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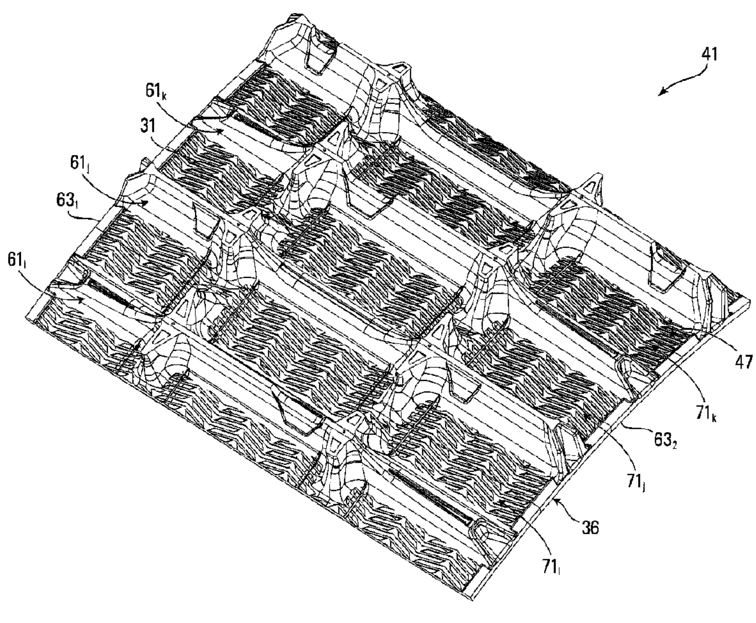
(54) **Titre :** CHENILLE SANS FIN POUR TRACTION D'UN VEHICULE HORS ROUTE, COMME UN VEHICULE TOUT-TERRAIN (VTT) OU UNE MOTONEIGE

(54) **Title:** ENDLESS TRACK FOR TRACTION OF AN OFF-ROAD VEHICLE SUCH AS AN ALL-TERRAIN VEHICLE (ATV) OR A SNOWMOBILE



(57) **Abrégé/Abstract:**

An endless track for traction of an off-road vehicle, such as an all-terrain vehicle (ATV) or a snowmobile. The endless track comprises an inner side for facing track-contacting wheels around which it is mountable and a ground-engaging outer side for engaging the ground. The ground-engaging outer side comprises a plurality of traction projections distributed along a longitudinal direction of the endless track. The traction projections may be designed to control rigidity characteristics, such as a longitudinal rigidity and a widthwise rigidity, of the endless track, while maintaining a weight of the endless track relatively low.

ABSTRACT

An endless track for traction of an off-road vehicle, such as an all-terrain vehicle (ATV) or a snowmobile. The endless track comprises an inner side for facing track-contacting wheels around which it is mountable and a ground-engaging outer side for engaging the ground. The ground-engaging outer side comprises a plurality of traction projections distributed along a longitudinal direction of the endless track. The traction projections may be designed to control rigidity characteristics, such as a longitudinal rigidity and a widthwise rigidity, of the endless track, while maintaining a weight of the endless track relatively low.

ENDLESS TRACK FOR TRACTION OF AN OFF-ROAD VEHICLE SUCH AS AN ALL-TERRAIN VEHICLE (ATV) OR A SNOWMOBILE

FIELD OF THE INVENTION

The invention relates generally to off-road vehicles such as all-terrain vehicles (ATVs) and snowmobiles and, more particularly, to endless tracks for providing traction to ATVs, snowmobiles and other off-road vehicles.

BACKGROUND

Certain off-road vehicles, such as snowmobiles and all-terrain vehicles (ATVs), may be equipped with elastomeric endless tracks which enhance their traction and floatation on soft, slippery and/or irregular grounds (e.g., soil, mud, sand, ice, snow, etc.) on which they operate

Traction, floatation and other performance aspects of tracked vehicles depend on various factors, including their endless tracks.

For example, rigidity characteristics of an endless track can have a significant influence on traction, floatation and other performance aspects of a vehicle propelled by the track. For instance, while the track needs to be longitudinally flexible to flex around a track-engaging assembly (e.g., comprising a drive wheel and roller wheels) of the vehicle, large deflections of a bottom run of the track (e.g., in gaps between adjacent rollers wheels) may occur if the track's longitudinal flexibility is too great, thereby detrimentally affecting traction and pressure distribution on the ground. Also, the track may comprise transversal stiffening rods such that it is very rigid transversally or may be free of transversal

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stiffening rods such that it is very flexible transversally, but a very high transversal rigidity or flexibility may present drawbacks (e.g., poor traction on uneven ground areas if too rigid transversally, poor floatation if too flexible transversally, etc.).

For these and other reasons, there is a need to improve endless tracks for ATVs, snowmobiles and other off-road vehicles.

SUMMARY OF THE INVENTION

According to an aspect of the invention, there is provided an endless track for traction of an off-road vehicle. The endless track is mountable around a plurality of track-contacting wheels which includes a drive wheel for driving the endless track. The endless track comprises elastomeric material allowing the endless track to flex around the track-contacting wheels. The endless track comprises an inner side for facing the track-contacting wheels and a ground-engaging outer side for engaging the ground. The ground-engaging outer side comprises a plurality of traction projections distributed along a longitudinal direction of the endless track. Each traction projection of the plurality of traction projections comprises: a transversal protrusion extending transversally to the longitudinal direction of the endless track; and an enlarged protrusion larger in the longitudinal direction of the endless track than the transversal protrusion of the traction projection. The enlarged protrusions of the traction projections are dimensioned and disposed relative to one another to enhance a rigidity of a bottom run of the endless track in the longitudinal direction of the endless track.

According to another aspect of the invention, there is provided an endless track for traction of an off-road vehicle. The endless track is mountable around a plurality of track-contacting wheels which includes (i) a drive wheel for driving the endless track and (ii) a plurality of roller wheels for rolling on a bottom run of the endless track. The endless track comprises elastomeric material allowing the endless track to flex around the track-contacting wheels. The endless track comprises an inner side for facing the track-contacting wheels and a ground-engaging outer side for engaging the ground. The ground-engaging outer side comprises a plurality of traction projections distributed along a longitudinal direction of the endless track. Each traction projection of the plurality of traction projections comprises: a transversal protrusion extending transversally to the longitudinal direction of the endless track; and an enlarged protrusion larger in the longitudinal direction of the endless track than the transversal protrusion of the traction projection. The enlarged protrusions of the traction projections are dimensioned and disposed relative to one another to oppose a tendency of the bottom run of the endless track to flex inwardly in a gap between adjacent ones of the roller wheels.

According to another aspect of the invention, there is provided an endless track for traction of an off-road vehicle. The endless track is mountable around a plurality of track-contacting wheels which includes a drive wheel for driving the endless track. The endless track comprises elastomeric material allowing the endless track to flex around the track-contacting wheels. The endless track comprises an inner side for facing the track-contacting wheels and a ground-engaging outer side for engaging the ground. The ground-engaging outer side comprises a plurality of traction projections distributed along a longitudinal direction of the endless track. Each traction projection of the plurality of traction projections comprises: a transversal protrusion extending transversally to the longitudinal direction of the endless track; and an enlarged protrusion larger in the longitudinal direction of the endless track than the transversal protrusion of the traction projection. A ratio of (i) a width of the enlarged protrusion of a first one of the traction projections in the longitudinal direction of the endless track over (ii) a longitudinal spacing of the first one of the traction projections and a second one of the traction projections which succeeds the first one of the traction projections in the longitudinal direction of the endless track is at least 0.8.

According to another aspect of the invention, there is provided an endless track for traction of an off-road vehicle. The endless track is mountable around a plurality of track-contacting wheels which includes a drive wheel for driving the endless track. The endless track comprises elastomeric material allowing the endless track to flex around the track-contacting wheels. The endless track comprises an inner side for facing the track-contacting wheels and a ground-engaging outer side for engaging the ground. The ground-engaging outer side comprises a plurality of traction projections distributed along a longitudinal direction of the endless track. Each traction projection of the plurality of traction projections comprises: a transversal protrusion extending transversally to the longitudinal direction of the endless track; a first enlarged protrusion larger in the longitudinal direction of the endless track than the transversal protrusion of the traction projection; and a second enlarged protrusion larger in the longitudinal direction of the endless track than the transversal protrusion of the traction projection. The first enlarged protrusion and the second enlarged protrusion of the traction projection are spaced apart in a widthwise direction of the endless track. The first enlarged protrusion of the traction projection is larger in the longitudinal direction of the endless track than the second enlarged protrusion of the traction projection.

According to another aspect of the invention, there is provided an endless track for traction of an off-road vehicle. The endless track is mountable around a plurality of track-contacting wheels which includes a drive wheel for driving the endless track. The endless track comprises elastomeric material allowing the endless track to flex around the track-contacting wheels. The endless track comprises an inner side for facing the track-contacting wheels and a ground-engaging outer side for engaging the ground. The ground-engaging outer side comprises a plurality of traction projections distributed along a longitudinal direction of the endless track. Each traction projection of the plurality of traction projections extends transversally to the longitudinal direction of the endless track.

A ratio of (i) a bending stiffness of the traction projection in a widthwise direction of the endless track over (ii) a cross-sectional weight per unit length of the traction projection at a cross-section of the traction projection is at least 5000 in.^{3}.

According to another aspect of the invention, there is provided an endless track for traction of an off-road vehicle. The endless track is mountable around a plurality of track-contacting wheels which includes a drive wheel for driving the endless track. The endless track comprises elastomeric material allowing the endless track to flex around the track-contacting wheels. The endless track comprises an inner side for facing the track-contacting wheels and a ground-engaging outer side for engaging the ground. The ground-engaging outer side comprises a plurality of traction projections distributed along a longitudinal direction of the endless track. Each traction projection of the plurality of traction projections extends transversally to the longitudinal direction of the endless track. A cross-section of the traction projection has: a width in the longitudinal direction of the endless track; a minimal dimension in the longitudinal direction of the endless track that is less than the width of the cross-section of the traction projection; and a height in a thickness direction of the endless track. A ratio of the width of the cross-section of the traction projection over the minimal dimension of the cross-section of the traction projection in the longitudinal direction of the endless track is at least 4. A ratio of the height of the cross-section of the traction projection over the minimal dimension of the cross-section of the traction projection in the longitudinal direction of the endless track is at least 6.

These and other aspects of the invention will now become apparent to those of ordinary skill in the art upon review of the following description of embodiments of the invention in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

A detailed description of embodiments of the invention is provided below, by way of example only, with reference to the accompanying drawings, in which:

Figures 1A and 1B show an example of an all-terrain vehicle (ATV) comprising track assemblies which comprise endless tracks in accordance with an embodiment of the invention;

Figures 2A and 2B show the ATV equipped with ground-engaging wheels instead of the track assemblies;

Figures 3 and 4 show perspective views of a front one and a rear one of the track assemblies;

Figures 5 and 6 show perspective views of the front one and the rear one of the track assemblies without their endless track;

Figures 7 and 8 show perspective views of a segment of the endless track of the rear track assembly, which depict features of an inner side and a ground-engaging outer side of the endless track that are not depicted in Figures 1A, 1B, 3 and 4, including traction projections of the endless track;

Figures 9 and 10 show views of the ground-engaging outer side and the inner side of the endless track of the rear track assembly;

Figure 11 shows a side view of the endless track of the rear track assembly;

Figures 12 and 13 show other views of the endless track of the rear track assembly;

Figure 14 shows a cross-sectional view of the endless track taken as indicated in Figure 9;

Figure 15 shows a partial cross-sectional view of the endless track taken in a widthwise direction of the track;

Figure 16 shows a variant in which the endless track comprises transversal stiffening rods in other embodiments;

Figures 17 to 23 show views of a segment of the endless track of the front track assembly, which depict features of an inner side and a ground-engaging outer side of the endless track that are not depicted in Figures 1A, 1B, 3 and 4;

Figure 24A represents a smooth shape of a bottom run of the endless track of the rear track assembly in contrast to Figure 24B which represents an excessive flexion of the endless track in gaps between wheels of the rear track assembly that could occur if the endless track lacked certain features;

Figure 25A shows a controlled flexion of the endless track in its widthwise direction in contrast to Figure 25B which represents an excessive flexion of the endless track in its widthwise direction that could occur if the endless track lacked certain features;

Figure 26 shows a close-up perspective view of the endless track of the rear track assembly;

Figure 27 shows another view of the ground-engaging outer side of the endless track;

Figure 28 shows a close-up of the cross-sectional view of the endless track taken as indicated in Figure 9;

Figure 29A shows an example of flexion of a traction projection of the endless track in the track's longitudinal direction;

Figure 29B shows a situation if the traction projection of the endless track was not flexing in the track's longitudinal direction;

Figure 30A shows an example of controlled flexion of the endless track in its widthwise direction;

Figure 30B shows a situation if there was excessive flexion of the endless track in its widthwise direction;

Figure 30C shows a situation if there was substantially no flexion of the endless track in its widthwise direction;

Figures 31 and 32 show variants of the endless track in accordance with other embodiments of the invention in which a traction projection of the track comprises an internal cavity;

Figure 33 shows a variant of the endless track in accordance with another embodiment of the invention in which a traction projection of the track comprises composite elastomeric material;

Figure 34 shows a variant of the endless track in accordance with another embodiment of the invention in which a traction projection of the track comprises composite cellular elastomeric material;

Figures 35 and 36 show variants of the endless track in accordance with other embodiments of the invention which depict examples of other shapes of a traction projection of the track; and

Figure 37 shows an example of a snowmobile comprising an elastomeric endless track in accordance with another embodiment of the invention.

It is to be expressly understood that the description and drawings are only for the purpose of illustrating certain embodiments of the invention and are an aid for understanding. They are not intended to be a definition of the limits of the invention.

DETAILED DESCRIPTION OF EMBODIMENTS

Figures 1A and 1B show an example of an all-terrain vehicle (ATV) 10 in accordance with an embodiment of the invention. The ATV 10 is a small open vehicle designed to travel off-road on a variety of terrains, including roadless rugged terrain, for recreational, utility and/or other purposes.

In this embodiment, the ATV 10 comprises a prime mover 12, a plurality of track assemblies 16_1-16_4, a seat 18, and a user interface 20, which enable a user of the ATV to ride the ATV 10 on the ground.

The prime mover 12 is a source of motive power that comprises one or more motors. For example, in this embodiment, the prime mover 12 comprises an internal combustion engine. In other embodiments, the prime mover 12 may comprise another type of motor (e.g., an electric motor) or a combination of different types of motor (e.g., an internal combustion engine and an electric motor).

The prime mover 12 is in a driving relationship with one or more of the track assemblies 16_1-16_4. That is, motive power generated by the prime mover 12 is transmitted to one or more of the track assemblies 16_1-16_2 via a powertrain of the ATV 10 (e.g., via a transmission and a differential of the powertrain).

In this case, the seat 18 is a straddle seat and the ATV 10 is usable by a single person such that the seat 18 accommodates only that person driving the ATV 10. In other cases, the seat 18 may be another type of seat, and/or the ATV 10 may be usable by two individuals, namely one person driving the ATV 10 and a passenger, such that the seat 18 may accommodate both of these individuals (e.g., behind one another or side-by-side) or the ATV 10 may comprise an additional seat for the passenger. For example, in other embodiments, the ATV 10 may be a side-by-side ATV, sometimes referred to as a "utility terrain vehicle" or "UTV".

The user interface 20 allows the user to interact with the ATV 10. More particularly, the user interface 20 comprises an accelerator, a brake control, and a steering device that are operated by the user to control motion of the ATV 10 on the ground. In this case, the steering device comprises handlebars. In other cases, the steering device may comprise a steering wheel or other type of steering element. The user interface 20 also comprises an instrument panel (e.g., a dashboard) which provides indicators (e.g., a speedometer indicator, a tachometer indicator, etc.) to convey information to the user.

The track assemblies 16_1-16_4 engage the ground to provide traction to the ATV 10. More particularly, in this example, front ones of the track assemblies 16_1-16_4 provide front traction to the ATV 10 while rear ones of the track assemblies 16_1-16_4 provide rear traction to the ATV 10. Each of the front ones of the track assemblies 16_1-16_4 is pivotable about a steering axis of the ATV 10 in response to input of the user at the handlebars in order to steer the ATV 10 on the ground.

In this embodiment, each track assembly 16_i is mounted in place of a ground-engaging wheel that may otherwise be mounted at a position of the track assembly 16_i to propel the ATV 10 on the ground. For example, as shown in Figures 2A and 2B, the ATV 10 may be propelled on the ground by four ground-engaging wheels 15_1-15_4 with tires instead of the track assemblies 16_1-16_4. Basically, in this embodiment, the track assemblies 16_1-16_4 may be used to convert the ATV 10 from a wheeled vehicle into a tracked vehicle, thereby enhancing its traction and floatation on the ground.

With additional reference to Figures 3 to 6, in this embodiment, each track assembly 16_i comprises a frame 44, a plurality of track-contacting wheels which includes a drive wheel 42 and a plurality of idler wheels 50_1-50_{10}, and an elastomeric endless track 41 disposed around the frame 44 and the wheels 42, 50_1-50_{10}. The track assembly 16_i has a front longitudinal end 57 and a rear longitudinal end 59 that define a length of the track assembly 16_i. A width of the track assembly 16_i is defined by a width of the endless track 41. An envelope of the track assembly 16_i is defined by a length of the track 41. The track assembly 16_i has a longitudinal direction, a widthwise direction, and a height direction.

The elastomeric endless track 41 engages the ground to provide traction to the ATV 10. Referring additionally to Figures 7 to 14, the track 41 comprises an inner side 45 facing the wheels 42, 50_1-50_{10} and defining an inner area of the track 41 in which these wheels are located. The track 41 also comprises a ground-engaging outer side 47 opposite the inner side 45 for engaging the ground on which the ATV 10 travels. Lateral edges 63_1, 63_2 of the track 41 define the track's width. The track 41 has a top run 65 which extends between the longitudinal ends 57, 59 of the track assembly 16_i and over the drive wheel 42, and a bottom run 66 which extends between the longitudinal ends 57, 59 of the track assembly 16_i and under the idler wheels 50_1-50_{10}. The track 41 has a longitudinal direction, a widthwise direction, and a thickness direction.

The endless track 41 is elastomeric in that it comprises elastomeric material allowing it to flex around the wheels 42, 50_1-50_{10}. The elastomeric material of the track 41 can include any polymeric material with suitable elasticity. In this embodiment, the elastomeric material includes rubber. Various rubber compounds may be used and, in some cases, different rubber compounds may be present in different areas of the track 22. In other embodiments, the elastomeric material of the track 41 may include another elastomer in addition to or instead of rubber (e.g., polyurethane elastomer).

While it is flexible, in this embodiment, the endless track 41 has certain rigidity characteristics which are useful for traction and other performance aspects of the track assembly 16_i, as discussed later.

The endless track 41 comprises an elastomeric belt-shaped body 36 underlying its inner side 45 and its ground-engaging outer side 47. In view of its underlying nature, the body 36 can be referred to as a "carcass". The carcass 36 comprises elastomeric material 37 which allows the track 41 to flex around the wheels 42, 50_1-50_{10}.

As shown in Figure 15, in this embodiment, the carcass 36 comprises a plurality of reinforcements embedded in its elastomeric material 37. One example of a reinforcement is a layer of reinforcing cables 38_1-38_C that are adjacent to one another and that extend in the longitudinal direction of the track 41 to enhance strength in tension of the track 41 along its longitudinal direction. In some cases, a reinforcing cable may be a cord or wire rope including a plurality of strands or wires. In other cases, a reinforcing cable may be another type of cable and may be made of any material suitably flexible longitudinally (e.g., fibers or wires of metal, plastic or composite material). Another example of a reinforcement is a layer of reinforcing fabric 40. Reinforcing fabric comprises pliable material made usually by weaving, felting, or knitting natural or synthetic fibers. For instance, a layer of reinforcing fabric may comprise a ply of reinforcing woven fibers (e.g., nylon fibers or other synthetic fibers). Various other types of reinforcements may be provided in the carcass 36 in other embodiments.

In this embodiment, the inner side 45 of the endless track 41 comprises an inner surface 32 of the carcass 36 and a plurality of wheel-contacting projections 48_1-48_N that project from the inner surface 32 and contact at least some of the wheels 42, 50_1-50_{10} and that are used to do at least one of driving (i.e., imparting motion to) the track 41 and guiding the track 41. In that sense, the wheel-contacting projections 48_1-48_N can be referred to as "drive/guide projections", meaning that each drive/guide projection is used to do at least one of driving the track 41 and guiding the track 41. Also, such drive/guide projections are sometimes referred to as "drive/guide lugs" and will thus be referred to as such herein. More particularly, in this embodiment, the drive/guide lugs 48_1-48_N interact with the drive wheel 42 in order to cause the track 41 to be driven, and also interact with the idler wheels 50_1-50_{10} in order to guide the track 41 as it is driven by the drive wheel 42. The drive/guide lugs 48_1-48_N are thus used to both drive the track 41 and guide the track 41 in this embodiment.

The drive/guide lugs 48_1-48_N are spaced apart along the longitudinal direction of the endless track 41. In this case, the drive/guide lugs 48_1-48_N are arranged in a plurality of rows that are spaced apart along the widthwise direction of the endless track 41. The drive/guide lugs 48_1-48_N may be arranged in other manners in other embodiments (e.g., a single row or more than two rows). Each drive/guide lug 48_i is an elastomeric drive/guide lug in that it comprises elastomeric material 68.

The ground-engaging outer side 47 of the endless track 41 comprises a ground-engaging outer surface 31 of the carcass 36 and a plurality of traction projections 61_1-61_M that project from the outer surface 31 and engage and may penetrate into the ground to enhance traction. The traction projections 61_1-61_M, which can sometimes be referred to as "traction lugs" or "traction profiles", are spaced apart in the longitudinal direction of the track assembly 16_i. The ground-engaging outer side 47 comprises a plurality of traction-projection-free areas 71_1-71_F (i.e., areas free of traction projections) between successive ones of the traction projections 61_1-61_M. In this example, each traction projection 61_i is an elastomeric traction projection in that it comprises elastomeric material 69.

In this embodiment, respective ones of the traction projections 61_1-61_M comprise one or more recesses 93_1-93_F extending from their outer end 77 to enhance traction on certain types of ground surfaces, such as compacted snow and other snow surfaces. For instance, in a traction projection 61_i including a recess 93_x, part of the traction projection's outer end 77 adjacent to the recess 93_x can apply more pressure on, and thus can have a greater tendency to penetrate, a compacted snow surface than if the recess 93_x was omitted. In this example, the recesses 93_1-93_F of successive ones of the traction projections 61_1-61_M are nonaligned in the widthwise direction of the endless track 41. For instance, snow can be compacted as it passes under a recess 93_x of a traction projection 61_i and a subsequent traction projection 61_k passing over the resulting compacted snow, with no recess aligned with the recess 93_x of the traction projection 61_i in the widthwise direction of the track 41, can engage and have better traction on the compacted snow.

The recesses 93_1-93_F of the traction projections 61_1-61_M may have any suitable shape. In this embodiment, the recesses 93_1-93_F of the traction projections 61_1-61_M taper in the thickness direction of the endless track 41. Also, in this embodiment, a recess 93_x of a traction projection 61_i has a depth d_r measured from the outer end 77 of the traction projection 61_i which corresponds to a substantial fraction of an overall height $H_{t\text{-}o}$ of the traction projection 61_i. For example, in some embodiments, a ratio $d_r/H_{t\text{-}o}$ of the depth d_r of the recess 93_x of the traction projection 61_i over the overall height $H_{t\text{-}o}$ of the traction projection 61_i may be at least 0.15, in some cases at least 0.25, in some cases at least 0.35, in some cases at least 0.45, and in some cases even more (e.g., at least 0.50). The ratio $d_r/H_{t\text{-}o}$ may have any other suitable value in other embodiments.

In this example, the carcass 36 has a thickness T_c which is relatively small. The thickness T_c of the carcass 36 is measured from the inner surface 32 to the ground-engaging outer surface 31 of the carcass 35 between longitudinally-adjacent ones of the traction projections 61_1-61_M. For example, in some embodiments, the thickness T_c of the carcass 36 may be no more than 0.250 inches, in some cases no more than 0.240 inches, in some cases no more than 0.230 inches, in some cases no more than 0.220 inches, in some cases no more than 0.210 inches, in some cases no more than 0.200 inches, and in some cases even less (e.g., 0.180 or 0.170 inches). The thickness T_c of the carcass 36 may have any other suitable value in other embodiments.

In this embodiment, as shown in Figure 15, the endless track 41 is free of transversal stiffening rods embedded in its elastomeric material. That is, the track 41 does not comprise transversal stiffening rods embedded in its elastomeric material and extending transversally to its longitudinal direction. Figure 16 shows a variant in which the track 41 may comprise transversal stiffening rods 53_1-53_M embedded in its elastomeric material and extending transversally to its longitudinal direction in other embodiments. This absence of transversal stiffening rods makes the track 41 more flexible in its widthwise direction than if the track 41 had the transversal stiffening rods 53_1-53_M but was otherwise identical.

The endless track 41 shown in Figures 7 to 14 is that of a given one of the rear track assemblies 16_3, 16_4. Figures 17 to 23 show the endless track 41 of a given one of the front track assemblies 16_1, 16_2, which is similar to the track 41 of the given one of the rear track assemblies 16_3, 16_4, except that it comprises bent lateral edge portions 64_1, 64_2 adjacent its lateral edges 63_1, 63_2 to facilitate steering of the given one of the front track assemblies 16_1, 16_2 on the ground, by creating a smaller ground-contacting area. More particularly, the carcass 36 of the track 41 of the given one of the front track assemblies 16_1, 16_2 is bent inwardly proximate the lateral edges 63_1, 63_2 of the track 41 such that its inner surface 32 and ground-engaging outer surface 31 are bent inwardly.

The endless track 41 may be constructed in various other ways in other embodiments. For example, in some embodiments, the track 41 may comprise a plurality of parts (e.g., rubber sections) interconnected to one another in a closed configuration, the track 41 may have recesses or holes that interact with the drive wheel 42 in order to cause the track 41 to be driven (e.g., in which case the drive/guide lugs 48_1-48_N may be used only to guide the track 41 without being used to drive the track 41), and/or the ground-engaging outer side 47 of the track 41 may comprise various patterns of traction projections.

The drive wheel 42 is rotatable about an axis of rotation 49 for driving the endless track 41. The axis of rotation 49 corresponds to an axle of the ATV 10. More particularly, in this example, the drive wheel 42 has a hub which is mounted to the axle of the ATV 10 such that power generated by the prime mover 12 and delivered over the powertrain of the ATV 10 rotates the axle, which rotates the drive wheel 42, which imparts motion of the track 41. In this embodiment in which the track assembly 16_i is mounted where a ground-engaging wheel 15_i could otherwise be mounted, the axle of the ATV 10 is capable of rotating the drive wheel 42 of the track assembly 16_i or the ground-engaging wheel 15_i.

In this embodiment, the drive wheel 42 comprises a drive sprocket engaging the drive/guide lugs 48_1-48_N of the inner side 45 of the track 41 in order to drive the track 41. In this case, the drive sprocket 42 comprises a plurality of teeth 46_1-46_T distributed circumferentially along its rim to define a plurality of lug-receiving spaces therebetween that receive the drive/guide lugs 48_1-48_N of the track 41. The drive wheel 42 may be configured in various other ways in other embodiments. For example, in embodiments where the track 41 comprises recesses or holes, the drive wheel 42 may have teeth that enter these recesses or holes in order to drive the track 41. As yet another example, in some embodiments, the drive wheel 42 may frictionally engage the inner side 45 of the track 41 in order to frictionally drive the track 41.

The idler wheels 50_1-50_{10} are not driven by power supplied by the prime mover 12, but are rather used to do at least one of supporting part of the weight of the ATV 10 on the ground via the track 41, guiding the track 41 as it is driven by the drive wheel 42, and tensioning the track 41. More particularly, in this embodiment, the idler wheels 50_1, 50_2 and the idler wheels 50_9, 50_{10} are respectively front idler wheels (leading idler wheels) and rear idler wheels (trailing idler wheels) that maintain the track 41 in tension, and can help to support part of the weight of the ATV 10 on the ground via the track 41. The idler wheels 50_3-50_8 are roller wheels that roll on the inner side 45 of the track 41 along the bottom run 66 of the track 41 to apply the bottom run 66 on the ground. The idler wheels 50_1-50_{10} move on respective ones of a plurality of idler wheel paths 50_1, 50_2 of the inner surface 32 of the carcass 35 of the endless track 41. Each of the idler wheel paths 50_1, 50_2 extends adjacent to respective ones of the drive/guide lugs 48_1-48_N to allow these lugs to guide motion of the track 41. As the roller wheels 50_3-50_8 roll on respective ones of the idler wheel paths 50_1, 50_2, these paths can be referred to as “rolling paths”.

