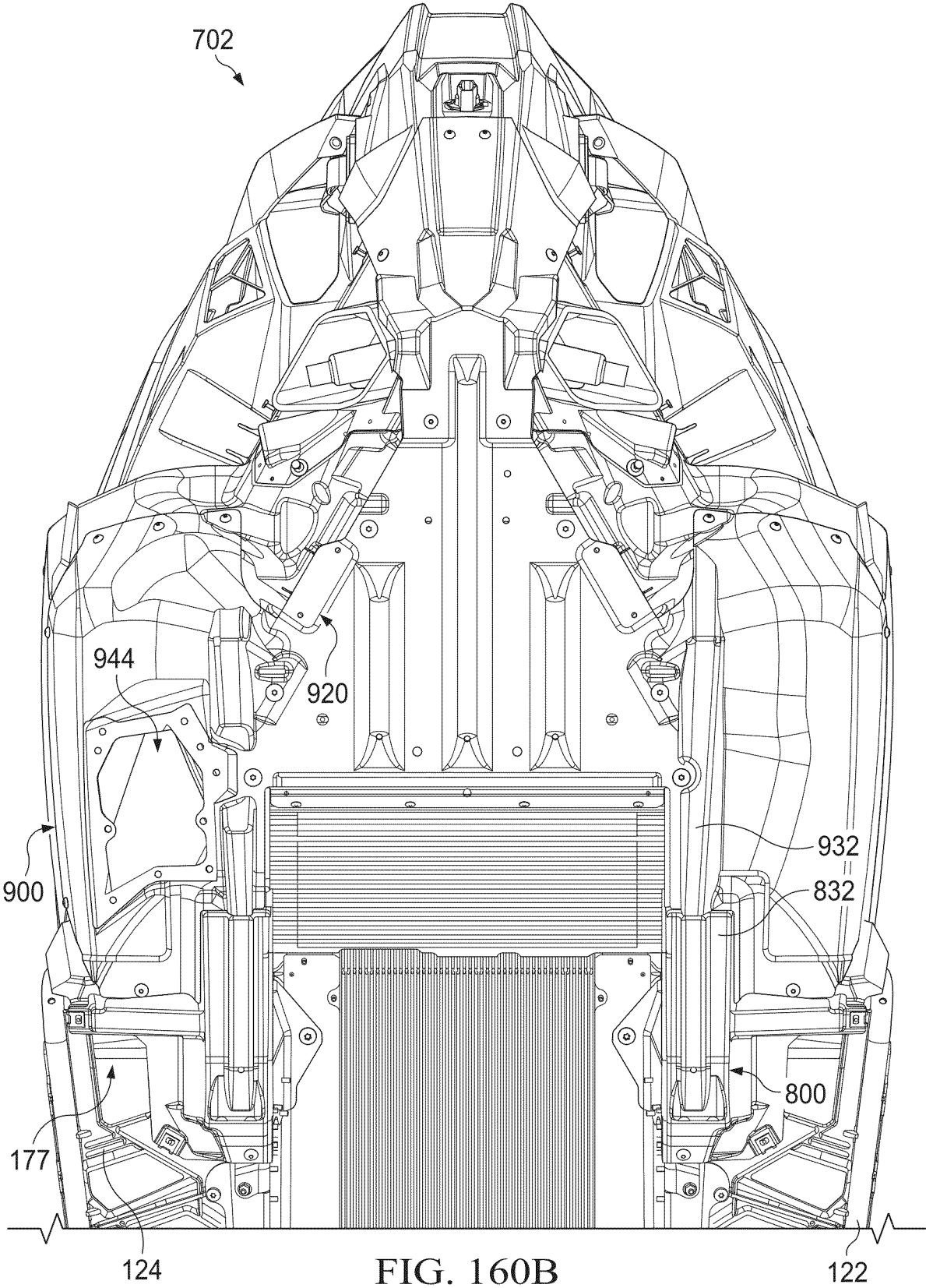


FIG. 160B

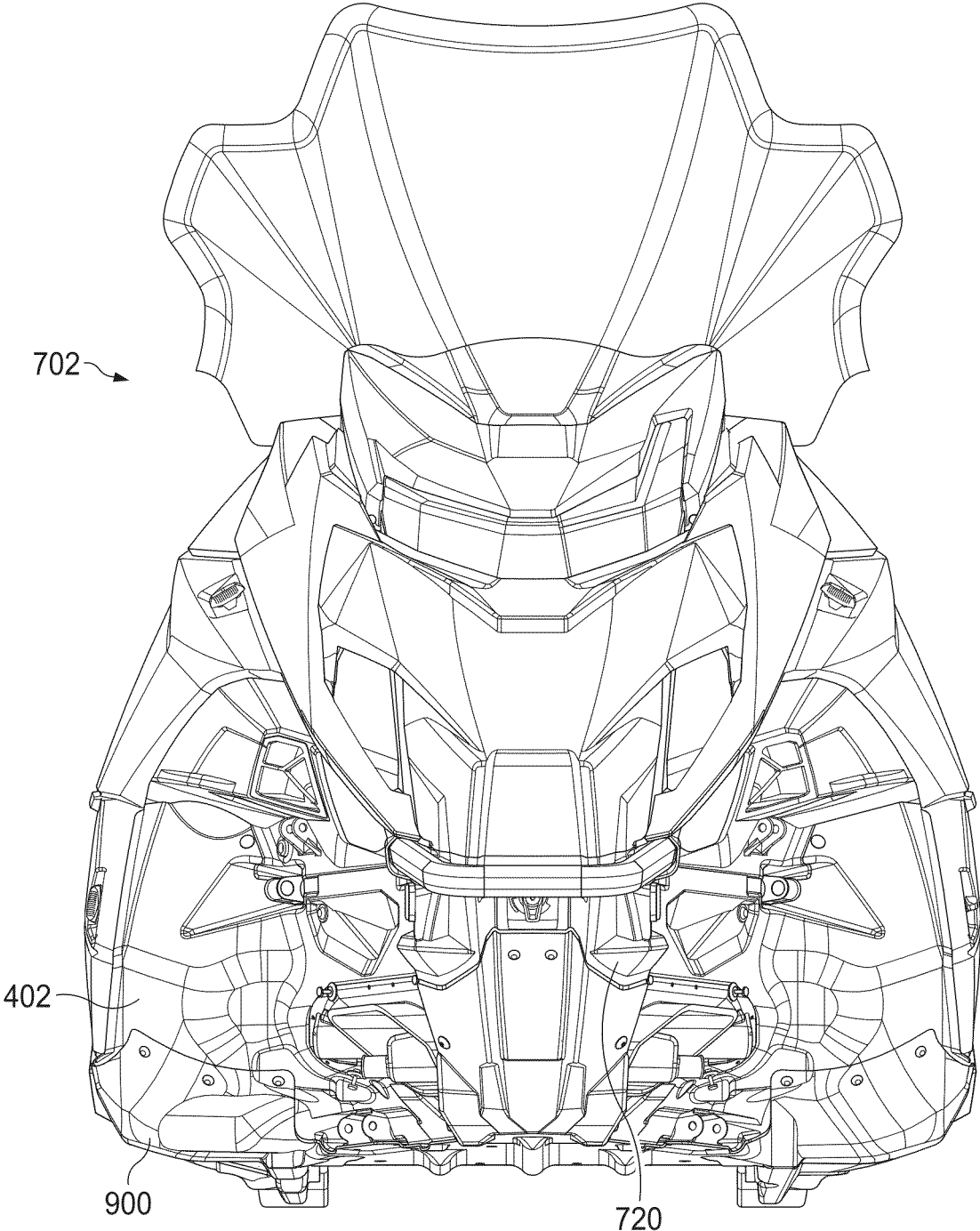


FIG. 161

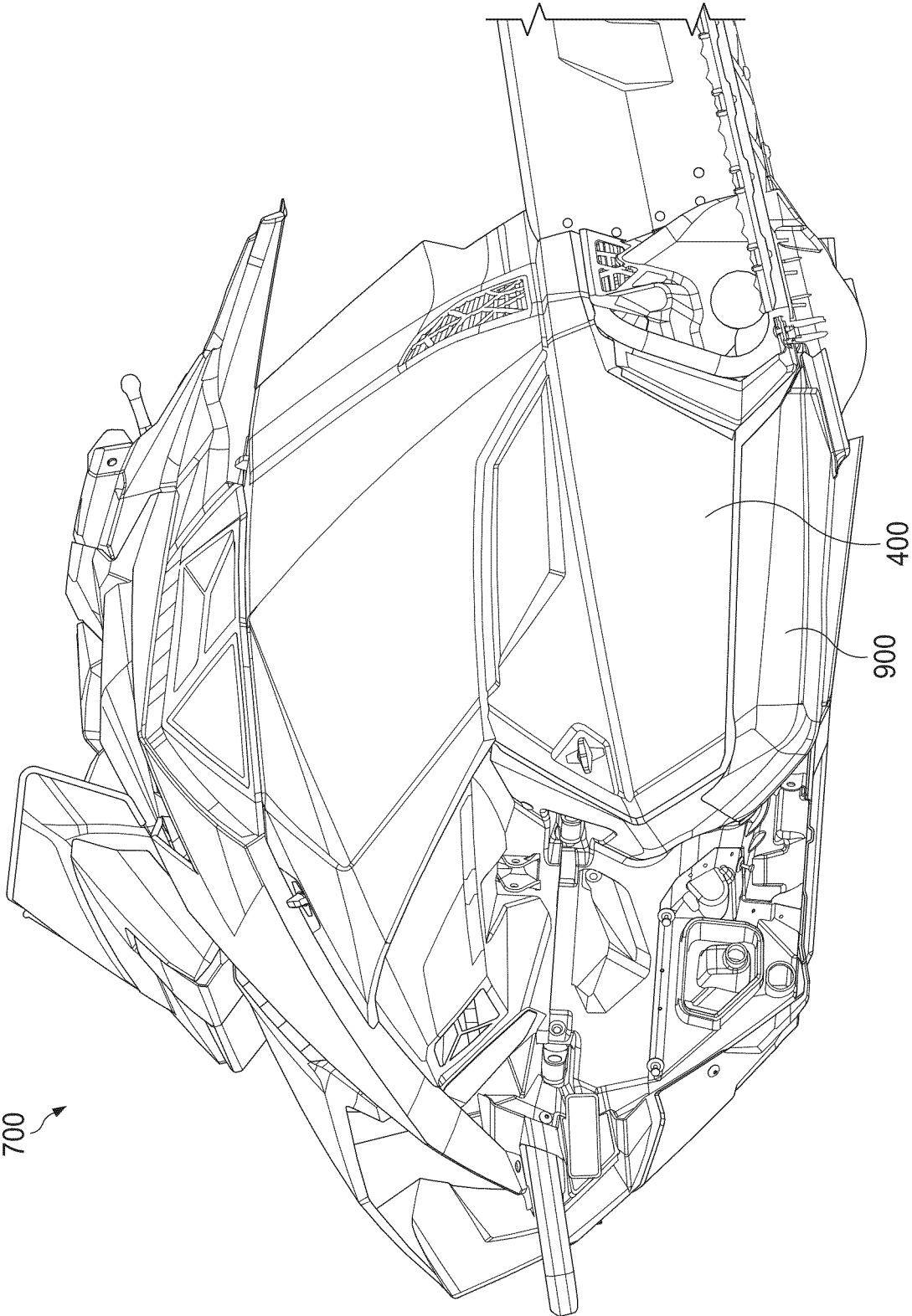


FIG. 162

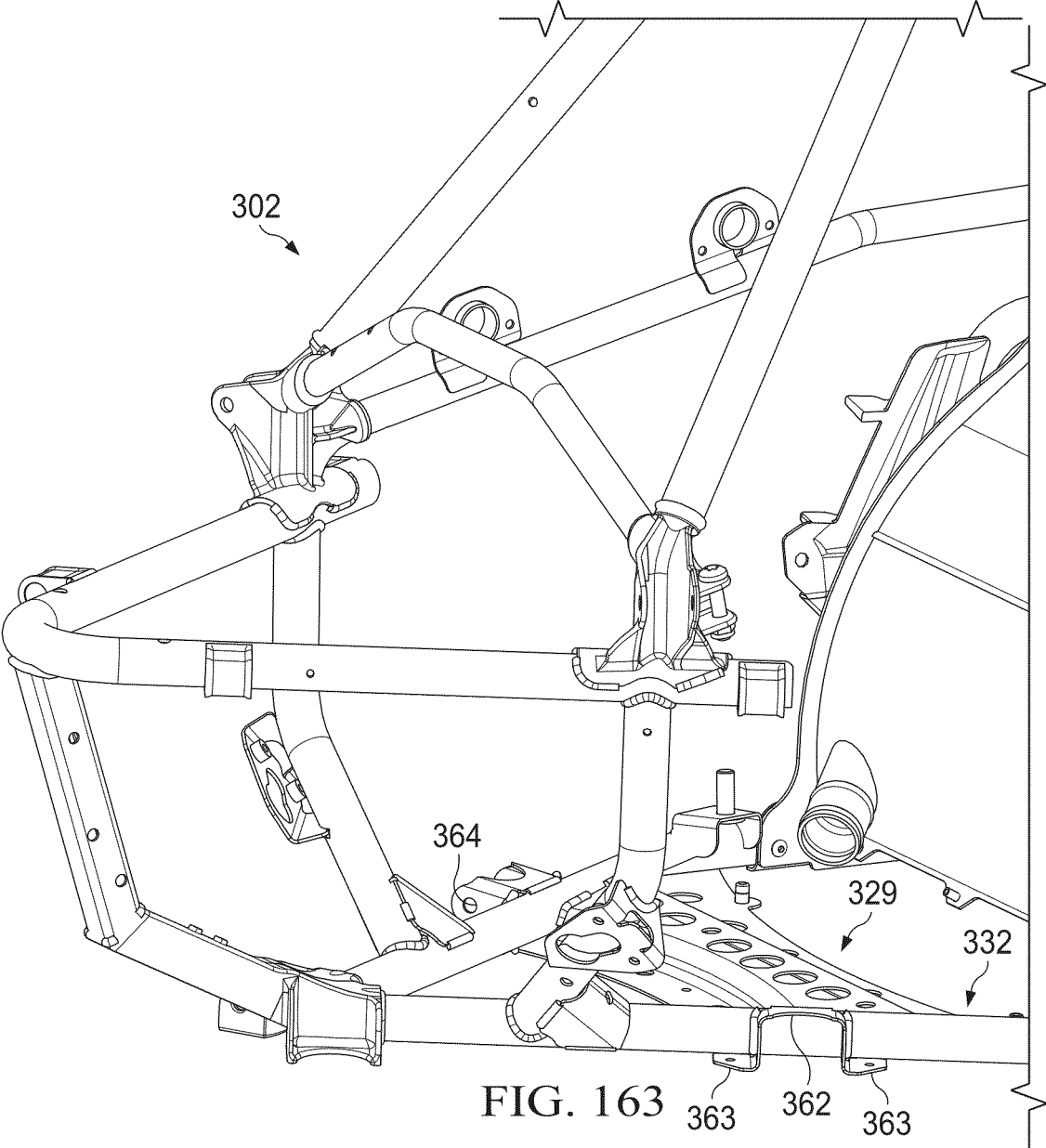


FIG. 163

**SKID PLATE, SECONDARY SKID PLATE,
AND TRACK DRIVE PROTECTOR FOR A
RECREATIONAL VEHICLE**

**CROSS-REFERENCE TO RELATED
APPLICATION**

[0001] This application is related to commonly-owned US Provisional Application No. 63/310,264, filed on Feb. 15, 2022 and entitled “Accessory Attachment System”, US Provisional Application No. 63/310,254, filed on Feb. 15, 2022 and entitled “Recreational Vehicle Spindle”, US Provisional Application No. 63/310,276, filed on Feb. 15, 2022 and entitled “Spindle for Recreational Vehicle”, US Provisional Application No. 63/310,232, filed on Feb. 15, 2022 and entitled “Headlight Assembly”, US Provisional Application No. 63/310,951, filed on Feb. 16, 2022 and entitled “Clutch Guard with Integrated Torque Control Link”, US Provisional Application No. 63/310,983, filed on Feb. 16, 2022 and entitled “Composite Running Board”, US Provisional Application No. 63/310,994, filed on Feb. 16, 2022 and entitled “Two-Stroke Engine”, US Provisional Application No. 63/342,447, filed on May 16, 2022 and entitled “Off-Road Vehicle”, US Provisional Application No. 63/344,165, filed on May 20, 2022 and entitled “Snowmobile Frame”, US Provisional Application No. 63/350,553, filed on Jun. 9, 2022 and entitled “Snowmobile with Seat and Gas Tank Assembly”, US Provisional Application No. 63/400,056, filed on Aug. 23, 2022 and entitled “Taillight Housing, Snow Flap and Assembly Thereof”, US Provisional Application No. 63/402,768, filed on Aug. 31, 2022 and entitled “Snow Vehicle Heat Exchanger Shield”, US Provisional Application No. 63/404,171, filed on Sep. 6, 2022 and entitled “Bumper Mount for a Snowmobile”, US Provisional Application No. 63/404,167, filed on Sep. 6, 2022 and entitled “Intake, Airbox, and Storage Assembly for Snowmobile”, US Provisional Application No. 63/404,856, filed on Sep. 8, 2022 and entitled “Recreational Vehicle Spindle”, US Provisional Application No. 63/404,841, filed on Sep. 8, 2022 and entitled “Spindle for a Recreational Vehicle”, US Provisional Application No. 63/404,655, filed on Sep. 8, 2022 and entitled “Snowmobile with Seat Assembly”, US Provisional Application No. 63/404,682, filed on Sep. 8, 2022 and entitled “Snowmobile with Seat Assembly”, US Provisional Application No. 63/404,822, filed on Sep. 8, 2022 and entitled “Recoil Housing, Engine Assembly, and Method of Assembling Engine Assembly”, US Provisional Application No. 63/404,617, filed on Sep. 8, 2022 and entitled “Recreational Vehicle Running Board”, US Provisional Application No. 63/404,731, filed on Sep. 8, 2022 and entitled “Muffler Assembly, Snow Vehicle Including a Muffler Assembly, Snow Vehicle Including Electronic Power Steering, and Methods of Assembling Thereof”, US Provisional Application No. 63/405,121, filed on Sep. 9, 2022 and entitled “Snowmobile Drive Shaft”, US Provisional Application No. 63/405,033, filed on Sep. 9, 2022 and entitled “Recreational Vehicle Toe Stop, Toe Stop Assemblies, and Methods of Assembling a Recreational Vehicle”, US Provisional Application No. 63/405,016, filed on Sep. 9, 2022 and entitled “Skid Plate, Secondary Skid Plate, and Track Drive Protector for a Recreational Vehicle”, US Provisional Application No. 63/405,176, filed on Sep. 9, 2022 and entitled “Recreational Vehicle Heat Exchanger End Caps and Assembly”, US Provisional Application No. 63/404,992, filed on Sep. 9, 2022 and entitled “Recreational Vehicle Bottom-Out Protector and Assemblies Thereof”, and US Provisional Application No. 63/434,382 filed on Dec. 21, 2022 and entitled “Skid Plate, Secondary Skid Plate, and Track Drive Protector for a Recreational Vehicle”, and which applications are hereby incorporated by reference in their entirety.

visional Application No. 63/404,992, filed on Sep. 9, 2022 and entitled “Recreational Vehicle Bottom-Out Protector and Assemblies Thereof”, and US Provisional Application No. 63/434,382 filed on Dec. 21, 2022 and entitled “Skid Plate, Secondary Skid Plate, and Track Drive Protector for a Recreational Vehicle”, and which applications are hereby incorporated by reference in their entirety.

[0002] A claim of priority is made to commonly-owned US Provisional Application No. 63/310,264, filed on Feb. 15, 2022 and entitled “Accessory Attachment System”, US Provisional Application No. 63/310,254, filed on Feb. 15, 2022 and entitled “Recreational Vehicle Spindle”, US Provisional Application No. 63/310,951, filed on Feb. 16, 2022 and entitled “Clutch Guard with Integrated Torque Control Link”, US Provisional Application No. 63/310,983, filed on Feb. 16, 2022 and entitled “Composite Running Board”, US Provisional Application No. 63/344,165, filed on May 20, 2022 and entitled “Snowmobile Frame”, US Provisional Application No. 63/400,056, filed on Aug. 23, 2022 and entitled “Taillight Housing, Snow Flap and Assembly Thereof”, US Provisional Application No. 63/402,768, filed on Aug. 31, 2022 and entitled “Snow Vehicle Heat Exchanger Shield”, US Provisional Application No. 63/404,171, filed on Sep. 6, 2022 and entitled “Bumper Mount for a Snowmobile”, US Provisional Application No. 63/404,856, filed on Sep. 8, 2022 and entitled “Recreational Vehicle Spindle”, US Provisional Application No. 63/404,822, filed on Sep. 8, 2022 and entitled “Recoil Housing, Engine Assembly, and Method of Assembling Engine Assembly”, US Provisional Application No. 63/404,617, filed on Sep. 8, 2022 and entitled “Recreational Vehicle Running Board”, US Provisional Application No. 63/404,731, filed on Sep. 8, 2022 and entitled “Muffler Assembly, Snow Vehicle Including a Muffler Assembly, Snow Vehicle Including Electronic Power Steering, and Methods of Assembling Thereof”, US Provisional Application No. 63/405,121, filed on Sep. 9, 2022 and entitled “Snowmobile Drive Shaft”, US Provisional Application No. 63/405,033, filed on Sep. 9, 2022 and entitled “Recreational Vehicle Toe Stop, Toe Stop Assemblies, and Methods of Assembling a Recreational Vehicle”, US Provisional Application No. 63/405,016, filed on Sep. 9, 2022 and entitled “Skid Plate, Secondary Skid Plate, and Track Drive Protector for a Recreational Vehicle”, US Provisional Application No. 63/405,176, filed on Sep. 9, 2022 and entitled “Recreational Vehicle Heat Exchanger End Caps and Assembly”, US Provisional Application No. 63/404,992, filed on Sep. 9, 2022 and entitled “Recreational Vehicle Bottom-Out Protector and Assemblies Thereof”, and US Provisional Application No. 63/434,382 filed on Dec. 21, 2022 and entitled “Skid Plate, Secondary Skid Plate, and Track Drive Protector for a Recreational Vehicle”, and which applications are hereby incorporated by reference in their entirety.

BACKGROUND

[0003] Snow vehicles, such as snowmobiles, are popular land vehicles used as transportation vehicles or as recreational vehicles in cold and snowy conditions. Generally, snowmobiles are available for various applications such as deep snow, high performance, luxury touring, and trail riding, for example. In general, a snowmobile has a chassis on or around which the various components of the snowmobile are assembled. Typical snowmobiles include one or more

skis for steering, a seat, handlebars, and an endless track for propulsion mounted to a central chassis. The engine drives a ground-engaging endless track disposed in a longitudinally extending drive tunnel. One or more skis serve to facilitate steering as well as to provide flotation of the front of the snowmobile over the snow in which it is operated. A handlebar assembly, positioned forward of the seat, is operatively linked to the skis for steering the snowmobile. The skis may be pivoted to steer the snowmobile, for example, by turning the handlebars. The snowmobile also includes a footrest for the rider while riding.

SUMMARY

[0004] A recreational vehicle may include a track drive protector attached to a bottom-out protector. The track drive protector is configured to mate with the bottom-out protector. A recreational vehicle may further or alternatively include a secondary skid plate attached to the skid plate. The secondary skid plate is configured to mate with the skid plate and/or the forward frame assembly. The track drive protector and the secondary skid plate may provide additional support to the vehicle, help deflect debris away from the underside of the vehicle, and/or absorb impact forces.

[0005] According to some embodiments of the present disclosure, a snowmobile including a forward frame assembly and a nose panel attached to the forward frame assembly. The snowmobile includes a skid plate attached to a first side of the forward frame assembly and a second side of the forward frame assembly, and a secondary skid plate configured to cover at least a portion of the skid plate. In some embodiments, the secondary skid plate includes a nose section configured to cover the nose panel. The skid plate may further include a body section extending rearward from the nose section, the body section configured to cover the forward frame assembly. A first wing may be positioned outboard of the body section, the first wing configured to cover the skid plate at the first side of the forward frame assembly, and a second wing may be positioned outboard of the body section, the second wing configured to cover the skid plate at the second side of the forward frame assembly.

[0006] According to some embodiments of the present disclosure, a skid plate assembly including a skid plate. The skid plate includes a body section configured to secure to an underbody of a snowmobile, a first wing positioned outboard of the body section, and a second wing positioned outboard of the body section. The skid plate may further comprise a first rib projection. The skid plate assembly may include a track drive protector including a second rib projection. The first rib projection and the second rib projection may define a continuous rib extending between the skid plate and the track drive protector.

[0007] According to some embodiments of the present disclosure, a method of assembling two different snowmobile models with a common skid plate. The method includes providing the common skid plate, the common skid plate including a first set of mounting features configured to secure a first pair of bottom out protectors and a second set of mounting features configured to secure a second pair of bottom out protectors. The method further includes securing the first pair of bottom out protectors or the second pair of bottom out protectors to the common skid plate. In some embodiments, the method may further comprise providing a secondary skid plate including a body section configured

to cover a forward frame assembly. The secondary skid plate may be configured to cover the common skid plate. The method may further include securing the secondary skid plate over the common skid plate. The body section may include a plurality of mounting features configured to removably secure to the forward frame assembly.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] This written disclosure describes illustrative embodiments that are non-limiting and non-exhaustive. Reference is made to illustrative embodiments that are depicted in the figures, in which:

[0009] FIG. 1 illustrates a side view of a first snowmobile, according to some embodiments.

[0010] FIG. 2 illustrates a perspective of the snowmobile of FIG. 1, according to some embodiments.

[0011] FIG. 3 illustrates a top view of the snowmobile of FIG. 1, according to some embodiments.

[0012] FIG. 4 illustrates a front view of the snowmobile of FIG. 1, according to some embodiments.

[0013] FIG. 5 illustrates a right side view of the snowmobile of FIG. 1 with portions of the engine cover removed, according to some embodiments.

[0014] FIG. 6 illustrates a right side perspective view of the snowmobile of FIG. 1 with portions of the engine cover removed, according to some embodiments.

[0015] FIG. 7 illustrates a top view of the snowmobile of FIG. 1 with portions of the engine cover removed, according to some embodiments.

[0016] FIG. 8 illustrates a right side view of a second snowmobile with portions of the engine cover removed, according to some embodiments.

[0017] FIG. 9 illustrates a right side perspective view of the snowmobile of FIG. 8 with portions of the engine cover removed, according to some embodiments.

[0018] FIG. 10 illustrates a top view of the snowmobile of FIG. 10 with portions of the engine cover removed, according to some embodiments.

[0019] FIG. 11 illustrates a perspective top view of the snowmobile chassis having a running board assembly connected thereto, according to some embodiments.

[0020] FIG. 12 illustrates an exploded top view of the running board assembly of FIG. 11, according to some embodiments.

[0021] FIG. 13 illustrates an exploded bottom view of the running board assembly of FIG. 11, according to some embodiments.

[0022] FIG. 14 illustrates an alternative perspective top view of the snowmobile chassis having the running board assembly attached to the tunnel, according to some embodiments.

[0023] FIG. 15A illustrates an isolated top view of the running board assembly, according to some embodiments.

[0024] FIG. 15B illustrates an isolated side view of the running board assembly, according to some embodiments.

[0025] FIG. 15C illustrates an isolated bottom view of the running board assembly, according to some embodiments.

[0026] FIG. 16 illustrate a cross section view of the running board assembly from line 16-16 in FIG. 15B, according to some embodiments.

[0027] FIG. 17A illustrates an exploded side view of the running board assembly, according to some embodiments.

[0028] FIG. 17B illustrates an isometric side view of the rear kick up assembly, according to some embodiments.

[0029] FIG. 18 illustrates a close up bottom view of the running board assembly, according to some embodiments.

[0030] FIG. 19 illustrates a bottom view of a foot support member of the running board assembly, according to some embodiments.

[0031] FIG. 20 illustrates a view of the forward end the foot support member of the running board assembly, according to some embodiments.

[0032] FIG. 21A illustrates a top view of the foot support member and a rear kick-up panel of the running board assembly, according to some embodiments.

[0033] FIG. 21B illustrates a bottom view of the foot support member and the rear kick-up panel of the running board assembly, according to some embodiments.

[0034] FIG. 22 illustrates a close-up bottom perspective view of a front end of the foot support member and support member of the running board assembly, according to some embodiments.

[0035] FIG. 23A illustrates a close-up bottom view of the foot support member and support member of the running board assembly, according to some embodiments.

[0036] FIG. 23B illustrates a close-up top view of the foot support member and support member of the running board assembly, according to some embodiments.

[0037] FIG. 24 illustrates another close-up bottom perspective view of the front end of the foot support member and support member of the running board assembly, according to some embodiments.

[0038] FIG. 25A illustrates a close-up bottom view of the foot support member of the running board assembly, according to some embodiments.

[0039] FIG. 25B illustrates a close-up top view of the foot support member of the running board assembly, according to some embodiments.

[0040] FIG. 26 illustrates an inboard view of a front toe stop of the running board assembly, according to some embodiments.

[0041] FIG. 27A illustrates a top perspective view of the front toe stop, the foot support member, and the support member of the running board assembly, with the tunnel and a portion of the forward frame assembly not shown for illustrative purposes, according to some embodiments.

[0042] FIG. 27B illustrates a bottom perspective view of the front toe stop, the foot support member, and the support member of the running board assembly, with the tunnel and a portion of the forward frame assembly not shown for illustrative purposes, according to some embodiments.

[0043] FIG. 28 illustrates a front perspective view of the front toe stop, the foot support member, the support member of the running board assembly, and bottom-out protector, with a belt housing assembly in a first position associated with the first snowmobile of FIG. 1, according to some embodiments.

[0044] FIG. 29 illustrates an alternative front perspective view of the front toe stop, the foot support member, the support member of the running board assembly, and bottom-out protector, with the belt housing assembly in a second position associated with the second snowmobile of FIG. 8, according to some embodiments.

[0045] FIG. 30 illustrates a side view of the assembly of FIG. 29, according to some embodiments.

[0046] FIG. 31 illustrates a top view of the assembly of FIG. 29, according to some embodiments.

[0047] FIG. 32 illustrates a rear view of the rear kick-up panel of the running board assembly, according to some embodiments.

[0048] FIG. 33 illustrates a bottom view of the rear kick-up panel of the running board assembly, according to some embodiments.

[0049] FIG. 34A illustrates a bottom view of the foot support member and the rear kick-up panel of the running board assembly in a first position associated with the first snowmobile of FIG. 1, according to some embodiments.

[0050] FIG. 34B illustrates a top view of the foot support member and the rear kick-up panel of the running board assembly of FIG. 34A, according to some embodiments.

