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**Lussier et al.**

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(54) **STANDARD COMPONENT OF A VEHICLE WITH A CONNECTOR DEDICATED TO CONNECTING A TRACK SYSTEM TO THE VEHICLE**

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(73) Assignee: **Camso Inc.**, Magog (CA)

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(51) **Int. Cl.**
***B62D 55/04*** (2006.01)
***B60B 35/12*** (2006.01)
(Continued)

(52) **U.S. Cl.**
CPC ..... ***B62D 55/04*** (2013.01); ***B60B 35/12*** (2013.01); ***B60B 35/16*** (2013.01); ***B62D 21/186*** (2013.01);
(Continued)

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See application file for complete search history.

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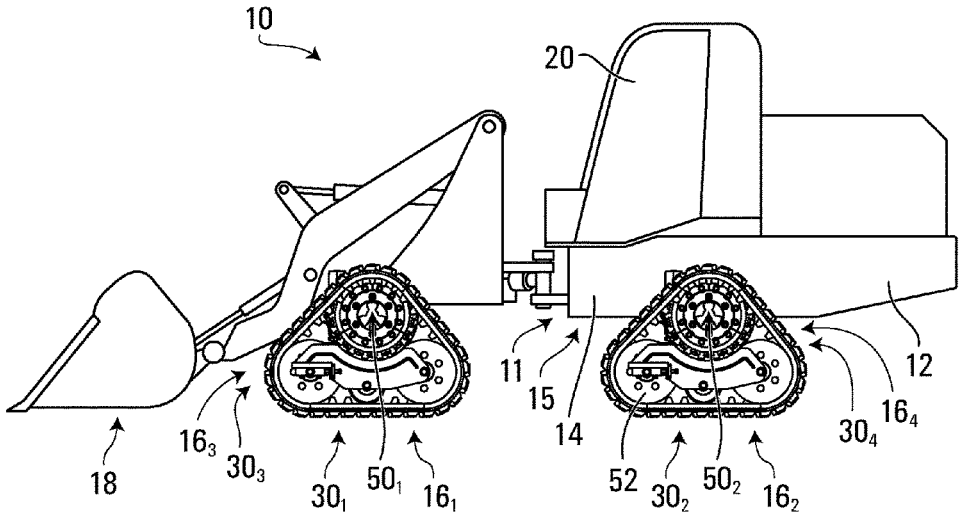
(57) **ABSTRACT**

A standard component of a vehicle equippable with a plurality of wheels or a plurality of track systems for engaging the ground, such as an axle housing or a frame of the vehicle, comprises a connector dedicated to connecting a given one of the track systems to the vehicle and provided during original manufacturing of the standard component of the vehicle. This may facilitate installation of the track systems on the vehicle.

**54 Claims, 17 Drawing Sheets**



(51) **Int. Cl.**

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|---|---|
| ***B60B 35/16*** | (2006.01) |
| ***B62D 21/18*** | (2006.01) |
| ***B62D 27/02*** | (2006.01) |
| ***B62D 55/065*** | (2006.01) |
| ***B62D 55/084*** | (2006.01) |
| ***E02F 9/02*** | (2006.01) |
| ***E02F 9/08*** | (2006.01) |

(52) **U.S. Cl.**

CPC ..... ***B62D 27/02*** (2013.01); ***B62D 55/065*** (2013.01); ***B62D 55/084*** (2013.01); ***E02F 9/02*** (2013.01); ***E02F 9/0808*** (2013.01); *B62D 55/0655* (2013.01)

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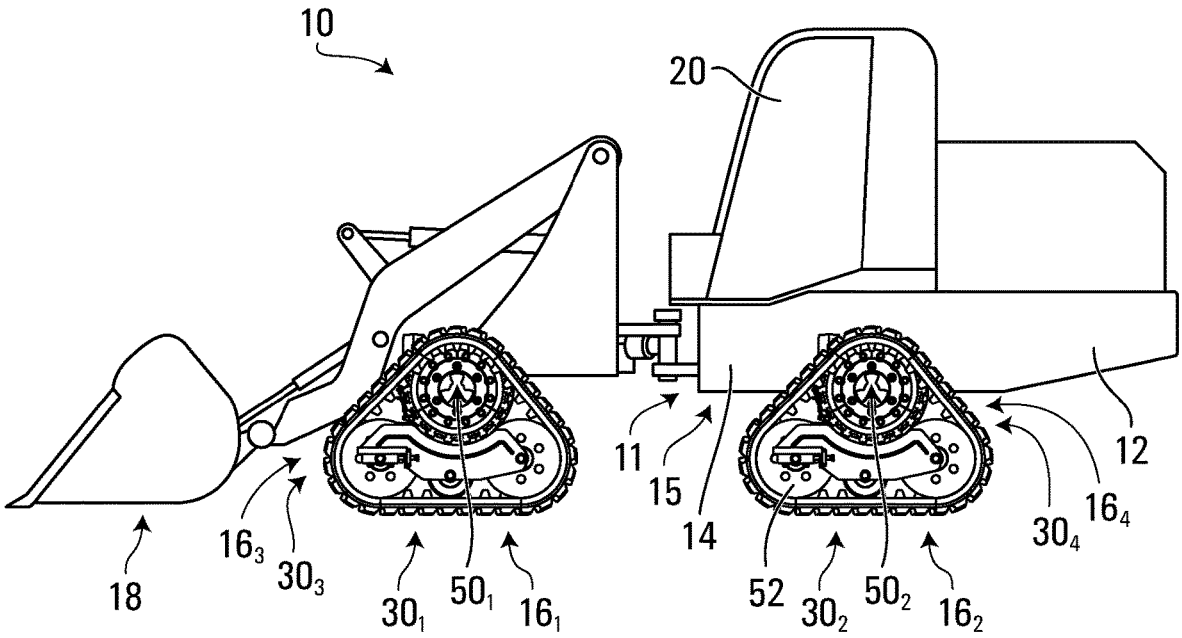
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FIG. 1

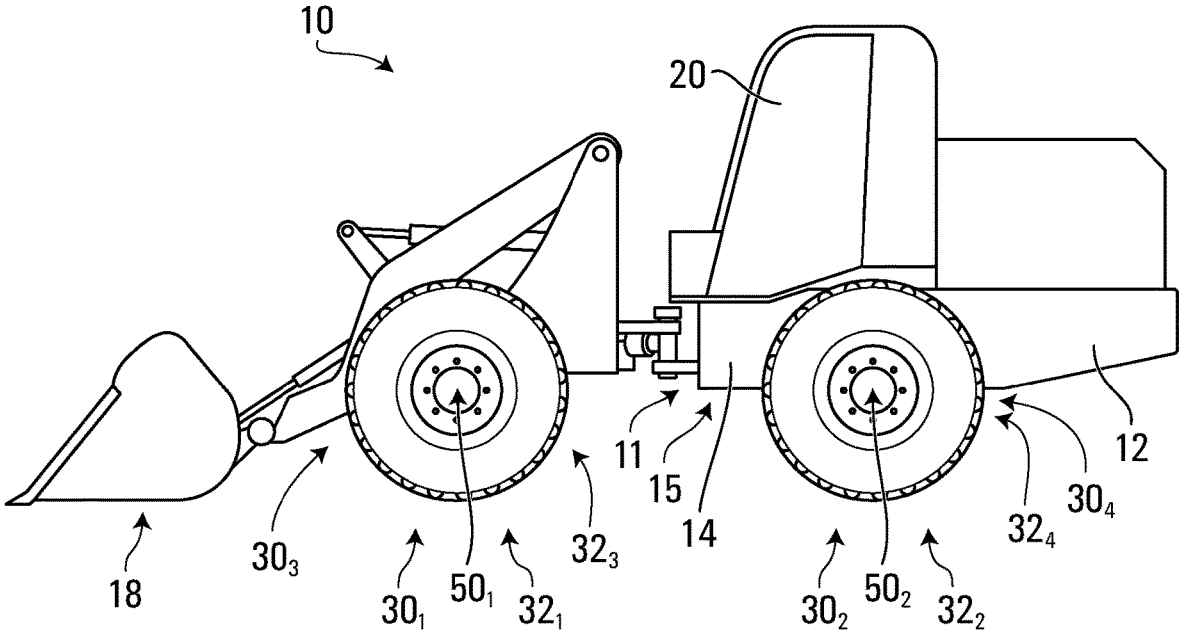
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FIG. 2

