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(54) **Title:** TRACK FOR TRACTION OF AN OFF-ROAD VEHICLE

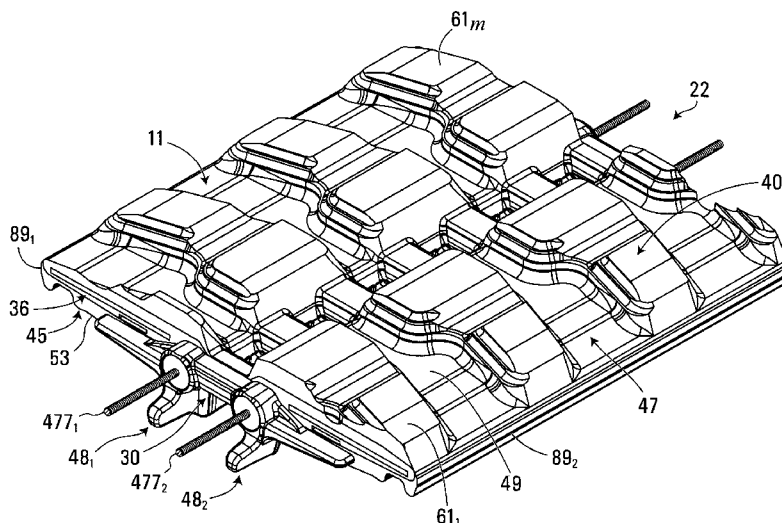


FIG. 38

(57) **Abstract:** A track for traction of an off-road vehicle (e.g., a construction vehicle, an agricultural vehicle, etc.). The track is mountable around a track-engaging assembly comprising a plurality of wheels. The wheels include a drive wheel for driving the track. The track comprises an inner surface for facing the track-engaging assembly, a ground-engaging outer surface for engaging the ground, and elastomeric material allowing the track to flex around the track-engaging assembly. The track may comprise a chain embedded in the elastomeric material and comprising a plurality of wheel-engaging links for interacting with at least one of the wheels. Peripheral elastomeric material of the track may have a superior quality (e.g., a greater resistance to wear and/or a greater resistance to rupture) than internal elastomeric material of the track.

TRACK FOR TRACTION OF AN OFF-ROAD VEHICLE

CROSS-REFERENCE TO RELATED APPLICATION

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This application claims priority from U.S. Provisional Patent Application 61/793,890 filed on March 15, 2013 and hereby incorporated by reference herein.

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FIELD OF THE INVENTION

The invention relates generally to tracks for providing traction to off-road vehicles.

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BACKGROUND

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Certain off-road vehicles, including industrial vehicles such as construction vehicles (e.g., excavators, bulldozers, loaders, etc.), agricultural vehicles (e.g., harvesters, combines, tractors, etc.), and forestry vehicles (e.g., feller-bunchers, tree chippers, knuckleboom loaders, etc.), military vehicles (e.g., combat engineering vehicles (CEVs), etc.), snowmobiles, and all-terrain vehicles (ATVs), for example, 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.

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An elastomeric endless track comprises elastomeric material (e.g., rubber) and reinforcements embedded in the elastomeric material. For example, the track typically includes a layer of longitudinal reinforcing cables (e.g., metallic cords) to reinforce it in tension. In some cases, transversal reinforcements may also be embedded to impart transversal rigidity to the track and possibly interact with wheels (e.g., a drive wheel and/or roller wheels) around which the track is

mounted. For example, when used on a construction vehicle, the track may comprise transversal metallic cores comprising projections on its inner side that interact with one or more of the wheels around which the track is disposed to guide and/or drive the track.

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The track's reinforcements, while useful, may cause certain issues. For example, these reinforcements may have a significant influence on the track's cost. Notably, metallic reinforcements such as transversal metallic cores and longitudinal metallic cables may represent an important part of the track's cost,
10 given metal prices. Also, the reinforcements may dictate to some extent an amount of elastomeric material included in the track (e.g., a thickness of the track), which also impacts the track's cost.

The elastomeric material in different regions of the track is subject to different
15 conditions. For example, the elastomeric material of the track's periphery, including its tread, may wear faster and/or be more prone to cutting or tearing than the elastomeric material inside the track's carcass, which is unexposed to external conditions. Yet, the same or similar elastomeric material may be used in these different regions. This may have undesirable consequences in certain
20 situations. For example, in some cases, such as in construction applications, it can often happen that the track suddenly fails due to an accidental event (e.g., when it accidentally hits a curb causing so-called "edge cutting"), as opposed to wearing normally over time, such that unnecessary cost may have been incurred in providing the same or similar elastomeric material throughout the track.

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For these and other reasons, there is a need to improve tracks of off-road vehicles.

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SUMMARY OF THE INVENTION

According to an aspect of the invention, there is provided a track for traction of an off-road vehicle. The track is mountable around a track-engaging assembly comprising a plurality of wheels. The plurality of wheels includes a drive wheel for driving the track. The track comprises an inner surface for facing the track-engaging assembly, a ground-engaging outer surface for engaging the ground, and elastomeric material allowing the track to flex around the track-engaging assembly. The track also comprises a chain embedded in the elastomeric material. The chain comprises a plurality of wheel-engaging links for interacting with at least one of the wheels.

According to another aspect of the invention, there is provided a track for traction of an off-road vehicle. The track is mountable around a track-engaging assembly comprising a plurality of wheels. The plurality of wheels includes a drive wheel for driving the track. The track comprises an inner surface for facing the track-engaging assembly, a ground-engaging outer surface for engaging the ground, and elastomeric material allowing the track to flex around the track-engaging assembly. The track also comprises a chain embedded in the elastomeric material. The chain comprises a plurality of wheel-engaging links for interacting with at least one of the wheels and a cable linking the wheel-engaging links.

According to another aspect of the invention, there is provided a track for traction of an off-road vehicle. The track is mountable around a track-engaging assembly comprising a plurality of wheels. The plurality of wheels includes a drive wheel for driving the track. The track comprises an inner surface for facing the track-engaging assembly, a ground-engaging outer surface for engaging the ground, and elastomeric material allowing the track to flex around the track-engaging assembly. The track also comprises a cable extending along a length of the track. The cable comprises a first longitudinal end portion and a second longitudinal end portion that are secured to one another.

According to another aspect of the invention, there is provided a track for traction of an off-road vehicle. The track is mountable around a track-engaging assembly comprising a plurality of wheels. The plurality of wheels includes a drive wheel for driving the track. The track is elastomeric to be flexible around the track-engaging assembly. The track comprises peripheral elastomeric material forming at least part of a periphery of the track. The periphery of the track comprises an inner side for facing the track-engaging assembly, a ground-engaging outer side for engaging the ground, and a pair of lateral edges defining a width of the track.

10 The track also comprises internal elastomeric material located away from the periphery of the track. The peripheral elastomeric material has a superior quality than the internal elastomeric material.

According to another aspect of the invention, there is provided a track for traction of an off-road vehicle. The track is mountable around a track-engaging assembly comprising a plurality of wheels. The plurality of wheels includes a drive wheel for driving the track. The track is elastomeric to be flexible around the track-engaging assembly. The track comprises peripheral elastomeric material forming at least part of a periphery of the track. The periphery of the track comprises an inner side for facing the track-engaging assembly, a ground-engaging outer side for engaging the ground, and a pair of lateral edges defining a width of the track.

20 The track also comprises internal elastomeric material located away from the periphery of the track. The peripheral elastomeric material has a greater resistance to wear than the internal elastomeric material.

25 According to another aspect of the invention, there is provided a track for traction of an off-road vehicle. The track is mountable around a track-engaging assembly comprising a plurality of wheels. The plurality of wheels includes a drive wheel for driving the track. The track is elastomeric to be flexible around the track-engaging assembly. The track comprises peripheral elastomeric material forming at least part of a periphery of the track. The periphery of the track comprises an

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inner side for facing the track-engaging assembly, a ground-engaging outer side for engaging the ground, and a pair of lateral edges defining a width of the track. The track also comprises internal elastomeric material located away from the periphery of the track. The peripheral elastomeric material has a greater
5 resistance to rupture than the internal elastomeric material.

According to another aspect of the invention, there is provided a track for traction of an off-road vehicle. The track is mountable around a track-engaging assembly comprising a plurality of wheels. The wheels include a drive wheel for driving the
10 track. The track comprises an inner surface for facing the track-engaging assembly and a ground-engaging outer surface for engaging the ground. The track comprises elastomeric material allowing the track to flex around the track-engaging assembly. The track comprises a plurality of cores embedded in the elastomeric material, spaced apart in a longitudinal direction of the track, and
15 extending transversally to the longitudinal direction of the track. Each core comprises a channel extending through the core. The track comprises a plurality of cables passing through the channel of each of the cores and providing a bulk of a tensile strength of the track.

20 According to another aspect of the invention, there is provided a track for traction of an off-road vehicle. The track is mountable around a track-engaging assembly comprising a plurality of wheels. The wheels include a drive wheel for driving the track. The track comprises an inner surface for facing the track-engaging assembly and a ground-engaging outer surface for engaging the ground. The
25 track comprises elastomeric material allowing the track to flex around the track-engaging assembly. The track comprises a plurality of cores embedded in the elastomeric material, spaced apart in a longitudinal direction of the track, and extending transversally to the longitudinal direction of the track. Each core comprises a guide protrusion projecting from the inner surface to contact at least
30 one of the wheels. The core comprises an opening extending through the core. The opening and the guide protrusion overlap in a widthwise direction of the

track. The track comprises a cable passing through the opening of each of the cores.

According to another aspect of the invention, there is provided a track for traction
5 of an off-road vehicle. The track is mountable around a track-engaging assembly
comprising a plurality of wheels. The wheels include a drive wheel for driving the
track. The track comprises an inner surface for facing the track-engaging
assembly and a ground-engaging outer surface for engaging the ground. The
10 track comprises elastomeric material allowing the track to flex around the track-
engaging assembly. The track comprises a plurality of cores embedded in the
elastomeric material, spaced apart in a longitudinal direction of the track, and
extending transversally to the longitudinal direction of the track. Each core
comprises a channel extending through the core. The track comprises a number
15 of cables passing through the channel of each of the cores. The number of
cables is no more than four.

According to another aspect of the invention, there is provided a track for traction
of an off-road vehicle. The track is mountable around a track-engaging assembly
comprising a plurality of wheels. The wheels include a drive wheel for driving the
20 track. The track comprises elastomeric material allowing the track to flex around
the track-engaging assembly. The elastomeric material comprises peripheral
elastomeric material forming at least part of a periphery of the track. The
periphery of the track comprises an inner surface for facing the track-engaging
assembly, a ground-engaging outer surface for engaging the ground, and a pair
25 of lateral edges defining a width of the track. The elastomeric material comprises
internal elastomeric material located away from the periphery of the track,
occupying at least a majority of the width of the track, and having a higher
modulus of elasticity than the peripheral elastomeric material.

30 According to another aspect of the invention, there is provided a track for traction
of an off-road vehicle. The track is mountable around a track-engaging assembly

comprising a plurality of wheels. The wheels include a drive wheel for driving the track. The track comprises an inner surface for facing the track-engaging assembly and a ground-engaging outer surface for engaging the ground. The track comprises elastomeric material allowing the track to flex around the track-engaging assembly. The track comprises a plurality of cores embedded in the elastomeric material, spaced apart in a longitudinal direction of the track, and extending transversally to the longitudinal direction of the track. Each core is formed as a one-piece structure. The core comprises a guide protrusion projecting from the inner surface to contact at least one of the wheels. The core comprising an opening extending through the core. The track comprises a cable passing through the opening of each of the cores.

According to another aspect of the invention, there is provided a track for traction of an off-road vehicle. The track is mountable around a track-engaging assembly comprising a plurality of wheels. The wheels include a drive wheel for driving the track. The track comprises an inner surface for facing the track-engaging assembly and a ground-engaging outer surface for engaging the ground. The track comprises elastomeric material allowing the track to flex around the track-engaging assembly. The track comprises a plurality of cores embedded in the elastomeric material, spaced apart in a longitudinal direction of the track, and extending transversally to the longitudinal direction of the track. Each core comprises a channel extending through the core. The track comprises a tensile reinforcement passing through the channel of each of the cores and providing a bulk of a tensile strength of the track.

According to another aspect of the invention, there is provided a track for traction of an off-road vehicle. The track is mountable around a track-engaging assembly comprising a plurality of wheels. The wheels include a drive wheel for driving the track. The track comprises an inner surface for facing the track-engaging assembly and a ground-engaging outer surface for engaging the ground. The track comprises elastomeric material allowing the track to flex around the track-

- engaging assembly. The track comprises a plurality of cores embedded in the elastomeric material, spaced apart in a longitudinal direction of the track, and extending transversally to the longitudinal direction of the track. Each core comprises a channel extending through the core. The track comprises a plurality of cables passing through the channel of each of the cores. The track comprises a plurality of cables not passing through the channel of each of the cores. The cables not passing through the channel of each of the cores are smaller in diameter than the cables passing through the channel of each of the cores.
- 10 According to another aspect of the invention, there is provided a track for traction of an off-road vehicle. The track is mountable around a track-engaging assembly comprising a plurality of wheels. The wheels include a drive wheel for driving the track. The track comprises an inner surface for facing the track-engaging assembly and a ground-engaging outer surface for engaging the ground. The track comprises elastomeric material allowing the track to flex around the track-engaging assembly. The track comprises a plurality of cores embedded in the elastomeric material, spaced apart in a longitudinal direction of the track, and extending transversally to the longitudinal direction of the track. Each core comprises a channel extending through the core. The track comprises a plurality of cables passing through the channel of each of the cores. The track comprises a layer of reinforcing fabric embedded in the elastomeric material.

- According to another aspect of the invention, there is provided a track for traction of an off-road vehicle. The track is mountable around a track-engaging assembly comprising a plurality of wheels. The wheels include a drive wheel for driving the track. The track comprises an inner surface for facing the track-engaging assembly and a ground-engaging outer surface for engaging the ground. The track comprises elastomeric material allowing the track to flex around the track-engaging assembly. The track comprises a plurality of cores embedded in the elastomeric material, spaced apart in a longitudinal direction of the track, and extending transversally to the longitudinal direction of the track. Each core

comprises a guide protrusion projecting from the inner surface to contact at least one of the wheels. The core comprises an opening extending through the core. No cable passes through the opening of each of the cores.

- 5 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

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

Figure 1 shows an example of an off-road vehicle in accordance with an
15 embodiment of the invention;

Figure 2 shows a track system of the vehicle;

Figure 3 shows a perspective view of a segment of a track of the track system;

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Figure 4 shows a plan view of a ground-engaging outer side of the track;

Figure 5 shows a cross-sectional view of the track;

25 Figure 6 shows a chain embedded in elastomeric material of the track;

Figures 7 and 8 show enlarged views of a segment of the chain;

Figures 9 and 10 show a roller wheel rolling on the track in accordance with
30 embodiments of the invention;

Figure 11 shows a variant of the chain in accordance with another embodiment of the invention;

Figure 12 shows a cross-sectional view of the track comprising a variant of the chain in accordance with another embodiment of the invention;

Figure 13 shows the chain of the track of Figure 12;

Figures 14 to 16 show front, top and side views of a wheel-engaging link of the chain of the track of Figure 12;

Figure 17 shows longitudinal end portions of a cable of the chain of the track of Figure 12 which are interconnected;

Figures 18 to 20 show front, top and side views of a variant of the wheel-engaging link of the chain of the track of Figure 12;

Figures 21 and 22 show spacers of the chain in accordance with another embodiment of the invention;

Figures 23 and 24 show a variant of the spacers of the chain in accordance with another embodiment of the invention;

Figure 25 shows a cross-sectional view of the track comprising another variant of the chain in accordance with another embodiment of the invention;

Figure 26 shows the chain of the track of Figure 25;

Figures 27 and 28 show front and side views of a wheel-engaging link of the chain of the track of Figure 25;

Figures 29 and 30 show front and side views of a non-wheel-engaging link of the chain of the track of Figure 25;

Figure 31 shows another variant of the chain of the track;

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Figures 32 and 33 show front and side views of a wheel-engaging link of the chain of the track of Figure 31;

Figures 34 and 35 show front and side views of another wheel-engaging link of the chain of the track of Figure 31;

10

Figure 36 shows a variant of the track comprising different elastomeric materials in different regions in accordance with another embodiment of the invention;

Figure 37 shows a variant of the track comprising a layer of reinforcing cables in accordance with another embodiment of the invention;

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Figures 38 to 40 show perspective views and a cross-sectional view of a variant of the track in accordance with another embodiment of the invention;

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Figure 41 shows a variant of the chain embedded in the elastomeric material of the track of Figures 38 to 40;

Figures 42 to 46 show views of a drive/guide link of the track of Figures 38 to 40;

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Figure 47 shows a roller wheel rolling on the track of Figures 38 to 40;

Figure 48 shows a cross-sectional view of a cable of the track of Figures 38 to 40;

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Figure 49 shows longitudinal end portions of a cable of the track of Figures 38 to 40 which are interconnected;

Figure 50 shows a cross-sectional view of the track of Figures 38 to 40 showing
5 different elastomeric materials in different regions of the track; and

Figures 51 to 54 show views of a variant of the track in accordance with another embodiment of the invention.

10 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.

15 DETAILED DESCRIPTION OF EMBODIMENTS

Figure 1 shows an example of an off-road tracked vehicle 10 in accordance with an embodiment of the invention. In this embodiment, the vehicle 10 is a heavy-duty work vehicle for performing construction, agricultural, or other industrial work
20 or military work. More particularly, in this embodiment, the vehicle 10 is a construction vehicle for performing construction work. Specifically, in this example, the construction vehicle 10 is a mini-excavator. In other examples, the construction vehicle 10 may be a backhoe loader, a bulldozer, a skid steer loader, or any other type of construction vehicle.

25 The construction vehicle 10 comprises a frame 12, a powertrain 13, a pair of track systems 16₁, 16₂, and an operator cabin 20, which enable an operator to move the construction vehicle 10 on the ground to perform construction work using a work implement 18.

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The powertrain 13 is configured for generating motive power and transmitting motive power to the track systems 16₁, 16₂ to propel the construction vehicle 10 on the ground. To that end, the powertrain 13 comprises a prime mover 14, which is a source of motive power that comprises one or more motors (e.g., an internal combustion engine, an electric motor, etc.). For example, in this embodiment, the prime mover 14 comprises an internal combustion engine. In other embodiments, the prime mover 14 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 13 is in a driving relationship with the track systems 16₁, 16₂. That is, the powertrain 13 transmits motive power from the primer mover 14 to the track systems 16₁, 16₂ in order to drive (i.e., impart motion to) the track systems 16₁, 16₂.

The work implement 18 is used to perform construction work. For example, in this embodiment, the work implement 18 is a bucket mounted to a hinged boom for moving soil, debris or other material. In other embodiments, the work implement 18 may be a dozer blade, a backhoe, a fork, a grapple, a scraper pan, an auger, a saw, a ripper, a material handling arm, or any other type of construction work implement.

The operator cabin 20 is where the operator sits and controls the construction vehicle 10. More particularly, the operator cabin 20 comprises a user interface including a set of controls that allow the operator to steer the construction vehicle 10 on the ground, operate the work implement 18, and control other aspects of the vehicle 10.

The track systems 16₁, 16₂ engage the ground to propel the construction vehicle 10. In this embodiment, each track system 16_i comprises a track-engaging assembly 21 and a track 22 disposed around the track-engaging assembly 21. More particularly, in this embodiment, with additional reference to Figure 2, the track-engaging assembly 21 comprises a plurality of wheels, including a drive

wheel 24 and a plurality of idler wheels, which includes a rear idler wheel 26 and a plurality of roller wheels 28₁-28₁₀. The track system 16_i also comprises a frame 15 which supports various components of the track system 16_i, including the roller wheels 28₁-28₁₀. The track system 16_i has a longitudinal direction and a first longitudinal end 57 and a second longitudinal end 59 that define a length of the track system 16_i. The track system 16_i has a widthwise direction and a width that is defined by a width of the track 22. The track system 16_i also has a height direction that is normal to its longitudinal direction and its widthwise direction.

10 The drive wheel 24 is rotatable using power generated by the prime mover 14 and delivered over the powertrain 13 to impart motion of the track 22. In this embodiment, the drive wheel 24 is a drive sprocket and the track 22 comprises a plurality of drive openings 31₁-31_D which receive teeth of the drive wheel 24 in order to drive the track 22.

15 The idler wheels 26 and the roller wheels 28₁-28₁₀ are not driven by power supplied by the prime mover 14, but are rather used to do at least one of supporting part of the weight of the vehicle 10 on the ground via the track 22, guiding the track 22 as it is driven by the drive wheel 24, and tensioning the track 22. More particularly, in this embodiment, the idler wheel 26 maintains the track 22 in tension and may help to support part of the weight of the vehicle 10 on the ground via the track 22. The roller wheels 28₁-28₁₀ roll on the track to apply the track 22 onto the ground. In this case, as they are located between frontmost and rearmost ones of the wheels of the track system 16_i, the roller wheels 28₁-28₁₀ can be referred to as "mid-rollers".

The track 22 engages the ground to provide traction to the construction vehicle 10. A length of the track 22 allows the track 22 to be mounted around the track-engaging assembly 21. In view of its closed configuration without ends that allows it to be disposed and moved around the track-engaging assembly 21, the track 22 can be referred to as an "endless" track. With additional reference to

Figures 3 to 6, the track 22 comprises a periphery 11 which comprises an inner side 45, a ground-engaging outer side 47, and lateral edges 89₁, 89₂. The inner side 45 faces the track-engaging assembly 21, while the ground-engaging outer side 47 engages the ground. A top run 65 of the track 22 extends between the longitudinal ends 57, 59 of the track system 16_i and over the wheels 24, 26, 28₁-28₁₀ and a bottom run 66 of the track 22 extends between the longitudinal ends 57, 59 of the track system 16_i and under the wheels 24, 26, 28₁-28₁₀. The track 22 has a longitudinal axis 19 which defines a longitudinal direction of the track 22 (i.e., a direction generally parallel to its longitudinal axis) and transversal directions of the track 22 (i.e., directions transverse to its longitudinal axis), including a widthwise direction of the track 22 (i.e., a lateral direction generally perpendicular to its longitudinal axis). The track 22 has a thickness direction normal to its longitudinal and widthwise directions.

The track 22 is elastomeric, i.e., comprises elastomeric material, to be flexible around the track-engaging assembly 21. The elastomeric material of the track 22 can include any polymeric material with suitable elasticity. In this embodiment, the elastomeric material of the track 22 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 22 may include another elastomer in addition to or instead of rubber (e.g., polyurethane elastomer).

More specifically, the track 22 comprises an endless body 36 underlying its inner side 45 and ground-engaging outer side 47. In view of its underlying nature, the body 36 will be referred to as a "carcass". The carcass 36 comprises an inner surface 53 that faces the track-engaging assembly 21 and a ground-engaging outer surface 49 for engaging the ground. The carcass 36 has a thickness T_c measured from its inner surface 53 to its ground-engaging outer surface 49. The carcass 36 is elastomeric in that it comprises elastomeric material 38, in this

case rubber, which allows the carcass 36 to elastically change in shape and thus the track 22 to flex as it is in motion around the track-engaging assembly 21.

Reinforcing elements are embedded in elastomeric material of the track 22,
5 including the rubber 38 of the carcass 36.

More particularly, in this embodiment, the track 22 comprises a chain 30 embedded in its rubber, including the rubber 38 of the carcass 36, to impart strength in tension of the track 22 in its longitudinal direction as well as drive the
10 track 22 and guide and bear loading from the mid-rollers 28₁-28₁₀, as further discussed later.

Also, in this embodiment, the carcass 36 comprises a layer of reinforcing fabric 43 embedded in its rubber 38. The reinforcing fabric 43 comprises thin pliable
15 material made usually by weaving, felting, knitting, interlacing, or otherwise crossing natural or synthetic elongated fabric elements, such as fibers, filaments, strands and/or others, such that some elongated fabric elements extend transversally to the longitudinal direction of the track 22 to have a reinforcing effect in a transversal direction of the track 22. For instance, the reinforcing fabric
20 43 may comprise a ply of reinforcing woven fibers (e.g., nylon fibers or other synthetic fibers). In this example of implementation, the layer of reinforcing fabric 43 is disposed between the chain 30 and the inner surface 53 of the carcass 36. This may further help anchoring the chain 30 in the track 22 and may provide cutting resistance.

25 In this embodiment, the track 22 comprises a plurality of transversal stiffeners 44₁-44_C that are spaced apart in and extend transversally to the longitudinal direction of the track 22 to impart transversal rigidity to the track 22. The transversal stiffeners 44₁-44_C are distinct from the chain 30 and are spaced from
30 the chain 30 in the thickness direction of the track 22. In this example, a length L_t of each of the transversal stiffeners 44₁-44_C is greater than a width W_c of the

chain 30 in the widthwise direction of the track 22 such that the transversal stiffeners 44₁-44_C may help to spread loading from the mid-rollers 28₁-28₁₀ over a greater part of the width of the track 22.

5 Each transversal stiffener 44_x is an elongated structure extending transversally to the longitudinal direction of the track 22 and comprising a pair of wings 95₁, 95₂ and a central portion 96 between the wings 95₁, 95₂. In this embodiment, a thickness T_t of the transversal stiffener 44_x is significant to allow the transversal stiffener 44_x to occupy more space within the track 22. For example, in some
10 embodiments, the thickness T_t of the transversal stiffener 44_x may be at least 20% of the thickness T_c of the carcass 36, in some cases at least 30% of the thickness T_c of the carcass 36, in some cases at least 40% of the thickness T_c of the carcass 36, in some cases at least 50% of the thickness T_c of the carcass 36, and in some cases even more (e.g., 60%, 70% or more). The thickness T_t of the
15 the transversal stiffener 44_x may have any other suitable value in other embodiments. More particularly, in this embodiment, the wings 95₁, 95₂ include enlargements 97₁, 97₂. In this example, the enlargements 97₁, 97₂ are located at longitudinal ends of the wings 95₁, 95₂. The enlargements 97₁, 97₂ may be located elsewhere along the transversal stiffeners 44₁-44_C in other examples.

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The transversal stiffener 44_x comprises a stiffening material 39 stiffer than a portion 88 of the rubber 38 of the carcass 36 adjacent to it. In this embodiment, the portion 88 of the rubber 38 of the carcass 36 adjacent to the transversal stiffener 44_x comprises rubber 88₁ of the inner side 45 of the track 22, rubber 88₂
25 of the ground-engaging outer side 47 of the track 22, and rubber 88₃, 88₄ of the lateral edges 89₁, 89₂ of the track 22, such that the transversal stiffener 44_x is encapsulated by this portion 88 of the rubber 38 of the carcass 36. In other embodiments, the portion 88 of the rubber 38 of the carcass 36 adjacent to the transversal stiffener 44_x may comprise some but not all of the rubber 88₁ of the
30 inner side 45 of the track 22, the rubber 88₂ of the ground-engaging outer side 47

of the track 22, and rubber 88₃, 88₄ of the lateral edges 89₁, 89₂ of the track 22, such that the transversal stiffener 44_x is not encapsulated but is rather exposed.

In this embodiment, the stiffening material 39 of the transversal stiffener 44_x is polymeric material. More particularly, in this embodiment, the polymeric material 39 is elastomeric material. In this example, the elastomeric material 39 is rubber. The rubber 39 is thus part of the rubber 38 of the carcass 36 but stiffer than the adjacent portion 88 of the rubber 38 of the carcass 36 in which it is embedded. The polymeric material 39 may be any other suitable elastomeric material or non-elastomeric polymeric material (e.g., polypropylene, polyethylene, etc.) in other embodiments. The stiffening material 39 may be another type of nonmetallic material, such as ceramic material or composite material, or metallic material in other embodiments.

The ground-engaging outer side 47 of the track 22 comprises the ground-engaging outer surface 49 of the carcass 36 and a plurality of traction projections 61₁-61_M that project from the ground-engaging outer surface 49 to form a tread pattern 40. The traction projections 61₁-61_M may have any suitable shape (e.g., straight shapes, curved shapes, shapes with straight parts and curved parts, etc.). In this example, each of the traction projections 61₁-61_M comprises elastomeric material 41, in this case rubber.

The inner side 45 of the track 22 comprises the inner surface 53 of the carcass 36 and a plurality of wheel-contacting projections 48₁-48_N that project from the inner surface 53 and are positioned to contact at least some of the wheels 24, 26, 28₁-28₁₀ to do at least one of driving (i.e., imparting motion to) the track 22 and guiding the track 22. Since each of them is used to do at least one of driving the track 22 and guiding the track 22, the inner projections 48₁-48_N can be referred to as "drive/guide projections".

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In this example, a drive/guide projection 48_i interacts with a given one of the idler wheels 26, 28_1 - 28_{10} to guide the track 22 to maintain proper track alignment or prevent de-tracking, without being used to drive the track 22, such that the drive/guide projection 48_i is a guide projection. In other examples, a drive/guide projection 48_i may interact with the drive wheel 24 to drive the track 22, such that the drive/guide projection 48_i is a drive projection. In yet other examples, a drive/guide projection 48_i may both (i) interact with the drive wheel 24 to drive the track 22 and (ii) interact with a given one of the idler wheels 26, 28_1 - 28_{10} to guide the track 22, such that the drive/guide projection 48_i is both a drive projection and a guide projection.