The idler wheels 50_1-50_{10} may be arranged in other configurations and/or the track assembly 16_i may comprise more or less idler wheels in other embodiments.

In this embodiment, the drive/guide lugs 48_1-48_N and the idler wheel paths 50_1, 50_2 of the endless track 41 are laterally offset towards the lateral edge 63_1 of the track 41. In this example, the lateral edge 63_1 of the track 41 is an inboard lateral edge of the track 41 that is closest to a centerline 81 of the ATV 10, while the lateral edge 63_2 of the track 41 is an outboard lateral edge of the track 41 that is farthest from the centerline 81 of the ATV 10. This lateral offset may help for traction, stability and steering of the ATV 10 since it allows the track assembly 16_i

to have a ground-contacting area (i.e., “contact patch”) that emulates a ground-contacting area that a ground-engaging wheel 15_i would have if mounted in place of the track assembly 16_i. Basically, the track assembly 16_i applies more pressure on the ground in a first half 83_1 of the width of the track 41 that is adjacent the inboard lateral edge 63_1 of the track 41 than in a second half 83_2 of the width of the track 41 that is adjacent to the outboard lateral edge 63_2 of the track 41, instead of applying substantially equal pressure on both halves 83_1, 83_2 of the track 41.

More particularly, in this embodiment, as shown in Figure 10, the drive/guide lugs 48_1-48_N and the idler wheel paths 50_1, 50_2 are asymmetrically disposed relative to a centerline 79 bisecting the width of the track 41 into its halves 83_1, 83_2. Each of a widthwise span 80 of the drive/guide lugs 48_1-48_N and a widthwise span 84 the idler wheel paths 50_1, 50_2 is thus asymmetrically disposed relative to the centerline 79 and located closer the inboard lateral edge 63_1 of the track 41 than to the outboard lateral edge 63_2 of the track 41.

The frame 44 supports components of the track assembly 16_i, including the idler wheels 50_1-50_{10}. More particularly, in this embodiment, the front idler wheels 50_1, 50_2 are mounted to the frame 44 in a front longitudinal end region of the frame 44 proximate the front longitudinal end 57 of the track assembly 16_i, while the rear idler wheels 50_9, 50_{10} are mounted to the frame 44 in a rear longitudinal end region of the frame 44 proximate the rear longitudinal end 59 of the track assembly 16_i. The roller wheels 50_3-50_8 are mounted to the frame 44 in a central region of the frame 44 between the front idler wheels 50_1, 50_2 and the rear idler wheels 50_9, 50_{10}. Each of the roller wheels 50_3-50_8 may be rotatably mounted directly to the frame 44 or may be rotatably mounted to a link which is pivotally mounted to the frame 44 to which is rotatably mounted an adjacent one of the roller wheels 50_3-50_8, thus forming a “tandem”.

The frame 44 is supported at a support area 39. More specifically, in this case, the frame 44 is supported by the axle of the ATV 10 to which is coupled the drive wheel 42, such that the support area 39 is intersected by the axis of rotation 49 of the drive wheel 42.

In this embodiment, the frame 44 is pivotable about a pivot axis 51 to facilitate motion of the track assembly 16_i on uneven terrain and enhance its traction on the ground. More particularly, in this embodiment, the pivot axis 51 corresponds to the axis of rotation 49 of the drive wheel 42 and the frame 44 can pivot about the axle of the ATV 10 to which the drive wheel 42 is coupled. In other embodiments, the pivot axis 51 of the frame 44 may be located elsewhere (e.g., lower) than the axis of rotation 49 of the drive wheel 42. In yet other embodiments, the frame 44 may not be pivotable.

Also, in this embodiment, the track assembly 16_i comprises an anti-rotation connector 52 to limit a pivoting movement of the track assembly 16_i relative to a chassis of the ATV 10. In this example, the anti-rotation connector 52 comprises a spring and a damper and is connected between the frame 44 of the track assembly 16_i and the chassis of the ATV 10 (e.g., via one or more mounting brackets and/or fasteners).

In this embodiment, the endless track 41 has rigidity characteristics which are useful for traction and other performance aspects of the track assembly 16_i. For example, in this embodiment, the track 41 has a longitudinal rigidity (i.e., rigidity in its longitudinal direction) such that, although it can flex in its longitudinal direction to move around the wheels 42, 50_1-50_{10}, it is sufficiently rigid in its longitudinal direction to help maintain a "smooth" shape of the bottom run 66 of the track 41 for proper traction, as conceptually represented in dotted line in Figure 24A, by tending to prevent the bottom run 66 of the track 41 from flexing inwardly in gaps between adjacent ones of the idler wheels 50_1-50_{10} (e.g., when bearing against a rock, a bump, or other ground unevenness), as conceptually represented in dotted line in Figure 24B. In addition, in this embodiment, the track 41 has a widthwise rigidity (i.e., rigidity in its widthwise direction) such that, although it can flex in its widthwise direction (e.g., notably since it has no transversal stiffening rods in this embodiment) to accommodate a ground surface which is uneven in its widthwise direction (e.g., a rut, bump, or side hill), it is sufficiently rigid in its widthwise direction to help maintain proper floatation and traction over the uneven ground surface, as conceptually represented in dotted line in Figure 25A, by tending to prevent an excessive flexion of the track 41 in its widthwise direction, as conceptually represented in dotted line in Figure 25B.

More particularly, in this embodiment, the traction projections 61_1-61_M are designed to control the rigidity characteristics of the endless track 41, while maintaining a weight of the track 41 relatively low. A shape and a material composition of each of the traction projections 61_1-61_M are selected to achieve the rigidity characteristics of the track 41. In this example, the traction projections 61_1-61_M have a dominant effect on the rigidity characteristics of the track 41 since the track 41 is free of transversal stiffening rods and its carcass 36 is thin.

Each traction projection 61_x extends transversally to the longitudinal direction of the endless track 41. That is, the traction projection 61_x has a longitudinal axis 54 extending transversally to the longitudinal direction of the track 41. In this example, the longitudinal axis 54 of the traction projection 61_x is substantially parallel to the widthwise direction of the track 41. In other examples, the longitudinal axis 54 of the traction projection 61_x may be transversal to the longitudinal direction of the track 41 without being parallel to the widthwise direction of the track 41.

In this embodiment, the traction projection 61_x extends across at least a majority of the width of the endless track 41. More particularly, in this example, the traction projection 61_x extends across substantially an entirety of the width of the track 41. The traction projection 61_x has longitudinal ends 60_1, 60_2 adjacent to respective ones of the lateral edges 63_1, 63_2 of the track 41. The traction projection 61_x may extend across any suitable part of the width of the endless track 41 in other embodiments.

The traction projection 61_x varies in cross-sectional shape along its longitudinal axis 54. That is, cross-sections of the traction projection 61_x at different positions along the longitudinal axis 54 of the traction projection 61_x are different. As shown in Figure 14, a cross-section of the traction projection 61_x at a given position along the longitudinal axis 54 of the traction projection 61_x is taken parallel to the longitudinal direction of the track 41 and a has width W_t (i.e., a maximal dimension in the longitudinal direction of the track 41) and a height H_t (i.e., a maximal dimension in the thickness direction of the track 41). More particularly, in this embodiment, the traction projection 61_x varies in width and height along its longitudinal axis 54. Also, in this embodiment, at a given position along its longitudinal axis 54, the traction projection 61_x varies in widthwise dimension in the thickness direction of the track 41.

More particularly, in this embodiment, as shown in Figures 7, 9, 11 to 14, 26 and 27, the traction projection 61_x comprises a transversal protrusion 55 and a plurality of enlarged protrusions 56_1, 56_2 which comprise respective portions of its elastomeric material 69.

The transversal protrusion 55 of the traction projection 61_x extends transversally to the longitudinal direction of the endless track 41. Specifically, the transversal protrusion 55 extends along the longitudinal axis 54 of the traction projection 61_x. In this embodiment, the transversal protrusion 55 comprises a lateral portion 67_1 between the lateral edge 63_1 of the track 41 and the enlarged protrusion 56_1, a central portion 70 between the enlarged protrusions 56_1, 56_2, and a lateral portion 67_2 between the lateral edge 63_2 of the track 41 and the enlarged protrusion 56_2. In this example, the central portion 70 and the lateral portions 67_1, 67_2 of the transversal protrusion 55 are generally straight such that the transversal protrusion 55 is generally straight. The transversal protrusion 55 may have any other suitable shape in other embodiments.

Each of the enlarged protrusions 56_1, 56_2 of the traction projection 61_x is larger in the longitudinal direction of the endless track 41 than the transversal protrusion 55 of the traction projection 61_x. That is, a width W_{t-e} of each of the enlarged protrusions 56_1, 56_2 is greater than a width W_{t-t} of the transversal protrusion 55. Thus, the transversal protrusion 55 is a relatively narrow protrusion and each of the enlarged protrusions 56_1, 56_2 is a relative wide protrusion that is wider than the transversal protrusion 55. For example, in some embodiments, a ratio W_{t-e}/W_{t-t} of the width W_{t-e} of a given one of the enlarged protrusions 56_1, 56_2 over the width W_{t-t} of the transversal protrusion 55 may be at least 2, in some cases at least 2.2, in some cases at least 2.4, in some cases at least 2.6, and in some cases even more (e.g., 3 or more). The ratio W_{t-e}/W_{t-t} may have any other suitable value in other embodiments.

The width W_{t-e} of each of the enlarged protrusions 56_1, 56_2 is therefore greater than a minimum width W_{t-min} of the traction projection 61_x. In this example in which the transversal protrusion 55 of the traction projection 61_x is generally straight, the minimum width W_{t-min} of the traction projection 61_x corresponds to the width W_{t-t} of the transversal protrusion 55. For example, in some embodiments, a ratio W_{t-e}/W_{t-min} of the width W_{t-e} of a given one of the enlarged protrusions 56_1, 56_2 over the minimum width W_{t-t} of the traction projection 61_x may be at least 2, in some cases at least 2.2, in some cases at least 2.4, in some cases at least 2.6, and in some cases even more (e.g., 3 or more). The ratio W_{t-e}/W_{t-min} may have any other suitable value in other embodiments.

The width W_{t-e} of a given one of the enlarged protrusions 56_1, 56_2 is a maximum width W_{t-max} of the traction projection 61_x. In this embodiment, the widths W_{t-e} of the enlarged protrusions 56_1, 56_2 are different such that the width W_{t-e} of one of the enlarged protrusions 56_1, 56_2 is greater than width W_{t-t} of the other one of the enlarged protrusions 56_1, 56_2 and is the maximum width $W_{t\text{-}max}$ of the traction projection 61_x. For example, in some embodiments, a ratio $W_{t\text{-}max}/W_{t\text{-}min}$ of the maximum width $W_{t\text{-}max}$ of the traction projection 61_x over the minimum width $W_{t\text{-}min}$ of the traction projection 61_x may be at least 2, in some cases at least 2.2, in some cases at least 2.4, in some cases at least 2.6, and in some cases even more (e.g., 3 or more). The ratio $W_{t\text{-}max}/W_{t\text{-}min}$ may have any other suitable value in other embodiments.

The width $W_{t\text{-}e}$ of a given one of the enlarged protrusions 56_1, 56_2 of the traction projection 61_x corresponding to the maximum width $W_{t\text{-}max}$ of the traction projection 61_x is significant in relation to a longitudinal spacing D_t of the traction projection 61_x and a traction projection 61_y which succeeds the traction projection 61_x in the longitudinal direction of the track 41. The longitudinal spacing D_t, which is a longitudinal distance between respective centers of the successive traction projections 61_x, 61_y, can be referred to as a "pitch" of the successive traction projections 61_x, 61_y. For example, in some embodiments, a ratio $W_{t\text{-}e}/D_t$ of the width $W_{t\text{-}e}$ of a given one of the enlarged protrusions 56_1, 56_2 of the traction projection 61_x over the pitch D_t of the successive traction projections 61_x, 61_y may be at least 0.8, in some cases at least 0.85, in some cases, at least 0.9, in some cases 0.95, in some cases at least 1.0, in some cases at least 1.05, and in some cases even more (e.g., 1.10 or more). In this example of implementation, the ratio $W_{t\text{-}e}/D_t$ is about 1.05. The ratio $W_{t\text{-}e}/D_t$ may have any other suitable value in other embodiments.

In this embodiment, each of the enlarged protrusions 56_1, 56_2 of a traction projection 61_x is elongated such that it has a longitudinal axis 62 transversal to the longitudinal axis 54 of the traction projection 61_x. More particularly, in this example, each of the enlarged protrusions 56_1, 56_2 is elongated in the longitudinal direction of the track 41 such that its longitudinal axis 62 is substantially parallel to the longitudinal direction of the track 41. In this case, each of the enlarged protrusions 56_1, 56_2 has a tapered configuration, here a triangle-like configuration, at the outer end 77 of the traction projection 61_x. This may be help for printing and traction of the traction projection 61_x on the ground (e.g., on a side hill by providing sideways support). Each of the enlarged protrusions 56_1, 56_2 may have any other suitable shape in other embodiments.

The enlarged protrusions 56_1, 56_2 of the traction projections 61_1-61_M are dimensioned and disposed relative to one another to enhance the longitudinal rigidity of the endless track 41, notably the longitudinal rigidity of the bottom run 66 of the track 41. In that sense, the enlarged protrusions 56_1, 56_2 of the traction projections 61_1-61_M constitute "longitudinal rigidifiers" which longitudinally rigidify (i.e., enhance the longitudinal rigidity of) the track 41.

The longitudinal rigidifiers constituted by respective ones of the enlarged protrusions 56_1, 56_2 of the traction projections 61_1-61_M form a plurality of elongated longitudinal rigidification structures 91_1, 91_2 which are spaced apart in the widthwise direction of the track 41. The enlarged protrusions 56_1 of the traction projections 61_1-61_M form the elongated longitudinal rigidification structure 91_1 and the enlarged protrusions 56_2 of the traction projections 61_1-61_M form the elongated longitudinal rigidification structure 91_2.

To that end, in this embodiment, the enlarged protrusion 56_1 of a traction projection 61_i and the enlarged protrusion 56_1 of a traction projection 61_j succeeding the traction projection 61_i in the longitudinal direction of the track 41 are aligned with one another in the widthwise direction of the track 41 (i.e., at least part of the enlarged protrusion 56_1 of the traction projection 61_i and at least part of the enlarged protrusion 56_1 of the traction projection 61_j overlap in the widthwise direction of the track 41) and the enlarged protrusion 56_2 of the traction projection 61_i and the enlarged protrusion 56_2 of the traction projection 61_j are aligned with one another in the widthwise direction of the track 41 (i.e., at least part of the enlarged protrusion 56_2 of the traction projection 61_i and at least part of the enlarged protrusion 56_2 of the traction projection 61_j overlap in the widthwise direction of the track 41). This contributes to forming the elongated longitudinal rigidification structures 91_1, 91_2 which longitudinally rigidify the track 41.

In this embodiment in which the widths W_{t-e} of the enlarged protrusions 56_1, 56_2 of each of the traction projections 61_1-61_M are different, larger ones of the enlarged protrusions 56_1, 56_2 of the traction projections 61_1-61_M alternate from side to side of the track 41 over successive ones of the traction projections 61_1-61_M such that: the enlarged protrusion 56_1 of the traction projection 61_i, which is larger than the enlarged protrusion 56_2 of the traction projection 61_i in the longitudinal direction of the track 41, is aligned in the widthwise direction of the track 41 with the enlarged protrusion 56_1 of the traction projection 61_j, which is smaller than the enlarged protrusion 56_2 of the traction projection 61_j in the longitudinal direction of the track 41; and the enlarged protrusion 56_2 of the traction projection 61_i, which is smaller than the enlarged protrusion 56_1 of the traction projection 61_i in the longitudinal direction of the track 41, is aligned in the widthwise direction of the track 41 with the enlarged protrusion 56_2 of the traction projection 61_j, which is larger than the enlarged protrusion 56_1 of the traction projection 61_j in the longitudinal direction of the track 41.

In this example of implementation, the larger ones of the enlarged protrusions 56_1, 56_2 of the traction projections 61_i, 61_j, i.e., the enlarged protrusion 56_1 of the traction projection 61_i and the enlarged protrusion 56_2 of the traction projection 61_j, overlap in the longitudinal direction of the track 41. There is a longitudinal overlap V_{t-e} between the enlarged protrusion 56_1 of the traction projection 61_i and the enlarged protrusion 56_2 of the traction projection 61_j.

The traction-projection-free area 71_x between the traction projections 61_i, 61_j comprises a flex zone 74 where the traction-projection-free area 71_x bends most in the longitudinal direction of the track 41 as the track 41 moves around the wheels 42, 50_1-50_{10}, and the enlarged protrusions 56_1, 56_2 of the traction projections 61_i, 61_j are configured to limit a size of the flex zone 74 and therefore longitudinally rigidify the track 41.

More particularly, in this embodiment, each of a longitudinal gap 72_1 between the enlarged protrusion 56_1 of the traction projection 61_i and the enlarged protrusion 56_1 of the traction projection 61_j and a longitudinal gap 72_2 between the enlarged protrusion 56_2 of the traction projection 61_i and the enlarged protrusion 56_2 of the traction projection 61_j is significantly smaller than a largest longitudinal gap 73 between the traction projection 61_i and the traction projection 61_j. Each of the longitudinal gaps 72_1, 72_2 thus forms a constriction of the flex zone 74 of the traction-projection-free area 71_x that makes the flex zone 74 "narrow" and helps to longitudinally rigidify the track 41.

A dimension G_{t-e} of each of the longitudinal gaps 72_1, 72_2 between the enlarged protrusions 56_1, 56_2 of the traction projections 61_i, 61_j is thus significantly less than a dimension G_{t-max} of the largest longitudinal gap 73 between the traction projections 61_i, 61_j. For example, in some embodiments, a ratio G_{t-e}/G_{t-max} of the dimension G_{t-e} of each of the longitudinal gaps 72_1, 72_2 between the enlarged protrusions 56_1, 56_2 of the traction projections 61_i, 61_j over the dimension G_{t-max} of the largest longitudinal gap 73 between the traction projections 61_i, 61_j may be no more than 0.4, in some cases no more than 0.35, in some cases no more than 0.3, in some cases no more than 0.25, in some cases no more than 0.2, and in some cases even less (e.g., no more than 0.15 or less). The ratio G_{t-e}/G_{t-max} may have any other suitable value in other embodiments.

In this example, each of the longitudinal gaps 72_1, 72_2 between the enlarged protrusions 56_1, 56_2 of the traction projections 61_i, 61_j is a smallest longitudinal gap between the traction projection 61_i and the traction projection 61_j such that its dimension G_{t-e} is a dimension G_{t-min} of the smallest longitudinal gap between these traction projections. Thus, in this example, a ratio G_{t-min}/G_{t-max} of the dimension G_{t-min} of the smallest longitudinal gap 72_1 or 72_2 between the traction projection 61_i and the traction projection 61_j over the dimension $G_{t\text{-}max}$ of the largest longitudinal gap 73 between the traction projection 61_i and the traction projection 61_j may be no more than 0.4, in some cases no more than 0.35, in some cases no more than 0.3, in some cases no more than 0.25, in some cases no more than 0.2, and in some cases even less (e.g., no more than 0.15 or less). The ratio $G_{t\text{-}min}/G_{t\text{-}max}$ may have any other suitable value in other embodiments.

In addition to limiting the size of the flex zone 74 of the traction-projection-free area 71_x, in this embodiment, the enlarged protrusions 56_1, 56_2 of each of the traction projections 61_i, 61_j impart a deviation of the flex zone 74 such that the flex zone 74 is not straight. That is, a centerline 75 of the flex zone 74 passing through the longitudinal gaps 72_1, 72_2 between the enlarged protrusions 56_1, 56_2 of the traction projections 61_i, 61_j is not parallel to the widthwise direction of the track 41. This deviation of the flex zone 74 may further longitudinally rigidify the track 41 since it makes it harder for the track 41 to bend across its width.

To that end, in this embodiment, the longitudinal gaps 72_1, 72_2 between the enlarged protrusions 56_1, 56_2 of the traction projections 61_i, 61_j are nonaligned with one another in the longitudinal direction of the track 41. There is a longitudinal offset O_g between respective centers of the longitudinal gaps 72_1, 72_2 between the enlarged protrusions 56_1, 56_2 of the traction projections 61_i, 61_j. For example, in some embodiments, a ratio $O_g/G_{t\text{-}max}$ of the longitudinal offset O_g of the longitudinal gaps 72_1, 72_2 between the enlarged protrusions 56_1, 56_2 of the traction projections 61_i, 61_j over the dimension $G_{t\text{-}max}$ of the largest longitudinal gap 73 between the traction projection 61_i and the traction projection 61_j may be at least 0.1, in some cases at least 0.2, in some cases at least 0.3, and in some cases even more (e.g., at least 0.4 or more). The ratio $O_g/G_{t\text{-}max}$ may have any other suitable value in other embodiments. The longitudinal gaps 72_1, 72_2 between the enlarged protrusions 56_1, 56_2 of successive ones of the traction projections 61_1-61_M are thus staggered in the longitudinal direction of the track 41.

In this embodiment, the enlarged protrusions 56_1, 56_2 of each of the traction projections 61_1-61_M enhance the longitudinal rigidity of the rolling paths 50_1, 50_2 of the inner surface 32 of the carcass 35 of the track 41 over which move the idler wheels 50_1-50_{10}. In that sense, the enlarged protrusions 56_1, 56_2 of each of the traction projections 61_1-61_M constitute "rolling path rigidifiers". This may promote a smooth shape of the bottom run 66 of the track 41 for proper traction, as shown in Figure 24A, by opposing a tendency of the bottom run 66 of the track 41 to bend inwardly in gaps between adjacent ones of the idler wheels 50_1-50_{10} (e.g., when bearing against a rock, a bump, or other ground unevenness), as shown in Figure 24B.

More particularly, in this embodiment, the enlarged protrusions 56_1, 56_2 of each of the traction projections 61_1-61_M are aligned in the widthwise direction of the endless track 41 with the rolling paths 50_1, 50_2 of the inner surface 32 of the carcass 35 of the track 41 over which move the idler wheels 50_1-50_{10} (i.e., at least part of the enlarged protrusion 56_1 of a traction projection 61_x overlaps the rolling path 50_1 in the widthwise direction of the track 41, and at least part of the enlarged protrusion 56_2 of the traction projection 61_x overlaps the rolling path 50_2 in the widthwise direction of the track 41). Respective ones of the idler wheels 50_1-50_{10} rolling on the rolling paths 50_1, 50_2 thus bear against more rigid regions of the traction projections 61_1-61_M which causes less bending of the bottom run 66 of the track 41 where these wheels are located.

In this example of implementation, the relatively high ratio W_{t-e}/D_t of the width W_{t-e} of a given one of the enlarged protrusions 56_1, 56_2 of each of the traction projections 61_1-61_M over the pitch D_t of successive ones of the traction projections 61_1-61_M helps to keep respective ones of the idler wheels 50_1-50_{10} longer on more rigid regions of the track 41. This may help to reduce vibrations in the track 41.

The width W_{t-e} of an enlarged protrusion 56_y of a traction projection 61_i over which passes a roller wheel 50_y may be significant in relation to a diameter D_w of the roller wheel 50_y. For example, in some embodiments, a ratio W_{t-e}/D_w of the width W_{t-e} of the enlarged protrusion 56_y over the diameter D_w of the roller wheel 50_y may be at least 0.3, in some cases at least 0.4, in some cases at least 0.5, and in some cases even more (e.g., 0.6 or more). The ratio W_{t-e}/D_w may have any other suitable value in other embodiments.

Also, in this embodiment, the longitudinal gaps 72_1, 72_2 between the enlarged protrusions 56_1, 56_2 of successive traction projections 61_i, 61_j are aligned in the widthwise direction of the track 41 with the rolling paths 50_1, 50_2 of the inner surface 32 of the carcass 35 of the track 41. Since these longitudinal gaps 72_1, 72_2 are relatively small, respective ones of the idler wheels 50_1-50_{10} on the rolling paths 50_1, 50_2 spend less time on the flex zone 74 of the traction-projection-free area 71_x of the successive traction projections 61_i, 61_j which causes less bending of the bottom run 66 of the track 41 where these wheels are located.

The dimension G_{t-e} of a longitudinal gap 72_y between aligned ones of the enlarged protrusions 56_1, 56_2 of the successive traction projections 61_i, 61_j over which passes a roller wheel 50_y may be relatively small in relation to the diameter D_w of the roller wheel 50_y. For example, in some embodiments, a ratio G_{t-e}/D_w of the dimension G_{t-e} of the longitudinal gap 72_y between aligned ones of the enlarged protrusions 56_1, 56_2 of the successive traction projections 61_i, 61_j over the diameter D_w of the roller wheel 50_y may be no more than 0.15, in some cases no more than 0.10, in some cases no more than 0.08, and in some cases even less (e.g., 0.05 or less). The ratio G_{t-e}/D_w may have any other suitable value in other embodiments.

Furthermore, in this embodiment, since the longitudinal gaps 72_1, 72_2 between the enlarged protrusions 56_1, 56_2 of successive traction projections 61_i, 61_j are nonaligned with one another in the longitudinal direction of the track 41, respective ones of the idler wheels 50_1-50_{10} on the rolling paths 50_1, 50_2 may not pass over these longitudinal gaps 72_1, 72_2 simultaneously, and this may cause less bending of the bottom run 66 of the track 41 where these wheels are located. This may also reduce vibrations and noise since the idler wheels 50_1-50_{10} transition between rigid and flexible regions at different times.

The longitudinal offset O_g of the longitudinal gaps 72_1, 72_2 between the enlarged protrusions 56_1, 56_2 of successive traction projections 61_i, 61_j over which pass roller wheels 50_y, 50_z may be related to the diameter D_w of each of the roller wheels 50_y, 50_z. For example, in some embodiments, a ratio O_g/D_w of the longitudinal offset O_g of the longitudinal gaps 72_1, 72_2 between the enlarged protrusions 56_1, 56_2 of the traction projections 61_i, 61_j over the diameter D_w of each of the roller wheels 50_y, 50_z may be at least 0.05, in some cases at least 0.1, in some cases at least 0.15, and in some cases even more (e.g., at least 0.2 or more). The ratio O_g/D_w may have any other suitable value in other embodiments.

Since in this embodiment the rolling paths 50_1, 50_2 of the inner side 45 of the track 41 are laterally offset towards the inboard lateral edge 63_1 of the track 41 and the enlarged protrusions 56_1, 56_2 of each of the traction projections 61_1-61_M are aligned in the widthwise direction of the track 41 with the rolling paths 50_1, 50_2, the enlarged protrusions 56_1, 56_2 of each of the traction projections 61_1-61_M are thus also laterally offset towards the inboard lateral edge 63_1 of the track 41. More particularly, in this embodiment, the enlarged protrusions 56_1, 56_2 of each of the traction projections 61_1-61_M are asymmetrically disposed relative to the centerline 79 bisecting the width of the track 41 into its halves 83_1, 83_2. A widthwise span 88 of the enlarged protrusions 56_1, 56_2 of each of the traction projections 61_1-61_M is thus asymmetrically disposed relative to the centerline 79 and located closer the inboard lateral edge 63_1 of the track 41 than to the outboard lateral edge 63_2 of the track 41.

With respect to the widthwise rigidity of the endless track 41, in this embodiment, each traction projection 61_x is designed such that a cross-section of the traction projection 61_x has an area moment of inertia (i.e., a second moment of area) I_t which is relatively high and/or its elastomeric material 69 has a modulus of elasticity E_t which is relatively high. As a result, a bending stiffness $B_t = E_tI_t$ of the traction projection 61_x in the widthwise direction of the track 41 is relatively high, while a weight of the traction projection 61_x may be kept relatively low.

Referring additionally to Figure 28, in this example, the cross-section of the traction projection 61_x is taken in the transversal protrusion 55 of the traction projection 61_x. The area moment of inertia I_t is calculated with respect to an axis parallel to the longitudinal direction of the track 41 at a base 76 of the cross-section of the traction projection 61_x. In cases where the modulus of elasticity E_t of the elastomeric material 69 of the traction projection 61_x varies along the traction projection 61_x, the modulus of elasticity E_t at the cross-section of the traction projection 61_x is considered. A cross-sectional weight per unit length M_t of the traction projection 61_x at the cross-section of the traction projection 61_x is calculated by multiplying a density ρ_t of the elastomeric material 69 of the traction projection 61_x at the cross-section by a cross-sectional area A_t of the traction projection 61_x at the cross-section ($M_t = \rho_tA_t$).