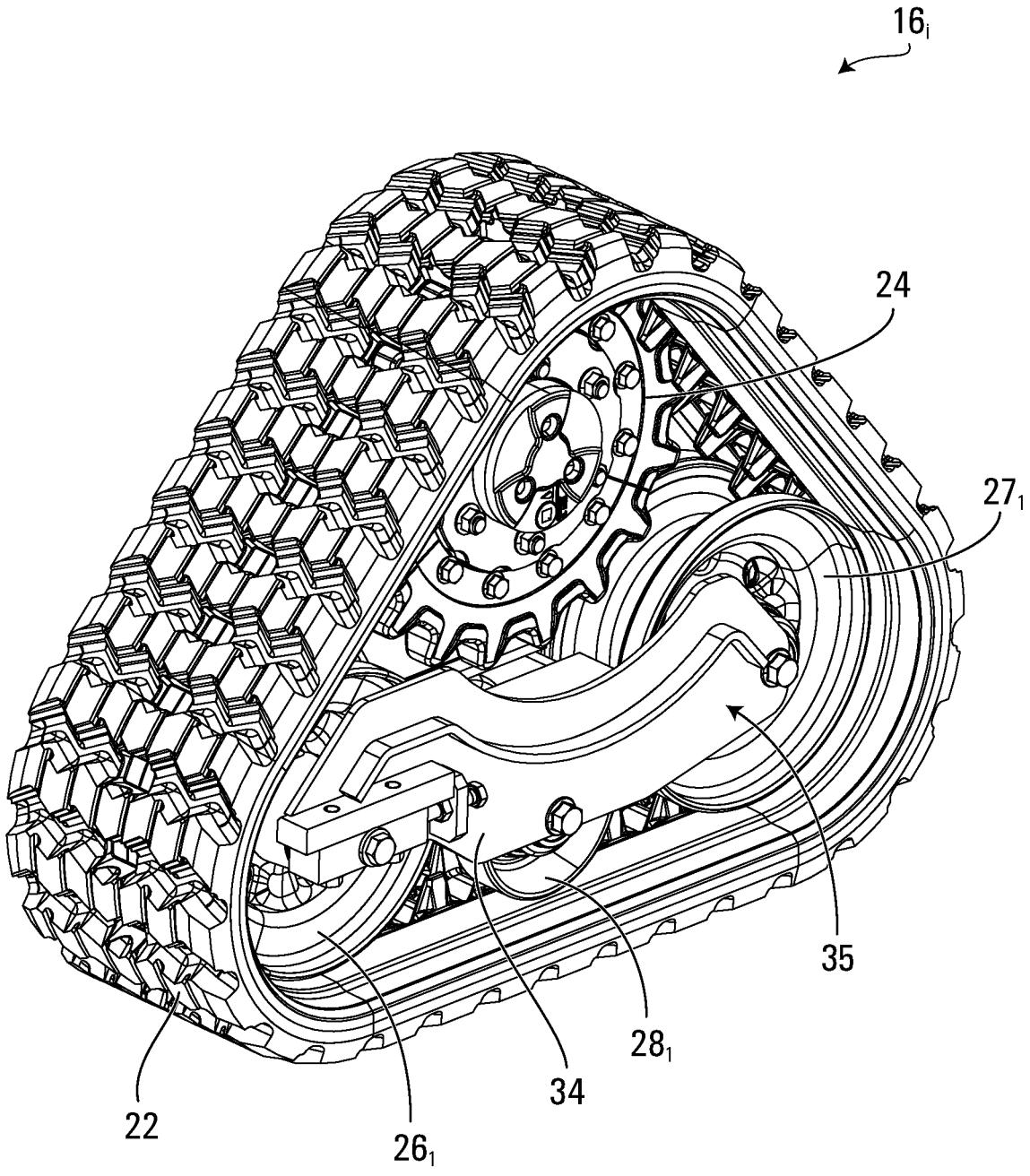


FIG. 3

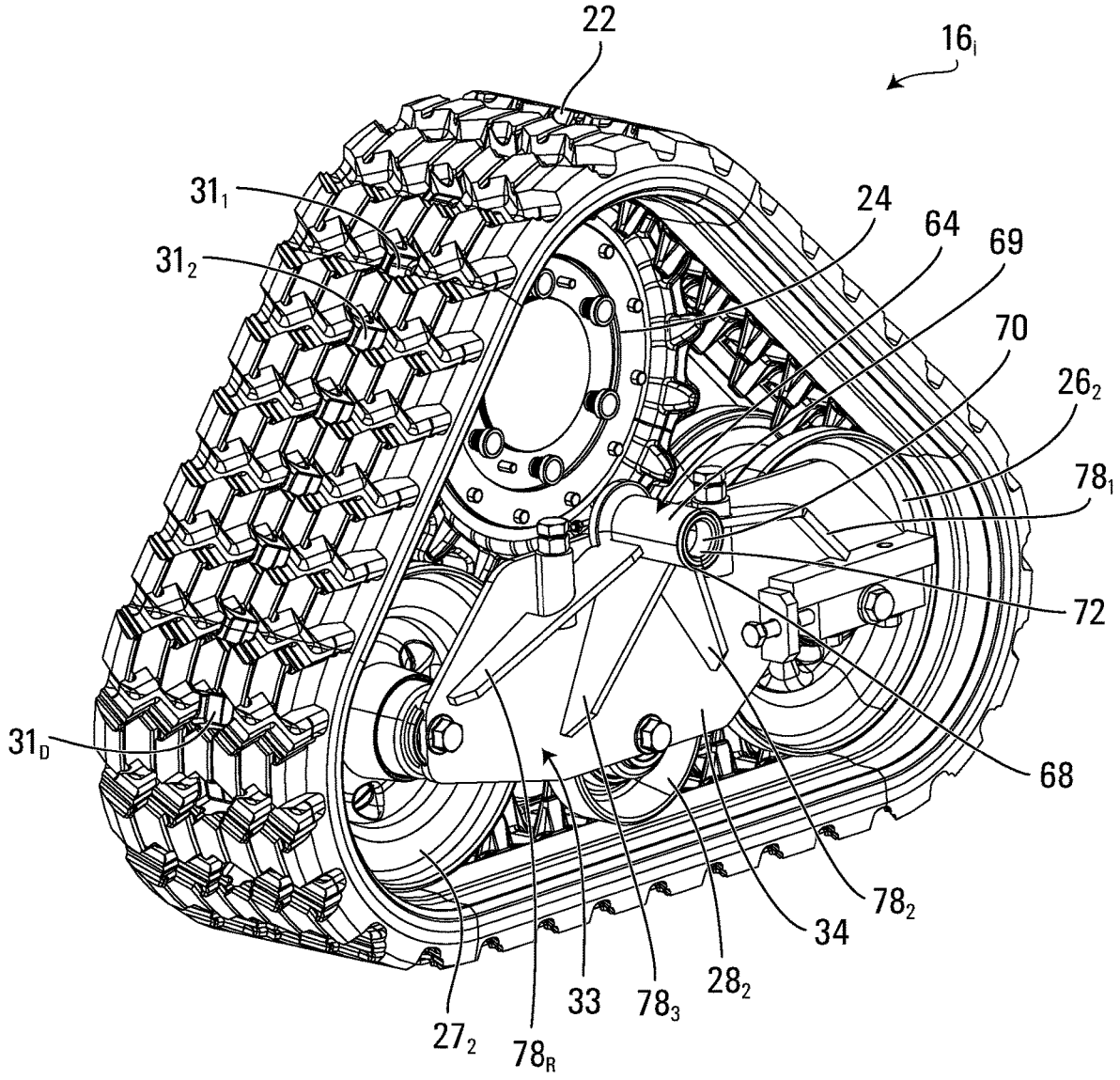
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FIG. 4