In this embodiment, each guide projection 48_i comprises elastomeric material 67, in this case rubber, and a part of the chain 30, as further discussed below.

The guide projections 48_1 - 48_N may have any suitable shape. Each guide projection 48_i has a periphery 69 which, in this embodiment, a top surface 86 and two lateral surfaces 81_1 , 81_2 . One or more of the surfaces of the guide projection 48_i may contact a given one of the roller wheels 28_1 - 28_{10} to help prevent excessive lateral movement of the track 22 and/or bear loading from that wheel. For example, in some cases, as shown in Figure 9, each of the top surface 86 and the lateral surfaces 81_1 , 81_2 may be a wheel-contacting surface that contacts a given one of the roller wheels 28_1 - 28_{10} when the guide projection 48_i contacts that wheel. In other cases, as shown in Figure 10, the lateral surface 81_1 may be a wheel-contacting surface that contacts a given one of the roller wheels 28_1 - 28_{10} when the guide projection 48_i contacts that wheel. Although it has a certain shape in this embodiment, the periphery 69 of the guide projection 48_i may have various other shapes in other embodiments.

In this embodiment, the inner surface 53 of the carcass 36 comprises a plurality of rolling paths 33_1 , 33_2 on which respective ones of the roller wheels 28_1 - 28_{10} may roll, namely the rolling path 33_1 on which the roller wheels 28_1 - 28_5 may roll

and the rolling path 33₂ on which the roller wheels 28₆-28₁₀ may roll. The guide projections 48₁-48_N are located between the rolling paths 33₁, 33₂ in the track system's widthwise direction.

- 5 In this embodiment, the rubber of the track 22, including the rubber 38, 41, 67 of the carcass 36, the traction projections 61₁-61_M and the guide projections 48₁-48_N, is molded into shape in a molding process during which the rubber is cured. For example, in this embodiment, a mold may be used to consolidate rubber components (e.g., sheets or other layers of rubber and/or blocks of rubber
- 10 previously produced using any suitable process such as calendering, molding, etc.) providing the rubber 38, 41, 67 of the carcass 36, the traction projections 61₁-61_M and the guide projections 48₁-48_N and the layer of reinforcing fabric 43 (e.g., a sheet of rubber with the fabric 43 embedded therein), with the chain 30 and the transversal stiffeners 44₁-44_C disposed in the mold so as to be
- 15 embedded in the rubber once consolidated.

The chain 30 is a closed structure that is embedded in the rubber of the track 22 and extends along the length of the track 22. Specifically, the chain 30 comprises a plurality of links 32₁-32_L that are interconnected into a closed configuration of

20 the chain 30. Owing to its closed configuration, the chain 30 reinforces the track 22 in the track's longitudinal direction as the track 22 is in tension around the track-engaging assembly 21. The chain 30 is thus a tensile reinforcing structure embedded in the rubber of the track 22 that resists a tensile force exerted on the track 22. Furthermore, in this embodiment, the chain 30 is configured to engage

25 the drive wheel 24 for driving the track 22 and guide and bear loading from the mid-rollers 28₁-28₁₀. The chain 30 also has an extent in the widthwise direction of the track 22 that helps in retaining the chain 30 in the rubber of the track 22 and may rigidify the track 22 in the track's widthwise direction, which may improve traction and floatation.

In this embodiment, with additional reference to Figures 7 and 8, the plurality of links 32₁-32_L of the chain 30 includes a plurality of wheel-engaging links 33₁-33_L to engage (i.e., interact with) at least one of the wheels 24, 26, 28₁-28₁₀ for at least one of (i) driving the track 22 and (ii) guiding the track 22. Each of the wheel-engaging links 33₁-33_L may thus be (1) a drive link for engaging the drive wheel 24 to impart motion to the track 22, (2) a guide link for engaging one or more of the idler wheels 26, 28₁-28₁₀ to guide the track 22 without being used for driving the track 22, or (3) a drive/guide link for both engaging the drive wheel 24 to impart motion to the track 22 and engaging one or more of the idler wheels 26, 28₁-28₁₀ to guide the track 22. In this example of implementation, all of the links 32₁-32_L of the chain 30 correspond to respective ones of the wheel-engaging links 33₁-33_L such that every link of the chain 30 is intended to engage one or more of the wheels 24, 26, 28₁-28₁₀.

More particularly, in this embodiment, the plurality of wheel-engaging links 33₁-33_L includes a plurality of guide links 34₁-34_G and a plurality of drive links 35₁-35_D that are interlinked. Adjacent ones of the guide links 34₁-34_G that are adjacent in the longitudinal direction of the track 22 are connected to one another by respective ones of the drive links 35₁-35_D. Also, in this example, the guide links 34₁-34_G are arranged in two rows of guide links 62₁, 62₂ that are spaced apart in the widthwise direction of the track 22 and that are interconnected by the drive links 35₁-35_D. Each of the guide links 34₁-34_G is elongated in the longitudinal direction of the track 22, while each of the drive links 35₁-35_D is elongated transversally to the longitudinal direction of the track 22, in this case in the widthwise direction of the track 22.

Each guide link 34_x comprises a guide member 60 configured to engage one or more of the idler wheels 26, 28₁-28₁₀. In this embodiment, the guide member 60 is configured to engage respective ones of the mid-rollers 28₁-28₁₀. The guide member 60 has a periphery 63 which can come into contact with respective ones of the mid-rollers 28₁-28₁₀ in use. More particularly, in this example, the periphery

63 of the guide member 60 comprises a top surface 64, a bottom surface 68, and two lateral surfaces 70₁, 70₂ opposite one another. One or more of these surfaces of the guide member 60 may contact a given one of the mid-rollers 28₁-28₁₀ to help prevent excessive lateral movement of the track 22 and/or bear
5 loading from that wheel. For example, in this embodiment, as shown in Figure 9, the lateral surface 70₂ may be a wheel-contacting surface that contacts a given one of the mid-rollers 28₁-28₁₀ when the guide link 34_x contacts that wheel. Also, in this embodiment, the top surface 64 may be a wheel-contacting surface that contacts a given one of the roller wheels 28₁-28₁₀ when the guide link 34_x
10 contacts that wheel.

In this embodiment, the guide member 60 of the guide link 34_x constitutes at least part (i.e., constitutes an entirety or less than an entirety) of a guide projection 48_i of the track 22. More particularly, in this embodiment, the guide
15 member 60 of the guide link 34_x projects away from the inner surface 53 of the carcass 36 on the inner side 45 of the track 22. In this example, the guide member 60 does not form part of the periphery 69 of the guide projection 48_i when the track 22 is new. More particularly, in this example, when the track 22 is new, the rubber 67 of the guide projection 48_i covers the guide member 60, as
20 shown in Figure 5. During use of the track 22, at least part of the guide member 60 may become exposed as some of the rubber 67 of the guide projection 48_i wears out. At that point, the guide member 60 provides at least part of the wheel-contacting surface of the guide projection 48_i such that the guide member 60 contacts a mid-roller 28_i when the guide projection 48_i contacts the mid-roller 28_i.

25 The guide link 34_x also comprises a pair of pivotal portions 71₁, 71₂ at which it is pivotally connected to adjacent ones of the guide links 34₁-34_G so as to be pivotable relative to these adjacent guide links. In this embodiment, the pivotal portions 71₁, 71₂ are configured to receive successive ones of the drive links 35₁-
30 35_D. More particularly, in this embodiment, each of the pivotal portions 71₁, 71₂

comprises an opening 72 to receive a given one of the drive links 35₁-35_D which provides an axle about which the guide link 34_x can pivot.

5 In this embodiment, individual ones of the guide links 34₁-34_G in each row of guide links 62_x form a continuous path for respective ones of the mid-rollers 28₁-28₁₀ facing that row of guide links. This path is "continuous" in that adjacent ones of the guide links 34₁-34_G in the row of guide links 62_x overlap in the longitudinal direction of the track 22. In this example, this path is a continuous rolling path for a mid-roller 28_i rolling on the top surfaces 64 of adjacent ones of the guide links 10 34₁-34_G in the row of guide links 62_x such that the mid-roller 28_i contacts a given guide link before leaving (i.e., ceasing to contact) a preceding guide link and contacts a following guide link before leaving the guide link. This may reduce or eliminate vibrations and provide a smoother ride.

15 In this example of implementation, the guide link 34_x comprises a void 76 (i.e., a hollow space) to reduce its weight. In this case, the void 76 is an opening extending transversally across the guide link 34_x. More particularly, in this case, the opening 76 is a slot extending generally parallel to the longitudinal direction of the track 22.

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Each drive link 35_x comprises a drive member 73 configured to engage the drive wheel 24 in order to impart motion to the track 22. In this embodiment, the drive member 73 is disposed between two successive drive openings 31_i, 31_j of the track 22 such that, when two teeth of the drive wheel 24 are received in the drive 25 openings 31_i, 31_j, the drive member 73 is located in a gap between these two teeth and transmits a rotational force from the drive wheel 24 to the track 22 for motion of the track 22. In this example, the drive member 73 has a cylindrical shape. The drive member 73 may have any other suitable shape in other examples.

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In addition to being used for driving the track 22, in this embodiment, the drive link 35_x interconnects respective ones of the guide links 34₁-34_G. More particularly, in this embodiment, the drive link 35_x comprises a pair of pivotal portions 74₁, 74₂ at which it is pivotally connected to adjacent ones of the guide links 34₁-34_G in each of the rows of guide links 62₁, 62₂ such that it is pivotable relative to these adjacent guide links. In this example, each of the pivotal portions 74₁, 74₂ is configured to be received in the openings 72 of adjacent ones of the guide links 34₁-34_G in each of the rows of guide links 62₁, 62₂. The drive link 35_x thus provides an axle about which these adjacent guide links can pivot. In some cases, caps, pins or other locking elements may be provided (e.g., at longitudinal ends of the drive link 35_x) to further ensure that individual ones of the guide links 34₁-34_G pivotally connected to the drive link 35_x remain in position.

In this embodiment, the chain 30 comprises a plurality of anchors 75₁-75_A embedded in the rubber of the track 22 for anchoring the chain 30 in the track's rubber. Specifically, in this embodiment, each of the anchors 75₁-75_A comprises a transversal extension that extends transversally to the longitudinal direction of the track 22 and is embedded in the rubber 38 of the carcass 36.

More particularly, in this embodiment, the anchors 75₁-75_A project from respective ones of the guide links 34₁-34_G in the widthwise direction of the track 22. For example, in some examples of implementation, the anchors 75₁-75_A may be molded or otherwise integrally formed with the guide members 60 of these respective guide links. In other examples of implementation, the anchors 75₁-75_A may be formed separately and secured to these respective guide links (e.g., by welding or by bolts, screws or other mechanical fasteners). The anchors 75₁-75_A may be arranged in various other ways in other embodiments (e.g., they may project from respective ones of the drive links 35₁-35_D in the widthwise direction of the track 22).

In this example of implementation, the anchors 75₁-75_A are disposed between the layer of reinforcing fabric 43 and the ground-engaging outer surface 49 of the carcass 36 in the thickness direction of the track 22. Specifically, in this case, the anchors 75₁-75_A are disposed between the layer of reinforcing fabric 43 and the transversal stiffeners 44₁-44_C in the thickness direction of the track 22. This may further enhance retention of the chain 22 in the track 22.

Each anchor 75_x is elongated such that it has a longitudinal axis extending transversally to the longitudinal direction of the track 22. In this embodiment, the longitudinal axis of the anchor 75_x is generally parallel to the widthwise direction of the track 22. Also, in this embodiment, the anchor 75_x tapers along its longitudinal axis. For example, this may help to sustain bending forces that are higher closer to guide links 34₁-34_G.

The links 32₁-32_L and the anchors 75₁-75_A of the chain 30 may be made of any suitable material. For example, in this embodiment, each of the links 32₁-32_L and the anchors 75₁-75_A is metallic, i.e., is at least mainly (i.e., it is mostly or entirely) made of metal. In this example, the metal of the links 32₁-32_L and the anchors 75₁-75_A includes steel. The metal of the links 32₁-32_L and the anchors 75₁-75_A may include any other suitable metal in other examples.

The chain 30 may be implemented in various other manners in other embodiments.

For example, in other embodiments, the links 32₁-32_L and/or the anchors 75₁-75_A may have any other suitable shape. For instance, in some embodiments, a guide link 34_x may be wider or narrower in the widthwise direction of the track 22, longer or shorter in the longitudinal direction of the track 22, and/or taller or shorter in the thickness direction of the track 22.

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As another example, in other embodiments, instead of including the opening 72 receiving an axle provided by a drive link 35_x, each of the pivotal portions 71₁, 71₂ of a guide link 34_x may comprise an axle that is received in an opening of the drive link 35_x.

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As another example, in other embodiments, the links 32₁-32_L and/or the anchors 75₁-75_A may be disposed in any other suitable way in the track 22. For instance, in some embodiments, as shown in Figure 11, the drive links 35₁-35_D may extend beyond the inner surface 53 of the carcass 36.

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As another example, in other embodiments, the links 32₁-32_L and/or the anchors 75₁-75_A may be made of any other suitable material. For instance, in other embodiments, the links 32₁-32_L and/or the anchors 75₁-75_A may be made of nonmetallic material, i.e., at least mainly (i.e., mostly or entirely) made of nonmetal. For example, in some cases, the nonmetallic material making up the links 32₁-32_L and/or the anchors 75₁-75_A may be polymeric material, ceramic material or composite material having high stiffness. Also, in some embodiments, different ones of the links 32₁-32_L and/or the anchors 75₁-75_A may be made of different materials (e.g., the guide links 34₁-34_G may be made of a given metallic material, while the drive links 35₁-35_D may be made of a different metallic material or of a polymeric material).

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As another example, in other embodiments, the chain 30 may have a different overall configuration.

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For instance, Figures 12 to 16 show another embodiment of the chain 30 in which the plurality of links 32₁-32_L includes a plurality of wheel-engaging links 133₁-133_L which engage at least one of the wheels 24, 26, 28₁-28₁₀ for at least one of (i) driving the track 22 and (ii) guiding the track 22 as well as a plurality of non-wheel-engaging links 177₁, 177₂ which do not engage the wheels 24, 26, 28₁-28₁₀.

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In this embodiment, each of the wheel-engaging links 133_1 - 133_L is a drive/guide link for both engaging the drive wheel 24 to impart motion to the track 22 and engaging the mid-rollers 28_1 - 28_{10} to guide the track 22. Also, in this embodiment,
5 each of the non-wheel-engaging links 177_1 , 177_2 is a cable that interconnects the drive/guide links 133_1 - 133_L . The cables 177_1 , 177_2 constitute a tensile reinforcement 129 that resists a tensile force exerted on the track 22.

Each drive/guide link 133_x comprises a guide member 160 configured to engage
10 the mid-rollers 28_1 - 28_{10} and a drive member 173 configured to engage the drive wheel 24 in order to impart motion to the track 22. The drive/guide link 133_x also comprises a pair of wings 192_1 , 192_2 which extend transversally to the longitudinal direction of the track 22 and between which is disposed the drive member 173. The drive/guide link 133_x may be referred to as a "core". More
15 particularly, in this embodiment where it is metallic, the drive/guide link 133_x may be referred to as a "metallic core".

In this embodiment, the guide member 160 of the core 133_x comprises a pair of guide protrusions 178_1 , 178_2 which project away from the inner surface 53 of the carcass 36 on the inner side 45 of the track 22 and are spaced apart in the
20 widthwise direction of the track 22. Each guide protrusion 178_x has a periphery 163 which can come into contact with respective ones of the mid-rollers 28_1 - 28_{10} in use. More particularly, in this example, the periphery 163 of the guide protrusion 178_x comprises a top surface 164 and two lateral surfaces 170_1 , 170_2
25 opposite one another. One or more of these surfaces of the guide protrusion 178_x may contact a given one of the mid-rollers 28_1 - 28_{10} to help prevent excessive lateral movement of the track 22 and/or bear loading from that wheel. For example, in this embodiment, as shown in Figure 12, each of the top surface 164 and the lateral surface 170_2 is a wheel-contacting surface that contacts a given
30 one of the mid-rollers 28_1 - 28_{10} when the core 133_x contacts that wheel.

More particularly, in this embodiment, the guide member 160 of the core 133_x constitutes at least part of one or more of the guide projections 48₁-48_N of the track 22. Specifically, in this embodiment, each guide protrusion 178_i of the core 133_x constitutes at least part of a guide projection 48_i of the track 22. In this example, the guide protrusion 178_i of the core 133_x does not form part of the periphery 69 of the guide projection 48_i of the track 22 when the track 22 is new. More particularly, in this example, when the track 22 is new, the rubber 67 of the guide projection 48_i covers the guide protrusion 178_i of the core 133_x, as shown in Figure 12. During use of the track 22, at least part of the guide protrusion 178_i of the core 133_x may become exposed as some of the rubber 67 of the guide projection 48_i wears out. At that point, the guide protrusion 178_i of the core 133_x provides at least part of the wheel-contacting surface of the guide projection 48_i such that the guide member 160 contacts a mid-roller 28_i when the guide projection 48_i contacts the mid-roller 28_i.

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In this embodiment, the guide protrusions 178₁, 178₂ of respective ones of the cores 133₁-133_L extend towards the guide projections 178₁, 178₂ of adjacent ones of the cores 133₁-133_L in the longitudinal direction of the track 22. This may help to reduce vibrations due to rolling of the mid-rollers 28₁-28₁₀, maintain proper positioning of the cores 133₁-133_L, and/or prevent detracking. More particularly, in this embodiment, a guide protrusion 178_x of a core 133_i comprises a longitudinal extension 182 that extends in the longitudinal direction of the track 22 towards a guide protrusion 178_x of an adjacent core 133_j.

In some examples of implementation, the longitudinal extensions 182 of the guide protrusion 178_x of the core 133_i and the guide protrusion 178_x of the adjacent core 133_j may reach one another (e.g., be contiguous in certain instances) or may extend very close to another (i.e., closer than what is shown in Figure 13). This may help to maintain proper positioning of the cores 133_i, 133_j as the longitudinal extensions 182 of the guide protrusion 178_x of the core 133_i and the

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guide protrusion 178_x of the adjacent core 133_j can abut against one another if the cores 133_i, 133_j tend to move laterally in relation to one another.

5 In other examples of implementation, the longitudinal extensions 182 of the guide protrusion 178_x of the core 133_i and the guide protrusion 178_x of the adjacent core 133_j may overlap in the longitudinal direction of the track 22. This longitudinal overlap creates a continuous rolling path for a mid-roller 28_x that contacts the guide protrusion 178_x of the core 133_j before leaving (i.e., ceasing to contact) the guide protrusion 178_x of the core 133_i.

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In this embodiment, the drive member 173 of the core 133_x extends between the guide protrusions 178₁, 178₂ of the guide member 160 of the core 133_x. The drive member 173 is disposed between two successive drive openings 31_i, 31_j of the track 22 such that, when two teeth of the drive wheel 24 are received in the drive
15 openings 31_i, 31_j, the drive member 173 is located in a gap between these two teeth and transmits a rotational force from the drive wheel 24 to the track 22 for motion of the track 22. In this example, the drive member 173 has a cylindrical shape. The drive member 173 may have any other suitable shape in other examples.

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The core 133_x comprises a channel 180 through which the cables 177₁, 177₂ pass. In this embodiment, the channel 180 comprises a pair of openings 182₁, 182₂ that are spaced part in the widthwise direction of the track 22 and that receive respective ones of the cables 177₁, 177₂. Passing the cables 177₁, 177₂
25 through the core 133_x repositions a neutral axis of the track 22 (i.e., an imaginary line of the track 22 where there is no longitudinal stress or strain when the track 22 flexes) more inwardly, which may allow the track 22 to be thinner.

In this example of implementations, the cables 177₁, 177₂ are fixed in (i.e., cannot move within) the openings 182₁, 182₂. More particularly, in this example,
30 portions 156₁, 156₂ of the rubber 38 of the carcass 36 are disposed in the

openings 182₁, 182₂ and surround the cables 177₁, 177₂ within the openings 182₁, 182₂ to fix the cables 177₁, 177₂ within the openings 182₁, 182₂ (e.g., some or all of these portions 156₁, 156₂ of the rubber 38 of the carcass 36 may flow within the openings 182₁, 182₂ during molding of the track 22).

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In this embodiment, each of the cores 133₁-133_L is metallic, i.e., is at least mainly (i.e., it is mostly or entirely) made of metal. More particularly, in this example, the metal of the cores 133₁-133_L includes steel. In this case, each core 133_x is molded (i.e., cast), forged or otherwise formed as a one-piece structure. That is,
10 parts of the core 133_x, including the wings 192₁, 192₂, the guide protrusions 178₁, 178₂ and the drive member 173, are formed together as a unit such that they are integral with one another. The cores 133₁-133_L may be made of any other suitable material and/or using any other suitable process in other embodiments.

15 The cables 177₁, 177₂ extend adjacent to one another in the longitudinal direction of the track 22. In this embodiment, each of the cables 177₁, 177₂ comprises a cord including a plurality of strands (e.g., textile fibers or metallic wires). More particularly, in this embodiment, each of the cables 177₁, 177₂ comprises a metallic cord including a plurality of metallic strands. In this example, the cables
20 177₁, 177₂ are steel cables. In other embodiments, each of the cables 177₁, 177₂ may be another type of cable made of any material suitably flexible along the cable's longitudinal axis (e.g., strands or plastic or composite material).

Each cable 177_x has a diameter D which may have any suitable value. For
25 example, in some embodiments, a ratio D/T_c of the diameter D of the cable 177_x over the thickness T_c of the carcass 36 may be at least 0.05, in some cases at least 0.1, in some cases at least 0.15, in some cases at least 0.2, and in some cases even more (e.g., 0.25 or more). The ratio D/T_c may have any other suitable value in other embodiments.

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A spacing C of the cables $177_1, 177_2$ in the widthwise direction of the track 22 may be have any suitable value. For example, in some embodiments, a ratio C/W of the spacing C of the cables $177_1, 177_2$ over the width W of the track 22 may be at least 0.1, in some cases at least 0.15, in some cases at least 0.2, in some cases at least 0.25, and in some cases even more (e.g., 0.3 or more). As another example, in some embodiments, a ratio C/G of the spacing C of the cables $177_1, 177_2$ over a spacing G of the guide protrusions $178_1, 178_2$ of a core 133_x may be at least 0.8, in some cases at least 0.85, in some cases at least 0.90, in some cases at least 0.95, in some cases at least 1, and in some cases even more (e.g., 1.05 or more). The ratio C/G may have any other suitable value in other embodiments. In this case, the ratio C/G is about 1.

In this embodiment, the cables $177_1, 177_2$ are located such that each cable 177_i is generally aligned with a guide protrusion 178_i of a core 133_x in the widthwise direction of the track 22. By "generally aligned", it is meant that the cable 177_i and the guide protrusion 178_i of the core 133_x overlap in the widthwise direction of the track 22. As such, each of the openings $182_1, 182_2$ of the core 133_x is generally aligned with, i.e., overlaps with, a respective one of the guide protrusions $178_1, 178_2$ of the core 133_x in the widthwise direction of the track 22.

A tensile strength TS_c of each cable 177_x is suitable for withstanding tensile stresses that it is expected to be subject to during use. The tensile strength TS_c of the cable 177_x refers to a tensile load required to break the cable 177_x . For example, in some embodiments, the tensile strength TS_c of the cable 177_x may be at least 10000 N, in some cases at least 25000 N, and in some cases at least 40000 N, and in some cases even greater. The tensile strength TS_c of the cable 177_x may have any other suitable value in other embodiments.

The tensile reinforcement 129 constituted by the cables $177_1, 177_2$ passing through the cores 133_1-133_L provides a bulk of a tensile strength TS_t of the track 22. That is, the tensile reinforcement 129 constituted by the cables $177_1, 177_2$

passing through the cores 133₁-133_L contributes a greatest part of the tensile strength TS_t of the track 22. For example, in some embodiments, a ratio TS_{tr}/TS_t of (i) a tensile strength TS_{tr} of the tensile reinforcement 129 constituted by the cables 177₁, 177₂ passing through the cores 133₁-133_L over (ii) the tensile strength TS_t of the track 22 may be at least 30%, in some cases at least 35%, in some cases at least 40%, in some cases at least 45%, in some cases at least 50%, in some cases at least 55%, and in some cases even more (e.g., 60%, 70%, 80% or more). The tensile strength TS_t of the track 22 refers to a tensile load required to break the track 22. The tensile strength TS_{tr} of the tensile reinforcement 129 constituted by the cables 177₁, 177₂ passing through the cores 133₁-133_L refers to a sum of the tensile strength TS_c of each cable 177_x.

When assembling the chain 30, each cable 177_x is passed in a respective one of the openings 182₁, 182₂ of the cores 133₁-133_L and longitudinal end portions 183₁, 183₂ of the cable 177_x are secured to one another, as shown in Figure 17. For example, in this embodiment, a connector 184 is mounted to the longitudinal end portions 183₁, 183₂ of the cable 177_x to interconnect them. For instance, in this example of implementation, the connector 184 comprises a ferrule crimped onto the longitudinal end portions 183₁, 183₂ of the cable 177_x. In other embodiments, the longitudinal end portions 183₁, 183₂ of the cable 177_x may be secured to one another in any other suitable way (e.g., by welding).

The chain 30, including the cores 133₁-133_L and the cables 177₁, 177₂, may be constructed in various other ways in other embodiments.

For example, in other embodiments, the cores 133₁-133_L may be configured in various other manners. For instance, in some embodiments, as shown in Figures 18 to 20, a core 133_x may comprise a pair of rolling platforms 185₁, 185₂ that are aligned with respective ones of the rolling paths 33₁, 33₂ of the track 22 in the widthwise direction of the track 22 (i.e., overlap with respective ones of the rolling paths 33₁, 33₂ of the track 22 in the widthwise direction of the track 22). Each of

the rolling platforms 185₁, 185₂ extends toward an adjacent one of the cores 133₁-133_L in the longitudinal direction of the track 22. This provides longer support surfaces for the mid-rollers 28₁-28₁₀ in embodiments in which they roll on the rolling paths 33₁, 33₂ of the bottom run 66 of the track 22 adjacent to the guide projections 48₁-48_N. In this case, since the mid-rollers 28₁-28₁₀ may roll only over the rolling platforms 185₁, 185₂ aligned with the rolling paths 33₁, 33₂, the guide protrusions 178₁, 178₂ of respective ones of the cores 133₁-133_L do not extend towards the guide projections 178₁, 178₂ of adjacent ones of the cores 133₁-133_L in the longitudinal direction of the track 22, i.e., do not comprise longitudinal extensions 182, as in embodiments discussed above. In other cases, the core 133_x may comprise both the rolling platforms 185₁, 185₂ and the lateral extensions 182 of the guide protrusions 178₁, 178₂.

In some embodiments, as shown in Figures 21 and 22, the chain 30 may comprise a plurality of spacers 190₁-190_P which maintain a spacing of the cores 133₁-133_L without being required for linking the cores 133₁-133_L together. The spacers 190₁-190_P can also be viewed as positioners which maintain positions of the cores 133₁-133_L relative to one another.

Each spacer 190_x extends between adjacent cores 133_i, 133_j to maintain the spacing of the adjacent cores 133_i, 133_j. More particularly, in this embodiment, each spacer 190_x comprises a bar 193 having longitudinal end portions 191₁, 191₂ configured to engage the adjacent cores 133_i, 133_j. In this example, each of the cores 133_i, 133_j comprises a plurality of openings 192₁-192₄ each configured to receive a given one of the longitudinal end portions 191₁, 191₂ of the spacer 190_x.

In addition, in this embodiment, the spacers 190₁-190_P are configured to oppose lateral movement of adjacent ones of the cores 133₁-133_L relative to one another in the widthwise direction of the track 22. This helps to maintain proper alignment of the cores 133₁-133_L with the wheels 24, 26, 28₁-28₁₀ and prevent detracking.

More particularly, in this embodiment, the spacers 190_x , 190_y between adjacent cores 133_i , 133_j are nonparallel and extend transversally to the longitudinal direction of the track 22 such that the spacers 190_x , 190_y exert opposite lateral force components in the widthwise direction of the track 22 on the adjacent cores 133_i , 133_j . In this example, the spacer 190_x defines an acute angle β relative to the widthwise direction of the track 22, while the spacer 190_y defines an opposite acute angle $-\beta$ relative to the widthwise direction of the track 22. The angles β , $-\beta$ may have any suitable value in various embodiments (e.g., $\pm 45^\circ$).