For example, in some embodiments, a ratio B_t/M_t of the bending stiffness B_t of the traction projection 61_x in the widthwise direction of the endless track 41 (in $lb \cdot in.^2$) over the cross-sectional weight per unit length M_t of the traction projection 61_x at the cross-section of the traction projection 61_x (in lb/in.) may be at least 5000 $in.^3$, in some cases at least 5200 $in.^3$, in some cases at least 5400 $in.^3$, and in some cases even more (e.g., 5500 $in.^3$ or more). The ratio B_t/M_t may have any other suitable value in other embodiments.

In some embodiments, a hardness S_t of the elastomeric material 69 of the traction projection 61_x may be used to characterize this elastomeric material, instead of its modulus of elasticity E_t. In cases where the hardness S_t of the elastomeric material 69 of the traction projection 61_x varies along the traction projection 61_x, the hardness S_t at the cross-section of the traction projection 61_x is considered. For instance, in some embodiments, the hardness S_t of the elastomeric material 69 of the traction projection 61_x may be at least 75 durometers Shore A, in some cases at least 80 durometers Shore A, and in some cases even more (e.g., 85 durometers Shore A).

The cross-section of the transversal protrusion 55 of the traction projection 61_x may have any suitable shape.

In this embodiment, the cross-section of the transversal protrusion 55 of the traction projection 61_x tapers in the thickness direction of the endless track 41. A minimal dimension $w_{t\text{-}t\text{-}min}$ of the cross-section of the transversal protrusion 55 in the longitudinal direction of the track 41 is less than the width $W_{t\text{-}t}$ of the cross-section of the transversal protrusion 55. For example, in some embodiments, a ratio $W_{t\text{-}t}/w_{t\text{-}t\text{-}min}$ of the width $W_{t\text{-}t}$ of the cross-section of the transversal protrusion 55 over the minimal dimension $w_{t\text{-}t\text{-}min}$ of the cross-section of the transversal protrusion 55 in the longitudinal direction of the track 41 may be at least 4, in some cases at least 4.5, in some cases at least 5, in some cases at least 5.5, and in some cases even more (e.g., 6 or more). The ratio $W_{t\text{-}t}/w_{t\text{-}t\text{-}min}$ may have any other suitable value in other embodiments.

More particularly, in this embodiment, the cross-section of the transversal protrusion 55 of the traction projection 61_x tapers in such a way that the minimal dimension $w_{t\text{-}t\text{-}min}$ of the cross-section of the transversal protrusion 55 in the longitudinal direction of the track 41 is at the outer end 77 of the traction projection 61_x. In this example, the cross-section of the transversal protrusion 55 tapers continuously outwardly from the base 76 to the outer end 77 of the traction projection 61_x. The transversal protrusion 55 thus comprises a “thin” or “sharp” outer edge 78 in this case. The minimal dimension $w_{t\text{-}t\text{-}min}$ of the cross-section of the transversal protrusion 55 in the longitudinal direction of the track 41 may be located between the base 76 and the outer end 77 of the traction projection 61_x in other embodiments.

Also, in this embodiment, a height H_{t-t} of the cross-section of the transversal protrusion 55 of the traction projection 61_x is significantly larger than the minimal dimension $w_{t-t-min}$ of the cross-section of the transversal protrusion 55 in the longitudinal direction of the track 41. For example, in some embodiments, a ratio $H_{t-t}/w_{t-t-min}$ of the height H_{t-t} of the cross-section of the transversal protrusion 55 over the minimal dimension $w_{t-t-min}$ of the cross-section of the transversal protrusion 55 in the longitudinal direction of the track 41 may be at least 6, in some cases at least 7, in some cases at least 8, and in some cases even more (e.g., 9 or more). The ratio $H_{t-t}/w_{t-t-min}$ may have any other suitable value in other embodiments.

In this example, the cross-section and the material properties of the elastomeric material 69 of the transversal protrusion 55 of the traction projection 61_x are such that the transversal protrusion 55 is relatively stiff in the widthwise direction of the endless track 41, which may help to prevent excessive bending of the track 21 in its widthwise direction and therefore help for proper traction and floatation. At the same time, the cross-section and the material properties of the elastomeric material 69 of the transversal protrusion 55 of the traction projection 61_x are such that the transversal protrusion 55 extends relatively high and is flexible at its thin or sharp outer edge 78 in the track's longitudinal direction, which may help for proper traction, vibration absorption, and durability.

For instance, in this embodiment, as shown in Figure 29A, the flexibility of the transversal protrusion 55 of the traction projection 61_x in the longitudinal direction of the track 41 may allow an outer end portion 90 of the traction projection 61_x adjacent to its outer end 77 to flex relative to a base portion 87 of the traction projection 61_x adjacent to its base 76 for proper traction on certain ground surfaces. For example, on compacted snow, flexion of the outer end portion 90 of the traction projection 61_x relative to the base portion 87 of the traction projection 61_x may cause a gradual pressure variation on the snow engaged by the traction projection 61_x which may avoid a stress concentration in the snow that could "break" the snow and result in traction loss. Basically, as shown in Figure 29B, if the outer end portion 90 of the traction projection 61_x did not flex relative to the base portion 87 of the traction projection 61_x, an abrupt pressure variation on the snow engaged by the traction projection 61_x would induce a stress concentration in the snow that could break the snow and result in traction loss. While the transversal protrusion 55 of the traction projection 61_x bends as shown in Figure 29A, the enlarged protrusions 56_1, 56_2 of the traction projection 61_x may not bend or bend less than the transversal protrusion 55 in the track's longitudinal direction due to their size. The flexibility of the transversal protrusion 55 of the traction projection 61_x in the longitudinal direction of the track 41 may be useful on other types of snow (e.g., medium-density snow if the track 41 undergoes high-speed spinning) or other types of grounds (e.g., hard terrain where this flexibility may give more traction into terrain details).

Also, in this embodiment, as shown in Figure 30A, the traction projection 61_x allows the track 41 to be relatively stiff without being rigid in its widthwise direction to provide proper traction as well as moderate side support on certain ground surfaces. For instance, on compacted snow, this results in a gradual pressure variation which may avoid a stress concentration in the snow that could break the snow and cause a loss of traction. In contrast, as shown in Figure 30B, if the traction projection 61_x was too flexible in the widthwise direction of the track 41, although it would have high side support, the track 41 could bend too much in its widthwise direction and cause an abrupt pressure variation resulting in a stress concentration that could lead to traction loss. Conversely, as shown in Figure 30C, if the track 41 was rigid in its widthwise direction, floatation could be maximized but there would be little or no side support.

The traction projections 61_1-61_M may be configured in various other ways in other embodiments.

For example, in other embodiments, the enlarged protrusions 56_1, 56_2 of each of the traction projections 61_1-61_M may have any other suitable shape. In other embodiments, a traction projection 61_x may comprise any other number of enlarged protrusions such as the enlarged protrusions 56_1, 56_2 (e.g., only one or three or more). In yet other embodiments, a traction projection 61_x may not comprise any enlarged protrusion such as the enlarged protrusions 56_1, 56_2.

As another example, in other embodiments, the enlarged protrusions 56_1, 56_2 of a traction projection 61_i and the enlarged protrusion 56_1, 56_2 of a traction projection 61_j succeeding the traction projection 61_i in the longitudinal direction of the track 41 may be aligned with one another in the widthwise direction of the track 41 and arranged such that, when the traction projections 61_i, 61_j are on the ground, the enlarged protrusions 56_1 of the traction projections 61_i, 61_j touch one another and/or the enlarged protrusions 56_2 of the traction projections 61_i, 61_j touch one another (i.e., the longitudinal gaps 72_1, 72_2 discussed above become closed such that the enlarged protrusions 56_1 of the traction projections 61_i, 61_j become contiguous and/or the enlarged protrusions 56_2 of the traction projections 61_i, 61_j become contiguous when the traction projections 61_i, 61_j are on the ground).

As another example, in other embodiments, the cross-section and the material properties of the elastomeric material 69 of the transversal protrusion 55 of a traction projection 61_x may respectively have any other suitable shape and/or any other suitable values. For instance, in other embodiments, the height H_{t-t} of the cross-section of the transversal protrusion 55 of a traction projection 61_x may be lower and the modulus of elasticity E_t and/or the hardness S_t of the elastomeric material 69 of the transversal protrusion 55 may be higher.

As another example, in other embodiments, as shown in Figure 31, a traction projection 61_x may have an internal cavity 82 to increase the area moment of inertia I_t of the cross-section of the traction projection 61_x while keeping the weight of the traction projection 61_x relatively low. Basically, the internal cavity 82 allows more area of the cross-section of the traction projection 61_x to be spread outwardly, thus increasing its area moment of inertia I_t (e.g., the cross-section of the traction projection 61_x may be wider and/or higher). In some cases, as shown in Figure 31, the internal cavity 82 may be left empty after manufacturing of the track 41 such that it constitutes a hollow cavity. The internal cavity 82 may be formed, for instance, by placing an insert (e.g., a rod) where the internal cavity 82 is to be created during molding of the track 41 and by removing the insert after molding of the track 41 to reveal the hollow cavity. In other cases, as shown in Figure 32, the internal cavity 82 may contain a filler 84 having a density lower than that of the elastomeric material 69 of the cross-section of the traction projection 61_x such that the weight of the traction projection 61_x is less than if the cavity 82 was omitted and replaced by more of the elastomeric material 69. For instance, in some examples of implementation, the filler 84 may be a foam material. In other examples of implementation, the filler 84 may comprise a rod, a roll of fabric, cord or fiber glass, or any other suitable material.

As another example, in other embodiments, as shown in Figure 33, the elastomeric material 69 of a traction projection 61_x may be a composite elastomeric material to control its modulus of elasticity E_t. The composite elastomeric material 69 is constituted of an elastomer matrix (e.g., a rubber matrix) 86 in which reinforcements 89_1-89_R are disposed. For instance, in some embodiments, the reinforcements 89_1-89_R may be arranged such that the modulus of elasticity E_t is greater in one part of the traction projection 61_x than in another part of the traction projection 61_x. For example, in this embodiment, the modulus of elasticity E_t is greater in the base portion 87 of the traction projection 61_x adjacent to its base 76 than in the outer end portion 90 of the traction projection 61_x adjacent to its outer end 77 such that the base portion 87 is more rigid than the outer end portion 90, which is more flexible. This is achieved by providing a greater concentration of the reinforcements 89_1-89_R in the base portion 87 than in the outer end portion 90 (which may have none of the reinforcements 89_1-89_R).

In this embodiment, the composite elastomeric material 69 is a fiber-reinforced elastomeric material 69 such that the reinforcements 89_1-89_R are fibers. For instance, in some cases, each of the fibers 89_1-89_R may extend along at least a majority of the length of the traction projection 61_x. In other cases, the fibers 89_1-89_R may be shorter (e.g., the fibers 89_1-89_R may be "chopped" or otherwise cut fibers which are few millimeters or centimeters long and are distributed throughout the traction projection 61_x). The fibers 89_1-89_R may be implemented in various manners. For example, in some embodiments, the fibers 89_1-89_R may be polymeric fibers (e.g., aramid fibers, polyvinyl alcohol (PVA) fibers, etc.), bamboo fibers, metallic fibers, carbon fibers, glass fibers, etc.

As another example, in other embodiments, as shown in Figure 34, the elastomeric material 69 of a traction projection 61_x may be cellular elastomeric material (e.g., cellular rubber) which contains cells (e.g., bubbles) 96_1-96_C created by introducing a gas (e.g., air) or a gas-producing agent (e.g., sodium bicarbonate) during manufacturing of the cellular elastomeric material 69 to reduce weight of the material. The cells 96_1-96_C of the cellular elastomeric material 69 may include closed cells and/or open cells.

As another example, in other embodiments, the traction projections 61_1-61_M may have any other suitable shape. For example, in some embodiments, as shown in Figure 35, the cross-section (e.g., of the transversal protrusion 55) of a traction projection 61_x may be a flanged cross-section, which includes one or more flanges and one or more webs, to increase its area moment of inertia I_t. For instance, in this embodiment, the cross-section of the traction projection 61_x is an I-shaped cross-section with top and bottom flanges 94_1, 94_2 and a web 95. As another example, in some embodiments, as shown in Figure 36, the cross-section (e.g., of the transversal protrusion 55) of a traction projection 61_x may have a generally convex outer surface 92 which may help to promote gradual pressure variation and thus reduce stress concentration when the track 41 is on certain types of ground surfaces, such as compacted snow, similar to what was discussed above.

While in this embodiment the track assembly 16_i is part of an ATV, in other embodiments, a track assembly, including an endless track, constructed according to principles discussed herein may be used as part of track assemblies of other types of off-road vehicles. For example, in some embodiments, as shown in Figure 37, an endless track 141 constructed according to principles discussed herein may be used as part of a track assembly 116 of a snowmobile 110.

The ATV 10 and the snowmobile 110 considered above are examples of recreational vehicles. While they can be used for recreational purposes, such recreational vehicles may also be used for utility purposes in some cases. Also, while these examples pertain to recreational vehicles, a track assembly, including an endless track, constructed according to principles discussed herein may be used as part of track assemblies of off-road vehicles other than recreational ones.

Any feature of any embodiment discussed herein may be combined with any feature of any other embodiment discussed herein in some examples of implementation.

Although various embodiments and examples have been presented, this was for the purpose of describing, but not limiting, the invention. Various modifications and enhancements will become apparent to those of ordinary skill in the art and are within the scope of the invention, which is defined by the appended claims.

CLAIMS

1. An endless track for traction of an off-road vehicle, the endless track being mountable around a plurality of track-contacting wheels which includes a drive wheel for driving the endless track, the endless track comprising elastomeric material allowing the endless track to flex around the track-contacting wheels, the endless track comprising:

- an inner side for facing the track-contacting wheels; and
- a ground-engaging outer side for engaging the ground, the ground-engaging outer side comprising a plurality of traction projections distributed along a longitudinal direction of the endless track, each traction projection of the plurality of traction projections comprising:
- a transversal protrusion extending transversally to the longitudinal direction of the endless track; and
- an enlarged protrusion larger in the longitudinal direction of the endless track than the transversal protrusion of the traction projection;

the enlarged protrusions of the traction projections being dimensioned and disposed relative to one another to enhance a rigidity of a bottom run of the endless track in the longitudinal direction of the endless track.

2. The endless track claimed in claim 1, wherein the enlarged protrusion of the traction projection is elongated such that a longitudinal axis of the enlarged protrusion of the traction projection extends transversally to a longitudinal axis of the traction projection.

3. The endless track claimed in claim 2, wherein the longitudinal axis of the enlarged protrusion of the traction projection is substantially parallel to the longitudinal direction of the endless track.

4. The endless track claimed in any one of claims 1 to 3, wherein the enlarged protrusion of a first one of the traction projections and the

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enlarged protrusion of a second one of the traction projections which succeeds the first one of the traction projections in the longitudinal direction of the endless track are aligned with one another in a widthwise direction of the endless track.

5. The endless track claimed in any one of claims 1 to 3, wherein the enlarged protrusion of the traction projection is a first enlarged protrusion of the traction projection, the traction projection comprising a second enlarged protrusion larger in the longitudinal direction of the endless track than the transversal protrusion of the traction projection, the first enlarged protrusion and the second enlarged protrusion of the traction projection being spaced apart in a widthwise direction of the endless track.

6. The endless track claimed in claim 5, wherein the first enlarged protrusion of the traction projection is larger in the longitudinal direction of the endless track than the second enlarged protrusion of the traction projection.

7. The endless track claimed in any one of claims 5 and 6, wherein the first enlarged protrusion of a first one of the traction projections and the second enlarged protrusion of a second one of the traction projections are aligned with one another in the widthwise direction of the endless track.

8. The endless track claimed in claim 7, wherein the second enlarged protrusion of the first one of the traction projections and the first enlarged protrusion of the second one of the traction projections are aligned with one another in the widthwise direction of the endless track.

9. The endless track claimed in claim 6, wherein the first enlarged protrusion of a first one of the traction projections and the first enlarged protrusion of a second one of the traction projections overlap in the longitudinal direction of the endless track.

10. The endless track claimed in any one of claims 6 to 9, wherein the transversal protrusion of the traction projection comprises a first lateral portion between a first lateral edge of the endless track and the first enlarged protrusion of the traction projection, a central portion between the first enlarged protrusion and the second enlarged protrusion of the traction projection, and a second lateral portion between the second lateral edge of the endless track and the second enlarged protrusion of the traction projection.

11. The endless track claimed in any one of claims 1 to 10, wherein the transversal protrusion has a width in the longitudinal direction of the endless track, the enlarged protrusion has a width in the longitudinal direction of the endless track, and a ratio of the width of the enlarged protrusion over the width of the transversal protrusion is at least 2.

12. The endless track claimed in any one of claims 1 to 10, wherein the traction projection has a maximum width in the longitudinal direction of the endless track and a minimum width in the longitudinal direction of the endless track, and a ratio of the maximum width of the traction projection over the minimum width of the traction projection is at least 2.

13. The endless track claimed in any one of claims 1 to 3, 5 and 6, wherein a ratio of (i) a width of the enlarged protrusion of a first one of the traction projections in the longitudinal direction of the endless track over (ii) a longitudinal spacing of the first one of the traction projections

and a second one of the traction projections which succeeds the first one of the traction projections in the longitudinal direction of the endless track is at least 0.8.

14. The endless track claimed in claim 13, wherein the ratio of (i) the width of the enlarged protrusion of the first one of the traction projections over (ii) the longitudinal spacing of the first one of the traction projections and the second one of the traction projections is at least 0.9.

15. The endless track claimed in claim 14, wherein the ratio of (i) the width of the enlarged protrusion of the first one of the traction projections over (ii) the longitudinal spacing of the first one of the traction projections and the second one of the traction projections is at least 1.

16. The endless track claimed in any one of claims 1 to 3, 5 and 6, wherein a ratio of (i) a dimension of a longitudinal gap between the enlarged protrusion of a first one of the traction projections and the enlarged protrusion of a second one of the traction projections which succeeds the first one of the traction projections in the longitudinal direction of the endless track over (ii) a dimension of a largest longitudinal gap between the first one of the traction projections and the second one of the traction projections is no more than 0.4.

17. The endless track claimed in any one of claims 1 to 3, 5 and 6, wherein a ratio of (i) a dimension of a smallest longitudinal gap between a first one of the traction projections and a second one of the traction projections which succeed one another in the longitudinal direction of the endless track over (ii) a dimension of a largest longitudinal gap between the first one of the traction projections and the second one of the traction projections is no more than 0.4.

18. The endless track claimed in any one of claims 1 to 3, 5 and 6, wherein the ground-engaging outer side comprises a plurality of traction-projection-free areas between respective ones of the traction projections which succeed one another in the longitudinal direction of the endless track, the enlarged protrusions of a first one of the traction projections and a second one of the traction projections imparting a deviation of a flex zone of the traction-projection-free area between the first one of the traction projections and the second one of the traction projections such that a centerline of the flex zone is not parallel to a widthwise direction of the endless track.

19. The endless track claimed in any one of claims 5 and 6, wherein a longitudinal gap between the first enlarged protrusion of a first one of the traction projections and the first enlarged protrusion of a second one of the traction projections which succeeds the first one of the traction projections in the longitudinal direction of the endless track and a longitudinal gap between the second enlarged protrusion of the first one of the traction projections and the second enlarged protrusion of the second one of the traction projections are nonaligned in the longitudinal direction of the endless track such that there is a longitudinal offset between a center of the longitudinal gap between the first enlarged protrusion of the first one of the traction projections and the first enlarged protrusion of the second one of the traction projections and a center of the longitudinal gap between the second enlarged protrusion of the first one of the traction projections and the second enlarged protrusion of the second one of the traction projections.

20. The endless track claimed in claim 19, wherein a ratio of (i) the longitudinal offset between the center of the longitudinal gap between

the first enlarged protrusion of the first one of the traction projections and the first enlarged protrusion of the second one of the traction projections and the center of the longitudinal gap between the second enlarged protrusion of the first one of the traction projections and the second enlarged protrusion of the second one of the traction projections over (ii) a dimension of a largest longitudinal gap between the first one of the traction projections and the second one of the traction projections is at least 0.1.

21. The endless track claimed in any one of claims 1 to 3, 5 and 6, wherein the plurality of track-contacting wheels includes a plurality of roller wheels for rolling on the bottom run of the endless track along a rolling path of the inner side of the endless track, the enlarged protrusion of the traction projection being aligned with the rolling path in a widthwise direction of the endless track.

22. The endless track claimed in claim 21, wherein the enlarged protrusion of the traction projection has a width in the longitudinal direction of the endless track, a given one of the roller wheels positioned to roll along the rolling path has a diameter, and a ratio of the width of the enlarged protrusion of the traction projection over the diameter of the given one of the roller wheels is at least 0.3.

23. The endless track claimed in claim 22, wherein a ratio of (i) a dimension of a longitudinal gap between the enlarged protrusion of a first one of the traction projections and the enlarged protrusion of a second one of the traction projections which succeeds the first one of the traction projections in the longitudinal direction of the endless track over (ii) a diameter of a given one of the roller wheels positioned to roll along the rolling path is no more than 0.15.

24. The endless track claimed in claim 20, wherein: the plurality of track-contacting wheels includes a first plurality of roller wheels for rolling on the bottom run of the endless track along a first rolling path of the inner side of the endless track and a second plurality of roller wheels for rolling on the bottom run of the endless track along a second rolling path of the inner side of the endless track; the first rolling path and the second rolling path are spaced apart in the widthwise direction of the endless track; the first enlarged protrusion of the first one of the traction projections is aligned with the first rolling path in the widthwise direction of the endless track; the second enlarged protrusion of the first one of the traction projections is aligned with the second rolling path in the widthwise direction of the endless track; the first enlarged protrusion of the second one of the traction projections is aligned with the first rolling path in the widthwise direction of the endless track;

the second enlarged protrusion of the second one of the traction projections is aligned with the second rolling path in the widthwise direction of the endless track; and a ratio of (i) the longitudinal offset between the center of the longitudinal gap between the first enlarged protrusion of the first one of the traction projections and the first enlarged protrusion of the second one of the traction projections and the center of the longitudinal gap between the second enlarged protrusion of the first one of the traction projections and the second enlarged protrusion of the second one of the traction projections over (ii) a diameter of a given one of the roller wheels positioned to roll along the first rolling path is at least 0.05.

25. The endless track claimed in claim 5, wherein the plurality of track-contacting wheels includes a first plurality of roller wheels for rolling on the bottom run of the endless track along a first rolling path of the inner side of the endless track and a second plurality of roller wheels for rolling on the bottom run of the endless track along a second rolling

path of the inner side of the endless track, the first rolling path and the second rolling path being spaced apart in the widthwise direction of the endless track, the first enlarged protrusion of the traction projection being aligned with the first rolling path in the widthwise direction of the endless track and the second enlarged protrusion of the traction projection being aligned with the second rolling path in the widthwise direction of the endless track.

26. The endless track claimed in claim 25, wherein the first enlarged protrusion and the second enlarged protrusion of the traction projection are offset in the widthwise direction of the endless track towards a lateral edge of the endless track.

27. The endless track claimed in claim 26, wherein the lateral edge of the endless track is an inboard lateral edge of the endless track.

28. The endless track claimed in any one of claims 1 to 27, wherein a cross-section of the traction projection tapers in a thickness direction of the endless track.

29. The endless track claimed in any one of claims 1 to 27, wherein a cross-section of the traction projection has a width in the longitudinal direction of the endless track and a minimal dimension in the longitudinal direction of the endless track that is less than the width of the cross-section of the traction projection.

30. The endless track claimed in claim 29, wherein a ratio of the width of the cross-section of the traction projection over the minimal dimension of the cross-section of the traction projection in the longitudinal direction of the endless track is at least 4.

31. The endless track claimed in any one of claims 29 and 30, wherein the cross-section of the traction projection has a height, and a ratio of the height of the cross-section of the traction projection over the minimal dimension of the cross-section of the traction projection in the longitudinal direction of the endless track is at least 6.

32. The endless track claimed in any one of claims 1 to 31, wherein a ratio of (i) a bending stiffness of the traction projection in a widthwise direction of the endless track over (ii) a cross-sectional weight per unit length of the traction projection at a cross-section of the traction projection is at least 5000 in3.

33. The endless track claimed in claim 32, wherein the ratio of (i) the bending stiffness of the traction projection in the widthwise direction of the endless track over (ii) the cross-sectional weight per unit length of the traction projection at the cross-section of the traction projection is at least 5200 in3.

34. The endless track claimed in claim 33, wherein the ratio of (i) the bending stiffness of the traction projection in the widthwise direction of the endless track over (ii) the cross-sectional weight per unit length of the traction projection at the cross-section of the traction projection is at least 5400 in3.

35. The endless track claimed in any one of claims 1 to 34, wherein the transversal protrusion of the traction projection is generally straight.

36. The endless track claimed in any one of claims 1 to 35, wherein the traction projection extends across at least a majority of a width of the endless track.

37. The endless track claimed in claim 36, wherein the traction projection extends across substantially an entirety of the width of the endless track.

38. The endless track claimed in any one of claims 1 to 37, wherein the endless track is free of transversal stiffening rods extending transversally to the longitudinal direction of the endless track.

39. The endless track claimed in any one of claims 1 to 3, 5 and 6, wherein the traction projection comprises a recess extending from an outer end of the traction projection.

40. The endless track claimed in claim 39, wherein the recess of a first one of the traction projections and the recess of a second one of the traction projections are nonaligned in a widthwise direction of the endless track.

41. The endless track claimed in claim 40, wherein the recess of a first one of the traction projections is located such that a second one of the traction projections has no recess aligned with the recess of the first one of the traction projections in a widthwise direction of the endless track.

42. The endless track claimed in any one of claims 39 to 41, wherein a ratio of a depth of the recess of the traction projection over an overall height of the traction projection is at least 0.15.

43. The endless track claimed in any one of claims 1 to 42, wherein, when the traction projection engages snow, an outer end portion of the

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transversal protrusion flexes relative to a base portion of the transversal protrusion.

44. The endless track claimed in any one of claims 1 to 43, wherein the endless track comprises bent lateral edge portions.

45. The endless track claimed in any one of claims 1 to 44, wherein the traction projection comprises an internal cavity.

46. The endless track claimed in claim 45, wherein the internal cavity is a hollow cavity.

47. The endless track claimed in claim 45, wherein the internal cavity contains a filler.

48. The endless track claimed in any one of claims 1 to 44, wherein the traction projection comprises composite elastomeric material.

49. The endless track claimed in claim 48, wherein the composite elastomeric material of the traction projection is a fiber-reinforced elastomeric material.

50. The endless track claimed in claim 48, wherein the composite elastomeric material of the traction projection is constituted of an elastomer matrix in which are disposed reinforcements, a concentration of the reinforcements being greater in a first portion of the traction projection than in a second portion of the traction projection.

51. The endless track claimed in any one of claims 1 to 44, wherein the traction projection comprises cellular elastomeric material.

52. The endless track claimed in any one of claims 1 to 44, wherein the traction projection has a flanged cross-section.

53. The endless track claimed in any one of claims 1 to 44, wherein the traction projection comprises a generally convex outer surface.

54. The endless track claimed in any one of claim 1 to 53, wherein the plurality of track-contacting wheels includes a plurality of roller wheels for rolling on the bottom run of the endless track along a rolling path of the inner side of the endless track, the rigidity of the bottom run of the endless track in the longitudinal direction of the endless track tending to prevent inward flexing of the bottom run of the endless track in gaps between adjacent ones of the roller wheels.

55. The endless track claimed in any one of claims 1 to 54, wherein the endless track is a snowmobile track or an ATV track.

56. An endless track for traction of an off-road vehicle, the endless track being mountable around a plurality of track-contacting wheels which includes (i) a drive wheel for driving the endless track and (ii) a plurality of roller wheels for rolling on a bottom run of the endless track, the endless track comprising elastomeric material allowing the endless track to flex around the track-contacting wheels, the endless track comprising:

- an inner side for facing the track-contacting wheels; and
- a ground-engaging outer side for engaging the ground, the ground-engaging outer side comprising a plurality of traction projections distributed along a longitudinal direction of the endless track, each traction projection of the plurality of traction projections comprising:

- a transversal protrusion extending transversally to the longitudinal direction of the endless track; and
- an enlarged protrusion larger in the longitudinal direction of the endless track than the transversal protrusion of the traction projection;

the enlarged protrusions of the traction projections being dimensioned and disposed relative to one another to oppose a tendency of the bottom run of the endless track to flex inwardly in a gap between adjacent ones of the roller wheels.