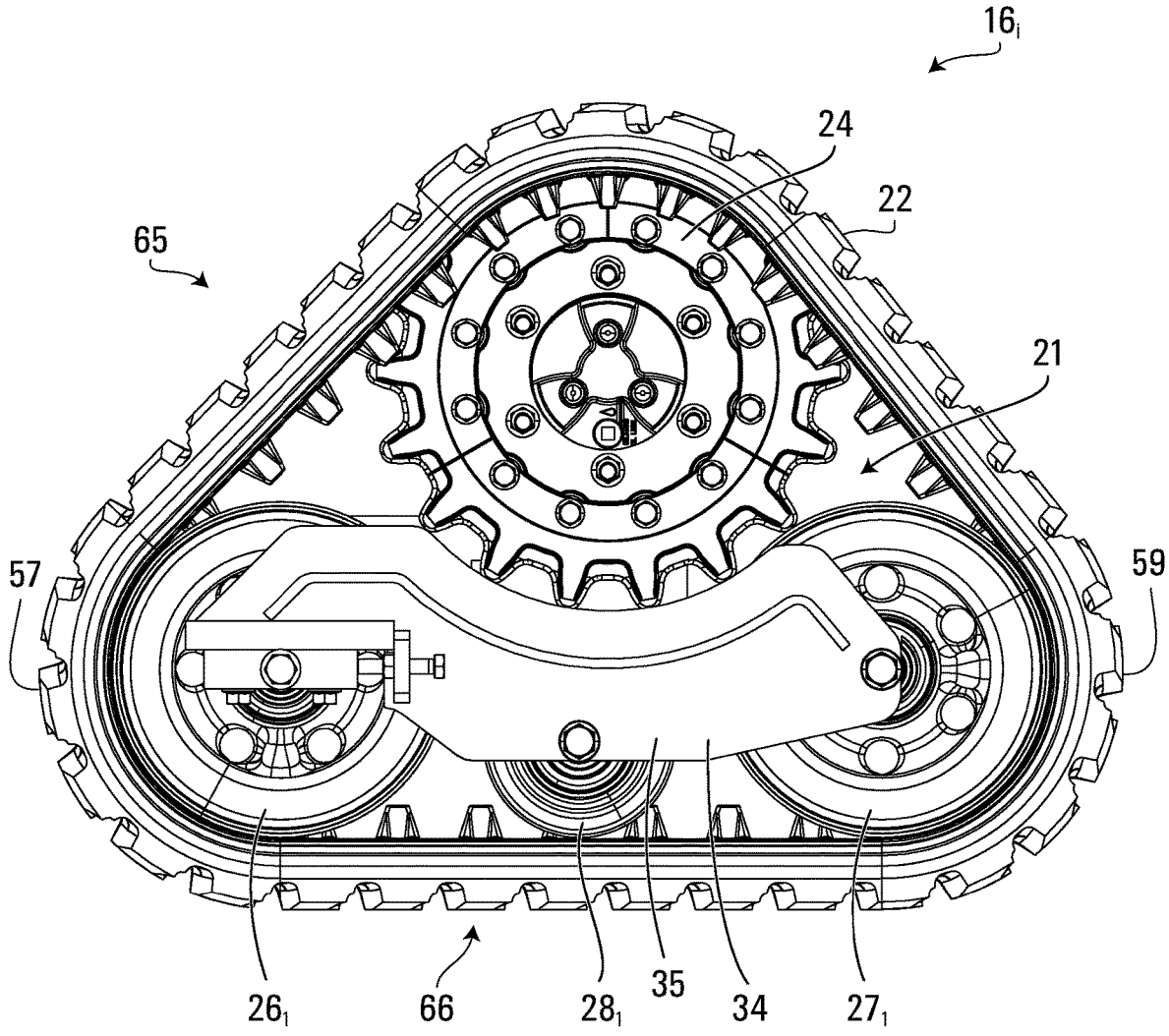


FIG. 5

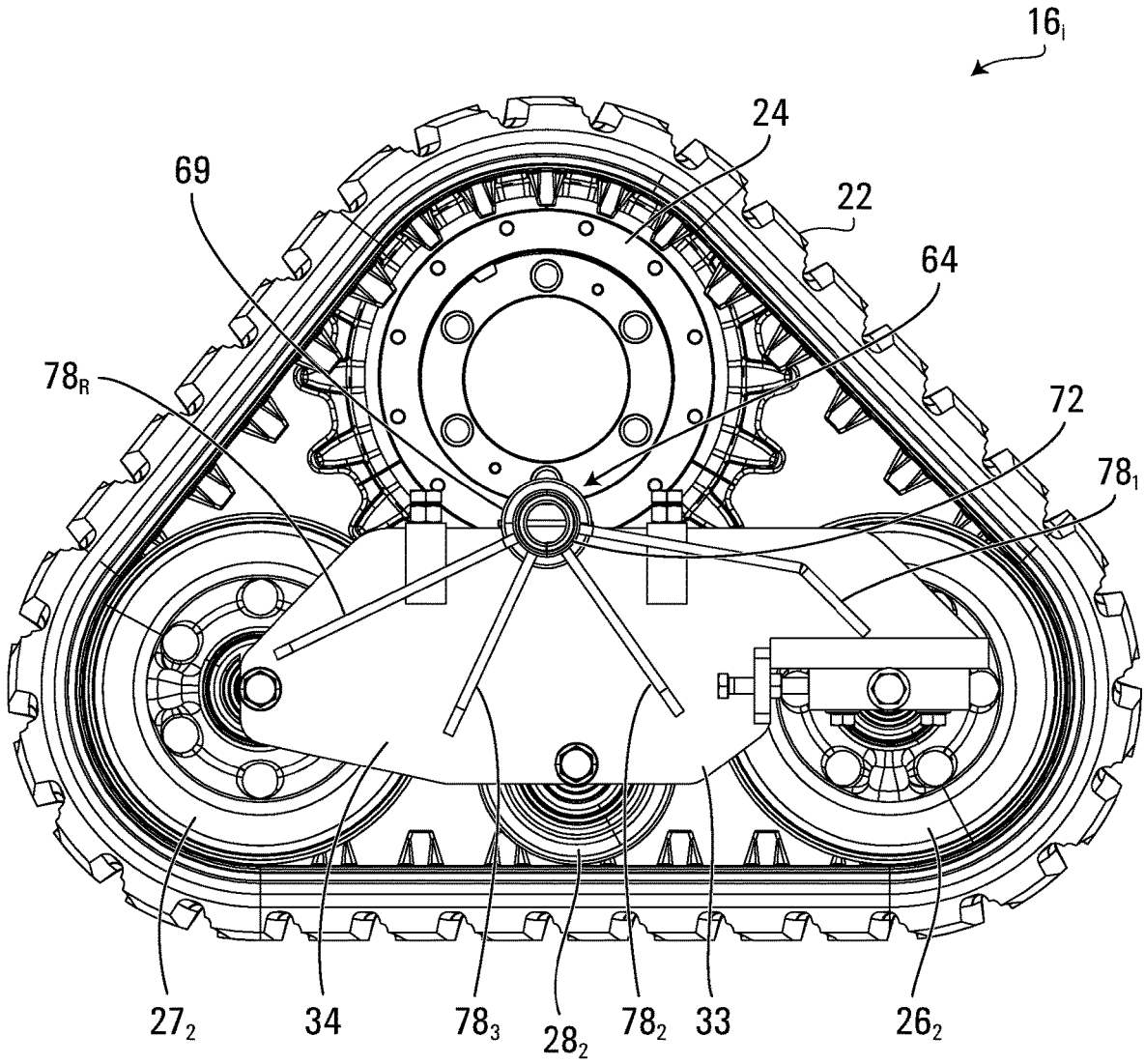


FIG. 6

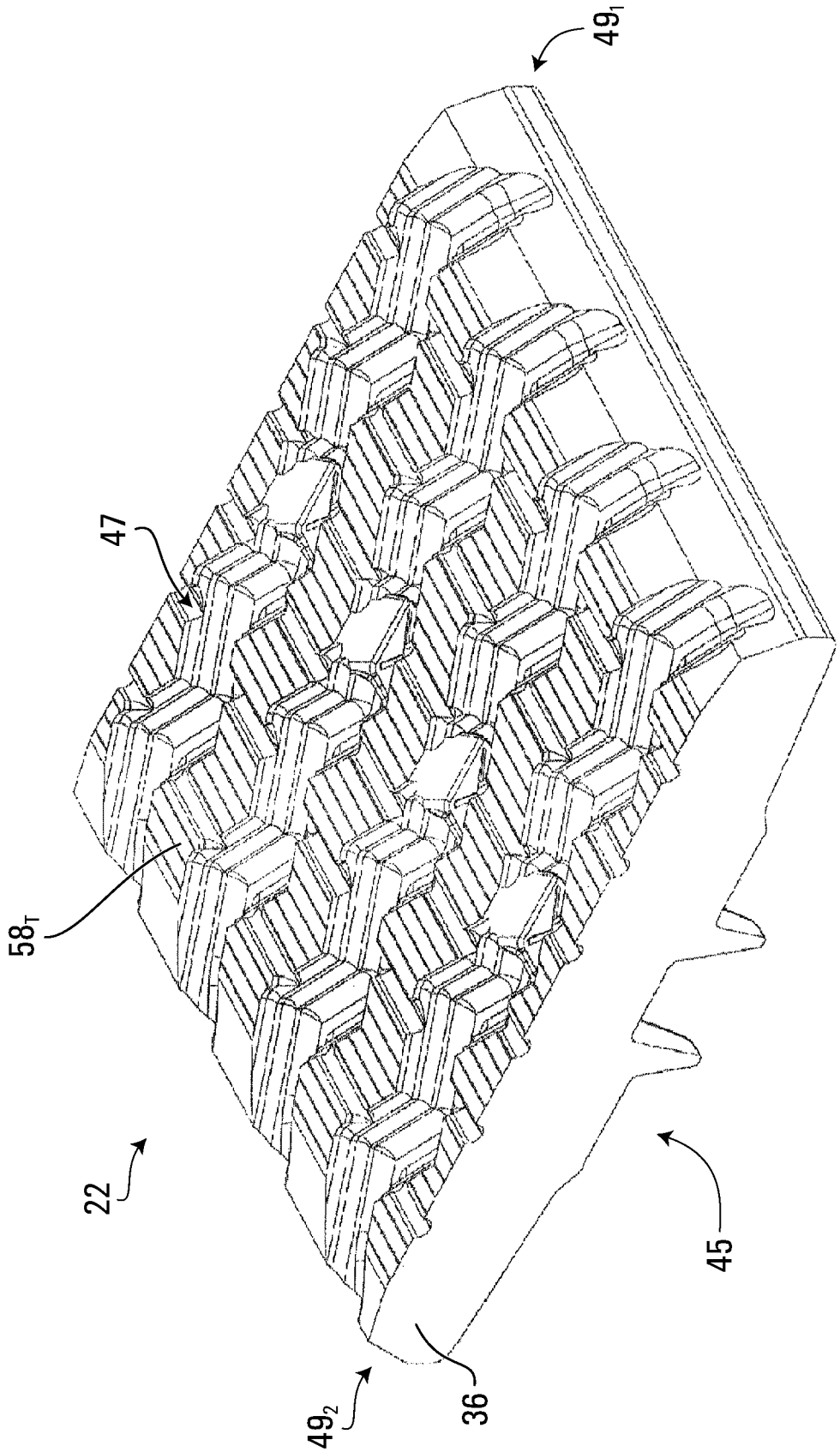


FIG. 7

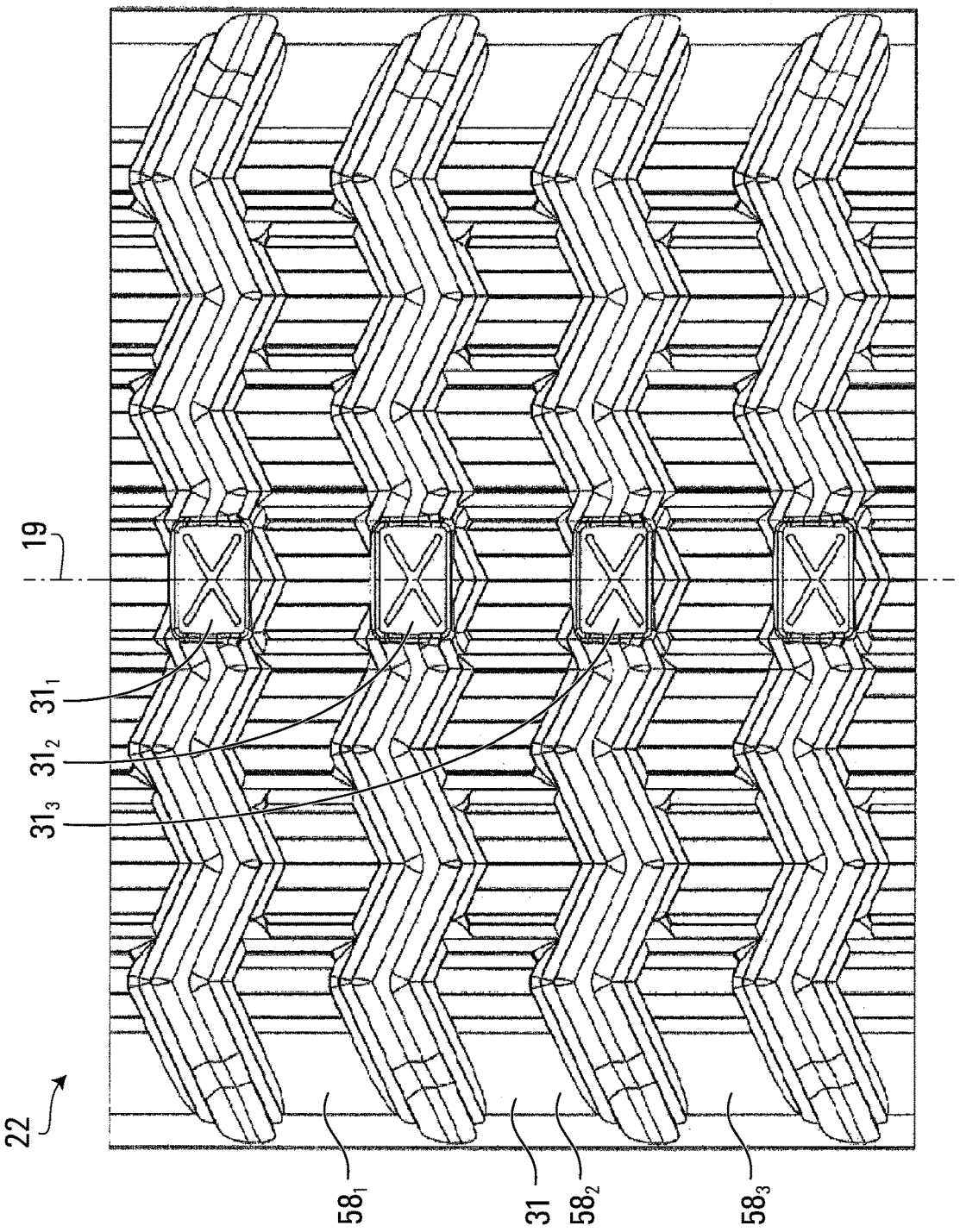


FIG. 8

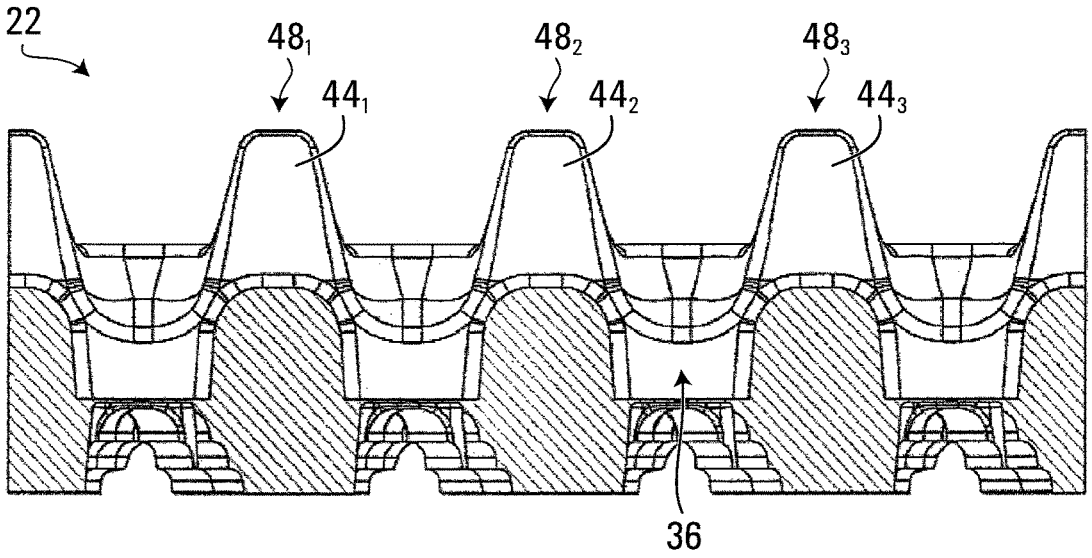
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FIG. 9

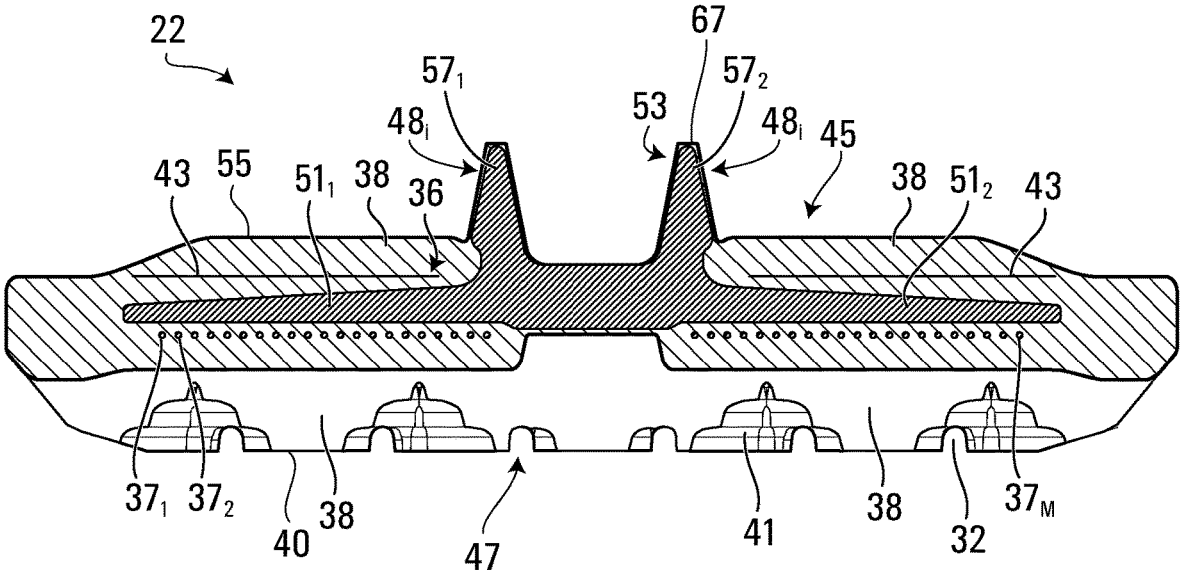
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FIG. 10