The spacers 190_1 - 190_P may be implemented in various other ways in other embodiments. For example, in some embodiments, as shown in Figures 23 and 24, each spacer 190_x may be mounted to a respective one of the cables 177_1 , 177_2 between adjacent cores 133_i , 133_j . More particularly, in this embodiment, the spacer 190_x comprises a sleeve 194 including an opening 195 which receives the respective one of the cables 177_1 , 177_2 and having longitudinal end portions 196_1 , 196_2 configured to engage the adjacent cores 133_i , 133_j . In this example, longitudinal end portions 196_1 , 196_2 of the sleeve 194 are not attached to the adjacent cores 133_i , 133_j , but can rather abut against the adjacent cores 133_i , 133_j if there is a slight movement of the adjacent cores 133_i , 133_j relative to one another.

In other embodiments, the chain 30 may comprise any other number of cables such as the cables 177_1 , 177_2 passing through the channel 180 of each of the cores 133_1 - 133_L . For example, in some embodiments, there may be a single cable such as the cables 177_1 , 177_2 passing through the channel 180 of each of the cores 133_1 - 133_L . As another example, in some embodiments, there may be more than two cables such as the cables 177_1 , 177_2 passing through the channel 180 of each of the cores 133_1 - 133_L , but yet the number of cables may be limited. For instance, in some embodiments, there may no more than four cables and in some cases no more than three cables such as the cables 177_1 , 177_2 passing through the channel 180 of each of the cores 133_1 - 133_L .

Figures 25 to 30 show another embodiment of the chain 30 in which the plurality of links 32₁-32_L includes a plurality of wheel-engaging links 233₁-233_L which engage at least one of the wheels 24, 26, 28₁-28₁₀ for at least one of (i) driving the track 22 and (ii) guiding the track 22 as well as a plurality of offset links 215₁-215_O which are offset from respective ones of the wheel-engaging links 233₁-233_L in the widthwise direction of the track 22. In this example of implementation, the offset links 215₁-215_O are non-wheel-engaging links which do not engage the wheels 24, 26, 28₁-28₁₀.

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More particularly, in this embodiment, the plurality of wheel-engaging links 233₁-233_L includes a plurality of guide links 234₁-234_G and a plurality of drive links 235₁-235_D. Adjacent ones of the drive links 235₁-235_D that are adjacent in the longitudinal direction of the track 22 are connected to one another by respective ones of the guide links 234₁-234_G and the offset links 215₁-215_O. The guide links 234₁-234_G are arranged in two rows of guide links 262₁, 262₂ that are spaced apart in the widthwise direction of the track 22 and that are interconnected by the drive links 235₁-235_D. Each of the guide links 234₁-234_G and the offset links 215₁-215_O is elongated in the longitudinal direction of the track 22, while each of the drive links 235₁-235_D is elongated transversally to the longitudinal direction of the track 22, in this case in the widthwise direction of the track 22.

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Each guide link 234_x comprises a guide member 260 configured to engage one or more of the idler wheels 26, 28₁-28₁₀. In this embodiment, the guide member 260 is configured to engage respective ones of the mid-rollers 28₁-28₁₀. More particularly, in this embodiment, the guide member 260 comprises a pair of guide protrusions 278₁, 278₂ which project away from the inner surface 53 of the carcass 36 on the inner side 45 of the track 22 and are spaced apart in the longitudinal direction of the track 22. Each guide protrusion 278_x has a periphery 263 which can come into contact with respective ones of the mid-rollers 28₁-28₁₀ in use. More specifically, in this example, the periphery 263 of the guide

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protrusion 278_x comprises a top surface 264 and two lateral surfaces 270₁, 270₂ opposite one another. One or more of these surfaces of the guide protrusion 278_x may contact a given one of the mid-rollers 28₁-28₁₀ to help prevent excessive lateral movement of the track 22 and/or bear loading from that wheel. For example, in this embodiment, as shown in Figure 25, the top surface 264 may be a wheel-contacting surface that contacts a given one of the roller wheels 28₁-28₁₀ when the guide link 234_x contacts that wheel. Also, in this embodiment, the lateral surface 170₂ may be a wheel-contacting surface that contacts a given one of the mid-rollers 28₁-28₁₀ when the guide link 234_x contacts that wheel.

More particularly, in this embodiment, the guide member 260 of the guide link 234_x constitutes at least part of one or more of the guide projections 48₁-48_N of the track 22. Specifically, in this embodiment, each guide protrusion 278_i of the guide link 234_x constitutes at least part of a guide projection 48_i of the track 22. In this example, the guide protrusion 278_i of the guide link 234_x does not form part of the periphery 69 of the guide projection 48_i of the track 22 when the track 22 is new. More particularly, in this example, when the track 22 is new, the rubber 67 of the guide projection 48_i covers the guide protrusion 278_i of the guide link 234_x, as shown in Figure 25. During use of the track 22, at least part of the guide protrusion 278_i of the guide link 234_x may become exposed as some of the rubber 67 of the guide projection 48_i wears out. At that point, the guide protrusion 278_i of the guide link 234_x provides at least part of the wheel-contacting surface of the guide projection 48_i such that the guide member 260 contacts a mid-roller 28_i when the guide projection 48_i contacts the mid-roller 28_i.

In this embodiment, a given one of the guide protrusions 278₁, 278₂ of the guide link 234_x projects towards the other one of the guide protrusions 178₁, 178₂ of the guide link 234_x or towards a given one of the guide protrusions 278₁, 278₂ of an adjacent one of the guide links 234₁-234_G in the longitudinal direction of the track 22. This may help to reduce vibrations due to rolling of the mid-rollers 28₁-28₁₀. More particularly, in this embodiment, a given one of the guide protrusions 278₁,

278₂ of the guide link 234_x comprises a longitudinal extension 282 that projects towards the other one of the guide protrusions 178₁, 178₂ of the guide link 234_x or towards a given one of the guide protrusions 278₁, 278₂ of an adjacent one of the guide links 234₁-234_G.

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The guide link 234_x also comprises a pair of pivotal portions 271₁, 271₂ at which it is pivotally connected to adjacent ones of the drive links 235₁-235_D so as to be pivotable relative to these adjacent drive links. In this embodiment, the pivotal portions 271₁, 271₂ are configured to receive successive ones of the drive links
10 235₁-235_D. More particularly, in this embodiment, each of the pivotal portions 271₁, 271₂ comprises an opening 272 to receive a given one of the drive links 235₁-235_D which provides an axle about which the guide link 234_x can pivot.

The offset links 215₁-215_O are laterally offset from the guide links 234₁-234_G and
15 interconnect adjacent ones of the drive links 235₁-235_D. In this embodiment, the offset links 215₁-215_O are arranged in two rows of offset links 217₁, 217₂ that are spaced apart in the widthwise direction of the track 22 and that are interconnected by the drive links 235₁-235_D. In this example, the rows of offset links 217₁, 217₂ are laterally offset outboard relative to the rows of guide links
20 262₁, 262₂. That is, each of the rows of offset links 217₁, 217₂ is disposed between a respective one of the rows of guide links 262₁, 262₂ and a respective one of the lateral edges 89₁, 89₂ of the track 22.

In this embodiment, each offset link 215_x is configured in a manner similar to a
25 guide link 234_x except that it does not comprise a pair of guide protrusions like the guide protrusions 278₁, 278₂ of the guide link 234_x.

Each drive link 235_x comprises a drive member 273 configured to engage the drive wheel 24 in order to impart motion to the track 22. In this embodiment, the
30 drive member 273 is disposed between two successive drive openings 31_i, 31_j of the track 22 such that, when two teeth of the drive wheel 24 are received in the

drive openings 31_i, 31_j, the drive member 273 is located in a gap between these two teeth and transmits a rotational force from the drive wheel 24 to the track 22 for motion of the track 22. In this example, the drive member 273 has a cylindrical shape. The drive member 273 may have any other suitable shape in other examples.

In addition to being used for driving the track 22, in this embodiment, the drive link 235_x interconnects respective ones of the guide links 234₁-234_G and the offset links 217₁, 217₂. More particularly, in this embodiment, the drive link 235_x comprises a pair of pivotal portions 274₁, 274₂ at which it is pivotally connected to adjacent ones of the guide links 234₁-234_G in each of the rows of guide links 262₁, 262₂ and to adjacent ones of the offset links 215₁-215_O in each of the rows of offset links 217₁, 217₂ such that it is pivotable relative to these adjacent guide links and adjacent offset links. In this example, each of the pivotal portions 274₁, 274₂ is configured to be received in the openings 272 of adjacent ones of the guide links 34₁-34_G and adjacent ones of the offset links 215₁-215_O. The drive link 235_x thus provides an axle about which these adjacent guide links and adjacent offset links can pivot. In some cases, caps, pins or other locking elements may be provided (e.g., at longitudinal ends of the drive link 235_x) to further ensure that individual ones of the guide links 234₁-234_G and the offset links 215₁-215_O pivotally connected to the drive link 35_x remain in position.

The chain 30, including the guide links 234₁-234_G, the drive links 235₁-235_D, and the offset links 215₁-215_O, may be constructed in various other ways in other embodiments.

For example, in some embodiments, as shown in Figures 31 to 35, the offset links 215₁-215_O may be wheel-engaging links configured to engage the mid-rollers 28₁-28₁₀. In this embodiment, each offset link 215_x is a guide link aligned with (i.e., overlaps with) a given one of the rolling paths 33₁, 33₂ of the track 22 in

the widthwise direction of the track 22 such that respective ones of mid-rollers 28₁-28₁₀ roll over the guide link 215_x in use.

More particularly, in this embodiment, the guide link 215_x comprises a pair of rolling platforms 285₁, 285₂ that are aligned with a given one of the rolling paths 33₁, 33₂ of the track 22 in the widthwise direction of the track 22. A given one of the rolling platforms 285₁, 285₂ of the guide link 215_x includes a longitudinal extension 231 that projects towards the other one of the rolling platforms 285₁, 285₂ of the guide link 215_x or towards a given one of the rolling platforms 285₁, 285₂ of an adjacent one of the guide links 215₁-215_O in the longitudinal direction of the track 22. This provides longer support surfaces for the mid-rollers 28₁-28₁₀ in embodiments in which they roll on the rolling paths 33₁, 33₂ of the bottom run 66 of the track 22 adjacent to the guide projections 48₁-48_N. In this case, since the mid-rollers 28₁-28₁₀ may roll only over the rolling platforms 285₁, 285₂ aligned with the rolling paths 33₁, 33₂, the guide protrusions 278₁, 278₂ of respective ones of the guide links 234₁-234_G do not comprise longitudinal extensions 182, as in embodiments discussed above. In other cases, each of the guide links 234₁-234_G may comprise the lateral extensions 182 of the guide protrusions 178₁, 178₂.

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In embodiments considered above, the chain 30 is a sole (i.e., the only) reinforcement that is embedded in the rubber of the track 22 and extends the length of the track 22 to reinforce the track 22 in the track's longitudinal direction as the track 22 is in tension around the track-engaging assembly 21. Notably, the carcass 36 is free of tensile reinforcing cables spaced from the chain 30, extending adjacent to one another in the longitudinal direction of the track 22, distributed across at least a majority of the width of the track 22, and reinforcing the track 22 in the track's longitudinal direction as the track 22 is in tension around the track-engaging assembly 21. In fact, in these embodiments, the carcass 36 is free of any reinforcing cable (except for cables passing through links of the chain 30, such as the cables 177₁, 177₂ passing through the cores

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133₁-133_L). This can avoid the track 22 becoming damaged due to cable breakage.

Because of this absence of reinforcing cables in the carcass 36, in some
5 embodiments, the thickness T_c of the carcass 36 may be reduced. For example,
in some embodiments, a ratio T_c/W of the thickness T_c of the carcass 36 over the
width W of the track 22 may be no more than 0.05, in some cases no more than
0.04, in some cases no more than 0.03, and in some cases even less (e.g., no
more than 0.02). The ratio T_c/W may have any other suitable value in other
10 embodiments.

In other embodiments, as shown in Figure 37, the carcass 36 may comprise a
layer of reinforcing cables 37₁-37_M spaced from the chain 30, extending adjacent
to one another in the longitudinal direction of the track 22, distributed across at
15 least a majority of the width of the track 22, and reinforcing the track 22 in the
track's longitudinal direction as the track 22 is in tension around the track-
engaging assembly 21. For instance, in some examples, each of the reinforcing
cables 37₁-37_M may be a cord including a plurality of strands (e.g., textile fibers
or metallic wires).

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In some embodiments, as shown in Figure 36, peripheral elastomeric material
forming at least part of the periphery 11 of the track 22, such as elastomeric
material 320 (in this case rubber) of the inner side 45 of the track 22, elastomeric
material 322 (in this case rubber) of the ground-engaging outer side 47 of the
25 track 22, and/or elastomeric material 340 (in this case rubber) of the lateral
edges 89₁, 89₂ of the track 22, may be of a superior quality than internal
elastomeric material located away from the periphery 11 of the track 22, such as
elastomeric material 330 (in this case rubber) inside the carcass 36. More
particularly, in this embodiment, the rubber 320 of the inner side 45 of the track
30 22, the rubber 322 of the ground-engaging outer side 47 of the track 22, and the
rubber 340 of the lateral edges 89₁, 89₂ of the track 22 may have a greater

resistance to wear and/or a greater resistance to rupture (i.e., to cutting or tearing) than the rubber 330 inside the carcass 36. To that end, different rubber compounds may be used in the inner side 45, the ground-engaging outer side 47 and/or the lateral edges 89₁, 89₂ of the track 22 than inside the carcass 36 (e.g.,
5 rubber compounds having different base polymers, different concentrations and/or types of carbon black, and/or different contents of sulfur or other vulcanizing agent).

In this embodiment, the rubber 320 of the inner side 45 of the track 22 is part of
10 the rubber 38 that constitutes the inner surface 53 of the carcass 36, the rubber 322 of the ground-engaging outer side 47 of the track 22 includes part of the rubber 38 that constitutes the ground-engaging outer surface 49 of the carcass 36 and the rubber 41 of each of the traction projections 61₁-61_M, and the rubber 330 inside the carcass 36 is part of the rubber 38 spaced from the inner surface
15 53 and the ground-engaging outer surface 49 of the carcass 36. In this example, the rubber 330 inside the carcass 36 is thus encapsulated in the rubber 320, 322, 340 of the inner side 45, the ground-engaging outer side 47 and the lateral edges 89₁, 89₂ of the track 22.

20 More particularly, in this embodiment, the rubber 320 of the inner side 45 of the track 22, the rubber 322 of the ground-engaging outer side 47 of the track 22, and/or the rubber 340 of the lateral edges 89₁, 89₂ of the track 22 has different tensile property, such as a different modulus of elasticity or a different tensile strength, than the rubber 330 inside the carcass 36. For example, in some
25 embodiments, the rubber 320 of the inner side 45 of the track 22, the rubber 322 of the ground-engaging outer side 47 of the track 22, and/or the rubber 340 of the lateral edges 89₁, 89₂ of the track 22 may have a lower modulus of elasticity than the rubber 330 inside the carcass 36. In other embodiments, the rubber 320 of the inner side 45 of the track 22, the rubber 322 of the ground-engaging outer
30 side 47 of the track 22, and/or the rubber 340 of the lateral edges 89₁, 89₂ of the track 22 may have a greater modulus of elasticity than the rubber 330 inside the

carcass 36. An elastomer's modulus of elasticity can be obtained from a standard ASTM D-412-A test (or equivalent test) based on a measurement at 100% elongation of the elastomer.

5 In this embodiment, a quantity of the rubber 330 inside the carcass 36, which is of a lower quality, is significant to allow this rubber to occupy more space within the track 22. For example, in some embodiments, a thickness T_q of the rubber 330 inside the carcass 36 may occupy at least 20% of the thickness T_c of the carcass 36, in some cases at least 30% of the thickness T_c of the carcass 36, in
10 some cases at least 40% of the thickness T_c of the carcass 36, in some cases at least 50% of the thickness T_c of the carcass 36, and in some cases even more (e.g., 60%, 70% or more). In this example of implementation, the thickness T_q of the rubber 330 inside the carcass 36 occupies at least a majority, in this case at least three-quarters, of the thickness T_c of the carcass 36. The thickness T_q of
15 the rubber 330 inside the carcass 36 may have any other suitable value in other embodiments. As another example, in some embodiments, a width W_q of the rubber 330 inside the carcass 36 may occupy at least be 20% of the width W of the track 22, in some cases at least 30% of the width W of the track 22, in some cases at least 40% of the width W of the track 22, in some cases at least 50% of
20 the width W of the track 22, and in some cases even more (e.g., 60%, 70% or more). In this example of implementation, the width W_q of the rubber 330 inside the carcass 36 occupies at least a majority, in this case at least three-quarters, of the width W of the track. The width W_q of the rubber 330 inside the carcass 36 may have any other suitable value in other embodiments. As yet another
25 example, in some embodiments, a weight of the rubber 330 inside the carcass 36 may constitute at least 30% of a total weight of rubber of the track 22, in some cases at least 35% of the total weight of rubber of the track 22, in some cases at least 40% of the total weight of rubber of the track 22, and in some cases even more.

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This arrangement of the rubber 330 inside the carcass 36 and the rubber 320, 322, 340 of the inner side 45, the ground-engaging outer side 47 and the lateral edges 89₁, 89₂ of the track 22 may be achieved by placing rubber components (e.g., sheets or other layers of rubber and/or blocks of rubber previously
5 produced using any suitable process such as calendering, molding, etc.) in a mold and consolidating them.

While in this embodiment the rubber 330 inside the carcass 36 is shown as being distinct from the stiffening material 39 of each of the transversal stiffeners
10 44₁-44_C, in some embodiments, the stiffening material 39 of each of the transversal stiffeners 44₁-44_C may be omitted and the rubber 330 inside the carcass 36 may in itself provide a stiffening effect.

Figures 38 to 41 show another embodiment of the chain 30 in which the plurality
15 of links 32₁-32_L includes a plurality of wheel-engaging links 433₁-433_L that engage at least one of the wheels 24, 26, 28₁-28₁₀ for at least one of (i) driving the track 22 and (ii) guiding the track 22 as well as a plurality of non-wheel-engaging links 477₁, 477₂ which do not engage the wheels 24, 26, 28₁-28₁₀.

20 In this embodiment, each of the wheel-engaging links 433₁-433_L is a drive/guide link for both engaging the drive wheel 24 to impart motion to the track 22 and engaging the mid-rollers 28₁-28₁₀ to guide the track 22. Also, in this embodiment, each of the non-wheel-engaging links 477₁, 477₂ is a cable that interconnects the drive/guide links 433₁-433_L. The cables 477₁, 477₂ constitute a tensile
25 reinforcement 429 that resists a tensile force exerted on the track 22.

Each drive/guide link 433_x comprises a guide member 460 configured to engage the mid-rollers 28₁-28₁₀ and a drive member 473 configured to engage the drive wheel 24 in order to impart motion to the track 22. The drive/guide link 433_x also
30 comprises a pair of wings 492₁, 492₂ which extend transversally to the longitudinal direction of the track 22 and between which is disposed the drive

member 473. The drive/guide link 433_x may be referred to as a “core”. More particularly, in this embodiment where it is metallic, the drive/guide link 133_x may be referred to as a “metallic core”.

5 In this embodiment, the guide member 460 of the core 433_x comprises a pair of guide protrusions 478₁, 478₂ which project away from the inner surface 53 of the carcass 36 on the inner side 45 of the track 22 and are spaced apart in the widthwise direction of the track 22. Each guide protrusion 478_x has a periphery 463 which can come into contact with respective ones of the mid-rollers 28₁-28₁₀
10 in use. More particularly, in this example, the periphery 463 of the guide protrusion 478_x comprises a top surface 464 and two lateral surfaces 470₁, 470₂ opposite one another. One or more of these surfaces of the guide protrusion 478_x may contact a given one of the mid-rollers 28₁-28₁₀ to help prevent excessive lateral movement of the track 22 and/or bear loading from that wheel. For
15 example, in this embodiment, as shown in Figure 42, each of the top surface 464 and the lateral surface 470₂ is a wheel-contacting surface that contacts a given one of the mid-rollers 28₁-28₁₀ when the core 433_x contacts that wheel.

More particularly, in this embodiment, the guide member 460 of the core 433_x
20 constitutes at least part of one or more of the guide projections 48₁-48_N of the track 22. Specifically, in this embodiment, each guide protrusion 478_i of the core 433_x constitutes at least part of a guide projection 48_i of the track 22. In this example, the guide protrusion 478_i of the core 433_x does not form part of the periphery 69 of the guide projection 48_i of the track 22 when the track 22 is new.
25 More particularly, in this example, when the track 22 is new, the rubber 67 of the guide projection 48_i covers the guide protrusion 478_i of the core 433_x, as shown in Figure 47. During use of the track 22, at least part of the guide protrusion 478_i of the core 433_x may become exposed as some of the rubber 67 of the guide projection 48_i wears out. At that point, the guide protrusion 478_i of the core 433_x
30 provides at least part of the wheel-contacting surface of the guide projection 48_i

such that the guide member 460 contacts a mid-roller 28_i when the guide projection 48_i contacts the mid-roller 28_i .

5 In this embodiment, the guide protrusions 478_1 , 478_2 of respective ones of the cores 433_1 - 433_L extend towards the guide projections 478_1 , 478_2 of adjacent ones of the cores 433_1 - 433_L in the longitudinal direction of the track 22. This may help to reduce vibrations due to rolling of the mid-rollers 28_1 - 28_{10} , maintain proper positioning of the cores 433_1 - 433_L , and/or prevent detracking. More particularly, in this embodiment, a guide protrusion 478_x of a core 433_i comprises
10 a longitudinal extension 479 that extends in the longitudinal direction of the track 22 towards a guide protrusion 478_x of an adjacent core 433_j .

The longitudinal extensions 479 of the guide protrusion 478_x of the core 433_i and the guide protrusion 478_x of the adjacent core 433_j may reach one another (e.g.,
15 be contiguous in certain instances) or may extend very close to another. This may help to maintain proper positioning of the cores 433_i , 433_j as the longitudinal extensions 479 of the guide protrusion 478_x of the core 433_i and the guide protrusion 478_x of the adjacent core 433_j can abut against one another if the cores 433_i , 433_j tend to move laterally in relation to one another. For instance,
20 this may help to prevent or reduce potential for detracking.

In this example of implementation, the longitudinal extensions 182 of the guide protrusion 478_x of the core 433_i and the guide protrusion 478_x of the adjacent core 433_j overlap in the longitudinal direction of the track 22, as shown in Figure
25 41. This longitudinal overlap creates a continuous rolling path for a mid-roller 28_x that contacts the guide protrusion 478_x of the core 433_j before leaving (i.e., ceasing to contact) the guide protrusion 478_x of the core 433_i .

In this embodiment, the drive member 473 of the core 433_x extends between the
30 guide protrusions 478_1 , 478_2 of the guide member 460 of the core 433_x . The drive member 473 is disposed between two successive drive openings 31_i , 31_j of the

track 22 such that, when two teeth of the drive wheel 24 are received in the drive openings 31_i, 31_j, the drive member 473 is located in a gap between these two teeth and transmits a rotational force from the drive wheel 24 to the track 22 for motion of the track 22. In this example, the drive member 473 has a curved (e.g.,
5 generally arc-shaped) upper surface and a generally flat bottom surface. The drive member 473 may have any other suitable shape in other examples.

The core 433_x comprises a channel 480 through which the cables 477₁, 477₂ pass. In this embodiment, the channel 480 comprises a pair of openings 482₁,
10 482₂ that are spaced part in the widthwise direction of the track 22 and that receive respective ones of the cables 477₁, 477₂. Passing the cables 477₁, 477₂ through the core 433_x repositions the neutral axis of the track 22 more inwardly, which may allow the track 22 to be thinner.

15 In this example of implementation, the cables 477₁, 477₂ are fixed in (i.e., cannot move within) the openings 482₁, 482₂. More particularly, in this example, portions 456₁, 456₂ of the rubber 38 of the carcass 36 are disposed in the openings 482₁, 482₂ and surround the cables 477₁, 477₂ within the openings 482₁, 482₂ to fix the cables 477₁, 477₂ within the openings 482₁, 482₂ (e.g., some or all of these
20 portions 456₁, 456₂ of the rubber 38 of the carcass 36 may flow within the openings 482₁, 482₂ during molding of the track 22).

In this embodiment, as shown in Figure 44, in order to accommodate bending of a cable 477_i passing in it when the track 22 flexes, each opening 482_i of the core
25 433_x varies in cross-sectional area in the longitudinal direction of the track 22. More particularly, in this embodiment, the opening 482_i tapers in the longitudinal direction of the track 22 such that its cross-sectional area decreases from outer regions 446₁, 446₂ of the core 433_x towards an inner region 442 of the core 433_x. This widening of the opening 482_i towards the outer regions 446₁, 446₂ of the
30 core 433_x provide more space for the cable 477_i to bend as the track 22 flexes. This may help to reduce stresses on the cable 477_i compared to if the cross-

sectional area of the opening 482_i was constant (e.g., by avoiding a sharp angle about which the cable 477_i would be forced to bend).

In this embodiment, each of the cores 433₁-433_L is metallic, i.e., is at least mainly (i.e., it is mostly or entirely) made of metal. More particularly, in this example, the metal of the cores 433₁-433_L includes steel. In this case, each core 433_x is molded (i.e., cast), forged or otherwise formed as a one-piece structure. That is, parts of the core 433_x, including the wings 492₁, 492₂, the guide protrusions 478₁, 478₂ and the drive member 473, are formed together as a unit such that they are integral with one another. The cores 433₁-433_L may be made of any other suitable material and/or using any other suitable process in other embodiments.

The cables 477₁, 477₂ extend adjacent to one another in the longitudinal direction of the track 22. In this embodiment, each of the cables 477₁, 477₂ comprises a cord including a plurality of strands (e.g., metallic wires or textile fibers). More particularly, in this embodiment, each of the cables 477₁, 477₂ comprises a metallic cord including a plurality of metallic strands. In this example, the cables 477₁, 477₂ are steel cables. In other embodiments, each of the cables 477₁, 477₂ may be another type of cable made of any material suitably flexible along the cable's longitudinal axis (e.g., strands or plastic or composite material).

For instance, with additional reference to Figure 48, in this embodiment, each of the cables 477₁, 477₂ comprises a steel cord 454 and an elastomeric layer 455 over the steel cord 454. The elastomeric layer 455, in this case a rubber layer, is provided (e.g., extruded) onto the steel cord 454 of each of the cables 477₁, 477₂ before the cables 477₁, 477₂ are provided into the track 22. The rubber layers 455 of the cables 477₁, 477₂ constitute at least part of the portions 456₁, 456₂ of the rubber 38 of the carcass 36 within the openings 482₁, 482₂ of each core 433_x. The steel cord 454 of each of the cables 477₁, 477₂ may have a brass coating or other coating at its outer layer that promotes adhesion to the rubber layer 455 of that cable.

Each cable 477_x has a diameter D which may have any suitable value. For example, in some embodiments, a ratio D/T_c of the diameter D of the cable 477_x over the thickness T_c of the carcass 36 may be at least 0.05, in some cases at least 0.1, in some cases at least 0.15, in some cases at least 0.2, and in some cases even more (e.g., 0.25 or more). The ratio D/T_c may have any other suitable value in other embodiments. Alternatively or additionally, in some embodiments, a ratio D/W of the diameter D of the cable 477_x over the width W of the track 22 may be at least 0.02, in some cases at least 0.03, in some cases at least 0.04, in some cases at least 0.05, and in some cases even more. For instance, in some embodiments, the diameter D of the cable 477_x may be at least 3 mm, in some cases at least 4 mm, in some cases at least 5 mm, in some cases at least 6 mm, and in some cases even more. The diameter D of the cable 477_x may have any other suitable value in other embodiments.

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A spacing C of the cables 477_1 , 477_2 in the widthwise direction of the track 22 may be have any suitable value. For example, in some embodiments, a ratio C/W of the spacing C of the cables 477_1 , 477_2 over the width W of the track 22 may be at least 0.1, in some cases at least 0.15, in some cases at least 0.2, in some cases at least 0.25, and in some cases even more (e.g., 0.3 or more). As another example, in some embodiments, a ratio C/G of the spacing C of the cables 477_1 , 477_2 over a spacing G of the guide protrusions 478_1 , 478_2 of a core 433_x may be at least 0.8, in some cases at least 0.85, in some cases at least 0.90, in some cases at least 0.95, in some cases at least 1, and in some cases even more (e.g., 1.05 or more). The ratio C/G may have any other suitable value in other embodiments. In this case, the ratio C/G is about 1.

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In this embodiment, the cables 477_1 , 477_2 are located such that each cable 477_i is generally aligned with a guide protrusion 478_i of a core 433_x in the widthwise direction of the track 22. By “generally aligned”, it is meant that the cable 477_i and the guide protrusion 478_i of the core 433_x overlap in the widthwise direction

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of the track 22. As such, each of the openings 482_1 , 482_2 of the core 433_x is generally aligned with, i.e., overlaps with, a respective one of the guide protrusions 478_1 , 478_2 of the core 433_x in the widthwise direction of the track 22. This may allow a minimization in weight of the core 433_x .