[0051] FIG. 35A illustrates a bottom view of the foot support member, the support member, and the rear kick-up panel of the running board assembly in a first position associated with the first snowmobile of FIG. 1, according to some embodiments.

[0052] FIG. 35B illustrates a top view of the assembly of FIG. 35A, according to some embodiments.

[0053] FIG. 35C illustrates a bottom view of a foot support member in a second position associated with the second snowmobile of FIG. 8, according to some embodiments.

[0054] FIG. 36 illustrates a side view of the foot support member, the support member, and the rear kick-up panel of the running board assembly, according to some embodiments.

[0055] FIG. 37A illustrates a top view of a support bracket for the running board assembly associated with the first snowmobile of FIG. 1, according to some embodiments.

[0056] FIG. 37B illustrates a side view of the support bracket of FIG. 37A, according to some embodiments.

[0057] FIG. 37C illustrates a top view of a support bracket for the running board assembly associated with the second snowmobile of FIG. 8, according to some embodiments.

[0058] FIG. 37D illustrates a side view of the support bracket of FIG. 37C, according to some embodiments.

[0059] FIG. 38 illustrates an end view of the support bracket of FIG. 37A, according to some embodiments.

[0060] FIG. 39 is a flowchart for a method of assembling a snowmobile, according to some embodiments.

[0061] FIG. 40A illustrates a perspective view of a snowmobile including a forward frame assembly, a heat exchanger assembly, and a tunnel, according to some embodiments.

[0062] FIG. 40B illustrates an exploded view of the snowmobile of FIG. 40A, according to some embodiments.

[0063] FIG. 40C illustrates a side view of the tunnel of FIG. 40A with the support bracket and support tube removed for viewing purposes, according to some embodiments.

[0064] FIG. 41A illustrates an engine being inserted into a forward frame assembly, according to some embodiments.

[0065] FIG. 41B illustrates right rear perspective view of a snowmobile forward frame assembly, according to some embodiments.

[0066] FIG. 41C illustrates left front perspective view of the snowmobile forward frame assembly, according to some embodiments.

[0067] FIG. 42A illustrates a right side view of the forward frame assembly with a belt housing assembly in a first position associated with the first snowmobile of FIG. 1, according to some embodiments.

[0068] FIG. 42B illustrates a left side view of the forward frame assembly of FIG. 42A with a track drive shaft in a first

position associated with the first snowmobile of FIG. 1, according to some embodiments.

[0069] FIG. 42C illustrates a right side view of the forward frame assembly with the belt housing assembly in a second position associated with the second snowmobile of FIG. 8, according to some embodiments.

[0070] FIG. 42D illustrates a left side view of the forward frame assembly of FIG. 42C with a track drive shaft in a second position associated with the second snowmobile of FIG. 8, according to some embodiments.

[0071] FIG. 43 illustrates a schematic rear view of the tunnel, the support bracket, and the foot support member, according to some embodiments.

[0072] FIG. 44 illustrates a bottom view of the foot support member, the support member, and the rear kick-up panel of the running board assembly installed on the snowmobile in a first position associated with the first snowmobile of FIG. 1, according to some embodiments.

[0073] FIG. 45 illustrates a close-up bottom view of the foot support member and the support member of FIG. 44, according to some embodiments.

[0074] FIG. 46 illustrates a side view of a forward frame assembly with a steering column and suspension components associated with the second snowmobile of FIG. 8, according to some embodiments.

[0075] FIG. 47 illustrates a side view of the forward frame assembly with a steering column and suspension components associated with the first snowmobile of FIG. 1, according to some embodiments.

[0076] FIG. 48 illustrates a front view of the assembly of FIG. 46, according to some embodiments.

[0077] FIG. 49 illustrates a front view of the assembly of FIG. 47, according to some embodiments.

[0078] FIG. 50A illustrates a side view of the steering column assembly of FIG. 46, according to some embodiments.

[0079] FIG. 50B illustrates a front view of the steering column assembly of FIG. 50A, according to some embodiments.

[0080] FIG. 51A illustrates a side view of the steering column assembly of FIG. 47, according to some embodiments.

[0081] FIG. 51B illustrates a front view of the steering column assembly of FIG. 51A, according to some embodiments.

[0082] FIG. 52A illustrates a side view of the steering column assembly of FIG. 50A superimposed with the steering column assembly of FIG. 51A, according to some embodiments.

[0083] FIG. 52B illustrates a front view of the steering column assembly of FIG. 50B superimposed with the steering column assembly of FIG. 51B, according to some embodiments.

[0084] FIG. 53 illustrates a top-down view of the forward frame assembly, suspension, and engine components associated with the second snowmobile of FIG. 8, according to some embodiments.

[0085] FIG. 54 illustrates a top-down view of the forward frame assembly, suspension, and engine components associated with the first snowmobile of FIG. 1, according to some embodiments.

[0086] FIG. 55 illustrates a top-down view of a forward frame assembly with steering column bracket, according to some embodiments.

[0087] FIG. 56A illustrates a top perspective view of a steering column bracket, according to some embodiments.

[0088] FIG. 56B illustrates a side perspective view of the steering column bracket of FIG. 56A, according to some embodiment.

[0089] FIG. 56C illustrates a rear perspective view of the steering column bracket of FIG. 56A, according to some embodiment

[0090] FIG. 57 illustrates a bottom perspective view of an assembly comprising a toe stop, bottom-out protector, running board components, and a body panel, according to some embodiments.

[0091] FIG. 58 illustrates a perspective view of a forward frame assembly with the support member associated with the first snowmobile of FIG. 1 superimposed with the support member associated with the second snowmobile of FIG. 8 to illustrate the common connection with the forward frame assembly for each support member.

[0092] FIG. 59 illustrates an isometric view of a seat assembly including a fuel tank, a rear panel, and seat frame, according to some embodiments.

[0093] FIG. 60 illustrates an isometric view of the seat assembly of FIG. 59 with the seat frame removed, according to some embodiments.

[0094] FIG. 61 illustrates a rear view of the rear panel of the seat assembly of FIG. 59, according to some embodiments.

[0095] FIG. 62 illustrates a bottom isometric view of the rear panel and the fuel tank of the seat assembly of FIG. 59, according to some embodiments.

[0096] FIG. 63 illustrates a top view of the fuel tank of the seat assembly of FIG. 59, according to some embodiments.

[0097] FIG. 64 illustrates a bottom view of the fuel tank and the rear panel of the seat assembly of FIG. 59, according to some embodiments.

[0098] FIG. 65 illustrates a right side cross-sectional view of the fuel tank, the tunnel, the heat exchanger assembly, and the forward frame assembly, according to some embodiments.

[0099] FIG. 66 illustrates a perspective top view of the fuel tank, toe stop, and running board components configured for the first snowmobile of FIG. 1, according to some embodiments.

[0100] FIG. 67 illustrates an isometric view of the seat assembly, according to some embodiments.

[0101] FIG. 68 illustrates an isometric view of the fuel tank of the seat assembly secured to the tunnel, according to some embodiments.

[0102] FIG. 69A illustrates an isometric view of a structural composite taillight housing, according to some embodiments.

[0103] FIG. 69B illustrates an isometric view of the structural composite taillight housing of FIG. 69A, according to some embodiments.

[0104] FIG. 70A illustrates a left side view of a snowmobile with a snow flap secured to the structural composite taillight housing of FIG. 69A, according to some embodiments.

[0105] FIG. 70B illustrates an isometric view of a structural composite taillight housing of FIG. 69A with a mounting point, according to some embodiments.

[0106] FIG. 71 illustrates an exploded view of a toe stop and bottom-out protector assembly according to some embodiments.

[0107] FIG. 72 illustrates a rear perspective view of a toe stop and bottom-out protector assembly, according to some embodiments.

[0108] FIG. 73 illustrates a rear perspective view of a toe stop that may be part of the running board assembly 120A of FIG. 7, according to some embodiments.

[0109] FIG. 74 illustrates a perspective view of a toe stop that may be part of the running board assembly 120A of FIG. 7, according to some embodiments.

[0110] FIG. 75 illustrates a side perspective view of a toe stop and a bottom out protector that may be part of the running board assembly 120B of FIG. 10, according to some embodiments.

[0111] FIG. 76 illustrates a cross-sectional overhead view of a toe stop and body panel configured for the first snowmobile of FIG. 1, with the belt housing assembly removed, according to some embodiments.

[0112] FIG. 77A illustrates an isometric view of a right toe stop that may be part of the running board assembly 120A of FIG. 7, according to some embodiments.

[0113] FIG. 77B illustrates an isometric view of a right toe stop that may be part of the running board assembly 120A of FIG. 7, according to some embodiments.

[0114] FIG. 78A illustrates an isometric view of the rearward facing side of the toe stop of FIGS. 77A and 77B, according to some embodiments.

[0115] FIG. 78B illustrates an isometric view the forward facing side of the toe stop of FIGS. 77A and 77B, according to some embodiments.

[0116] FIG. 79A illustrates an isometric view from above the toe stop of FIGS. 77A and 77B, according to some embodiments.

[0117] FIG. 79B illustrates an isometric view from below the toe stop of FIGS. 77A and 77B, according to some embodiments.

[0118] FIG. 80A illustrates an isometric view of an inboard side of the toe stop of FIGS. 77A and 77B, according to some embodiments.

[0119] FIG. 80B illustrates an isometric view of the inboard side of the toe stop of FIGS. 77A and 77B, according to some embodiments.

[0120] FIG. 81A illustrates an isometric view of an outboard side of a left toe stop that may be part of the running board assembly 120A of FIG. 7, according to some embodiments.

[0121] FIG. 81B illustrates an isometric view of an inboard side of a left toe stop that may be part of the running board assembly 120A of FIG. 7, according to some embodiments.

[0122] FIG. 82A illustrates an isometric view of the outboard side of the left side toe stop of FIGS. 81A and 81B, according to some embodiments.

[0123] FIG. 82B illustrates an isometric view of the inboard side of the left side toe stop of FIGS. 81A and 81B, according to some embodiments.

[0124] FIG. 83A illustrates an isometric view of the rearward facing side of the left side toe stop of FIGS. 81A and 81B, according to some embodiments.

[0125] FIG. 83B illustrates an isometric view of the forward facing side of the left side toe stop of FIGS. 81A and 81B, according to some embodiments.

[0126] FIG. 84A illustrates an isometric view from above the left side toe stop of FIGS. 81A and 81B, according to some embodiments.

[0127] FIG. 84B illustrates an isometric view from below the left side toe stop of FIGS. 81A and 81B, according to some embodiments.

[0128] FIG. 85A illustrates a view of the right side toe stop of FIGS. 77A and 77B installed as part of the running board assembly 120A, according to some embodiments.

[0129] FIG. 85B illustrates a view of the left side toe stop of FIGS. 81A and 81B installed as part of the running board assembly 120A, according to some embodiments.

[0130] FIG. 86A illustrates a view of the forward facing surface of the right side toe stop of FIGS. 77A and 77B installed as part of the running board assembly 120A, according to some embodiments.

[0131] FIG. 86B illustrates a bottom view of the right side toe stop of FIGS. 77A and 77B installed as part of the running board assembly 120A, with the bottom-out protector installed, according to some embodiments.

[0132] FIG. 87A illustrates a bottom view of the left side toe stop of FIGS. 81A and 81B installed as part of the running board assembly 120A, with the bottom-out protector installed, according to some embodiments.

[0133] FIG. 87B illustrates a bottom view of the left side toe stop of FIGS. 81A and 81B installed as part of the running board assembly 120A, without the bottom-out protector, according to some embodiments.

[0134] FIG. 88A illustrates an isometric view of the left side toe stop of FIGS. 81A and 81B installed as part of the running board assembly 120A, without the bottom-out protector, according to some embodiments.

[0135] FIG. 88B illustrates left side view of the left side toe stop of FIGS. 81A and 81B installed as part of the running board assembly 120A, according to some embodiments.

[0136] FIG. 89 illustrates the forward facing surface of the left side toe stop of FIGS. 81A and 81B installed as part of the running board assembly 120A, according to some embodiments.

[0137] FIG. 90A illustrates a left side view of a right toe stop that may be part of the running board assembly 120B of FIG. 10, according to some embodiments.

[0138] FIG. 90B illustrates a perspective view of an inboard side of the right toe stop of FIG. 90A that may be part of the running board assembly 120B of FIG. 10, according to some embodiments.

[0139] FIG. 91A illustrates a perspective view of the outboard side of the right side toe stop of FIGS. 90A and 90B, according to some embodiments.

[0140] FIG. 91B illustrates a perspective view of the inboard side of the right toe stop of FIGS. 90A and 90B, according to some embodiments.

[0141] FIG. 92A illustrates a rear view of the rearward facing side of the toe stop of FIGS. 90A and 90B, according to some embodiments.

[0142] FIG. 92B illustrates a front view of the forward facing side of the toe stop of FIGS. 90A and 90B, according to some embodiments.

[0143] FIG. 93A illustrates a top view of the toe stop of FIGS. 90A and 90B, according to some embodiments.

[0144] FIG. 93B illustrates a bottom view of the toe stop of FIGS. 90A and 90B, according to some embodiments.

[0145] FIG. 94A illustrates a perspective view of an outboard side of a left side toe stop that may be part of the running board assembly 120B of FIG. 10, according to some embodiments.

[0146] FIG. 94B illustrates a perspective view of an inboard side of the left toe stop of FIG. 94A that may be part of the running board assembly 120B of FIG. 10, according to some embodiments.

[0147] FIG. 95A illustrates an isometric view of the outboard side of the left side toe stop of FIGS. 94A and 94B, according to some embodiments.

[0148] FIG. 95B illustrates an isometric view of the inboard side of the left side toe stop of FIGS. 94A and 94B, according to some embodiments.

[0149] FIG. 96A illustrates a rear view of the rearward facing side of the toe stop of FIGS. 94A and 94B, according to some embodiments.

[0150] FIG. 96B illustrates a front view of the forward facing side of the toe stop of FIGS. 94A and 94B, according to some embodiments.

[0151] FIG. 97A illustrates a top view of the toe stop of FIGS. 94A and 94B, according to some embodiments.

[0152] FIG. 97B illustrates a bottom view of the toe stop of FIGS. 94A and 94B, according to some embodiments.

[0153] FIG. 98A illustrates an isometric view of the right side toe stop of FIGS. 90A and 90B installed as part of the running board assembly 120B, according to some embodiments.

[0154] FIG. 98B illustrates an isometric view of the left side toe stop of FIGS. 94A and 94B installed as part of the running board assembly 120B, according to some embodiments.

[0155] FIG. 99A illustrates a front view of the forward facing surface of the right side toe stop of FIGS. 90A and 90B installed as part of the running board assembly 120B, without the bottom-out protector, according to some embodiments.

[0156] FIG. 99B illustrates a bottom view of the right side toe stop of FIGS. 90A and 90B installed as part of the running board assembly 120B, without the bottom-out protector, according to some embodiments.

[0157] FIG. 100A illustrates a front view of the left side toe stop of FIGS. 94A and 94B installed as part of the running board assembly 120B, with the bottom-out protector, according to some embodiments.

[0158] FIG. 100B illustrates an isometric view of the left side toe stop of FIGS. 94A and 94B installed as part of the running board assembly 120B, according to some embodiments.

[0159] FIG. 101 illustrates a bottom isometric view of the left side toe stop of FIGS. 94A and 94B installed as part of the running board assembly 120B, without the bottom-out protector, according to some embodiments.

[0160] FIG. 102 illustrates a belt side bottom-out protector that may be installed as part of the second snowmobile of FIG. 8 with the running board assembly 120B, with the toe stop shown in FIG. 90A, and with the track drive shaft position of FIGS. 42C-D, according to some embodiments.

[0161] FIG. 103A illustrates a bottom view of the bottom-out protector of FIG. 102, according to some embodiments.

[0162] FIG. 103B illustrates a top view of the bottom-out protector of FIG. 102, according to some embodiments.

[0163] FIG. 104A illustrates an outboard side view of the bottom-out protector of FIG. 102, according to some embodiments.

[0164] FIG. 104B illustrates an inboard side view of the bottom-out protector of FIG. 102, according to some embodiments.

[0165] FIG. 105A illustrates a rear view of the bottom-out protector of FIG. 102, according to some embodiments.

[0166] FIG. 105B illustrates a front view of the bottom-out protector of FIG. 102, according to some embodiments.

[0167] FIG. 106A illustrates a brake side bottom-out protector that may be installed as part of the second snowmobile of FIG. 8 with the running board assembly 120B, with the toe stop shown in FIG. 94A, and with the track drive shaft position of FIGS. 42C-D, according to some embodiments.

[0168] FIG. 106B illustrates a bottom view of the bottom-out protector of FIG. 106A, according to some embodiments.

[0169] FIG. 107A illustrates an outboard side view of the bottom-out protector of FIG. 106A, according to some embodiments.

[0170] FIG. 107B illustrates a perspective view of the bottom-out protector of FIG. 106A, according to some embodiments.

[0171] FIG. 108A illustrates a side view of the outboard side of the bottom-out protector of FIG. 106A, according to some embodiments.

[0172] FIG. 108B illustrates a side view of the inboard side of the bottom-out protector of FIG. 106A, according to some embodiments.

[0173] FIG. 109A illustrates a rear view of the bottom-out protector of FIG. 106A, according to some embodiments.

[0174] FIG. 109B illustrates a front view of the bottom-out protector of FIG. 106A, according to some embodiments.

[0175] FIG. 110 illustrates a side view of an assembly that includes a foot support member, a toe stop as shown in FIG. 90A, and a belt side bottom-out protector as shown in FIG. 102, according to some embodiments.

[0176] FIG. 111 illustrates a bottom view of the assembly of FIG. 110, according to some embodiments.

[0177] FIG. 112 illustrates a front view of the assembly of FIG. 110 with the heat exchanger end cap received in the bottom-out protector, according to some embodiments.

[0178] FIG. 113 illustrates an inboard side view of the assembly of FIG. 110, with a portion of the bottom-out protector extending along an inboard side of the heat exchange end cap, according to some embodiments.

[0179] FIG. 114 illustrates an inboard side view of the assembly of FIG. 110 with the track drive shaft removed, according to some embodiments.

[0180] FIG. 115A illustrates a lower side view of bottom-out protectors of FIGS. 102 and 106A, with the track drive shaft, the belt housing assembly, and the running board assembly each in a second position associated with the second snowmobile of FIG. 8, according to some embodiments.

[0181] FIG. 115B illustrates bottom view of the bottom-out protectors of FIG. 115A, according to some embodiments.

[0182] FIG. 116A illustrates an isometric view of a belt side bottom-out protector that may be installed as part of the first snowmobile of FIG. 1 with the running board assembly 120A, with the toe stop shown in FIG. 77A, and with the track drive shaft position of FIGS. 42A-B, according to some embodiments.

[0183] FIG. 116B illustrates an outboard side view of the belt side bottom-out protector of FIG. 116A, according to some embodiments.

[0184] FIG. 117A illustrates a side view of the outboard side of the bottom-out protector of FIG. 116A, according to some embodiments.

[0185] FIG. 117B illustrates a left side view of the inboard side of the bottom-out protector of FIG. 116A, according to some embodiments.

[0186] FIG. 118 illustrates a bottom view of the bottom-out protector of FIG. 116A, according to some embodiments.

[0187] FIG. 119A illustrates a front view of the bottom-out protector of FIG. 116A, according to some embodiments.

[0188] FIG. 119B illustrates a rear view of the bottom-out protector of FIG. 116A, according to some embodiments.

[0189] FIG. 120 illustrates an isometric view of a brake side bottom-out protector that may be installed as part of the first snowmobile of FIG. 1 with the running board assembly of FIG. 120A, with the toe stop shown in FIG. 81A, and with the track drive shaft position of FIGS. 42A-B, according to some embodiments.

[0190] FIG. 121A illustrates an inboard side view of the bottom-out protector of FIG. 120, according to some embodiments.

[0191] FIG. 121B illustrates an outboard side view of the bottom-out protector of FIG. 120, according to some embodiments.

[0192] FIG. 122A illustrates a top view of the bottom-out protector of FIG. 120, according to some embodiments.

[0193] FIG. 122B illustrates a bottom view of the bottom-out protector of FIG. 120, according to some embodiments.

[0194] FIG. 123A illustrates a rear view of the bottom-out protector of FIG. 120, according to some embodiments.

[0195] FIG. 123B illustrates a front view of the bottom-out protector of FIG. 120, according to some embodiments.

[0196] FIG. 124 illustrates a bottom isometric view of the belt side bottom-out protector of FIG. 116A secured to a heat exchanger end cap and the forward frame assembly, wherein the bottom-out protector is positioned to be secured to a foot support member, according to some embodiments.

[0197] FIG. 125 illustrates a bottom view of the brake side bottom out protector of FIG. 120 secured to the heat exchanger end cap, the forward frame assembly, the foot support member, and the skid plate, according to some embodiments.

[0198] FIG. 126 illustrates a perspective view of the toe stop of FIG. 77A and the bottom out protector of FIG. 116A housing a portion of the belt case assembly that is in the first position on the first snowmobile of FIG. 1, according to some embodiments.

[0199] FIG. 127 illustrates a bottom perspective view of the bottom-out protectors of FIGS. 116A and 120, the toe stops of FIGS. 77A and 81A, and the running board assembly of FIG. 120A on the first snowmobile of FIG. 1, according to some embodiments.

[0200] FIG. 128 illustrates an exploded bottom view of attachment of the bottom-out protector of FIG. 106A and an accessory skid plate assembly according to some embodiments.

[0201] FIG. 129A illustrates a view of the bottom-out protectors of FIGS. 102 and 106A, a heat exchanger end cap, and the track drive protector of FIG. 137B according to some embodiments.

[0202] FIG. 129B illustrates a view of bottom out protectors of FIGS. 102 and 106A secured to the underside of a

snowmobile, with an accessory skid plate assembly including the bottom out protectors of FIGS. 136A and 136B positioned over the bottom out protectors, according to some embodiments.

[0203] FIG. 130A illustrates a front perspective view of the snowmobile of FIGS. 8-10, according to some embodiments.

[0204] FIG. 130B illustrates a front perspective view of the snowmobile of FIGS. 1-7, according to some embodiments.

[0205] FIG. 131A illustrates a left side perspective view of the snowmobile of FIG. 130A, according to some embodiments.

[0206] FIG. 131B illustrates a left side perspective view of the snowmobile of FIG. 130B, according to some embodiments.

[0207] FIG. 132 illustrates an enlarged side perspective view of body panels, according to some embodiments.

[0208] FIG. 133A illustrates a bottom perspective view of the running board assembly 120B, bottom-out protectors of FIGS. 102 and 106A, heat exchanger assembly components, front frame assembly components, and body panels of the snowmobile of FIG. 130A, according to some embodiments.

[0209] FIG. 133B illustrates a bottom perspective view of the running board assembly 120A, the bottom-out protectors of FIGS. 116A and 120, heat exchanger assembly components, front frame assembly components, and body panels of the snowmobile of FIG. 130B, according to some embodiments.

[0210] FIG. 134 illustrates a bottom perspective view of a front frame assembly and a heat exchanger assembly of the snowmobile of FIG. 130A, according to some embodiments.

[0211] FIG. 135 illustrates a flowchart for a method of assembling a snowmobile according to some embodiments.

[0212] FIG. 136A illustrates a top perspective view of a track drive protector of the snowmobile of FIG. 130A, according to some embodiments.

[0213] FIG. 136B illustrates a top perspective view of a track drive protector of the snowmobile of FIG. 130A, according to some embodiments.

[0214] FIG. 137A illustrates a bottom perspective view of a track drive protector of FIGS. 136A-B, according to some embodiments.

[0215] FIG. 137B illustrates a bottom perspective view of a track drive protector of FIGS. 136A-B, according to some embodiments.

[0216] FIG. 138A illustrates an outboard side perspective view of a track drive protector of FIGS. 136A-B, according to some embodiments.

[0217] FIG. 138B illustrates an inboard side perspective view of a track drive protector of FIGS. 136A-B, according to some embodiments.

[0218] FIG. 139A illustrates a top perspective view of a track drive protector for the snowmobile of FIG. 130B, according to some embodiments.

[0219] FIG. 139B illustrates a top perspective view of a track drive protector for the snowmobile of FIG. 130B, according to some embodiments.

[0220] FIG. 140A illustrates a bottom perspective view of the track drive protector of FIGS. 139A-B, according to some embodiments.

[0221] FIG. 140B illustrates a bottom perspective view of the track drive protector of FIGS. 139A-B, according to some embodiments.

[0222] FIG. 141A illustrates an outboard side perspective view of the track drive protector of FIGS. 139A-B, according to some embodiments.

[0223] FIG. 141B illustrates an inboard side perspective view of the track drive protector of FIGS. 139A-B, according to some embodiments.

[0224] FIG. 142 illustrates a bottom perspective view of a secondary skid plate, according to some embodiments.

[0225] FIG. 143 illustrates a front side perspective view of the top of the secondary skid plate of FIG. 142, according to some embodiments.

[0226] FIG. 144 illustrates a front perspective view of the secondary skid plate of FIG. 142, according to some embodiments.

[0227] FIG. 145 illustrates a rear perspective view of the secondary skid plate of FIG. 142, according to some embodiments.

[0228] FIG. 146A illustrates a top perspective view of a secondary skid plate of FIG. 142 and the track drive protectors of FIGS. 136A-B for use on the snowmobile of FIGS. 8-10, according to some embodiments.

[0229] FIG. 146B illustrates a top perspective view of a secondary skid plate of FIG. 142 and a track drive protector of FIGS. 139A and B for use on the snowmobile of FIGS. 1-7, according to some embodiments.

[0230] FIG. 147A illustrates a cross-sectional side view of the secondary skid plate assembly of FIG. 146A, according to some embodiments.

[0231] FIG. 147B illustrates a cross sectional side view of the secondary skid plate assembly of FIG. 146B, according to some embodiments.

[0232] FIG. 148 illustrates a flowchart for a method of assembling a snowmobile, according to some embodiments.

[0233] FIG. 149 is an exploded side view of the bottom-out protector and the secondary skid plate assembly of FIG. 147A from outboard of the brake side of a snowmobile, according to some embodiments.

[0234] FIG. 150 is a cross-sectional view of the snowmobile with an exploded side view of the bottom-out protector and the secondary skid plate assembly of FIG. 149 from the inboard side of the heat exchanger end cap along the brake side of the snowmobile, according to some embodiments.

[0235] FIG. 151 is an exploded side view of the skid plate, the bottom-out protector, and the accessory skid plate assembly of FIG. 149 from outboard of the brake side, according to some embodiments.

[0236] FIG. 152 is an exploded perspective view of the skid plate, the bottom-out protector, and the accessory skid plate assembly of FIG. 149 from outboard and above the brake side, according to some embodiments.

[0237] FIG. 153 is an exploded side view of the skid plate, the bottom-out protector, and the accessory skid plate assembly of FIG. 149 from outboard and below the brake side, according to some embodiments.

[0238] FIG. 154 is an exploded view of the skid plate, the bottom-out protector, and the accessory skid plate assembly of FIG. 149 from outboard and below the brake side and the heat exchanger assembly, according to some embodiments.

[0239] FIG. 155 is an exploded view of the skid plate, the bottom-out protector, and the accessory skid plate assembly

of FIG. 149 from inboard and below the brake side and the heat exchanger assembly, according to some embodiments.

[0240] FIG. 156 illustrates a perspective view of the accessory skid plate assembly of FIG. 149, according to some embodiments.

[0241] FIG. 157 illustrates a perspective view of a secondary skid plate and track drive protector, according to some embodiments.

[0242] FIG. 158 illustrates a perspective view of a secondary skid plate and track drive protector, according to some embodiments.

[0243] FIG. 159A illustrates a partial bottom view of the track drive protector of FIG. 136B secured to the underside of the brake side of the snowmobile of FIG. 131A, according to some embodiments.

[0244] FIG. 159B illustrates a partial bottom view of the track drive protector of FIG. 136B secured to the underside of the brake side of the snowmobile of FIG. 131A, according to some embodiments.

[0245] FIG. 160A illustrates a bottom view of a snowmobile with a secondary skid plate and track drive protectors on the snowmobile of FIGS. 8-10, according to some embodiments.

[0246] FIG. 160B illustrates a bottom view of a snowmobile with a secondary skid plate and track drive protectors on the snowmobile of FIGS. 1-7, according to some embodiments.

[0247] FIG. 161 illustrates a front view of the snowmobile of FIG. 130B with the secondary skid plate and track drive protector of FIG. 160B, according to some embodiments.

[0248] FIG. 162 illustrates a partial left side view of the snowmobile of FIG. 130B with the secondary skid plate and track drive protector of FIG. 160B, according to some embodiments.

[0249] FIG. 163 illustrates a perspective side view of a forward frame assembly, according to some embodiments.

DETAILED DESCRIPTION

[0250] Embodiments of the present disclosure describe one or more components of a running board assembly, a toe stop, a bottom-out protector, and an accessory skid plate assembly, and combinations thereof, that can be removably secured to one or more vehicles, such as snowmobiles 100. The snowmobiles 100 are generally shown in FIGS. 1-10 and may include a chassis 102, a tunnel 104, a motor or engine 106 (hereinafter referred to as “the engine 106”) attached to the chassis 102 and disposed within an engine bay 108, a drive track 110 disposed within the tunnel 104, and a drivetrain 112 configured to provide motive power from the engine 106 to the drive track 110. The snowmobile 100 further includes one or more skis 114 operably connected to handlebars 116 that are used to turn the snowmobile 100 and a seat 118 for the snowmobile driver/passenger. [0251] As shown in FIG. 11-26B, a running board assembly 120 may include a support member 122 and a running board or foot support member 124 (hereinafter referred to as “the foot support member 124”). The support member 122 may be a tube, may be hollow, and may be comprised of a metal, a metal alloy, a polymeric material, or a fiber reinforced polymer composite. In a non-limiting example, the support member 122 is a steel tube. The rearward end of the support member 122 is removably securable to the tunnel 104, or to a support bracket 184 that is secured to an

interior surface of a side panel **182** of the tunnel **104** by a first plurality of screws or threaded fasteners **126**. As shown in FIGS. **8** and **11**, the rearward end of the support member **122** may extend downwardly from an outboard side **127** of the foot support member **124** and inward to where it is removably attached to a rearward portion **191** of the support bracket **184** that extends below the adjacent portion of the tunnel side panel **182**. As shown in FIGS. **5**, **8**, **70A** and **70B**, the rearward portion **191** may also provide a common mounting point for a rear suspension component **192** positioned in or below the tunnel **104**. In a non-limiting example, a fastener **123** may be inserted through an aperture **194** in the support member **122** and an aperture **193** in the rearward portion **191** to secure the support member **122** to an outward facing surface of the rearward portion **191**, and into an aperture in the rear suspension component **192** to secure the rear suspension component **192** to an inward facing surface of the rearward portion **191**. In an illustrative example, the rear suspension component **192** may be an upper horizontal member of a rear idler arm that is connected to a rear arm of a rear suspension on a skid frame assembly, or a component operably coupled thereto. An example of such an upper horizontal member is shown in U.S. Patent No. 9,771,130, entitled "Snowmobile Skid Frame Assembly", the contents of which are hereby incorporated by reference in its entirety. A forward end **632** of the support member **122** may be removably secured to the snowmobile by, for example, inserting within a tubular rearward leg **326/338** of a forward frame **312** and securing the two tubes together with a removable fastener **125** as best shown in FIGS. **28** and **29**. It is also to be understood that the end of the rearward leg **326/338** may be inserted in the forward end of the support member **122** to secure the two together. The forward frame **312** may be the forward frame assembly described in U.S. Provisional Patent Application No. 63/344,165 filed on May 20, 2022, and entitled "Snowmobile Frame," the contents of which are incorporated by reference in its entirety. The forward end **632** of the support member **122** extends outward, forward, and downward from the rearward leg **326** and transitions into a rearward extending portion that provides an outboard support platform for the foot support member **124**. This provides a continuous tubular member comprised of the support member **122** and the rearward leg **326**, **338** of the forward frame **312**. The continuous tubular member extends from a steering column mount component **328**, shown in FIGS. **41B** and **41C**, located at the top of the forward frame **312** forward of the tunnel **104** and the track drive shaft **352**. One or more fasteners **123**, **125** provide a removable attachment of the support member **122** to the snowmobile **100** in case the support member **122** needs to be removed or replaced. For example, removal of the fastener **123** allows the support member **122** to be decoupled from the rearward leg **326** or **338**. It is to be understood that the forward end **632** and rearward ends **634** of the support member **122** may be fastened to the tunnel **104**, a support bracket **184**, and/or forward frame **312** by removeable threaded fasteners, fir tree fasteners, clips, etc. The support member **122** may alternatively be formed integrally with the tunnel **104**, the foot support member **124**, and/or the forward frame **312**.