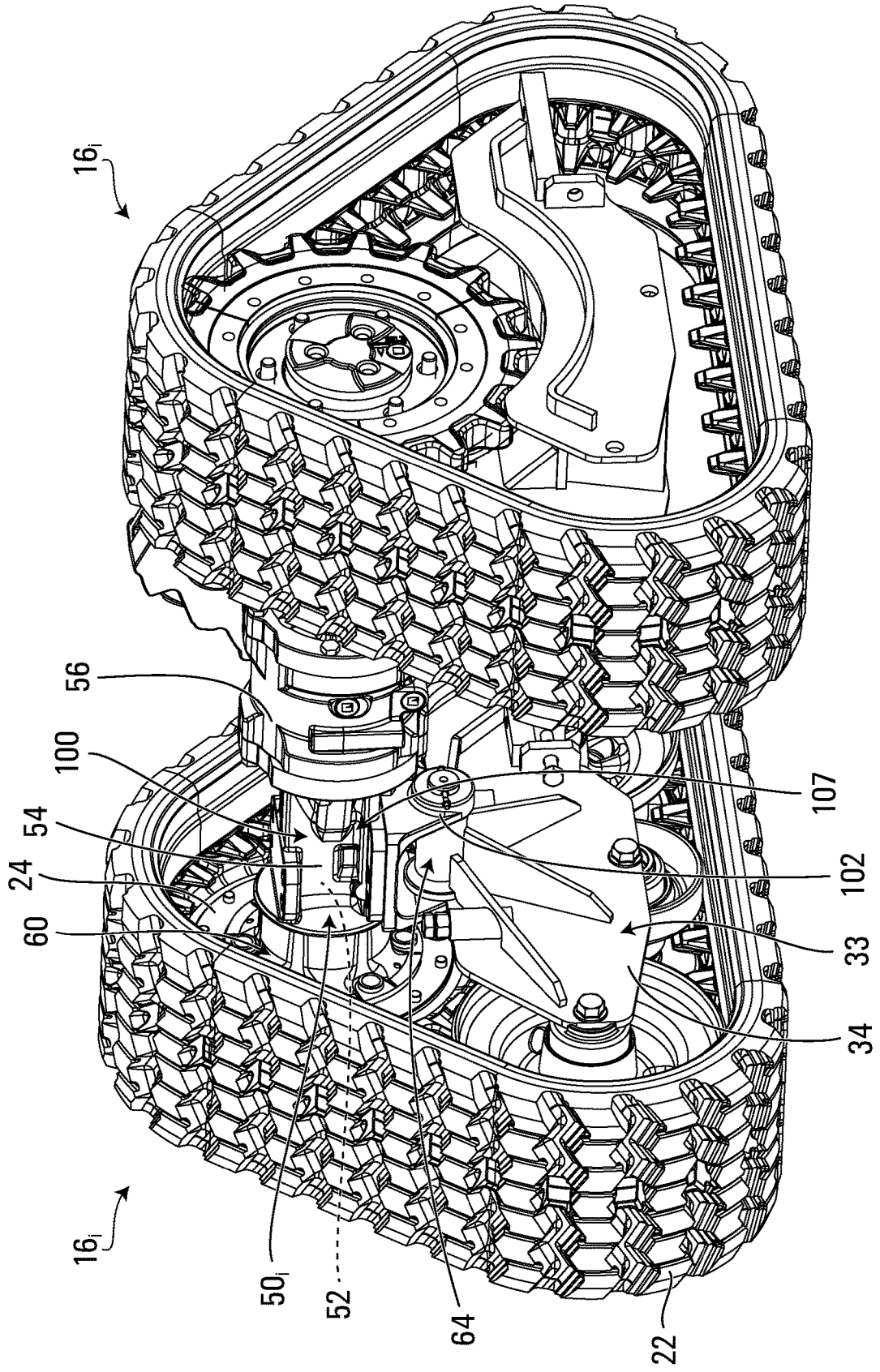


FIG. 11A

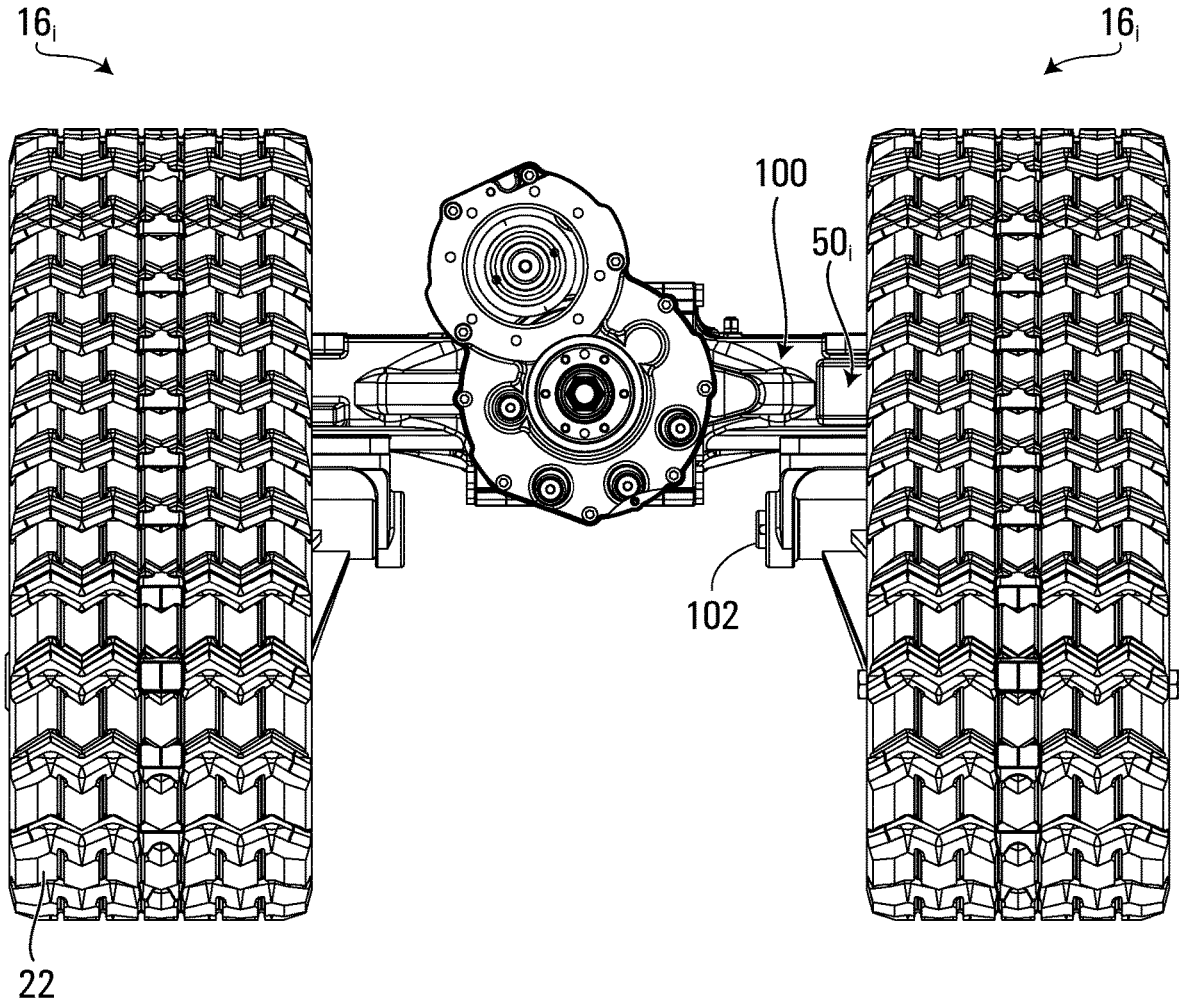


FIG. 11B

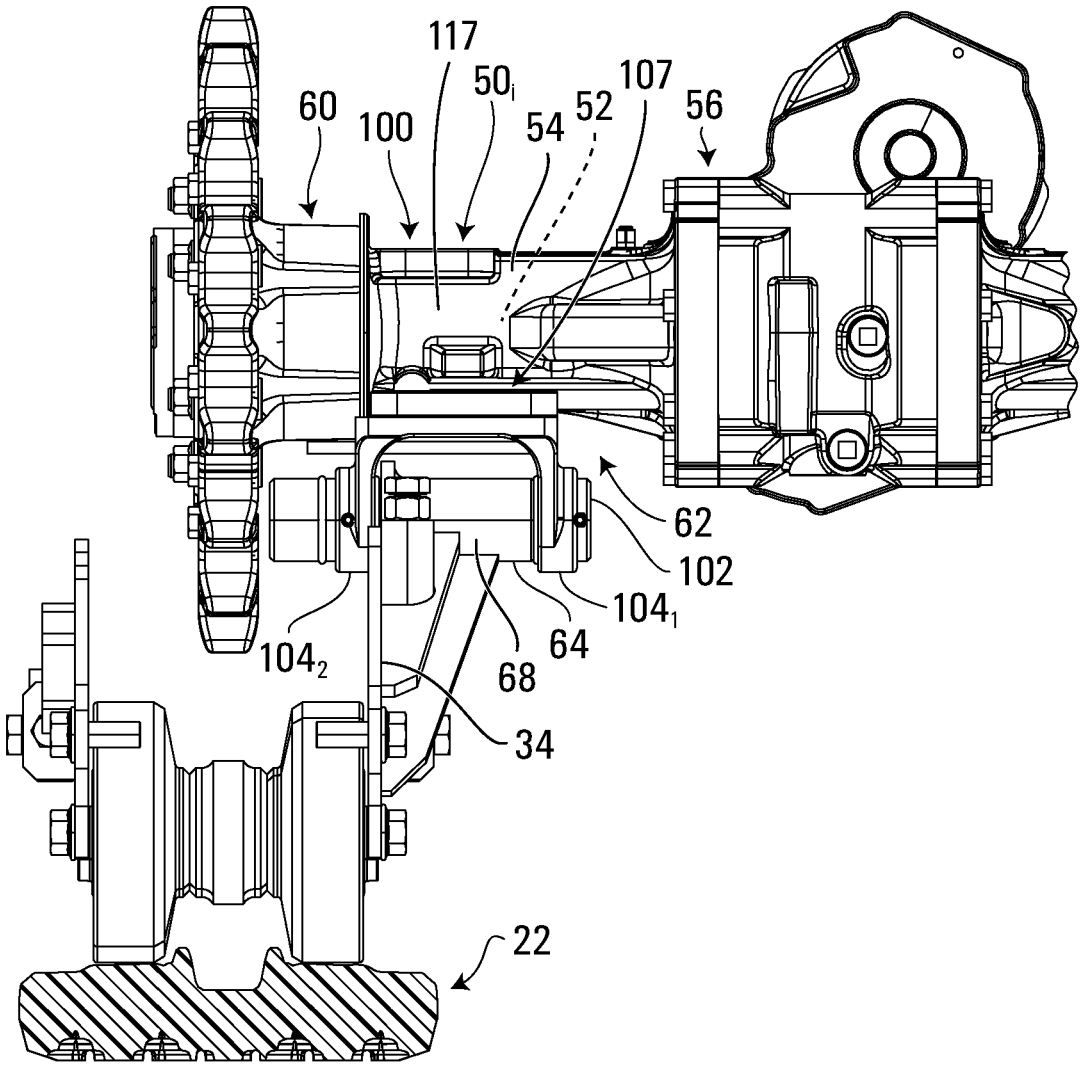


FIG. 12

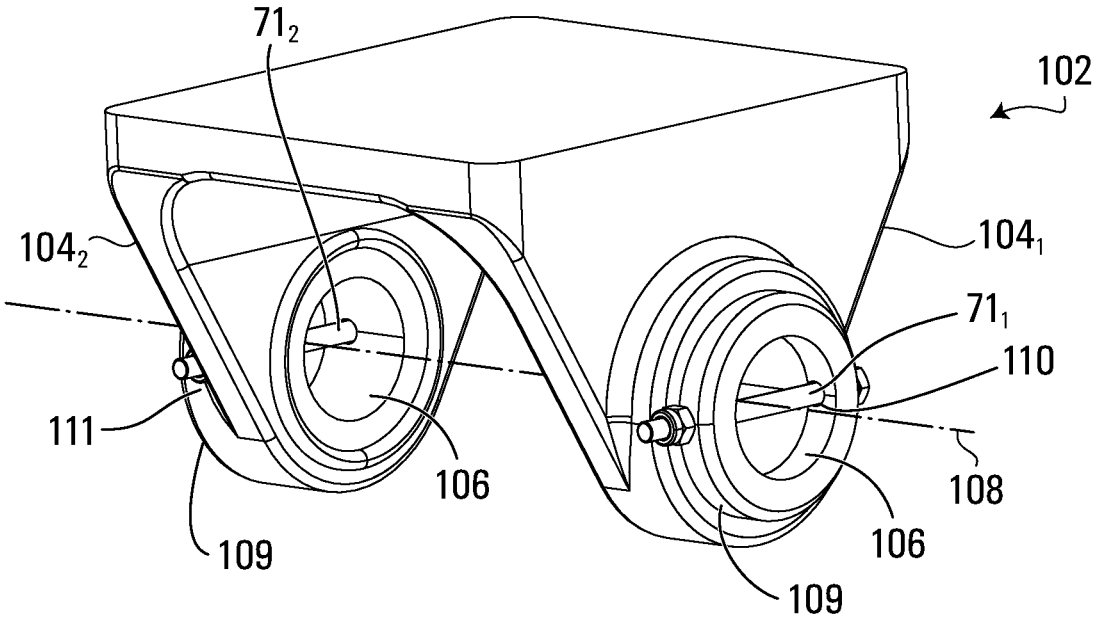
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FIG. 13

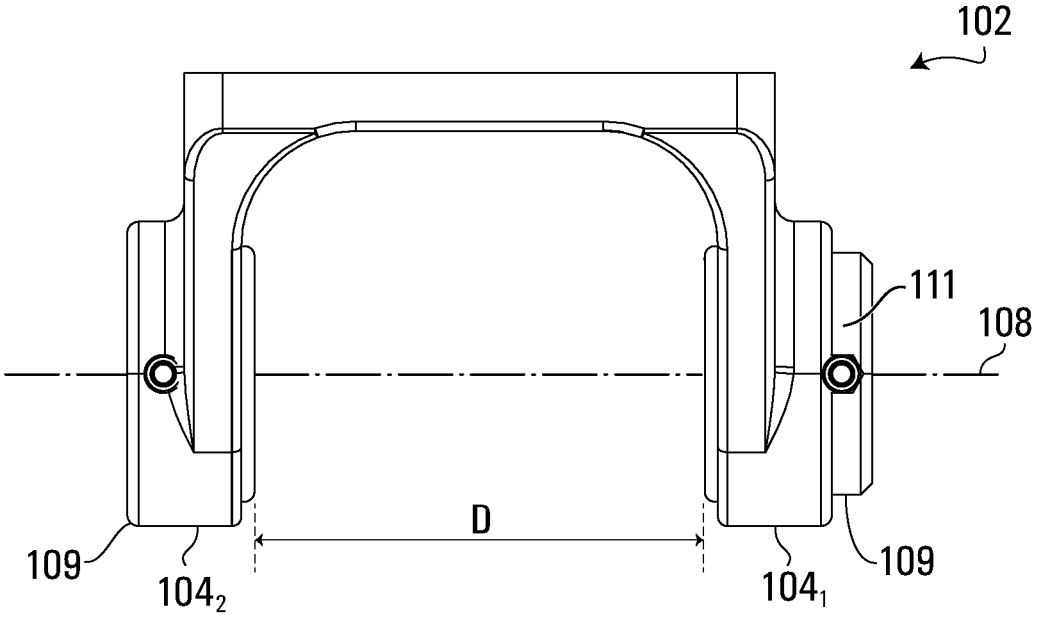
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FIG. 14