5

A tensile strength TS_c of each cable 477_x is suitable for withstanding tensile stresses that it is expected to be subject to during use. The tensile strength TS_c of the cable 477_x refers to a tensile load required to break the cable 477_x . For example, in some embodiments, the tensile strength TS_c of the cable 477_x may
10 be at least 10000 N, in some cases at least 20000 N, and in some cases at least 40000 N, and in some cases even greater. The tensile strength TS_c of the cable 477_x may have any other suitable value in other embodiments.

The tensile reinforcement 429 constituted by the cables 477_1 , 477_2 passing
15 through the cores 433_1 - 433_L provides a bulk of a tensile strength TS_t of the track 22. That is, the tensile reinforcement 429 constituted by the cables 477_1 , 477_2 passing through the cores 433_1 - 433_L contributes a greatest part of the tensile strength TS_t of the track 22. For example, in some embodiments, a ratio TS_{tr}/TS_t of (i) a tensile strength TS_{tr} of the tensile reinforcement 429 constituted by the
20 cables 477_1 , 477_2 passing through the cores 433_1 - 433_L over (ii) the tensile strength TS_t of the track 22 may be at least 30%, in some cases at least 35%, in some cases 40%, in some cases at least 45%, in some cases at least 50%, in some cases at least 55%, and in some cases even more (e.g., 60%, 70%, 80% or more). The tensile strength TS_t of the track 22 refers to a tensile load required
25 to break the track 22. The tensile strength TS_{tr} of the tensile reinforcement 429 constituted by the cables 477_1 , 477_2 passing through the cores 433_1 - 433_L refers to a sum of the tensile strength TS_c of each cable 477_x .

When assembling the chain 30, each cable 477_x is passed in a respective one of
30 the openings 482_1 , 482_2 of the cores 433_1 - 433_L and longitudinal end portions 483_1 , 483_2 of the cable 477_x are secured to one another to form a cable joint, as

shown in Figure 49. For example, in this embodiment, a connector 484 is mounted to the longitudinal end portions 483₁, 483₂ of the cable 477_x to interconnect them at the cable joint.

5 In this example of implementation, the connector 484 comprises a plurality of connecting elements 487₁-487₃ secured onto the longitudinal end portions 483₁, 483₂ of the cable 477_x. More particularly, in this example of implementation, each connecting element 487_i is a sleeve in which extend the longitudinal end portions 483₁, 483₂ of the cable 477_x. In this embodiment, the sleeve 487_i is a metallic
10 sleeve. For instance, the sleeve 487_i may be made of aluminum or another ductile metal that is more ductile than the steel cord 454 of the cable 477_x. This may create a stronger joint by virtue of the aluminum or other ductile metal deforming and embedding itself into the steel cord 454 of the cable 477_x. The sleeve 487_i is swaged, crimped, or otherwise forged or formed such that it is
15 pressed onto the longitudinal end portions 483₁, 483₂ of the cable 477_x so as to be secured thereto. For instance, this may be achieved by manually pressing or hydraulically pressing the sleeve 487_i onto the longitudinal end portions 483₁, 483₂ of the cable 477_x. In this embodiment, part of the elastomeric layer 455 provided on the steel cord 454 of the cable 477_x may be removed from the steel
20 cord 454 in the longitudinal end portions 483₁, 483₂ of the cable 477_x to allow the sleeve 487_i to be pressed in direct contact with the steel cord 454.

In other embodiments, the connector 484 may comprise any other number (e.g., a single, two, four, or five) connecting elements such as the connecting elements
25 487₁-487₃ and/or a connecting element of the connector 484 may be of any other type (e.g., a wire rope clip). In yet other embodiments, the longitudinal end portions 483₁, 483₂ of the cable 477_x may be secured to one another in any other suitable way (e.g., by welding).

30 In addition to the cables 477₁, 477₂, in this embodiment, the track 22 comprises two zones of reinforcing cables 437₁-437₁₀, 537₁-537₁₀ that are adjacent to

respective ones of the wings 492_1 , 492_2 of the cores 433_1 - 433_L . The reinforcing cables 437_1 - 437_{10} , 537_1 - 537_{10} are spaced from the chain 30, extend adjacent to one another in the longitudinal direction of the track 22, and reinforce the track 22 in the track's longitudinal direction as the track 22 is in tension around the track-engaging assembly 21.

The zones of reinforcing cables 437_1 - 437_{10} , 537_1 - 537_{10} are narrow and spaced apart from one another in the track's widthwise direction. Notably, each of the zones of reinforcing cables 437_1 - 437_{10} , 537_1 - 537_{10} is significantly narrower than half of the track's width. In this example, the zones of reinforcing cables 437_1 - 437_{10} , 537_1 - 537_{10} do not extend beyond the wings 492_1 , 492_2 of the cores 433_1 - 433_L in the widthwise direction of the track 22.

In some embodiments, the zones of reinforcing cables 437_1 - 437_{10} , 537_1 - 537_{10} may be generally aligned with the rolling paths 33_1 , 33_2 on which respective ones of the roller wheels 28_1 - 28_{10} may roll. In other embodiments, the zones of reinforcing cables 437_1 - 437_{10} , 537_1 - 537_{10} may not be aligned with the rolling paths 33_1 , 33_2 .

Each of the reinforcing cables 437_1 - 437_{10} , 537_1 - 537_{10} is smaller in diameter than the cables 477_1 , 477_2 passing through the cores 433_1 - 433_L . For example, in some embodiments, a ratio d/D of a diameter of a given one of the reinforcing cables 437_1 - 437_{10} , 537_1 - 537_{10} over the diameter D of a given one of the cables 477_1 , 477_2 may be no more than 0.5, in some cases no more than 0.4, in some cases no more than 0.3, and in some cases even less. The ratio d/D may have any other suitable value in other embodiments.

In this embodiment, the zones of reinforcing cables 437_1 - 437_{10} , 537_1 - 537_{10} are generally aligned (i.e., overlap) with the cables 477_1 , 477_2 passing through the cores 433_1 - 433_L in the thickness direction of the track 22. This helps for positioning the neutral axis of the track 22.

Each of the reinforcing cables 437₁-437₁₀, 537₁-537₁₀ may comprise a cord including a plurality of strands (e.g., textile fibers or metallic wires). For example, in this embodiment, each of the reinforcing cables 437₁-437_M, 537₁-537_M
5 comprises a steel cord having a brass coating or other coating promoting adhesion with rubber.

The zones of reinforcing cables 437₁-437₁₀, 537₁-537₁₀ may be arranged in various other ways in other embodiments. For example, while in this embodiment
10 there are ten reinforcing cables in each of the zones of reinforcing cables 437₁-437₁₀, 537₁-537₁₀, there may be any other number of reinforcing cables in the zones of reinforcing cables 437₁-437₁₀, 537₁-537₁₀ in other embodiments. Also, in other embodiments, the track 22 may be free of (i.e., may not have) any zone of reinforcing cables such as the zones of reinforcing cables 437₁-437₁₀, 537₁-
15 537₁₀.

With additional reference to Figure 50, in this embodiment, peripheral elastomeric material forming at least part of the periphery 11 of the track 22, such as elastomeric material 520 (in this case rubber) of the inner side 45 of the track
20 22, elastomeric material 522 (in this case rubber) of the ground-engaging outer side 47 of the track 22, and/or elastomeric material 540 (in this case rubber) of the lateral edges 89₁, 89₂ of the track 22, may be of a superior quality than internal elastomeric material located away from the periphery 11 of the track 22, such as elastomeric material 530 (in this case rubber) inside the carcass 36.
25 More particularly, in this embodiment, the rubber 520 of the inner side 45 of the track 22, the rubber 522 of the ground-engaging outer side 47 of the track 22, and the rubber 540 of the lateral edges 89₁, 89₂ of the track 22 may have a greater resistance to wear and/or a greater resistance to rupture (i.e., to cutting or tearing) than the rubber 530 inside the carcass 36. This may help to reduce a
30 manufacturing cost of the track 22 while providing suitable wear resistance, rupture resistance, and/or other useful properties in regions of the track 22 that

may be expected to wear faster, be more prone to cutting or tearing, and/or experience other particular conditions during use.

To that end, different rubber compounds may be used in the inner side 45, the
5 ground-engaging outer side 47 and/or the lateral edges 89₁, 89₂ of the track 22 than inside the carcass 36 (e.g., rubber compounds having different base polymers, different concentrations and/or types of carbon black, and/or different contents of sulfur or other vulcanizing agent).

10 In this embodiment, the rubber 520 of the inner side 45 of the track 22 is part of the rubber 38 that constitutes the inner surface 53 of the carcass 36, the rubber 522 of the ground-engaging outer side 47 of the track 22 includes part of the rubber 38 that constitutes the ground-engaging outer surface 49 of the carcass 36 and the rubber 41 of each of the traction projections 61₁-61_M, and the rubber
15 530 inside the carcass 36 is part of the rubber 38 spaced from the inner surface 53 and the ground-engaging outer surface 49 of the carcass 36. In this example, the rubber 530 inside the carcass 36 is thus encapsulated in the rubber 520, 522, 540 of the inner side 45, the ground-engaging outer side 47 and the lateral edges 89₁, 89₂ of the track 22.

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More particularly, in this embodiment, each of the rubber 520 of the inner side 45 of the track 22, the rubber 522 of the ground-engaging outer side 47 of the track 22, and the rubber 540 of the lateral edges 89₁, 89₂ of the track 22 has a different tensile property, such as a different modulus of elasticity or a different tensile
25 strength, than the rubber 530 inside the carcass 36. For example, in some embodiments, each of the rubber 520 of the inner side 45 of the track 22, the rubber 522 of the ground-engaging outer side 47 of the track 22, and the rubber 540 of the lateral edges 89₁, 89₂ of the track 22 may have a lower modulus of elasticity than the rubber 530 inside the carcass 36. That is, the internal rubber
30 530 away from the track's periphery 11 may be stiffer than the peripheral rubber 520, 522, 540 at the track's periphery 11. This may result in the peripheral rubber

520, 522, 540 of the track 22 having a greater resistance to wear and/or a greater resistance to rupture (i.e., to cutting or tearing) than the internal rubber 530 inside the track 22. In other embodiments, the rubber 520 of the inner side 45 of the track 22, the rubber 522 of the ground-engaging outer side 47 of the track 22, and/or the rubber 540 of the lateral edges 89₁, 89₂ of the track 22 may have a greater modulus of elasticity than the rubber 530 inside the carcass 36. An elastomer's modulus of elasticity can be obtained from a standard ASTM D-412-A test (or equivalent test) based on a measurement at 100% elongation of the elastomer.

In this embodiment, a quantity of the rubber 530 inside the carcass 36 is significant to allow this rubber to occupy more space within the track 22. For example, in some embodiments, a thickness T_q of the rubber 530 inside the carcass 36 may occupy at least 20% of the thickness T_c of the carcass 36, in some cases at least 30% of the thickness T_c of the carcass 36, in some cases at least 40% of the thickness T_c of the carcass 36, in some cases at least 50% of the thickness T_c of the carcass 36, and in some cases even more (e.g., 60%, 70% or more). In this example of implementation, the thickness T_q of the rubber 530 inside the carcass 36 occupies at least a majority, in this case at least three-quarters, of the thickness T_c of the carcass 36. The thickness T_q of the rubber 530 inside the carcass 36 may have any other suitable value in other embodiments. As another example, in some embodiments, a width W_q of the rubber 530 inside the carcass 36 may occupy at least be 20% of the width W of the track 22, in some cases at least 30% of the width W of the track 22, in some cases at least 40% of the width W of the track 22, in some cases at least 50% of the width W of the track 22, and in some cases even more (e.g., 60%, 70% or more). In this example of implementation, the width W_q of the rubber 530 inside the carcass 36 occupies at least a majority, in this case at least three-quarters, of the width W of the track. In this example, the rubber 530 inside the carcass 36 is constituted of separate segments (here, two segments) such that its width W_q corresponds to a sum of a width of each of these separate segments. The width

W_q of the rubber 530 inside the carcass 36 may have any other suitable value in other embodiments. As yet another example, in some embodiments, a weight of the rubber 530 inside the carcass 36 may constitute at least 25% of a total weight of rubber of the track 22, in some cases at least 30% of the total weight of rubber of the track 22, in some cases at least 35% of the total weight of rubber of the track 22, in some cases at least 40% of the total weight of rubber of the track 22, and in some cases even more.

This arrangement of the rubber 530 inside the carcass 36 and the rubber 520, 522, 540 of the inner side 45, the ground-engaging outer side 47 and the lateral edges 89₁, 89₂ of the track 22 may be achieved by placing rubber components (e.g., sheets or other layers of rubber and/or blocks of rubber previously produced using any suitable process such as calendering, molding, etc.) in a mold and consolidating them.

In this embodiment, the track 22 comprises a pair of layers of reinforcing fabric 543₁, 543₂ disposed between the wings 492₁, 492₂ of the cores 433₁-433_L and the track's ground-engaging outer side 47. The layers of reinforcing fabric 543₁, 543₂ may help to provide stiffness in the track's widthwise direction and/or enhance a puncture resistance of the track 22. The layers of reinforcing fabric 543₁, 543₂ are spaced apart in the track's widthwise direction.

Each layer of reinforcing fabric 543_i comprises thin pliable material made usually by weaving, felting, knitting, interlacing, or otherwise crossing natural or synthetic elongated fabric elements, such as fibers, filaments, strands and/or others, such that some elongated fabric elements extend transversally to the longitudinal direction of the track 22 to have a reinforcing effect in a transversal direction of the track 22. For instance, the layer of reinforcing fabric 543_i may comprise a ply of reinforcing woven fibers (e.g., nylon fibers or other synthetic fibers). In this example of implementation, the layer of reinforcing fabric 543_i comprises fibers (e.g., cords) oriented in the widthwise direction of the track 22 (i.e., 90°-fabric

having fibers oriented at 90° relative to the track's longitudinal direction). In other examples of implementation, the layer of reinforcing fabric 543_i may comprise fibers (e.g., cords) oriented at +/-10° from the widthwise direction of the track 22.

- 5 The chain 30, including the cores 433₁-433_L and the cables 477₁, 477₂, may be constructed in various other ways in other embodiments.

For example, in other embodiments, the chain 30 may comprise any other number of cables such as the cables 477₁, 477₂ passing through the channel 180
10 of each of the cores 433₁-433_L. For example, in some embodiments, there may be a single cable such as the cables 477₁, 477₂ passing through the channel 180 of each of the cores 433₁-433_L. As another example, in some embodiments, there may be more than two cables such as the cables 477₁, 477₂ passing through the channel 180 of each of the cores 133₁-133_L, but yet the number of
15 cables may be limited. For instance, in some embodiments, there may no more than four cables and in some cases no more than three cables such as the cables 477₁, 477₂ passing through the channel 180 of each of the cores 133₁-133_L.

- 20 Although the chain 30 is part of the track 22 in embodiments considered above, in other embodiments, certain components of the chain 30 may be present in the track 22 without the track 22 actually including an entirety of the chain 30.

For example, in some embodiments, with additional reference to Figures 51 to
25 54, the track 22 may comprise the cores 433₁-433_L described above but lack the cables 477₁, 477₂ extending through the cores 433₁-433_L. That is, no cable passes through the cores 433₁-433_L. The channel 480 of each core 433_x is thus free of any cable.

- 30 In this embodiment, portions 556₁, 556₂ of the rubber 38 of the carcass 36 within the openings 482₁, 482₂ of each core 433_x help to improve retention of the core

433_x within the track 22. More particularly, in this embodiment, these portions 556₁, 556₂ of the rubber 38 of the carcass 36 may flow within the openings 482₁, 482₂ of the core 433_x during molding of the track 22 and mechanically interlock the core 433_x and the rubber 38 of the carcass 36. In other words, the rubber 38
5 of the carcass 36 extends through the core 433_x, interlocking these elements together.

Since there is no cable extending through the cores 433₁-433_L, in some embodiments, the zones of reinforcing cables 437₁-437₁₀, 537₁-537₁₀ may be
10 modified to ensure proper reinforcement of the track 22 in its longitudinal direction. For example, in some embodiments, the reinforcing cables 437₁-437₁₀, 537₁-537₁₀ may be larger in diameter and/or there may be a greater number of reinforcing cables in these zones of reinforcing cables.

15 The track system 16_i may be configured in various other ways in other embodiments.

For example, in other embodiments, the guide/drive projections 48₁-48_N may also be used to drive the track 22 such that the drive wheel 24 may engage the
20 guide/drive projections 48₁-48_N to impart motion to the track 22 (i.e., the drive wheel 24 and the track 22 may implement a "positive drive" system). In other embodiments, the drive wheel 24 may frictionally engage the inner side 45 of the track 22 in order to frictionally drive the track 22 (i.e., the drive wheel 24 and the track 22 may implement a "friction drive" system).

25 As another example, the track system 16_i may have a different overall configuration in other embodiments. For instance, in other embodiments, the track system 16_i may have a generally triangular configuration in which the drive wheel 24 is mounted higher than in leading and trailing idler wheels.

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While in embodiments considered above the off-road vehicle 10 is a construction vehicle, in other embodiments, the vehicle 10 may be another type of work vehicle such as an agricultural vehicle (e.g., a combine harvester, another type of harvester, a tractor, etc.) for performing agricultural work, a forestry vehicle (e.g.,
5 a feller-buncher, a tree chipper, a knuckleboom loader, etc.) for performing forestry work, or a military vehicle (e.g., a combat engineering vehicle (CEV), etc.) for performing military work, or may be a snowmobile, an all-terrain vehicle (ATV), or any other type of vehicle operable off paved roads. Although operable off paved roads, the vehicle 10 may also be operable on paved roads in some
10 cases. Also, while in embodiments considered above the off-road vehicle 10 is driven by a human operator in the vehicle 10, in other embodiments, the vehicle 10 may be an unmanned ground vehicle (e.g., a teleoperated or autonomous unmanned ground vehicle).

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

Certain additional elements that may be needed for operation of certain
20 embodiments have not been described or illustrated as they are assumed to be within the purview of those of ordinary skill in the art. Moreover, certain embodiments may be free of, may lack and/or may function without any element that is not specifically disclosed herein.

25 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.

30

CLAIMS

1. A track for traction of an off-road vehicle, the track being mountable around a track-engaging assembly comprising a plurality of wheels, the wheels including a drive wheel for driving the track, the track comprising:
- 5
- an inner surface for facing the track-engaging assembly;
 - a ground-engaging outer surface for engaging the ground;
 - elastomeric material allowing the track to flex around the track-engaging assembly;

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 - a plurality of cores embedded in the elastomeric material, spaced apart in a longitudinal direction of the track, and extending transversally to the longitudinal direction of the track, each core comprising a channel extending through the core; and
 - a plurality of cables passing through the channel of each of the cores and

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 - providing a bulk of a tensile strength of the track.
2. The track claimed in claim 1, wherein: the channel comprises a plurality of openings extending through the core and spaced apart from one another; and the cables pass through respective ones of the openings of each of the cores.
- 20
3. The track claimed in claim 2, wherein a single one of the cables passes through a given one of the openings of each of the cores.
4. The track claimed in claim 1, wherein the core comprises a guide protrusion projecting from the inner surface to contact at least one of the wheels.
- 25
5. The track claimed in claim 4, wherein: the channel comprises an opening extending through the core; the opening and the guide protrusion overlap in a widthwise direction of the track; and a given one of the cables passes through
- 30
- the opening of each of the cores.

6. The track claimed in claim 5, wherein: the guide protrusion is a first guide protrusion; the opening is a first opening; the given one of the cables is a first one of the cables; the core comprises a second guide protrusion projecting from the inner surface to contact at least one of the wheels and spaced apart from the first guide protrusion in the widthwise direction of the track; the channel comprises a second opening extending through the core and spaced apart from the first opening in the widthwise direction of the core; the second opening and the second guide protrusion overlap in the widthwise direction of the track; and a second one of the cables passes through the second opening of each of the cores.
7. The track claimed in claim 4, wherein the guide protrusion of a given one of the cores extends towards the guide protrusion of an adjacent one of the cores in the longitudinal direction of the track.
8. The track claimed in claim 7, wherein the guide protrusion of the given one of the cores and the guide protrusion of the adjacent one of the cores overlap in the longitudinal direction of the track.
9. The track claimed in claim 1, wherein a portion of the elastomeric material is disposed in the channel of each of the cores.
10. The track claimed in claim 1, wherein the core comprises a drive member for engaging the drive wheel.
11. The track claimed in claim 1, wherein each of the cables comprises a metallic cord including a plurality of metallic strands.
12. The track claimed in claim 1, wherein a ratio of (i) a diameter of each cable over (ii) a thickness of the track from the inner surface to the ground-engaging outer surface is at least 0.1.

13. The track claimed in claim 1, wherein a ratio of (i) a spacing of adjacent ones of the cables in a widthwise direction of the track over (ii) a width of the track may be at least 0.1.

5

14. The track claimed in claim 1, comprising, for each cable, a connector mounted to longitudinal end portions of the cable to secure the longitudinal end portions of the cable to one another.

10 15. The track claimed in claim 1, wherein the elastomeric material comprises:

- peripheral elastomeric material forming at least part of a periphery of the track, the periphery of the track comprising the inner surface, the ground-engaging outer surface, and a pair of lateral edges of the track; and
- internal elastomeric material located away from the periphery of the track;

15 the peripheral elastomeric material having a superior quality than the internal elastomeric material.

16. The track claimed in claim 1, wherein the elastomeric material comprises:

- peripheral elastomeric material forming at least part of a periphery of the track, the periphery of the track comprising the inner surface, the ground-engaging outer surface, and a pair of lateral edges of the track; and
- internal elastomeric material located away from the periphery of the track; the peripheral elastomeric material having a greater resistance to wear than the internal elastomeric material.

25

17. The track claimed in claim 1, wherein the elastomeric material comprises:

- peripheral elastomeric material forming at least part of a periphery of the track, the periphery of the track comprising the inner surface, the ground-engaging outer surface, and a pair of lateral edges of the track; and
- internal elastomeric material located away from the periphery of the track;

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the peripheral elastomeric material having a greater resistance to rupture than the internal elastomeric material.

18. The track claimed in claim 1, wherein the elastomeric material comprises:

- 5 - peripheral elastomeric material forming at least part of a periphery of the track, the periphery of the track comprising the inner surface, the ground-engaging outer surface, and a pair of lateral edges of the track; and
- internal elastomeric material located away from the periphery of the track and having a higher modulus of elasticity than the peripheral elastomeric material.
- 10

19. The track claimed in claim 18, wherein the internal elastomeric material occupies at least a majority of a width of the track.

15 20. The track claimed in claim 19, wherein the internal elastomeric material occupies at least three-quarters of the width of the track.

 21. The track claimed in claim 18, wherein the internal elastomeric material occupies at least 30% of a thickness of the track from the inner surface to the ground-engaging outer surface.

20

22. The track claimed in claim 1, comprising a layer of reinforcing fabric embedded in the elastomeric material.

25 23. A track for traction of an off-road vehicle, the track being mountable around a track-engaging assembly comprising a plurality of wheels, the wheels including a drive wheel for driving the track, the track comprising:

 - an inner surface for facing the track-engaging assembly;

 - a ground-engaging outer surface for engaging the ground;

30 - elastomeric material allowing the track to flex around the track-engaging assembly;

- a plurality of cores embedded in the elastomeric material, spaced apart in a longitudinal direction of the track, and extending transversally to the longitudinal direction of the track, each core comprising:
 - a guide protrusion projecting from the inner surface to contact at least one of the wheels; and
 - an opening extending through the core, the opening and the guide protrusion overlapping in a widthwise direction of the track;
- and
- a cable passing through the opening of each of the cores.

10

24. The track claimed in claim 23, wherein: the guide protrusion is a first guide protrusion; the opening is a first opening; the cable is a first cable; the core comprises a second guide protrusion projecting from the inner surface to contact at least one of the wheels; the core comprises a second opening extending through the core; the second opening and the second guide protrusion overlap in the widthwise direction of the track; and the track comprises a second cable passing through the second opening of each of the cores.

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25. The track claimed in claim 23, wherein the cable is a sole cable passing through the opening of each of the cores.

20

26. The track claimed in claim 23, wherein the guide protrusion of a given one of the cores extends towards the guide protrusion of an adjacent one of the cores in the longitudinal direction of the track.

25

27. The track claimed in claim 26, wherein the guide protrusion of the given one of the cores and the guide protrusion of the adjacent one of the cores overlap in the longitudinal direction of the track.

30

28. The track claimed in claim 23, wherein a portion of the elastomeric material is disposed in the opening of each of the cores.
29. The track claimed in claim 23, wherein the core comprises a drive member for engaging the drive wheel.
30. The track claimed in claim 23, wherein the cable comprises a metallic cord including a plurality of metallic strands.
31. The track claimed in claim 23, wherein a ratio of (i) a diameter of the cable over (ii) a thickness of the track from the inner surface to the ground-engaging outer surface is at least 0.1.
32. The track claimed in claim 24, wherein a ratio of (i) a spacing of the first cable and the second cable in a widthwise direction of the track over (ii) a width of the track may be at least 0.1.
33. The track claimed in claim 23, comprising a connector mounted to longitudinal end portions of the cable to secure the longitudinal end portions of the cable to one another.
34. The track claimed in claim 23, wherein the elastomeric material comprises:
- peripheral elastomeric material forming at least part of a periphery of the track, the periphery of the track comprising the inner surface, the ground-engaging outer surface, and a pair of lateral edges of the track; and
 - internal elastomeric material located away from the periphery of the track; the peripheral elastomeric material having a superior quality than the internal elastomeric material.
35. The track claimed in claim 23, wherein the elastomeric material comprises:

- peripheral elastomeric material forming at least part of a periphery of the track, the periphery of the track comprising the inner surface, the ground-engaging outer surface, and a pair of lateral edges of the track; and
 - internal elastomeric material located away from the periphery of the track;
- 5 the peripheral elastomeric material having a greater resistance to wear than the internal elastomeric material.

36. The track claimed in claim 23, wherein the elastomeric material comprises:

- peripheral elastomeric material forming at least part of a periphery of the track, the periphery of the track comprising the inner surface, the ground-engaging outer surface, and a pair of lateral edges of the track; and
 - internal elastomeric material located away from the periphery of the track;
- 10 the peripheral elastomeric material having a greater resistance to rupture than the internal elastomeric material.

15

37. The track claimed in claim 23, wherein the elastomeric material comprises:

- peripheral elastomeric material forming at least part of a periphery of the track, the periphery of the track comprising the inner surface, the ground-engaging outer surface, and a pair of lateral edges of the track; and
 - internal elastomeric material located away from the periphery of the track and having a higher modulus of elasticity than the peripheral elastomeric material.
- 20

38. The track claimed in claim 37, wherein the internal elastomeric material occupies at least a majority of a width of the track.

25

39. The track claimed in claim 38, wherein the internal elastomeric material occupies at least three-quarters of the width of the track.

40. The track claimed in claim 37, wherein the internal elastomeric material occupies at least 30% of a thickness of the track from the inner surface to the ground-engaging outer surface.

5 41. The track claimed in claim 23, comprising a layer of reinforcing fabric embedded in the elastomeric material.

42. A track for traction of an off-road vehicle, the track being mountable around a track-engaging assembly comprising a plurality of wheels, the wheels
10 including a drive wheel for driving the track, the track comprising:

- an inner surface for facing the track-engaging assembly;
- a ground-engaging outer surface for engaging the ground;
- elastomeric material allowing the track to flex around the track-engaging assembly;
- 15 - a plurality of cores embedded in the elastomeric material, spaced apart in a longitudinal direction of the track, and extending transversally to the longitudinal direction of the track, each core comprising a channel extending through the core; and
- a number of cables passing through the channel of each of the cores, the
20 number of cables being no more than four.