[0252] The foot support member **124** provides a support platform for the rider's feet while mounting and riding the snowmobile **100**. In an illustrative example as shown in FIG. **15A**, a first rail **600** defines an inboard side **128** of

the foot support member **124** that is attached to the tunnel **104** or a mounting surface **186** of the support bracket **184** by a second plurality of screws or threaded fasteners **130**. As illustrated in FIGS. **19** and **20**, a second rail **605** of the foot support member **124** defines a channel **131** extending along an outboard side **127** of the foot support member **124** that receives the support member **122** therein. The first rail **600** may be positioned a first distance apart from the second rail **605** at the forward end **622** of the foot support member **124**, and the first rail **600** may intersect or be positioned a second distance apart from the second rail **605** at a rearward end **624** of the foot support member **124**. The second rail **605** may be longer than the first rail **600**. As used herein, inboard may refer to a location or direction closer to the longitudinal centerline of the snowmobile and outboard may refer to a location or direction further from the longitudinal centerline of the snowmobile. As best shown in FIGS. **16**, **19**, **25A** and **25B**, an interior surface of the channel **131** defines a downward facing opening **615** and has a generally semicircular cross section having a radius that is substantially equal to the radius of an outer surface of the support member **122**. The downward facing opening **615** may extend continuously along the length of the channel **131** to allow the support member **122** to be inserted into the channel **131** via the opening **615**. The second rail **605** defines a plurality of retaining members including, but not limited to, flexible curved clips **132** extending from an outer side of the channel **131** toward the downward facing opening **615** of the channel **131**. The retaining members may be integrally formed with the foot support member **124**. A second set of retaining members may be provided, such as clips **133** that are positioned adjacent the cross members **610** and extend from the opposite side of the channel **131** toward the downward facing opening **615** of the channel **131**. The clips **132** and **133** may have a radius substantially equal to that of the channel **131**. The combination of the channel **131** and the clips **132**, and optionally the clips **133**, may have a cross section with a circular sector shape having a measurement greater than 1.02π radians and less than 1.5π radians so that the channel **131** and clips **132** (with or without the clips **133**) wrap around at least 40% of a circumference of the support member **122**, and optionally at least 50% of a circumference of the support member **122**, and optionally between 51% and 75% of a circumference of the support member **122**. The radius of this circular sector is substantially equal to the radius of an outer surface of the support member **122** and is sized so that the flexible clips **132** apply a compressive force to the support member **122** to removably secure the foot support member **124** to the support member **122**. The clips **132** are offset from the clips **133** along the length of the channel **131**. Offsetting the clips **132** and **133** along the length of the channel **131** facilitates insertion and removal of the support member **122** in the channel **131** and maintains the strength of the region of the foot support member **124** forming the channel **131**. The outboard side **127** of the foot support member **124** may be retained to the support member **122** solely by the clips **132** and **133** to allow the support member to be inserted in or removed from the channel **131** without tools. However, it is to be understood that fasteners may be driven through the foot support member **124** and the support member **122** to removably secure the foot support member **124** to the outboard side of the support member **122**. In a non-limiting example, fasteners may be used in combination with the clips **132** and

133 to secure the foot support member **124** to the support member **122**.

[0253] In some examples, the foot support member **124** is formed of a polymeric material. Illustrative polymeric materials may include, but are not limited to, a polyamide, e.g., NYLON 6/6 OR NYLON **12**. In other non-limiting examples, such a polymeric material includes, but is not limited to, polyetheretherketone (PEEK), polypropylene (PP), polyphthalamide (PPA) and/or polybutylene terephthalate (PBT). In some examples, the foot support member **124** may be formed of a composite of a polymer and other materials. For example, the foot support member **124** may comprise a composite including one or more of the above-described polymers and one or more types of reinforcements including, but not limited to, glass and/or carbon fibers, e.g., 30 wt % glass filled polyamide. In a non-limiting example, the fiber % by weight of the composite material may range from 10 wt % to 50 wt %, and may optionally be in the range of 20 wt % to 60 wt %, or optionally in the range of 45 wt % to 55 wt %. In some embodiments, the foot support member **124** includes polymeric material including, but not limited to, Nylon 6/6, Polyetheretherketone (PEEK), Polypropylene (PP), or Polyphthalamide (PPA) as a matrix material with glass, carbon, or ratio of both carbon and fiber material for fiber fill varying in percent volume from 10%-50%, optionally from 40%-60%, and in some embodiments, from 45%-55%. These materials have the advantages of being tough enough to withstand impacts while also being flexible enough to form the flexible clips **132** and **133** so that the flexible clips **132** and **133** may be integrally formed with the foot support member **124**. The polymeric composite materials may comprise a thermal conductivity that is less than 10 W/m·°K, and optionally less than 5 W/m·°K, and optionally less than 1 W/m·°K. This thermal conductivity may provide the benefit of reducing conductive heat loss through a rider's boot from contact with the foot support member **124**.

[0254] The support member **122** and the foot support member **124** are removably attached to the tunnel **104** or to a support bracket **184** that is secured to a side panel **182** of the tunnel **104**. The foot support member **124** is removably secured to the support member **122**, thereby allowing these components to be separately replaced.

[0255] As shown in FIGS. 15A, 21A-21B, and 23A-23B, the foot support member **124** includes a first rail **600**, a second rail **605** that at least partially defines the channel **131**, and plurality of cross members **610** extending between the first rail **600** and the second rail **605**. The cross members **610** partially define a plurality of apertures **134** extending from the first rail **600** to the second rail **605**. These apertures **134** are configured to shed snow or other debris through the cross members **610** of the foot support member **124** and may reduce the weight of the snowmobile and/or the material needed to form the foot support member **124**. The foot support member **124** may define a plurality of ridges **136** that extending from a top surface **138** of the cross members and optionally along the first rail **600**. At least some of the ridges **136** are located intermediate at least some of the apertures **134**. The ridges **136** are configured to enhance traction of a rider's boot with the foot support member **124**. As shown in FIG. 17, the ridges **136** may be notched or serrated to further enhance traction. As best shown in FIG. 16, the inclusion of a series of ridges **136** inboard of the cross members **610** along the first rail **600** provides additional surface

area for boot traction when at least a portion of the forward end of the foot support member **124** is positioned further outboard from the tunnel **104** in a first configuration (running board assembly **120A**) as shown in FIG. 3 than a second configuration (running board assembly **120B**) as shown in FIG. 10. In an illustrative example, the running board assembly **120A** may include a first support tube **122A** (FIG. 58) and a first support bracket **184A** (FIGS. 37A-B), and the running board assembly **120B** may include a second support tube **122B** (FIGS. 37C-D) that is different than the first support tube **122A**, and a second support bracket **184B** that is different than the first support bracket **184A**. Although the support tubes **122A**, **122B** and the support brackets **184A**, **184B** are different, each are still compatible with and can be removably secured to the common foot support member **124**. Accordingly, the same foot support member **124** can be used on different snowmobile configurations or models that arrange the foot support member **124** in a different configuration or position with respect to the tunnel **104**. The series of ridges **136** positioned along the first rail **600** may have a base or a crown that is positioned lower than a corresponding base or crown of the ridges **136** on the cross members **610**, and the base or crown of ridges **136** positioned along the second rail **605** be positioned higher than the corresponding base or crown of the ridges **136** on the cross members **610**.

[0256] In an embodiment as shown in FIGS. 26-31, toe stops **140** are provided. In an illustrative example, the toe stops **140** may be removably securable to one or more of the foot support member **124**, the forward frame assembly **312**, and the tunnel **104** by screws or threaded fasteners **142**. The toe stops **140** may be configured to receive at least a portion of the rider's boots. The front toe stops **140** are positionable at the front end of the running board assembly **120** and may be at least partially disposed within or positioned adjacent to a front cowl or body panel **400** of the snowmobile forming the engine bay **108**. As shown in FIG. 26, the front toe stops **140** define a plurality of openings **144** that are in fluid communication with the engine bay **108** and are configured to exhaust air warmed by the engine **106** from inside the engine bay **108**. These openings **144** may transfer heat from inside the engine bay **108** and direct it toward the toe pocket **222**. The front toe stops **140** may include one or more features to receive and optionally secure the support member **122** thereto. The support member **122** may define a substantially U-shaped configuration along the outboard side **127** of the foot support member **124** with an open end facing rearwardly to accommodate the transition between the toe stops **140** and the foot support member **124**. The front toe stops **140** may comprise a polymeric composite material, optionally the same material used to form the foot support member **124**. For example, the toe stop **140** may comprise a composite including one or more of the above-described polymers and one or more types of reinforcements including, but not limited to, glass and/or carbon fibers, e.g., 30 wt % glass filled polyamide. In a non-limiting example, the fiber % by weight of the composite material may range from 10 wt % to 50 wt %, and may optionally be in the range of 20 wt % to 60 wt %, or optionally in the range of 45 wt % to 55 wt %. In some embodiments, the toe stop **140** includes polymeric material including, but not limited to, Nylon 6/6, Polyetheretherketone (PEEK), Polypropylene (PP), or Polyphthalamide (PPA) as a matrix material with glass, carbon, or ratio of both carbon and fiber material

for fiber fill varying in percent volume from 10%-50%, optionally from 40%-60%, and in some embodiments, from 45%-55%.

[0257] In an embodiment as shown in FIGS. 32-37, a rear kick-up panel 146 is provided. In an illustrative example, the rear kick-up panel 146 extends from the foot support member 122 along a transition length 105 of the tunnel 104 to a part of the bumper assembly, such as an arm 525. In addition to, or alternatively, the rear kick-up panel 146 is supported by the support member 122 on the forward outboard end of the rear kick-up panel 146. The rear kick-up panel 146 may be removably secured to one or more of the rearward end of the foot support member 124, the support bracket 184, the rear bumper 530, and the side panel 182 of the tunnel 104. In a non-limiting example, the rear kick-up panel 146 includes a first rail 500, a second rail 505, and one or more cross members 510 extending between the first rail 500 and the second rail 505. The forward end 147 of the rear kick-up panel 146 may overlap a rearward end of the foot support member 124, and the rear kick-up panel 146 may define one or more apertures 555 that may receive a fastener (e.g., fastener 553 in FIG. 44) to maintain positioning of the foot support member 124 and the rear kick-up panels 146. In an illustrative example as shown in FIGS. 35A and 35C, the foot support member 124 may define one or more slots 557 that are alignable with the apertures 555 in the rear kick-up panel 146. Although the position of the rear kick-up panel 146 may be fixed with respect to the tunnel 104, the slots allow the foot support member 124 to be fastened to the rear kick-up panel 146 in either of the running board assembly positions 120A or 120B. As shown in FIG. 35A, the apertures 555 are located near a rearward end of the slots when in the running board assembly 120A configuration is desired. As shown in FIG. 35C, the apertures are located near a forward end of the slots when the running board assembly 120B configuration is desired. As shown in FIG. 44, a self-tapping (and removable) fastener may be inserted from the bottom of the foot support member 124 through the slot and into the apertures 555 to secure the foot support member 124 to the rear kick-up panel 146. Accordingly, the slots allow for the same foot support member 124 and the same kick-up panel 146 to be used on both running board assembly 120A-B configurations, thereby reducing inefficiencies associated with the production of different components specific to a particular configuration. Although the slots are included on the foot support member 124 and the apertures 555 are included on the rear kick-up panels 146, it is to be understood that the rear kick-up panels 146 could include the slots and the foot support member 124 could include the apertures 555. It is also to be understood that the present disclosure is not limited to a slot and aperture system for allowing the foot support member 124 to be selectively positioned in different configurations with respect to the tunnel 104 and/or the rear kick-up panel 146. As shown in FIGS. 33 and 36, the second rail 505 may define a channel 149 at the forward end 147 that is positioned adjacent the foot support member 124 and is shaped to receive a portion of the support member 122 therein. The first rail 500 and the second rail 505 may extend from the forward end 147 and converge at a rearward end 515 to define a member 520 extending therefrom. As shown in FIG. 17, the member 520 is removably securable to, for example, the side panel 182 of the tunnel 104 and/or an arm 525 extending from the rear bumper 530. In a non-limit-

ing example, the arm 525 may be a hollow member. The member 520 may an upper wall 522 that is positionable on top of an upper surface of the arm 525 to support the rear kick-up panel 146 thereon. An outboard wall 524 of the member 520 overlaps an outboard wall 526 of the arm 525 and defines an aperture for receiving a threaded fastener 535 therethrough. The threaded fastener 535 may be inserted through coaxially aligned apertures on the member 520 and the arm 525 to removably secure the kick-up panel 146 to the rear bumper 530 with, for example, a clip nut 550 positioned on an underside of the member 520 and the arm 525 when installed thereon. The member 520 is optionally removably secured to the side panel 182. As shown in FIG. 36, a flange 540 extends downward from the first rail 500 and is positioned adjacent an edge of a transitional length of the side panel 182 of the tunnel 104, and is removably secured thereto with threaded fasteners 544 inserted from the inner surface of the side panel 182 through apertures 227, that optionally also extend through the body 185 of the support bracket 184 through apertures 188 (as shown in FIGS. 37B and 37D), and outward through the flange 540 and removably secured with nuts 545. The rear kick-up panels 146 may comprise a polymeric composite material, optionally the same material used to form the foot support member 124. The rear kick-up panels 146 may also define apertures 134 and ridges 136 similar to those of the foot support member 124 as shown in FIGS. 34A and 34B.

[0258] In an embodiment, bottom-out protectors 148 may be provided. In an illustrative example as shown in FIGS. 13, 27B, and 30, the bottom-out protectors may project from a portion of the chassis 102 and are configured to inhibit the transmission of forces directly to the chassis 102. The bottom-out protectors 148 are positioned on the chassis 102 in a location lower than the foot support member 124. In a non-limiting example, the bottom-out protectors 148 are positioned at least partially outboard of the tunnel 104, and at least partially inboard of the support member 122 of the running board assembly. The bottom-out protectors 148 may be positioned to contact a ground-based obstacle before another part of the chassis 102. The bottom-out protectors 148 are formed from a resilient material, such as, for example, an unfilled thermoplastic olefin material. In some embodiments, the bottom-out protector 148 may be formed of a fiber reinforced polymer material including one or more of the above-described polymers and one or more types of reinforcements including, but not limited to, glass and/or carbon fibers, e.g., 30 wt % glass filled polyamide. In a non-limiting example, the fiber % by weight of the composite material may range from 20 wt % to 60 wt %, and may optionally be in the range of 20 wt % to 40 wt %, or optionally in the range of 25 wt % to 35 wt %. In some embodiments, the bottom-out protector 148 includes polymeric material including, but not limited to, Nylon 6/6, Polyetheretherketone (PEEK), Polypropylene (PP), or Polyphthalamide (PPA) as a matrix material with glass, carbon, or ratio of both carbon and fiber material for fiber fill varying in percent volume from 10%-50%, optionally from 40%-60%, and in some embodiments, from 45%-55%.

[0259] As shown in FIGS. 37A and 37B, the support bracket 184 is provided with a body 185 that includes a plurality of apertures 188 for receiving the fasteners 126 to secure the support bracket 184 to an interior surface of the side panel 182. As shown in FIGS. 37A and 43, the support bracket includes an upper flange 189 that is positionable

along the underside of the center plate **180** and extends toward a centerline of the tunnel **104**. The upper flange **189** is provided with a plurality of apertures **190** for receiving fasteners therethrough to secure the upper flange **189** to the underside of the center plate **180**. As shown in FIG. **40C**, the tunnel **104** comprises a lower end, the lower end including a first length **103**, a transition length **105**, and a second length **107** extending to a rear end **109** (i.e., a second end) of the tunnel **104**. The support bracket **184** may be configured to extend from the first length **103** to the second length **107** along the transition length **105**. In some embodiments, the first length **103** and the second length **107** may be substantially parallel, with the transition length **105** oriented non-parallel to the first length **103** and the second length **107**. In some embodiments, the first length **103** and the second length **107** may be substantially parallel to the top surface of the tunnel **104**. In some embodiments, the bumper arm **525** may be positioned along the second length **107** of the side panel **182**.

[**0260**] The tunnel **104** of the snowmobile **100** may also include a center plate **180** and a first and second side panel **182**. The first side panel **182** includes a first end that is connected to the center plate **180** and a second, or free, end extending away from the center plate **180**. The second side panel **182** also includes a first end that is connected to the center plate **180** and a second end that extends from the center plate **180**. As shown in FIG. **43**, a first support bracket **184** is secured to an interior surface of the first side panel **182**, and a second support bracket **184** is secured to an interior surface of the second side panel **182**. In a non-limiting example, the support brackets **184** may extend along one or more lengths of the free end of the side panels **182** of the tunnel **104**. The free end of the side panels **182** may comprise a first length, a second length positioned rearward from the first length, and a transition length extending from the first length to the second length. The support bracket **184** may be positioned along at least a portion of one or more of the first length, the second length, and the transition length. The portion of the support bracket **184** positioned along the first length may be secured to the foot support member **124**, the portion of the support bracket **184** positioned along the transition length may be secured to the rear kick-up panel **146**, and the portion of the support bracket **184** positioned along the second length may be secured to a portion of the bumper **530**. Accordingly, the support bracket **184** can reinforce the tunnel **104** to support components positioned outboard thereof. Each support bracket **184** may include a mounting surface **186** extending underneath the second ends of the side panels **182** and outboard from the side panel **182** that the foot support members **124** are removably secured to. The mounting surface **186** may be provided with one or more projections **195** extending outward, and the apertures **187** may be provided on the projections **195**. The apertures **187** for receiving the fasteners **130** for securing the foot support members **124** to the mounting surface **186** may each be positioned at the same distance from the longitudinal centerline of the tunnel **104** as utilized in the running board assembly **120B** configuration. Optionally, one or more of the apertures **187** may be positioned at a greater distance from the longitudinal centerline of the tunnel **104** than the other apertures **187**, as utilized in the running board assembly **120A** configuration.

[**0261**] As shown in FIGS. **44** and **45**, the inboard side of the foot support members **124** may be positioned on top of

the mounting surfaces **186** and the fasteners **130** used to secure the foot support member **124** may be inserted through the apertures **187** in the support bracket **184** and threaded into the foot support member **124**. The fasteners may be inserted into the first rail **600**, the cross member **610**, or an area positioned at the intersection of the first rail **600** and the cross member **610**.

[**0262**] As explained above, the foot support member **124** may be positioned in different configurations with respect to one or both of the chassis **102** and tunnel **104** by modifying one or both of the support member **122** and the support bracket **184**. As shown in FIG. **37A**, the support bracket **184** is provided with a series of the apertures **187** for receiving fasteners **130** for removably securing the foot support member **124** thereto. In a first configuration (running board assembly **120A**) as shown in FIGS. **7**, **37A** and **87B**, the apertures **187** on the mounting surface **186** are positioned along a line that extends progressively outward from the body **185** of the support bracket **184** and the adjacent side panel **182**. In a second configuration as shown in FIGS. **10**, **12**, **37C** and **101**, the apertures **187** on the mounting surface **186** may be positioned the same distance from the body **185** of the support bracket **184**, so that the apertures **187** are positioned along a line parallel to the adjacent side panel **182**. The distance that the forward end of the support member **122** extends outward from the rearward leg **326** and the sides of the snowmobile **100** can be increased or decreased to accommodate the differences between the first and second configurations. Accordingly, the same foot support member **124** can be applied to different snowmobile configurations or models without modification of the foot support member **124**, simply by using a support bracket **184** with a different mounting surface **186** configuration. It is to be understood, however, that different support members could be used with the different support brackets. As shown in FIG. **58**, different support members **122A**, **122B** may be provided to accommodate the different orientation of the foot support member **124** due to the use of different support brackets **184**. When the support bracket **184** shown in FIG. **37A** is used, the support tube **122A** is used and it extends further outboard than the support tube **122B** used when the support bracket **184** shown in FIG. **37C** is used. The rear end of the support tubes **122A**, **122B** are secured to either the side panel **184** of the tunnel **104** and/or the support bracket **184**. The rear end of the support tubes **122A**, **122B** may be secured in the same location on the different snowmobiles, or at different positions. For example, the support tube **122A** may be connected to a first rear suspension, and the support tube **122B** may be connected to a second rear suspension that is different than the first rear suspension.

[**0263**] In a non-limiting example, the support bracket **184** may be used to provide targeted reinforcement to portions of the tunnel **104**, thereby allowing the tunnel **104** to be made of a thinner and lighter gauge of sheet metal or a fiber reinforced polymer. In a non-limiting example, the first side panel **182** comprises a sheet metal or metal alloy that has a first thickness and the first support bracket **184** comprises a sheet metal or metal alloy that has a second thickness that is different than, and optionally greater than the first thickness. In addition to, or alternatively, the tunnel **104** may be comprised of a first material, e.g., aluminum or an aluminum alloy, and the first support bracket **184** may be comprised of a second material, such as steel, that is different than the first material and has a higher value of Young's modulus.

It is to be understood, however, that the support bracket 184 may be comprised of the same material as the tunnel 104.

[0264] With respect to the foot support member 124, the second rail 605 may define a plurality of openings 675 from the top surface 138 to the channel 131 that extend along an outboard side of the second rail 605 and face outwardly from the tunnel 104. Optionally, the second rail 605 may define a second plurality of openings 680 from the top surface 138 to the channel 131 that extend along an inboard side of the second rail 605 and face inwardly toward the tunnel 104. The openings 680 may be offset from the openings 675 along the length of the channel 131. One or more ridges 136 may at least partially define the outer perimeter of the openings 675, and optionally the outer perimeter of the openings 680. As shown in FIG. 25A, the clips 132 may be positioned along the second rail 605 below the openings 675 and extend downward and inward toward the downward facing opening 615. As shown in FIG. 25B, the clips 133 may be positioned along the second rail 605 below the openings 680 and extend downward from the bottom surface 139 of the foot support member 124 and outward towards the downward facing opening 615. The clips 133 may be at least partially positioned along a leading edge 617 of the cross members 610 and extend outward therefrom toward the downward facing opening 615.

[0265] While the running board and running board assembly presented herein is employed on a snowmobile, different embodiments of the running board and running board assembly may be applied to other types of vehicles, such as a snow bike or a personal off-road vehicle.

[0266] FIG. 39 shows a illustrative method 200 of assembling a snowmobile that includes a chassis 102, an engine 106 attached to the chassis and disposed within an engine bay 108, a drive track 110, a drivetrain 112 operatively interconnecting the engine with the drive track 110 and configured to deliver propulsive power to the drive track 110, a tunnel 104 attached to the chassis 102, and a running board assembly 120 attached to the tunnel 104. The method 200 includes the following steps:

[0267] STEP 202, ATTACH A SUPPORT MEMBER, includes attaching a support member 122 to one or more of the forward frame assembly 312, the tunnel 104 and the support bracket 184 to position the support member 122 outboard of the tunnel 104;

[0268] STEP 204, ATTACH INBOARD SIDES OF A FOOT SUPPORT MEMBER, includes attaching inboard sides 128 of a foot support member 124 to the tunnel 104 and/or the support bracket 184 using a plurality of threaded fasteners 130;

[0269] STEP 206, ATTACH THE FOOT SUPPORT MEMBER TO THE SUPPORT MEMBER, includes retaining outboard sides 127 of the foot support member 124 to the support member 122 optionally using a plurality of flexible clips 132 that are integrally formed with the foot support member 124 and are defined on an outboard edge of the foot support member 124. Each of the flexible clips 132 wraps around at least 51% and at most 75% of a circumference of the support member 122. The flexible clips 132 are sized to apply a compressive force to the support member 122;

[0270] STEP 208, ATTACH FRONT TOE STOPS, includes attaching front toe stops 140 to one or more of the foot support member 124, the support member 122, the

tunnel 104, body panels 400, 402, and the forward frame assembly 312;

[0271] STEP 210, ATTACH REAR KICK-UP PANELS, includes attaching rear kick-up panels 146 to one or more of the bumper 530, the support bracket 184, the foot support member 124, the support member 122, and the tunnel 104; and

[0272] STEP 212, ATTACH BOTTOM-OUT PROTECTORS, includes attaching bottom-out protectors 148 to one or more of the tunnel 104, the heat exchanger end cap 178, the forward frame assembly 312, the foot support member 124, the toe stop 140, and body panels 400, 402. The bottom-out protectors 148 may be formed of an unfilled thermoplastic olefin material or a thermoplastic polyurethane material. The bottom-out protectors 148 may be located outboard of at least a portion of the tunnel 104 and inboard of at least a portion of the support member 122, wherein the bottom-out protectors 148 are positioned on the chassis 102 in a location that is lower, i.e., closer to the ground, than the tunnel 104 and the foot support member 124. It is to be understood that steps 202, 204, 206, 208, 210 and 212 may be performed in any order, and that one or more of the steps may be optional.

[0273] As illustrated in a non-limiting example of FIGS. 40A-42D, the snowmobile 100 may include a forward frame assembly 312 including a plurality of tube members. The forward frame assembly 312 may be assembled prior to securing to one or both the tunnel 104 and heat exchanger assembly 174. The forward frame assembly 312 may define a front, a rear, and a longitudinal centerline. The forward frame assembly 312 may include a first side 304 extending substantially along the longitudinal centerline and a second side 306 extending substantially along the longitudinal centerline and spaced apart from the first side 304. Each of the first side 304 and the second side 306 includes an inner perimeter 308 defining a side opening 310. The first side 304 and the second side 306 are positioned to define a rear opening 314 therebetween at the rear of the forward frame assembly 312 for receiving the heat exchanger assembly 174, tunnel 104, or both therein.

[0274] According to one or more aspects of the present disclosure, a forward frame assembly 312 for a snowmobile 100 is provided including a front, a rear, and a longitudinal centerline extending from front to rear. The forward frame 312 includes a first side 304 extending along the longitudinal centerline, a second side 306 extending along the longitudinal centerline and spaced apart from the first side 304. Each of the first side 304 and the second side 306 includes an inner perimeter 308 defining a side opening 310. The first side 304 and the second side 306 define a rear opening 314 therebetween at the rear of the forward frame 312 for receiving a heat exchanger assembly 174 and/or tunnel 104 therein.

[0275] Optionally, the first side 304 defines an outer perimeter 318, the second side 306 defines an outer perimeter 318, and a track drive shaft 352 extends across the forward frame assembly 312. The track drive shaft 352 is positioned rearward of the outer perimeter 318 of the first side 304 and forward of the outer perimeter 318 of the second side 306.

[0276] Optionally, the track drive shaft 352 is positioned rearward of the inner perimeter 308 of the first side 304 and rearward of the inner perimeter 308 of the second side 306.

[0277] Optionally, the second side 306 includes a metal plate or sheet 320 (hereinafter referred to as “the metal

sheet 320”) defining an aperture 322 for receiving the track drive shaft 352 therethrough when the metal sheet 320 is positioned to overlap a heat exchanger end cap 178 of the heat exchanger assembly 174 or a side of the tunnel 104.

[0278] Optionally, the metal sheet 320 of the second side 306 defines a first aperture 324 therein for receiving the track drive shaft 352 in a first position or a second position that is different than the first position.

[0279] Optionally, the second side 306 includes a rearward leg 326, such as a hollow tube, extending upward and forward from the metal sheet 320 to a steering column mount component 328, a forward leg 330, such as a hollow tube, extending upward and rearward to the steering column mount component 328, and a horizontal member 331 (shown in FIGS. 12 and 41A) substantially extending along the longitudinal centerline from the forward leg 330 to the rearward leg 326. An upper end of the metal sheet 320 is shaped to support a rearward end of the horizontal member 331 and is removably secured thereto, and the rearward end of the horizontal member 331 is vertically positioned higher than the front end of the tunnel 104.

[0280] Optionally, the steering column mount component 328 may be configured to secured to the forward legs 330 and the rearward legs 326 (see e.g., FIG. 55-56C). The steering column mount component 328 may include one or more mounting points 333 configured to secured to a steering column.

[0281] Optionally, the first side 304 includes a metal plate or sheet 334 (hereinafter referred to as “the metal sheet 334”) defining an aperture for securing a belt housing assembly 354 thereto when the metal sheet 334 is positioned to overlap the heat exchanger end cap 178 of the heat exchanger assembly 174 and/or a side panel 182 of the tunnel 104.

[0282] Optionally, the metal sheet 334 of the first side 304 defines a first aperture therein for securing the belt housing assembly 354 in a first position as shown in FIG. 42A or a second position as shown in FIG. 42C that is different than the first position.

[0283] Optionally, the first side 304 includes a rearward leg 338 extending upward and forward from the metal sheet 334 to a steering column mount component 328, a forward leg 330 extending upward and rearward to the steering column mount component 328, and a horizontal member 342 substantially extending along the longitudinal centerline from the forward leg 330 to the rearward leg 326, and a rearward end of the horizontal member 342 is vertically positioned higher than the front of the tunnel 104.