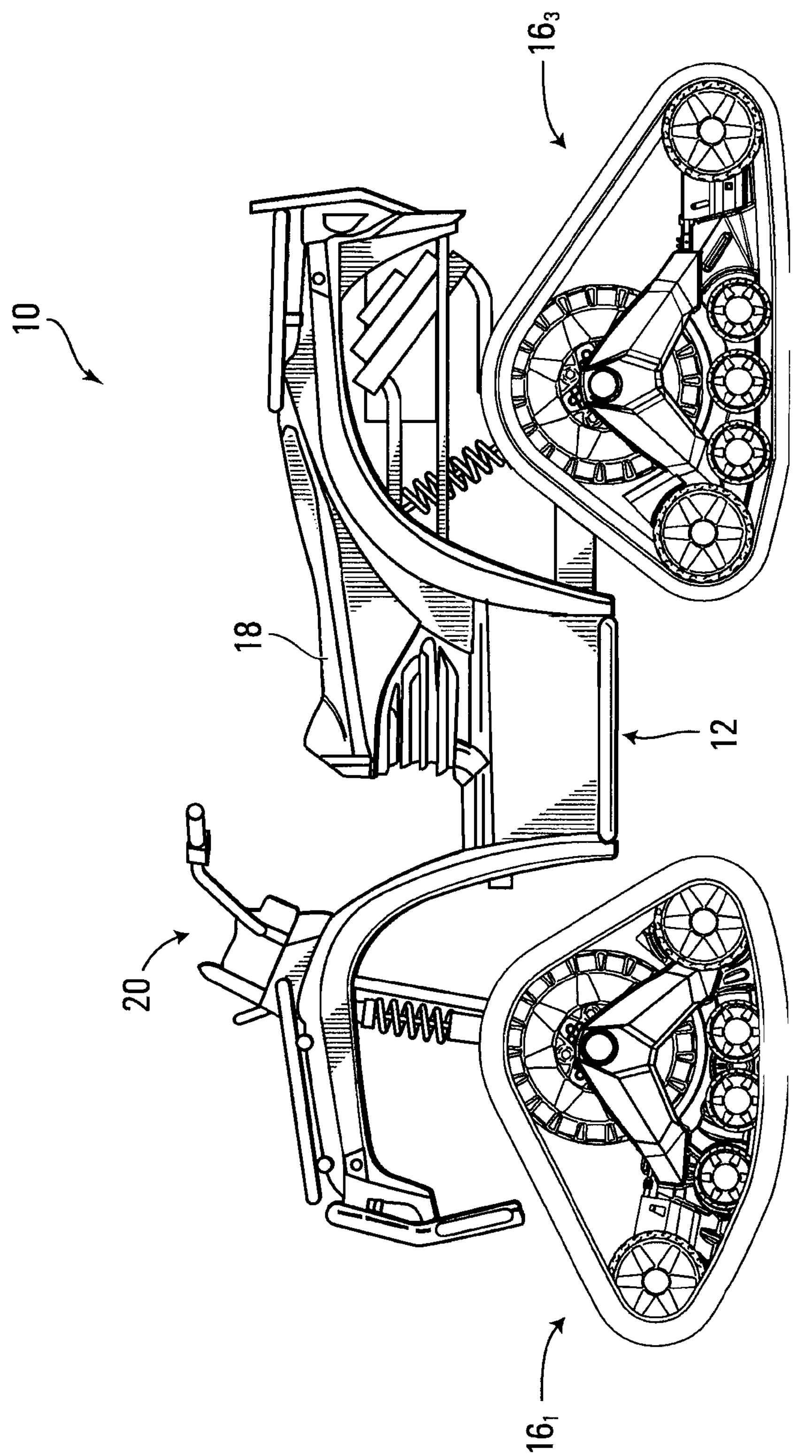


FIG. 1A

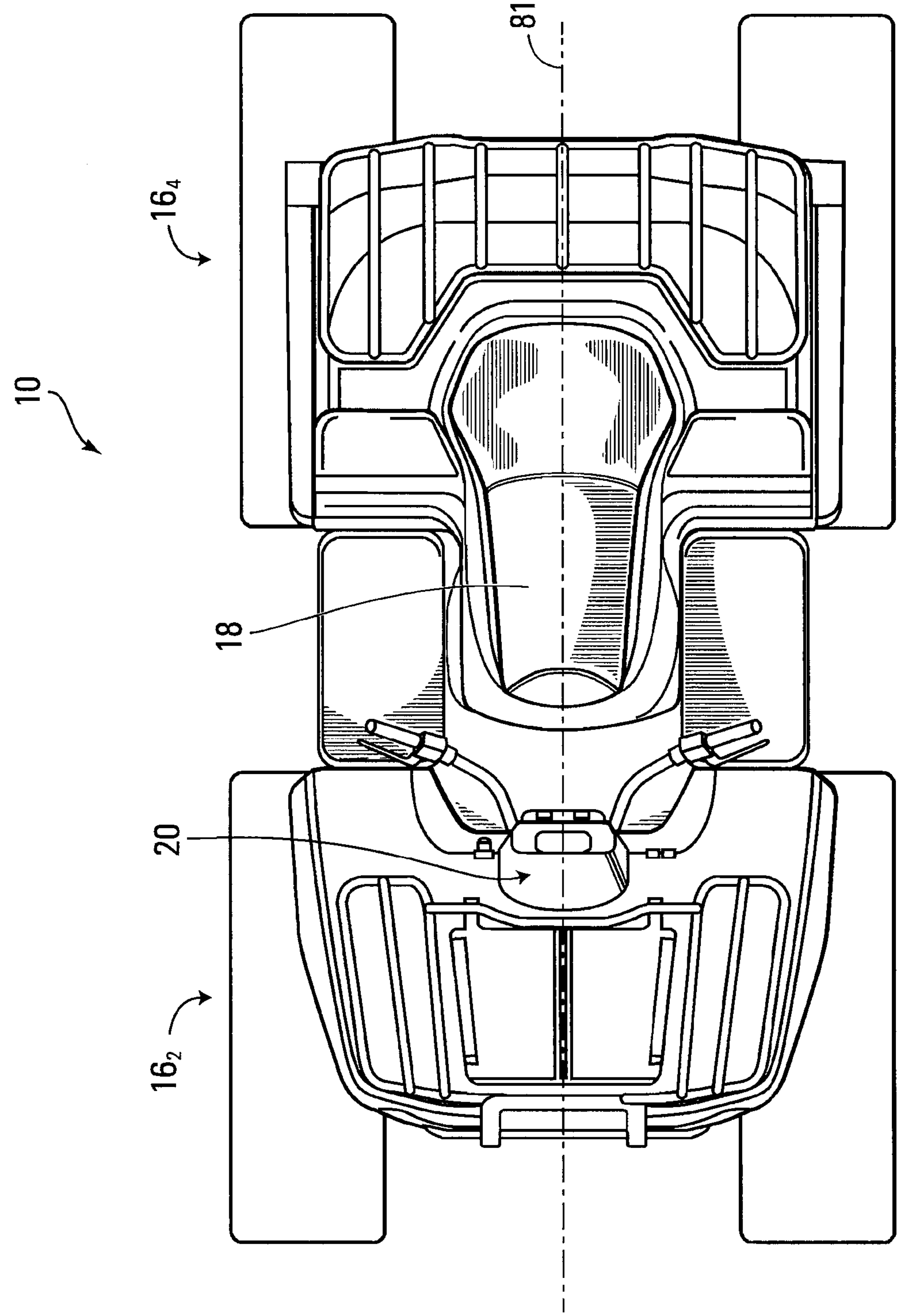


FIG. 1B

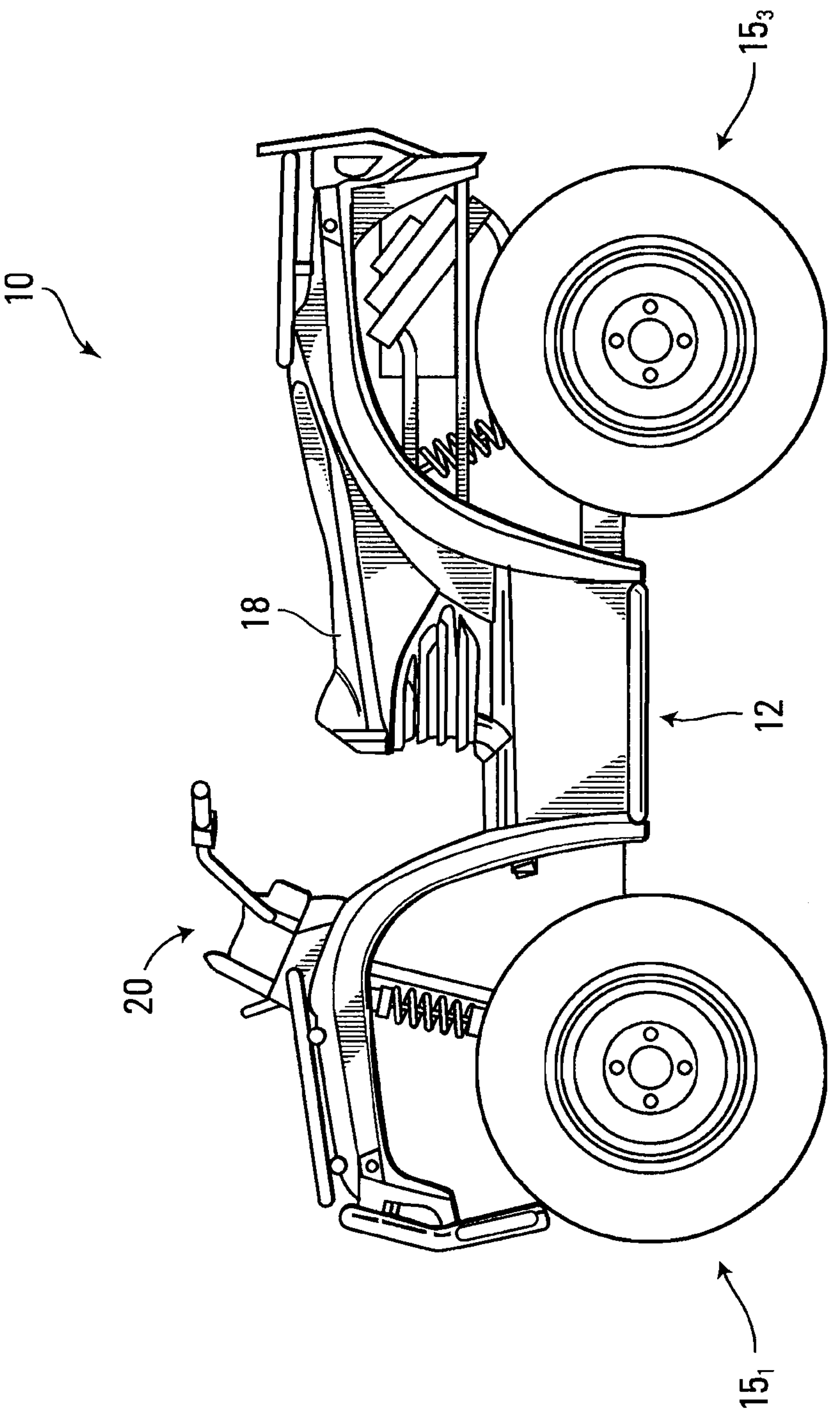


FIG. 2A

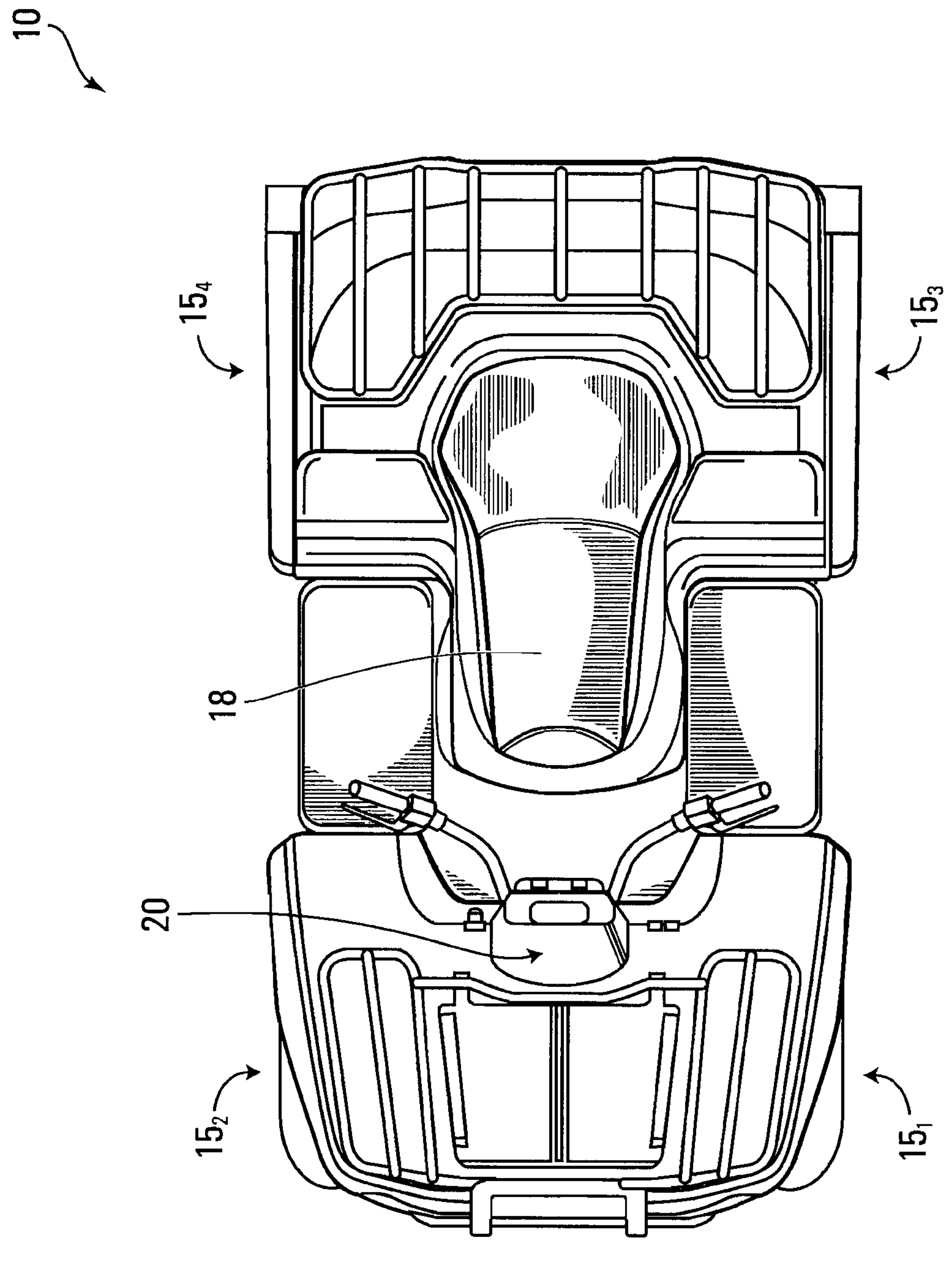


FIG. 2B

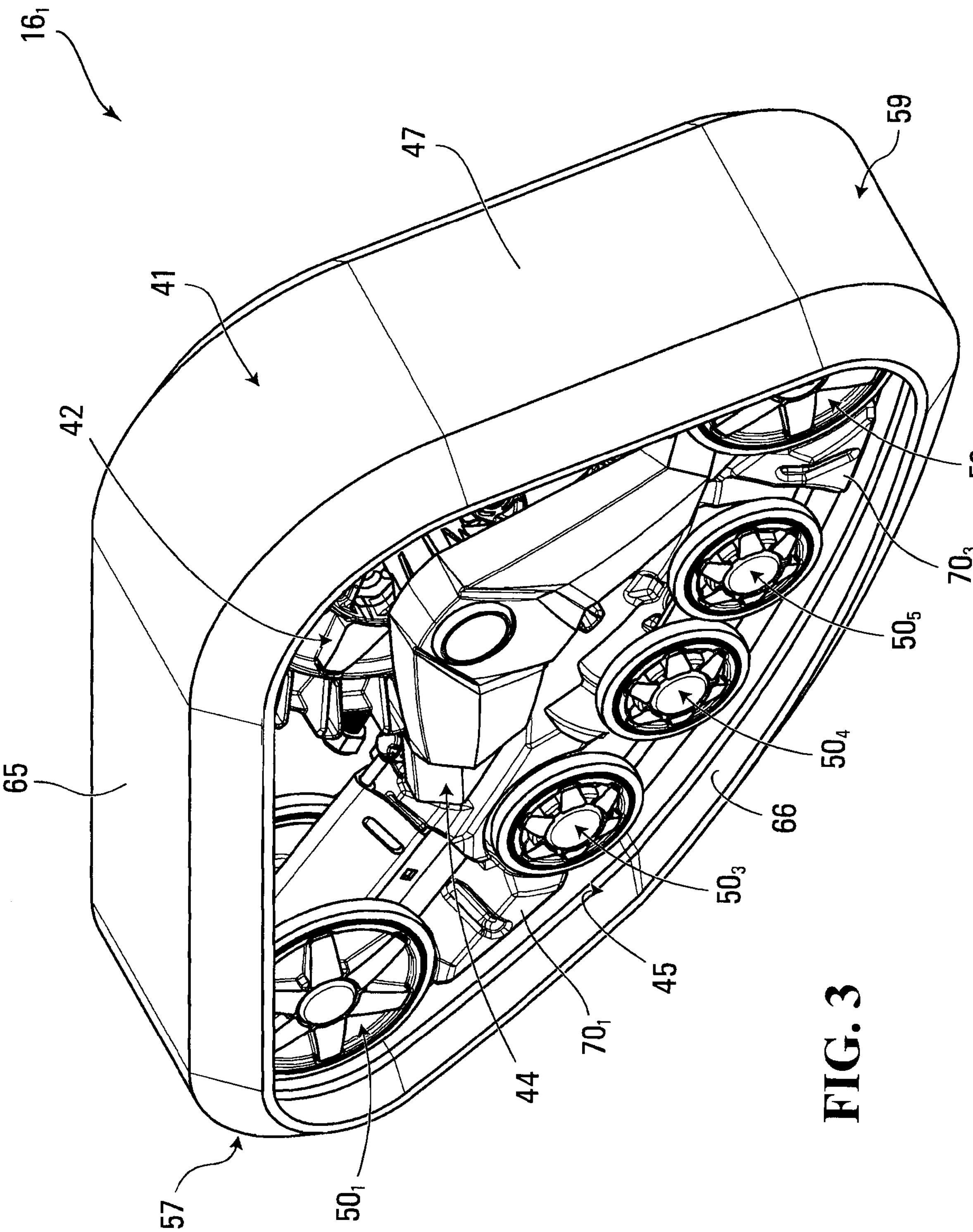


FIG. 3

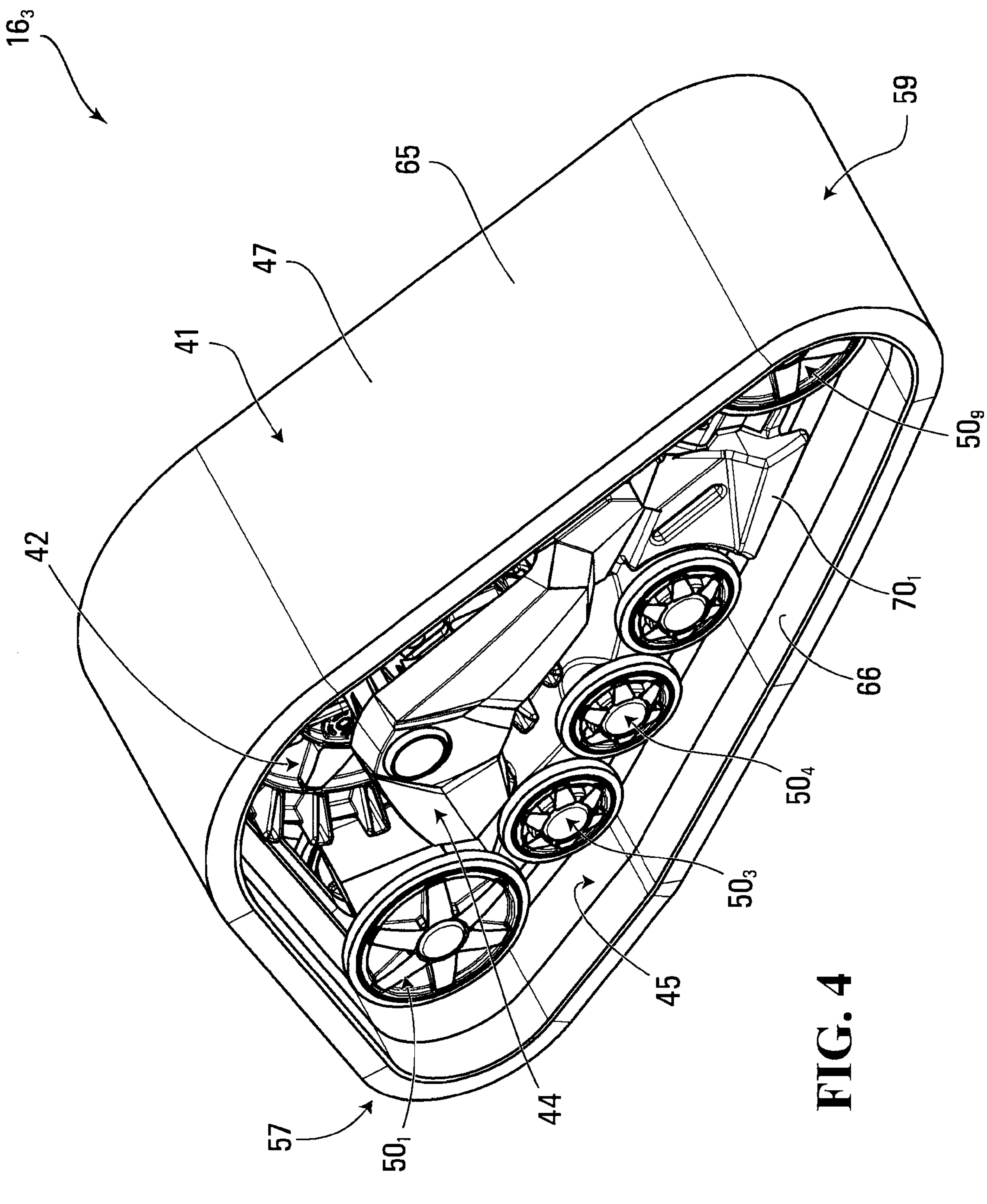


FIG. 4

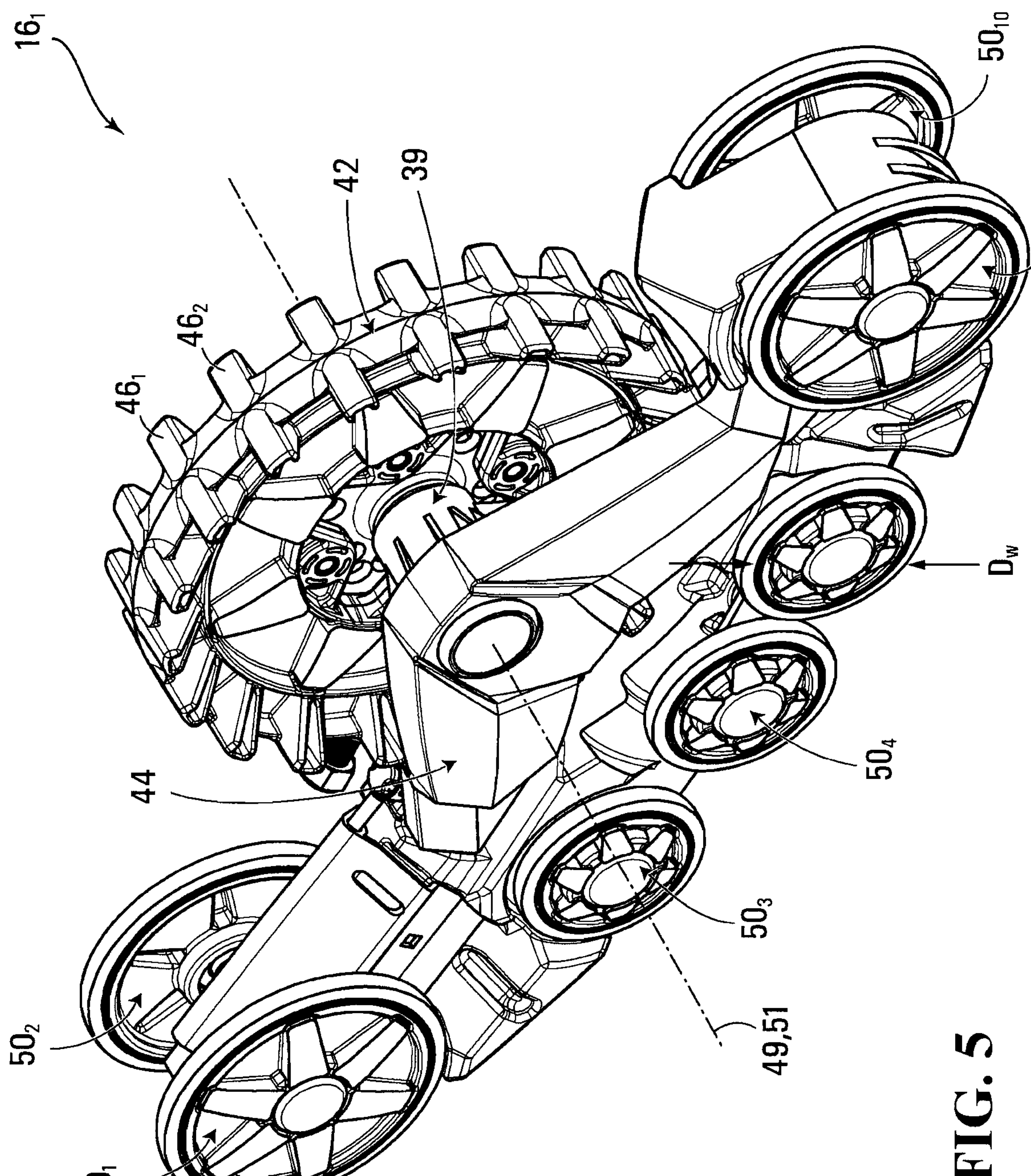


FIG. 5

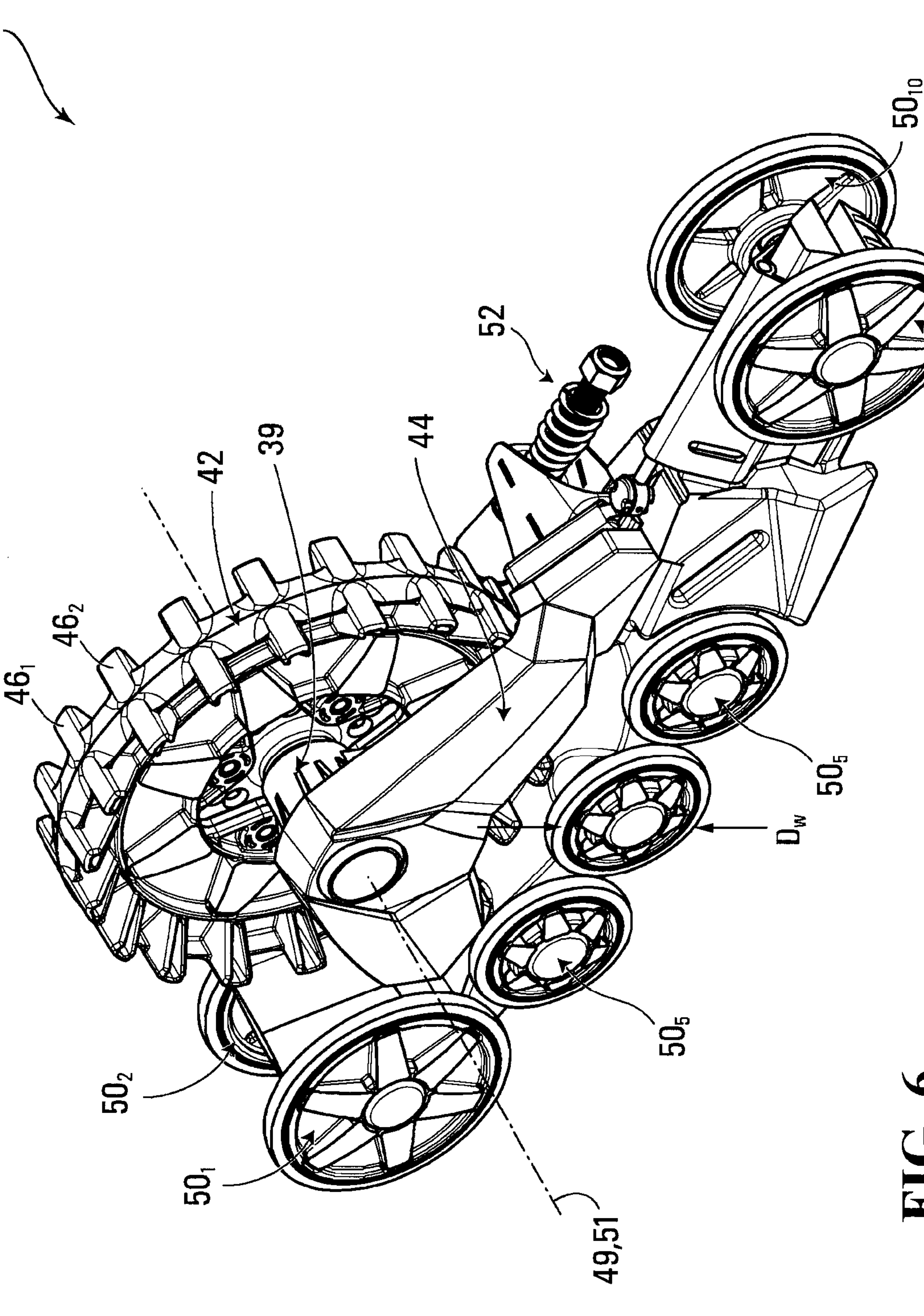


FIG. 6

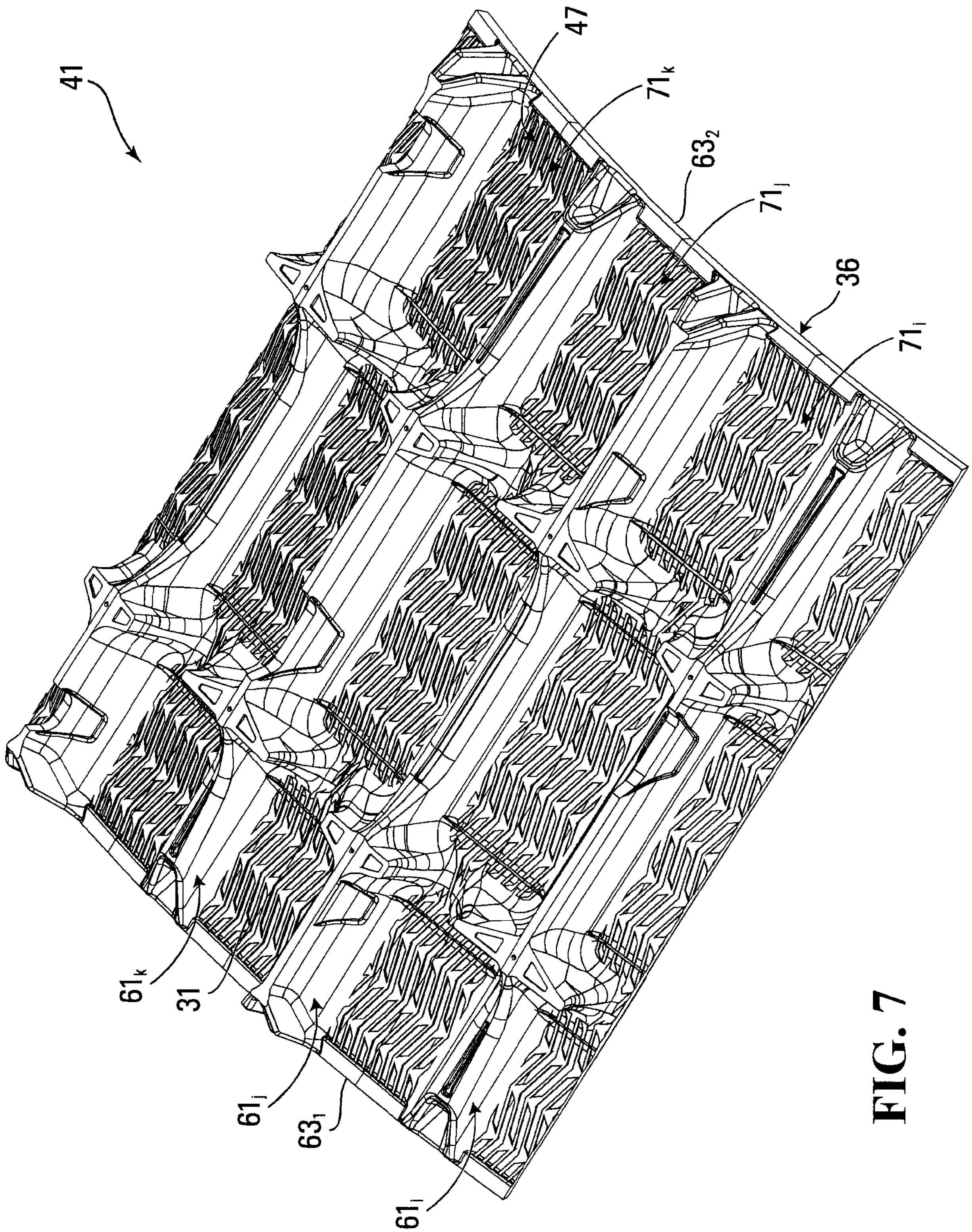


FIG. 7

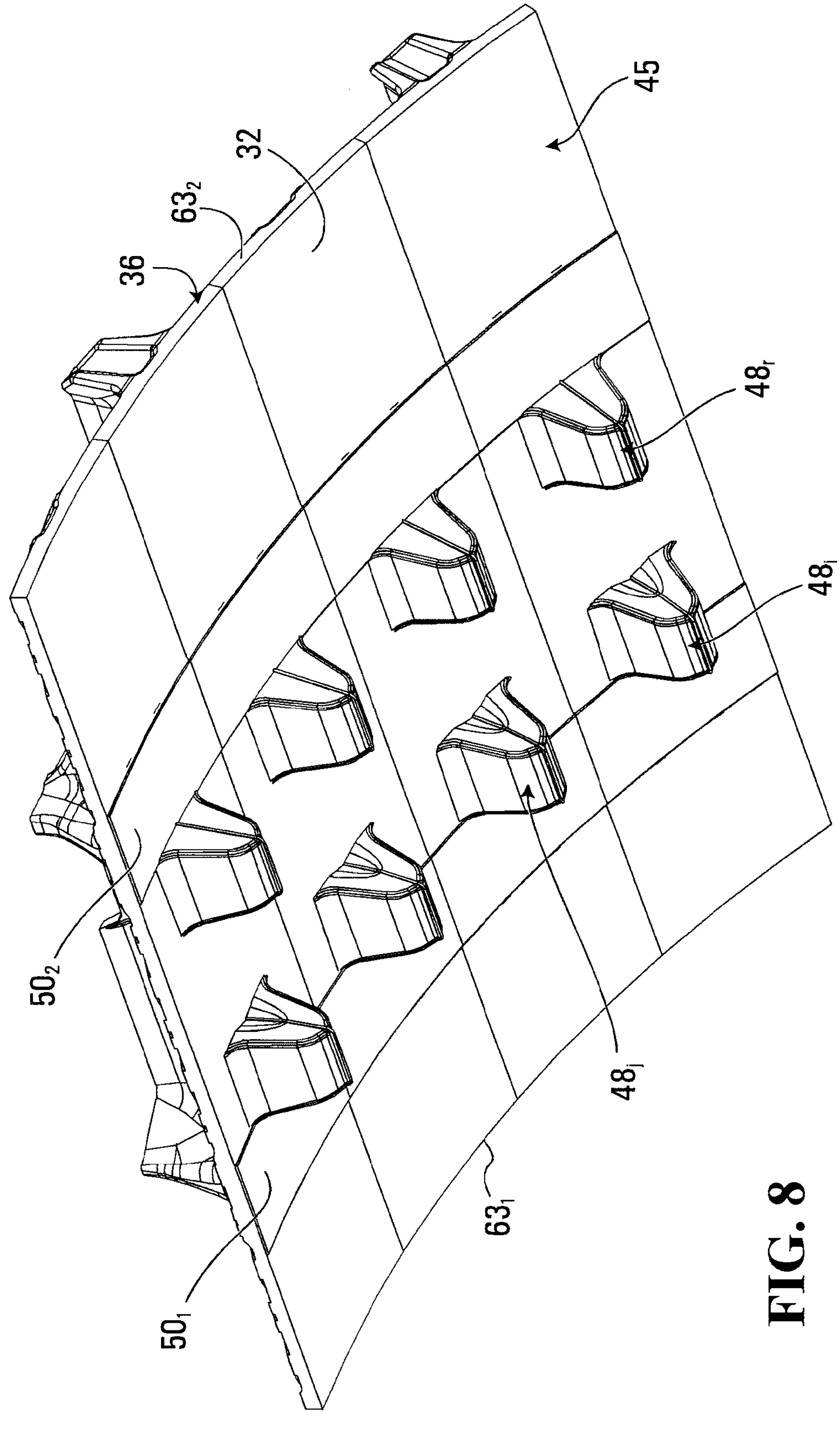