43. The track claimed in claim 42, wherein the number of cables is two.

44. A track for traction of an off-road vehicle, the track being mountable around a
25 track-engaging assembly comprising a plurality of wheels, the wheels including a drive wheel for driving the track, the track comprising elastomeric material allowing the track to flex around the track-engaging assembly, the elastomeric material comprising:

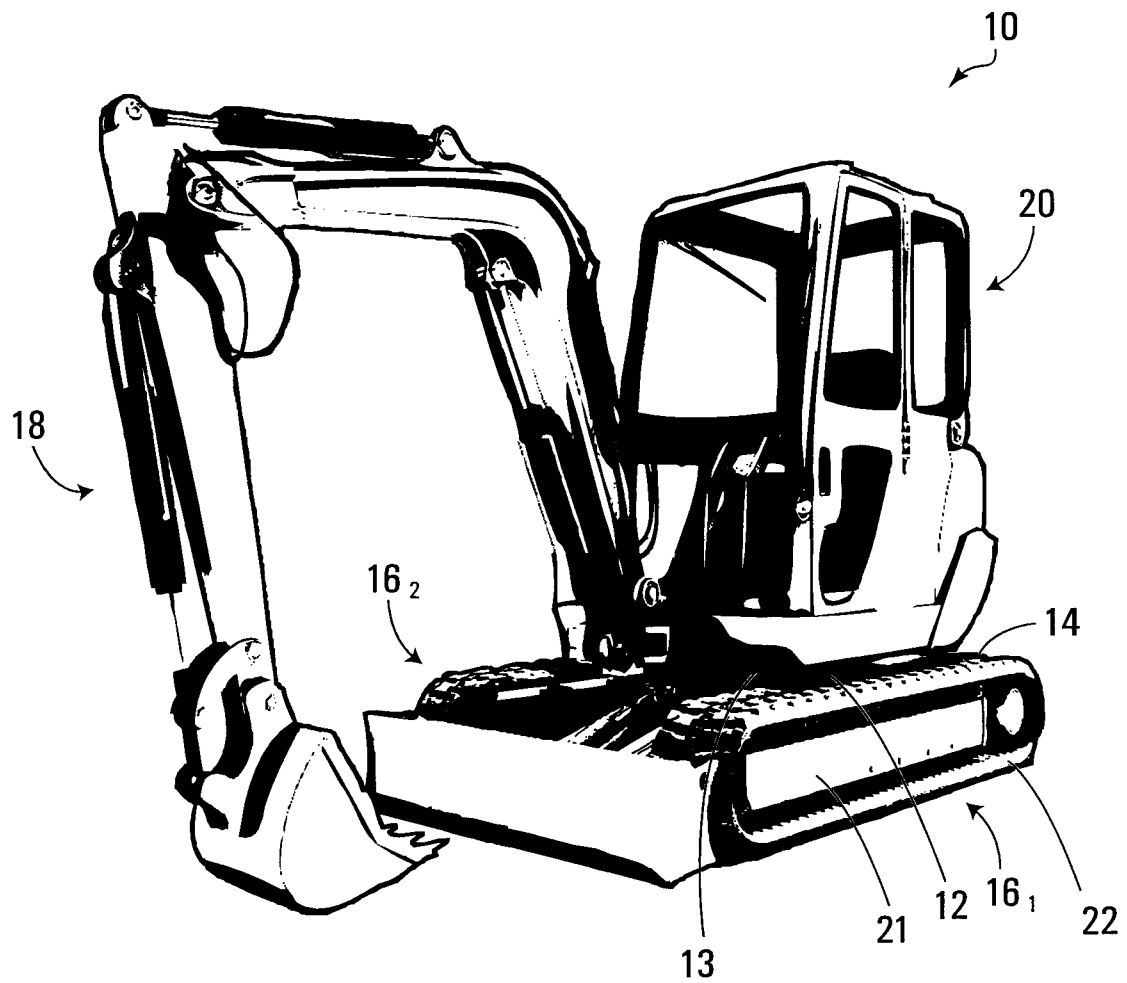
- peripheral elastomeric material forming at least part of a periphery of the
30 track, the periphery of the track comprising an inner surface for facing the

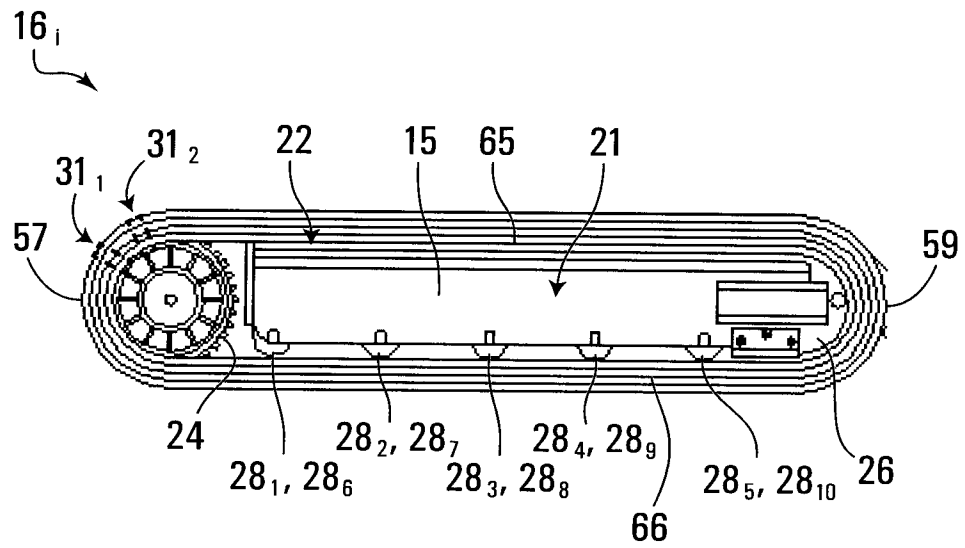
- track-engaging assembly, a ground-engaging outer surface for engaging the ground, and a pair of lateral edges defining a width of the track; and
- internal elastomeric material located away from the periphery of the track, occupying at least a majority of the width of the track, and having a higher modulus of elasticity than the peripheral elastomeric material.
- 5

45. The track claimed in claim 44, wherein the internal elastomeric material occupies at least three-quarters of the width of the track.

- 10 46. The track claimed in claim 44, wherein the internal elastomeric material occupies at least 30% of a thickness of the track from the inner surface to the ground-engaging outer surface.

- 15 47. The track claimed in claim 44, comprising a plurality of cores embedded in the elastomeric material, spaced apart in a longitudinal direction of the track, and extending transversally to the longitudinal direction of the track, each core comprising a guide protrusion projecting from the inner surface to contact at least one of the wheels.

**FIG. 1**

**FIG. 2**

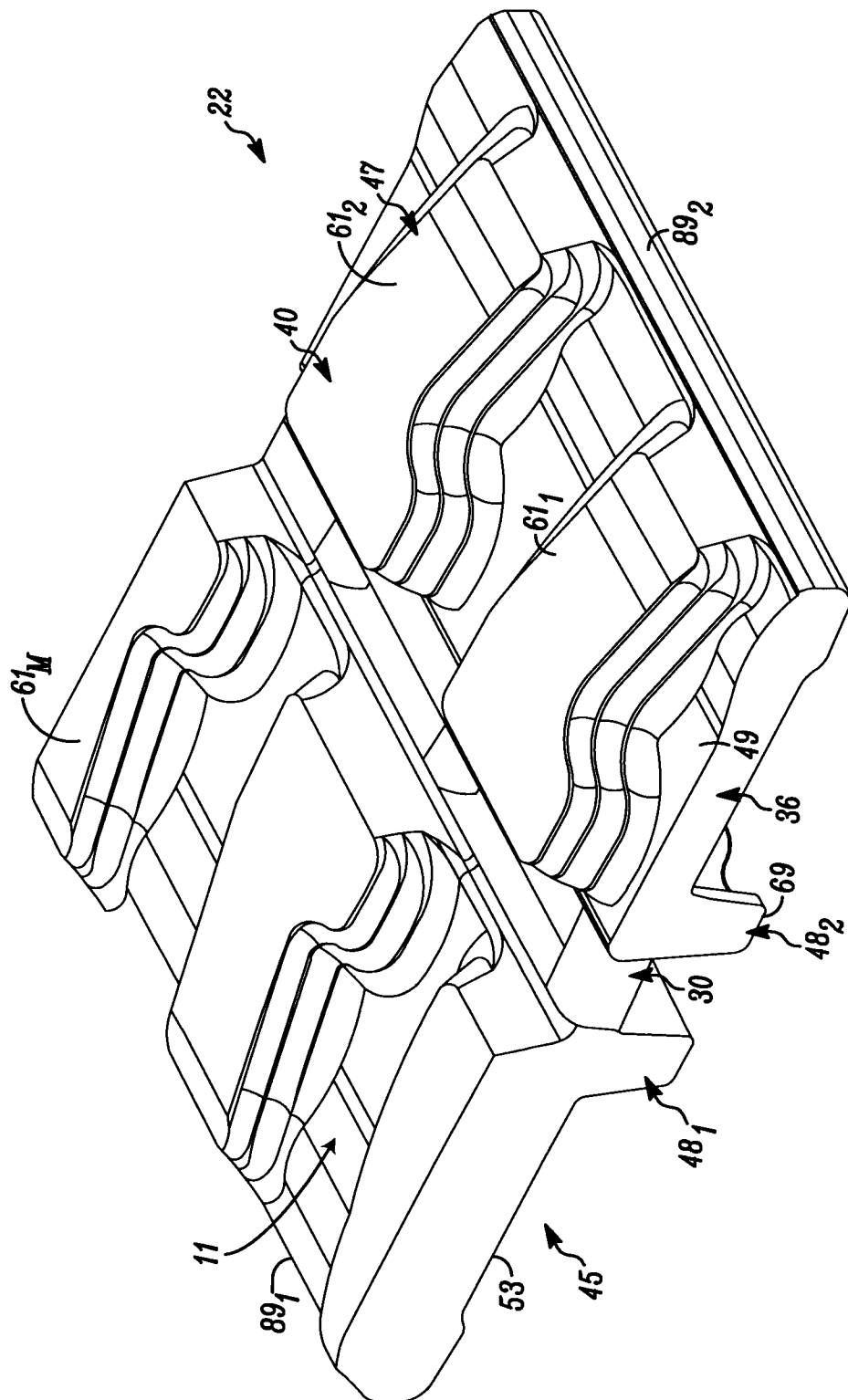


FIG. 3

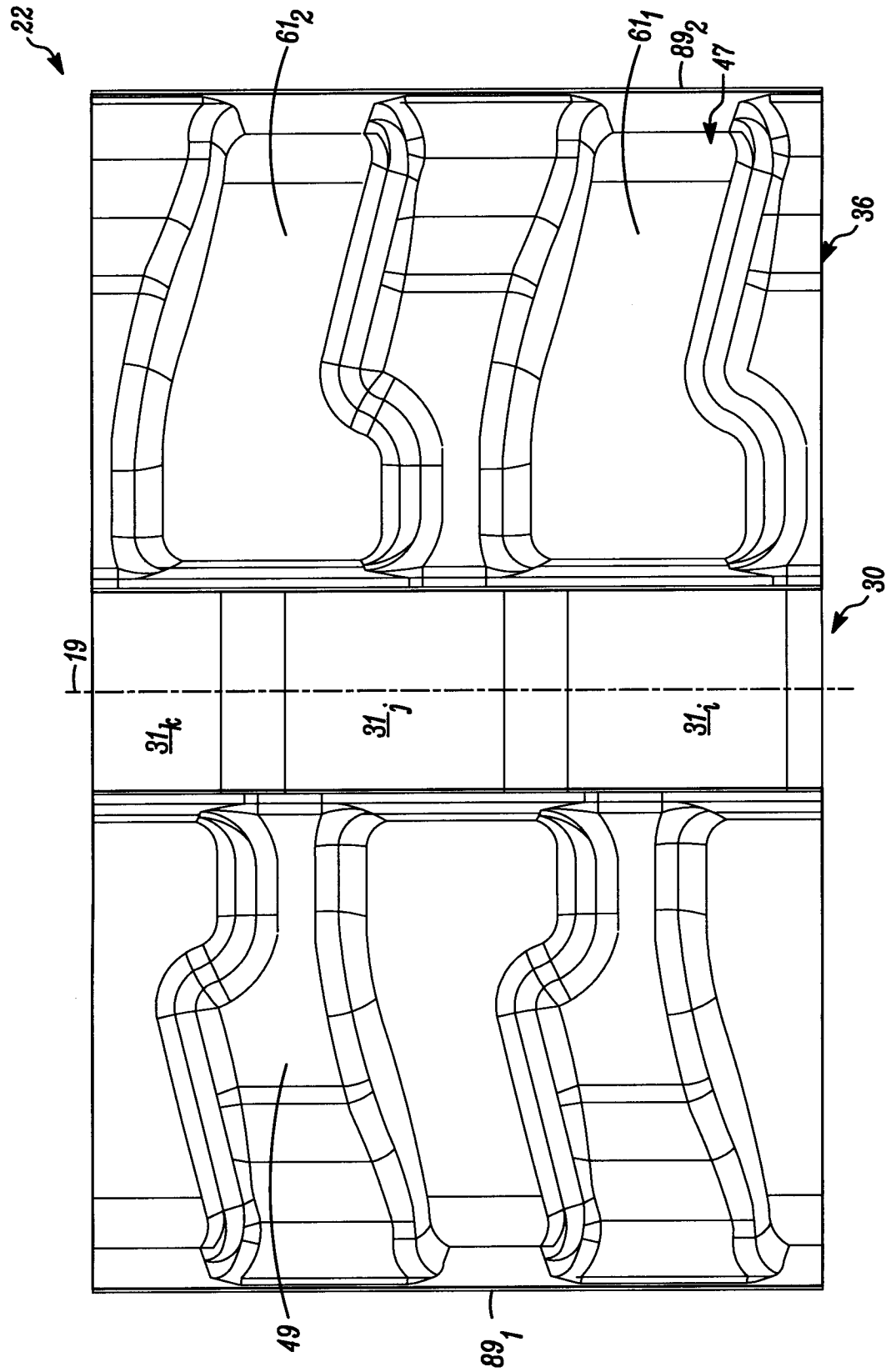
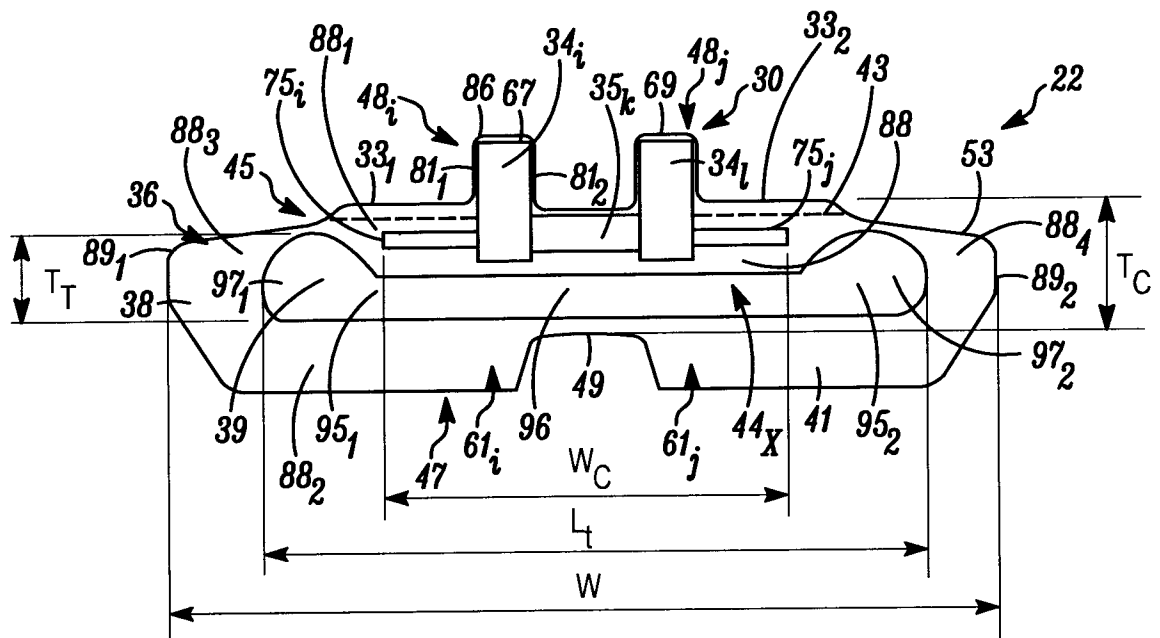
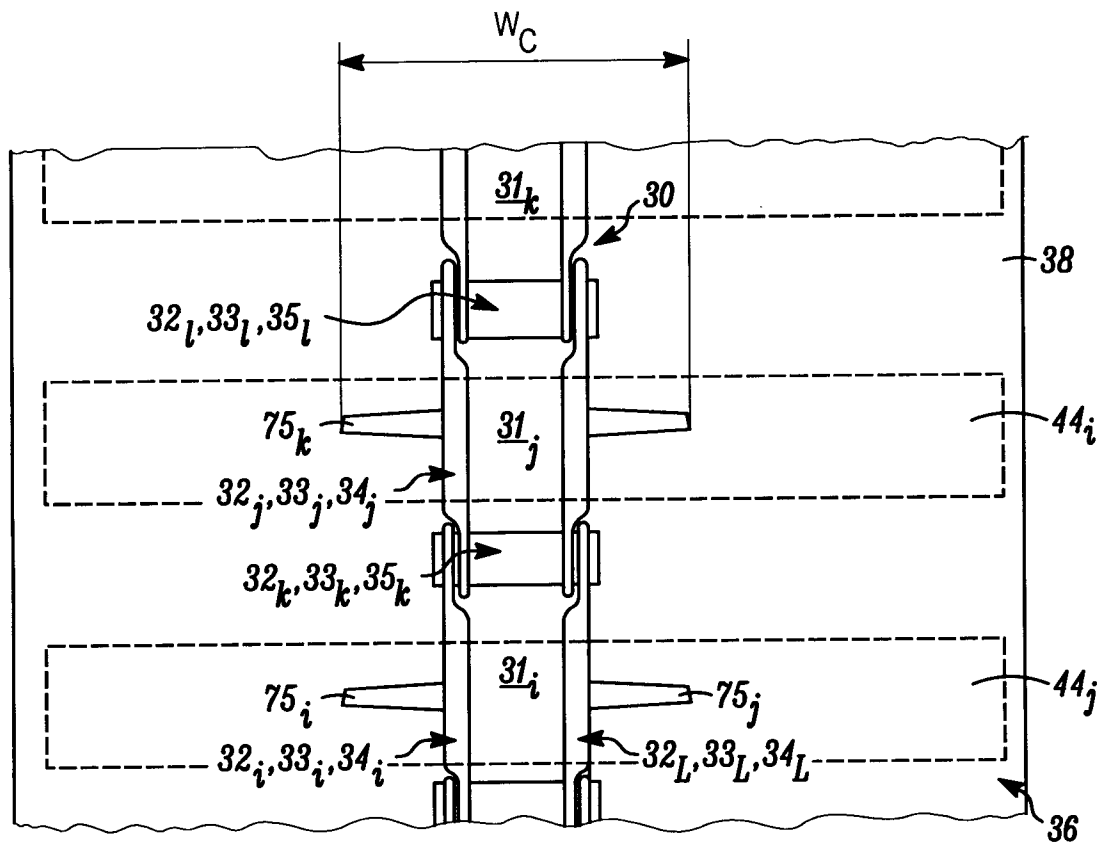