[0284] Optionally, a jack shaft, as disclosed in U.S. Pat. Application Serial No. 17/588, 487, entitled ADJUSTABLE BELT DRIVE ASSEMBLY, SYSTEM AND METHOD, filed Jan. 31, 2022, which is commonly owned and incorporated herein by reference in its entirety, extends across the forward frame 312 and is positioned beneath the horizontal member 342 of the first side 304.

[0285] Optionally, a steering column mount component 328 extends between the first side 304 and the second side 306. The first side 304 and the second side 306 each includes a leg 326, 338 extending upward and forward from the rear of the forward frame 312 to the steering column mount component 328.

[0286] Optionally, the steering column mount component 328 includes a first side including a first steering mount 344 that is securable to the steering column assembly shown in

FIGS. 41C, 51A and 51B, and a second side that includes a second steering mount 346 that is securable to the steering column assembly shown in FIGS. 41B, 50A and 50B, wherein the second side is positioned rearward of the first side along the longitudinal centerline.

[0287] Optionally, the first steering mount 344 is positioned forward along the longitudinal centerline of the forward frame assembly 312, of the heat exchanger assembly 174, and the tunnel 104.

[0288] Optionally, the first side 304 includes a rearward tube 338. The rearward tube 338 include a first end extending upward and forward from the metal sheet 334 to a steering column mount component 328, and a second end extending outward from the first side 304. A support member 122 is provided that includes a tube with a first end that is mated with the second end of the first side rearward tube 338 and a second end secured to a rearward portion of the tunnel 104 and/or support bracket 184. The rearward tube 338 of the first side 304 and the tube of the support member 122 define a continuous tubular length extending from the steering column mount component 328 to rearward of the foot support member 124 to a rear suspension component.

[0289] According to one or more aspects of the present disclosure, a method of assembling a snowmobile 100 is provided including providing a preassembled forward frame 312 including a front and rear, the forward frame 312 including a first side 304 and a second side 306. The first and second sides 304, 306 are spaced apart from each other to define a rear opening 314 at the rear of the forward frame 312. At least a portion of a heat exchanger assembly 174, a tunnel 104, or both are positioned in the rear opening 314 between the first side 304 and the second side 306. The preassembled forward frame 312 is then secured to the heat exchanger assembly 174, the tunnel 104, or both.

[0290] Optionally, each of the first side 304 and the second side 306 includes an inner perimeter 308 defining a side opening 310.

[0291] Optionally, the method includes inserting an engine 106 through the side opening 310 of the second side 306 and securing the engine 106 to the forward frame 312.

[0292] According to one or more aspects of the present disclosure, a method of assembling two different snowmobiles with a common forward frame, optionally on a common assembly line, is provided including providing a common forward frame, providing a first rear body component or a second rear body component, securing either the first body component or the second body component to the forward frame, and securing a track drive shaft 352 in a first position with respect to the forward frame when the first body component is secured to the forward frame or securing a track drive shaft 352 in a second position with respect to the forward frame when the second body component is secured to the forward frame, wherein the first position is different than the second position. In a non-limiting example, the first body component and the second body component are different tunnels. In a non-limiting example, the first body component and the second body component are different heat exchanger assemblies. In a non-limiting example, the first body component and the second body component are different support members 122. In a non-limiting example, the first body component and the second body component are different steering column assemblies. In a non-limiting example, the first body component and the

second body component are different front suspensions. In a non-limiting example, the first body component and the second body component are different steering column assemblies. In a non-limiting example, the first body component and the second body component are different toe stops. In a non-limiting example, the first body component and the second body component are different bottom-out protectors.

[0293] Optionally, the method includes securing a belt housing assembly to the forward frame, the belt drive housing defining a track drive shaft opening, wherein the track drive shaft opening is located at a first position with respect to the forward frame when the forward frame is secured to the first rear body component, and wherein the track drive shaft opening is located at a second position with respect to the forward frame when the forward frame is secured to the second rear body component, wherein the first position is different than the second position.

[0294] Optionally, the first body component is a tunnel, a heat exchanger assembly component, or both. Optionally, the first body component is a running board assembly. Optionally, the second body component is a tunnel, a heat exchanger assembly, or both. Optionally the second body component is a running board assembly.

[0295] According to one or more aspects of the present disclosure, a method of assembling two types of snowmobiles with different drive track requirements is provided including providing a common forward frame, providing a first body component with a first drive track requirement and a second body component with a second drive track requirement that is different than the first drive track requirement, wherein at least a first engine mount is provided on one or more of the forward frame, the first body component, and the second body component, positioning either the first body component or the second body component adjacent the forward frame, and securing a belt housing assembly 354 to the first engine mount, the belt housing assembly 354 defining a track drive opening, wherein the track drive opening is located at a first position with respect to the first engine mount when the forward frame is secured to the first body component, and wherein the track drive opening is located at a second position with respect to the first engine mount when the forward frame is secured to the second body component, wherein the first position is different than the second position.

[0296] Optionally, the first body component is a tunnel, a heat exchanger assembly, or both. Optionally the first body component is a running board assembly. Optionally, the second body component is a tunnel, a heat exchanger assembly, or both. Optionally the second body component is a running board assembly.

[0297] According to one or more aspects of the present disclosure, a method of assembling two types of snowmobiles with different drive track requirements is provided including providing a common forward frame including a front and rear, the forward frame including a first side, and a second side spaced apart from the first side to define a rear opening at the rear of the forward frame. The method includes providing a first body component with a first drive track shaft position and a second body component with a second drive track shaft position that is different than the first drive track position. The method includes positioning either the first body component or the second body component in the rear opening between the first side and the second side, providing a belt drive housing that defines a

track drive shaft opening, securing the belt housing assembly to the first side of the forward frame, wherein the track drive shaft opening is located at a first position with respect to the first side when the forward frame is secured to the first body component, and wherein the track drive shaft opening is located at a second position with respect to the first side when the forward frame is secured to the second body component, wherein the first position is different than the second position.

[0298] Optionally, each of the first side and the second side includes an inner perimeter defining a side opening.

[0299] Optionally, the belt housing assembly is secured to the first side for both body components with a jackshaft axis extending through the side openings of the first side and the second side, and a track drive shaft axis positioned outside of an outer perimeter of the first side and inside of an outer perimeter of the second side.

[0300] Optionally, the method includes inserting an engine through the side opening of the second side and securing the engine to the preassembled frame at a position between the first and second sides.

[0301] According to one or more aspects of the present disclosure, a front frame assembly 312 for a snowmobile 100 is provided including a front, a rear, and a longitudinal centerline. The forward frame 312 includes a first side 304 extending along the longitudinal centerline and a second side 306 extending along the longitudinal centerline and spaced apart from the first side 304. Each of the first side 304 and the second side 306 includes an inner perimeter 308 defining a side opening 310. The first side 304 and the second side 306 define a rear opening 314 at the rear of the forward frame 312 therebetween for receiving a heat exchanger assembly 174, a tunnel 104, or both therein.

[0302] Optionally, the first side 304 defines an outer perimeter 318, and the second side 306 defines an outer perimeter 318. A track drive shaft 352 extends across the forward frame 312 and is positioned rearward of the outer perimeter 318 of the first side 304 and forward of the outer perimeter 318 of the second side 306.

[0303] Optionally, the first side 304 defines an inner perimeter 308, the second side 306 defines an inner perimeter 308, and the track drive shaft 352 is positioned rearward of the inner perimeter 308 of the first side 304 and rearward of the inner perimeter 308 of the second side 306.

[0304] Optionally, the second side 306 includes a plate or metal sheet, hereinafter referred to as metal sheet 320, defining an aperture 322 for receiving the track drive shaft 352 therethrough when the metal sheet 320 is positioned to overlap an end cap 178 of the heat exchanger assembly 174, a side panel 182 of the tunnel 104, or both.

[0305] Optionally, the aperture of the metal sheet 320 of the second side 306 defines is shaped to receive the track drive shaft 352 in a first position 322 or a second position 324 that is different than the first position.

[0306] Optionally, the second side 306 includes a support tube or rearward leg, hereinafter referred to as rearward leg 326, extending upward and forward from the metal sheet 320 to a steering column mount component 328, a support tube or forward leg, hereinafter referred to as forward leg 330, extending upward and rearward to the steering column mount component 328, and a horizontal member 331 substantially extending along the longitudinal centerline from the forward leg 330 to the rearward leg 326. An upper end of the metal sheet 320 is shaped to support a rearward end of

the horizontal member 331 and is removably secured thereto, and the rearward end of the horizontal member 331 is vertically positioned higher than a forward end of the tunnel 104.

[0307] Optionally, the first side 304 includes a metal sheet or plate, hereinafter referred to as metal sheet 334, defining an aperture for securing a belt housing assembly 354 thereto when the metal sheet 320 is positioned to overlap an end cap 178 of the heat exchanger assembly 174, a side panel 182 of the tunnel 104, or both.

[0308] Optionally, the metal sheet 334 of the first side 304 defines a first aperture therein for securing the belt housing assembly 354 in a first position as shown in FIG. 42A, and a second aperture therein for securing the belt housing assembly 354 in a second position as shown in FIG. 42C that is different than the first position.

[0309] Optionally, the first side 304 includes a rearward leg 338 extending upward and forward from the metal sheet 334 to a steering column mount component 328, a forward leg 330 extending upward and rearward to the steering column mount component 328, and a horizontal member 342 substantially extending along the longitudinal centerline from the forward leg 330 to the rearward leg 326, and a rearward end of the horizontal member 342 is vertically positioned higher than a forward end of the tunnel 104.

[0310] Optionally, a jack shaft extends across the forward frame 312 and is positioned beneath the horizontal member 342 of the first side 304.

[0311] Optionally, a steering column mount component 328 extends between the first side 304 and the second side 306, wherein the first side 304 and the second side 306 each includes a leg extending upward and forward from the rear of the forward frame to the steering column mount component.

[0312] Optionally, the steering column mount component 328 includes a first side including a first steering mount, and a second side that includes a second steering mount, wherein the second side is positioned rearward of the first side along the longitudinal centerline.

[0313] Optionally, the first steering mount is positioned forward along the longitudinal centerline of the heat exchanger and the tunnel.

[0314] Optionally, the first side 304 includes a rearward tube 338 including a first end extending upward and forward from the metal sheet 334 to a steering column mount component 328, and a second end extending outward from the first side 304, and further including a support member 122 including a tube with a first end that is mated with the second end of the first side tube and a second end secured to a rearward portion of the tunnel 104 and/or support bracket 184, wherein the rearward tube 338 of the first side and the tube of the support member 122 define a continuous tubular length extending from the steering column mount component 328 to a rear suspension component, and/or rearward of the foot support member 124.

[0315] In an embodiment, a method of assembling two different types of snowmobiles with a common forward frame 312 is provided that includes providing a common forward frame 312 including a longitudinal centerline and a support member 122 mounting point 317 positioned outward of the longitudinal centerline, providing a first running board assembly 120A including a support member 122A; providing a second running board assembly 120B including at least one component that is different than at

least one component of the first running board assembly, the second running board assembly 120B including a support member 122B, and securing either the first running board assembly 120A or the second running board assembly 120B to the mounting point 317, wherein the first running board assembly 120B is located at a first position with respect to the longitudinal centerline of the forward frame 312 when secured to the mounting point 317, and wherein the second running board assembly 120B is located at a second position with respect to the longitudinal centerline of the forward frame 312 when secured to the mounting point 317, wherein the first position is different than the second position.

[0316] Optionally, each running board assembly includes a foot support member 124, a support member 122, and optionally a support bracket 184. Optionally, the foot support member 124 is a fiber reinforced polymer composite, and the support member 122 is a hollow tube.

[0317] Optionally, the mounting point 317 extends outward and forwardly from the forward frame 312. Optionally, the mounting point 317 is positioned below an upper surface of a portion of the tunnel 104 that is secured to the forward frame 312. Optionally, the support member 122 of the first running board assembly 120A extends outward from the centerline of the vehicle farther than the support member 122B of the second running board assembly 120B.

[0318] Optionally, the common forward frame 312 includes an A-arm mounting point, and the method may further comprise providing a first suspension assembly (FIGS. 47 and 54) including a control arm and a spindle 492 that includes a lower A-arm ball joint, providing a second suspension assembly (FIGS. 46 and 53) that is different than the first suspension assembly, the second suspension assembly including a control arm and a spindle 490 that includes a lower A-arm ball joint, and securing the A-arm of the first suspension assembly to the A-arm mounting point when the first running board assembly 120A is secured to the mounting point 317 or the second suspension assembly to the A-arm mounting point when the second running board assembly 120B is secured to the mounting point 317, wherein optionally the first lower A-arm ball joint is positioned at a different position with respect to the common forward frame 312 than the second lower A-arm ball joint when the respective suspension assembly is secured to the common forward frame 312. The first suspension assembly may comprise the assemblies disclosed in U.S. Provisional Pat. Application No. 63/310,254 filed Feb. 15, 2022, and entitled "Recreational Vehicle Spindle", U.S. Provisional Pat. Application No. 63/404,856 filed Sep. 8, 2022, and entitled "Recreational Vehicle Spindle", and U.S. Pat. Application Serial No. 17/982,748 filed on Nov. 8, 2022, and entitled "Recreational Vehicle Spindle," the contents of each is incorporated by reference in its entirety. The second suspension assembly may comprise the assemblies disclosed in U.S. Provisional Pat. Application No. 63/310,276 filed Feb. 15, 2022, and entitled "Spindle for a Recreational Vehicle", U.S. Provisional Pat. Application No. 63/404,841 filed Sep. 8, 2022, and entitled "Spindle for a Recreational Vehicle," and U.S. Pat. Application Serial No. 17/988,304 filed on Nov. 16, 2022, and entitled "Spindle for a Recreational Vehicle," the contents of each is incorporated by reference in its entirety.

[0319] Optionally, the support member 122A of the first running board assembly 120A extends outward from the

centerline of the vehicle farther than the support member **122B** of the second running board assembly **120B**, and the lower A-arm ball joint of the first suspension assembly is positioned outward from the centerline of the vehicle a greater distance than the lower A-arm ball joint of the second suspension assembly.

[**0320**] Optionally, wherein the support member **122A** of the first running board assembly **120A** extends outward from the centerline of the vehicle farther than the support member **122B** of the second running board assembly **120B**, and the lower A-arm ball joint of the first suspension assembly is positioned farther forward with respect to the common forward frame **312** than the lower A-arm ball joint of the second suspension assembly.

[**0321**] Optionally, wherein the support member **122A** of the first running board assembly **120A** extends outward from the centerline of the vehicle farther than the support member **122B** of the second running board assembly **120B**, and the lower A-arm ball joint of the first suspension assembly is positioned along the centerline of the common forward frame **312** farther forward from the mounting point **317** than the lower A-arm ball joint of the second suspension assembly.

[**0322**] In a non-limiting example, different snowmobile models may be assembled using a common forward frame assembly by changing one or more of a spindle, a suspension component such as a control or A-arm, and a steering assembly between models. FIGS. **46** and **47** illustrates a side view of a common forward frame assembly **312** with different suspension components including a second spindle **490** and a first spindle **492**, according to some embodiments. FIGS. **48** and **49** show a front view of the two different models utilizing the common forward frame assembly. As shown in FIGS. **49** and **54**, the model with the first spindle **492** may have a wider width or stance than the model shown in FIGS. **48** and **53** with the second spindle **490**. This difference in width may be configured by providing different control arms for the different models (that extend different distances from the vehicle longitudinal centerline). The location of the spindles **490/492** (and/or at least a portion of the attached skis) may be positioned at different locations along the longitudinal centerline of the vehicle. As shown in FIG. **53**, the model may position the second spindle **490** and/or the rearward end of the ski attached to the second spindle **490** farther forward along the longitudinal centerline (and farther forward with respect to the forward frame) than the model with the first spindle **492** and/or the rearward portion of the ski attached to the first spindle **492** (those being positioned further rearward along the longitudinal centerline and further rearward with respect to the forward frame). The height of the two different models may be the same, or different. It is also to be understood that the steering assembly may be the same or different for the different models and may extend forward (FIG. **47**) or rearward (FIG. **48**) of a steering column bracket (shown in FIGS. **56A, B, C**) positioned at the upper portion of the forward frame.

[**0323**] FIGS. **50A-B** illustrate side and front views of a steering column assembly used in the assembly of FIGS. **46** and **48**, according to some embodiments. FIGS. **51A-B** illustrate side and front views of the steering column assembly used in the assembly of FIGS. **47** and **49**, according to some embodiments. FIGS. **52A-B** illustrate side and front views of the different steering column assemblies superimposed for comparison of the location of the different steering

column assemblies when mounted to the forward frame, according to some embodiments. In a non-limiting example, the lower forward end of both steering columns are secured to the same location on the forward frame assembly **312**.

[**0324**] FIGS. **53** and **54** illustrate a top-down view of forward frame, suspension, and engine components in a second configuration (FIG. **53**) and a first configuration (FIG. **54**), according to some embodiments.

[**0325**] FIG. **55** illustrates a top-down view of a forward frame assembly with steering column bracket, according to some embodiments; and FIGS. **56A-C** illustrate perspective views of a steering column bracket, according to some embodiments. The steering column bracket may include the one described in U.S. Provisional Pat. Application No. 63/344,165 filed on May 20, 2022, and entitled "Snowmobile Frame," the contents of which are incorporated by reference in its entirety.

[**0326**] FIG. **57** is a view of a polymeric assembly including one or more of the foot support member **124**, the toe stop **140**, the bottom out protector **148**, a rear kick-up panel **146** (not shown) and a body panel **400** or **402**. The polymeric assembly may extend from the front of the vehicle to the bumper **530**. Optionally, the polymeric assembly comprises one or more components that are positioned outboard of the side panel **182** of the tunnel **104** and extend rearward from the track drive shaft **352** to a point rearward of the fuel tank **650**, and optionally to the bumper **530**.

[**0327**] FIG. **58** is a side view of two different running board support tubes **122A, 122B** used for two different models for comparison purposes. As shown, the one model (high performance) includes the support tube **122A** that extends further outboard from the forward frame and is secured to the suspension assembly at a point higher than the support tube **122B** for the other model that does not extend outboard as far from the forward frame.

[**0328**] FIGS. **59-68** illustrate a seat support assembly in an illustrative embodiment. The support assembly may include a fuel tank **650** with mounting features **658** for securing a seat or seat frame **652** thereto. A rear panel **656** slidingly engages the fuel tank **650** to define a compartment **668** therebetween that may be used for storage or to house a battery **660** therein. The mounting features **658** may be integral with the fuel tank **650** and may provide a locking feature with the seat frame to provide for more stability both vertically, laterally, and in the forward/rearward directions. The mounting features **658** may be positioned on a raised portion of the fuel tank that may have a triangular shape that is at least partially surrounded by a flat or flangelike surface. A seat fastener feature **662** may be provided on the rear panel **656** for engaging a portion of the seat or the seat frame **652**. The underside **664** of the fuel tank **650** may be upwardly recessed along the lower perimeter to slidingly receive extensions **666** of the rear panel **656** therealong so that the extensions **666** of the rear panel **656** are positioned between the underside **664** of the fuel tank **650** and the upper surface of the tunnel. As shown in FIG. **65**, a removable accessory mount **181** may be secured to both the tunnel **104** and the support bracket **184**. As shown in FIG. **63**, the fuel tank **650** may have a convex outer shape and may be almost entirely contained within the rider envelope (all positioned inboard of the upper legs of the front frame member and greater than 95% of the fuel tank volume is positioned inboard of the tunnel side walls, and optionally greater than 97% of the fuel tank volume is positioned inboard of the

tunnel side walls, and optionally 99% or greater. The seat assembly may include the one described in U.S. Provisional Pat. Application No. 63/350,553 filed on Jun. 9, 2022, and entitled “Snowmobile with Seat and Gas Tank Assembly,” U.S. Provisional Pat. Application No. 63/404,682 filed on Sep. 8, 2022, and entitled “Snowmobile with Seat Assembly,” and U.S. Pat. Application Serial No. 17/988,111 filed on Nov. 16, 2022, and entitled “Fuel Tank and Seat Assembly for a Vehicle,” the contents of each of which are incorporated by reference in its entirety.

[0329] FIGS. 69 and 70 show a structural composite taillight housing 700 that is positioned on the upper surface of the rearward end of the tunnel 104. The composite may comprise a polymeric matrix and a fiber reinforcement. The structural composite taillight housing 700 houses the taillight and provides a structural reinforcement on the upper surface of the rearward end of the tunnel 104 that optionally may allow for thinner gauges of tunnel material and may optionally eliminate internal tunnel reinforcements at the rearward end. The structural composite taillight housing 700 also provides a plurality of mounting points 701 for a snow flap 702 that helps to maintain the snow flap position away from the track and rear suspension components. As shown in FIGS. 69 and 70, the ends of the structural composite taillight housing 700 extend around the sides of the rear bumper or grab bar and may engage the outer sides of the snow flap 702. The structural composite taillight housing and the snow flap may include those described in U.S. Provisional Pat. Application No. 63/400,056 filed on Aug. 23, 2022, and entitled “Taillight Housing, Snow Flap and Assembly Thereof,” U.S. Pat. Application Serial No. 17/979,091 filed on November 2, and entitled “Snow Vehicle Heat Exchanger Shield,” and U.S. Pat. Application Serial No. 17/979,066 filed on Nov. 2, 2022, and entitled “Taillight Housing, Snow Flap and Assembly Thereof,” the contents of each of which are incorporated by reference in its entirety.

[0330] As discussed above with reference to FIGS. 26-31, a toe stop 140 is provided. In a non-limiting example, the toe stop 140 may be attached to the foot support member 124 and may be shaped to house a vehicle component and/or receive the rider’s foot. Additional views of a toe stop 140 are illustrated in FIGS. 57, 66, and 71-76. A first embodiment of a pair of toe stops 140a/140b with one or more of the features described below is illustrated in FIGS. 74, and 77-89 that is configured for the first snowmobile of FIGS. 1-7 and the first running board assembly 120A. A second embodiment of a pair of toe stops 140c/140d with one or more of the features described below is illustrated in FIGS. 90-101 that is configured for the second snowmobile of FIGS. 8 - 10 and the second running board assembly 120B. The figures illustrate the toe stop 140 from the front/forward side 10, rear/rearward side 12, the top 14, the bottom 16, the outboard side 127, and the inboard side 128.

[0331] In one aspect, the toe stop 140 is a unitary body that can define a toe pocket 222 for receiving the rider’s foot. In some implementations, the toe stop 140 is a molded polymeric, and optionally a molded polymeric composite material. In another aspect, the toe stops 140 may be a right (or belt-side) toe stop 140a/140c and a left (or brake-side) toe stop 140b/140d (see e.g., FIG. 66). As discussed below in greater detail, the right and left toe stops 140a/140c, 140b/140d may have different shapes to, for example, accommodate the different composite running board assemblies

120A/120B associated with different snowmobiles. In addition to or alternatively, the toe stop 140 includes one or more features that at least partially house vehicle components including, but not limited to, the belt case assembly or the brake assembly. Thus, parts can be reduced and assembly simplified. In one aspect, the toe stop 140 defines a recess/space to receive one or more internal components. In an aspect, although the toe stops 140a/140c and 140b/140d are shaped differently to, for example, accommodate different vehicle component positions and or running board assemblies on different snowmobiles, the toe stops 140a/140c and 140b/140d may include common mounting features configured to be used, for example, with the common forward frame assembly 312 and any body paneling (such as 400 and 402) that is common between the different snowmobiles 100.

[0332] The toe stop 140 may include one or more of the following features: a bottom flange 176 that is engageable with a forward end of the foot support member 124, an outboard wall 197 that is engageable with a body panel 400 and/or 402, a forward wall 163, a toe hook 141, an inboard wall 171/173 that may at least partially house a vehicle component, and a rearward wall 230 that may partially house a vehicle component. The toe stop 140 may be removably secured to one or more components, including, but not limited to, the foot support member 124, the forward frame 312, the bottom-out protector 148, the support member 122, the heat exchanger end cap 178, the body panels 400, 402, and the tunnel 104. For example, the toe stop 140 may be removably secured to mounting features 135/137 of the foot support member 124 (see e.g., FIGS. 21A-B, 31, 87B, 99B, and 101). The toe stop 140 may also be removably secured to mounting features 424/426 of the bottom-out protector 148 (see e.g. FIGS. 27B, 44). Accordingly, the flange portions at the forward end of the foot support member 124 defining the mounting features 135/137 may be positioned between the bottom flange 176 of the toe stop 140 and the mounting features 424/426 of the bottom-out protector 148.

[0333] Optionally, the toe stop 140 includes one or more ribs 153/179 (see e.g., FIGS. 80A, and 92B). One or more ribs 179 may be located on the forward surface of the forward wall 163. One or more ribs 153 may be located on the inboard surface of inboard wall 171/173 and/or the forward surface of the rearward wall 230. In one aspect, the ribs 153/179 strengthen areas of the walls 163/171/173/230 where openings 144/162/175/231 are located. The toe stop 140 may be removably secured to one or more components, including, but not limited to, the foot support member 124, the forward frame 312, the bottom-out protector 148, the support member 122, the heat exchanger end cap 178, and the tunnel 104.

[0334] The bottom flange 176 forms a bottom surface of the toe stop 140. The bottom flange 176 may have a zig-zag configuration (see e.g., FIGS. 79B and 93B). In some implementations, the bottom flange 176 is wider than in other implementations. In some embodiments, the rearward end region of the bottom flange 176, adjacent to the rearward wall 230, is narrower than the other regions (see e.g., FIGS. 77B and 79B). In some embodiments, the bottom flange 176 has a narrow portion between two wider portions (see e.g., FIG. 93B). The bottom flange 176 includes one or more apertures or slots 165 that are aligned with the mounting features 135/137 of the foot support member 124 to receive a fastener 142 for removably coupling the toe stop

140 to the running board assembly 120 (see e.g., FIGS. 31 and 71). Slots 165 may be U-shaped. The location of one or more of the slots 165 may differ between embodiments of the toe stop 140 (e.g., compare the positions of the inboard, rearward slot 165a in FIGS. 79B and 93B) to account for the different positions of the foot support member 124 in the different running board assemblies 120A, 120B. In one non-limiting example, the slot has a diameter of 5 mm to receive a fastener with a 10 mm diameter head. The bottom flange 176 may extend from the rearward wall 230, the inboard wall 171/173, and/or the forward wall 163 (see e.g., FIG. 72). In at least one embodiment, an opening 177 is defined by the bottom flange 176, and the flange portion 129 of the foot support member 124. The opening 177 is positioned below the toe pocket 222 defined by the toe stop 140. Although the opening 177 is shown as being defined by the toe stop 140 and the foot support member 124, it is to be understood that the opening 177 may be entirely defined by the toe stop 140, or the opening may be entirely defined by the foot support member 124.

[0335] For example, as shown in FIGS. 71 - 73, the toe stop 140 may be positioned with the bottom flange 176 positioned over the flange at the forward end of the foot support member 124 with the slots 165a/b of the toe stop 140 aligned with the openings or mounting features 135/137 defined by the foot support member 124 flange to receive the fasteners 142 to removably secure the toe stop 140 thereto. As shown in FIGS. 86B and 87B, one of the openings 135 in the foot support member 124 flange (covered by the bottom-out protector) may be positioned forward of the track drive shaft axis of rotation 350, and opening 137 may be positioned rearward of the track drive shaft axis of rotation 350. For example, the outboard portion of the foot support member 124 may extend forward of the track drive shaft axis of rotation 350, and the inboard side of the foot support member 124 may be positioned rearward of the track drive shaft axis of rotation 350. Similarly, one of the slots 165b on the toe stop 140 (corresponding to the opening 135) may be positioned forward of the track drive shaft axis of rotation 350 and the slot 165a (corresponding to the opening 137) may be positioned rearward of the track drive shaft axis of rotation 350, and both may be positioned outboard of the inboard wall 171. Accordingly spacing is provided for the inboard wall 171 of the toe stop 140 to define a chamber for housing one or more vehicle components while still providing sufficient spacing for the opening 177 to be defined by the toe stop 140 and the foot support member 124 to allow snow to pass therethrough. In another non-limiting example as shown in FIG. 101, the mounting features 135/137 of the foot support member 124 and the openings 165a/165b of the toe stop 140 may all be positioned rearward of the track drive shaft axis of rotation 350. As described in detail below, the bottom-out protector 148 may be removably secured to the underside of the foot support member 124 flange and removably secured thereto to define the opening 177 on the underside of the foot support member 124 (see e.g., FIGS. 31, 57, 86B, and 101) that is aligned with the opening 177 partially defined by the toe stop 140.

[0336] In an illustrative example, the slots 165a, 165b of the toe stop 140 (for use with the running board assembly 120A) may be positioned further outboard from the inboard wall 173 and/or other features on the toe stop 140. In addition to, or alternatively, the slots 165a, 165b (and the flange 176) of the pair of toe stops 140c, 140d (for use with running

board assembly 120A) may be positioned further outboard from the inboard wall 173 and/or other features on the toe stop 140 than the slots 165a, 165b of the pair of toe stops 140a, 140b (for use with the running board assembly 120B). Changing the location of such features between the pairs of the toe stops 140 allows for the toe stops 140 to be compatible with common components, such as the forward frame 312, between the snowmobile of FIG. 1 and the snowmobile of FIG. 8, as well as with components that are not common or commonly configured (such as the running board assemblies 120A and 120B) between the snowmobile of FIG. 1 and the snowmobile of FIG. 8.

[0337] In an illustrative example as shown in FIGS. 74, 77B, 78B and 91A, the outboard wall 197 is positioned at least partially forward of the bottom flange 176 of the toe stop 140. The outboard wall 197 may have a shape that is configured to extend along the toe pocket 222 and include a side panel interface 154 that may be at least partially overlapped by the body paneling 400 and optionally the skid plate 402. The outboard wall 197 may be configured in a V-shape (see e.g., FIGS. 78A-7B). For example, the apex of the V may be oriented towards the outboard side of the snowmobile 100 (see e.g., lines 36 and 37 of FIG. 96A). The side panel interface 154 includes a first portion 198 and a second portion 199 extending forward from the first portion 198 and forward of the toe pocket 222 defined by the toe stop 140 (see e.g., FIG. 27A). One or more ribs 152 extend out from the second portion 199 that is overlapped by one or both of the body paneling 400 and the skid plate 402. The ribs 152 may extend outboard for different lengths (see e.g., FIG. 83B).

[0338] Optionally, the outboard wall 197 may include a feature for removably securing the body panel 400 and/or the skid plate 402 thereto. In an illustrative example, the feature may be a mounting point 155 or aperture that is positioned below the bottom rib 152 along the outboard wall 197. The mounting point 155 may be configured to receive a U-clip (see e.g., FIG. 89) that is coaxially aligned with an aperture defined in the mounting point 155. A fastener 321 may be utilized to removably couple the toe stop 140 and the body panel 400 and/or the skid plate 402 together. A skid plate interface 156 extends forward from the first portion 198 and may be positioned below the mounting point 155 (see e.g., FIGS. 26, 27A, and 30). In some implementations, an interior/inboard face of the skid plate 402 overlaps and/or directly contacts the skid plate interface 156 (see e.g., FIG. 85A).