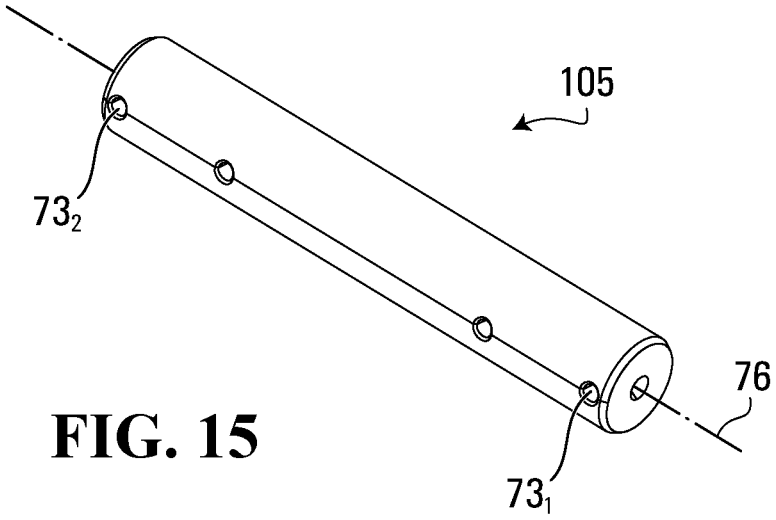


FIG. 15

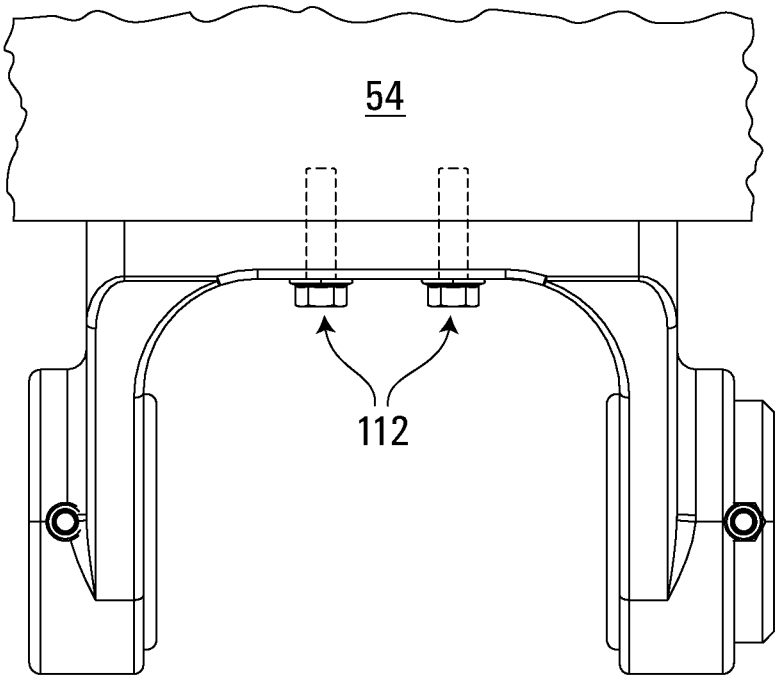


FIG. 16

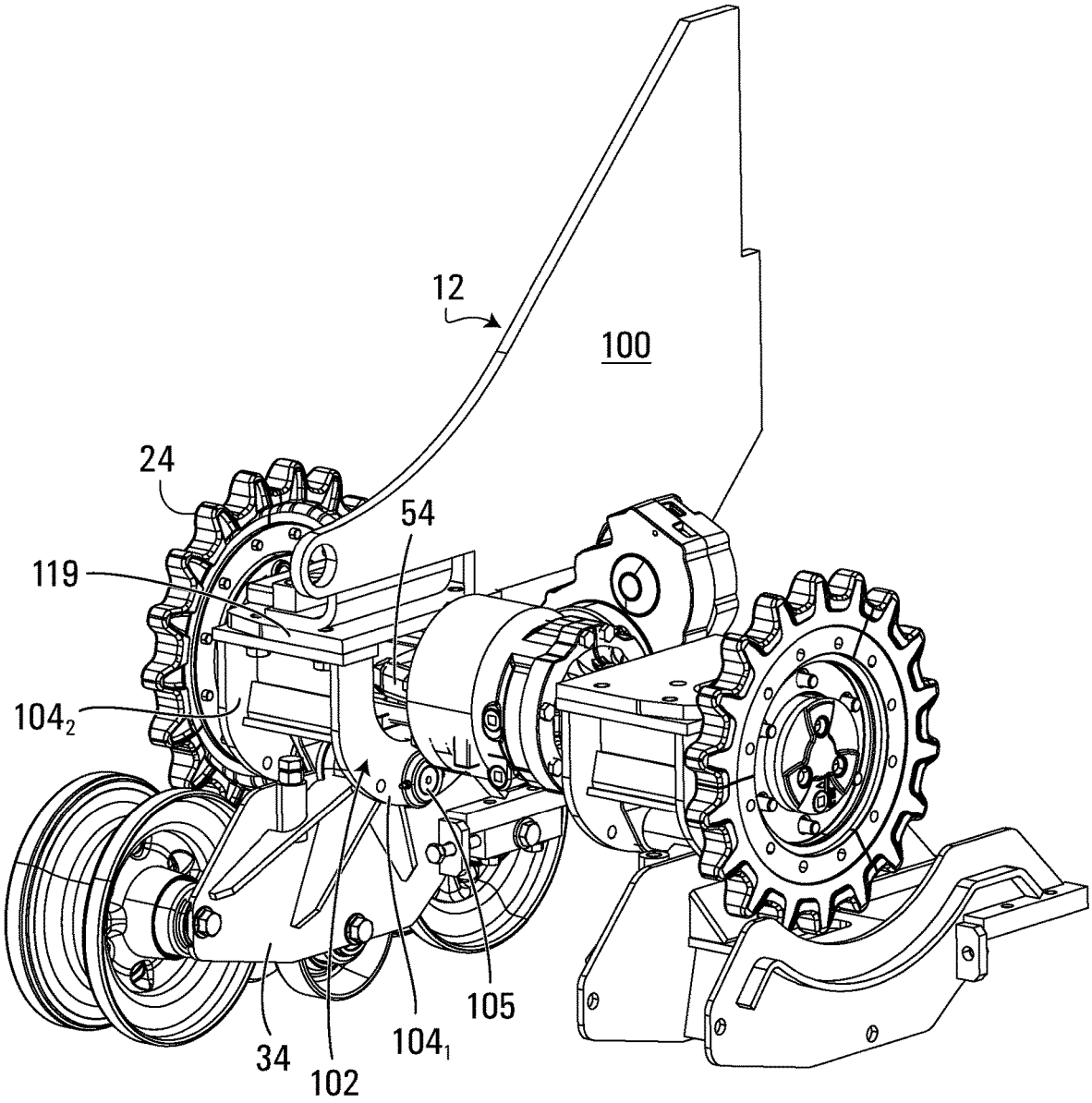


FIG. 17

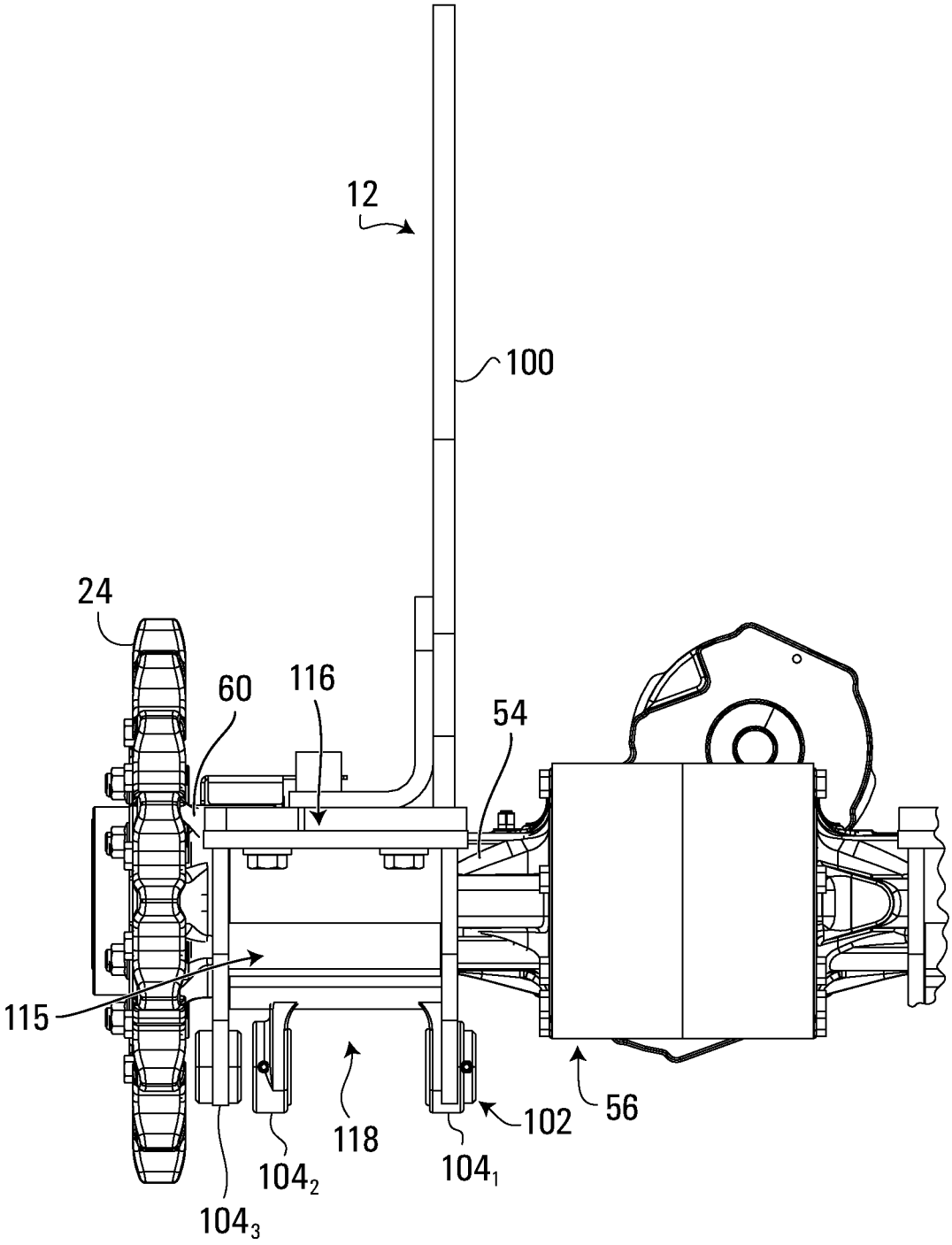


FIG. 18

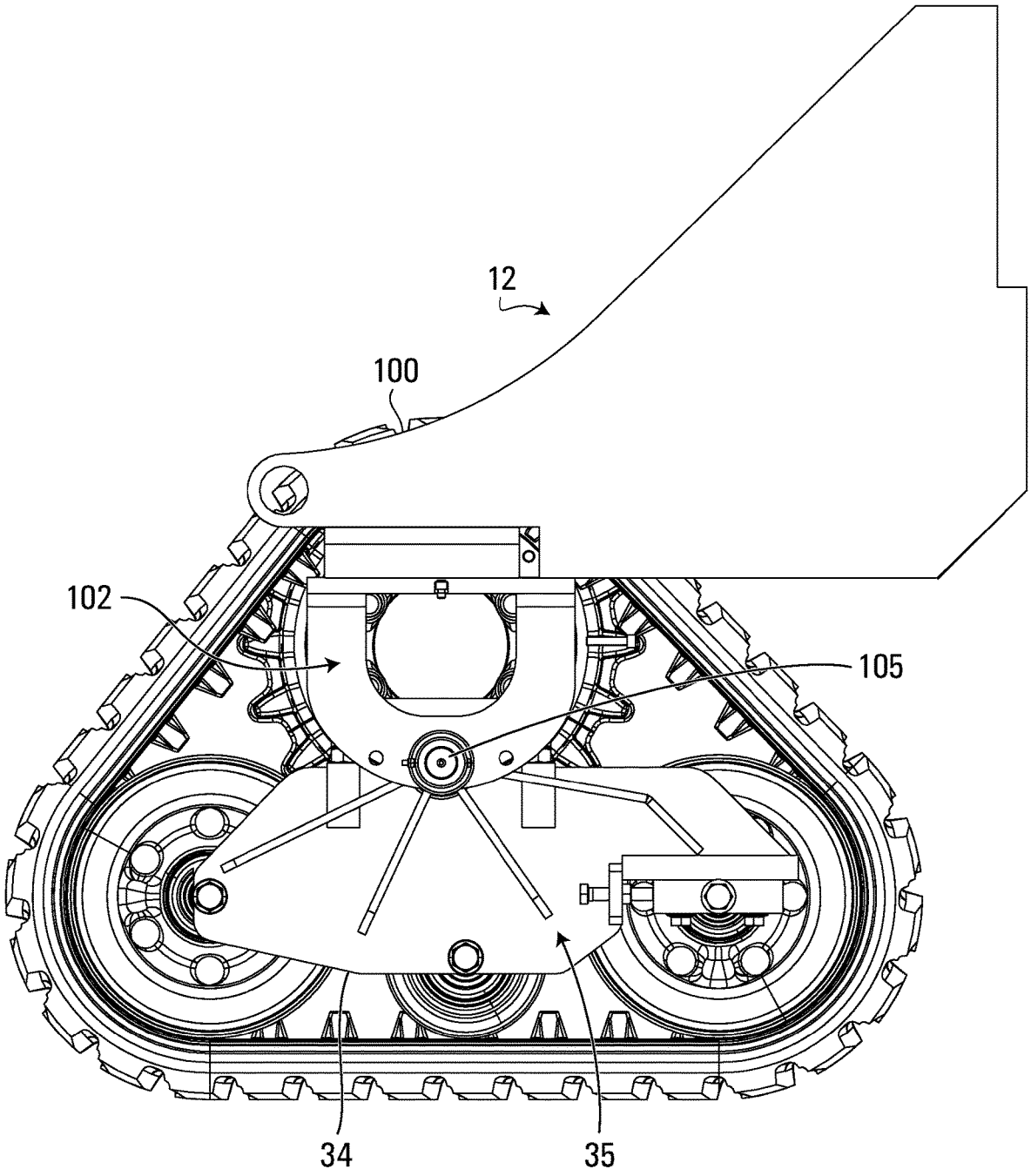


FIG. 19

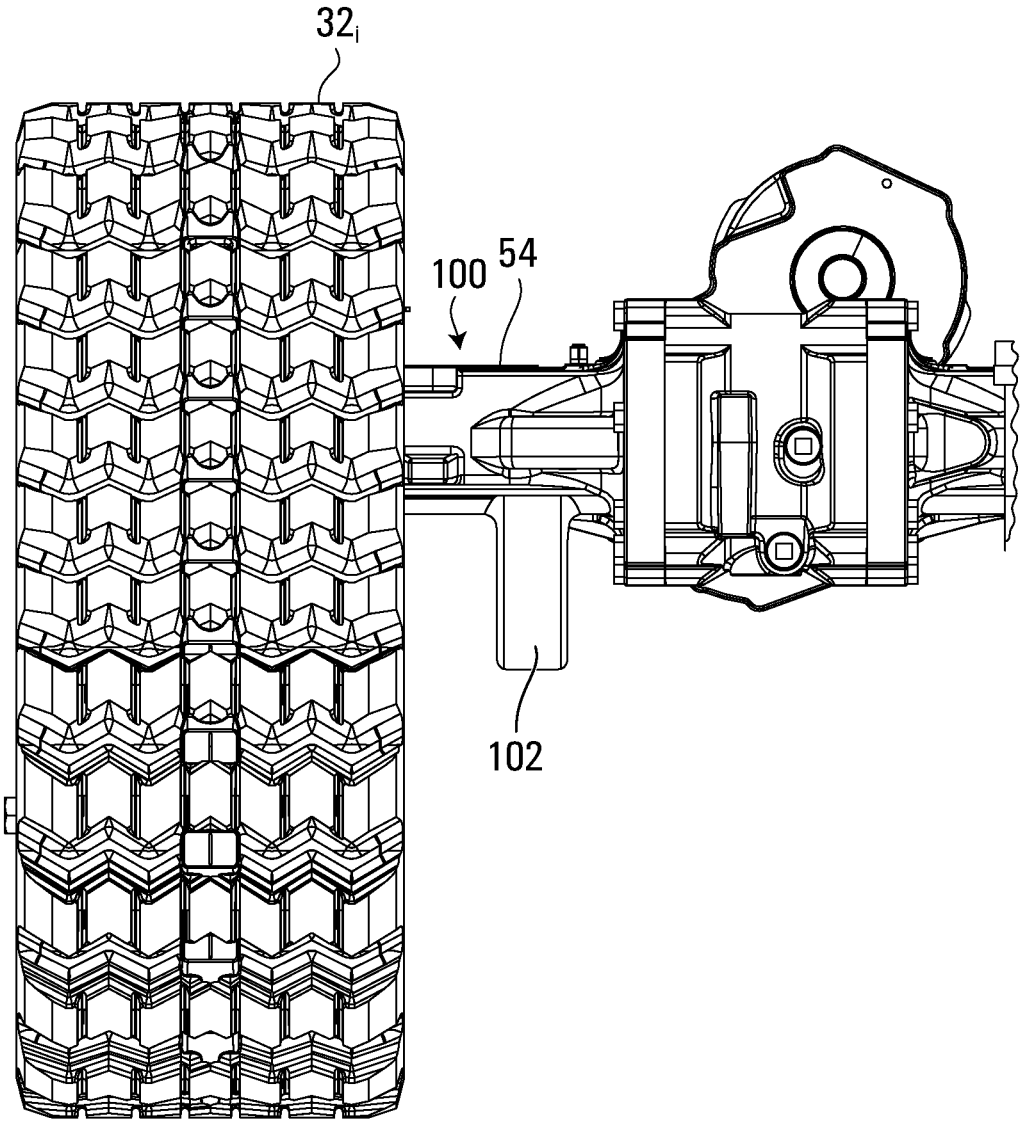


FIG. 20

# STANDARD COMPONENT OF A VEHICLE WITH A CONNECTOR DEDICATED TO CONNECTING A TRACK SYSTEM TO THE VEHICLE

## CROSS-REFERENCE TO RELATED APPLICATION

This application claims priority from U.S. Provisional Patent Application 62/534,946 filed on Jul. 20, 2017 and incorporated by reference herein.

## FIELD

This disclosure relates generally to vehicles and, more particularly, to vehicles comprising track systems for traction.

## BACKGROUND

Certain 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 track systems to enhance their traction and floatation on soft, slippery and/or irregular grounds (e.g., soil, mud, sand, ice, snow, etc.) on which they operate.

Installing track systems on a vehicle can sometimes be complex and/or time-consuming. In some cases, the track systems may be mounted to the vehicle to replace ground-engaging wheels of the vehicle (e.g., depending on an application, a terrain, and/or other factors). In other cases, the track systems may be mounted to the vehicle during original manufacturing of the vehicle.

For these and other reasons, there is a need to improve vehicles, including to facilitate installation of tracks systems on vehicles.

## SUMMARY

According to an aspect of this disclosure, there is provided a vehicle equippable with a plurality of wheels or a plurality of track systems for engaging the ground. A standard component of the vehicle comprises a connector dedicated to connecting a given one of the track systems to the vehicle and provided during original manufacturing of the standard component of the vehicle.

According to another aspect of this disclosure, there is provided a standard component of a vehicle. The vehicle is equippable with a plurality of wheels or a plurality of track systems for engaging the ground. The standard component of the vehicle comprises a connector dedicated to connecting a given one of the track systems to the vehicle and provided during original manufacturing of the standard component of the vehicle.

According to another aspect of this disclosure, there is provided an axle housing for housing an axle of a vehicle. The vehicle is equippable with a plurality of track systems for engaging the ground. The axle housing comprises a connector dedicated to connecting a given one of the track systems to the vehicle and provided during original manufacturing of the axle housing.

According to another aspect of this disclosure, there is provided a frame for a vehicle. The vehicle is equippable with a plurality of wheels or a plurality of track systems for engaging the ground. The frame comprises a connector dedicated to connecting a given one of the track systems to the vehicle and provided during original manufacturing of the frame.

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



## BRIEF DESCRIPTION OF THE DRAWINGS

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

FIG. **1** shows an example of a vehicle comprising track systems in accordance with an embodiment;

FIG. **2** shows an example in which the vehicle is equipped with ground-engaging wheels in place of the track systems;

FIGS. **3** and **4** are front and rear perspective views of an embodiment of a track system of the vehicle;

FIGS. **5** and **6** are front and rear elevational views of the track system;

FIGS. **7** to **10** show a track of the track system;

FIGS. **11**A and **11**B show an example of an embodiment in which an axle housing of the vehicle comprises a connector dedicated to connecting the track system to the vehicle;

FIG. **12** shows part of the track system connected to the connector of the axle housing;

FIGS. **13** and **14** are perspective and front views of the connector of FIG. **11**;

FIG. **15** shows an example of a shaft for interconnecting the connector of the axle housing to a connector of the track system;

FIG. **16** shows an example of an embodiment in which the connector of the axle housing is formed separately from and fastened to another part of the axle housing;

FIG. **17** shows an example of an embodiment in which a frame of the vehicle comprises the connector dedicated to connecting the track system to the vehicle;

FIG. **18** shows a rear view of the connector of FIG. **17**;

FIG. **19** shows an inner side view of the connector of FIG. **17**; and

FIG. **20** shows a rear view of the connector when a ground-engaging wheel is mounted to the vehicle in place of the track system.

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

## DETAILED DESCRIPTION OF EMBODIMENTS

FIG. **1** shows an example of a vehicle **10** in accordance with an embodiment. In this embodiment, the vehicle **10** is a heavy-duty work vehicle for performing construction, agricultural, or other industrial work 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 front loader. 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.

The construction vehicle **10** comprises a chassis **11** connected to a plurality of ground-engaging traction components $\mathbf{30}_1$-$\mathbf{30}_4$ which enable an operator to move the con-

struction vehicle **10** on the ground to perform construction work using a work implement **18**.

In this embodiment, the ground-engaging traction components $\mathbf{30}_1$-$\mathbf{30}_4$ with which the construction vehicle **10** can be equipped may be a plurality of ground-engaging track systems $\mathbf{16}_1$-$\mathbf{16}_4$ as in FIG. **1** or a plurality of ground-engaging wheels $\mathbf{32}_1$-$\mathbf{32}_4$ as in FIG. **2**. By being equippable (i.e., capable of being equipped) with either the wheels $\mathbf{32}_1$-$\mathbf{32}_4$ or the track systems $\mathbf{16}_1$-$\mathbf{16}_4$, the construction vehicle **10** is better able to adapt itself to an environment in which it is used. For example, the construction vehicle **10** may be equipped with the wheels $\mathbf{32}_1$-$\mathbf{32}_4$ in an environment (e.g., a trail, a relatively hard soil, etc.) where they provide adequate floatation and traction, whereas the construction vehicle **10** may be equipped with the track systems $\mathbf{16}_1$-$\mathbf{16}_4$ in an environment (e.g., soft soil, snow, ice, mud, sand, marsh, etc.) where the wheels $\mathbf{32}_1$-$\mathbf{32}_4$ would not provide adequate floatation and traction possibly resulting in the construction vehicle **10** bogging down or getting stuck. In other words, the construction vehicle **10** may be equipped with the track systems $\mathbf{16}_1$-$\mathbf{16}_4$ to enhance its floatation and traction compared to when it is equipped with the wheels $\mathbf{32}_1$-$\mathbf{32}_4$.