FIG. 4

**FIG. 5**

**FIG. 6**

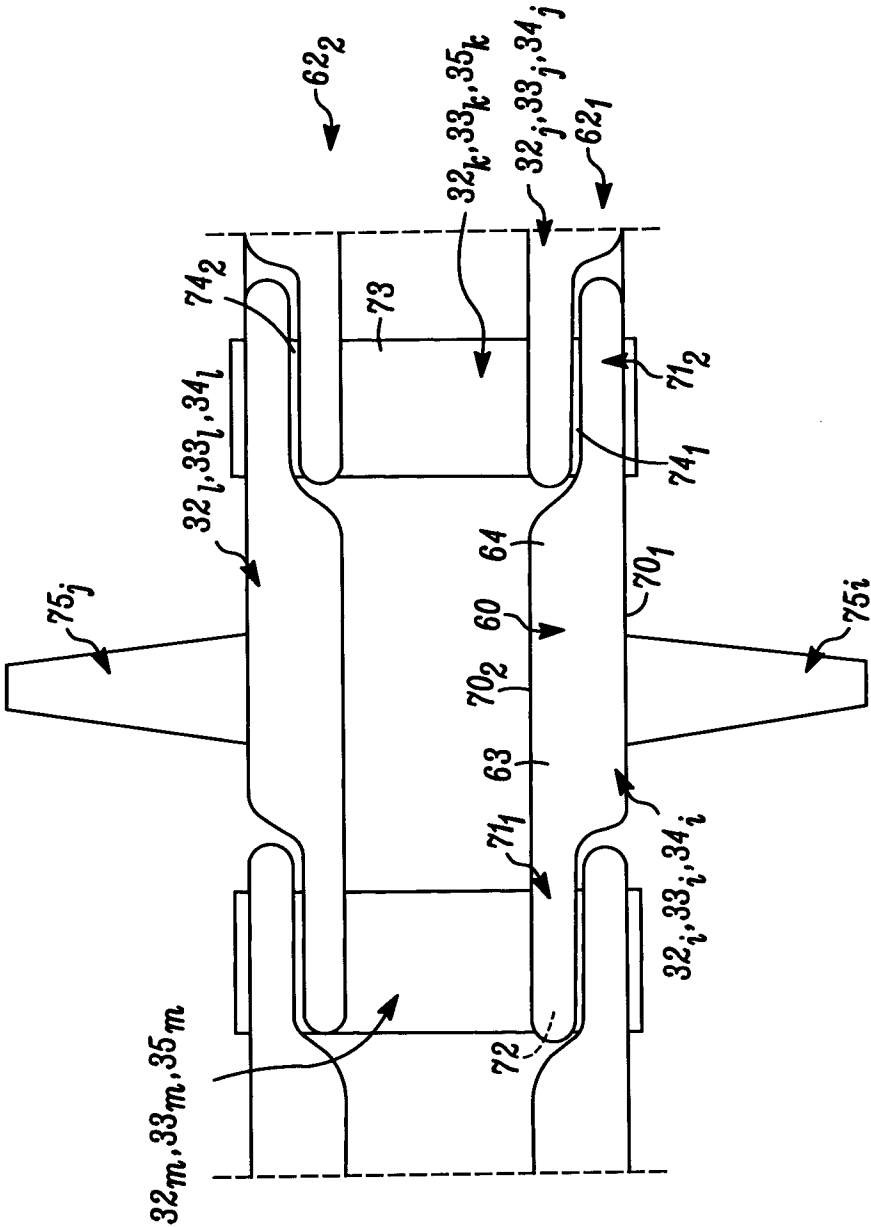


FIG. 7

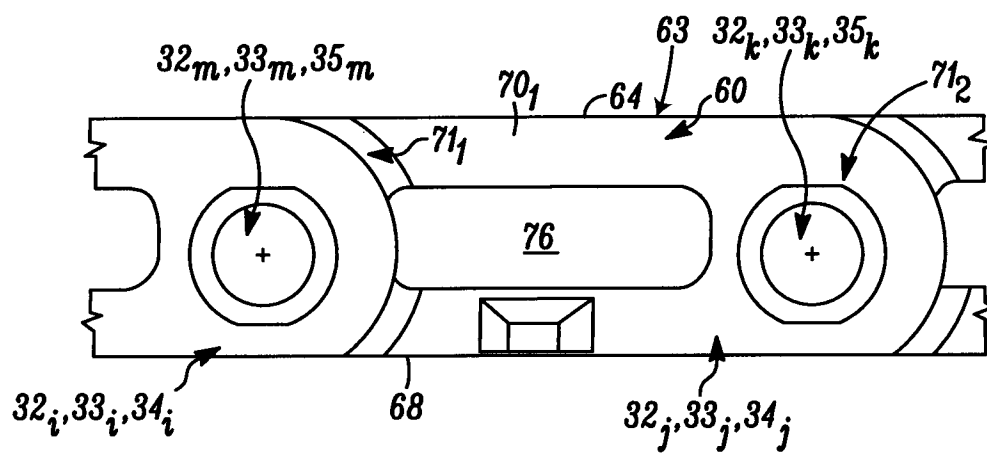


FIG. 8

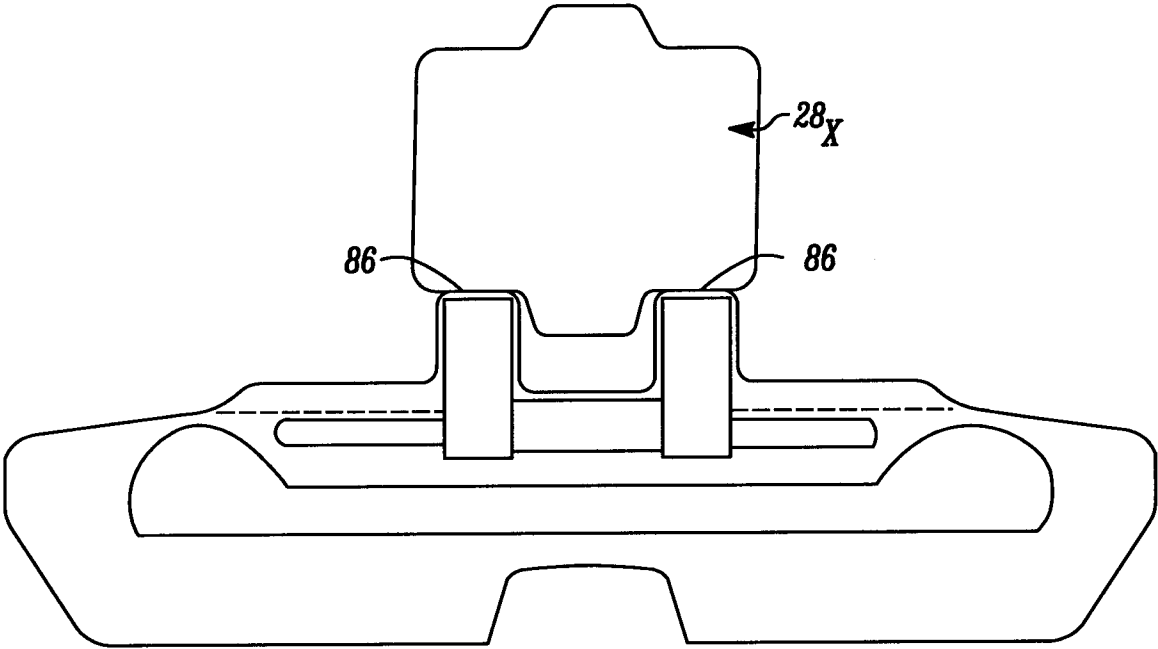


FIG. 9

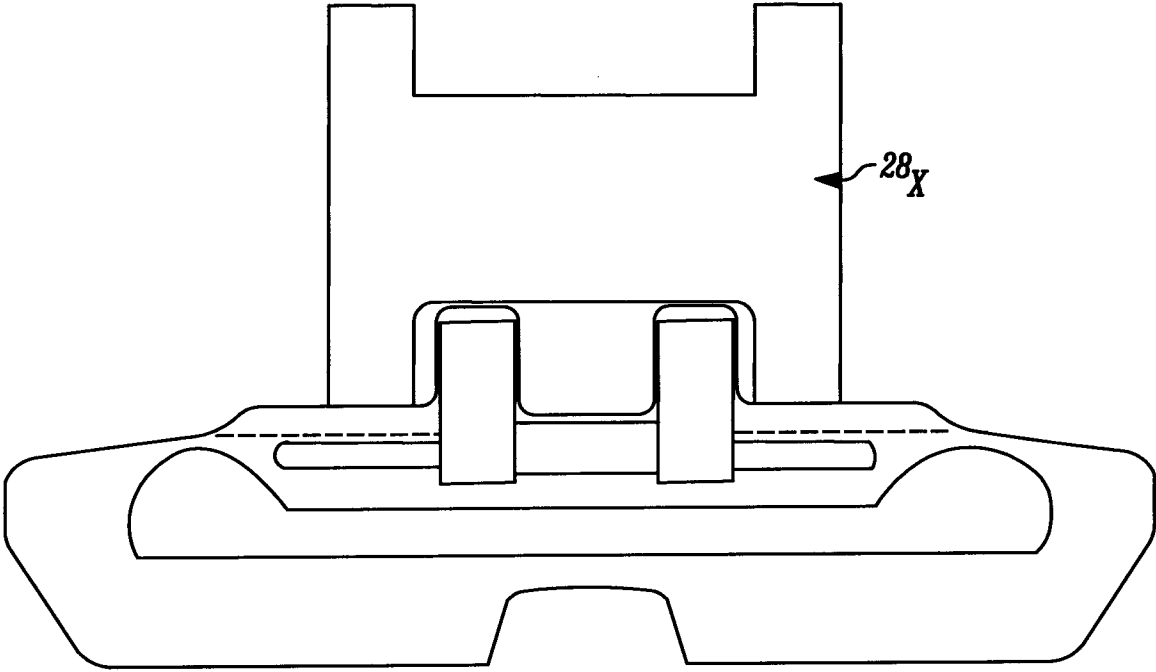


FIG. 10

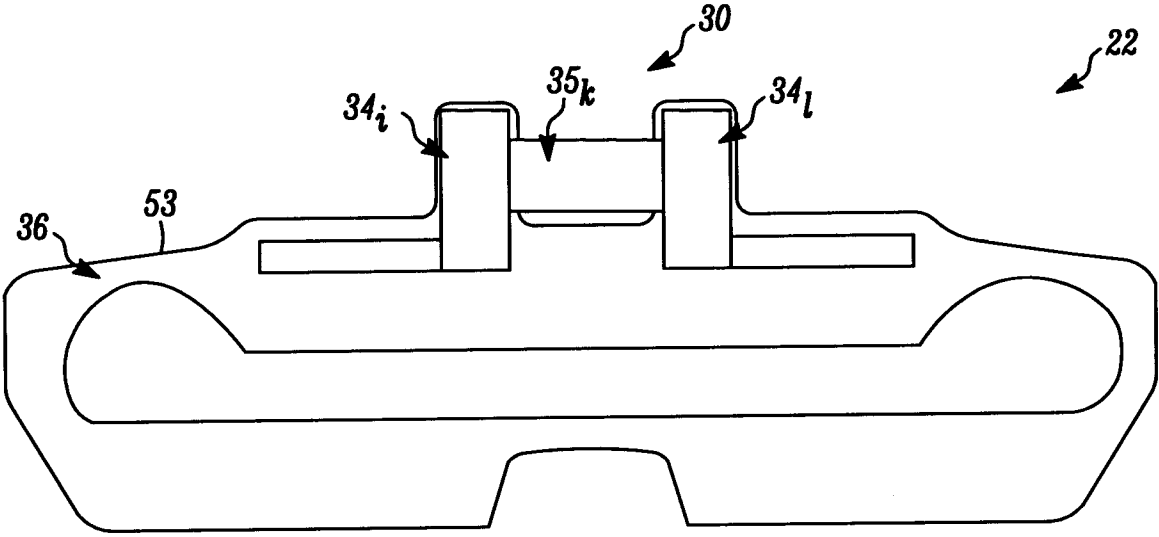


FIG. 11

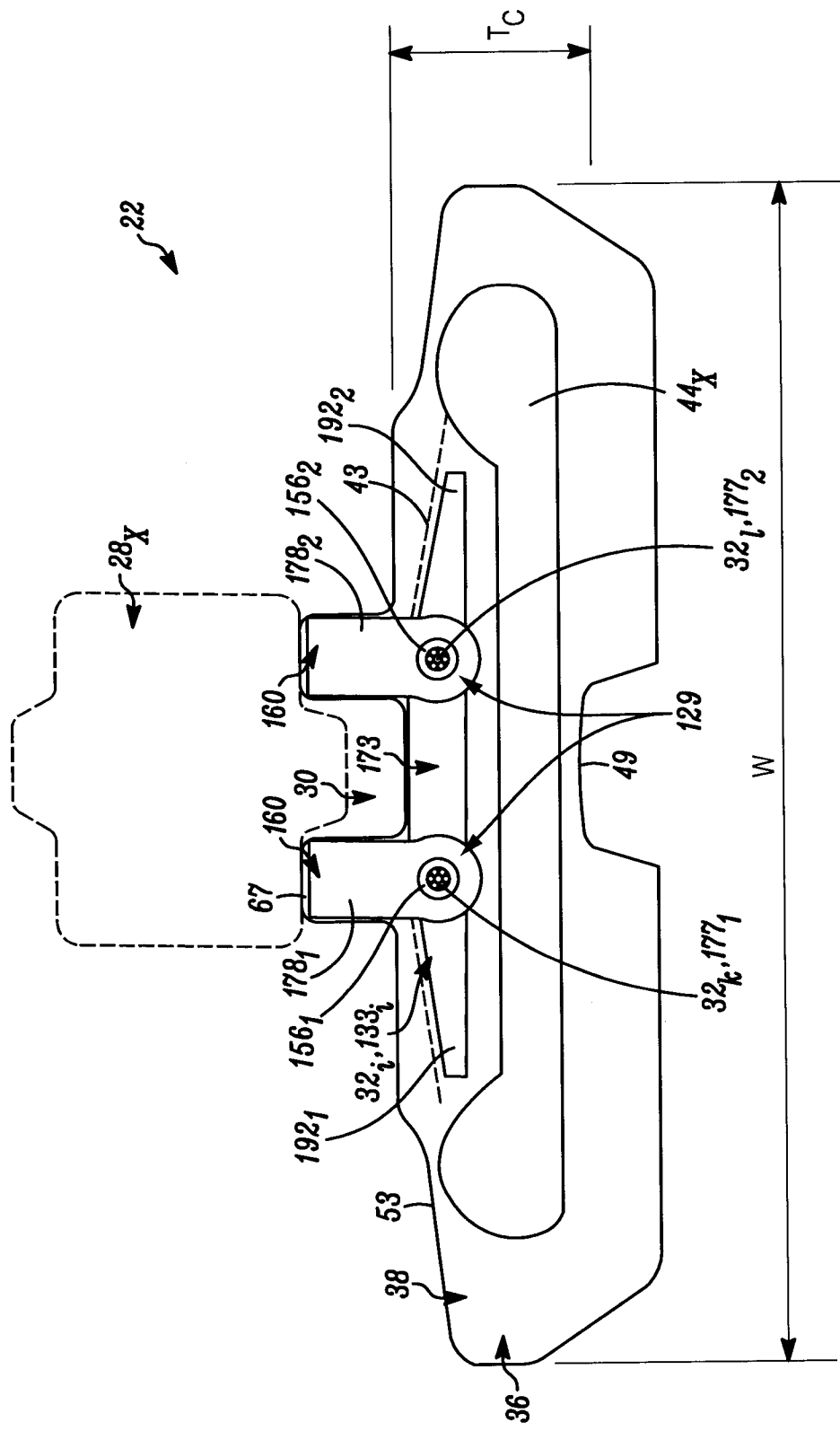
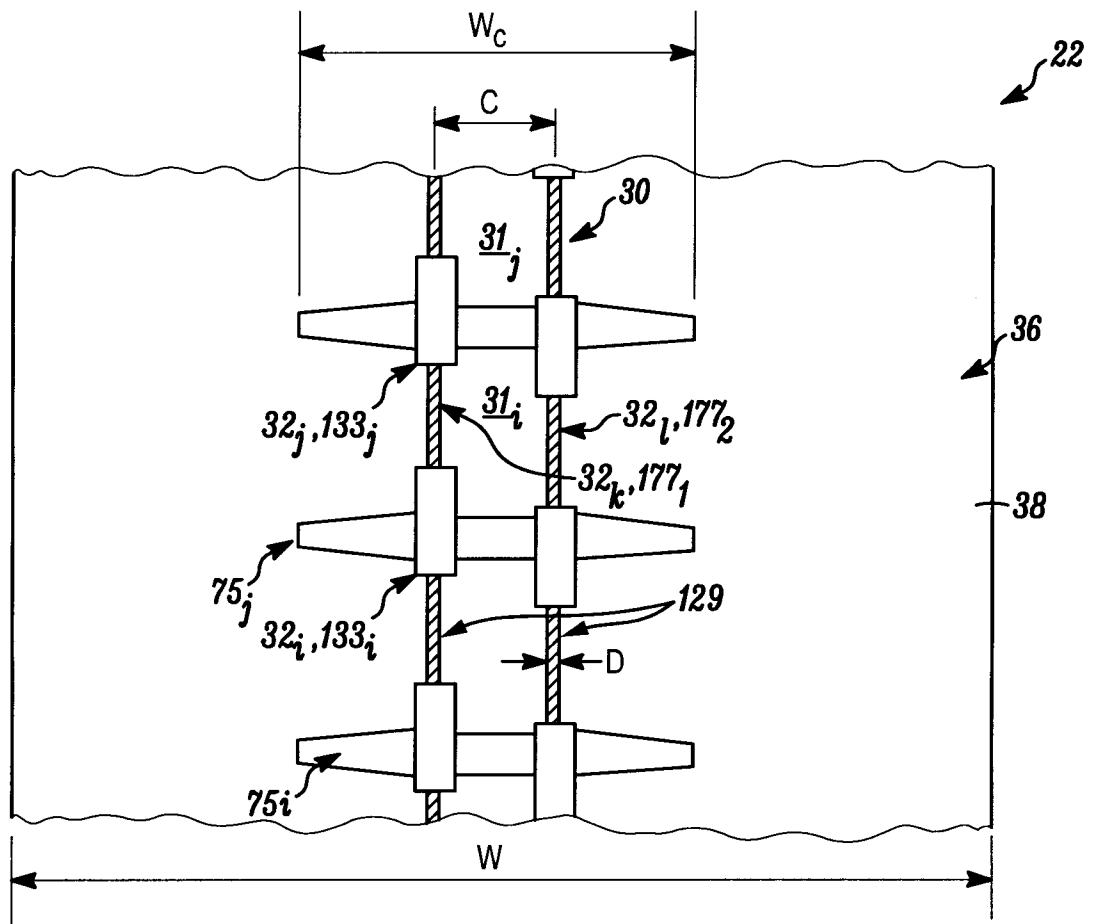
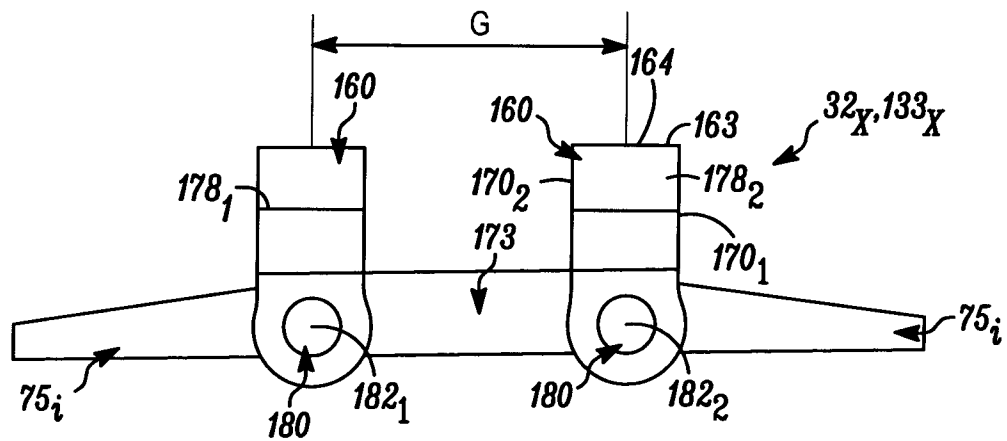
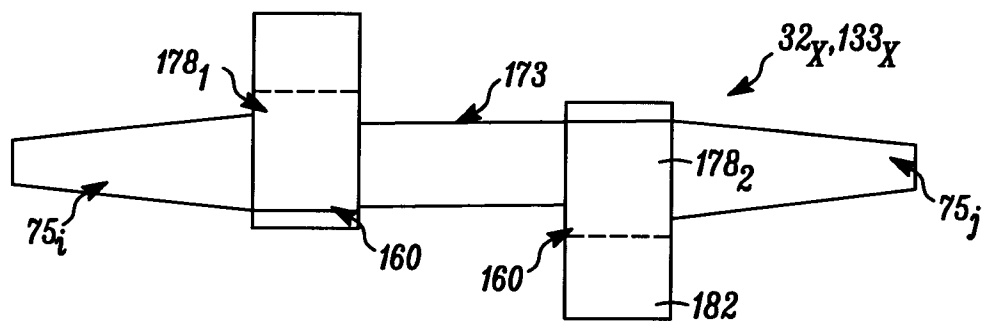