FIG. 8

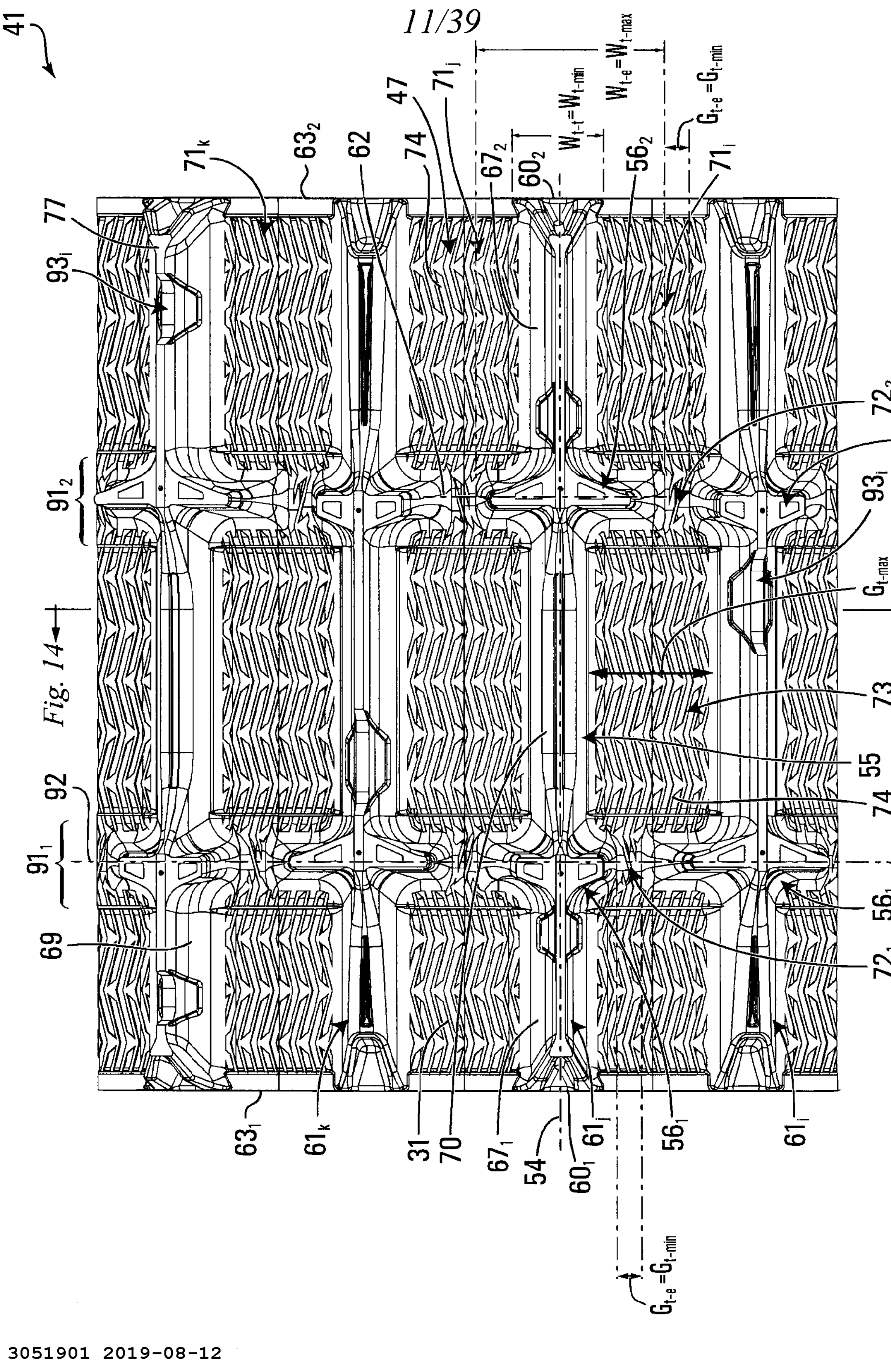

41
77
93i
91₂
Fig. 14
92
91₁
69
71k
63₂
62
74
47
71j
67₂
60₂
Wt-f =Wt-min
Wt-e =Wt-max
56₂
Gt-e =Gt-min
71i
72₂
56₂
93i
Gt-max
73
55
74
Fig. 14
72₁
56₁
63₁
61k
31
70
67₁
54
60₁
61j
56₁
61i
Gt-e =Gt-min

FIG. 9

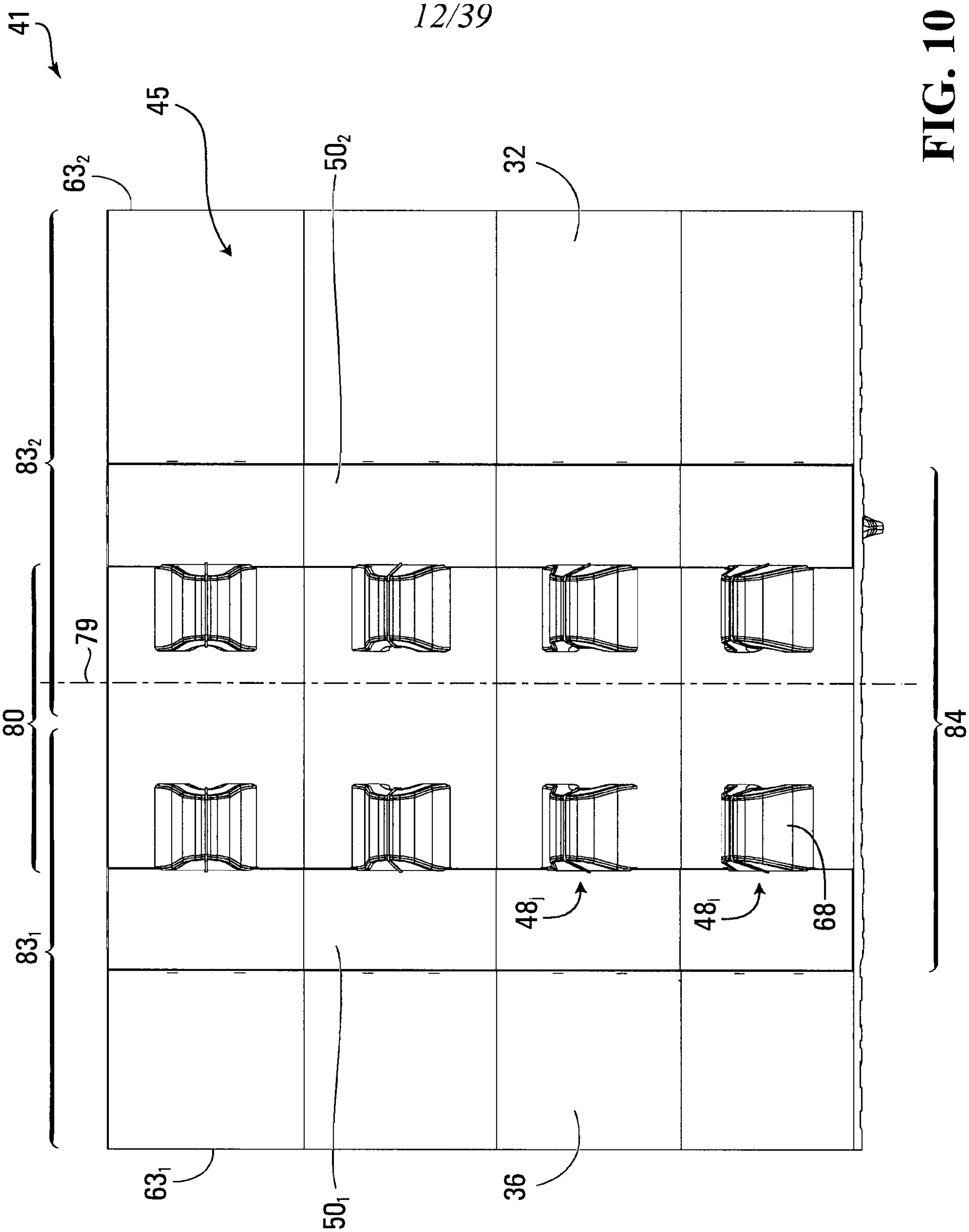


FIG. 10

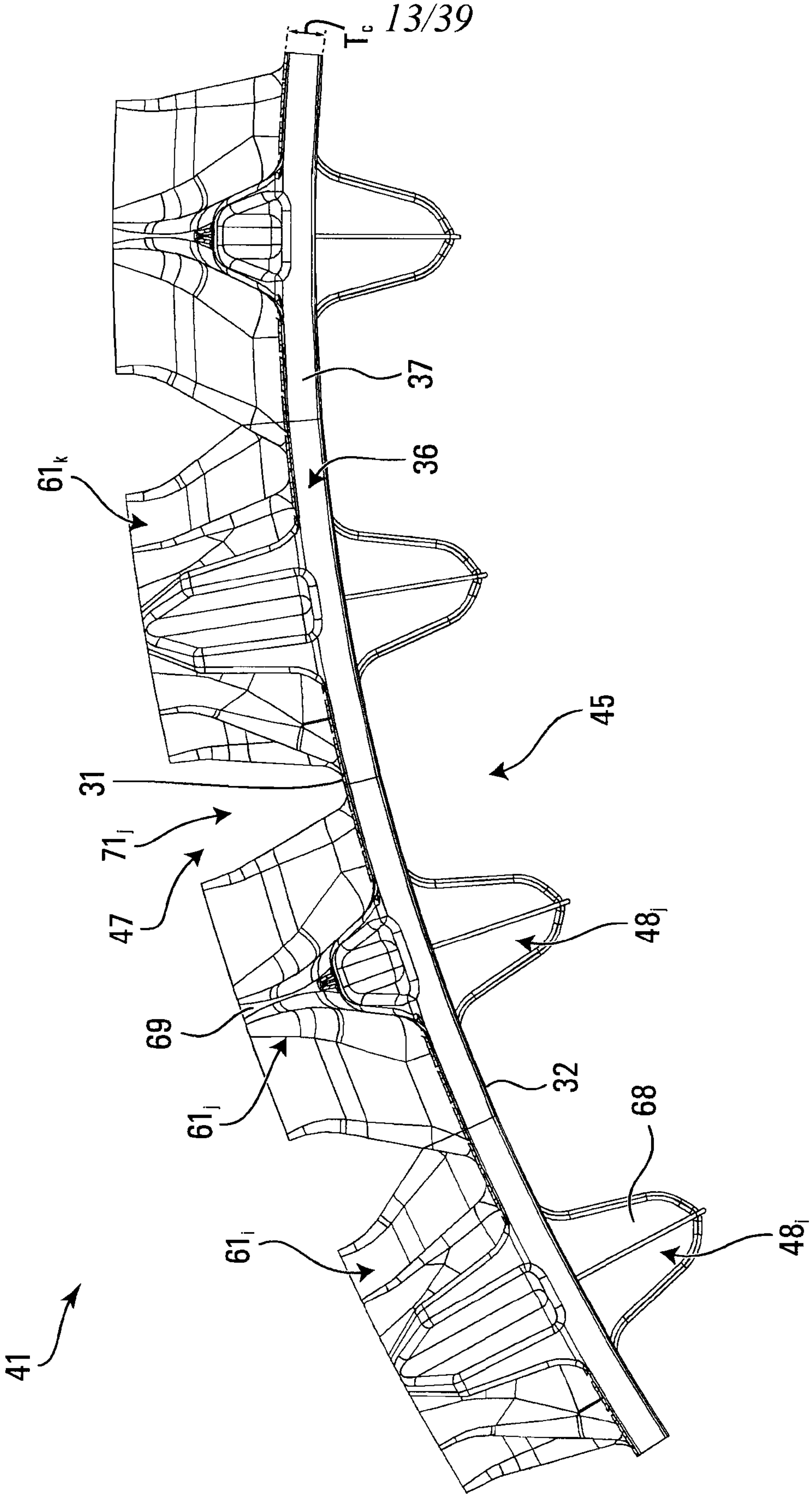
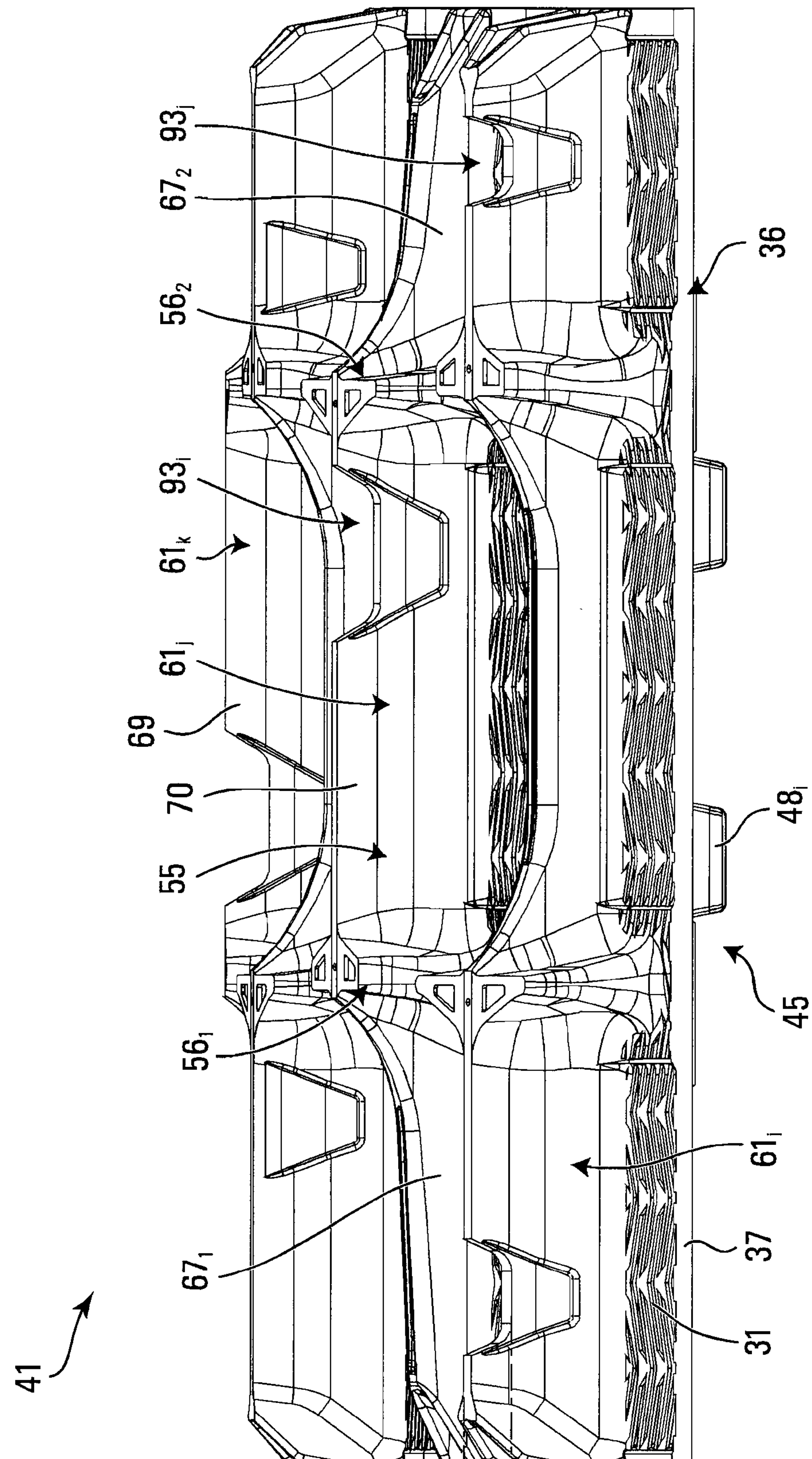


FIG. 11



41
67_1
56_1
55
70
69
61_j
61_k
93_i
56_2
67_2
93_j
36
45
48_i
61_i
37
31
d_r
H_{t-0}