[0339] When the toe stop 140 is coupled to the snowmobile 100, the first portion 198 is visible 198 while the second portion 199 including the interfaces 154/156 is positioned behind the body panel 400 and/or the skid plate 402 and is not visible, or only partially visible, when viewed from the side (see e.g., FIGS. 85A-B and 98A-B). The first portion 198 is positioned along the length of the vehicle between the body panel 400 and the support member 122. In some implementations, the one or more ribs 152 about the inboard (inner) surface of the body panel 400 - in other words, the body panel 400 rests on the one or more ribs 152. In one aspect, the space between adjacent ribs 152 and the body panel 400 provide a passageway for air to vent, e.g., underhood hot air may vent (see e.g., FIG. 76). In a non-limiting example, the ribs 152 provide a standoff between the toe stop 140 and the body paneling 400 to define a gap therebetween that is a ventilation feature positioned outboard of

the toe pocket 222 for air to flow out of the engine compartment and/or the belt case assembly 354 covered by the body paneling 400 and/or the toe stop 140. As the first portion 198 extends rearward and outboard of the second portion 199, the air flowing out of the gap defined by the toe stop 140 and the body panel 140 deflects off the first portion 198 and flows outboard away from the rider's envelope

[0340] The forward wall 163 at least partially defines the toe pocket 222 and separates the toe pocket 222 from the engine compartment. The forward wall 163 may include a lower wall that extends forward and upward from the bottom flange 176, and an upper wall that extends forward and downward from an upper panel 240 of the toe stop 140 (that is positioned forward of the toe grip 141) at least partially forward of the support member 122 and the mounting point 317 of the forward frame 312 to intersect the lower wall. The forward wall 163 may form a V-shape with the apex positioned forward (just below the openings 144) and the open end facing rearward (see e.g., FIG. 77B). The forward wall 163 may form the rearward side of the outboard wall 197 (see e.g., FIG. 74). As shown in FIGS. 74, and 78A-78B, the forward wall 163 may extend inboard from the outboard wall 197 to the inboard wall 171. As discussed above, the forward wall 163 may include one or more openings 144. The openings 144 may extend horizontally from the outboard wall 197 to the inboard wall 171, may optionally only be provided in the upper wall of the forward wall 163. Placement of the openings 144 at the upper portion of the toe pocket 222 allows warm air to flow downward from the engine compartment or belt casing 354 and across the toe pocket 222 while inhibiting snow from entering the engine compartment.

[0341] In some implementations, the toe stop 140 is an abutment for one or more components of the running board assembly 120. For example, a portion of the forward wall 163 and/or the outboard wall 197 may form a channel 161 with a rearward facing support face 167 for the support member 122 (see e.g., FIG. 73). In other words, the support member 122 is positioned adjacent to the rearward side of the forward wall 163 and/or outboard wall 197 along the support face 167. As illustrated for example, in FIGS. 85A-85B, when the toe stop 140 is coupled to the snowmobile 100, the support member 122 extends along the forward end of the foot support member 124 where it is received by the toe stop 140 along the lower and upper portions of the rearward facing side of the toe stop 140 (along support face 167). The support member 122 is positioned in the vertical channel 161 as the support tube 122 extends upward and rearward from its forwardmost point of the forward wall 163 before extending inboard through the clearance feature 160 to where it is inserted in the end of the rearward leg 326 or 338 and removably secured thereto with the fastener 125 at the mounting point 317 of the forward frame 312. In some embodiments, the rearward leg 326, 338 may be referred to as a tube extending downward and rearward from the steering column mount. The support member 122 may be exposed on the outboard side 127 - in other words it is not covered by a body panel 400, or toe stop 140. The support member 122 may form a continuous tube with the rearward leg 326, 338, the continuous tube may extend from the steering column mount to the rear suspension component 192. In some embodiments, the support member 122 (also referred to as a "member" or "tube") may be secured to the rear suspension component 192. The rear suspension component

192 may be a component of a rear suspension 111 of the snow vehicle, the rear suspension component 192 connected with a skid rail 115. In some embodiments, the rear suspension 111 may include a rear arm 117 pivotally secured to the skid rail 115. The support member 122 may include a forward portion 360, including a base 362 positioned outboard from a lower edge of the side panel of the tunnel 104, a vertical leg 364 extending upward from the base 362, and a horizontal leg 366 extending inboard from the vertical leg 364. The horizontal leg 366 may define a first end that is secured to the forward frame 312 at the mounting point 317. The support member 122 may include a rearward portion 370 including a rear base 372 and a leg 374. The rear base 372 may be positioned outboard from a lower edge of a side panel of the tunnel 104, and the leg 374 may include an end that extends inboard from the rear base 372 and is operably secured to the rear suspension component 192.

[0342] The toe stop 140 may include one or more features such as a toe hook 141 (see e.g., FIG. 74) positioned in and/or above the toe pocket 222 that provides a grip for the rider's foot. In one aspect, since the toe hook 141 is a part of the unitary toe stop 140, the toe hook 141 is not directly fastened to the frame. In another aspect, since the toe stop 140 is polymeric composite material, the toe stop 140 is not a metal tube, stamped or formed part like a conventional toe stop. In at least one embodiment, the toe hook 141 includes a curved bottom (see e.g., FIG. 81A). In some implementations, the toe hook 141 when viewed from an inboard side includes a recess and a triangular shaped rear wall extending upward from the recess (see e.g., FIG. 80B). The recess of the toe hook 141 as shown in FIG. 90B may have a rectangular or U shape that produces a rectangular or U shape for the toe hook 141 as shown in FIG. 90A.

[0343] In at least one embodiment, the toe hook 141 is adjacent to a panel 168 that extends inboard therefrom. In some implementations, the toe hook 141 includes an angled edge 234 that extends from the outboard end of the upper edge of panel 168 downward and inward towards the inboard wall 171 (see e.g., FIG. 78A). In one example, the rearward side of the toe hook 141 is an extension of the panel 168 (see also FIG. 78B). In other implementations, the toe hook 141 is positioned under the panel 168 (see e.g., FIGS. 90A and 92A) and the panel 168 extends upward and rearward therefrom. The toe hook 141 may be at least partially positioned rearward of the forward wall 163. The forward wall 163 may extend further outboard than the toe hook 141 (see e.g., FIGS. 78A, 83A, and 92A) to accommodate the forward end of the support member 122. In some implementations, an upper panel 240 is positioned between the forward wall 163 and the toe hook 141 (see e.g., FIG. 91A).

[0344] One or more of the outboard wall 197, the inboard wall 171/173, the forward wall 163, the upper panel 240, and the toe hook 141 may define a toe pocket 222 configured to receive at least the toe portion of the rider's foot. In some implementations, the bottom flange 176 and forward wall 163 is substantially C-shaped, with an upper portion of the forward wall 163 curving rearward to form a ceiling of the toe pocket 222 (see e.g., FIG. 31). In other implementations, the upper panel 240 extends rearward from the forward wall 163 to the toe hook 141 to at least partially form the ceiling of the toe pocket 222 (see e.g., FIGS. 74 and 77A). As shown in FIGS. 91A and 94A, at least a portion of the toe

hook **141** extends downward into the toe pocket **222** below the upper panel **240**.

[0345] Optionally, a clearance feature **160** may be positioned forward of and/or above the toe hook **141** (see e.g., FIG. **74**) and rearward of the first portion **198**. The clearance feature **160** is sized to receive the support member **122** forward of the toe hook **141** (see e.g., FIG. **27A**) so that the support member **122** extends inboard forward of the panel **168**. In one example, the clearance feature **160** is a U-shaped slot. In some implementations, the U-shaped clearance feature **160** is formed by the panel **168**, panel **240**, and the outboard wall **197** (see e.g., FIGS. **74** and **91A**). The support member **122** may extend alongside and/or rest against the forward facing surface **166** of the panel **168** (see e.g., FIGS. **75** and **88A**).

[0346] The inboard wall **171/173** extends rearward from the forward wall **163**. In one aspect, an inboard surface of the inboard wall **171/173** defines at least a portion of a chamber for receiving a vehicle component therein and thereby separates the rider's foot therefrom. In a non-limiting example, the inboard wall **171** defines a chamber **228** that receives one or more of a belt case assembly including, but not limited to, a belt, a bottom drive sprocket or gear, a belt housing assembly **354**, and a track drive shaft **352**. Accordingly, the toe stop **140** can eliminate the need for a separate housing components. For example, the belt case does not require a separate cover, which reduces the weight of the belt housing assembly **354** (see e.g., FIG. **28**). A portion of the inboard wall **171** may be positioned under the toe hook **141** that extends outboard from the inboard wall.

[0347] In an illustrative example, inboard wall **173** may define a chamber **228** that receives a brake component including, but not limited to, a track drive shaft, a rotor **351** and/or a caliper **353** (see e.g., FIG. **88A**). As shown in FIGS. **81A**, **81B**, **94A** and **94B**, the inboard wall **173** may define a second chamber **229** that extends outboard to receive a portion of the brake assembly or drive shaft therein. In one illustrative example, the second chamber **229** receives an end of the drive shaft **352**. The shape of the inboard wall **171/173** and one or more other dimensions of the toe stop **140** such as the width from inboard side to outboard side of the toe stop **140** may differ depending on the drive shaft position of the snowmobile **100** and/or the orientation of the foot support **124**. For example, the toe stops **140** shown in FIGS. **77** and **81** may be part of the running board assembly **120A** of FIG. **7** wherein the track drive shaft is positioned as shown in FIGS. **42A** and **42B**. The toe stops **140** shown in FIGS. **90** and **94** may be part of the running board assembly **120B** of FIG. **10** wherein the track drive shaft is positioned as shown in FIGS. **42C** and **42D**. The inboard wall **171/173** may include one or more openings for venting. For example, the inboard wall **171** may include one or more openings **162** (see e.g., FIG. **90B**). As another example, the inboard wall **173** may include one or more openings **175** for venting the brake caliper (see e.g., FIG. **81A**). As shown in FIG. **85B**, the brake caliper **353** may extend through the opening **175** and outboard of at least a portion of the inboard wall **173**.

[0348] The inboard wall **171/173** may curve inboard to form the rearward wall **230** (see e.g., FIGS. **73**, **77A** and **96A**) that with the inboard wall **171/173** may define the chamber **228/229** for receiving the vehicle component therein (see e.g., FIGS. **78B**, **81B**, **83B**, **87B**). The inboard side of the rearward wall **230** may be positioned adjacent the

side panel **182** of the tunnel **104** and/or the heat exchanger end cap **178** to form the chamber **228/229** with the inboard wall **171/173** and the side panel **182** and/or heat exchanger end cap **178**. The heat exchanger end cap **178** may include those described in U.S. Provisional Pat. Application Serial No. 63/405,176 filed on Sep. 9, 2022, and entitled "RECREATIONAL VEHICLE HEAT EXCHANGER END CAPS AND ASSEMBLY," the contents of which are incorporated by reference in its entirety. The rearward wall **230** may be shaped to conform with the shape of the component that is housed in the chamber **228/229**. In an illustrative example, the rearward wall **230** is shaped to conform with the lower portion of the belt assembly **354** as shown in FIG. **29**. In some embodiments, the belt assembly **354** may include a chain assembly and may be received by the toe stop **140** and the bottom out protector **148**. The belt assembly **354** may include a separate cover from the toe stop **140** and the bottom out protector **148**. In another illustrative example, the rearward wall **230** is shaped to conform to the shape of a brake rotor **351** as shown in FIGS. **87B** and **88A**. The rearward wall **230** may include one or more openings **231** (see e.g., FIG. **96A**) for providing ventilation to the component housed in the chamber **228/229**.

[0349] The panel **168** may extend inboard from the toe hook **141** and be positioned above the inboard wall **171/173**. In some implementations, the rearward surface of the lower portion of the panel **168** abuts or otherwise intersects the rearward surface of the toe hook **141** (see e.g., FIGS. **66** and **74**). The panel **168** may extend outboard from the inboard side of the toe stop **140** at an angle that is different than the angle that the toe hook **141** extends outboard from the inboard side **171/173**. Accordingly, the inboard side of the panel **168** may be positioned rearward of the outboard end of the panel **168** (see e.g., FIG. **66**). The inboard side of the panel **168** may be positioned rearward of the toe hook **141**, and the outboard side of the panel **168** may intersect the toe hook **141**. The panel **168** may include one or more openings **169**. Openings **169** may vent air from the engine bay **108**. In one example, the panel **168** has three openings **169** (see e.g., FIG. **75**). In another example, the panel **168** has four openings **169** (see e.g., FIGS. **26** and **77**). Optionally, one or more ribs **170** may extend over the openings **169** (see e.g., FIG. **26**). The ribs **170** may be positioned on the forward side of the panel **168**. In one aspect, the ribs **170** add strength to the panel **168**.

[0350] The panel **168** may include an attachment feature **158** to couple the toe stop **140** to the body panel **400** (see e.g., FIGS. **85A-85B**). For example, the upper edge of the panel **168** may include the attachment feature. In some implementations the attachment feature **158** is a hook feature - e.g., the panel **168** includes a hook feature configured to mate with a hook feature of the body panel **400**. In other implementations, the panel **168** includes a ledge surface configured for the bottom edge of the body panel **400** to rest upon. The attachment feature **158** may extend along the upper edge of the panel **168** from the outboard side to the inboard side and is positioned forward of a frame mount member **150** extending therefrom.

[0351] The frame mount member **150** provides an aperture **151** or another feature for removably securing the toe stop **140** to the forward frame **312**. The frame mount member **150** may extend upward from the upper portion of the panel **168**. In one example, the frame mount member **150** extends upward and forward from the panel **168** (see e.g.,

FIG. 27A). In some implementations, the frame mount member 150 extends along only a portion of the upper end of the panel (see e.g., FIG. 66). In other implementations, the frame mount member 150 extends along a majority of the upper end of the panel 168 (see e.g., FIG. 71). In one example, the frame mount member 150 is positioned in the middle of the panel 168 (see e.g., FIG. 90). Optionally, the frame mount member 150 further includes one or more apertures 164 (see e.g., FIG. 71).

[0352] The frame mount member 150 may include one or more mounting apertures 151. In one aspect, the toe stop 140 may be coupled to a mounting member 327 of the forward frame 312 by the frame mount member 150. The mounting member 327 is coupled to the rearward leg 326/338 and includes one or more apertures 325 (see e.g., FIGS. 31 and 71). In an illustrative example, the mounting member 327 has a lower aperture 325a, a middle aperture 325b, and an upper aperture 325c that may be utilized for the attachment of different snowmobile components, including the toe stop 140. The frame mount member 150 may be positioned on the mounting member 327 and a fastener 172 may extend through an aperture 151 in the frame mount member 150 and through an aperture 325 in the mounting member 327 (see e.g., FIG. 66). In an illustrative example, the toe stop 140 may be attached via the lower aperture 325a of the mounting member 327 and a guard member 355 may be attached via the middle aperture 325b of the mounting member 327 (see e.g., FIGS. 59, 66, and 88A). The frame mount member 150 may be coupled to the rearward side of the mounting member 327 (see also, FIGS. 27A, and 28). When the toe stop 140 is coupled to a snowmobile 100, the frame mount member 150 is positioned inside the chamber formed by the body panel 400 (see e.g., FIGS. 85A-85B and 98A-98B) and the panel 168, so that it is not visible on the exterior of the snowmobile with the body panel 400 installed.

[0353] The toe stop 140 may include one or more sensor mount/mounting features 143 for a sensor 145 (see, FIGS. 26, 27A, 79A-79B). The sensor mount 143 may be located or otherwise accessible from the inboard surface of the inboard wall 171/173. In an illustrative example, the inboard wall 171 may include a sensor mount 143 (see e.g., FIGS. 77A, 80A, 80B, 90A, 90B, and 91B). As shown in FIG. 26, the sensor 145 may include a wire/cable 183 and a connector 196 (see e.g., FIG. 29). In some embodiments, the sensor 145 is a speed sensor that detects movement of the track drive shaft or a component operably connected thereto. At least a portion of the sensor 145 may be fabricated from a polymeric material. As illustrated in FIG. 26, the mount 143 may define a channel on the inboard side of the inboard wall 171/173 with an open end at the top, and the sensor 145 may slide into the channel of the sensor mount 143 through the opening at the top until the bottom of the sensor 145 is supported by the bottom/closed end of the channel of the sensor mount 143. As shown in FIG. 86A, the sensor 145 is secured in the sensor mount 143 opposite the track drive shaft 352 or a component of the belt housing assembly 354 to sense rotation or movement thereof for one or more purposes, including, but not limited to, measuring or calculating the speed of the vehicle. A gap is provided between the sensor 145 and the object being measured by the offset provided between the tunnel 104 (or heat exchanger end cap 178) and the inboard wall 171/173 by the rearward wall 230. In one aspect, the sensor mount 143 is configured to provide a

snug fit with the sensor 145 without mechanical fasteners - in other words by an interference fit. The sensor cable 183 may extend from the sensor mount 143 so that at least a portion of it is positioned inboard from the toe stop 140 and forward from the panel 168 and frame mount member 150 (see also FIGS. 29 and 31). The sensor cable 183 may be forward of the rearward leg 326. The sensor cable 183 may be further positioned rearward of the belt housing assembly 354. In one aspect, the arrangement positions the sensor 145 outside the belt housing assembly 354. In one aspect, the mount 143 extends from the inboard surface of the inboard wall 171/173 to position the sensor 145 at least partially within the belt housing assembly 354 but spaced apart from any component in the belt housing assembly 354 and supported only by the toe stop mount 140.

[0354] The position of the mount 143 and the sensor 145 on the inboard wall 171/173 may depend on the location of the track drive shaft 352 and/or the belt housing assembly 354. As shown from the inboard view of FIG. 80A (and from the outboard view of FIG. 77B), the location of at least a portion of the toe hook 141 along the vehicle may overlap with a portion of the mount 143, and optionally the toe hook 141 overlaps with the track drive shaft 352 or the axis of rotation of the track drive shaft 352 along the length of the vehicle when the track drive shaft 352 and belt housing assembly 354 are provided in the position shown in FIGS. 42A and 42B. As shown from the inboard view of FIG. 90B (and from the outboard view of FIG. 90A), the location of at least a portion of the toe hook 141 along the vehicle may be positioned rearward of the mount 143, and optionally the toe hook 141 is positioned rearward of the track drive shaft 352 or the axis of rotation of the track drive shaft 352 along the length of the vehicle when the track drive shaft 352 and belt housing assembly 354 are provided in the position shown in FIGS. 42C and 42D. Accordingly, the position of the toe hook 141 with respect to the forward frame assembly 312 is maintained in the same location for the first snowmobile of FIG. 1 and the second snowmobile of FIG. 8, even though different toe stops 140 are used. In both illustrative examples, the toe grip or hook 141 may be provided forward of the rearwardmost position of the belt or the belt housing assembly 354. In addition to, or alternatively, the toe hook 141 may at least partially overlap the track drive shaft axis of rotation as evidenced by the chamber (or projection) 229 as shown in FIG. 82A that receives the track drive shaft 352 therein or be positioned entirely almost rearward of it as shown in FIG. 94A depending on the location of the track drive shaft 352.

[0355] The toe stop 140 may include a wire retaining feature 159, as shown in FIG. 80B, for one or more vehicle components. In some implementations, the wire retaining feature 159 forms a part of or is otherwise defined by a portion of the toe hook 141 (see also, FIG. 27A). The wire retaining feature 159 may comprise one or more fingers extending inboard from an inboard surface of the toe hook 141 to retain the wire therebetween inside of the body panel 400. In other implementations, the wire retaining feature 159 forms a part of or is otherwise defined by a portion of the panel 240 positioned forward of the toe hook 141 and rearward of the outboard wall 197 (see e.g., FIG. 90A). In such an illustrative example, the wire retaining feature 159 may include one or more fingers extending inboard from an inboard surface of the panel 240 to retain the wire there-

between inside of the body panel 400, and may be positioned along or beneath the clearance feature 160.

[0356] In some implementations, the wire retaining feature 159 is configured to hold and/or secure the position of one or more wires/cables 183 of the sensor 145 in the sensor mount 143. In one non-limiting example, the wire retaining feature 159 includes two keys or fingers to route the wire/cable 183 and retain it at that position. In one implementation, the wire retaining feature 159 includes an aperture on an outboard side of the toe stop 140 so that a tool can access the wire retaining feature 159 positioned on the inboard side of the toe stop 140 and secure the sensor wire/cable 183 to the wire retaining feature 159. As discussed above, the belt case drive assembly 354 may not include a cover so, in one aspect, the wire retaining feature 159 positions the sensor wire/cable 183 away from the drive train 112.

[0357] In an illustrative example, the toe stop 140 includes a wire guide 157. The channel 157 may be included in a wall 232 that extends rearward from the inboard wall 171/173 and/or the rearward wall 230. The channel 157 is partially defined by the side panel 182 of the tunnel 104 or the heat exchanger end cap 178 when the wall 232 is positioned thereagainst. The channel 157 includes an open end at a forward end of the wall 232 so that a wire or other item can be routed from inside the region enclosed by the toe stop 140 and the body panel 400 through the open end and rearward along the side panel 182 or the end cap 178. An aperture is provided in the side panel 182 or the end cap 178 for routing the wiring to, for example, a suspension component. In some implementations, the wire guide 157 guides, locates, protects, and/or secures a wire extending from the main harness to the rear suspension. The wire guide 157 may be a channel in a panel/wall 232 extending from the rearward wall 230 (see e.g., FIGS. 74 and 75).

[0358] In at least one embodiment, method 200 further includes attaching a toe stop to the foot support member. In a non-limiting example, the method includes attaching a first pair of toe stops 140 (as shown in FIGS. 77A and 81A) to a common forward frame assembly 312 for use with the snowmobile of FIG. 1, and attaching a second pair of toe stops 140 (as shown in FIGS. 90A and 94A) to a common forward frame assembly 312 for use with the second snowmobile of FIG. 8. The first pair of toe stops 140 and the second pair of toe stops 140 may include one or more features commonly positioned with respect to the forward frame assembly 312 (in the same location for both pairs) including, but not limited to, the frame mount member 150, the toe hook 141, the side panel interface 154, the mounting point 155, the skid plate interface 156, and the attachment feature 158. In a non-limiting example, one or more features may be positioned differently with respect to the forward frame assembly 312 (in different locations for the pairs) including, but not limited to, the chambers 228, 229, the sensor mount 143, and slots 165a and 165b. In a non-limiting example, the width of the rearward facing support face 167 may be different between the two pairs.

[0359] As discussed above with reference to FIGS. 13, 27B, and 30, bottom-out protectors 148 may be provided. The bottom-out protectors may be configured to inhibit the transfer of forces directly to the chassis 102. A first embodiment of a pair of bottom-out protectors 148a/148b with one or more of the features described below is illustrated in FIGS. 102-115. A second embodiment of a pair of bottom-out protectors 148c/148d with one or more of the features

described below is illustrated in FIGS. 116-125. The figures illustrate the bottom-out protectors 148 from the front/forward side 10, rear/rearward side 12, the top 14, the bottom 16, the outboard side 127, and the inboard side 128.

[0360] In one aspect, the bottom-out protector 148 is unitary/one-piece construction. The material utilized to form the bottom-out protector 148 may be tough and/or ductile. Thermoplastic polyurethane (TPU) is a non-limiting example of a material that may be utilized for the bottom-out protector 148. In some implementations, the unitary bottom-out protector 148 is a molded material. In other implementations, the bottom-out protector 148 is fabricated from a metal material. As one non-limiting example, the bottom-out protector 148 may be fabricated from a metallic billet, e.g., an aluminum or aluminum alloy billet. In another aspect, the bottom-out protector 148 may be a right or left side bottom-out protector 148a/148c (positioned under the rider's right foot) that is shaped to receive the lowest portion of the belt housing 354 therein and a left or brake side bottom-out protector 148b/148d (positioned under the rider's left foot) that is shaped to receive at least a portion of the brake rotor 351 therein (see e.g., FIGS. 115A-B). As discussed below in greater detail, the right and left bottom-out protectors 148a/148c, 148b/148d may have different shapes. In another aspect, as discussed below in greater detail, the bottom-out protectors 148 couples/ties/interconnects together one or more components of the snowmobile.

[0361] The bottom-out protector 148 may include one or more of the following features: a bottom wall 410, an inboard outer wall 404 extending upward from the bottom wall 410, an outboard outer wall 407 extending upward from the bottom wall 410, an outward support member 414/415 extending outboard from the outboard outer wall 407, and one or more mounting features to couple the bottom-out protector 148 to one or more components of a snowmobile (see e.g., FIGS. 27B and 102).

[0362] The front end of the bottom wall 410 may form at least a portion of the forward end of the bottom-out protector 148 and the rear end of the bottom wall 410 may form at least a portion of the rearward end of the bottom-out protector 148 (see e.g., FIGS. 103A and 120). In some implementations, one end of the bottom wall 410 is wider than the other end (see e.g., FIG. 102, 106A, 116A). The width at the narrower end may taper (see e.g., FIGS. 122A-B) or may decrease in a stepped manner (see e.g., FIG. 106A). The bottom wall 410 may be curved (see e.g., FIG. 104A, 107A). In at least one embodiment the inner (upper) surface of the bottom wall 410 is curved (see e.g., FIG. 102, 106A). The curve of the bottom wall 410 may conform to the shape of the bottom of a component that is housed therein, such as the lowermost portion of the belt housing 354 or the brake rotor, 351 and/or the curve of the bottom edge of the end cap 178 of the heat exchanger assembly 174 (see e.g., FIGS. 129A-B), or the bottom edge of the side panel 182 of the tunnel 104. In some implementations when the track drive shaft 352 is in the location shown in FIGS. 42C and 42D, the apex of the curve is positioned in the middle of the bottom-out protector 148 (see e.g., FIG. 108A) to accommodate the location of the belt housing 354 and the brake rotor 351. In other implementations when the track drive shaft 352 is in the location shown in FIGS. 42A and 42B, the apex of the curve is positioned rearward of the middle of the bottom-out protector 148 (see e.g., FIG. 117A) to accommodate the location of the belt housing 354 and the brake rotor 351.

The belt housing (and assembly thereof), the track drive shaft **352**, and the brake rotor **351** may include those described in U.S. Pat. Application Serial No. 17/588, 487, entitled ADJUSTABLE BELT DRIVE ASSEMBLY, SYSTEM AND METHOD, filed Jan. 31, 2022, which is commonly owned and incorporated herein by reference in its entirety. In at least one embodiment, the bottom wall **410** extending forward from the apex of the curve is curved (see e.g., FIG. **104B**). In some embodiments, the bottom wall **410** extending forward from the apex of the curve is linear or substantially linear (see e.g., FIG. **117A**).

[**0363**] In at least one embodiment, the bottom wall **410** includes one or more mounting features **418/420** with an aperture for mounting the bottom-out protector **148** to a snowmobile. For example, a fastener **434** extending upwards through the rearward mounting feature **418** may couple the bottom-out protector **148** to the chassis **102** and/or the heat exchanger end cap **178** of a snowmobile **100** (see e.g., FIG. **27A** and FIG. **128**). A U-clip **432** may be positioned above the upper surface of the rearward mounting feature **418** (see e.g., FIG. **102**). In some implementations as shown in FIG. **128**, the heat exchanger end cap **178** includes an integrated mount **452** extending outward therefrom to couple the heat exchanger assembly **174** to the rearward mounting feature **418** (see also, FIGS. **27B**, **44**, **101**, **111**, **124** and **125**). The mount **452** may include a forward opening **451** for coupling to the bottom-out protector **148** with a removable fastener and a rearward opening **453** for coupling to the mounting surface **186** of the support bracket **184** and/or foot support member **124** with a removable fastener. For example, the mounting surface **186** and the foot support member **124** are both secured with a fastener to the rearward opening **453** when part of the running board assembly **120B**, and only the mounting surface is secured with a fastener to the rearward opening **453** when part of the running board assembly **120A**.

[**0364**] A fastener **434** extending upwards through the forward mounting feature **420** may couple the bottom-out protector **148** to the chassis **102** (e.g., the forward frame assembly **312/forward frame 312**) and/or the skid plate **402** (see e.g., FIGS. **115B** and **125**). For example, a portion of the forward frame assembly **312**, such as the metal sheet **320/334**, may include an outboard extending flange **335** with a tab **336** for coupling with the bottom-out protector **148** (see e.g., FIG. **27B**, **101**, and **128**). The U-clip **432** positioned above the upper surface of the mounting feature **418** may be positioned around the tab **336**. The fastener **434** extends through the aperture of the mounting feature **418/420**, through the U-clip **432** and into the other component of the snowmobile (see e.g., FIGS. **27A** and **112**, see also FIGS. **57A** and **111**). As shown in FIG. **126**, the tab **336** may extend outward from below a point where the lower frame member **332** is welded or otherwise secured to the metal sheet **320/334** to provide additional rigidity to the chassis in the region of the tab **336**. This is one example of how the bottom-out protector **148** ties together different components. Although shown and described as securing the front **10** of the bottom-out protector **148** to the forward frame **312**, it is to be understood that the front **10** of the bottom-out protector **148** may be secured to the heat exchanger end cap **178** instead of the forward frame assembly **312**.

[**0365**] The bottom-out protector **148** may be provided with one or more horizontal interior ribs **411** that extend upward from the inner surface of the bottom wall (see e.g.,

FIGS. **116A** and **120**). In at least one embodiment, the interior ribs **411** are positioned in the forward half of the bottom-out protector **148**. In one non-limiting example, there are two ribs **411**. The ribs **411** may be oriented perpendicular to the walls **404/406/407** or at an angle to the walls **404/406/407**. In some implementations, the ribs **411** extend between the outboard outer wall **407** and an interior wall **406**. In one aspect, the one or more ribs **411** provide additional support to the bottom-out protector.