FIG. 12

**FIG. 13**

**FIG. 14****FIG. 15**

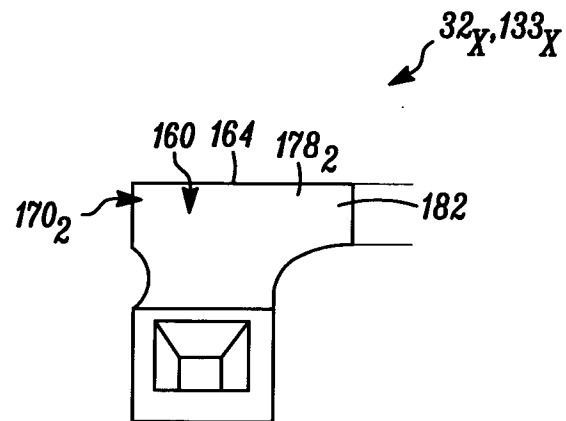


FIG. 16

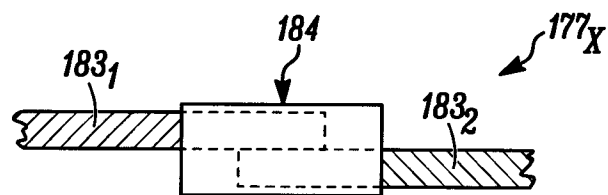


FIG. 17

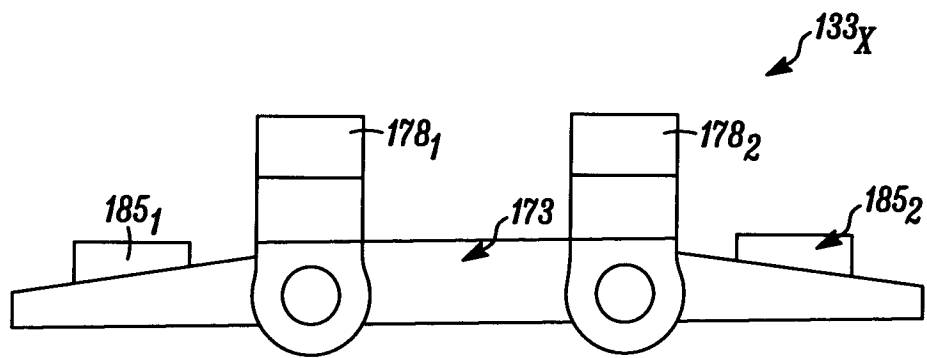


FIG. 18

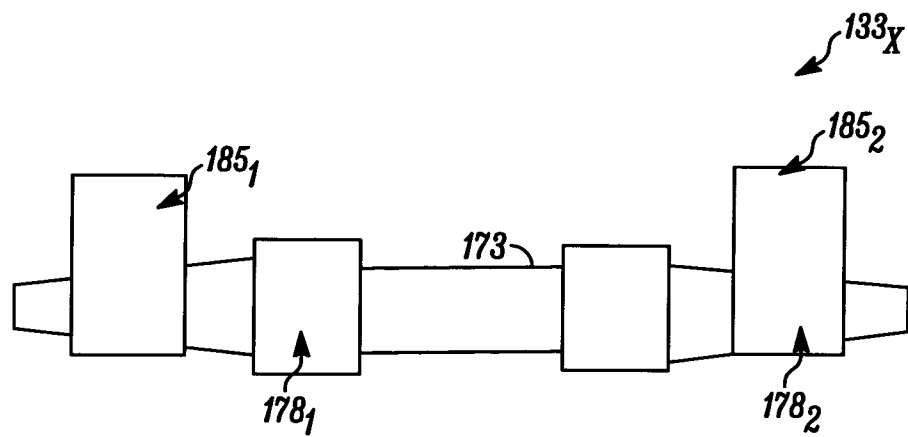


FIG. 19

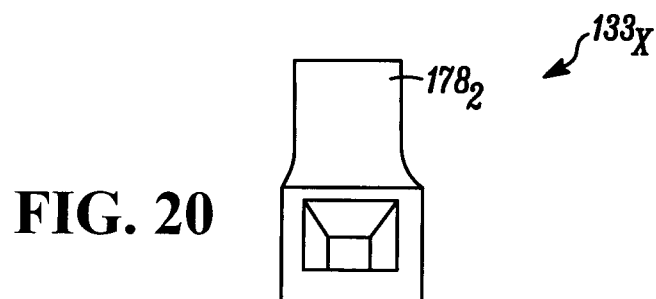


FIG. 20

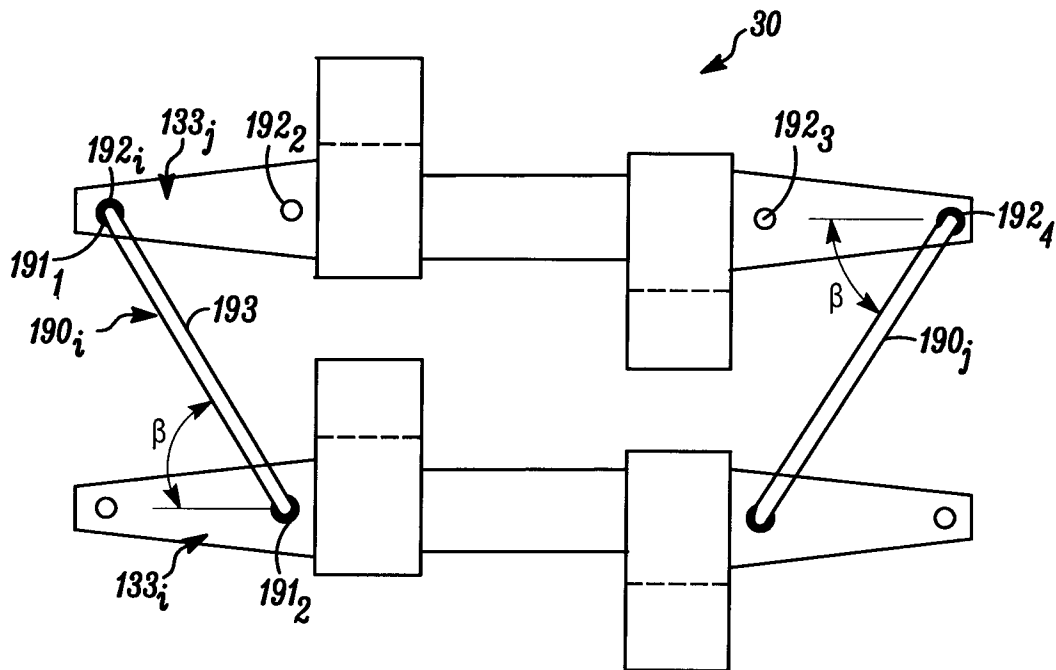


FIG. 21

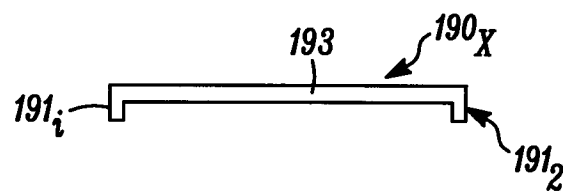


FIG. 22

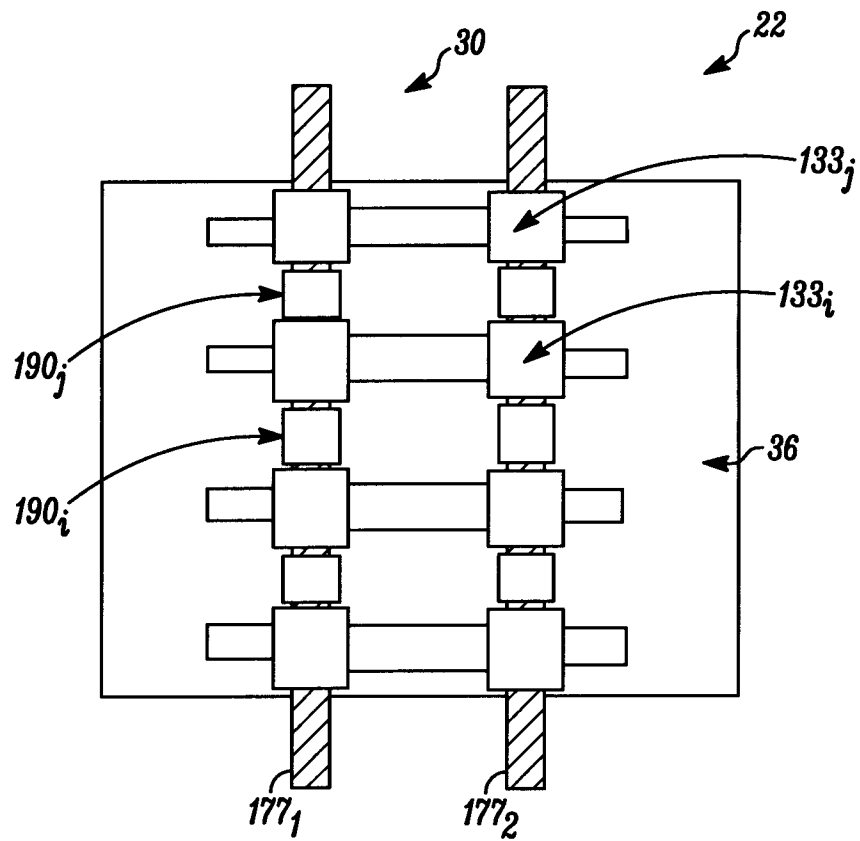


FIG. 23

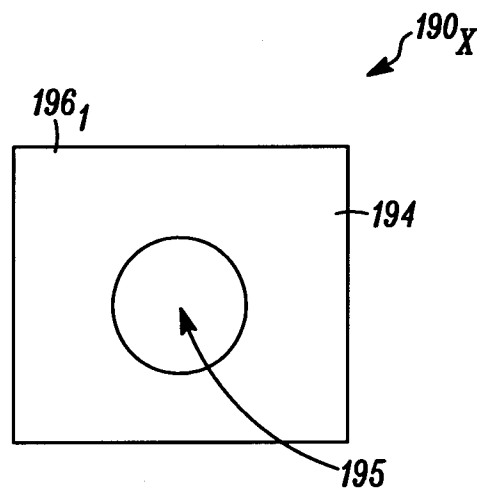


FIG. 24

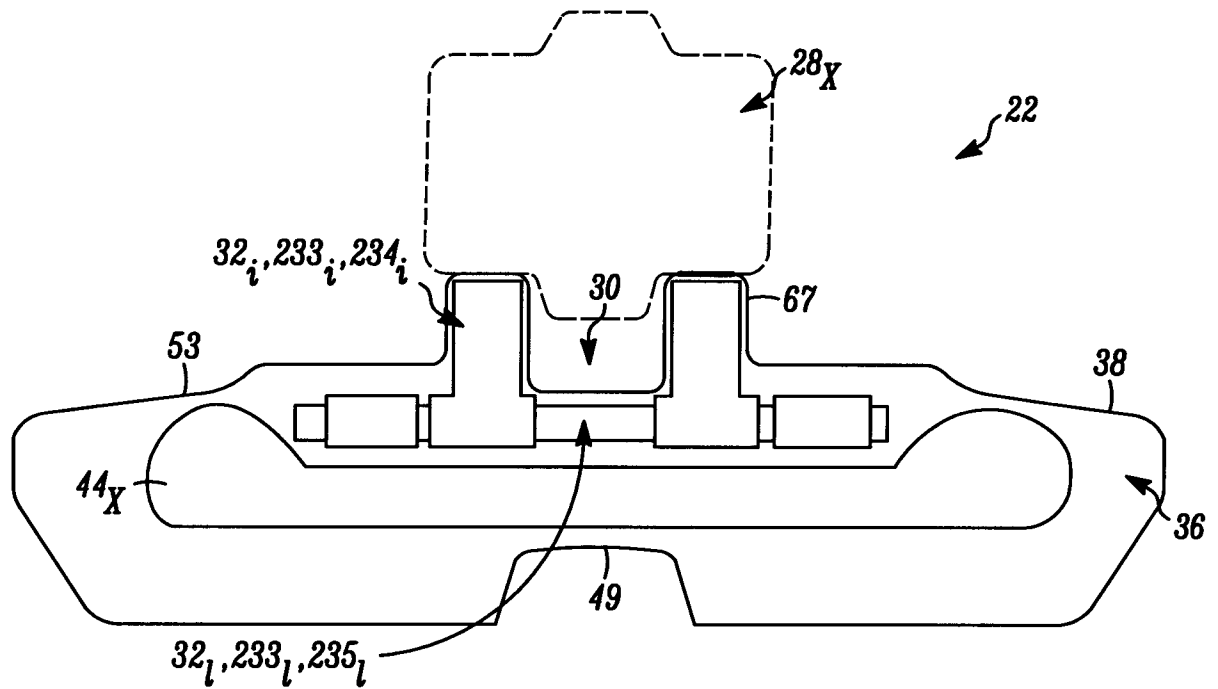


FIG. 25

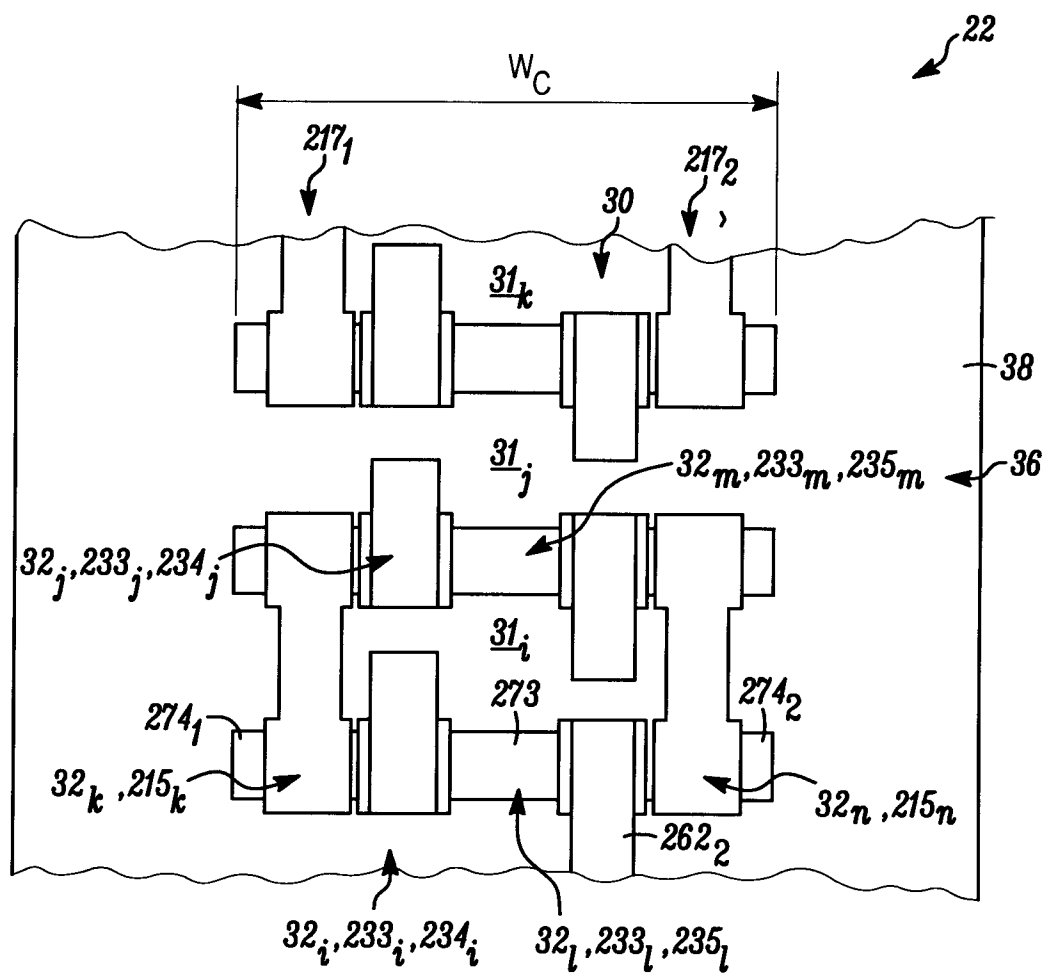


FIG. 26

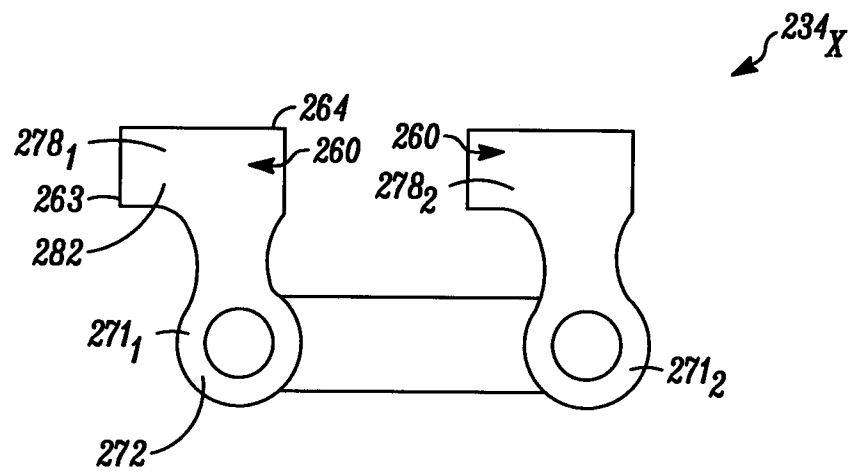


FIG. 27

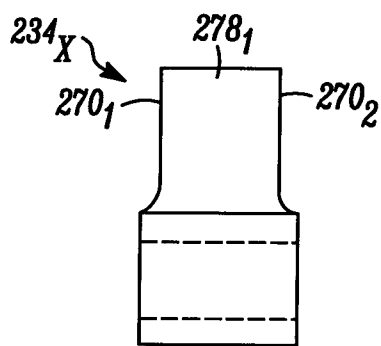


FIG. 28

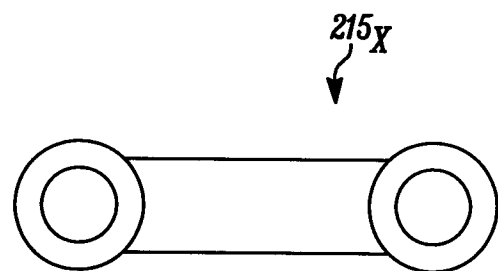


FIG. 29

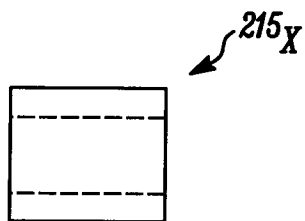


FIG. 30

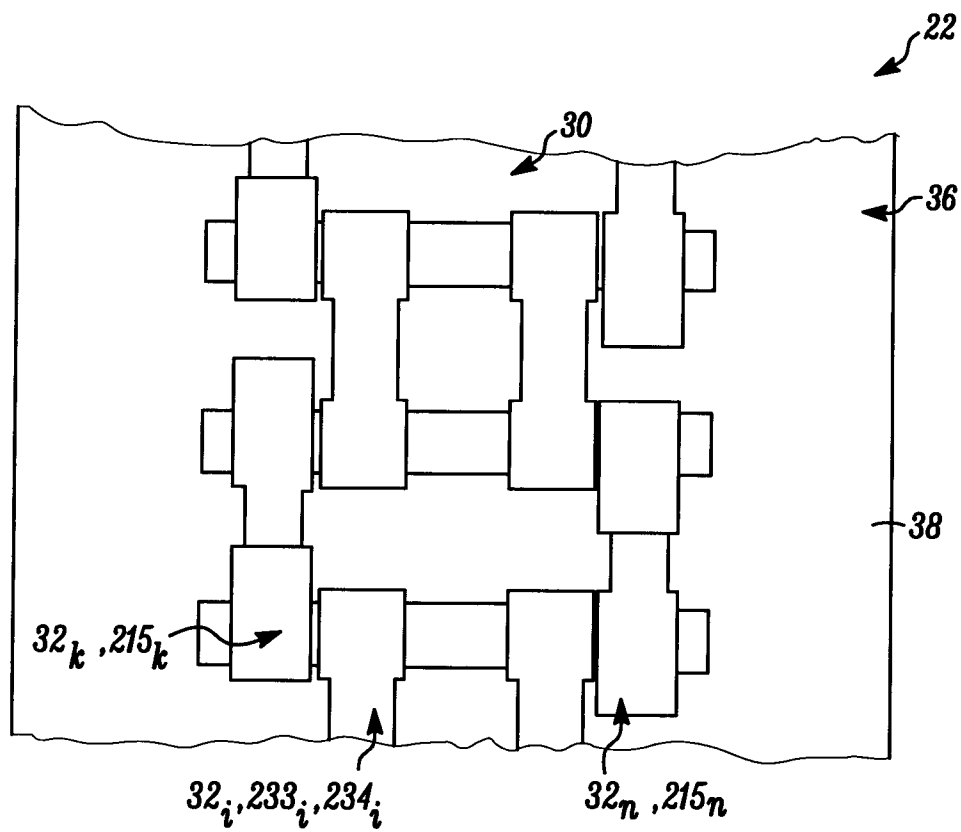


FIG. 31

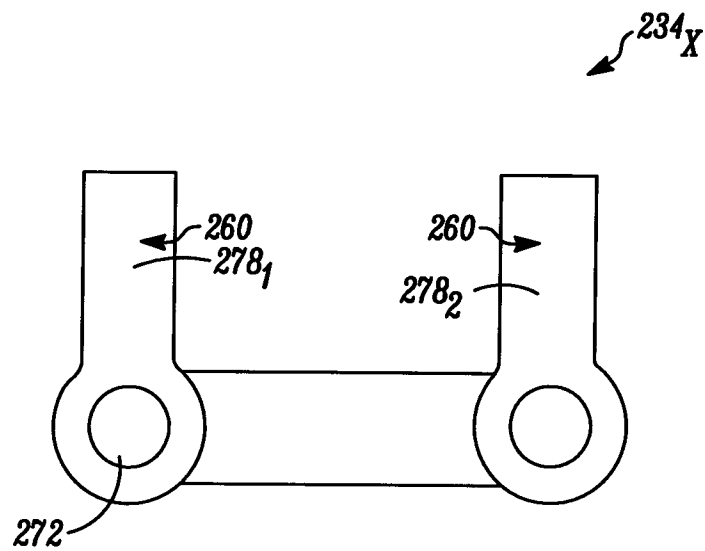


FIG. 32

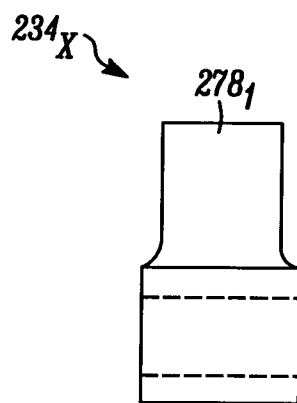


FIG. 33

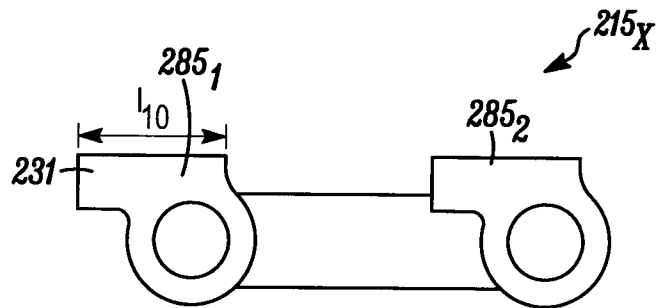


FIG. 34

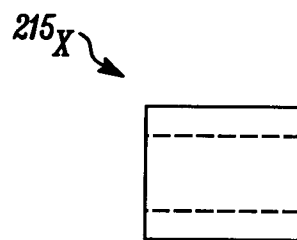


FIG. 35

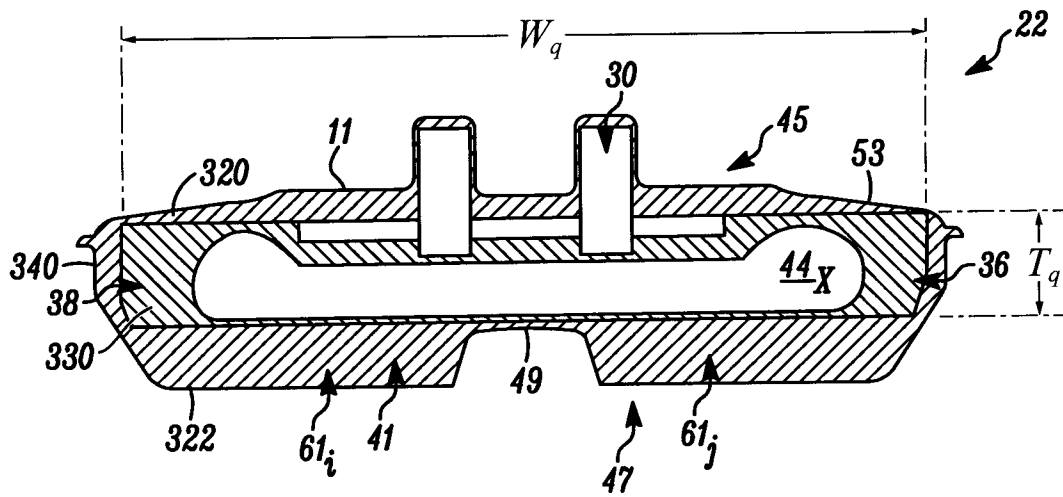


FIG. 36

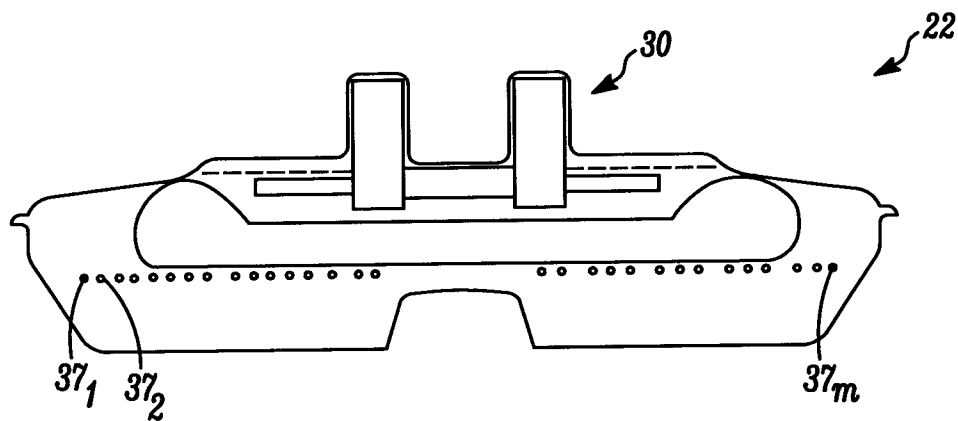


FIG. 37

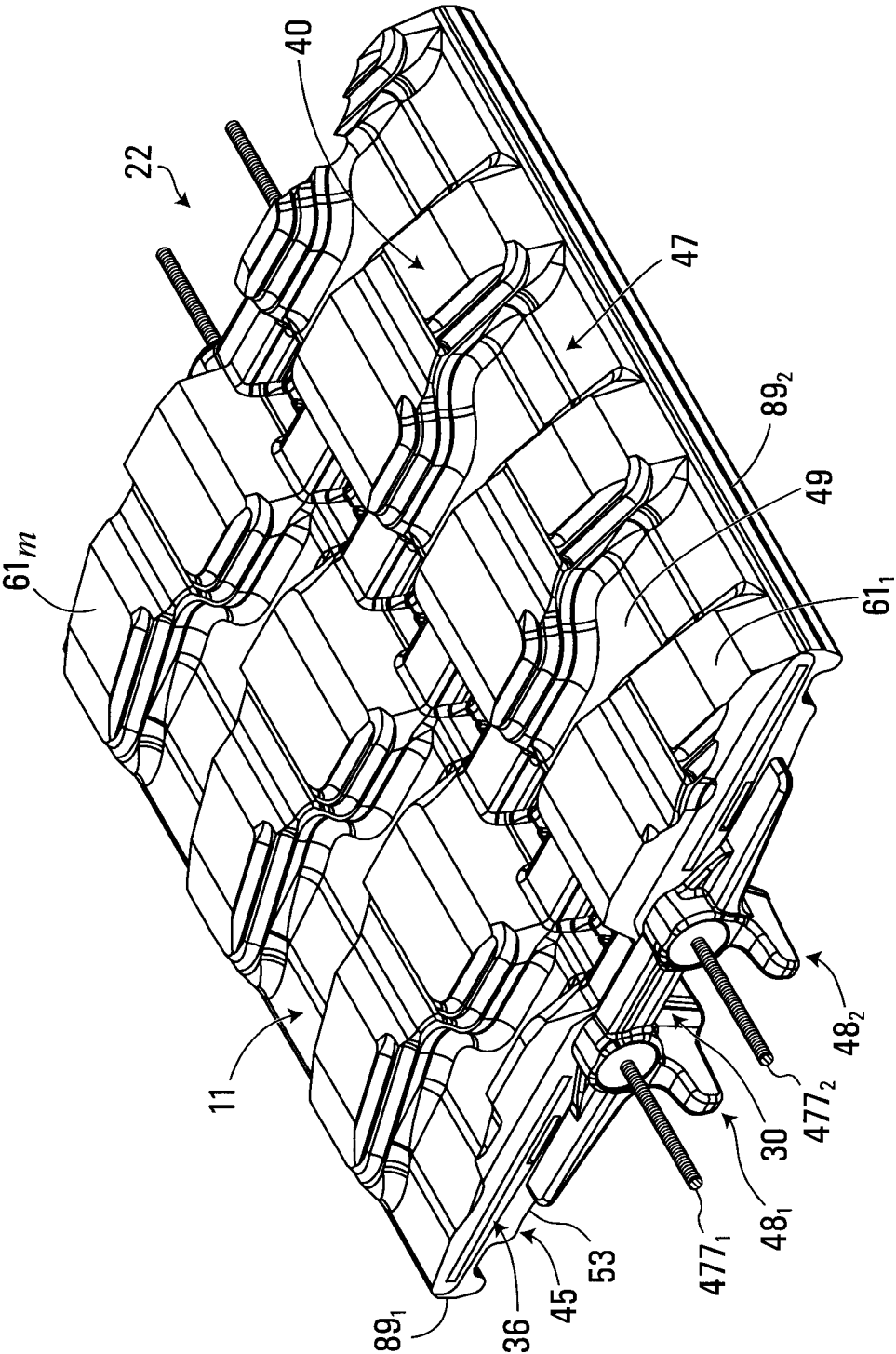


FIG. 38

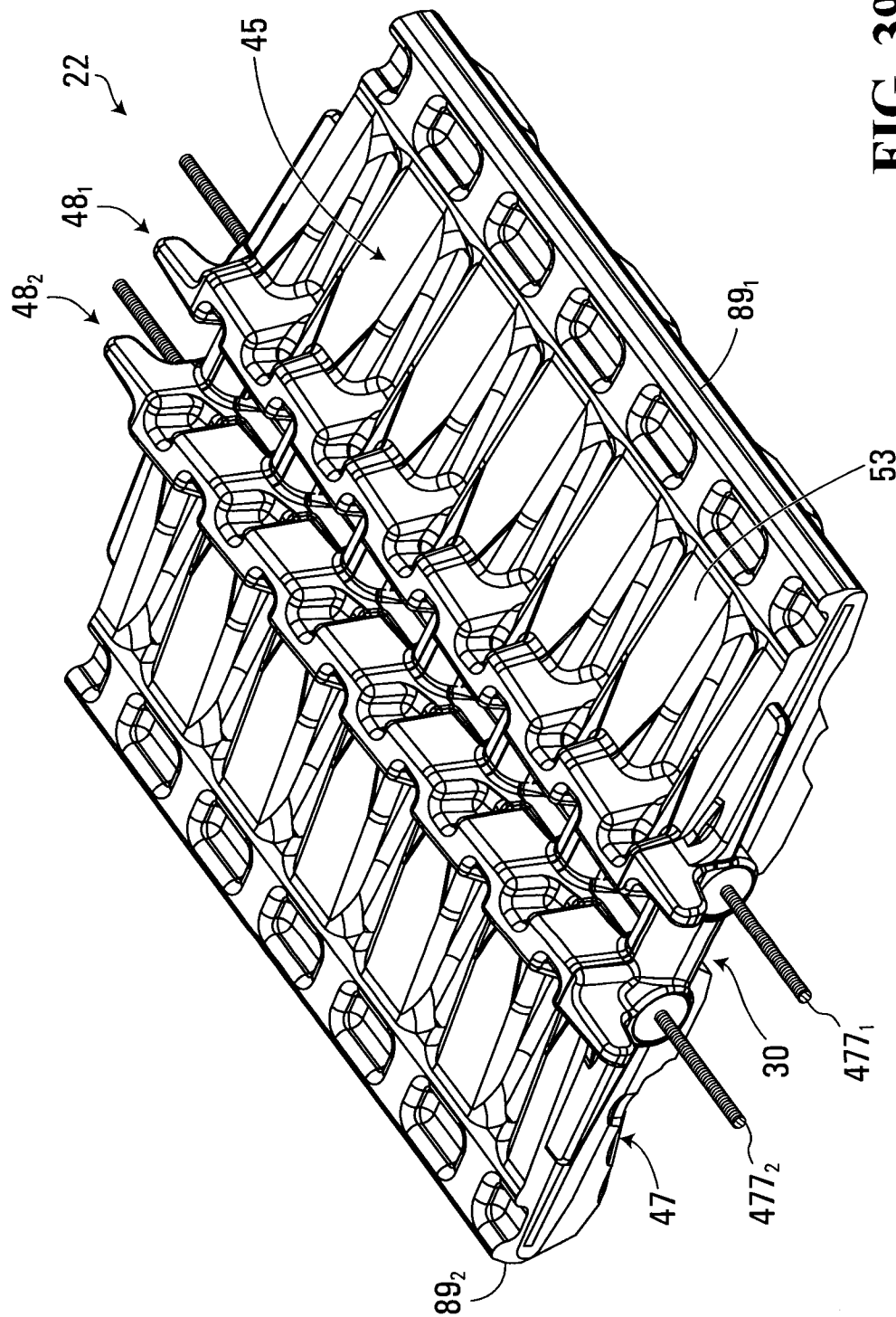


FIG. 39

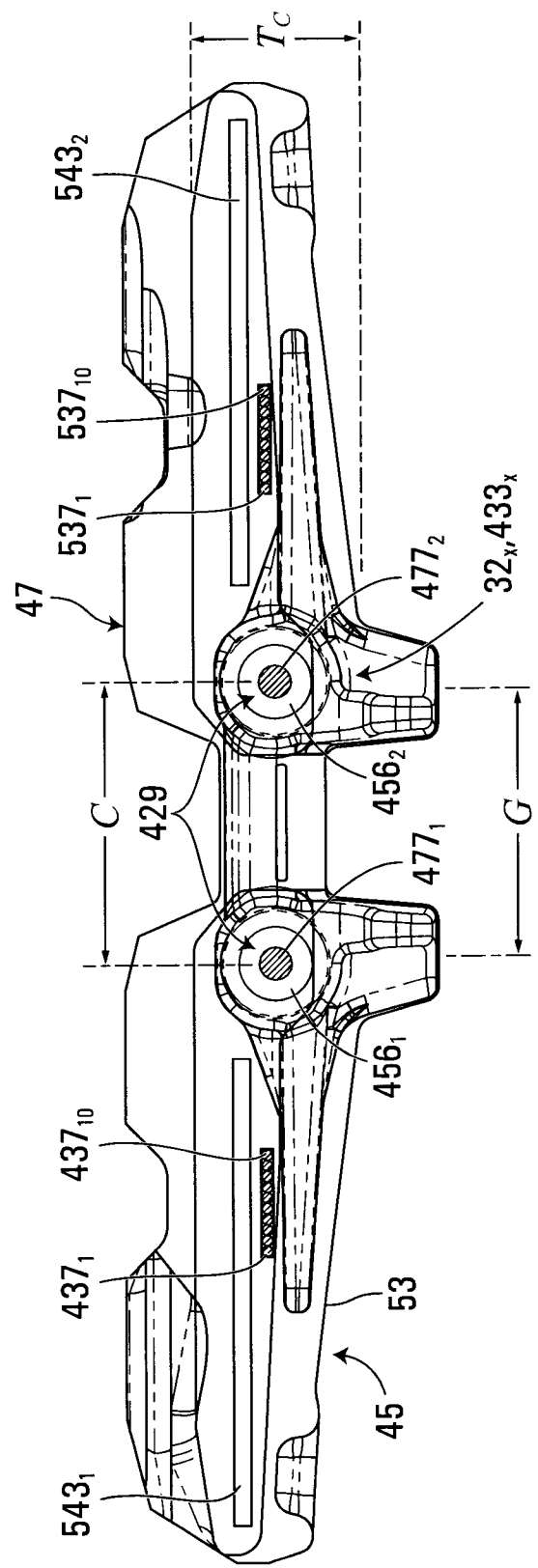


FIG. 40

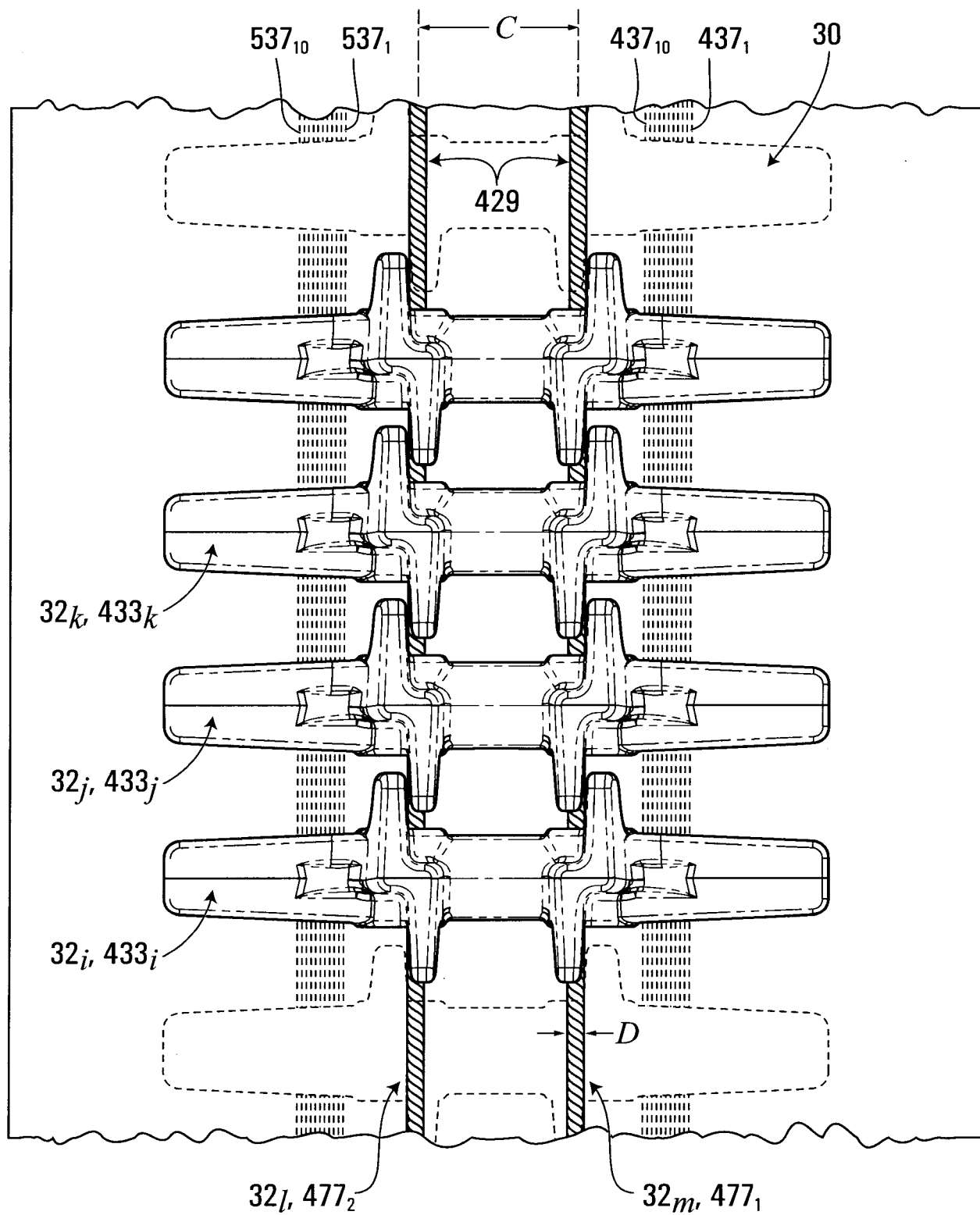
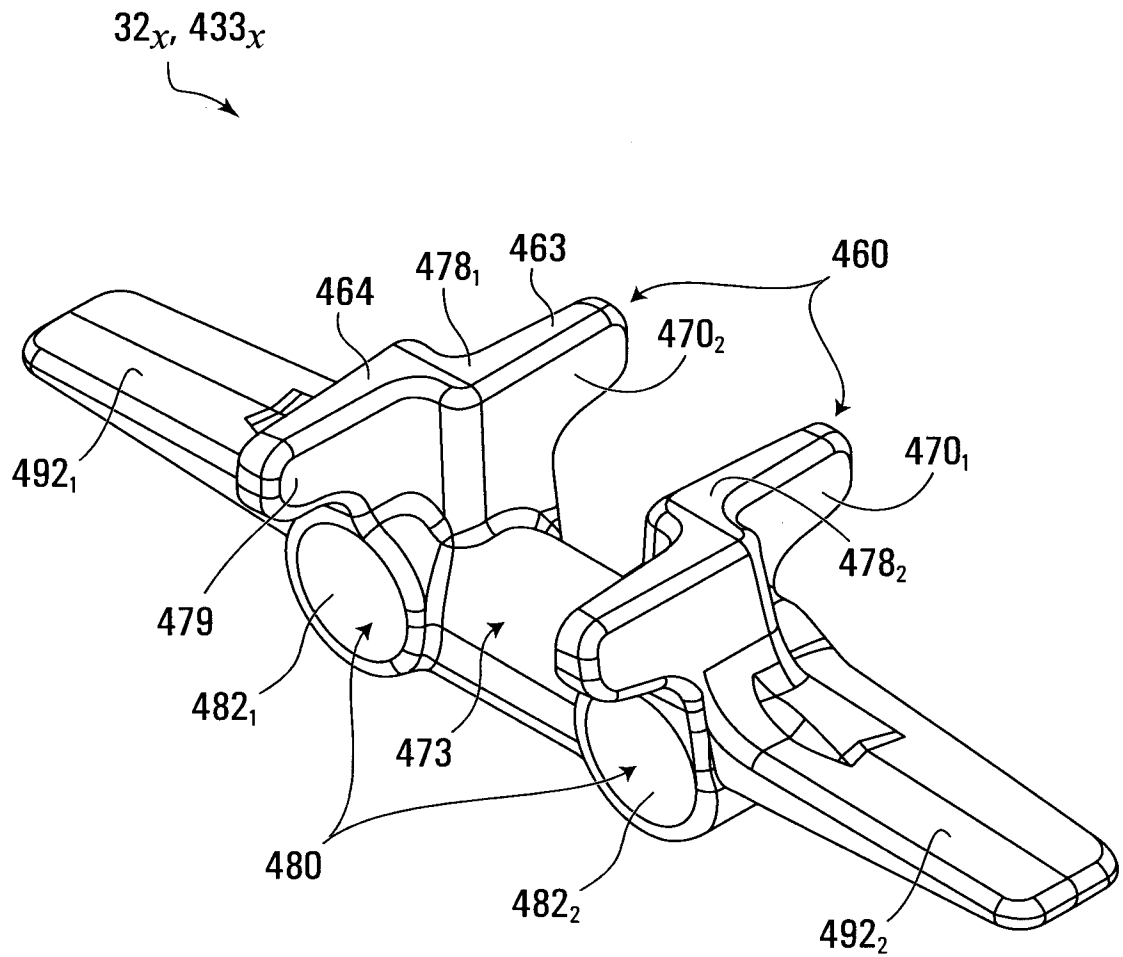