FIG. 12

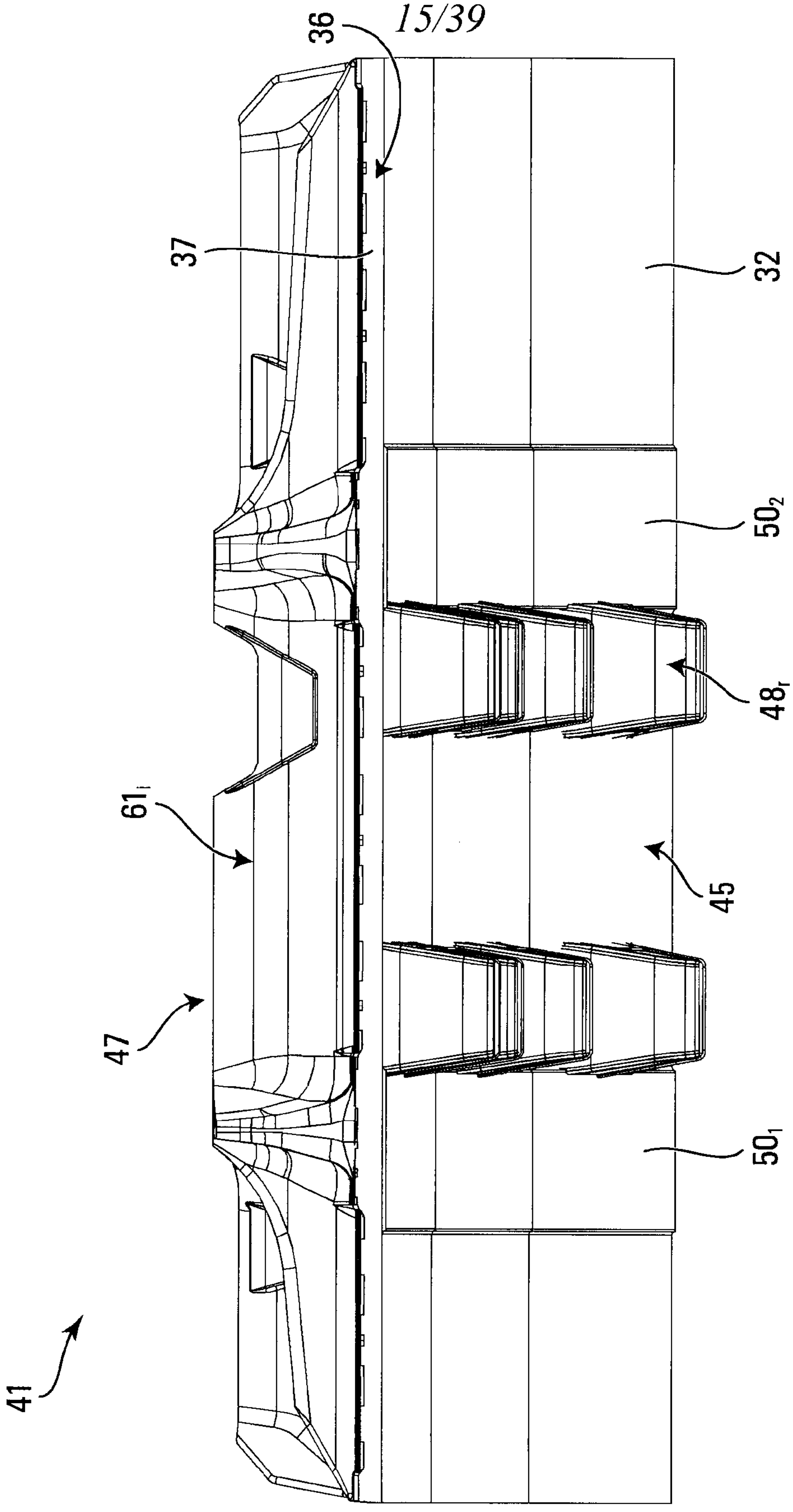


FIG. 13

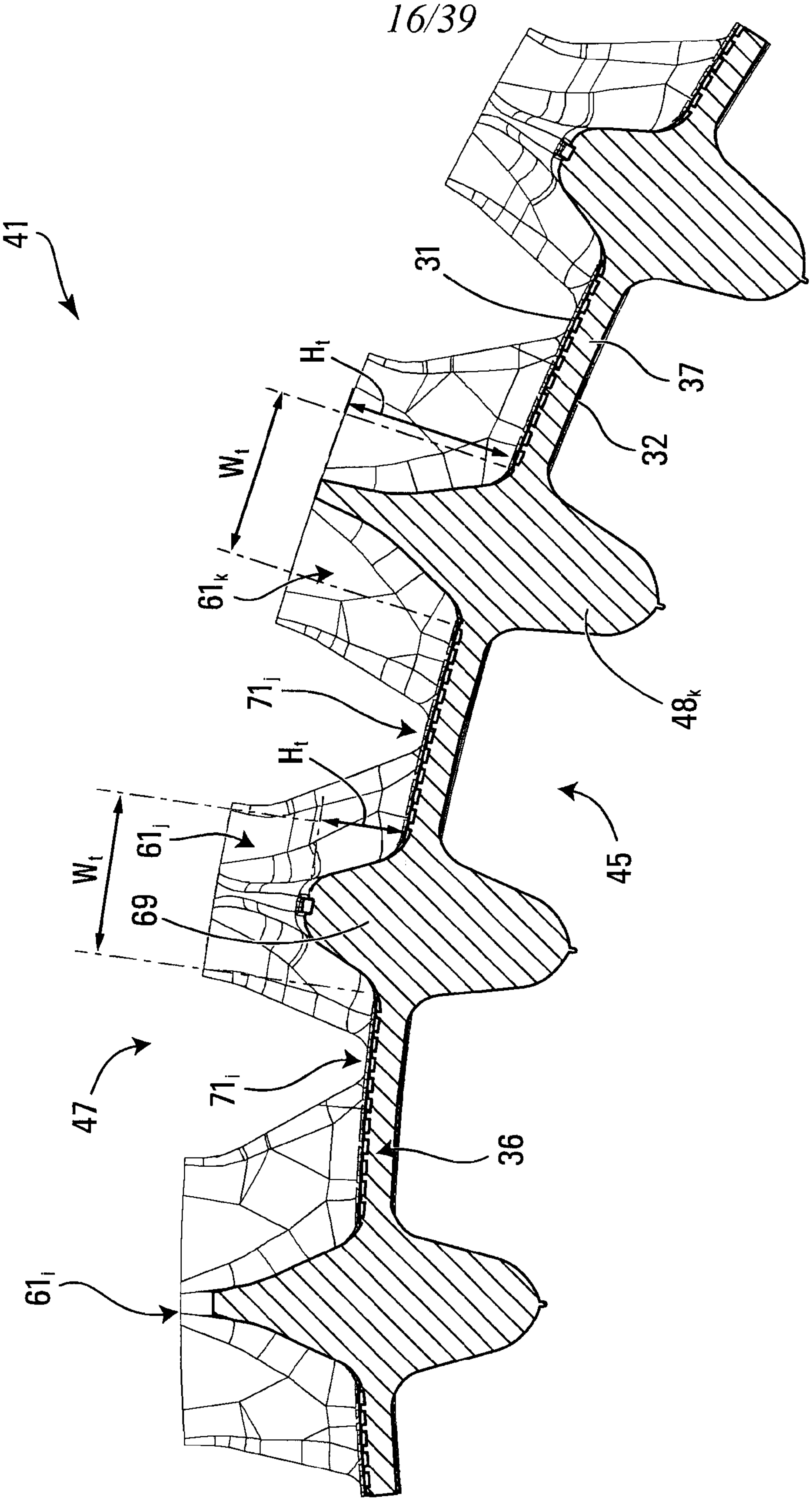


FIG. 14

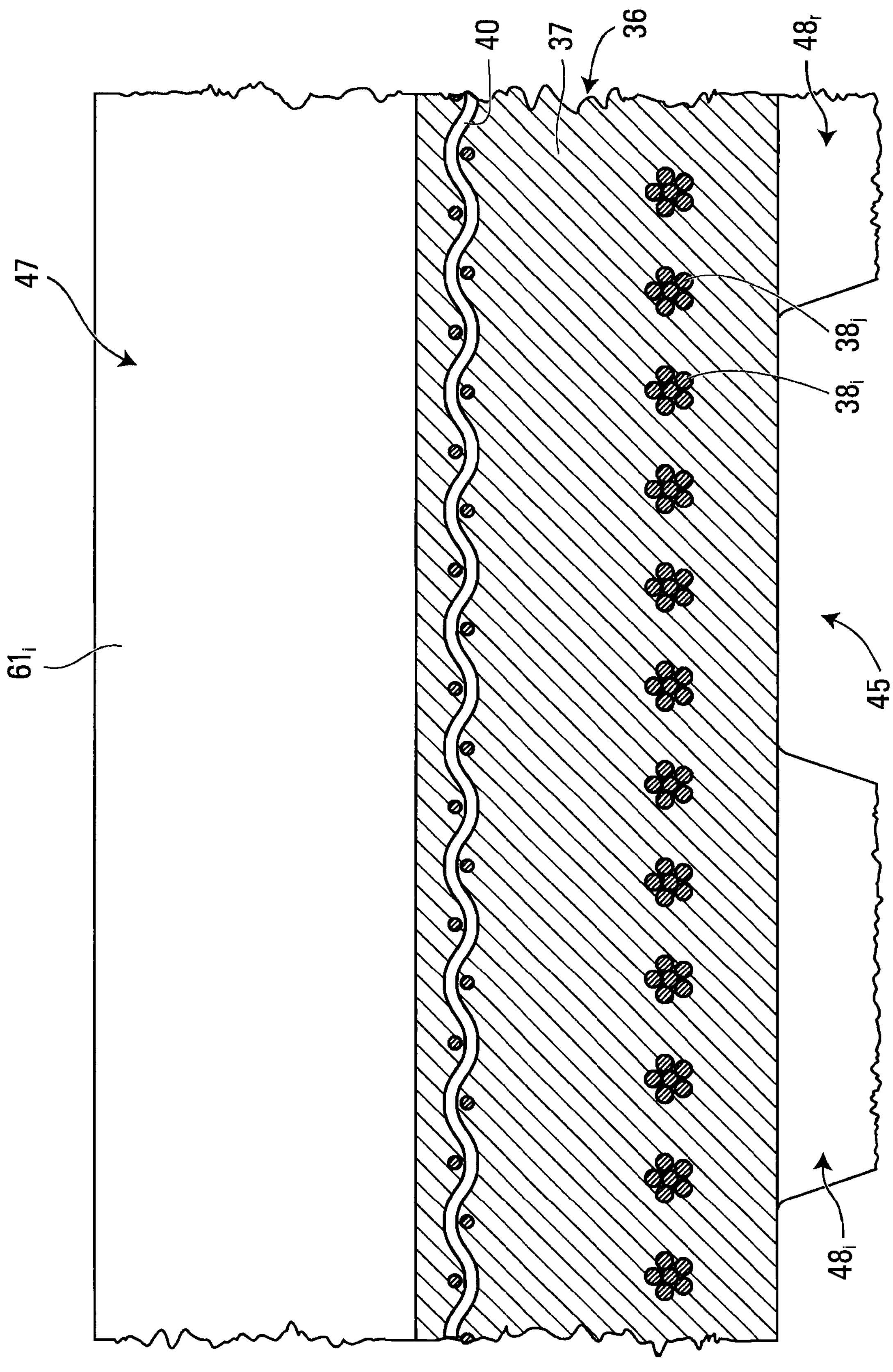


FIG. 15

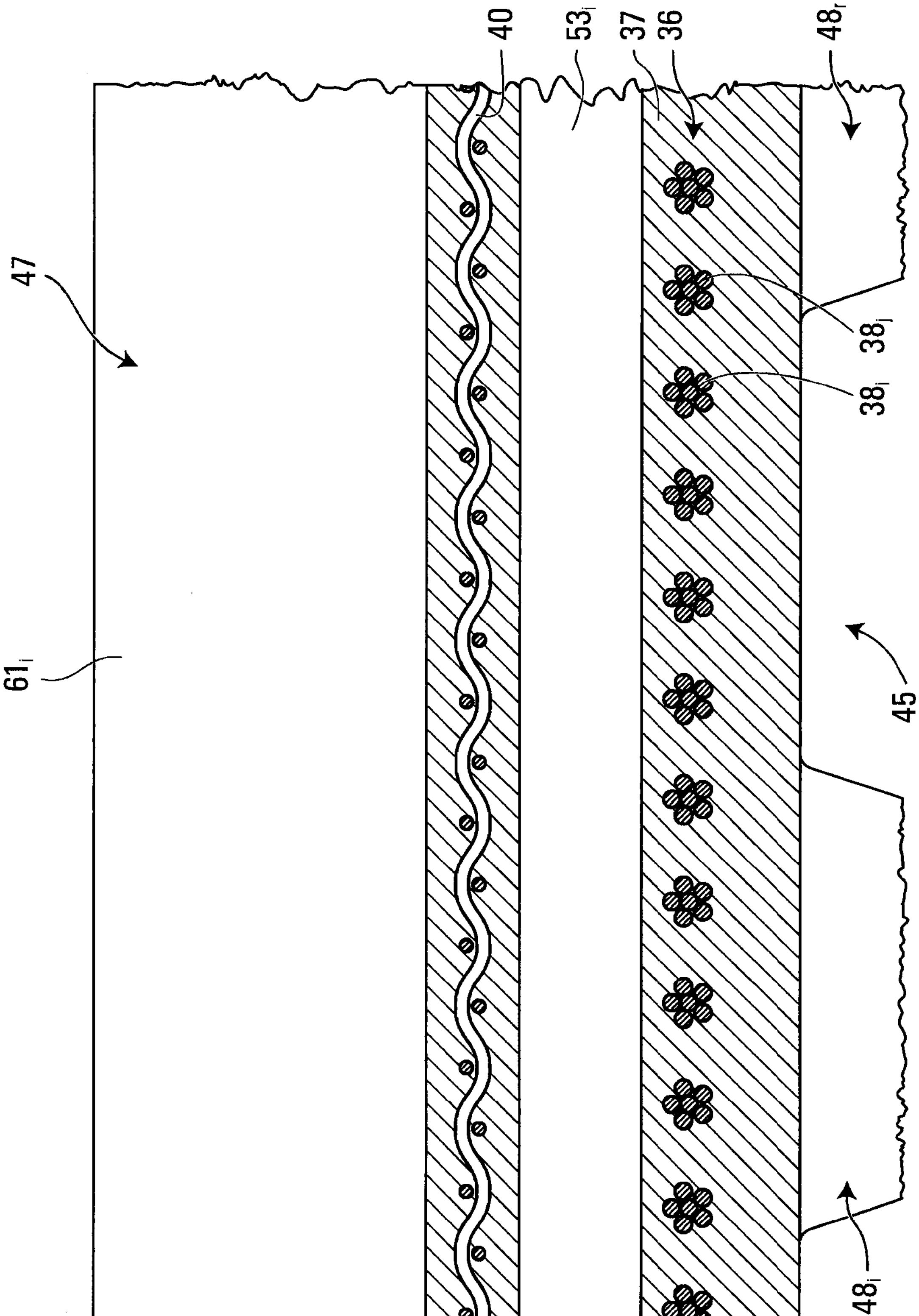


FIG. 16

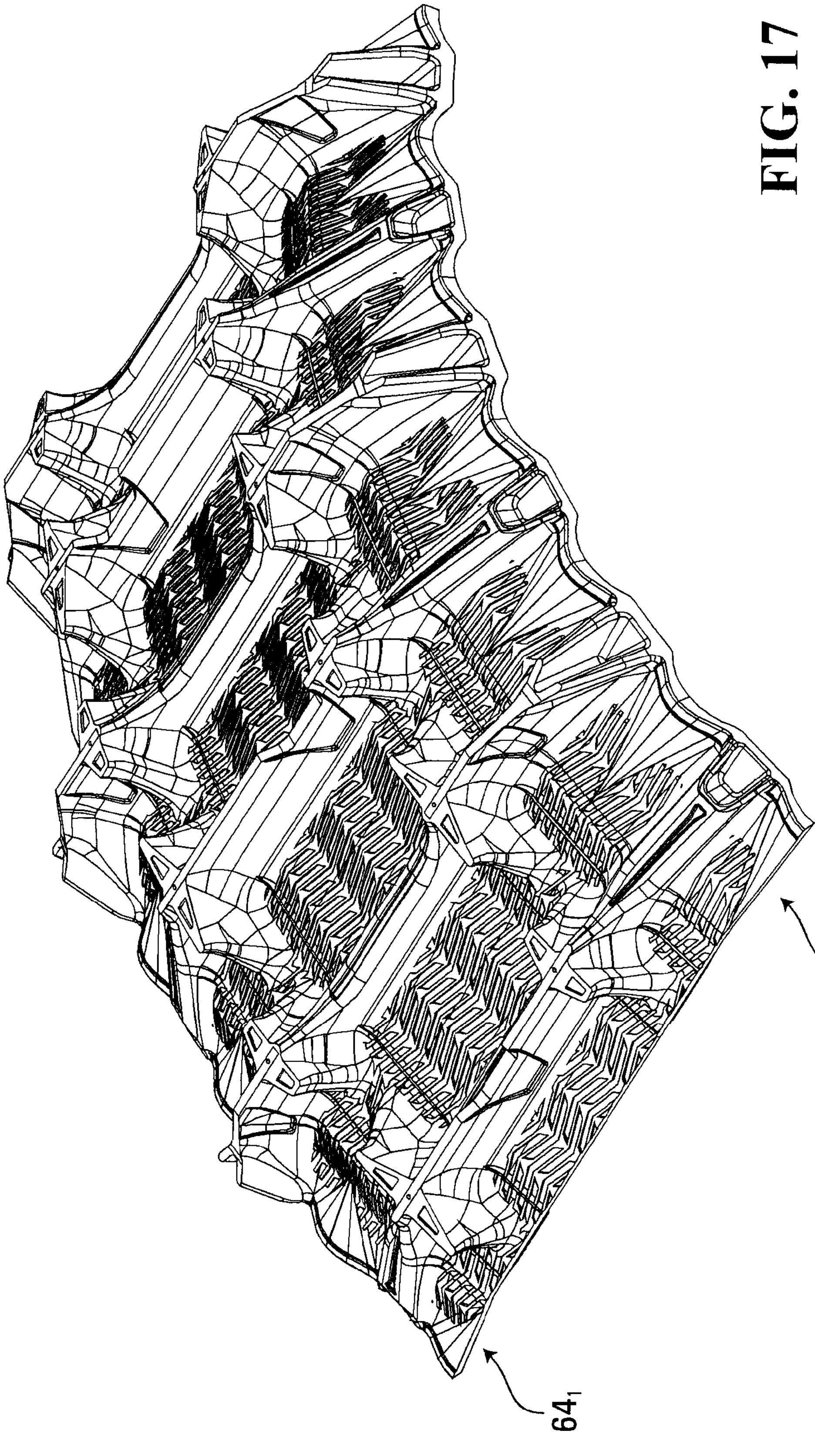


FIG. 17

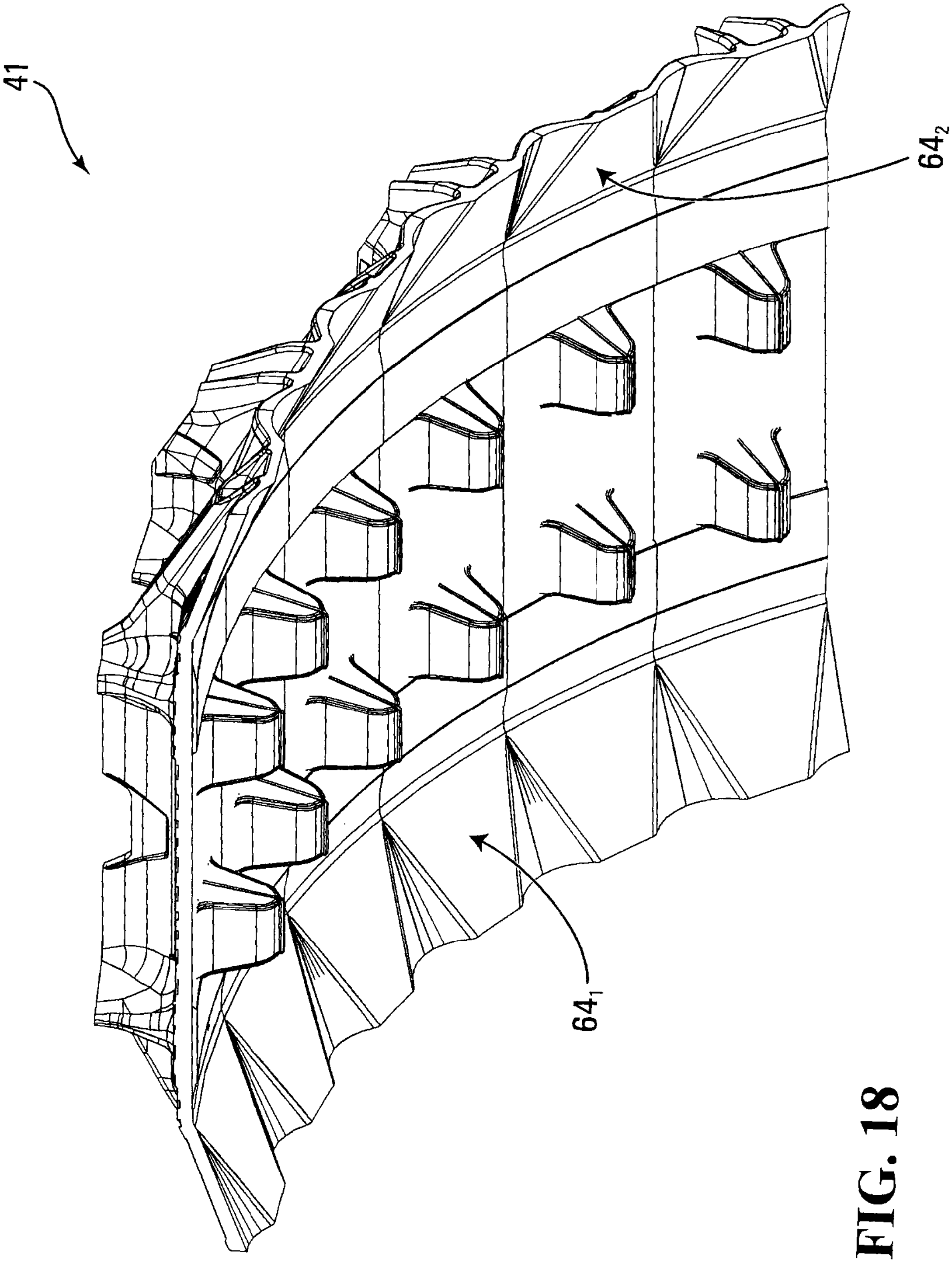


FIG. 18

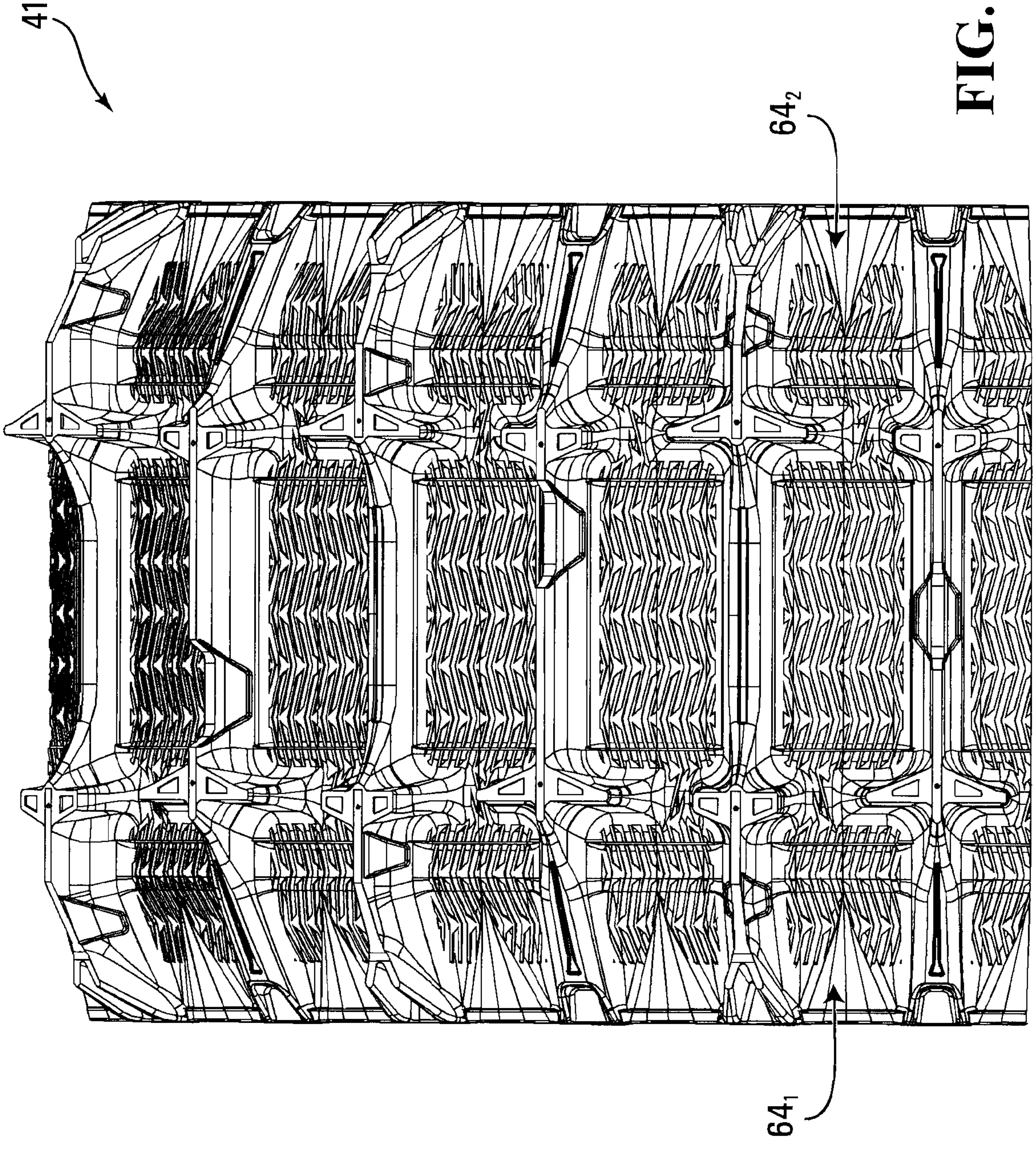


FIG. 19

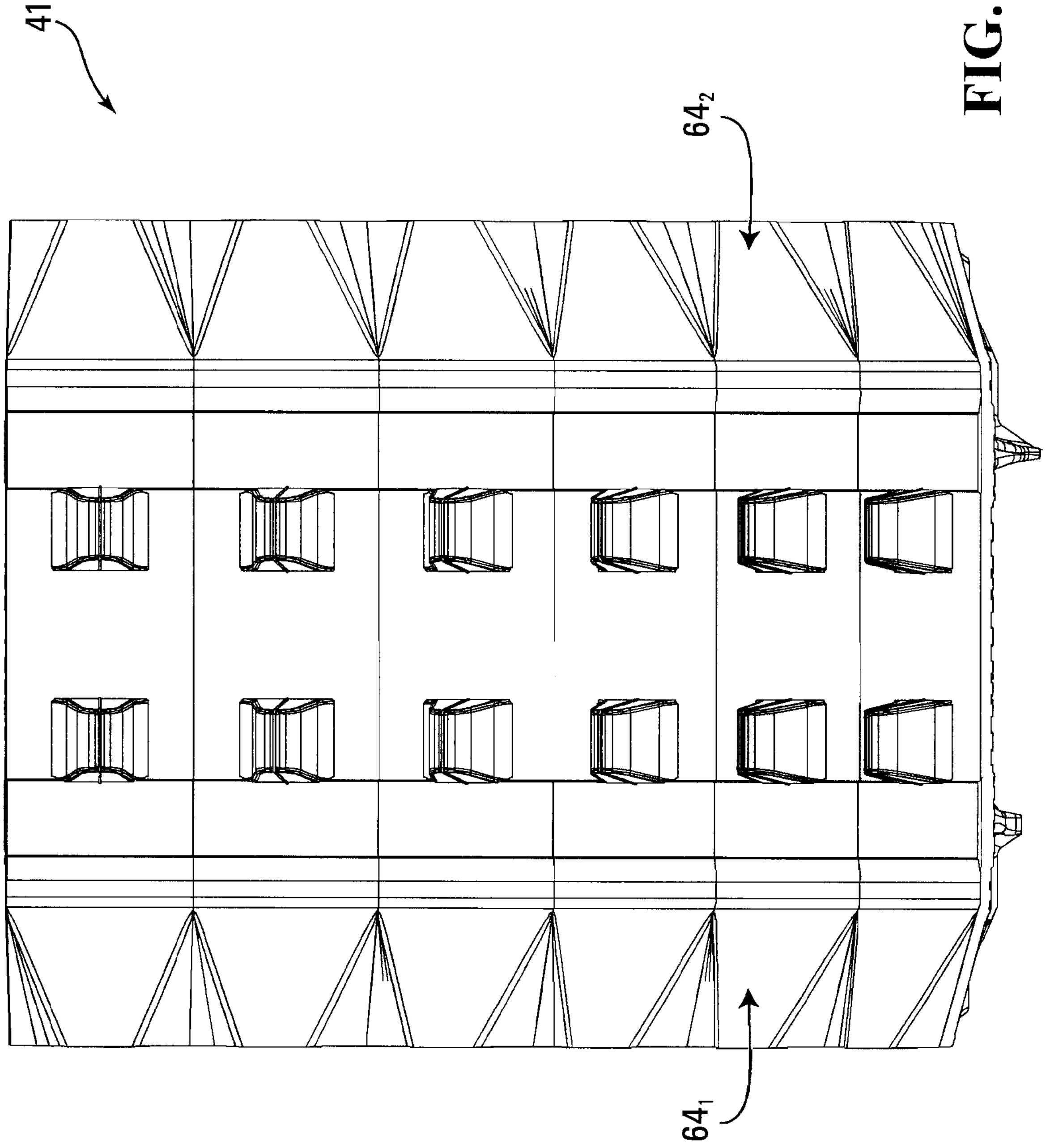


FIG. 20

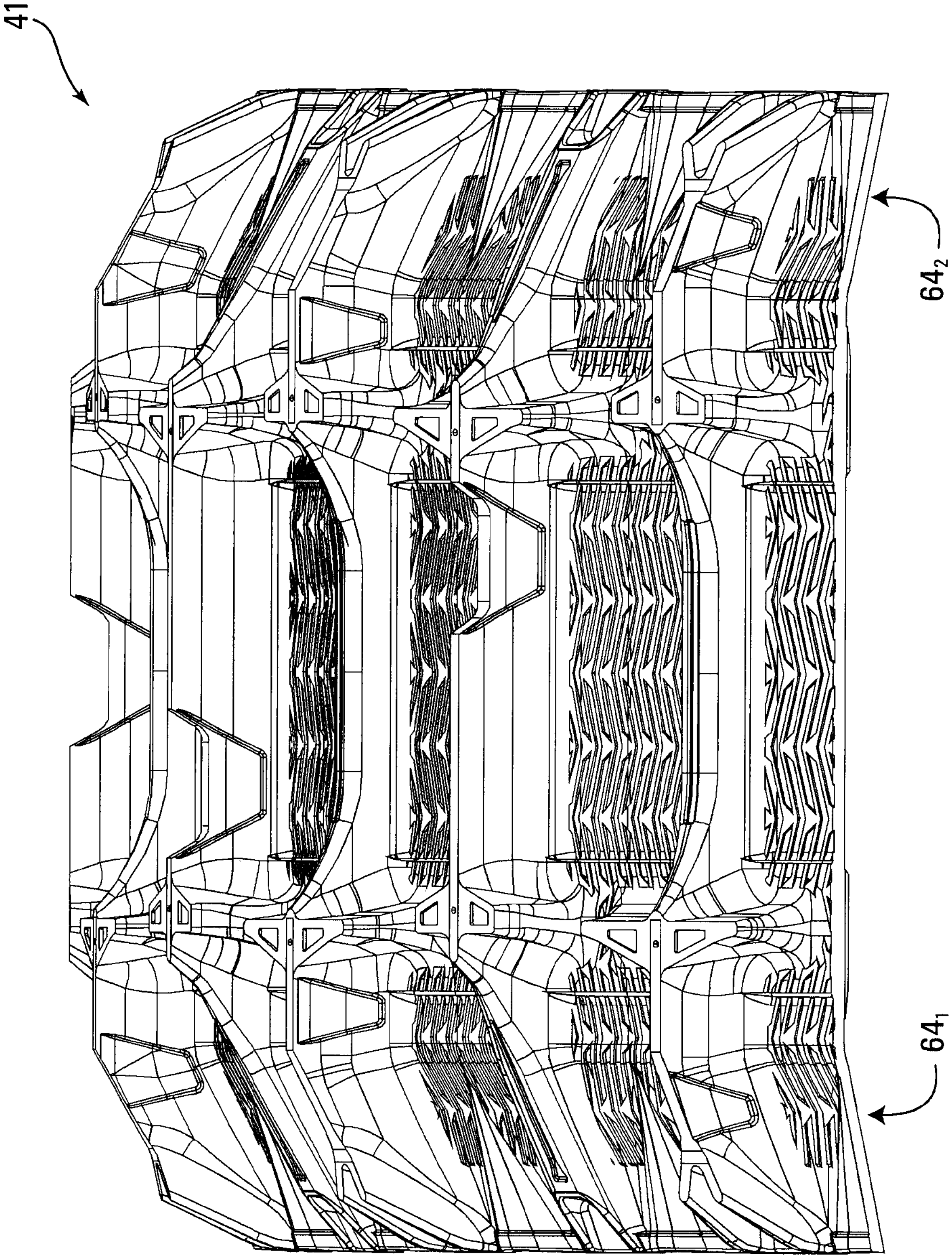


FIG. 21