[**0366**] The bottom wall **410** may include one or more drains **412** to drain fluid/moisture from the bottom-out protector **148** (see e.g., FIGS. **27A** and **103A**). In one example, the bottom-out protector **148** has two drains **412**. The entrance to the one or more drains **412** is defined by channels extending rearward to exit openings defined by a drain wall **413**. The channels extend from the interior surface of the bottom wall **410** to the outer surface of the bottom wall **410** and through the drain wall **413** to the exit openings. The channels may include a forward end positioned in a lower, or lowest, point of the bottom wall **410** so that fluid may drain downward to the rearward end of the channel and out of the bottom-out protector **148**. In some embodiments, the exit opening of the drain **412** faces rearward (see e.g., FIGS. **104B** and **116A**). The bottom wall **410** may curve downward to form a drain wall **413** (see e.g., FIGS. **103A-B**). In some embodiments, the drain wall **413** is positioned above and parallel to a horizontal line **20** tangent to the bottom curve of the bottom wall **410** (see e.g., FIGS. **104B** and **108B**). Positioning of the exit openings of the drains **412** rearward and above or at least partially above the lowest portion of the bottom-out protector **148** shields the exit openings of the drains **412** from snow and other materials as the snowmobile travels forward. In other embodiments, the drain wall **413** is positioned on a line **22** extending along an upward extending linear section of the bottom wall **410** (see e.g., FIGS. **117A** and **121A**). In one aspect, a downward oriented drain **412** aids the drainage of fluid/moisture from the bottom-out protector **148**. Positioning of the exit openings of the drains **412** rearward and above the lower (forward facing) portion of the drain wall **413** directs snow away from the exit openings and shields the openings of the drains **412** from snow and other materials as the snowmobile travels forward. In some implementations, the drains **412** are centered between the outer walls **404/407** (see e.g., FIG. **109A**) so that each drain is positioned approximately the same distance from the adjacent outer wall **404/407** of the bottom-out protector. In other implementations, one of the drains **412** is positioned closer to the adjacent outer wall, for example, the outboard wall **407** - in other words, the drains **412** are not centered between the outer walls **404/407** (see e.g., FIG. **119B**). In some implementations, the one or more drains **412** are positioned adjacent to the middle of the bottom-out protector **148** (see e.g., FIG. **103A**). In other implementations, the one or more drains **412** are positioned adjacent to a rear end **12** of the bottom-out protector **148** (see e.g., FIG. **122B**). As shown in FIGS. **111** and **125**, the exit openings of the drains **412** may be positioned along the length of the vehicle rearward of the track drive shaft, optionally rearward of the forward end of the opening **177**, and optionally forward of the rearward end of the opening **177**.

[**0367**] The inboard outer wall **404** is positioned opposite the outboard outer wall **407**. In some implementations, the inboard outer wall **404** is perpendicular to the bottom wall

410 (see e.g., FIG. 109B). The upper edge of the inboard outer wall **404** may have a curved configuration. In one implementation, the curve of the top edge of the inboard outer wall **404** may be different from the curve of the bottom wall **410** (see also, FIG. 108B). In some implementations, the vertical height of the inboard outer wall **404** varies. In other implementations, the vertical height of the inboard outer wall **404** is substantially the same along the length of the inboard outer wall **404** (see e.g., FIG. 117B). In some embodiments, one or more portions of the inboard outer wall **404**, such as the front and rear portions, extend above the outboard wall **407** - in other words, when viewed from an outboard side **127**, the inboard outer wall **404** is visible (see e.g., FIGS. 104A, 108A, 117A).

[0368] An interior wall **406** may be positioned between the outer walls **404/407** and extends upward from the bottom wall **410** (see e.g., FIG. 102). In some embodiments, the interior wall **406** is positioned closer to the inboard outer wall **404** than to the outboard outer wall **407**. In at least one embodiment, a forward end of the interior wall **406** is positioned rearward of a forward end of the bottom wall **410** and a rearward end of the interior wall **406** is positioned forward of a rearward end of the bottom wall **410**. In some embodiments, the interior wall **406** is positioned between the forward mounting feature **420** and the rearward mounting feature **418**. The interior wall **406** may extend parallel to the inboard outer wall **404** and/or the outboard outer wall **407**. In at least one embodiment, the height of the interior wall **406** is at most equal to the height of the inboard outer wall **404**. In some implementations, the height of the interior wall **406** varies (see e.g., FIGS. 102 and 120). In one non-limiting example, the height of the interior wall **406** tapers at one end (see e.g., FIG. 102). In some implementations, the upper edge of the interior wall **406** has the same curve configuration as the inboard outer wall **404**.

[0369] In at least one embodiment, the interior wall **406** and the inboard outer wall **404** form a mounting feature or a chamber **409** for receiving a portion of the snowmobile therein. For example, the interior wall **406** on one side is positioned adjacent the inboard wall **404** on the other side (see e.g., FIG. 103B) to define a gap comprising a channel or chamber **409** therebetween. When the bottom-out protector **148** is coupled to the snowmobile, a portion of another component of the snowmobile may be placed/inserted into the channel. For example, of the lower end of a heat exchanger end cap **178** may be inserted in the channel **409** (see e.g., FIGS. 112 and 114). As another example, a portion of the forward frame assembly **312** may be inserted into the channel **409**, e.g., metal sheet **320/334**. As another example, a lower end of the side panel **182** of the tunnel **104** may be inserted into the channel **409**. When the side panel **182** or the heat exchanger end cap **178** is inserted into the channel **409** as shown in FIGS. 58, 71, at least a portion of the inboard side of the interior wall extends along an outboard surface of the side panel **182** or the heat exchanger end cap **178**, and the outboard side of the inboard wall **404** extends along an inboard surface of the side panel **182** or the heat exchanger end cap **178** as shown in FIGS. 65, 86A and 127. This is another example of how the bottom-out protector **148** ties together different components when coupled to a snowmobile **100**. As shown in FIGS. 40A and 40B, the heat exchanger end cap **178** may be provided with a curved surface along the rearward end of the bottom edge **468**. The channel defined by the interior wall **406** and the inboard wall

404 may be shaped to conform to the curved surface and receive the curved surface (and regions forward and rearward thereof) in the channel to shield this low point on the vehicle during operation (see e.g., FIGS. 112-114, 115A, 127-128, and 129B). As shown in FIGS. 40A and 89, a curved surface **357** at the rearward end of the heat exchanger end cap **178** extends downward from the adjacent outer perimeter **318** of the forward frame **312**.

[0370] In at least one embodiment, another component of the snowmobile **100** may be positioned in a chamber **409** defined by one or more of the bottom wall **410**, the interior wall **406**, and the outboard outer wall **407** (see e.g., FIGS. 29, 100A-B). For example, a component of the belt housing **354** may be positioned in the chamber **409** above the bottom wall **410** (see e.g., FIG. 29).

[0371] In some embodiments, the outboard outer wall **407** is comprised of two offset lengths extending parallel to the inboard outer wall **404** and a connecting portion extending between the two parallel lengths (see e.g., FIG. 103A). The outboard wall **407** may extend upwards from the bottom wall **410** at a non-perpendicular angle (see e.g., FIG. 109A).

[0372] In at least one embodiment, the outward support member **414/415** extends from the front **10** to the rear **12** of the bottom-out protector **148** (see e.g., FIGS. 102, 103A, 116A, and 122A). In some embodiments, the outward support member **414/415** extends from the upper edge of the outboard outer wall **407**. In some implementations, the outward support member **414/415** includes a narrow section between a forward outboard support member **414** and a rearward outboard support member **415** (see e.g., FIG. 106A). In these implementations, the outward support member **414/415** appears to be discontinuous. In other implementations, the section between the forward outboard support member **414** and a rearward outboard support member **415** is wide so that the outward support member **414/415** is continuous (see e.g., FIG. 116A).

[0373] The outboard edge of the outward support member **414/415** may have curved corners and/or sharp corners. In one non-limiting example, the corners in a forward portion of the outward support member **414/415** are curved while the corners in a rearward portion are sharp (see e.g., FIGS. 103A and 122A). The outward support member **414/415** may extend upwards from the outboard outer wall **407** (see e.g., FIG. 109A). In one aspect, the outward support member **414/415** supports the foot support member **124** and/or the toe stop **140**. The corner between the outboard wall **407** to the outward support member **414/415** may be curved or sharp. For example, the exterior corner between the inner surface of the outboard wall **407** and the upper surface of the outward support member **414** may be curved (see e.g., FIG. 106A) while the interior corner is sharp (see e.g., FIG. 103A).

[0374] As discussed above, an opening **177** is defined by the foot support member **124**, the toe stop **140**, and/or the bottom out protector **148**, and/or combinations thereof. In at least one embodiment, the outward support member **414/415** is configured to at least partially define the opening **177** (see e.g., FIG. 111).

[0375] The outward support member **414/415** includes one or more mounting features **424/426/430** with an aperture for mounting the bottom-out protector **148** to a snowmobile **100** (see e.g., FIGS. 102 and 122A). The mounting features **424/426/430** may be configured to receive a U-clip **432** (see e.g., FIG. 102). Mounting feature **426** may be posi-

tioned adjacent to the rearward end of the bottom-out protector 148 and inboard to mounting features 424/430. Mounting feature 426 may further be positioned outboard to the rearward mounting feature 418. Mounting feature 424 may be positioned outboard to mounting feature 430. In an illustrative example, the mounting feature 424 (and the outward support members 414) of the pair of bottom-out protectors 148c and 148d (for use with running board assembly 120A) may be positioned further outboard from the mounting feature 430 and/or other feature on the bottom-out protector 148 (such as the forward mounting feature 420 and/or the rearward mounting feature 418) than the mounting feature 424 (and the outward support member 414) of the pair of bottom-out protectors 148a and 148b (for use with running board assembly 120B). In addition to, or alternatively, the mounting feature 426 (and the outward support member 415) of the pair of bottom-out protectors 148c and 148d (for use with running board assembly 120A) may be positioned further outboard from the forward mounting feature 420 and/or the rearward mounting feature 418 (other feature on the bottom-out protector 148) than the mounting feature 426 (and the outward support member 415) of the pair of bottom-out protectors 148a and 148b (for use with the running board assembly 120B). Changing the location of such features between the pairs of the bottom-out protectors 148 allows for the bottom-out protectors 148 to be compatible with common components, such as the forward frame 312, between the snowmobile of FIG. 1 and the snowmobile of FIG. 8, as well as with components that are not common or commonly configured (such as the running board assemblies 120A and 120B) between the snowmobile of FIG. 1 and the snowmobile of FIG. 8. Mounting feature 424 may be further positioned rearward of mounting feature 430 and forward of mounting feature 426. In one example, two mounting features 424/426 are oriented outboard and one mounting feature 430 is oriented forward (see e.g., FIG. 102). In another example, one mounting feature is oriented outboard, one mounting feature is oriented forward, and a third mounting feature is oriented at an angle to a rear end of the bottom-out protector 148 (see e.g., FIG. 122A).

[0376] In one example, the forward outboard support member 414 has two mounting features 424/430 and the rearward outboard support member 415 has one mounting feature 426 (see e.g., FIG. 102). Mounting features 424/430 on the forward outboard support member 414 may be positioned adjacent one another, as best shown in FIG. 102, or positioned apart from one another, as best shown in FIG. 116A. Mounting features 424/430 may be positioned in a middle region of the bottom-out protector 148 in outward support member 414.

[0377] The mounting features 424/426/430 of the outward support member 414/415 are another example of how the bottom-out protector 148 is configured to couple/tie/interconnect components of a snowmobile together. In some implementations, the mounting features 424/426/430 may couple the bottom-out protector 148 to one or more components of the running board assembly 120, the toe stop 140, and/or the skid plate 402 (see e.g., FIGS. 44, 57, 71-72, 75, and 115B). When the bottom-out protector 148 is coupled to the snowmobile, mounting feature 430 may be positioned forward of at least the lower wall of the forward wall 163 of the toe stop 140 and mount 424 is positioned rearward of the forward wall 163 of the toe stop 140 (see e.g., FIGS. 86B, 87A, 100A, and 100B). For example, mounting fea-

tures 424/426 may interconnect the bottom-out protector 148, the support bracket 184, one or more components of the running board assembly 120, and/or the toe stop 140, and mounting feature 430 may interconnect the bottom-out protector 148 and the skid plate 402. Additionally, as discussed above, the channel defined by the inner wall 406 and the inboard outer wall 404 further interconnects the bottom-out protector 148, the running board assembly 120, the toe stop 140, and the skid plate 402, to the chassis 102, the heat exchanger assembly 178 and/or tunnel 104.

[0378] The bottom-out protector 148 may include one or more features that provide support to one or more components in the region of the toe pocket 222. In an illustrative example, one or more ribs 416 may extend along the bottom surface of the outward support member 414/415 from the outboard wall 407 (see e.g., FIGS. 103A, 108A, 109B, and 116B). The ribs 416 may be perpendicular to the outboard wall 407. The ribs 416 may be perpendicular to the outward support member 414/415 or at an angle to the outward support member 414/415 (see e.g., FIGS. 108A and 121B). The ribs 416 may be positioned in the rearward half of the bottom-out protector 148. In one non-limiting example, a forward rib 416 may be positioned rearward of mounting feature 430. One or more ribs may extend from the outboard outer wall 407 to the mounting features 424/426 (see e.g., FIGS. 103A and 122B). The one or more ribs 416 may include a rib 416 extending outward at an angle to the outboard corner between two linear sections of the outboard outer wall 407. The ribs 416 may have a tapered height with the height being greatest adjacent to the outboard wall 407 (see also FIG. 109A). The amount of taper may vary (compare FIGS. 109A and 119A). In one aspect the ribs 416 provide added support to the outward support member 414/415 adjacent to a mounting feature 424/426/430. In another aspect, by providing more structure to the bottom-out protector 148, the bottom-out protector 148 may provide support for the toe stops 140 and/or foot support members 124. In a non-limiting example, the bottom-out protector 148 reinforces the region of the toe pocket 222 and the opening 177. Securing the forward mounting feature 420 to the forward frame assembly 312 and the rearward mounting feature 418 to the side panel 182 of the tunnel 104 and/or the heat exchanger end cap 178 provides a stable connection for the bottom-out protector 148 to the snowmobile. Reinforcing the outward support members 414/415 with ribs 416 provides support to the forward end of the foot support member 124 and/or the toe stop 140 in the region inboard of the support member 122. The flange defining the opening 135 on the foot support member 124 is positioned under the opening 165b of the toe stop 140 and over the outward support member 414 and aligned with the mounting feature 424 to receive a fastener through the outward support member 414, the opening 135, and the slot 165b of the toe stop 140. Similarly, the flange defining the opening 137 on the foot support member 124 is positioned under the opening 165a of the toe stop 140 and over the outward support member 415 and aligned with the mounting feature 426 to receive a fastener through the outward support member 415, the opening 137, and the slot 165a of the toe stop 140. Accordingly, the toe stop 140 and the foot support member 124 are supported by the bottom-out protector 148 in the region of the toe pocket 222 and the opening 177 defined by one or more of the foot support member 124, the toe stop 140, and the bottom-out protector 148.

[0379] In at least one embodiment, when the bottom-out protector 148 is coupled to snowmobile 100, the bottom-out protector 148 is positioned under the foot support member 124, which is positioned under the toe stop 140 (see e.g., FIGS. 27B, 30, 57, 86B, 87A, 98B, 110-112, 115A-B). Accordingly, portions of the front end of the foot support member 124 in the regions defining the openings 135 and 137 are positioned between the toe stop 140 and the bottom-out protector 148 to form a three-layer (and optionally a multi-material) joint in the region of the toe pocket 222. The bottom-out protector 148 may be seen when the snowmobile 100 is viewed from the side (see e.g., FIG. 8). The bottom-out protector 148 may be positioned at least partially outboard from the forward frame assembly 312 and at least partially inward from the foot support member 124 (see e.g., FIGS. 12, 58, and 111-112). The bottom-out protector 148 may be positioned at least partially forward of the toe stop 140 and at least partially rearward of a skid plate 402. Such an arrangement allows for the mounting feature 430 which is located forward of the mounting feature 424 on the outward support member 414 and the lower wall of the forward wall 163 as shown in FIGS. 100A and 100B to be secured to the skid plate 402 with a removable fastener inserted through an aperture defined in the skid plate 402 and through the mounting feature 430 as shown in FIGS. 125 and 128.

[0380] In an illustrative example, the lower surface of the forward portion of the foot support member 124 is positioned on at least a portion of the upper surfaces of the outward support members 414/415 to align mounting features 424/426 with the mounting features 135/137. A removable fastener is inserted through the mounting features 135/137 of the foot support member 124 and the co-aligned mounting features 424/426 of the bottom-out protector 148 to removably secure the bottom-out protector 148 to the foot support member 124. In an illustrative example, the same fasteners 142 inserted through slots or openings 165b/a in the toe stop 140 to removably secure the toe stop 140 to the mounting features 135/137 of the foot support member 124 may extend through the foot support member 124 to extend into co-aligned mounting features 424/426 to secure the three separate components into an overlapping joint along the opening 177 with the foot support member 124 positioned in the middle between the toe stop 140 and the bottom-out protector 148. As shown in FIG. 112, this positions at least a lower portion of the forward wall 163 of the toe stop 140 between the mounting features 424 and 426 and provides sufficient clearance to removably secure the skid plate 402 to the mounting feature 430 with a removable fastener as discussed above and shown in FIG. 125. In at least one embodiment, a method is provided that includes attaching a bottom-out protector 148 to one or more of the forward frame assembly 312, the toe stop 140, the foot support member 124, the tunnel 104, the skid plate 402, and the heat exchanger end cap 178. In a non-limiting example, the method includes providing a first pair of bottom-out protectors 148 (as shown in FIGS. 116A and 120) for attaching to a common forward frame assembly 312 for use with the snowmobile of FIG. 1 and providing a second pair of bottom-out protectors 148 (as shown in FIGS. 102 and 106A) for attaching to a common forward frame assembly 312 for use with the second snowmobile of FIG. 8. The first pair of bottom-out protectors 148 and the second pair of bottom-out protectors 148 may include one or more features commonly

positioned with respect to the forward frame assembly 312 (in the same location for both pairs) including, but not limited to, the forward mounting feature 420, the rearward mounting feature 418, and the mounting feature 430. In a non-limiting example, one or more features may be positioned differently with respect to the forward frame assembly 312 (in different locations for the pairs) including, but not limited to, the mounting features 424 and 426. In a non-limiting example, the shape or configuration of one or more features including, but not limited to, the bottom wall 410, the outward support member 414/415, the ribs 416, the inboard wall 404, the interior wall 406, and the outboard wall 407 may be different between the two pairs. Such differences may accommodate, for example, the different running board assemblies 120A, 120B, the different toe stops 140, the different positions of the components shown in FIGS. 42A - D (such as those components housed in the bottom-out protector 148), different tunnels 104, and different heat exchanger end caps 178.

[0381] As shown in FIGS. 130A-133B, one or more body panels, discussed below in greater detail, are attached to the forward frame assembly 312. The snowmobile 100/700/702 may also include a windshield 704 and a headlight assembly 706. The forward frame assembly 312 may be a common frame assembly - i.e., utilized for different snowmobile models 100/700/702 (see e.g., FIGS. 42A-D). In one aspect, a common forward frame assembly 312 provides an opportunity to attach one or more common body panels to the forward frame assembly 312. Thus, different snowmobile models 100/700/702 may utilize the same forward frame assembly 312 and/or one or more body panels.

[0382] The body panels may be injection molded, or compression molded, and/or machined. The material utilized to form the body panels may be tough and/or ductile. The body panels may be formed of a polymeric material, a polymeric composite material, a composite including one or more of the above-described polymers and one or more types of fibers (i.e., a reinforced polymer), carbon fiber, and/or a metallic material. In one non-limiting example, the polymeric material may be thermoplastic polyurethane (TPU). In some embodiments, a polymer composite includes polymeric material including, but not limited to, Nylon 6/6, Polyetheretherketone (PEEK), Polypropylene (PP), or Polyphthalamide (PPA) as a matrix material with glass, carbon, or ratio of both carbon and fiber material for fiber fill varying in percent volume from 10%-50%, optionally from 40%-60%, and in some embodiments, from 45%-55%.

[0383] A body panel may include one or more mounting features to couple the body panel to the snowmobile 100/700/702. In at least one embodiment, the mounting features allow the body panel to be releasably attached to the snowmobile 100/700/702. In some embodiments, the mounting feature may include an aperture configured to receive a fastener.

[0384] The body panels may include a forward body panel 708, an upper side body panel 710, a side body panel 400, a lower side body panel 714, a nose panel 720, and/or a skid plate 402 (see e.g., FIGS. 130A-B and 132). A panel 712 with an engine air intake may be positioned between the side body panel 400 and a lower body panel/skid plate 402 (see e.g., FIG. 132). The engine air intake may be the engine air intake described in U.S. Pat. Application No. 17/984,050 filed on Nov. 9, 2022, and entitled "Air Intake for Snowmobile," the contents of which are incorporated by reference in

its entirety. The headlight assembly 706 may be positioned above the forward body panel 708. The upper side body panels 710 include right and left upper side body panels 710a/710b which are positioned alongside the headlight assembly 706 and the forward body panel 708. The side body panel 400 may be positioned below the upper side body panels 710. The side body panel 400 may also be positioned at least partially rearward of the upper side body panel 710.

[0385] The lower side body panel 714 may be positioned rearward of the nose panel 720. The upper and rear sides of the lower side body panel 714 may be adjacent to the skid plate 402. At least one mounting feature 716 may attach the lower side body panel 714 and the skid plate 402. The lower side body panel 714 may include at least one opening 718 for a component of the front suspension assembly 113 to extend through the lower side body panel 714 (see e.g., FIG. 132). For example, a tie rod arm 358 may extend through a first opening and a lower control arm 356 may extend through a second opening. At least one mounting feature 717 may attach the skid plate 402 and panel 712 together.

[0386] The nose panel 720 may be positioned below a forward end of the upper side body panels 710. The nose panel 720 may extend downward from the forward body panel 708. In some embodiments, a portion of the nose panel 720 is positioned rearward of a portion of the upper side body panel 710 (see e.g., FIG. 132). The nose panel 720 and the upper side body panel 710 may be coupled together by a mounting feature 724. The nose panel 720 and lower side body panel 714 may be attached by one or more mounting features. In the non-limiting example, two mounting features 726/728 couple the nose panel 720 and the lower side body panel 714 (see e.g., FIG. 132). A portion of the nose panel 720 may extend around the front bumper mount 303 and be removably secured thereto. The front bumper mount 303 may be the front bumper mount described in U.S. Pat. Application No. 17/983,968 filed on Nov. 9, 2022, and entitled "Bumper Mount for Snowmobile," the contents of which are incorporated by reference in its entirety. The nose panel 720 may incorporate a hood latch. In some embodiments, the nose panel 720 and the forward body panel 708 are separate body panels. In other embodiments, the nose panel 720 and the forward body panel 708 are integrated into one body panel.

[0387] At least a portion of the skid plate 402 forms a bottom surface of the snowmobile 700/702. In some embodiments, the skid plate 402 is fabricated from the same material as the bottom-out protector 148. In one aspect, the skid plate 402 may be the first point of contact. The skid plate 402 may include right and left skid plates 402a/402b (or right and left skid plate portions 402a/402b) extending rearward from the nose panel 720 (see e.g., FIG. 133B). In some embodiments, the right skid plate portion 402a and the left skid plate portion 402b may be connected together as a one-piece component. In other embodiments, the right skid plate portion 402a may be a separate, distinct component from the left skid plate portion 402b. The right skid plate 402a may include an opening 744 surrounded by a mounting flange 746 (see e.g., FIG. 133B) that allows engine exhaust from a muffler housed inside of the enclosure defined by the body panels to exit. An oil pan may be attached to the mounting flange 746 and the opening 744 may be utilized to change the oil of the engine 106.

[0388] The nose panel 720 and the skid plate 402 include one or more mounting features, e.g., an aperture, configured to receive a fastener (see e.g., FIG. 133A). At least some of the mounting features attach the nose panel 720 and/or the skid plate 402 to the forward frame assembly 312. As shown in FIG. 134, the right and left arms of the lower horizontal member 331/332 include a plurality of mounting features 305/307/309/337 that may be aligned with one or more mounting features of other components of the snowmobile 100/700/702. For example, mounting features 722 of the nose panel 720 may be aligned with mounting features 305 (see e.g., FIG. 134). Mounting features 750/758 of the skid plate 402 may be aligned with mounting features 307/309. Mounting features 752 of the skid plate 402 may be aligned with mounting features 337. Mounting features 754 of the skid plate 402 may be aligned with the forward mounting feature 420 of the bottom-out protector 148 and the tab 336 of the metal sheet 320/334. Mounting features 756 may be aligned with the mounting feature 430 of the bottom-out protector 148. Apertures of the mounting features 305/307/309/337 may extend through the lower horizontal member 331/332 and/or the flange 335 of the metal sheet 320/334.

[0389] In one aspect, the skid plate 402 encapsulates the underside and/or the engine bay 108. In another aspect, the skid plate 402 is positioned and configured to shield the underside of the snowmobile 100/700/702 from debris. For example, the skid plate 402 may deflect debris away from the snowmobile 100/700/702. In a further aspect, the skid plate 402 may be configured to inhibit the direct transmission of force to the chassis 102.

[0390] FIG. 135 shows a non-limiting example of a method 780 of assembling a snowmobile that includes one or more components including, but not limited to, a skid plate 402, a bottom-out protector 148, a foot support member 124, a toe stop 140, and a heat exchanger assembly 147. It is to be understood that the method is not limited to the steps, the order of the steps, the components, or combinations of the components shown in FIG. 135. The method 780 may include any part of one or more of the following steps: [0391] STEP 782, ATTACH A SKID PLATE AND/OR A BOTTOM-OUT PROTECTOR TO A FIRST LOCATION UTILIZING A FIRST ATTACHMENT ASSEMBLY, includes attaching a skid plate 402 and/or a bottom-out protector 148 to a first location utilizing a first attachment assembly (see e.g., FIG. 128). The first location may be part of the forward frame assembly 312. In a non-limiting example, the first location is the tab 336 of the flange 335 of the metal sheet 316/320/334. In an illustrative example, the first attachment assembly includes a reusable and removable fastener 755, a mounting feature 754 of the skid plate 402, and the forward mounting feature 420 of the bottom-out protector 148. As discussed above, the U-clip 432 may be positioned on the tab 336 to threadingly engage the fastener. The head of the fastener may be positioned adjacent to the bottom side of the skid plate 402. The tab 336 may be positioned between the legs of a U-clip. Thus, from bottom to top, the components of the first attachment assembly may be arranged as follows: fastener, skid plate 402, bottom-out protector 148, first leg of U-clip 432, tab 336, and second leg of U-clip 432. The fastener may be removed to allow for disassembly and replacement of any parts.

[0392] STEP 784, ATTACH THE SKID PLATE AND BOTTOM-OUT PROTECTOR TO A SECOND LOCA-

TION UTILIZING A SECOND ATTACHMENT ASSEMBLY, includes attaching the skid plate 402 and the bottom-out protector 148 to a second location utilizing a second attachment assembly. The second location may be rearward of the first location. In an illustrative example, the second attachment assembly includes a fastener 753, a mounting feature 756 of the skid plate 402, and a mounting feature 430 of the bottom-out assembly 148. The mounting feature 430 may be positioned between legs of a U-clip 432 for threadingly engaging the fastener. The head of the fastener may be positioned adjacent to the bottom side of the skid plate 402. In other words, the fastener may be inserted upwards through the mounting feature 756 of the skid plate 402 and the mounting feature 430 of the bottom-out protector 148. Thus, from bottom to top, the components of the first attachment assembly may be arranged as follows: fastener, skid plate 402, first leg of U-clip 432, bottom-out protector 148, second leg of U-clip 432. The fastener may be removed to allow for disassembly and replacement of any parts.

[0393] STEP 786, ATTACH TWO OR MORE OF THE BOTTOM-OUT PROTECTOR, A FOOT SUPPORT MEMBER, AND A TOE STOP TO A THIRD LOCATION UTILIZING A THIRD ATTACHMENT ASSEMBLY, includes attaching two or more of the bottom-out protector 148, a foot support member 124, and a toe stop 140 to a third location utilizing a third attachment assembly. The third location may be rearward of the second location. In an illustrative example, the third attachment assembly includes a fastener, a mounting feature 424 of the bottom-out protector 148, a forward mounting feature 135 of the foot support member 124, and a forward slot 165b in the bottom flange 176 of the toe stop 140. The mounting feature 424 may be positioned between legs of the U-clip 432 for threadingly engaging the fastener. As shown in FIG. 71, the head of the fastener 142 may be positioned adjacent to the toe stop 140. In other words, the fastener 142 may be inserted downwards through the outboard slot 165b of the toe stop 140, through the of the foot support member 124, and through the mounting feature 424 of the bottom-out protector 148 to threadingly engage the first leg of the U-clip 432. Thus, from bottom to top, the components of the first attachment assembly may be arranged as follows: first leg of U-clip 432, bottom-out protector 148, second leg of U-clip 432, foot support member 124, toe stop 140, and fastener 142.

[0394] STEP 788, ATTACH TWO OR MORE OF THE BOTTOM-OUT PROTECTOR, FOOT SUPPORT MEMBER, AND TOE STOP TO A FOURTH LOCATION UTILIZING A FOURTH ATTACHMENT ASSEMBLY, includes attaching two or more of the bottom-out protector 148, the foot support member 124, and the toe stop 140 to a fourth location utilizing a fourth attachment assembly. The fourth location may be rearward of the third location. The fourth location may be positioned inboard from the third location. In an illustrative example, the fourth attachment assembly includes a reusable and removable fastener, a mounting feature 426 of the bottom-out protector 148, a rearward mounting feature 137 of the foot support member 124, and a rearward slot 165a in the bottom flange 176 of the toe stop 140. The mounting feature 426 may be positioned between legs of the U-clip 432 that threadingly engages the fastener. The head of the fastener may be positioned adjacent to the toe stop 140 as shown in FIG. 71. In other words, the fastener may be inserted downwards through the rear-

ward slot 165a of the toe stop 140, through the rearward mounting feature 137 of the foot support member 124, and through the mounting feature 426 of the bottom-out protector 148 to threadingly engage the first leg of the U-clip 432. Thus, from bottom to top, the components of the first attachment assembly may be arranged as follows: first leg of U-clip 432, bottom-out protector 148, second leg of U-clip, foot support member 124, toe stop 140, and fastener. The fastener may be removed to allow for disassembly and replacement of any parts.

[0395] STEP 790, ATTACH THE BOTTOM-OUT PROTECTOR TO A FIFTH LOCATION UTILIZING A FIFTH ATTACHMENT ASSEMBLY, includes attaching the bottom-out protector 148 to a fifth location utilizing a fifth attachment assembly. In an illustrative example, the fifth location may be a side panel 182 of the tunnel 104 or an end cap 178 of a heat exchanger assembly 174. The fifth location may be a mounting flange 452 of an end cap 178 of a heat exchanger assembly 174. The fifth location may be located inboard of the fourth location. In an illustrative example, the fifth attachment assembly includes a fastener 434, a rearward mounting feature 418 of the bottom-out protector 148, and the mounting flange 452. The head of the fastener 434 may be adjacent to the bottom side of the bottom-out protector 148 (see e.g., FIGS. 111 and 124). In other words, the fastener 434 may be inserted upwards from the rearward mounting feature 418 of the bottom-out protector 148 and the forward opening 451 of the mounting flange 452 (see e.g., FIG. 128). As discussed above, a U-clip 432 may be positioned on the mounting feature 452 of the heat exchanger assembly 174. Thus, from bottom to top, the components of the first attachment assembly may be arranged as follows: fastener 434, bottom-out protector 148, first leg of U-clip 432, mounting feature 452 of heat exchanger assembly 174, and second leg of U-clip 432 that threadingly engages the fastener 434. The fastener may be removed to allow for disassembly and replacement of any parts.