FIG. 41

**FIG. 42**

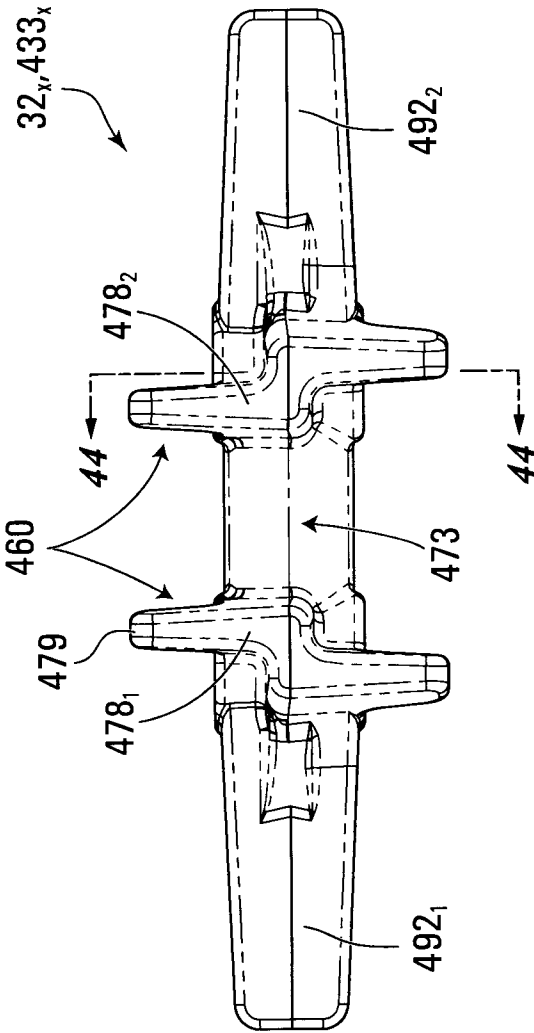


FIG. 43

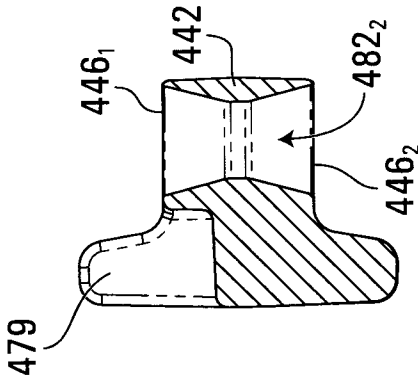


FIG. 44

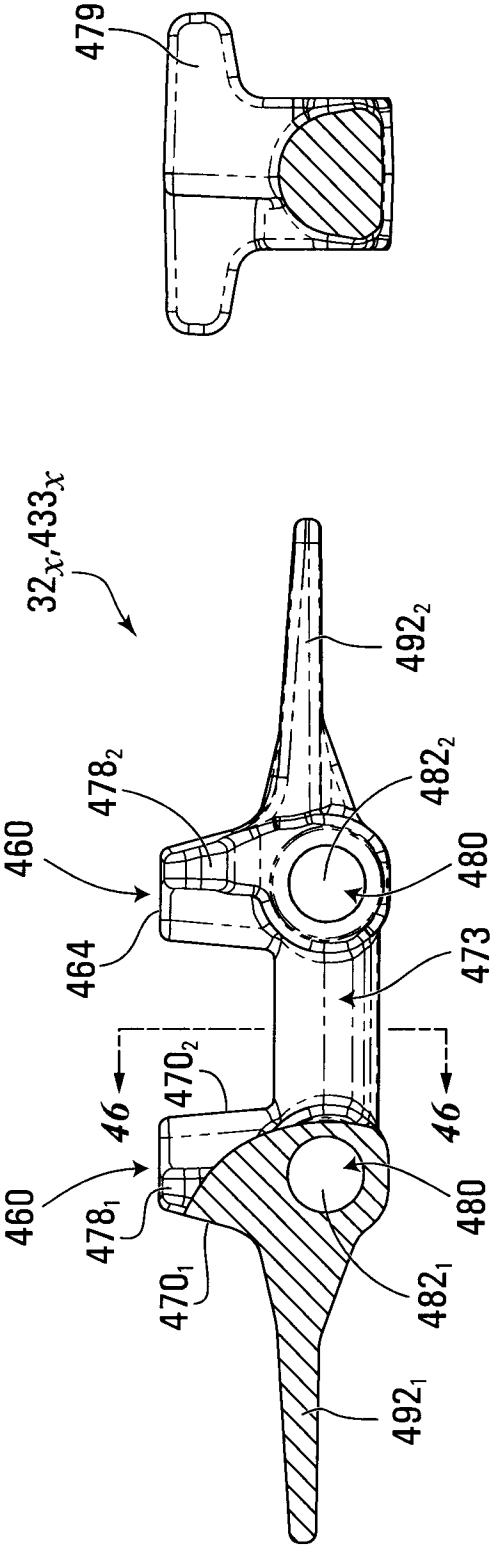


FIG. 45

FIG. 46

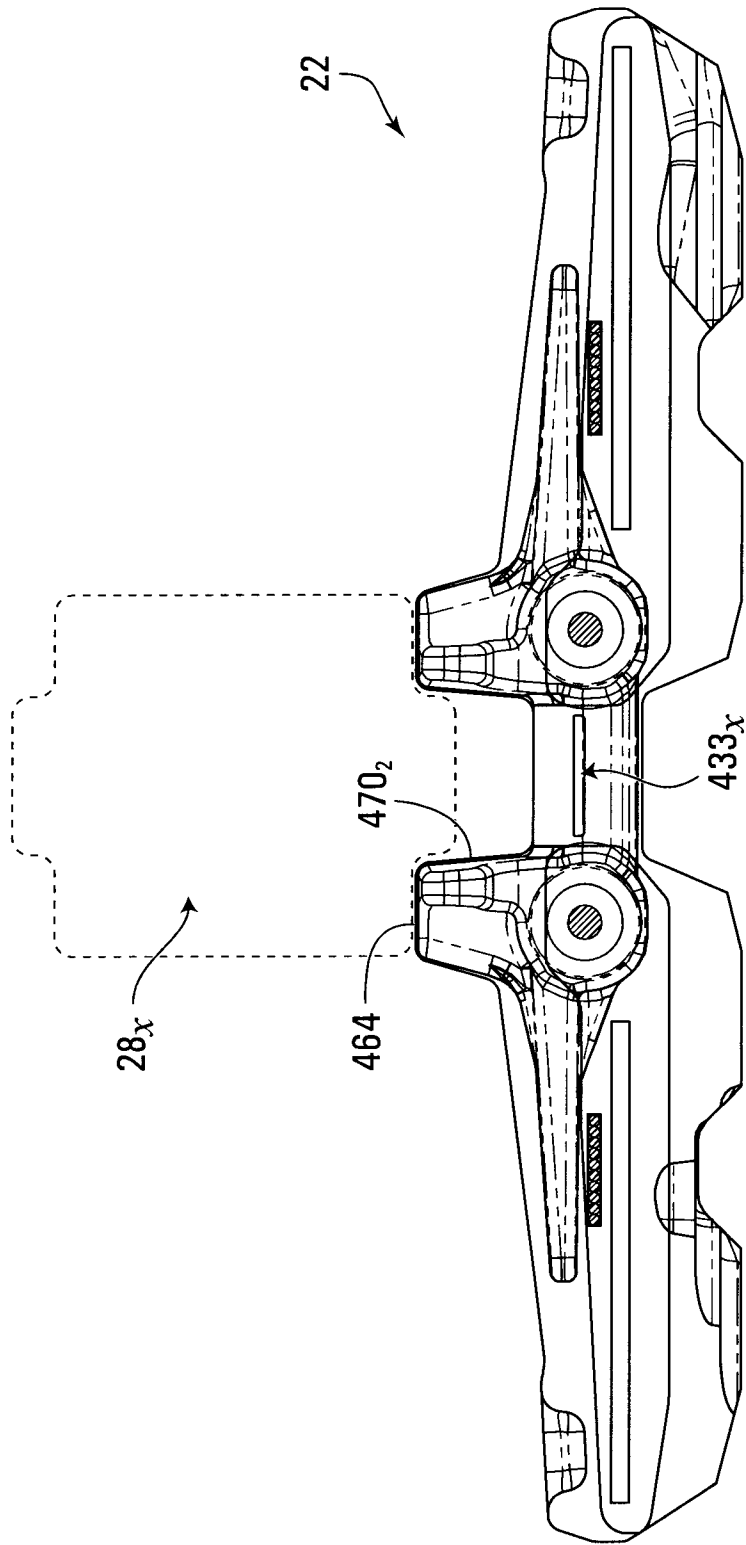
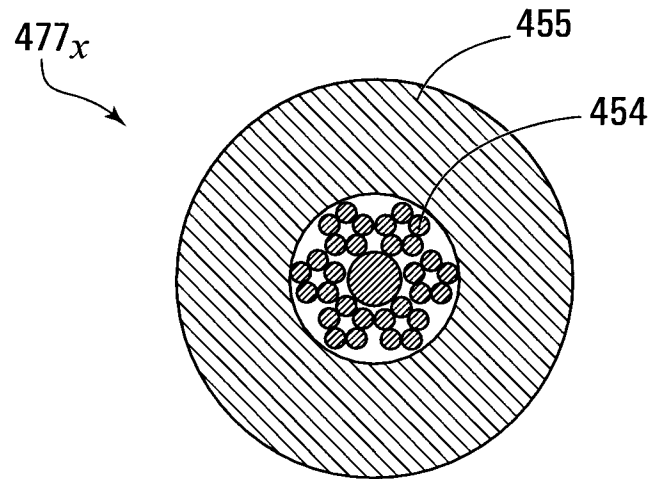


FIG. 47

**FIG. 48**

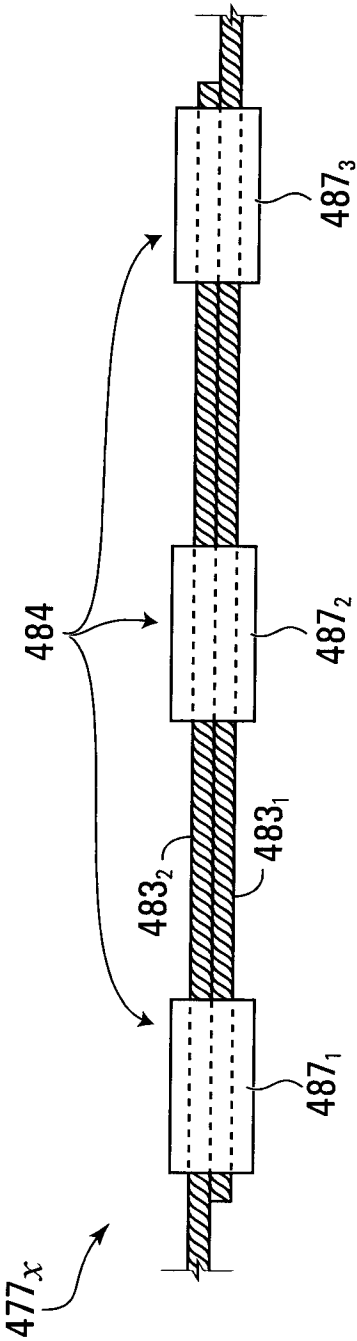


FIG. 49

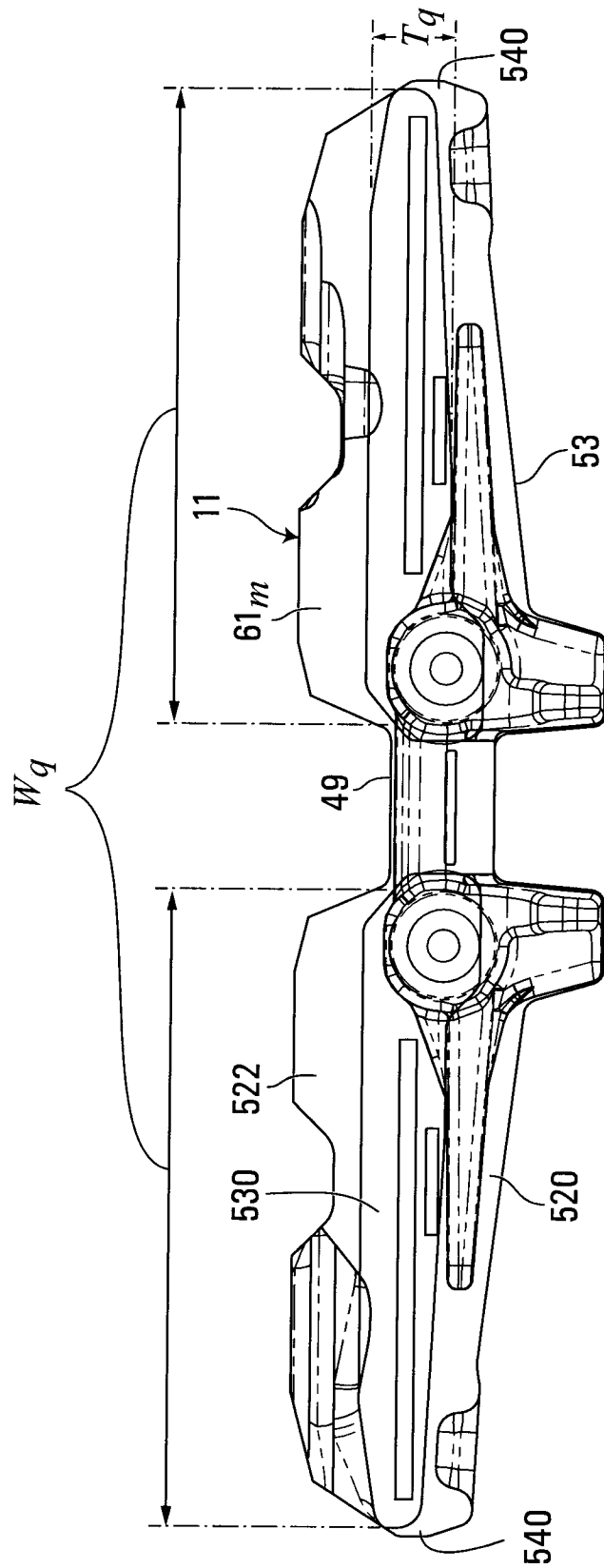


FIG. 50

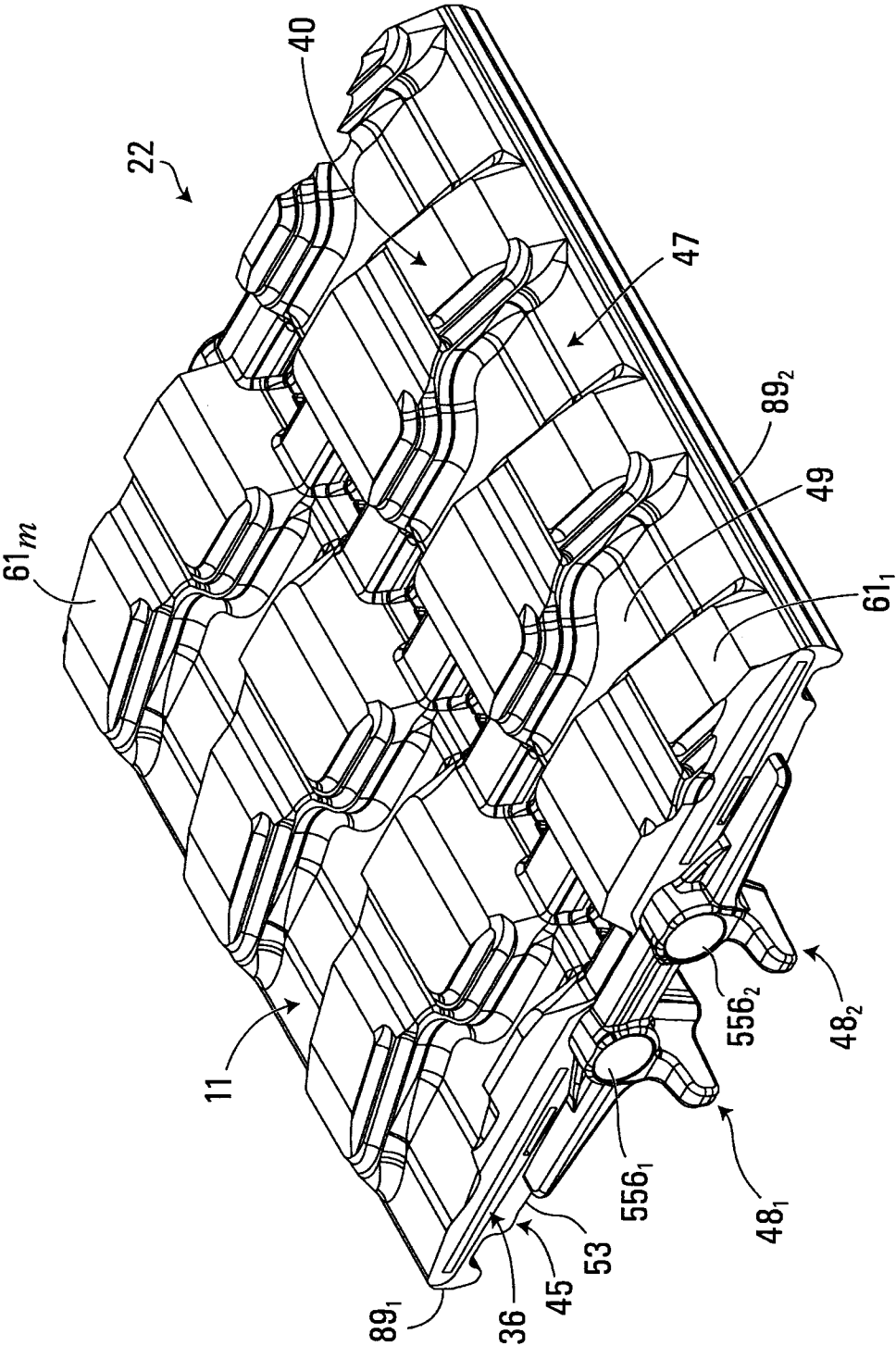


FIG. 51

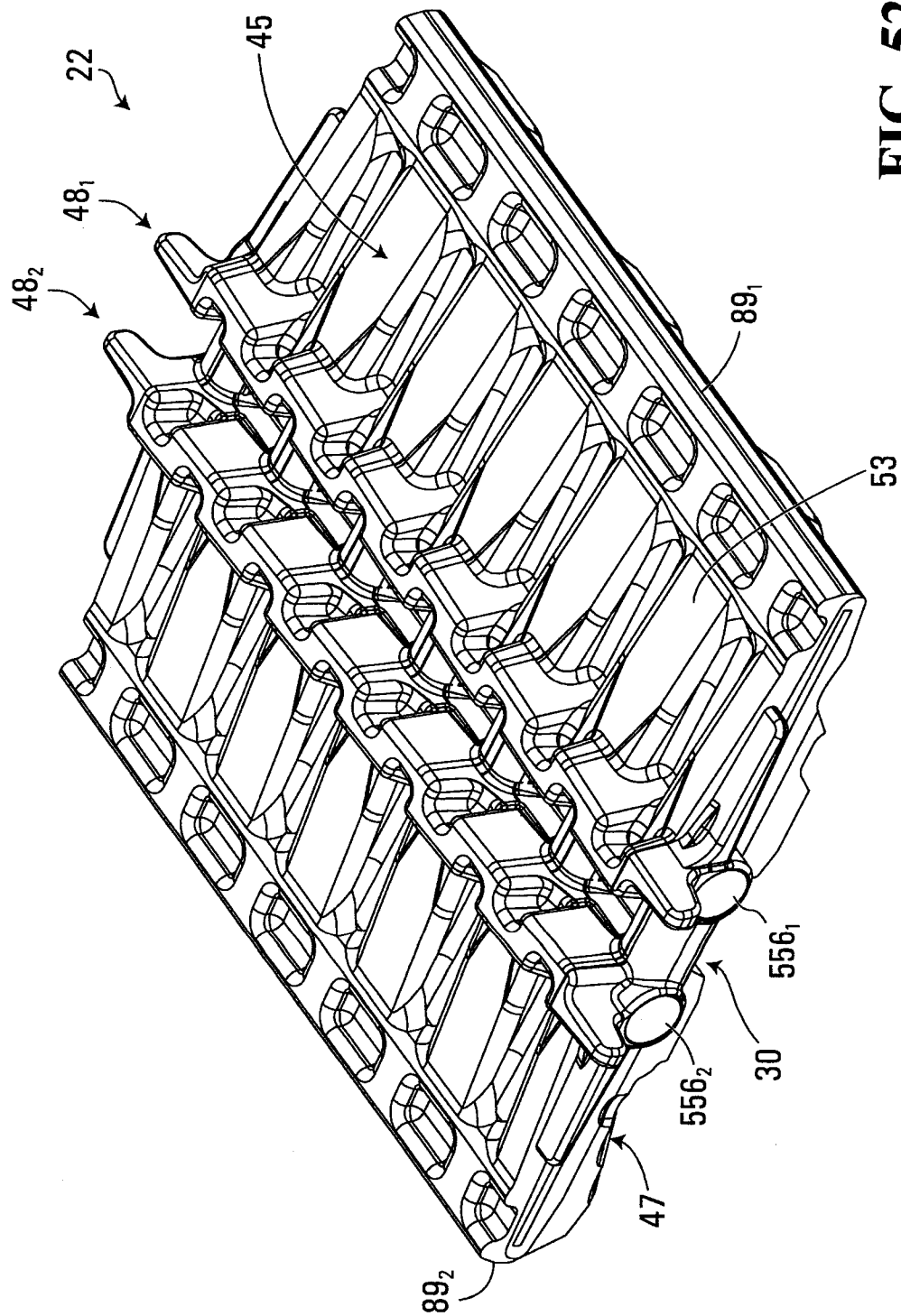


FIG. 52

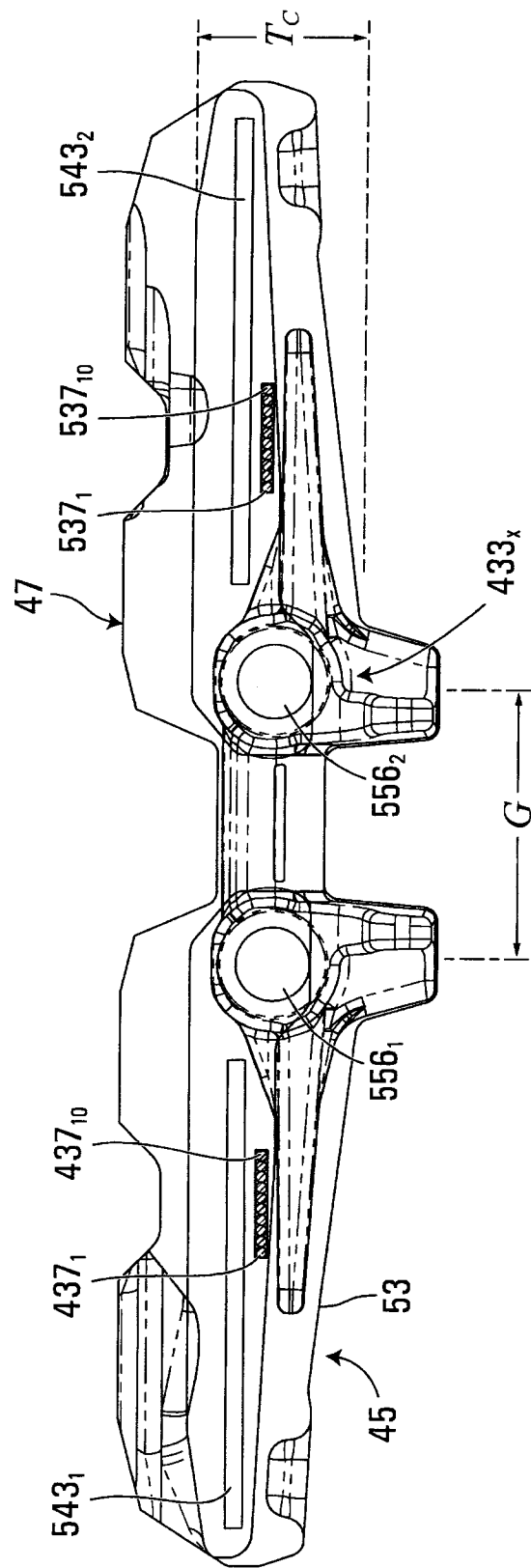
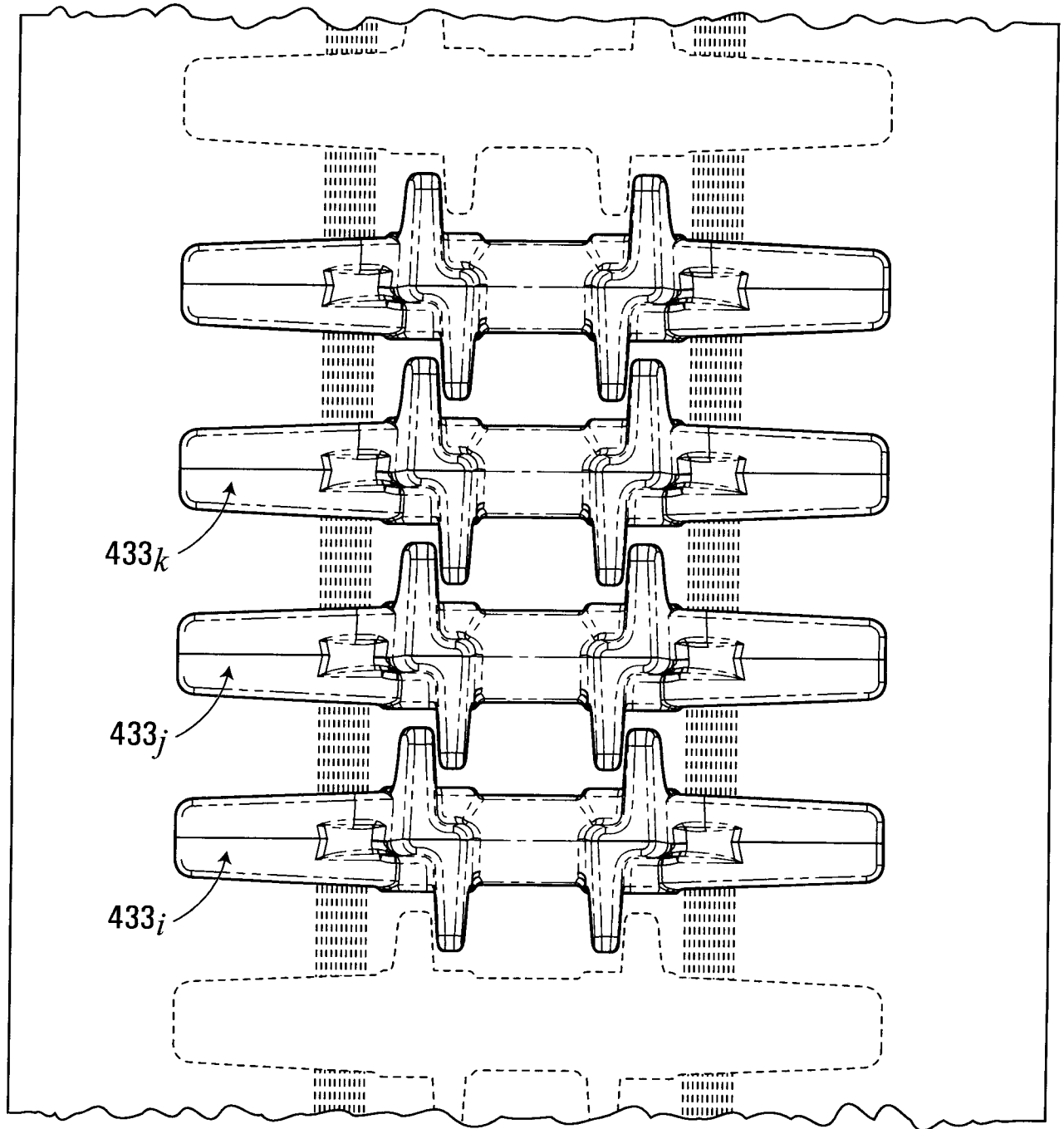


FIG. 53

**FIG. 54**

INTERNATIONAL SEARCH REPORT

International application No.

PCT/CA2014/000262

A. CLASSIFICATION OF SUBJECT MATTER
IPC: **B62D 55/08** (2006.01), **B62D 55/24** (2006.01)

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC(2006.01): B62D55/08, B62D55/18 and B62D55/24

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic database(s) consulted during the international search (name of database(s) and, where practicable, search terms used)
Databases: Canadian Patent Database (CPD), EPOQUE (X-Full, Epodoc)
Keywords: CORE, CHANNEL, CABLE, TENSION, GUIDE, OPENING, HOLE, MODULUS

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	US2378427A (MYERS, E. C.) 19 June 1945 (19-06-1945) *Figures 1 – 5*	1 – 4, 7 – 14, 22, 42 and 43 15 – 20
X Y	JPS55119572A (TOGASHI, S.) 13 September 1980 (13-09-1980) *English abstract; Figures 3 – 5*	44, 45 and 47 15 – 20
A	US7377601B2 (KATOH, Y. et al.) 27 May 2008 (27-05-2008) *The whole document*	1 – 47
A	US6474755B1 (PRINGIERS, K.) 05 November 2002 (05-11-2002) *The whole document*	1 – 47
A	US2011316330A1 (DOYLE, R.) 29 December 2011 (29-12-2011) *The whole document*	1 – 47

 Further documents are listed in the continuation of Box C.

 See patent family annex.

* “A” “E” “L” “O” “P”	Special categories of cited documents: document defining the general state of the art which is not considered to be of particular relevance earlier application or patent but published on or after the international filing date document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) document referring to an oral disclosure, use, exhibition or other means document published prior to the international filing date but later than the priority date claimed	“T” “X” “Y” “&”	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art document member of the same patent family
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Date of the actual completion of the international search
05 June 2014 (05-06-2014)

Date of mailing of the international search report
02 July 2014 (02-07-2014)

Name and mailing address of the ISA/CA
Canadian Intellectual Property Office
Place du Portage I, C114 - 1st Floor, Box PCT
50 Victoria Street
Gatineau, Quebec K1A 0C9
Facsimile No.: 001-819-953-2476

Authorized officer

Adeeb Zarifa (819) 934-2692

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CA2014/000262

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of the first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claim Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claim Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claim Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

Group A (Claims 1 – 43) is directed to an endless track comprising cores, each core comprising at least one channel extending through the core and at least one cable passing through the at least one channel of each of the cores; and

Group B (claims 44 – 47) is directed to an endless track having an elastomeric body comprising peripheral elastomeric material and internal elastomeric material.

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☒ As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claim Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claim Nos.:

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- ☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- ☐ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.

PCT/CA2014/000262

Patent Document Cited in Search Report	Publication Date	Patent Family Member(s)	Publication Date
US2378427A	19 June 1945 (19-06-1945)	None	
JPS55119572A	13 September 1980 (13-09-1980)	JPS55119572A	13 September 1980 (13-09-1980)
		JPS5743470B2	14 September 1982 (14-09-1982)
US7377601B2	27 May 2008 (27-05-2008)	US2004150263A1	05 August 2004 (05-08-2004)
		CN1518509A	04 August 2004 (04-08-2004)
		CN100352720C	05 December 2007 (05-12-2007)
		DE60229244D1	20 November 2008 (20-11-2008)
		EP1398252A1	17 March 2004 (17-03-2004)
		EP1398252A4	31 January 2007 (31-01-2007)
		EP1398252B1	08 October 2008 (08-10-2008)
		WO03000537A1	03 January 2003 (03-01-2003)
		JP2003002263A	08 January 2003 (08-01-2003)
		JP4809549B2	09 November 2011 (09-11-2011)
US6474755B1	05 November 2002 (05-11-2002)	US6474755B1	05 November 2002 (05-11-2002)
		AT270996T	15 July 2004 (15-07-2004)
		BE1012369A3	03 October 2000 (03-10-2000)
		DE69918647D1	19 August 2004 (19-08-2004)
		DE69918647T2	24 March 2005 (24-03-2005)
		EP1013542A1	28 June 2000 (28-06-2000)
		EP1013542B1	14 July 2004 (14-07-2004)
		ES2224591T3	01 March 2005 (01-03-2005)
		JP2000190881A	11 July 2000 (11-07-2000)
		JP3479014B2	15 December 2003 (15-12-2003)
US2011316330A1	29 December 2011 (29-12-2011)	US2011316330A1	29 December 2011 (29-12-2011)
		WO2011163504A2	29 December 2011 (29-12-2011)
		WO2011163504A3	19 April 2012 (19-04-2012)