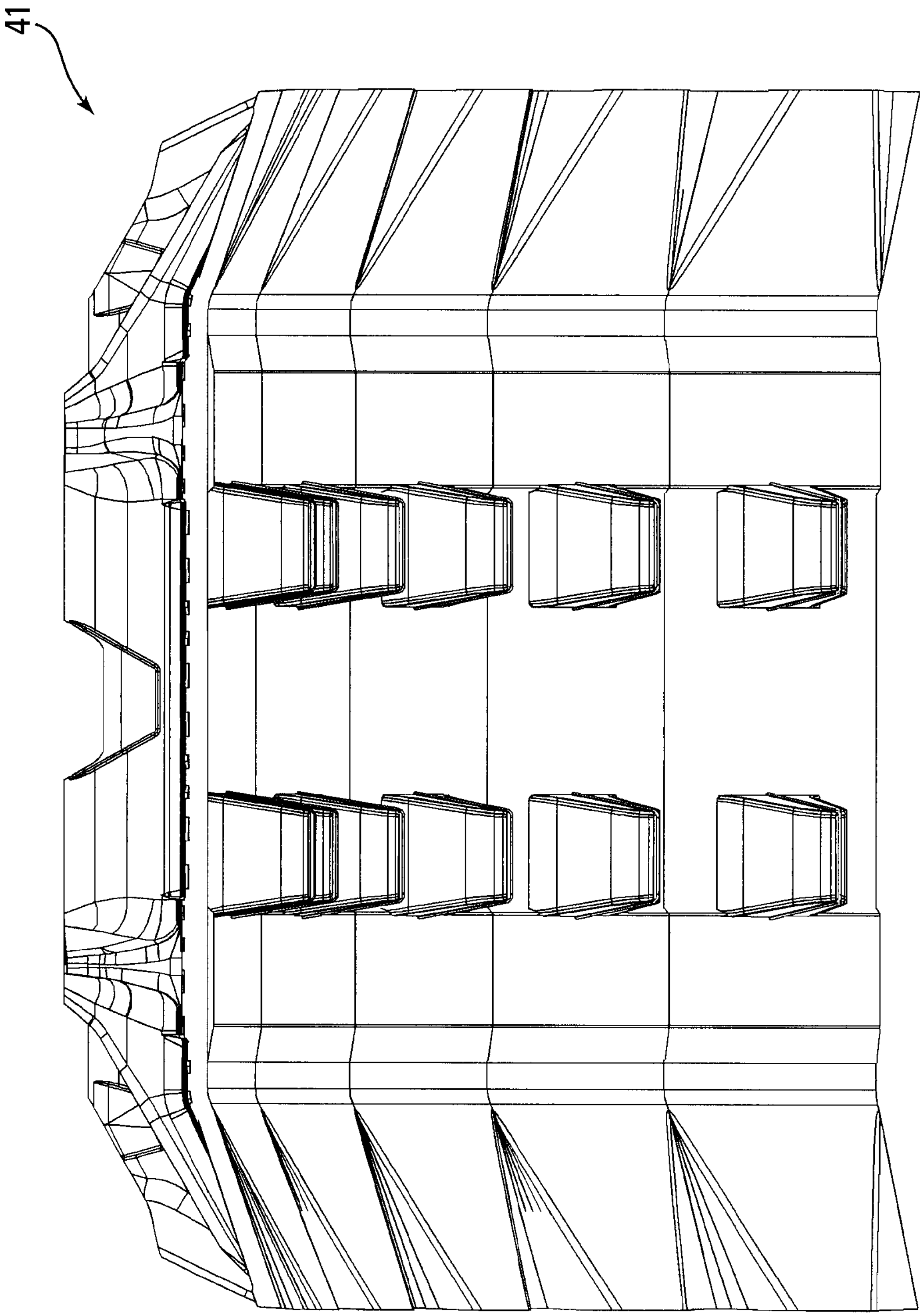


FIG. 22

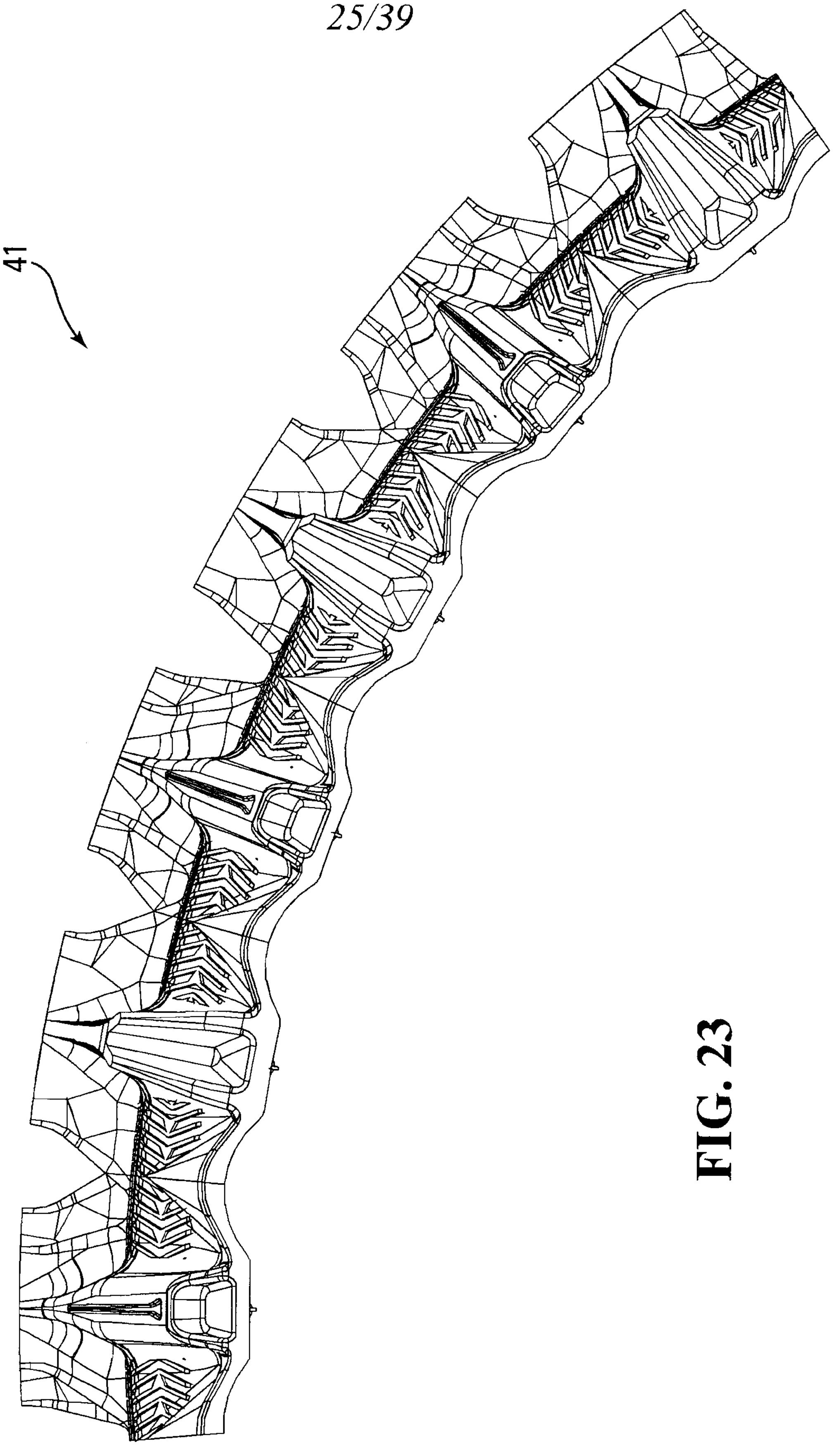


FIG. 23

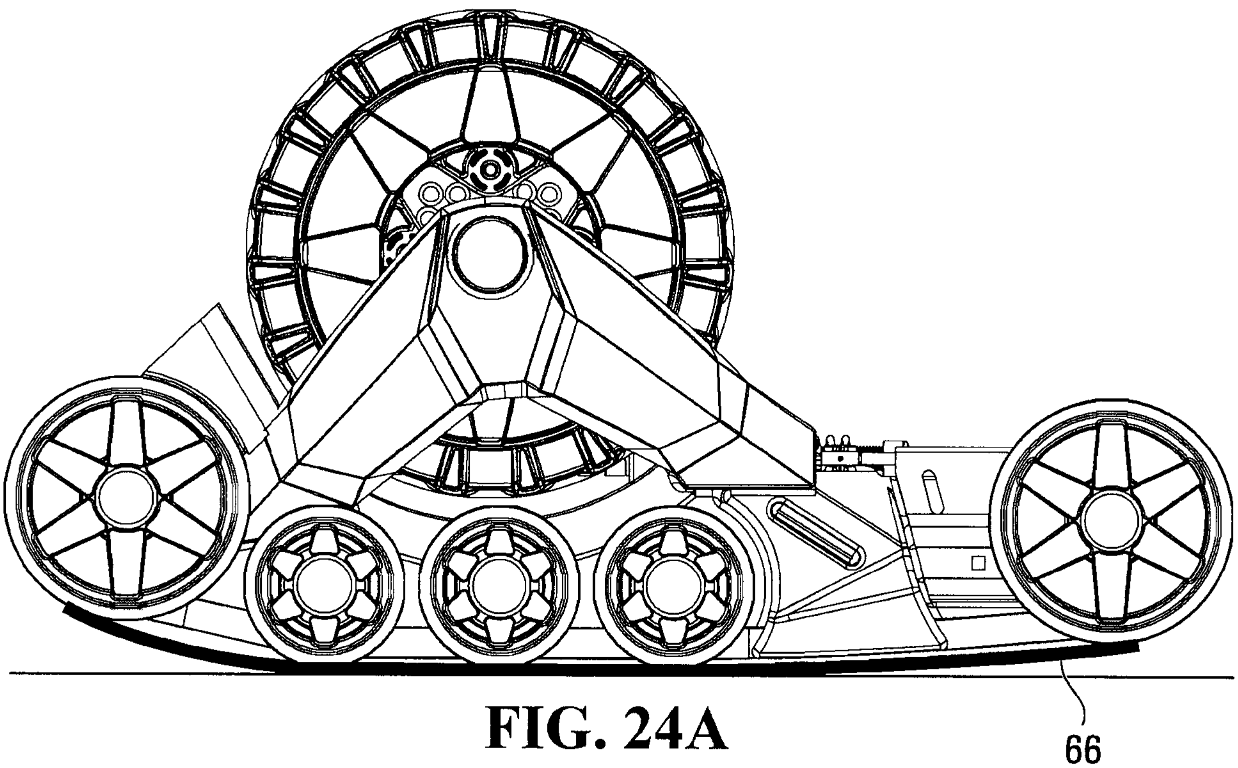


FIG. 24A

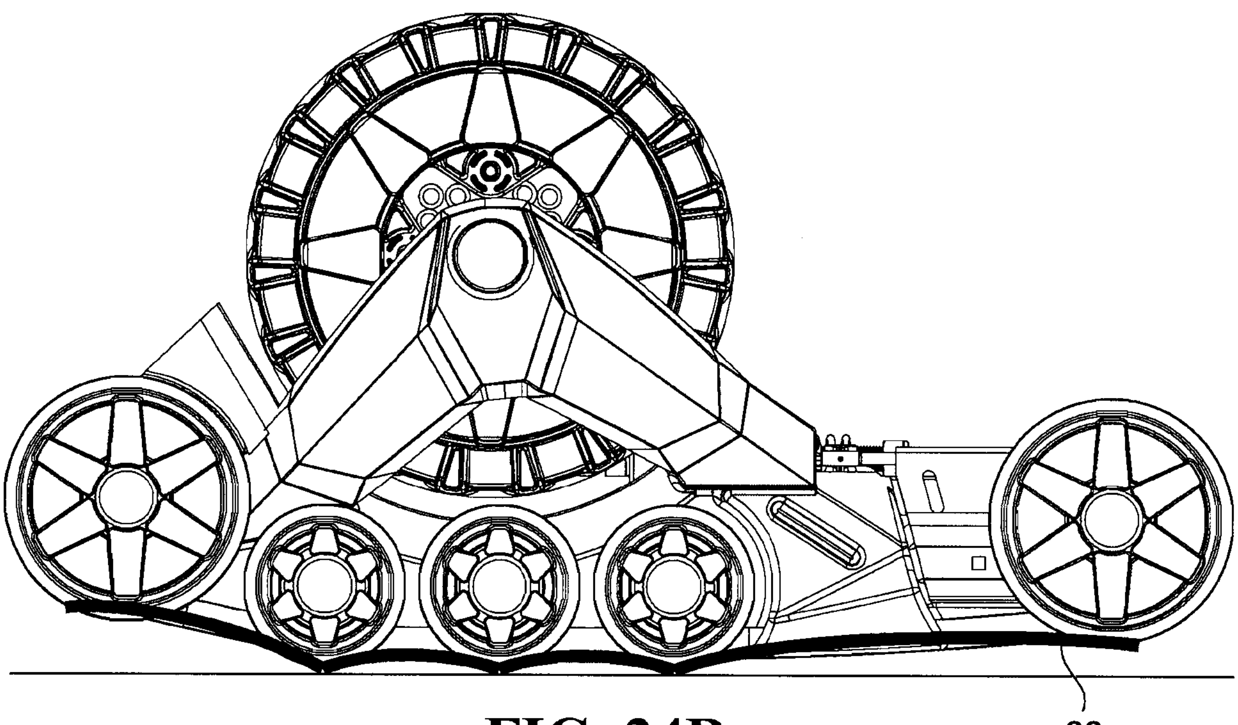


FIG. 24B

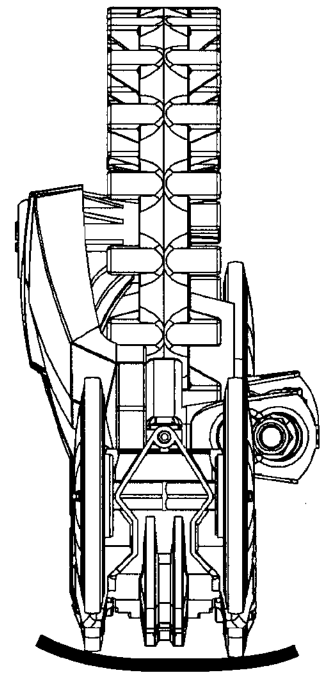


FIG. 25A

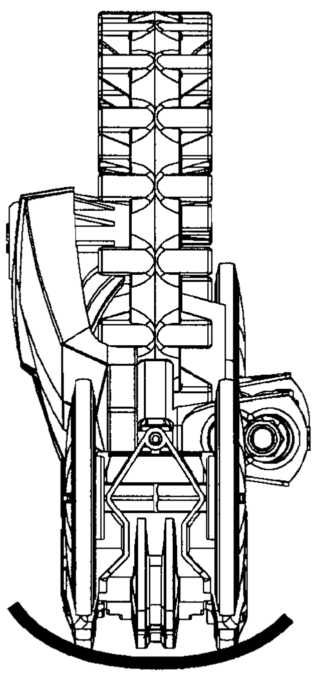


FIG. 25B

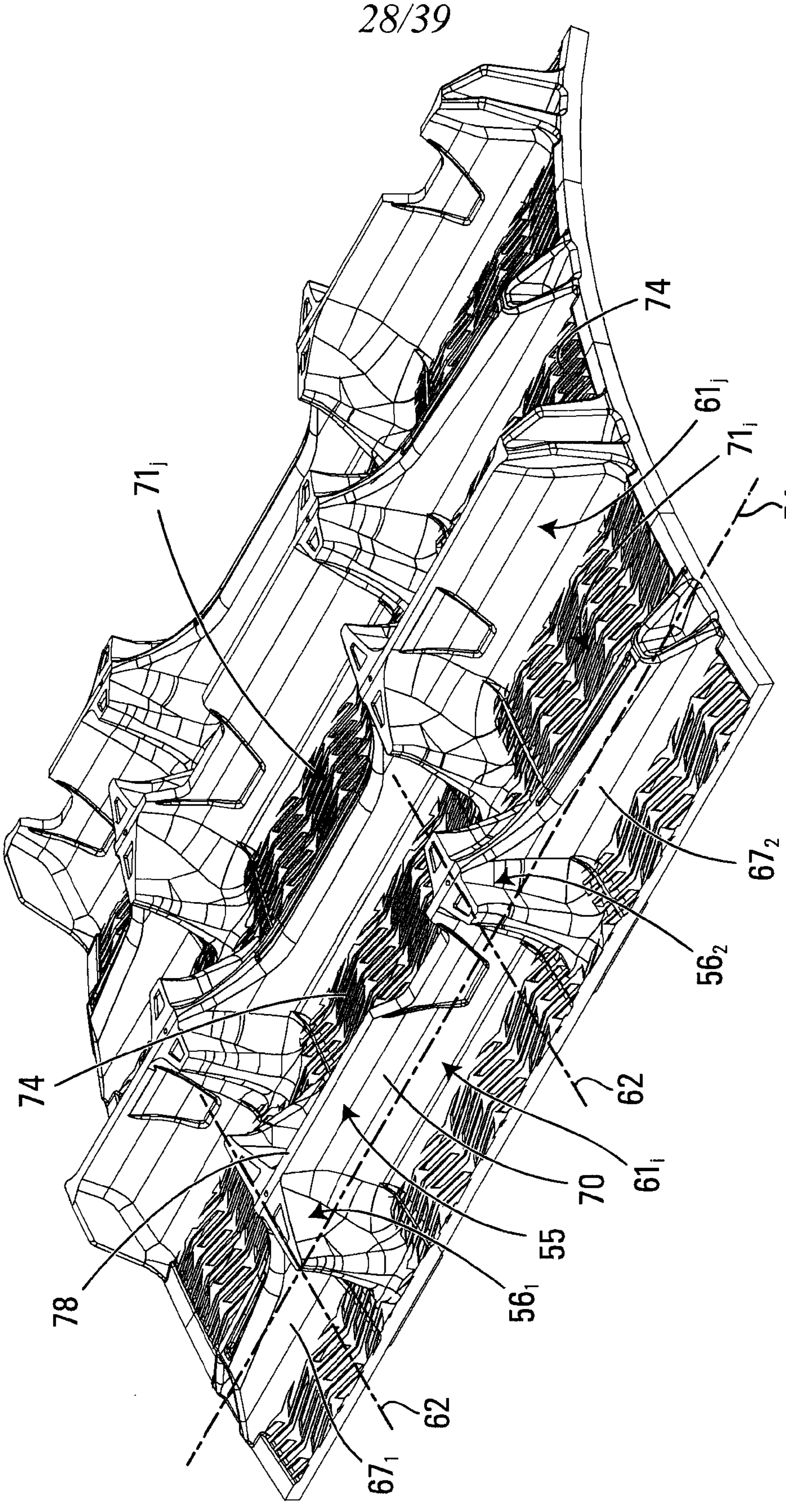


FIG. 26

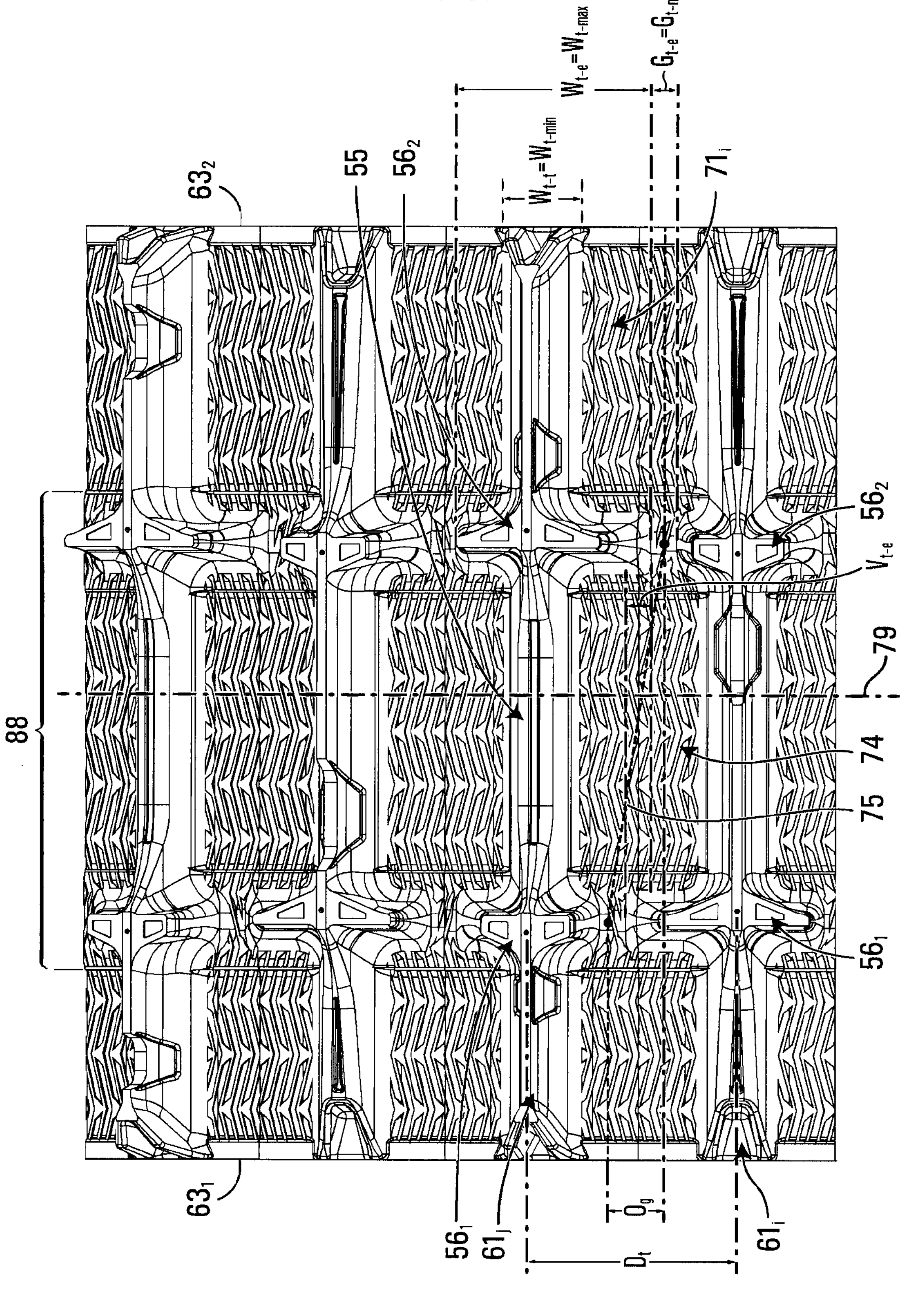

88
63₂
63₁
55
56₂
56₁
61ⱼ
61ᵢ
71ᵢ
74
75
79
Vt-e
Wt-t=Wt-min
Wt-e=Wt-max
Gt-e=Gt-min
Og
Dt