[0396] Turning to FIGS. 136-141, the snowmobile 100/700/702 may optionally include a track drive protector 800. FIGS. 136-138 illustrate a first embodiment of a pair of track drive protectors 800a/800b for the snowmobile of FIG. 130A. FIGS. 139-141 illustrate a second embodiment of a pair of track drive protectors 800c/800d for the snowmobile of FIG. 130B. As discussed below in greater detail, the track-drive protectors 800 are configured to be placed on, house, or cover, at least a portion of the bottom-out protector 148, or optionally replace the bottom-out protector 148. Thus, the track drive protector 800 may also be referred to as a secondary bottom-out protector. Because the track drive protector 800 is configured to mate with/cover the bottom-out protector 148, the track drive protector 800 may include one or more of the same features discussed above for a bottom-out protector 148. For example, the track drive protector 800 may include a right track drive protector 800a and a left track drive protector 800b (see e.g., FIGS. 136A-B).

[0397] The track drive protector 800 may include one or more features configured to protect the bottom-out protector 148 and/or the components housed by the bottom-out protector 148. In an illustrative example, the track drive protector 800 is positioned with respect to the bottom-out protector 148 to maintain a gap therebetween along at least a portion of the length of the track drive protector 800. Off-

setting at least a portion of the track drive protector **800** from the bottom-out protector **148** allows a bottom wall **810** of the track drive protector **800** to maintain a continuous surface with the adjacent portion of the secondary skid plate **900** as described in greater detail below. The track drive protector **800** includes a body with a base or bottom wall **810**, an inboard wall **804**, and an outboard wall **807**. As shown in FIG. **129B**, the side of the outboard wall **807** may be positioned along and abut the side of the outboard wall **407** of the bottom-out protector **148**, and the upper end of the outboard wall **807** may abut an underside of the bottom-out protectors such as the underside of the outward support member **414/415**. The inboard wall **804** may be positioned inboard of the inboard wall **404** of the bottom-out protector **148** with the end of the inboard wall **804** abutting the bottom wall **410** of the bottom-out protector **148** to maintain a gap between the bottom wall **410** of the bottom-out protector **148** and the bottom wall **810** of the track drive protector **800**. The gap may extend along the length of the bottom wall **810** of the track drive protector **800**, or along a portion of the length of the bottom wall **810**, such as the forward portion of the track drive protector **800** along the inboard wall **804** as shown in FIG. **129B**. In such a configuration, the inboard wall **804** of the track drive protector **800** may extend upwards from only a portion of the bottom wall **810** (see e.g., FIG. **129B**, **138B**, and **141B**) and the bottom wall **810** of the track drive protector **800** may abut the bottom wall **410** of the bottom-out protector **148** rearward of the inboard wall **804** at a position at or forward of the lowest point of the bottom-out protector **148** and may continue to contact the bottom wall **410** rearward to the end of the bottom wall **808** of the track drive protector **800**. Although the gap is maintained by positioning the end of the inboard wall **804** on the bottom wall **410** of the bottom-out protector **148**, it is to be understood that the present disclosure is not limited to such a configuration to maintain the gap. It is to be understood that the inboard wall **804** may not abut the bottom wall **410**, and that the gap may be maintained by one or more other features on the track drive protector **800** and/or the bottom-out protector **148**. The track drive protector **800** may include an inboard wall **804**, an outboard wall **807**, an outward support member **814**, a bottom wall **810**, a drain **812** configured to align with the drain **412** of the bottom-out protector **148**, and mounting features **818/820/824/826/830** (see also FIGS. **136A**, **137A**, and **159A**).

[**0398**] The track drive protector **800** may include an outward support member **814** extending outward from the outboard wall **807** similar to the outward support member **414** of the bottom-out protector **148**. The upper surface of the outward support member **814** of the track drive protector **800** may define a chamber **828** to house or otherwise accommodate the ribs **416** extending underneath the outward support member **414** of the bottom-out protector **148** (compare e.g., FIGS. **108A** and **138A**). The chamber **828** may be positioned inboard of mounting feature **824** and rearward of mounting feature **830**. In an illustrative example, the mounting feature **824** (and the outward support members **814**) of the pair of track drive protectors **139A** and **139B** (for use with running board assembly **120A**) may be positioned further outboard from the mounting feature **830** and/or other feature on the track drive protectors of FIGS. **139A** and **139B** (such as the forward mounting feature **820** and/or the rearward mounting feature **818**) than the mounting

feature **824** (and the outward support member **814**) of the pair of track drive protectors of FIGS. **136A** and **136B** (for use with the running board assembly **120B**). In addition to, or alternatively, the mounting feature **826** (and the outward support member **814**) of the pair of track drive protectors of FIGS. **139A** and **139B** (for use with running board assembly **120A**) may be positioned further outboard from the forward mounting feature **420** and/or the rearward mounting feature **418** than the mounting feature **826** (and the outward support member **814**) of the pair of track drive protectors of FIGS. **136A** and **136B** (for use with the running board assembly **120B**). Changing the location of such features between the pairs of the track drive protectors **800** allows for the track drive protectors **800** to be compatible with common components, such as the forward frame **312**, between the snowmobile of FIG. **1** and the snowmobile of FIG. **8**, as well as with components that are not common or commonly configured (such as the running board assemblies **120A** and **120B**) between the snowmobile of FIG. **1** and the snowmobile of FIG. **8**. As described above with respect to the toe stop **140** and the bottom-out protector **148**, the opening **177** to the toe pocket **222** may be at least partially defined by the track drive protector **800**.

[**0399**] The track drive protector **800** may define at least one channel **832** that extends downward from the upper surface of the bottom wall **810**. Thus, when the track drive protector **800** is viewed from the side or below, the channel **832** appears to be a rib/projection extending downward from the bottom wall **810**. As shown in FIGS. **147A**, **147B**, **160A**, **160B**, and **162**, the projection defined by channel **832** is positioned adjacent the projection **932** of the secondary skid plate **800** to define a continuous or substantially continuous surface that extends from a forward portion of the wings **906** to a rearward portion of the track drive protector **800**. For example, the bottom wall **810** defines the longitudinal channel **832** extending forward from a drain **812** (see e.g., FIGS. **136B**, **137A**, **139B**, and **140A**) that is configured to align with the drain **412** of the bottom-out protector **148**. It is to be understood that the channel **832** (and therefore the projection) may be offset from the centerline of the bottom wall **810** and/or provided with one or more gaps therealong to accommodate the location of one or more features such as the mounting feature **826** and/or the drains **812**. In a non-limiting example, a second channel **836** may be separated from and positioned rearward of the channel **832** to accommodate the drains **812**, and is offset from the centerline of the bottom wall **810** to accommodate the mounting feature **826**. In an illustrative example, the second channel **836** may have an L-shape. In one aspect, channel **836** may aid the absorption of an impact by the track drive protector **800**. Optionally, one or both channels **832/836** includes a drainage hole/drain. For example, channel **832** includes a drain **834**. The distance of the drain **834** from drain **812** may vary (see e.g., FIGS. **136B** and **139B**). In one aspect, the channels **832/836** may function as a structure to facilitate traversing obstacles during operation of the snowmobile **100/700/702** when the track drive protector **800** is attached to the snowmobile **100/700/702**. In another aspect one or both channels **832/836** provide structural strength to the track drive protector **800**. Although the formation of the projection(s) on one side of the bottom wall **810** is the result of a channel formed on the other side of the bottom wall **810**, the present disclosure is not limited to such a configuration. It is to be understood that the projection(s) on the bottom wall **810** may be

present without a channel on the opposite side of the bottom wall 810.

[0400] The track drive protector 800 may be fabricated from the same or a different material as the bottom-out protector 148. In a non-limiting example, the bottom-out protector 148 comprises a first polymeric material, and the track drive protector 800 comprises a second material that is same as or different than the first material. In an illustrative example, the track drive protector 800 comprises a thermoplastic material including heat-compacted woven polymer fibers. In one aspect, the track drive protector 800 provides additional protection to the snowmobile 100/700/702. For example, the track drive protector 800 is configured to absorb some impact forces so that they are not transmitted directly to the chassis 102. As another example, the track drive protector 800 may shield the underside of the snowmobile 100/700/702 from debris.

[0401] Turning to FIGS. 142-145, the snowmobile 100/700/702 may optionally include a secondary skid plate 900. The secondary skid plate 900 may be made from a polymeric material, a laminate polymer composite, a polymeric material with fibers, carbon fiber, and/or a metallic material. In one aspect, the secondary skid plate 900 is thinner than a conventional skid plate while maintaining the strength of a conventional skid plate. The secondary skid plate 900 may be fabricated by compression molding, injection molding, or injection thermoforming. In one example, the secondary skid plate 900 is fabricated by compression molding a polymer matrix with directional fibers. The secondary skid plate 900 may comprise the same material as the track drive protector 800. In a non-limiting example, secondary skid plate 900 comprises a thermoplastic material including heat-compacted woven polymer fibers. In some embodiments, the secondary skid plate 900 may be formed of a fiber reinforced polymer material including one or more of the above-described polymers and one or more types of reinforcements including, but not limited to, glass and/or carbon fibers, e.g., 30 wt % glass filled polyamide. In a non-limiting example, the fiber % by weight of the composite material may range from 20 wt % to 60 wt %, and may optionally be in the range of 20 wt % to 40 wt %, or optionally in the range of 25 wt % to 35 wt %.

[0402] The secondary skid plate 900 includes a nose section 902, a body section 904, and a wing 906 (see e.g., FIG. 142). As discussed below in greater detail, the secondary skid plate 900 includes a plurality of mounting features for coupling the secondary skid plate 900 to a snowmobile 100/700/702.

[0403] The nose section 902 extends forward and upwards from the body section 904 (see e.g., FIGS. 143 and 147A-B). In other words, the forward end of the nose section 902 is positioned forward and/or upwards of the rear end of the nose section 902. The nose section 902 may include a central panel 908 extending forward from a base panel 912, and two side panels 910 flanking the central panel 908 (see e.g., FIGS. 142 and 144). The side panels 910 may extend rearward from the central panel 908 (see e.g., FIGS. 143 and 147A-B). In one aspect, this configuration allows the nose section 902 to wrap around the nose panel 720 when the secondary skid plate 900 is attached to a snowmobile 100/700/702 (see e.g., FIGS. 162-163). Accordingly, a polymeric assembly is provided that extends from the front bumper or the front bumper mount 303 to the rear bumper 530. In an illustrative example, the polymeric assembly extend-

ing from the front bumper to the rear bumper may comprise any combination of the following: the side body panel 710, the forward body panel 708, the nose panel 720, the secondary skid plate 900, the body panel 400, the skid plate 402, the bottom-out protector 148, the track drive protector 800, the toe stop 140, the foot support member 124, and the rear kick-up panel 146.

[0404] The body section 904 may be oriented horizontally (see e.g., FIG. 144). The body section 904 extends rearward from the nose section 902 (see e.g., FIG. 142). The outboard sides of the body section 904 may extend rearward at an angle to the longitudinal axis 6 of the snowmobile 100/700/702. The width of the front end of the body section 904 may be the same as the width of the rear end of the nose section 902. The rear end of the body section 904 may be wider than the front end. In some embodiments, the shape of the body section 904 may be the same as the shape of the forward frame assembly 312. In this example, the lower horizontal members 331/332 of the frame assembly 312 and the body section 904 have a generally triangular shape (see e.g., FIGS. 134 and 142). The body section 904 may further be positioned between the wings 906, e.g., the body section 904 is flanked by the wings 906. The front end of the body section 904 may be positioned forward of the front end of the wings 906 and the rear end of the body section 904 may be positioned forward of the rear end of the wings 906.

[0405] The body section 904 may define one or more channels 914 (see e.g., FIG. 142). The channels 914 may be oriented parallel to the longitudinal axis 6 of the snowmobile 100/700/702. When the secondary skid plate 900 is viewed from behind, the channels 914 appear to be ribs extending downward from the body section 904 (see e.g., FIG. 145). In one non-limiting example, the body section 904 has three channels 914. In some embodiments, one channel 914 extends forward into the base panel 912 of the nose section 902 (see e.g., FIG. 142). Optionally, the channel 914 includes a drain 916. In one aspect, the channels/ribs 914 increase the strength of the secondary skid plate 900.

[0406] The body section 904 may include a mounting region 920 positioned along the outboard sides. The mounting region 920 may be positioned adjacent to the wings 906. The mounting region 920 may form the rearward end of the angled outboard sides of the body section 904. As discussed below in greater detail, the mounting region 920 may be configured to mate with a front suspension mount 362 of the forward frame assembly 312 (see e.g., FIG. 163). Optionally, the mounting region 920 may be raised or lowered relative to an adjacent region of the body section 904 (see e.g., FIG. 156).

[0407] Optionally, the body section 904 may include an open channel 918 extending inwards from the side of the body section 904 (see e.g., FIG. 142). The open channel 918 may be positioned forward of the mounting features 950 and extend downward from the body section 904 to shield the head of any fastener positioned on the underside of the body section 904 and inserted through features 950. In one non-limiting example, two open channels 918 are positioned on opposite side of the body section 904 and are aligned. Similar features may be provided forward of the mounting features 958 positioned on the body section 904 along the wings 906.

[0408] The wings 906 may be positioned rearward of the nose section 902. The height of the wings 906 may be less

than the height of the nose section 902 (see e.g., FIGS. 147A-B). The wings 906 may be positioned outboard of the nose section 902 and the body section 904. The front and outboard sides of the wing 906 may be curved. The wings 906 may curve upward in an outboard direction from the body section 904, curve upward in a forward direction, and/or curve upward in an outboard direction from the opening 944 (see e.g., FIG. 143). The rear end of the wings 906 may include a rear flange 940 configured to abut/cover/mate with the drive track protector 800 and/or the bottom-out protector 148 (see e.g., FIGS. 142, 147A-B, 156 and 159A-B). The rear flange 940 may have a zig-zag configuration.

[0409] The secondary skid plate 900 may include one or more features that define a continuous or near continuous surface with the track drive protector 800. In an illustrative example, the wings 906 may include a channel 932 on the upper surface. The channel 932 may be oriented parallel or substantially parallel to the longitudinal axis 6 of the snowmobile 100/700/702. When viewed from the front, from behind, or from the side, the channel 932 may define a rib extending from the lower surface (see e.g., FIGS. 144-145 and 147A-B). The channel/rib 932 may be continuous, e.g., channel 932*b*, or discontinuous, e.g., channel 932*a*. As discussed below in greater detail, the channel/rib 932 may be aligned with the channel/rib 832 of the track drive protector 800 when the secondary skid plate 900 and the track drive protector 800 are attached to the snowmobile 100/700/702 (see e.g., FIG. 160B). In one aspect, this configuration provides a deflection rib spanning more than one component of the underside of the snowmobile 100/700/702. In one aspect, the deflection rib 832/932 may deflect an impact. In an illustrative example, the continuous surface defined by the ribs 832/932 may facilitate traversing objects such as logs as the continuous surface provides for a smooth transition along the underbody when passing over such obstacles. The continuous surface defined by 832/932 may be provided by positioning the forward end of the track drive protector 800 over the rearward end of the secondary skid plate to align the ribs 832/932. The mounting feature 820 of the track drive protector 800 that is secured to the forward frame assembly 312 may be positioned directly above the continuous surface to provide support to the continuous surface. In some embodiments, the secondary skid plate 900 may overlap the track drive protector 800. As shown in FIGS. 160A and 160B, the continuous surface defined by 832/932 may extend from forward of the heat exchanger assembly to rearward of the track drive shaft. Optionally, the continuous surface defined by 832/932 may extend from a front suspension mount located adjacent mounting region 920 to rearward of the track drive shaft.

[0410] The right wing 906*a* may include an opening 944 (see e.g., FIG. 142). The perimeter of the opening may be irregular. In some embodiments, a portion of the opening 944 is positioned between portions of the rib 932*a*. The opening 944 may be configured to be aligned with the opening 744 of the skid plate 402 when the secondary skid plate 900 is attached to the snowmobile 100/700/702. In some embodiments, the opening 944 in the secondary skid plate 900 is larger than the opening 744 of the skid plate 402 (see e.g., FIGS. 157 and 161A-B). The right wing 906*a* having the opening 944 may be configured for an engine exhaust. In some embodiments, the opening 944 may be configured to allow an engine exhaust gas to pass through, and out of, an

engine exhaust pipe housed at least partially in the secondary skid plate 900.

[0411] As discussed below in greater detail, the secondary skid plate 900 may be configured to be placed on, or cover, the underside of the forward frame assembly 312, portions of the skid plate 402, and/or the nose panel 720. Thus, the secondary skid plate 900 may include features complementary to one or more body panels. For example, the nose section 902 may include features complementary to the features of the nose panel 720. In one aspect, a secondary skid plate 900 with complementary features has a closer fit when attached to the snowmobile 100/700/702, which may provide additional support to the snowmobile.

[0412] The secondary skid plate 900 may include one or more mounting features to attach the secondary skid plate 900 to the snowmobile 100/700/702. A mounting feature may further include an aperture configured to receive a fastener. For example, the nose section 902 includes one or more mounting features 909/911 positioned in the central section 908 for removable securing the nose section 902 to the nose panel 720, the side sections 910, and/or the base section 912 (see e.g., FIG. 142). In one non-limiting example, the central section 908 has two apertures 909 and each side section 910 has one aperture 911. Some of the mounting features of the nose section 902 may be aligned with mounting features of another snowmobile component. For example, mounting features 922 are aligned with mounting features 722 of the nose panel 720, mounting features 722 of the skid plate 402, and/or mounting features 305 of the forward frame assembly 312 (see e.g., FIG. 134).

[0413] The body section 904 includes a plurality of mounting features 920/950/958. Some of the mounting features 920/950 may be aligned along outboard sides of the body section 904. Some of the mounting features of the body section 904 may be aligned with mounting features of another snowmobile component. For example, mounting feature 950 may be aligned with mounting feature 750 of the skid plate 402, and mounting feature 307 of the forward frame assembly 312; and mounting feature 958 may be aligned with mounting feature 758 of the skid plate 402 and mounting feature 309 of the forward frame assembly 312. The mounting feature 920 may be provided with one or more apertures that are alignable with the apertures provided in the underside 363 of the rearwardmost mounts on the forward frame for the lower suspension arms and may be removably secured thereto with a fastener. Accordingly, the secondary skid plate 900 may protect or otherwise cover more of the forward frame assembly 312 than the skid plate 402.

[0414] The wings 906 include a plurality of mounting features 930/936/956 positioned along the sides of the wings 906 (see also FIG. 143). For example, a plurality of mounting features 930 are positioned along a forward side, a plurality of the mounting features 936 are positioned along an outboard side, and at least one mounting feature 956 is positioned along the rear side. Mounting features 930 may be utilized to attach the front of the secondary skid plate 900 to the front of the skid plate 402. Mounting features 936 may be utilized to attach the side of the secondary skid plate 900 to the side of the skid plate 402. Some of the mounting features of the wing 906 may be aligned with mounting features of another snowmobile component. For example, mounting feature 956 may be aligned with mounting feature 830 of the track drive protector 800, mounting feature 756 of the skid

plate 402, and/or mounting feature 430 of the bottom-out protector 148.

[0415] FIG. 148 shows a non-limiting example of a method 980 of assembling a snowmobile 100/700/702 that includes, but is not limited to, two or more of a track drive protector 800, a secondary skid plate 900, a skid plate 402, a bottom-out protector 148, a foot support member 124, a toe stop 140, and a heat exchanger assembly 147. It is to be understood that the assembly of the secondary skid plate 900 with either the pair of track drive protectors 800 shown in FIG. 160A (for use with the running board assembly 120B), or the pair of track drive protectors 800 shown in FIG. 160B (for use with the running board assembly 120A) allows the secondary skid plate 900 to be a common component for both the snowmobile shown in FIG. 1 and the snowmobile shown in FIG. 8. Accordingly, in some embodiments, only the track drive protectors 800 are changed when producing one snowmobile or the other with the assembly. In some embodiments, the running board assembly 120A, the toe stops 148 and the skid plate 402 may be changed when producing one snowmobile or the other with the assembly. It is to be understood that the method is not limited to the steps, the order of the steps, the components, or combinations of the components shown in FIG. 135. It is to be understood that any combination of two or more of these components may be secured directly or indirectly to each other. In an illustrative example, the track drive protector 800 may be removably secured to the foot support member 124 with a removable and reusable fastener. The method 780 of assembling two or more of these components may include any part of one or more of the following steps:

[0416] STEP 982, ATTACH A TRACK DRIVE PROTECTOR AND ONE OR MORE OF A SKID PLATE, AND A BOTTOM-OUT PROTECTOR TO A FIRST LOCATION UTILIZING A FIRST ATTACHMENT ASSEMBLY, includes attaching a track drive protector 800 and one or more of a skid plate 402, and a bottom-out protector 148 to a first location utilizing a first attachment assembly (see e.g., FIG. 128). The first location may be on the forward frame assembly 312. In a non-limiting example, the first location is the tab 336 of the flange 335 of the metal sheet 316/320/334. In an illustrative example, the first attachment assembly includes a reusable and removable fastener, a mounting feature 820 of the track drive protector 800, a mounting feature 754 of the skid plate 402, and the forward mounting feature 420 of the bottom-out assembly 148. As discussed above, a U-clip 432 may be positioned on the tab 336 of the metal sheet 316/320/334. The legs of the U-clip 432 may be positioned on the tab 336. The head of the fastener may be positioned adjacent to the bottom side of the skid plate 402. Thus, from bottom to top, the components of the first attachment assembly may be arranged as follows: fastener, track drive protector 800, skid plate 402, bottom-out protector 148, first leg of U-clip 432, tab 336, and second leg of U-clip 432 that threadingly engages the removable and reusable fastener. The fastener may be removed to allow for disassembly and replacement of any parts.

[0417] STEP 984, ATTACH A SECONDARY SKID PLATE AND/OR THE TRACK DRIVE PROTECTOR WITH ONE OR MORE OF THE SKID PLATE, AND THE BOTTOM-OUT PROTECTOR TO A SECOND LOCATION UTILIZING A SECOND ATTACHMENT ASSEMBLY, includes attaching a secondary skid plate 900

and/or the track drive protector 800 with one or more of the skid plate 402, and the bottom-out protector 148 to a second location utilizing a second attachment assembly. The second location is rearward of the first location. In an illustrative example, the second attachment assembly includes a reusable and removable fastener, a mounting feature 956 of the secondary skid plate 900, a mounting feature 830 of the track drive protector 800, a mounting feature 756 of the skid plate 402 and a mounting feature 430 of the bottom-out assembly 148. The mounting feature 430 may be positioned between legs of a U-clip 432. The head of the fastener may be positioned adjacent to the bottom side of the secondary skid plate 900. In other words, the fastener may be inserted upwards through the mounting feature 956 of the secondary skid plate 900, the mounting feature 830 of the track drive protector 800, the mounting feature 756 of the skid plate 402, and the mounting feature 430 of the bottom-out protector 148. Thus, from bottom to top, the components of the second attachment assembly may be arranged as follows: fastener, secondary skid plate 900, track drive protector 800, skid plate 402, first leg of U-clip 432, bottom-out protector 148, and second leg of the U-clip 432 that threadingly engages the removable fastener. The secondary skid plate 900 may overlap the first location. For example, the rear flange 940 may overlap the first location (see e.g., FIGS. 146-147 and 159B). The fastener may be removed to allow for disassembly and replacement of any parts.

[0418] STEP 986, ATTACH THE TRACK DRIVE PROTECTOR AND ONE OR MORE OF THE BOTTOM-OUT PROTECTOR, A FOOT SUPPORT MEMBER, AND A TOE STOP TO A THIRD LOCATION UTILIZING A THIRD ATTACHMENT ASSEMBLY, includes attaching the track drive protector 800 and one or more of the bottom-out protector 148, a foot support member 124, and a toe stop 140 to a third location utilizing a third attachment assembly, the third location is rearward of the second location. In an illustrative example, the third attachment assembly includes a reusable and removable fastener 142, a mounting feature 824 of the track drive protector 800, and one or more of a mounting feature 424 of the bottom-out protector 148, a forward mounting feature 135 of the foot support member 124, and a forward slot 165b in the bottom flange 176 of the toe stop 140. In an illustrative example, the mounting feature 824 of the track drive protector 800 may be positioned between legs of a U-clip 432. The head of the fastener 142 may be positioned adjacent to the toe stop 140. In other words, the fastener may be inserted downwards through the outboard slot 165b of the toe stop 140, through the forward mounting feature 135 of the foot support member 124, through the mounting feature 424 of the bottom-out protector 148, through the second leg of U-clip, through the mounting feature 824 of the track drive protector 800, and through the first leg of the U-clip that threadingly engages the removable fastener. Thus, from bottom to top, the components of the third attachment assembly may be arranged as follows: first leg of U-clip 432, track drive protector 800, second leg of U-clip 432, bottom-out protector 148, foot support member 124, toe stop 140, and fastener 142. The fastener may be removed to allow for disassembly and replacement of parts.

[0419] STEP 988, ATTACH THE TRACK DRIVE PROTECTOR AND ONE OR MORE OF THE BOTTOM-OUT PROTECTOR, THE FOOT SUPPORT MEMBER, AND THE TOE STOP TO A FOURTH LOCATION UTILIZING

A FOURTH ATTACHMENT ASSEMBLY, includes attaching the track drive protector **800** and one or more of the bottom-out protector **148**, the foot support member **124**, and the toe stop **140** to a fourth location utilizing a fourth attachment assembly. The fourth location is rearward of the third location. The fourth location may also be positioned inboard from the third location. The fourth attachment assembly includes a removable and reusable fastener, a mounting feature **826** of the track drive protector **800**, and one or more of a mounting feature **426** of the bottom-out protector **148**, a rearward mounting feature **137** of the foot support member **124**, and a rearward slot **165a** in the bottom flange **176** of the toe stop **140**. The mounting feature **826** may be positioned between legs of a U-clip **432**. The head of the fastener **142** may be positioned adjacent to the toe stop **140** as shown in FIG. 71. In other words, the fastener **142** may be inserted downwards through the rearward slot **165a** of the toe stop **140**, through the rearward mounting feature **137** of the foot support member **124**, through the mounting feature **426** of the bottom-out protector **148**, through the second leg of the U-clip **432**, through the mounting feature **824** of the track drive protector **800**, and through the first leg of the U-clip that threadingly engages the removable fastener **142**. Thus, from bottom to top, the components of the fourth attachment assembly may be arranged as follows: first leg of U-clip **432**, track drive protector **800**, second leg of U-clip, bottom-out protector **148**, foot support member **124**, toe stop **140**, and fastener. The fastener may be removed to allow for disassembly and replacement of any parts.

[0420] STEP 990, ATTACH THE TRACK DRIVE PROTECTOR AND THE BOTTOM-OUT PROTECTOR TO A FIFTH LOCATION UTILIZING A FIFTH ATTACHMENT ASSEMBLY, includes attaching the track drive protector **800** and the bottom-out protector **148** to a fifth location utilizing a fifth attachment assembly. The fifth location may be a mounting flange **452** of a side panel **182** of the tunnel **104** or an end cap **178** of a heat exchanger assembly **174**. The fifth location may be located inboard to the fourth location. The fifth location may be outboard of the side panel **182** of the tunnel **104** or an end cap **178** of a heat exchanger assembly. In an illustrative example, the fifth attachment assembly includes a removable and reusable fastener, a mounting feature **818** of the track drive protector **800**, a rearward mounting feature **418** of the bottom-out protector **148**, and the mounting flange **452**. The head of the fastener may be adjacent to the bottom side of the track drive protector **800** (see e.g., FIGS. 159A-B). In other words, the fastener may be inserted upwards from the rearward mounting feature **818** of the track drive protector **800**, through the rearward mounting feature **418** of the bottom-out protector **148**, and the forward opening **451** of the mounting flange **452** (see e.g., FIG. 128). As discussed above, a U-clip may be positioned on the heat exchanger assembly mount **452** about forward opening **451**. Thus, from bottom to top, the components of the fifth attachment assembly may be arranged as follows: fastener, track drive protector **800**, bottom-out protector **148**, first leg of U-clip **432**, heat exchanger assembly mount **452**, and second leg of U-clip **432** that is threadingly engaged with the removable fastener. The fastener may be removed to allow for disassembly and replacement of any parts.

[0421] As discussed above, the nose section **902** is configured to cover/overlay the nose panel **720**, the body section

904 is configured to cover/overlay the forward and rear belly pans **319/323** of the forward frame assembly **312**, and the wing **906** is configured to cover/overlay the skid plate **402**. In one aspect, when attached to the snowmobile **100/700/702**, the secondary skid plate **900** provides additional protection to the underside of the snowmobile **100/700/702**. For example, the secondary skid plate **900** may be configured to absorb some impact forces so that they are not transmitted directly to the chassis **102**. As another example, the secondary skid plate **900** may shield the underside of the snowmobile **100/700/702** from debris. As discussed above, the rib **932** of the secondary skid plate **900** may be aligned with the rib **832** of the track drive protector **800** (see e.g., FIG. 160B) to provide a continuous or substantially continuous surface to facilitate the traversal of obstacles during operation of the vehicle. The nose section **902** is configured to cover/overlay the nose panel **720** with the removable fasteners at mounting feature **909** secured to the nose panel **720** in a channel below a knob of a latch assembly that can be actuated to release and remove one or more of the body panels and components positioned thereabove including, but not limited to, parts **708** and **710**. Therefore, upper portions of the snowmobile may be removed to access one or more components thereunder without removing the secondary skid plate **900**.

[0422] FIGS. 128 and 149-155 provide various non-limiting views illustrating assembling a snowmobile **100/700/702** according to methods **780/980** discussed above. Reference numbers 1-5 correspond to step **782/982**, step **784/984**, step **786/986**, step **788/988**, and step **790/990** of method **780** and method **980** respectively. One or all of the mounting feature **818/820/824/826/830** of the track drive protector **800** is aligned with one or all of the corresponding mounting feature **418/420/424/426/430** of the bottom-out protector **148** (see e.g., FIG. 128). For example, mounting feature **820** of the track drive protector **800** is aligned with the forward mounting feature **420** of the bottom-out protector **148** and mounting feature **754** of the skid plate **402**. Thus, a fastening device may be utilized to attach the track drive protector **800** to the bottom-out protector **148** and to other components **124/178/335/402**. The fastening device for any or all of the mounting features may be removable and reusable to allow the components to be disassembled and reassembled without fastening with a weld or permanent mechanical fastener such as a rivet. However, the present disclosure is not limited to such fasteners and single-use fasteners and permanent connections between the components can be used.