As will be further discussed later, in this embodiment, the construction vehicle **10** is configured to facilitate installation of the track systems $\mathbf{16}_1$-$\mathbf{16}_4$ thereon. Part of a standard component of the vehicle **10** (e.g., part of the chassis **11**) may be dedicated to connecting each of the track systems $\mathbf{16}_1$-$\mathbf{16}_4$ to the vehicle **10**. This may simplify connection of the track systems $\mathbf{16}_1$-$\mathbf{16}_4$ to the vehicle **10** and thus reduce time and effort required for connecting the track systems $\mathbf{16}_1$-$\mathbf{16}_4$ to the vehicle **10**.

The chassis **11** comprises a frame **12** of the construction vehicle **10**. In this embodiment, the chassis **11** also comprises at least part of a powertrain **15** of the construction vehicle **10**.

The powertrain **15** is configured for generating motive power for the vehicle **10**, including to cause the ground-engaging traction components $\mathbf{30}_1$-$\mathbf{30}_4$ to propel the vehicle **10** on the ground. To that end, the powertrain **15** 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).

In this embodiment, the prime mover **14** is in a driving relationship with the ground-engaging traction components $\mathbf{30}_1$-$\mathbf{30}_4$. That is, the powertrain **15** transmits motive power from the prime mover **14** to the ground-engaging traction components $\mathbf{30}_1$-$\mathbf{30}_4$ in order to drive (i.e., impart motion to) the ground-engaging traction components $\mathbf{30}_1$-$\mathbf{30}_4$. To that end, in this embodiment, the powertrain **15** comprises front and rear axle assemblies $\mathbf{50}_1$, $\mathbf{50}_2$ for driving front and rear ones of the ground-engaging traction components $\mathbf{30}_1$-$\mathbf{30}_4$. Each axle assembly $\mathbf{50}_i$ comprises an axle **52** that is driven by power generated by the prime mover **14** to drive a given one of the ground-engaging traction components $\mathbf{30}_1$-$\mathbf{30}_4$. Also, in this embodiment, the axle assembly $\mathbf{50}_i$ comprises an axle housing **54** that houses the axle **52** such as to cover at least part of the axle **52**.

In this example, the construction vehicle **10** comprises an operator cabin **20** for the operator. 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 work implement **18** is used to perform construction work. For example, in some embodiments, the work implement **18** may comprise 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.

Each track system $\mathbf{16}_i$ engages the ground to provide traction to the construction vehicle **10**. With additional reference to FIGS. **3** to **6**, in this embodiment, the track system $\mathbf{16}_i$ comprises a track-engaging assembly **21** and a track **22** disposed around the track-engaging assembly **21**. The track-engaging assembly **21** comprises a plurality of wheels, including a drive wheel **24** and a plurality of idler wheels, which includes front (i.e., leading) idler wheels $\mathbf{26}_1$, $\mathbf{26}_2$, rear (i.e., trailing) idler wheels $\mathbf{27}_1$, $\mathbf{27}_2$ and roller wheels $\mathbf{28}_1$, $\mathbf{28}_2$. The track system $\mathbf{16}_i$ also comprises a frame **34** which supports various components of the track system $\mathbf{16}_i$ including the idler wheels $\mathbf{26}_1$, $\mathbf{26}_2$, $\mathbf{27}_1$, $\mathbf{27}_2$, $\mathbf{28}_1$, $\mathbf{28}_2$. The track system $\mathbf{16}_i$ has a longitudinal direction and a first longitudinal end **57** and a second longitudinal end **59** that define a length of the track system $\mathbf{16}_i$. The track system $\mathbf{16}_i$ has a widthwise direction and a width that is defined by a width of the track **22**. The track system $\mathbf{16}_i$ also has a height direction that is normal to its longitudinal direction and its widthwise direction.

The drive wheel **24** is rotatable using power generated by the prime mover **14** and delivered over the powertrain **15** 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 voids $\mathbf{31}_1$-$\mathbf{31}_D$ (i.e., hollow spaces) which receive drive members (e.g., teeth) of the drive wheel **24** in order to drive the track **22**. In some cases, the drive voids $\mathbf{31}_1$-$\mathbf{31}_D$ may be recesses. In other cases, the drive voids $\mathbf{31}_1$-$\mathbf{31}_D$ may be openings which traverse a thickness of the track **22**.

The idler wheels $\mathbf{26}_1$, $\mathbf{26}_2$, $\mathbf{27}_1$, $\mathbf{27}_2$, $\mathbf{28}_1$, $\mathbf{28}_2$ are not driven by power supplied by the prime mover **14**, but are rather used to do at least one of supporting part of a 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 front and rear idler wheels $\mathbf{26}_1$, $\mathbf{26}_2$, $\mathbf{27}_1$, $\mathbf{27}_2$ maintain 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 $\mathbf{28}_1$, $\mathbf{28}_2$ 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 $\mathbf{16}_i$, the roller wheels $\mathbf{28}_1$, $\mathbf{28}_2$ 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 FIGS. **7** to **10**, the track **22** comprises an inner side **45**, a ground-engaging outer side **47**, and lateral edges $\mathbf{49}_1$, $\mathbf{49}_2$. 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 $\mathbf{16}_i$ and over the wheels **24**, $\mathbf{26}_1$, $\mathbf{26}_2$, $\mathbf{27}_1$,

$27_2$, $28_1$, $28_2$. 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**, $26_1$, $26_2$, $27_1$, $27_2$, $28_1$, $28_2$. 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 thicknesswise direction normal to its longitudinal and widthwise directions.

In this embodiment, 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 particularly, in this embodiment, 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** is elastomeric in that it comprises elastomeric material **38** 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**.