FIG. 27

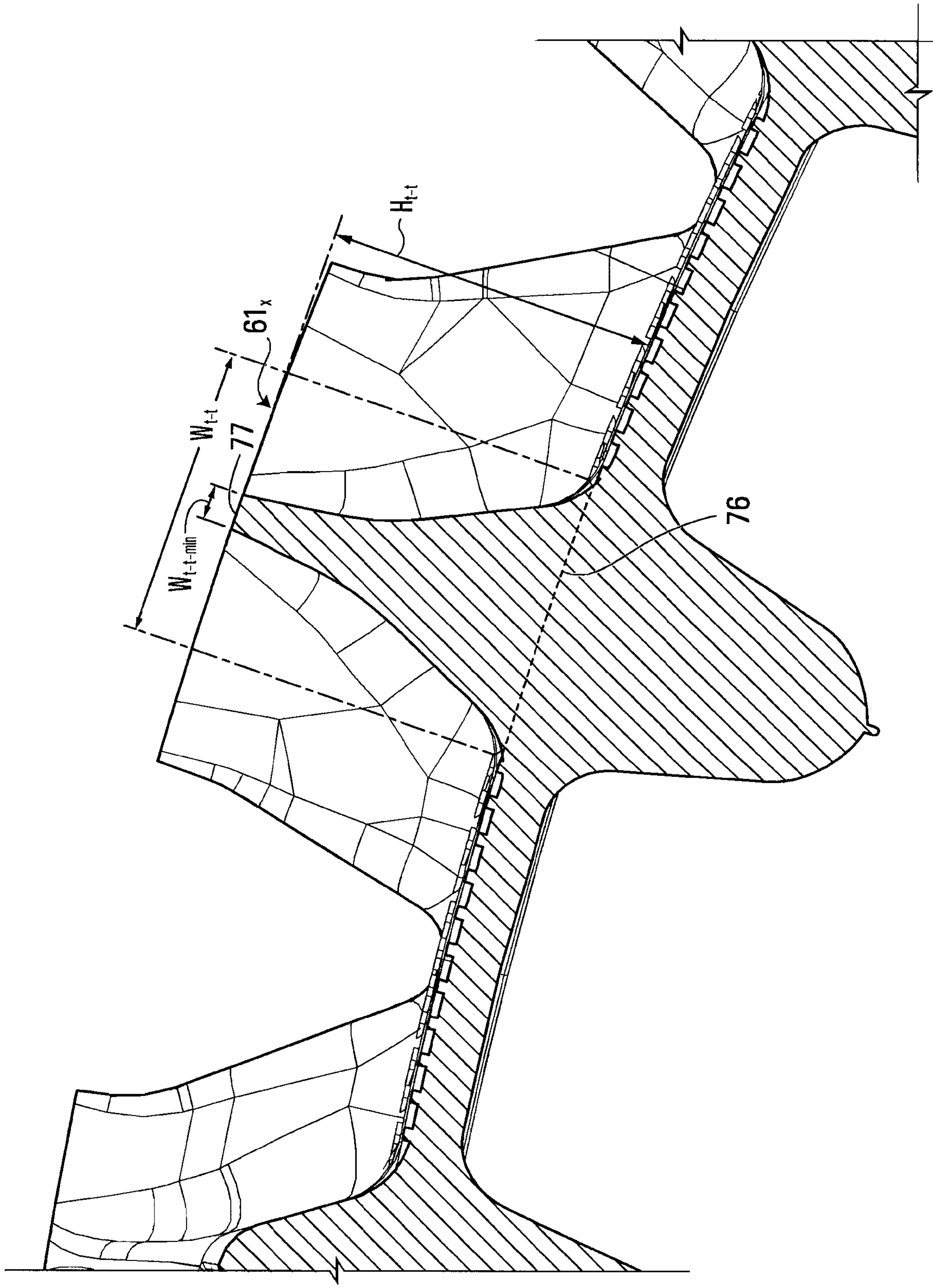


FIG. 28

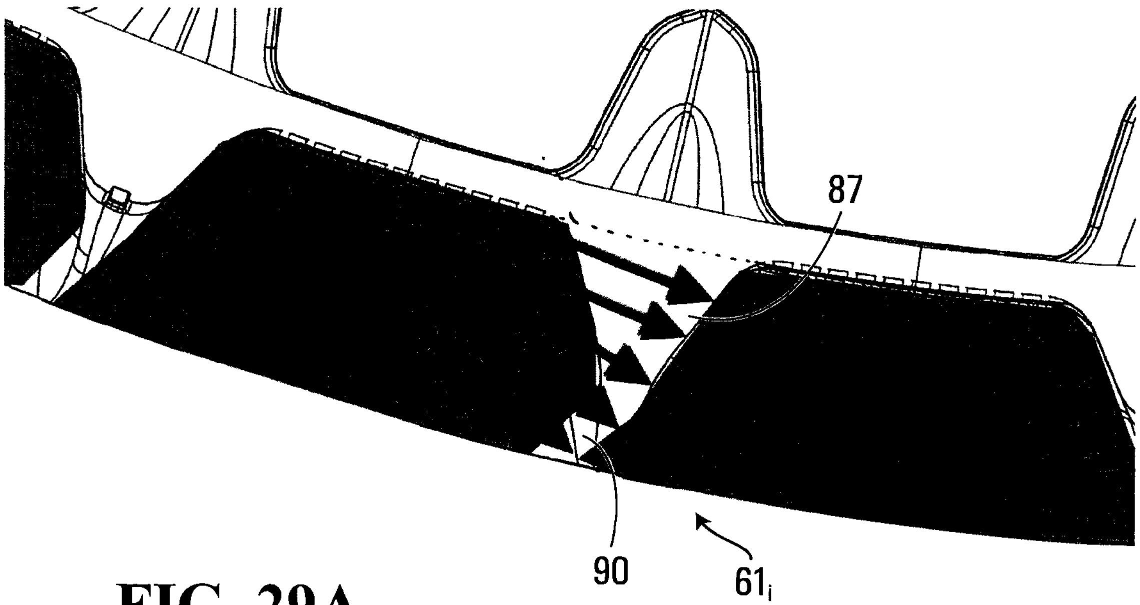


FIG. 29A

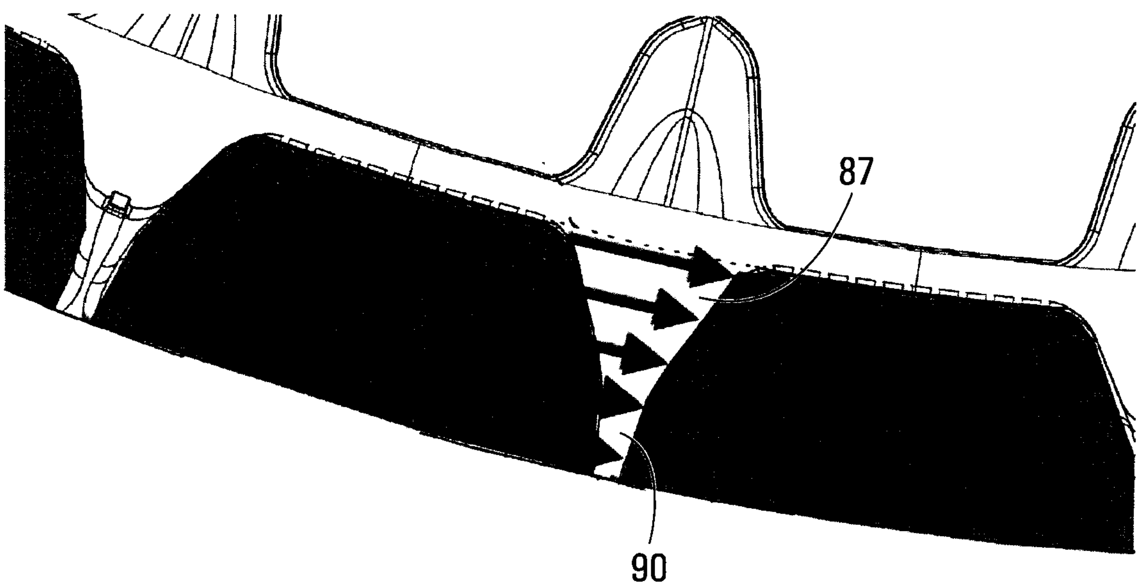


FIG. 29B

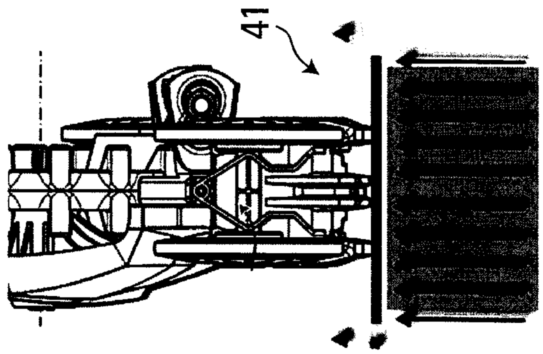


FIG. 30C

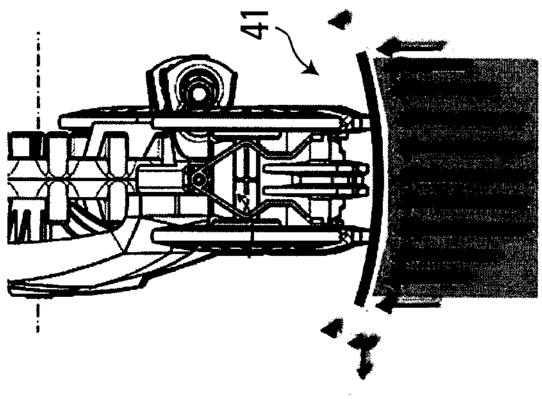


FIG. 30A

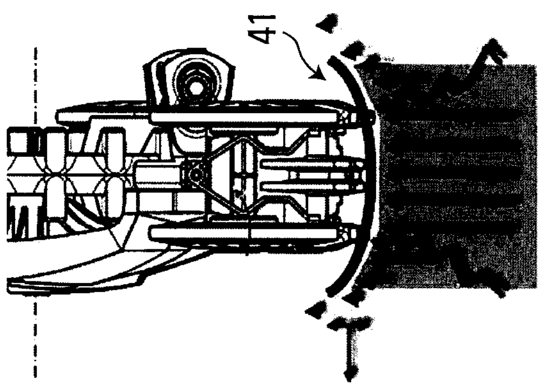


FIG. 30B

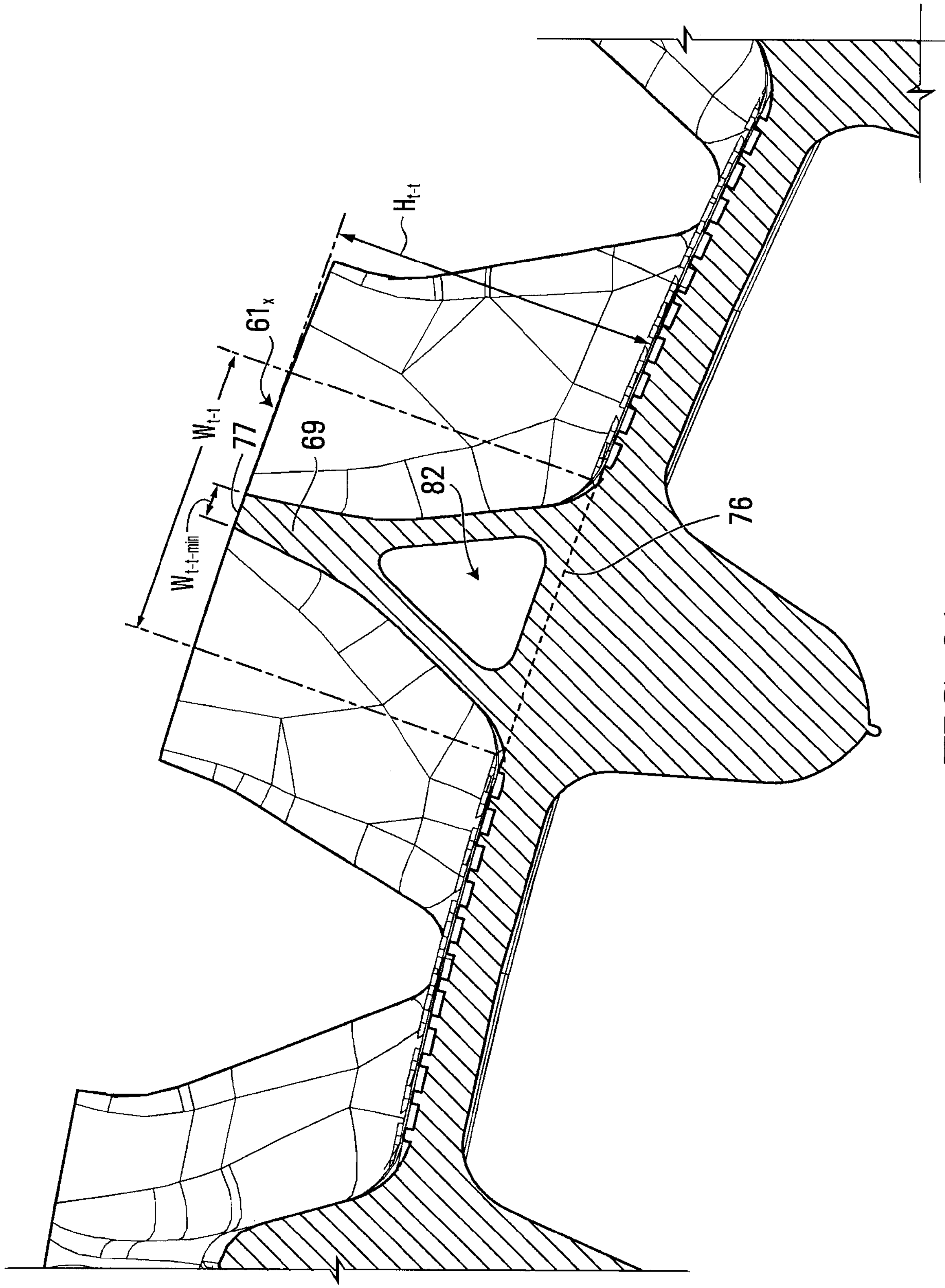


FIG. 31

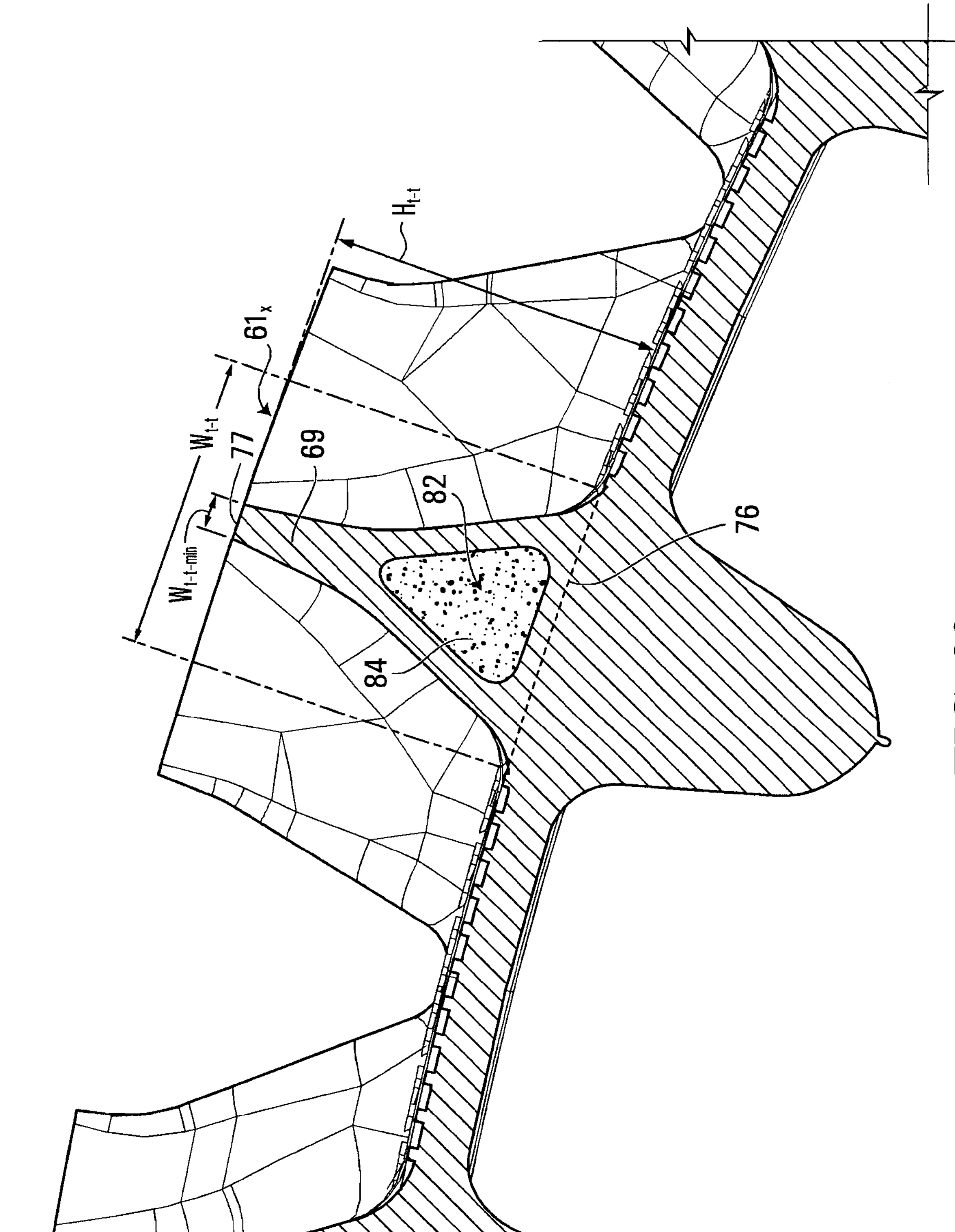


FIG. 32

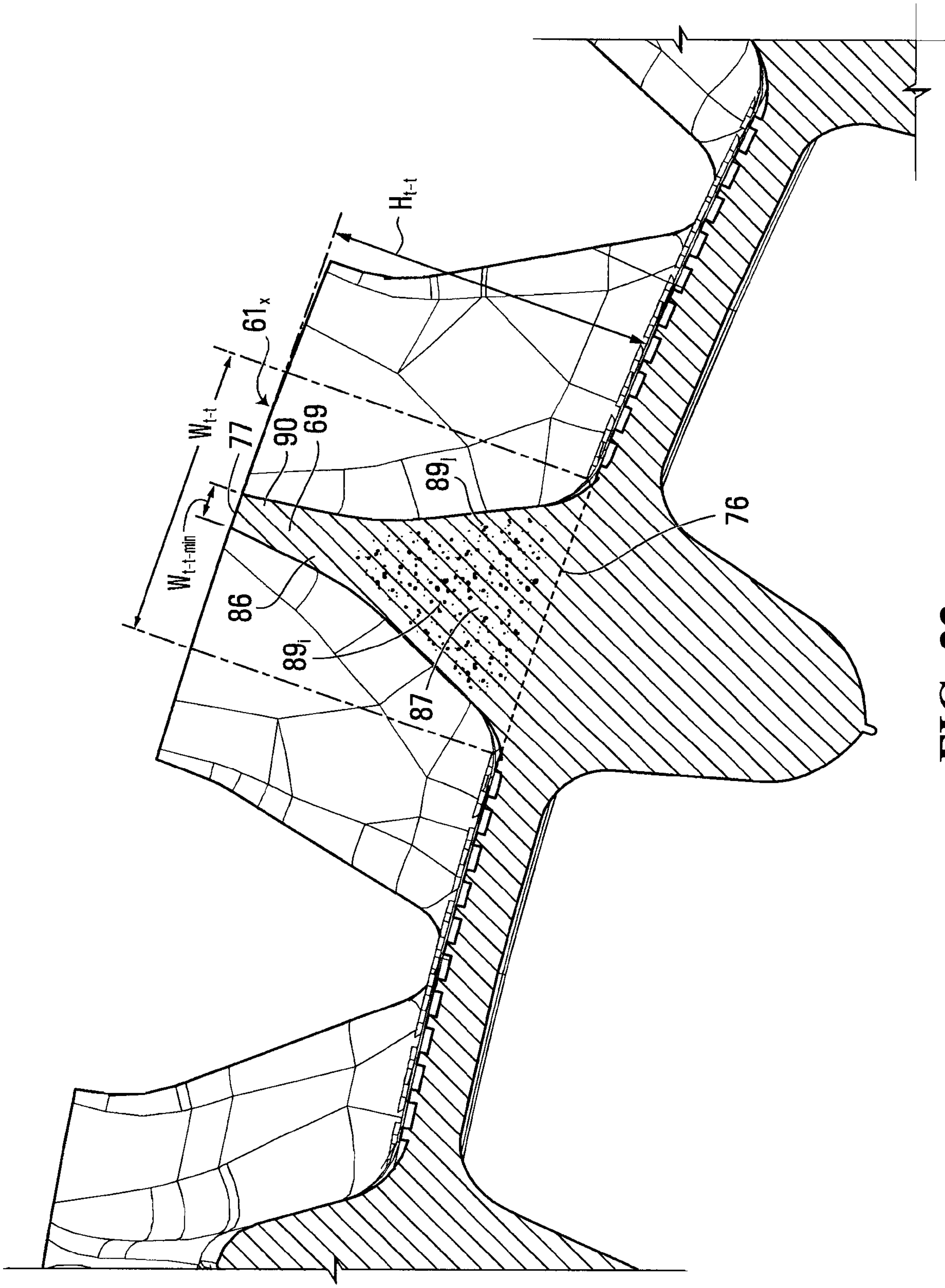


FIG. 33

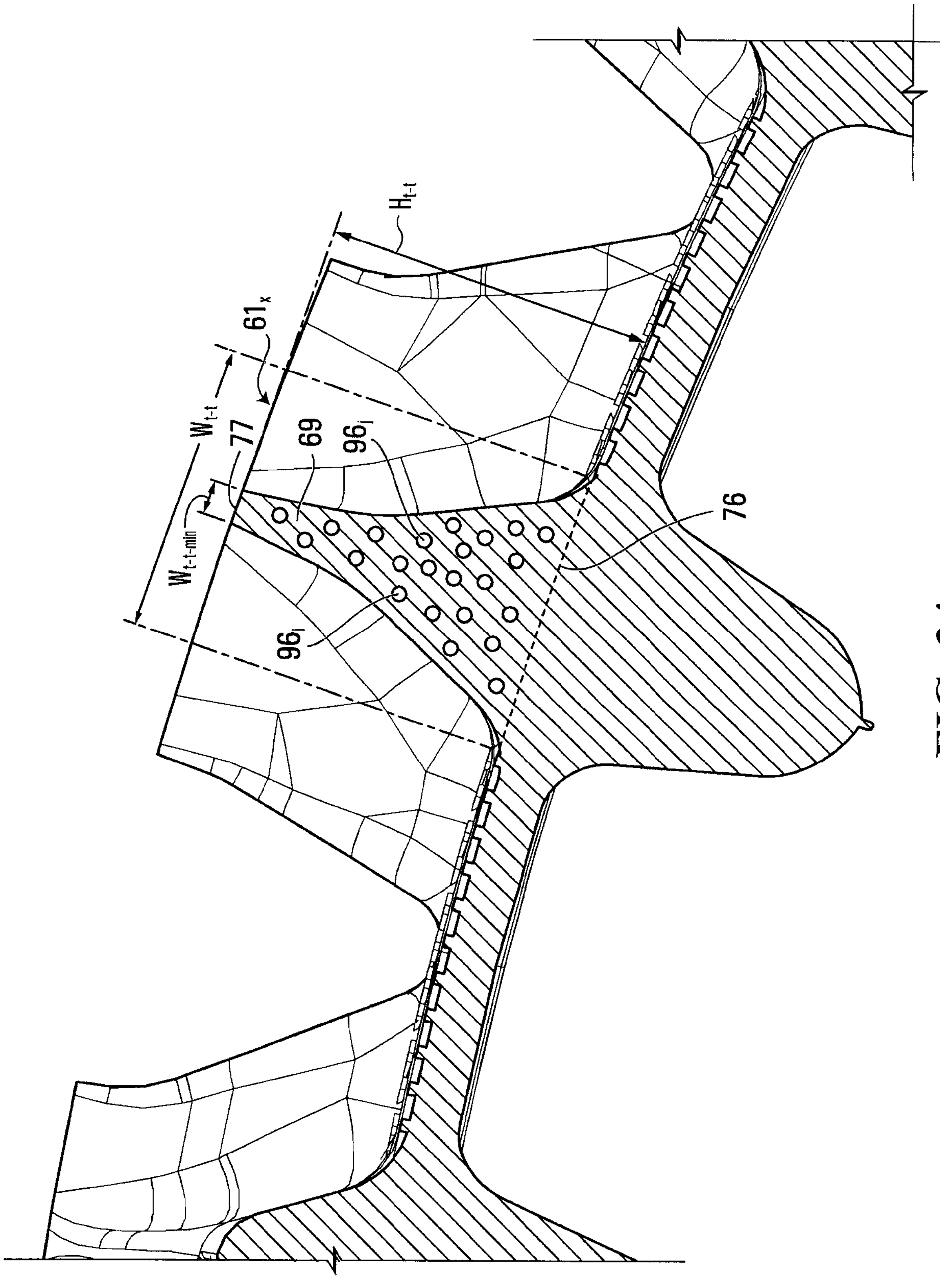


FIG. 34

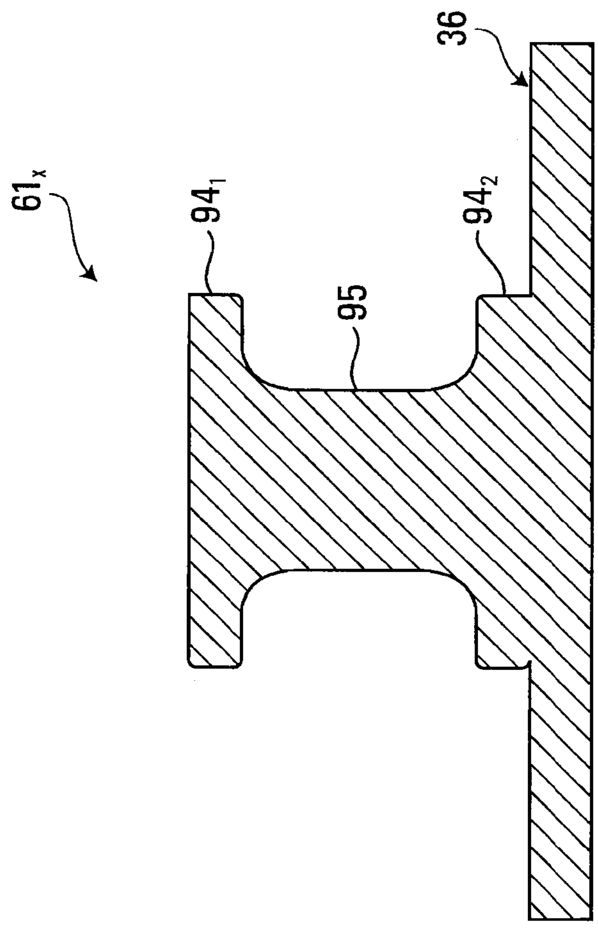


FIG. 35

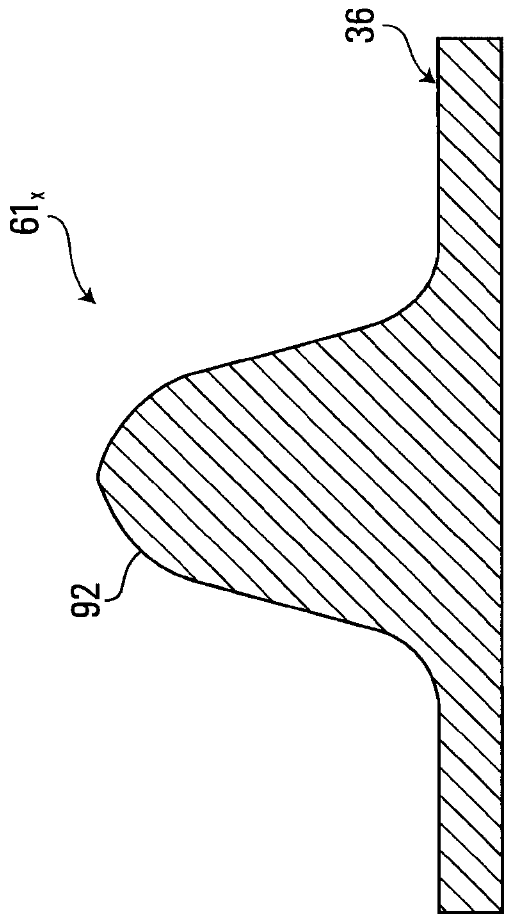


FIG. 36

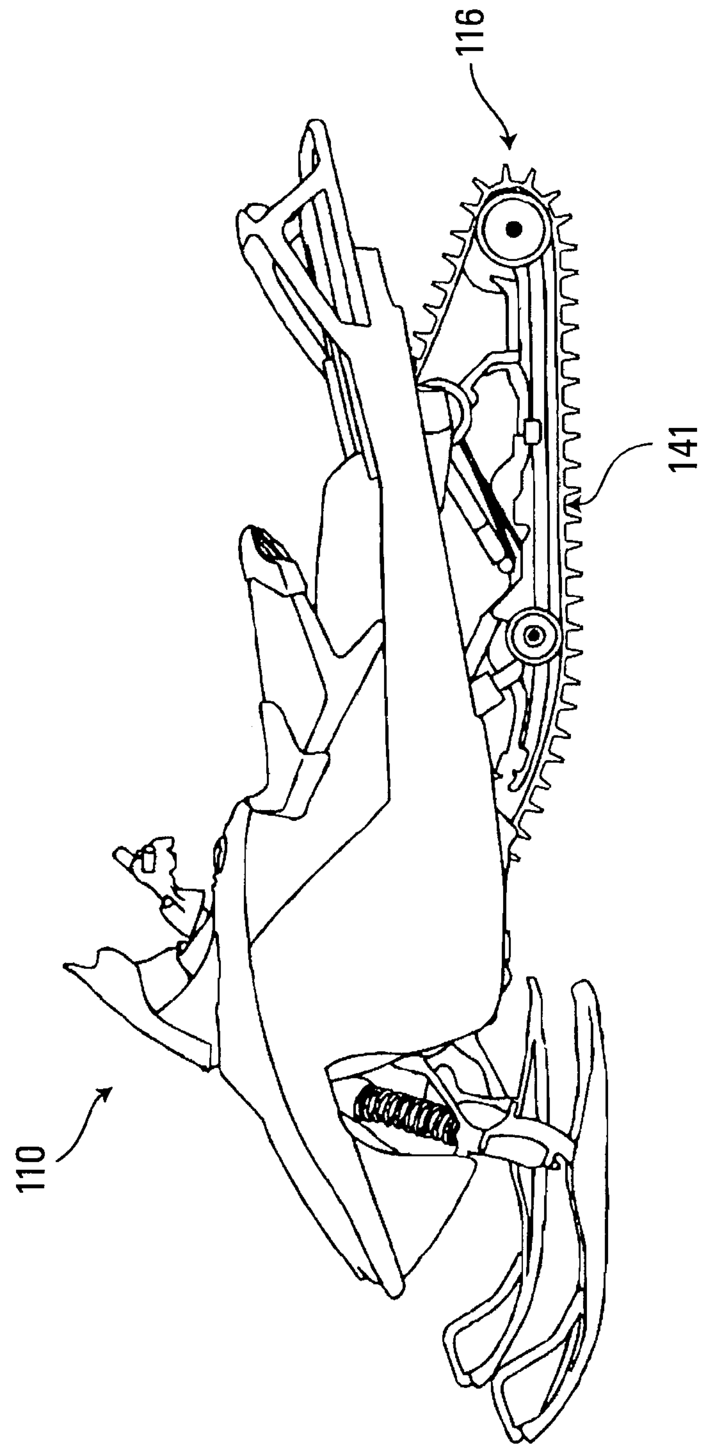
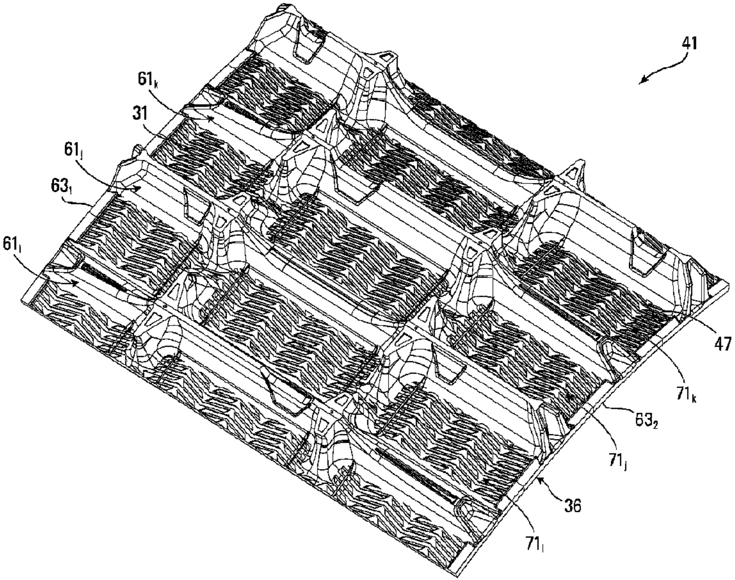


FIG. 37


41
61k
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61j
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61i
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71k
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71j
36
71i