[0423] When the secondary skid plate **900** is attached to the snowmobile **100/700/702**, the body section **904** extends under the forward and rear belly pans **319/323** of the forward frame assembly **312** (see e.g., FIGS. 156-158 and 160A-B). The rear belly pan **319** may be attached to the bottom plate **329**, and/or the lower horizontal member **332**. For example, the front end of the rear belly pan **319** is attached to the bottom plate **329**, the sides are attached to the lower horizontal member **332**, and the rear end is attached to the heat exchanger assembly **174** and/or the lower horizontal member **332**. The forward belly pan **323** may be attached to the bottom plate **329** and/or the lower horizontal member **332**. For example, the front end and/or sides of the forward belly pan **323** are attached to the lower horizontal member **332** and the rear end of the forward belly pan **323** is attached to the bottom plate **329**. In some embodiments, the forward belly pan **323** extends under the bottom plate **329**

(see e.g., FIG. 115B). In one aspect, a forward belly pan 323 extending under the bottom plate 329 provides two layers of support for an engine 106 mounted to the bottom plate 329. In a further aspect, attaching a secondary skid plate 900 to the snowmobile provides an additional layer of support for the engine 106 in addition to deflecting debris away from the underside of the snowmobile 100/700/702.

[0424] One aspect of a secondary skid plate 900 as discussed above, is that it may be larger than a conventional skid plate. For example, the nose section 902 covers a majority of the nose panel 720 when the secondary skid plate 900 is attached to the snowmobile 100/700/702 (see e.g., FIG. 161). In some embodiments, 65-90% or 80-90% of the nose panel 720 may be covered by the secondary skid plate 900. As another example, when the secondary skid plate 900 is attached to the snowmobile 100/700/702, the front end of the wings 906 is positioned higher than the front end of a conventional skid plate. In some embodiments, the front end of the wings 906 covers 20-40% of the front end of the skid plate 402. In one non-limiting example, the front end of the wings 906 is positioned higher than the bottom of the side body panel 400 (see e.g., FIG. 162). In another example, the outboard side of the wings 906 covers the majority of the outboard side of the skid plate 402. In some embodiments, the wings 906 cover 80-100% of the outboard side of the skid plate 402. In one non-limiting example, the wings 906 cover all of the outboard side of the skid plate 402.

[0425] According to one or more aspects of the present disclosure, a toe stop includes a composite body that includes: a first portion defining a toe pocket; and a second portion at least partially defining a chamber positioned inboard of the toe pocket, wherein the chamber is shaped to at least partially house a vehicle component therein.

[0426] In one or more embodiments of the toe stop according to the previous paragraph, the chamber is partially defined by an inboard wall, the inboard wall comprising a sensor mount configured to receive a sensor.

[0427] In one or more embodiments of the toe stop according to any one of the previous paragraphs, the chamber is partially defined by a rearward wall extending inward from the inboard wall, the composite body further comprising a wire guide panel extending from the rearward wall, the wire guide panel comprising a wire guide.

[0428] In one or more embodiments of the toe stop according to any one of the previous paragraphs, the toe pocket is partially defined by a toe hook and a forward wall and the toe hook is positioned rearward of the forward wall.

[0429] According to one or more aspects of the present disclosure, a toe stop includes a composite body. The composite body includes a first portion defining a toe pocket; and a wall positioned inboard of the first portion and extending rearward therefrom, wherein an inboard side of the wall defines a channel configured to receive at least a portion of a wire harness for an electrical component therein.

[0430] According to one or more aspects of the present disclosure, a toe stop includes a composite body. The composite body includes a toe pocket; and a wall positioned inboard of the toe pocket and extending rearward therefrom, wherein the wall defines a sensor mount.

[0431] In one or more embodiments of the toe stop according to the previous paragraph, the toe hook is further positioned above the sensor mount.

[0432] According to one or more aspects of the present disclosure, a toe stop includes a unitary body. The unitary body includes a bottom flange forming a bottom surface of the top stop; a forward wall extending upward from the bottom flange; an inboard wall extending upward from the bottom flange and rearward from the forward wall; and a rearward wall extending upward from the bottom flange and inward from the inboard wall. A toe pocket is partially defined by the forward wall and the inboard wall.

[0433] In one or more embodiments of the toe stop according to the previous paragraph, the bottom flange includes one or more slots for attaching the toe stop to a running board assembly of a snowmobile.

[0434] In one or more embodiments of the toe stop according to any one of the previous paragraphs, the unitary body further including an outboard wall positioned forward of the bottom flange and extending forward from the forward wall. The outboard wall includes a side panel interface and/or a skid plate interface.

[0435] In one or more embodiments of the toe stop according to any one of the previous paragraphs, the outboard wall includes the side panel interface and the skid plate interface, wherein the side panel interface is positioned above the skid plate interface.

[0436] In one or more embodiments of the toe stop according to any one of the previous paragraphs, the outboard wall is V-shaped.

[0437] In one or more embodiments of the toe stop according to any one of the previous paragraphs, the toe stop further including one or more ribs extending outward from an outboard surface of the outboard wall.

[0438] In one or more embodiments of the toe stop according to any one of the previous paragraphs, the outboard wall includes a skid plate mounting point located above the skid plate interface.

[0439] In one or more embodiments of the toe stop according to any one of the previous paragraphs, the skid plate mounting point is further located below the one or more ribs.

[0440] In one or more embodiments of the toe stop according to any one of the previous paragraphs, the unitary body further includes a toe hook positioned rearward of the forward wall, wherein the toe pocket is further defined by the toe hook.

[0441] In one or more embodiments of the toe stop according to any one of the previous paragraphs, the toe hook comprises a wire retaining feature positioned on an outboard side of the toe hook.

[0442] In one or more embodiments of the toe stop according to any one of the previous paragraphs, the toe hook has a triangular or rectangular shape.

[0443] In one or more embodiments of the toe stop according to any one of the previous paragraphs, the toe stop further includes a toe hook panel positioned forward of the forward wall, above the inboard wall, and rearward of the rearward wall, the toe hook extending inboard to an inboard side of the toe stop; and a frame mount member extending upwards from an upper edge of the toe hook panel, the frame mount member including a mounting aperture for mounting the toe stop to a forward frame.

[0444] In one or more embodiments of the toe stop according to any one of the previous paragraphs, the toe hook is positioned along a rearward surface of the toe hook panel.

[0445] In one or more embodiments of the toe stop according to any one of the previous paragraphs, the toe hook is positioned along a bottom surface of the toe hook panel.

[0446] In one or more embodiments of the toe stop according to any one of the previous paragraphs, the toe hook panel defines one or more openings.

[0447] In one or more embodiments of the toe stop according to any one of the previous paragraphs, the toe stop including one or more ribs extend over the one or more openings.

[0448] In one or more embodiments of the toe stop according to any one of the previous paragraphs, the ribs are positioned on a forward surface of the toe hook panel.

[0449] In one or more embodiments of the toe stop according to any one of the previous paragraphs, an upper edge of the toe hook panel includes an attachment feature for coupling the toe stop to a body panel of a snowmobile.

[0450] In one or more embodiments of the toe stop according to any one of the previous paragraphs, the toe stop further includes a panel extending forward from the toe hook to the forward wall. The panel, the toe hook and the forward wall define a clearance feature sized to receive a tubular running board support member.

[0451] In one or more embodiments of the toe stop according to any one of the previous paragraphs, the inward wall and the rearward wall defining a chamber for a belt assembly positioned inboard from the toe stop.

[0452] In one or more embodiments of the toe stop according to any one of the previous paragraphs, the inward wall and the rearward wall defining a chamber for a belt assembly positioned inboard from the toe stop.

[0453] In one or more embodiments of the toe stop according to any one of the previous paragraphs, the toe stop including one or more vent holes.

[0454] In one or more embodiments of the toe stop according to any one of the previous paragraphs, the one or more vent holes includes a vent hole in the inboard wall, the forward wall, and/or the rearward wall.

[0455] In one or more embodiments of the toe stop according to any one of the previous paragraphs, a forward surface of the toe stop includes one or more ribs.

[0456] In one or more embodiments of the toe stop according to any one of the previous paragraphs, the toe stop is unitary.

[0457] In one or more embodiments of the toe stop according to any one of the previous paragraphs, the toe stop is a molded polymeric composite material.

[0458] In one or more embodiments of the toe stop according to any one of the previous paragraphs, the toe stop further including a sensor coupled to the sensor mount feature by an interference fit.

[0459] In one or more embodiments of the toe stop according to any one of the previous paragraphs, the toe stop is coupled to a running board assembly of a snowmobile.

[0460] According to one or more aspects of the present disclosure, a snowmobile, includes a body including a tunnel and a running board assembly secured to the body. The running board assembly including a support member positioned outboard of the tunnel, and a foot support member having an inboard side removably secured to the tunnel. A toe stop is coupled to the foot support member, wherein the toe stop is a molded polymeric composite material.

[0461] In one or more embodiments of the toe stop according to the previous paragraph, the foot support member is formed of a material having thermal conductivity of less than $1 \text{ W/m} \cdot ^\circ\text{K}$.

[0462] In one or more embodiments of the toe stop according to any one of the previous paragraphs, the support member and the foot support member are removably attached to the tunnel and the foot support member is removably secured to the support member.

[0463] In one or more embodiments of the toe stop according to any one of the previous paragraphs, the foot support member defines a plurality of apertures extending from near the inboard side to near the outboard side of the foot support member and configured to shed snow or other debris therethrough.

[0464] In one or more embodiments of the toe stop according to any one of the previous paragraphs, the toe stops define a plurality of openings in fluid communication with an engine bay of the snowmobile. The openings are configured to exhaust air warmed by the engine from inside the engine bay.

[0465] According to one or more aspects of the present disclosure, a method of assembling a snowmobile that includes a body defining a tunnel is presented. The method includes attaching a support member to the tunnel using a first plurality of fasteners such that the support member is located outboard of the tunnel; attaching inboard sides of a foot support member to the tunnel using a second plurality of fasteners; securing outboard sides of the foot support member to the support member using a plurality of flexible clips integrally formed with the foot support member that is defined on an outboard side of the foot support member; and attaching a toe stop to the foot support member using one or more second fasteners, the toe stop comprising a bottom flange with one or more slots, each slot configured to receive one of the second fasteners.

[0466] In one or more embodiments of the method according to the previous paragraph, the toe stop comprises a plurality of openings and attaching the toe stop includes arranging the plurality of openings such that they are in fluid communication with an engine bay of the snowmobile and configured to exhaust air warmed by the engine from inside the engine bay.

[0467] According to one or more aspects of the present disclosure, a snowmobile includes a body including a tunnel and a running board assembly secured to the body. The running board assembly further includes a support member positioned outboard of the tunnel, a foot support member having an inboard side removably secured to the tunnel, and an outboard side removably secured to the support member by a plurality of flexible clips defined on an outboard side of the foot support member. Each of the flexible clips wraps around at least 51% of a circumference of the support member and is sized to apply a compressive force to the support member.

[0468] In one or more embodiments of the snowmobile according to the previous paragraph, each of the flexible clips wraps around at least 60% of a circumference of the support member.

[0469] In one or more embodiments of the snowmobile according to any one of the previous paragraphs, each of the flexible clips wraps around no more than 75% of a circumference of the support member.

[0470] In one or more embodiments of the snowmobile according to any one of the previous paragraphs, the foot support member is formed of a material having thermal conductivity of less than $1 \text{ W/m}^\circ\text{K}$.

[0471] In one or more embodiments of the snowmobile according to any one of the previous paragraphs, the foot support member is formed of a polymeric composite material.

[0472] In one or more embodiments of the snowmobile according to any one of the previous paragraphs, the plurality of flexible clips are integrally formed with the foot support member of the same polymeric composite material.

[0473] In one or more embodiments of the snowmobile according to any one of the previous paragraphs, the support member and the foot support member are removably attached to the tunnel and the foot support member is removably secured to the support member.

[0474] In one or more embodiments of the snowmobile according to any one of the previous paragraphs, the support member is removably attached to the tunnel by a plurality of threaded fasteners.

[0475] In one or more embodiments of the snowmobile according to any one of the previous paragraphs, the foot support member defines a plurality of apertures extending from near the inboard side to near the outboard side of the foot support member and configured to shed snow or other debris therethrough.

[0476] In one or more embodiments of the snowmobile according to any one of the previous paragraphs, the foot support member defines a plurality of serrated ridges extending from a top surface of the foot support member and located intermediate the plurality of apertures. The plurality of serrated ridges are configured to enhance traction of a rider's boot with the running boards.

[0477] In one or more embodiments of the snowmobile according to any one of the previous paragraphs, the running board assembly further includes front toe stops attached to the foot support member and the tunnel.

[0478] In one or more embodiments of the snowmobile according to any one of the previous paragraphs, the front toe stops define a plurality of openings in fluid communication with an engine bay of the snowmobile. The openings are configured to exhaust air warmed by the engine from inside the engine bay.

[0479] In one or more embodiments of the snowmobile according to any one of the previous paragraphs, the running board assembly further includes rear kick-up panels that are attached to the foot support member and the tunnel.

[0480] In one or more embodiments of the snowmobile according to any one of the previous paragraphs, the snowmobile further includes bottom-out protectors that project from the body and are located outboard of the tunnel and are located inboard of the support member of the running board assembly. The bottom-out protectors are positioned on the body in a location lower than the tunnel and the foot support member.

[0481] In one or more embodiments of the snowmobile according to any one of the previous paragraphs, the bottom-out protectors are formed from an unfilled thermoplastic olefin material.

[0482] According to one or more aspects of the present disclosure, a method of assembling a snowmobile that includes a body defining a tunnel is presented. The method includes attaching a support member to the tunnel using a

first plurality of fasteners such that the support member is located outboard of the tunnel, attaching inboard sides of a foot support member to the tunnel using a second plurality of fasteners and securing outboard sides of the foot support member to the support member using a plurality of flexible clips integrally formed with the foot support member that is defined on an outboard side of the foot support member. Each of the flexible clips wraps around at least 51% and at most 75% of a circumference of the support member and is sized to apply a compressive force to the support member.

[0483] In one or more embodiments of the method according to the previous paragraph, the method further includes attaching front toe stops to the foot support member and the tunnel and arranging a plurality of openings in the front toe stops such that they are in fluid communication with an engine bay of the snowmobile and configured to exhaust air warmed by the engine from inside the engine bay.

[0484] In one or more embodiments of the method according to any one of the previous paragraphs, the method further includes attaching rear kick-up panels to the foot support member and the tunnel.

[0485] In one or more embodiments of the method according to any one of the previous paragraphs, the method further includes attaching bottom-out protectors formed from an unfilled thermoplastic olefin material to the body. The bottom-out protectors are located outboard of the tunnel and inboard of the support member to which the plurality of flexible clips defined on the outboard side of the foot support member are secured. The bottom-out protectors are positioned on the body in a location lower than the tunnel and the foot support member.

[0486] According to one or more aspects of the present disclosure, a snowmobile includes a chassis, a tunnel attached to the chassis, a running board assembly, and bottom-out protectors projecting from the chassis and located outboard of the tunnel and inboard of an outboard side of the running board assembly. The bottom-out protectors are positioned on the chassis in a location lower than the tunnel and the running board assembly. The bottom-out protectors are formed from a thermoplastic olefin material.

[0487] According to one or more aspects of the present disclosure, a composite running board includes a first side rail that is securable to a snowmobile and a second side rail positioned outboard of the first side rail. The second side rail at least partially defines a channel shaped to receive a support. The composite running board further includes a plurality of cross members extending from the first side rail to the second side rail.

[0488] In one or more embodiments of the composite running board according to the previous paragraph, the channel extends along a length of the second rail.

[0489] In one or more embodiments of the composite running board according to any one of the previous paragraphs, the support has a tubular shape.

[0490] In one or more embodiments of the composite running board according to any one of the previous paragraphs, the lower surface of the running board defines the channel and the lower surface of the running board that defines the channel is curved to form a downward facing opening that extends along a length of the second side rail for receiving a support in the channel.

[0491] In one or more embodiments of the composite running board according to any one of the previous paragraphs, a first plurality of retaining members extend toward the

opening from the second rail along an outboard side of the downward facing opening.

[0492] In one or more embodiments of the composite running board according to any one of the previous paragraphs, the second side rail defines a first plurality of upwardly facing holes on the upper surface to the channel. The first plurality of upwardly facing holes are aligned along the length of the second side rail. At least some of the first plurality of retaining members are positioned outboard and adjacent the first plurality of upwardly facing holes.

[0493] In one or more embodiments of the composite running board according to any one of the previous paragraphs, a first plurality of retaining members extend toward the opening from the lower surface of the running board along an inboard side of a downwardly facing opening.

[0494] In one or more embodiments of the composite running board according to any one of the previous paragraphs, a second plurality of retaining members extend toward the opening from the lower surface of the running board along an inboard side of the downwardly facing opening.

[0495] In one or more embodiments of the composite running board according to any one of the previous paragraphs, the second side rail defines a second plurality of upwardly facing openings on the upper surface to the channel that are aligned along the length of the second side rail. The second plurality of upwardly facing openings are positioned on an inboard side of the channel and the first plurality of openings are positioned on an outboard side of the channel.

[0496] In one or more embodiments of the composite running board according to any one of the previous paragraphs, a first plurality of retaining members extend toward the opening from the second rail along an outboard side of the downward facing opening.

[0497] In one or more embodiments of the composite running board according to any one of the previous paragraphs, the first plurality of retaining members are offset from the second plurality of retaining members along the length of the second rail.

[0498] In one or more embodiments of the composite running board according to any one of the previous paragraphs, the first plurality of upwardly facing openings and the second plurality of upwardly facing openings are offset from each other along the length of the second side rail.

[0499] In one or more embodiments of the composite running board according to any one of the previous paragraphs, the first plurality of retaining members are at least partially positioned along a leading edge of the cross members and extend outboard therefrom toward the downwardly facing opening.

[0500] According to one or more aspects of the present disclosure, a composite running board includes a first side rail securable to a snowmobile and a second side rail positioned outboard of the first side rail. The second side rail includes a plurality of features that are fastenable to a support member. The composite running board further includes a plurality of cross members extending from the first side rail to the second side rail. The first side rail, the second side rail, and the cross members include a fiber reinforced polymer.

[0501] According to one or more aspects of the present disclosure, a composite running board includes a first side rail that is securable to a snowmobile and a second side rail positioned outboard of the first side rail, the second side rail at least partially defines retaining member shaped to engage

a support. The composite running board further includes a plurality of cross members extending from the first side rail to the second side rail. The first side rail, the second side rail, and the cross members include a fiber reinforced polymer.

[0502] According to one or more aspects of the present disclosure, a composite running board includes a first side rail securable to the side of a snowmobile and a second side rail positioned outboard of the first side rail. The second side rail includes an outboard edge that defines a channel extending along a length of the second rail and shaped to receive a plurality of support members. The composite running board further includes a plurality of cross members extending from the first side rail to the second side rail.

[0503] According to one or more aspects of the present disclosure, a snowmobile tunnel assembly includes a tunnel including a center plate and a first side panel including a first end connected to the center plate and a second end extending therefrom. The snowmobile tunnel assembly further has a second side panel including a first end connected to the center plate and a second end extending therefrom. The snowmobile tunnel assembly additionally includes a first support bracket secured to the first side panel. The first support bracket has a mounting surface extending outboard from the first side panel.

[0504] In one or more embodiments of the snowmobile tunnel assembly according to the previous paragraph, the first side panel has a first thickness and the mounting surface of the first support has a second thickness that is greater than the first thickness.

[0505] In one or more embodiments of the snowmobile tunnel assembly according to any one of the previous paragraphs, the tunnel includes a first material and the first support bracket includes a second material that is different than the first material.

[0506] In one or more embodiments of the snowmobile tunnel assembly according to any one of the previous paragraphs, the first support includes a first vertical member that is secured to an inboard surface of the first panel. The mounting surface extends from the vertical member beneath the second end of the first panel and outboard therefrom.

[0507] In one or more embodiments of the snowmobile tunnel assembly according to any one of the previous paragraphs, the snowmobile tunnel assembly further includes a running board including a first side rail, a second side rail, and a plurality of cross members extending between the first rail and the second rail. The running board is secured to the mounting surface with the first side rail positioned adjacent and parallel to the first side panel of the tunnel.

[0508] In one or more embodiments of the snowmobile tunnel assembly according to any one of the previous paragraphs, the snowmobile tunnel assembly further includes a running board including a first side rail, a second side rail, and a plurality of cross member extending between the first rail and the second rail. The running board is secured to the mounting surface with the first side rail positioned adjacent to the first side panel of the tunnel. A rearward end of the first side rail is positioned a first distance from the first side panel and a forward end of the first side rail is positioned at a second distance from the first side panel that is greater than the first distance.

[0509] In one or more embodiments of the snowmobile tunnel assembly according to any one of the previous paragraphs, the mounting surface has a length extending at least partially between a forward end of the tunnel and a rearward

end of the tunnel. The mounting surface extends outboard from the first panel a distance at the forward end that is greater than a distance at the rearward end.

[0510] In one or more embodiments of the snowmobile tunnel assembly according to any one of the previous paragraphs, the first support includes a rear suspension mounting point vertically offset from the mounting surface.

[0511] According to one or more aspects of the present disclosure, a method of making a snowmobile with a common running board is presented. The method includes providing a tunnel assembly including a tunnel including a center plate, a first side panel including a first end connected to the center plate and a second end extending therefrom, and a second side panel including a first end connected to the center plate and a second end extending therefrom and securing either a first support bracket or a second support bracket to the first side panel. The first support bracket includes a mounting surface with a first dimension and the second support bracket includes a mounting surface with a second dimension that is different than the first dimension. The method further includes securing a common running board including a longitudinal centerline to the mounting surface of either the first support bracket or the second support bracket. The longitudinal centerline of the running board is positioned at a first angle with respect to the first side panel when secured to the first support bracket and is positioned at a second angle with respect to the first side panel when secured to the second support bracket. The first angle is different than the second angle.

[0512] In one or more embodiments of the method according to the previous paragraph, the method further includes providing a common forward frame assembly including a first side including a tube mounting member and an inner perimeter defining a first opening, a second side positioned adjacent the first side, the second side including a tube mounting member and an inner perimeter defining a second opening. A rearward portion of the first side and the second side define a rearward opening therebetween. The method additionally includes securing the tunnel assembly to the forward frame with a portion of the tunnel assembly positioned in the rearward opening between the first side and the second side and securing either a first running board support tube associated with the first running board support to the tube mounting member on the first side of the forward frame assembly, or a second running board support tube associated with the second support bracket to the tube mounting member on the first side of the forward frame assembly. The first running board support tube has a length that is different than the second running board support tube. The method also includes securing a second side rail of the common running board that is positioned outboard of a first side rail of the common running board to either the first running board support tube or the second running board support tube.

[0513] According to one or more aspects of the present disclosure, a method of assembling two different types of snowmobiles with a common forward frame is presented. The method includes providing a common forward frame including a longitudinal centerline and a running board mounting point positioned outboard of the longitudinal centerline, providing a first running board assembly, e.g., a running board assembly of a high performance snowmobile having a shorter chassis, including a forward mount, providing a second running board assembly that is different than the first running board assembly, e.g., a running board

assembly of a snowmobile designed for hills and mountains having a longer chassis, the second running board assembly including a forward mount, and securing the forward mount of either the first running board assembly or the second running board assembly to the running board mounting point. The first running board assembly is located at a first position with respect to the longitudinal centerline of the forward frame when secured to the running board mounting point. The second running board assembly is located at a second position with respect to the longitudinal centerline of the forward frame when secured to the running board mounting point. The first position is different than the second position.

[0514] In one or more embodiments of the method according to the previous paragraph, the running board mounting point extends outward and forwardly from the forward frame.

[0515] In one or more embodiments of the method according to any one of the previous paragraphs, the running board mounting point is positioned below an upper surface of a tunnel secured to the forward frame.

[0516] In one or more embodiments of the method according to any one of the previous paragraphs, the forward mount of the first running board assembly extends outward from the centerline of the vehicle farther than the forward mount of the second running board assembly.

[0517] In one or more embodiments of the method according to any one of the previous paragraphs, the common forward frame includes a control arm mounting point and the method further includes providing a first suspension assembly including a control arm and a spindle that includes a lower A-arm ball joint, providing a second suspension assembly that is different than the first suspension assembly, the second suspension assembly including a control arm and a spindle that includes a lower A-arm ball joint; and securing the control arm of the first suspension assembly to the control arm mounting point when the first running board assembly is secured to the forward mount or the second suspension assembly to the control arm mounting point when the second running board assembly is secured to the forward mount. The first lower A-arm ball joint is positioned at a different position with respect to the common frame, e.g., from or along the common front frame, than the second lower A-arm ball joint when the respective suspension assembly is secured to the common front frame.

[0518] In one or more embodiments of the method according to any one of the previous paragraphs, the forward mount of the first running board assembly extends outward from the centerline of the vehicle farther than the forward mount of the second running board assembly, and the lower A-arm ball joint of the first suspension assembly extends outward from the centerline of the vehicle farther than the lower A-arm ball joint of the second suspension assembly.

[0519] In one or more embodiments of the method according to any one of the previous paragraphs, the forward mount of the first running board assembly extends outward from the centerline of the vehicle farther than the forward mount of the second running board assembly, and the lower A-arm ball joint of the first suspension assembly farther forward with respect to the common frame than the lower A-arm ball joint of the second suspension assembly.

[0520] In one or more embodiments of the method according to any one of the previous paragraphs, the forward mount of the first running board assembly extends outward from the centerline of the vehicle farther than the forward

mount of the second running board assembly, and the lower A-arm ball joint of the first suspension assembly is positioned along the centerline of the forward frame farther forward from the running board mounting point than the lower A-arm ball joint of the second suspension assembly.

[0521] While the disclosed snowmobile has been described with reference to an exemplary embodiment(s), 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 scope of the invention. In addition, many modifications may be made to adapt a particular situation or material to the teachings of the invention without departing from the essential scope thereof. Therefore, it is intended that the invention is not limited to the particular embodiment(s) disclosed, but that the invention will include all embodiments falling within the scope of the appended claims.

1. A snowmobile comprising:
 - a forward frame assembly;
 - a nose panel attached to the forward frame assembly;
 - a skid plate attached to a first side of the forward frame assembly and a second side of the forward frame assembly; and
 - a secondary skid plate configured to cover at least a portion of the skid plate.
2. The snowmobile of claim 1, wherein the secondary skid plate comprises:
 - a nose section configured to cover the nose panel;
 - a body section extending rearward from the nose section, the body section configured to cover the forward frame assembly;
 - a first wing positioned outboard of the body section, the first wing configured to cover the skid plate at the first side of the forward frame assembly; and
 - a second wing positioned outboard of the body section, the second wing configured to cover the skid plate at the second side of the forward frame assembly.
3. The snowmobile of claim 2, wherein the nose section extends upward from the body section to cover at least a portion of a front end of the snowmobile.
4. The snowmobile of claim 3, wherein the first wing and the second wing extend upward in an outboard direction.
5. The snowmobile of claim 1, wherein the skid plate includes an opening configured to access an interior component of the snowmobile, and wherein the secondary skid plate includes an opening configured to be aligned with the opening of the skid plate.
6. The snowmobile of claim 1, wherein the nose panel is positioned forward of where the skid plate is attached to the first side of the forward frame assembly and the second side of the forward frame assembly.
7. The snowmobile of claim 1, further comprising:
 - a first bottom out protector attached to a rear edge of the skid plate and the forward frame assembly at the first side of the forward frame assembly; and
 - a second bottom out protector attached to a rear edge of the skid plate and the forward frame assembly at the second side of the forward frame assembly.
8. The snowmobile of claim 7, further comprising:
 - a first track drive protector covering the first bottom out protector; and
 - a second track drive protector covering the second bottom out protector,
 wherein the first track drive protector and the second track drive protector include a deflection rib.

9. The snowmobile of claim 8, wherein the secondary skid plate includes one or more ribs configured to be aligned with the deflection rib of the first track drive protector and the deflection rib of the second track protector, wherein the one or more ribs and the deflection rib form a continuous surface.

10. A skid plate assembly, comprising:
 - a skid plate including:
 - a body section configured to secure to an underbody of a snowmobile,
 - a first wing positioned outboard of the body section,
 - a second wing positioned outboard of the body section,
 - and
 - a first rib projection; and
 - a track drive protector including a second rib projection, wherein the first rib projection and the second rib projection define a continuous rib extending between the skid plate and the track drive protector.
11. The skid plate assembly of claim 10, wherein the track drive protector is removably securable to the skid plate.
12. The skid plate assembly of claim 10, further comprising:
 - a bottom out protector positionable along the underbody of the snowmobile to house a snowmobile component therein,
 wherein the bottom out protector is positioned between the snowmobile and the track drive protector.
13. The skid plate assembly of claim 12, wherein the bottom out protector includes a bottom wall and the track drive protector include a bottom surface, wherein at least a portion of the bottom wall and the bottom surface are positioned apart from each other to define a gap therebetween.
14. The skid plate assembly of claim 13, wherein a rear portion of the bottom wall of the bottom out protector abuts a rear portion of the bottom surface of the track drive protector.
15. The skid plate assembly of claim 10, wherein the skid plate includes an opening configured to access an interior component of the snowmobile.
16. The skid plate assembly of claim 10, wherein the skid plate includes:
 - a nose section extending forward and upward from the body section to cover a front end of the snowmobile,
 wherein the first wing and the second wing extend upward from the body section, and wherein the nose section extends upwards to a greater height than the first wing and the second wing.
17. A method of assembling two different snowmobile models with a common skid plate, the method comprising:
 - providing the common skid plate, the common skid plate including:
 - a first set of mounting features configured to secure a first pair of bottom out protectors, and
 - a second set of mounting features configured to secure a second pair of bottom out protectors; and
 - securing the first pair of bottom out protectors or the second pair of bottom out protectors to the common skid plate.
18. The method of claim 17 further comprising:
 - providing a secondary skid plate including a body section configured to cover a forward frame assembly, the secondary skid plate configured to cover the common skid plate; and
 - securing the secondary skid plate over the common skid plate,
 wherein the body section includes a plurality of mounting features configured to removably secure to the forward frame assembly.

19. The method of claim **18** further comprising:
providing a common set of track drive protectors, the common set of track drive protectors configured to cover the first pair of bottom out protectors and the second pair of bottom out protectors; and
securing the common set of track drive protectors over the first pair of bottom out protectors or the second pair of bottom out protectors.

20. The method of claim **19**, wherein a gap is defined between the common set of track drive protectors and the first pair of bottom out protectors or the second pair of bottom out protectors.

21. A snowmobile, comprising:
a skid plate;
a bottom out protector;
a running board assembly, including a rear kick-up and a bracket;
a toe stop; and
a heat exchanger assembly,
wherein one or more of the skid plate, the bottom out protector, the running board assembly, the toe stop, and/or the heat exchanger assembly includes a fiber reinforced polymer material.

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