In this embodiment, the carcass **36** comprises a plurality of reinforcements embedded in its elastomeric material **38**. These reinforcements can take on various forms.

For example, in this embodiment, a plurality of cores $44_1$-$44_N$ are at least partially embedded in the elastomeric material **38**. The cores $44_1$-$44_N$ are distributed along and extend transversally to the longitudinal direction of the track **22** to impart transverse rigidity to the track **22**. The cores $44_1$-$44_N$ may also help to drive the track **22** by engagement with the drive wheel **24** and/or guide some of the wheels **24**, $26_1$, $26_2$, $27_1$, $27_2$, $28_1$, $28_2$ as the track **22** is driven by the drive wheel **24**.

Each core $44_i$ has a longitudinal axis extending transversally (in this case, perpendicularly) to the longitudinal axis **19** of the track **22**. More particularly, in this embodiment, each core $44_i$ comprises a pair of wings $51_1$, $51_2$ (i.e., extensions) and a wheel guide **53**.

The wings $51_1$, $51_2$ are elongated along the longitudinal axis of the core $44_i$ to impart transverse rigidity to the track **22**. Each of the wings $51_1$, $51_2$ has a top surface oriented towards the inner side **45** of the track **22** and a bottom surface oriented towards the ground-engaging outer side **47** of the track **22**. In this embodiment, each of the wings $51_1$, $51_2$ has a tapered shape whereby its top surface converges longitudinally outwardly towards its bottom surface. The wings $51_1$, $51_2$ may have various other shapes in other embodiments.

The wheel guide **53** is located between the pair of wings $51_1$, $51_2$ and serves to guide some of the wheels **24**, $26_1$, $26_2$, $27_1$, $27_2$, $28_1$, $28_2$ as the track **22** is driven by the drive wheel **24**. More particularly, in this embodiment, the wheel guide **53** comprises a pair of guide projections $57_1$, $57_2$ that project on the inner side **55** of the track **22**. Each guide projection $57_i$ comprises a top end, a base, and a pair of wheel-facing sides opposite one another and extending from its base to its top end. The wheel guide **53** may be configured in various other ways in other embodiments (e.g., it may comprise only one guide projection or more than two (2) guide projections).

In this embodiment, the core $44_i$, including its wings $51_1$, $51_2$ and wheel guide **53**, is made of metallic material. For instance, in some embodiments, the core $44_i$ may be made of steel formed into shape by casting. The core $44_i$ may have various other shapes, may comprise various other components, may be made of various other rigid materials (e.g., polymers, ceramics, composites, etc.), and/or may be made using various other processes (e.g., forging, welding, fastening, etc.) in other embodiments.

In this example, in this embodiment, the carcass **36** comprises a layer of reinforcing cables $37_1$-$37_M$ that are adjacent to one another and extend generally in the longitudinal direction of the track **22** to enhance strength in tension of the track **22** along its longitudinal direction. In this case, each of the reinforcing cables $37_1$-$37_M$ is a cord including a plurality of strands (e.g., textile fibers or metallic wires). In other cases, each of the reinforcing cables $37_1$-$37_M$ may be another type of cable and may be made of any material suitably flexible along the cable's longitudinal axis (e.g., fibers or wires of metal, plastic or composite material).

As another example, in this embodiment, the carcass **36** comprises a layer of reinforcing fabric **43**. The reinforcing fabric **43** 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 reinforcing fabric **43** may comprise a ply of reinforcing woven fibers (e.g., nylon fibers or other synthetic fibers).

The carcass **36** may be molded into shape in a molding process during which the rubber **38** is cured. For example, in this embodiment, a mold may be used to consolidate layers of rubber providing the rubber **38** of the carcass **36**, the reinforcing cables $37_1$-$37_M$ and the layer of reinforcing fabric **43**, while the cores $44_1$-$44_N$ are disposed between them.

The inner side **45** of the track **22** comprises an inner surface **55** of the carcass **36** and a plurality of wheel-contacting projections $48_1$-$48_N$ that project from the inner surface **55** and are positioned to contact at least some of the wheels **24**, $26_1$, $26_2$, $27_1$, $27_2$, $28_1$-$28_R$ 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 wheel-contacting projections $48_1$-$48_N$ can be referred to as "drive/guide projections". In some examples of implementation, a drive/guide projection **48**, may interact with the drive wheel **24** to drive the track **22**, in which case the drive/guide projection $48_i$, is a drive projection. In other examples of implementation, a drive/guide projection $48_i$, may interact with the front and rear idler wheels $26_1$, $26_2$, $27_1$, $27_2$ and/or the roller wheels $28_1$-$28_R$ to guide the track **22** to maintain proper track alignment and prevent de-tracking without being used to drive the track **22**, in which case the drive/guide projection $48_i$, is a guide projection. In yet other examples of implementation, a drive/guide projection $48_i$, may both (i) interact with the drive wheel **24** to drive the track and (ii) interact with the idler wheels $26_1$, $26_2$, $27_1$, $27_2$ and/or the roller wheels $28_1$-$28_R$ to guide the track **22** to maintain proper track alignment and prevent de-tracking, in which case the drive/guide projection $48_i$ is both a drive projection and a guide projection.

In this embodiment, each drive/guide projection **48**$_i$ comprises elastomeric material **67** overlying a given one of the guide projections **57**$_1$, **57**$_2$ of the cores **44**$_1$-**44**$_N$. The elastomeric material **67** can be any polymeric material with suitable elasticity. More particularly, in this embodiment, the elastomeric material **67** includes rubber. Various rubber compounds may be used and, in some cases, different rubber compounds may be present in different areas of the drive/guide projection **48**$_i$.

The ground-engaging outer side **47** comprises a ground-engaging outer surface **31** of the carcass **36** and a tread pattern **40** to enhance traction on the ground. The tread pattern **40** comprises a plurality of traction projections **58**$_1$-**58**$_T$ projecting from the ground-engaging outer surface **31**, spaced apart in the longitudinal direction of the track **22** and engaging the ground to enhance traction. The traction projections **58**$_1$-**58**$_T$ may be referred to as "tread projections" or "traction lugs".

In this embodiment, each traction lug **58**$_i$ is an elastomeric traction lug in that it comprises elastomeric material **41**. The elastomeric material **41** can be any polymeric material with suitable elasticity. More particularly, in this embodiment, the elastomeric material **41** includes rubber. Various rubber compounds may be used and, in some cases, different rubber compounds may be present in different areas of the traction lug **58**$_i$. In other embodiments, the elastomeric material **41** may include another elastomer in addition to or instead of rubber (e.g., polyurethane elastomer). The traction lugs **58**$_1$-**58**$_T$ may be provided on the ground-engaging outer side **47** in various ways. For example, in this embodiment, the traction lugs **58**$_1$-**58**$_T$ are provided on the ground-engaging outer side **47** by being molded with the carcass **36**.

The track **22** may be constructed in various other manners in other embodiments. For example, in some embodiments, the cores **44**$_1$-**44**$_N$ may be omitted from the track **22**.

The track system **16**$_i$ may be configured in various other ways in other embodiments. For example, in various embodiments, the track system **16**$_i$ may comprises more or fewer wheels, have a different (e.g., elongated) shape, etc.

The construction vehicle **10** is configured to facilitate installation of the track systems **16**$_1$-**16**$_4$ on the vehicle **10**. To that end, with additional reference to FIGS. **11**A and **11**B, in this embodiment, a standard component **100** of the vehicle **10** comprises a connector **102** dedicated to connecting each track system **16**$_i$ to the vehicle **10**. The standard component **100** of the vehicle **10** is "standard" in that it is an ordinary and normal part of the vehicle **10**, i.e., it is normally present in all vehicles like the vehicle **10**. The track system **16**$_i$ can thus be installed more easily on the vehicle **10** by using the connector **102**, which is provided as part of the standard component **100** of the vehicle **10**.

The standard component **100** of the vehicle **10** may be any suitable part of the chassis **11**, such as the frame **12** or a portion of the powertrain **15**. In this embodiment, the standard component **100** of the vehicle **10** is nonrotatable for driving of the track **22** of the track system **16**$_i$ or a wheel **32**$_i$ that would be mounted in place of the track system **16**$_i$. That is, the standard component **100** of the vehicle **10** is not configured to rotate to drive the track **22** or the wheel **32**$_i$. In that sense, the standard component **100** of the vehicle **10** may be referred to as a standard nonrotating component of the vehicle **10**. More particularly, in this embodiment, the standard component **100** of the vehicle **10** is fixed (i.e., immobile) relative to at least part of the frame **12** of the vehicle **10**.

The connector **102** of the standard component **100** of the vehicle **10** remains in place irrespective of whether or not the track system **16**$_i$ is connected thereto. In other words, the connector **102** remains when the track system **16**$_i$ is not mounted to the vehicle **10** and the wheel **32**$_i$ is mounted in its place, as shown in FIG. **20**.

In this embodiment, the standard component **100** of the vehicle **10** is part of the axle assembly **50**$_i$ of the powertrain **15** of the vehicle **10** to drive the track system **16**$_i$ such that the axle assembly **50**$_i$ comprises the connector **102** dedicated to the track system **16**$_i$. More particularly, in this embodiment, the standard component **100** of the vehicle **10** is the axle housing **54** of the axle assembly **50**$_i$ that houses the axle **52**. In this example, the axle housing **54** extends between a differential **56** of the powertrain **15** and a drive hub **60** of the axle assembly **50**$_i$ to which the drive wheel **24** of the track system **16**$_i$ or the ground-engaging wheel **32**$_i$ is to be connected.

The connector **102** is dedicated to connecting the track system **16**$_i$ to the vehicle **10**. Thus, the connector **102** is unnecessary for a primary function of the standard component **100** of the vehicle **10**, i.e., it could be omitted (e.g., removed) and the primary function of the standard component **100** of the vehicle **10** would still be fulfilled. For example, in this embodiment where it is part of the axle housing **54**, the connector **102** could be omitted (e.g., removed) from the axle housing **54** and the axle housing **54** would still house the axle **52**.

Moreover, the connector **102** is a built-in connector in that it is provided as part of the standard component **100** of the vehicle **10** during original manufacturing of the standard component **100** of the vehicle **10**. Therefore, in this embodiment in which the standard component **100** of the vehicle is the axle housing **54**, the connector **102** is provided as part of the axle housing **54** during original manufacturing of the axle housing **54**. The connector **102** is thus joined to an adjacent part **107** of the axle housing **54** during original manufacturing of the axle housing **54**. The adjacent part **107** of the axle housing **54** may be a portion of a body **117** of the axle housing **54** which houses the axle **52**.

More particularly, in this embodiment, the connector **102** is integral with the adjacent part **107** of the axle housing **54**, i.e., integrally formed with the adjacent part **107** of the axle housing **54** such that the connector **102** and the adjacent part **107** of the axle housing **54** are unitarily formed as a single piece. That is, the connector **102** is manufactured such that material of the connector **102** is continuous and integral with material of the adjacent part **107** of the axle housing **54**. For example, in this embodiment, the axle housing **54** is molded in a mold and the connector **102** is formed during molding of the axle housing **54** in the mold. In this case, the axle housing **54** is cast and the connector **102** is formed during casting of the axle housing **54**. The connector **102** may thus be formed of metallic material that is continuous and integral with metallic material of the adjacent part **107** of the axle housing **54**.

The connector **102** dedicated to connecting the track system **16**$_i$ may be implemented in any suitable way.

In this embodiment, the connector **102** comprises a bracket **109** to receive part of the track system **16**$_i$. The connector **102** projects from the adjacent part **107** of the axle housing **54**. In this case, the connector **102** depends downwardly from the adjacent part **107** of the axle housing **54**.

More particularly, with reference to FIGS. **13** and **14**, in this embodiment, the connector **102** comprises flanges **104**$_1$, **104**$_2$ that project from the adjacent part **107** of the axle housing **54**, are generally parallel to one another and are spaced apart by a distance D in a widthwise direction of the vehicle **10**, which is parallel to the widthwise direction of the

track system $16_i$. More specifically, in this example of implementation, the flanges $104_1$, $104_2$ extend downwardly from an underside **62** of the adjacent part **107** of the axle housing **54**. Each flange $104_i$ comprises a shaft-receiving opening **106** that extends through the flange $104_i$ in the widthwise direction of the vehicle **10**. The opening **106** of the flange $104_1$ is concentrically aligned with the opening **106** of the flange $104_2$ such that they define a common center axis **108** extending in the widthwise direction of the vehicle **10**. The shaft-receiving opening **106** is sized to receive a shaft **105** that, as will be explained in more detail below, secures the track system $16_i$ to the connector **102**.

The connector **102** of the axle housing **54** may connect to the track system $16_i$ in any suitable way. In this embodiment, the frame **34** of the track system $16_i$ is configured for being coupled to the connector **102** of the axle housing **54**. To that end, in this embodiment, as shown in FIGS. **4** and **6**, an inboard side **33** of the frame **34**, which is opposite to an outboard side **35** of the frame **34** and configured to face inwardly toward a centerline of the vehicle **10**, comprises a connector **64** for connecting to the connector **102** of the axle housing **54**. In this embodiment, the connector **64** of the frame **34** of the track system $16_i$ comprises a hub **68** which comprises a tubular body **69** extending in the widthwise direction of the track system $16_i$. The hub **68** has a length, defined between its opposite longitudinal ends, which can be substantially equal to or less than the distance D between the flanges $104_1$, $104_2$ of the connector **102** of the axle housing **54**. The hub **68** also comprises at least one bearing **72** defining an opening **70** of the hub **68** which extends along the length of the hub **68** and is configured for receiving the shaft **105** to interconnect the connector **64** of the track system $16_i$ and the connector **102** of the axle housing **54**. In some embodiments, the hub **68** may comprise more than one bearing **72**, in which case these bearings are concentrically aligned with one another.

In this embodiment, the frame **34** of the track system $16_i$ also comprises a plurality of reinforcing ribs $78_1$-$78_R$ for reinforcing a connection between the hub **68** and a remainder of the frame **34**. The reinforcing ribs $78_1$-$78_R$ extend on the inboard side **33** of the frame **34** and are connected (e.g., welded) to an outer surface of the hub **68**. The frame **34** of the track system $16_i$ may be configured differently in other embodiments.

Thus, as shown in FIG. **12**, in this embodiment, in order to connect the track system $16_i$ to the connector **102** of the axle housing **54**, the hub **68** of the connector **64** of the frame **34** of the track system $16_i$ is positioned between the flanges $104_1$, $104_2$ of the connector **102** of the axle housing **54** such that the opening **70** of the hub **68** is aligned with the openings **106** of each of the flanges $104_1$, $104_2$. Then, the shaft **105** is inserted into the openings **106** of the flanges $104_1$, $104_2$ and into the opening **70** of the hub **68** such that an axis **76** along which the shaft **105** extends is aligned with the axis **108** defined by the openings **106** of the flanges $104_1$, $104_2$. In order to fix the shaft **105** in this position, fasteners $71_1$, $71_2$ are provided for engaging the flanges $104_1$, $104_2$ and the shaft **105** such as to secure the shaft **105** to the flanges $104_1$, $104_2$. In this embodiment, each fastener $71_i$ comprises a bolt and a nut. In other embodiments, the fasteners $71_1$, $71_2$ may comprise screws or other threaded fasteners, rivets, cotter pins, or any other suitable fasteners. As shown in FIG. **15**, the shaft **105** comprises a plurality of openings $73_1$, $73_2$ extending in a direction transversal to an axis **76** of the shaft **105**, and a collar portion **111** of each of the flanges $104_1$, $104_2$ comprises an opening **110** for being aligned with a respective opening $73_i$ of the shaft **105**. Each fastener $71_i$ is inserted into the openings $73_i$, **110** such as to secure the shaft **105** to the connector **102**.

In this embodiment, since the shaft **105** is mounted to the bearing **72** of the hub **68**, the hub **68** is pivotable about the axis **76** of the shaft **105**. In other words, the frame **34** of the track system $16_i$ is pivotable about the axis **76** of the shaft **105** which is coincident with the axis **108** defined by the flanges $104_1$, $104_2$ of the connector **102**. This may allow the track system $16_i$ to accommodate an uneven ground, such as an uneven terrain and/or an obstacle encountered on the ground.

While in this embodiment the connector **102** of the axle housing **54** is an integral part of the axle housing **54**, in other embodiments, the connector **102** may be a separate part of the axle housing **54** that is secured to the adjacent part **107** of the axle housing **54** after manufacturing of the adjacent part **107** of the axle housing **54**. In other words, the connector **102** may be formed separately form the adjacent part **107** of the axle housing **54** and affixed thereto subsequently during original manufacturing of the axle housing **54**. For example, in some embodiments, as shown in FIG. **16**, the connector **102** may be fastened to the axle housing **54** via one or more fasteners **112**. As another example, in some embodiments, the connector **102** may be welded to the axle housing **54**.

Although in this embodiment it is the axle housing **54**, the standard component **100** of the vehicle **10** that comprises the connector **102** dedicated to connecting the track system $16_i$ may be any other suitable standard part of the vehicle **10**.

For example, in some embodiments, as shown in FIG. **17**, the standard component **100** of the vehicle **10** may be the frame **12** of the vehicle **10** such that the frame **12** comprises the connector **102**. That is, in this embodiment, the connector **102** is part of the frame **12** of the vehicle **10**. For instance, in this example of implementation, the connector **102** is disposed between the drive hub **60** and the differential **56** of the powertrain **15** in the widthwise direction of the vehicle **10** and comprises a frame member **115** configured to wrap about the axle housing **54**. More specifically, the frame member **115** is hollow such as to receive the axle housing **54** therein. The frame member **115** comprises a top side **116** and a bottom side **118** opposite to the top side **116**.

The connector **102** comprises the flanges $104_1$, $104_2$ and, in this example, a third flange $104_3$, each of which is located on the bottom side **118** of the frame member **115** and extends downwardly parallel to one another. The flange $104_3$ is configured similarly to the flanges $104_1$, $104_2$ notably comprising the opening **106** which is concentrically aligned with the openings **106** of the flanges $104_1$, $104_2$ and is configured to receive the shaft **105** therein. As such, in this embodiment, the shaft **105** engages the openings **106** of the flanges $104_1$, $104_2$, $104_3$ with the hub **68** being disposed between the flanges $104_1$, $104_2$. The shaft **105** is secured to the flanges $104_1$, $104_2$, $104_3$ in a manner similar to that described above.

In this embodiment, the frame member **115** is connected to an adjacent part **119** of the frame **12** of the vehicle **10** at its top side **116**. More specifically, in this example of implementation, the top side **116** of the frame member **115** is fastened to the adjacent part **119** of the frame **12**. Fastening of the top side **116** of the frame member **112** to the adjacent part **119** of the frame **12** **10** may be done in any suitable way. For instance, in this example, the top side **116** of the frame member **115** is welded to the adjacent part **119** of the frame **12** of the vehicle **10**. In other cases, the top side **116** of the frame member **115** may be fastened to the adjacent part **119** of the frame **12** via one or more fasteners (e.g., bolts, screws, rivets, etc.).

While in embodiments considered above the 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., 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 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).

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 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.

Although various embodiments and examples have been presented, this was for purposes of description, but should not be limiting. Various modifications and enhancements will become apparent to those of ordinary skill in the art.

The invention claimed is:

**1**. A vehicle equippable with a plurality of wheels or a plurality of track systems for engaging the ground, wherein a frame of the vehicle comprises a connector dedicated to connecting a given one of the track systems to the vehicle, unnecessary for a primary function of the frame of the vehicle and provided during original manufacturing of the frame of the vehicle, the connector being configured to allow the given one of the track systems to pivot relative to the vehicle.

**2**. The vehicle of claim **1**, wherein the connector is integral with an adjacent part of the frame of the vehicle.

**3**. The vehicle of claim **2**, wherein the connector is molded with the adjacent part of the frame of the vehicle.

**4**. The vehicle of claim **2**, wherein the connector is cast with the adjacent part of the frame of the vehicle.

**5**. The vehicle of claim **1**, wherein the connector is secured to an adjacent part of the frame of the vehicle after manufacturing of the adjacent part of the frame of the vehicle.

**6**. The vehicle of claim **1**, wherein the connector is fastened to an adjacent part of the frame of the vehicle.

**7**. The vehicle of claim **6**, wherein the connector is fastened to the adjacent part of the frame of the vehicle by a plurality of mechanical fasteners.

**8**. The vehicle of claim **1**, wherein the connector is welded to an adjacent part of the frame of the vehicle.

**9**. The vehicle of claim **1**, wherein the connector projects from an adjacent part of the frame of the vehicle.

**10**. The vehicle of claim **9**, wherein the connector depends downwardly from the adjacent part of the frame of the vehicle.

**11**. The vehicle of claim **1**, wherein the connector comprises a bracket.

**12**. The vehicle of claim **1**, wherein the connector comprises a flange.

**13**. The vehicle of claim **1**, wherein the connector comprises a plurality of flanges.

**14**. The vehicle of claim **1**, wherein the connector comprises an opening to receive a shaft interconnecting the connector and the given one of the track systems.

**15**. The vehicle of claim **1**, wherein the vehicle comprises an axle and an axle housing that houses the axle, and the connector is configured to wrap about the axle housing.

**16**. The vehicle of claim **1**, wherein the vehicle is a construction vehicle.

**17**. A standard nonrotating component of a vehicle, the vehicle being equippable with a plurality of wheels or a plurality of track systems for engaging the ground and comprising an axle and an axle housing that houses the axle, the standard nonrotating component of the vehicle comprising a connector dedicated to connecting a given one of the track systems to the vehicle, unnecessary for a primary function of the standard nonrotating component of the vehicle and provided during original manufacturing of the standard nonrotating component of the vehicle, wherein the connector is configured to wrap about the axle housing.

**18**. The standard nonrotating component of the vehicle of claim **17**, wherein the standard nonrotating component of the vehicle is part of an axle assembly of the vehicle, the axle assembly comprising the axle and the axle housing.

**19**. The standard nonrotating component of the vehicle of claim **17**, wherein the connector is molded with the adjacent part of the standard nonrotating component of the vehicle.

**20**. The standard nonrotating component of the vehicle of claim **17**, wherein the connector is cast with the adjacent part of the standard nonrotating component of the vehicle.

**21**. The standard nonrotating component of the vehicle of claim **17**, wherein the connector projects from an adjacent part of the standard nonrotating component of the vehicle.

**22**. The standard nonrotating component of the vehicle of claim **21**, wherein the connector depends downwardly from the adjacent part of the standard nonrotating component of the vehicle.

**23**. The standard nonrotating component of the vehicle of claim **17**, wherein the connector comprises a bracket.

**24**. The standard nonrotating component of the vehicle of claim **17**, wherein the connector comprises a flange.

**25**. The standard nonrotating component of the vehicle of claim **17**, wherein the connector comprises a plurality of flanges.

**26**. The standard nonrotating component of the vehicle of claim **17**, wherein the connector comprises an opening to receive a shaft interconnecting the connector and the given one of the track systems.

**27**. The standard nonrotating component of the vehicle of claim **17**, wherein the connector is integral with an adjacent part of the standard nonrotating component of the vehicle.

**28**. The standard nonrotating component of the vehicle of claim **17**, wherein the connector is configured to allow the given one of the track systems to pivot relative to the vehicle.

**29**. The standard nonrotating component of the vehicle of claim **17**, wherein the vehicle is a construction vehicle.

**30**. An axle housing for housing an axle of a vehicle, the vehicle being equippable with a plurality of track systems for engaging the ground, the axle housing comprising a connector dedicated to connecting a given one of the track systems to the vehicle and provided during original manufacturing of the axle housing, wherein the connector is configured to allow the given one of the track systems to pivot relative to the vehicle.

31. The axle housing of claim 30, wherein the connector projects from an adjacent part of the axle housing.

32. The axle housing of claim 31, wherein the connector depends downwardly from the adjacent part of the axle housing.

33. The axle housing of claim 30, wherein the connector comprises a bracket.

34. The axle housing of claim 30, wherein the connector comprises a flange.

35. The axle housing of claim 30, wherein the connector comprises a plurality of flanges.

36. The axle housing of claim 30, wherein the connector comprises an opening to receive a shaft interconnecting the connector and the given one of the track systems.

37. The axle housing of claim 30, wherein the connector is integral with an adjacent part of the axle housing.

38. The axle housing of claim 37, wherein the connector is molded with the adjacent part of the axle housing.

39. The axle housing of claim 37, wherein the connector is cast with the adjacent part of the axle housing.

40. The axle housing of claim 30, wherein the vehicle is a construction vehicle.

41. A standard nonrotating component of a vehicle, the vehicle being equippable with a plurality of wheels or a plurality of track systems for engaging the ground, the standard nonrotating component of the vehicle comprising a connector dedicated to connecting a given one of the track systems to the vehicle, unnecessary for a primary function of the standard nonrotating component of the vehicle and provided during original manufacturing of the standard nonrotating component of the vehicle, wherein the connector is configured to allow the given one of the track systems to pivot relative to the vehicle.

42. The standard nonrotating component of the vehicle of claim 41, wherein the standard nonrotating component of the vehicle is part of an axle assembly of the vehicle.

43. The standard nonrotating component of the vehicle of claim 42, wherein the axle assembly of the vehicle comprises an axle and an axle housing that houses the axle and the standard nonrotating component of the vehicle is the axle housing of the vehicle.

44. The standard nonrotating component of the vehicle of claim 41, wherein the standard nonrotating component of the vehicle is a frame of the vehicle.

45. The standard nonrotating component of the vehicle of claim 41, wherein the connector comprises a bracket.

46. The standard nonrotating component of the vehicle of claim 41, wherein the connector comprises a flange.

47. The standard nonrotating component of the vehicle of claim 41, wherein the connector comprises a plurality of flanges.

48. The standard nonrotating component of the vehicle of claim 41, wherein the connector comprises an opening to receive a shaft interconnecting the connector and the given one of the track systems.

49. The standard nonrotating component of the vehicle of claim 41, wherein the vehicle comprises an axle and an axle housing that houses the axle, and the connector is configured to wrap about the axle housing.

50. The standard nonrotating component of the vehicle of claim 41, wherein the connector is welded to an adjacent part of the standard nonrotating component of the vehicle.

51. The standard nonrotating component of the vehicle of claim 41, wherein the vehicle is a construction vehicle.

52. The standard nonrotating component of the vehicle of claim 50, wherein the connector is welded to the adjacent part of the standard nonrotating component of the vehicle after manufacturing of the adjacent part of the standard nonrotating component of the vehicle.

53. The standard nonrotating component of the vehicle of claim 50, wherein the connector projects from the adjacent part of the standard nonrotating component of the vehicle.

54. The standard nonrotating component of the vehicle of claim 53, wherein the connector depends downwardly from the adjacent part of the standard nonrotating component of the vehicle.

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