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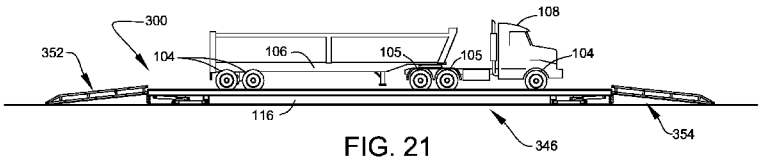

FIG. 21

(57) Abstract: A portable system for preventing the "track out" of dust, mud, and similar debris by vehicles leaving a construction site. The system provides a plurality of rollers in combination with vibratory structures designed to rotate and vibrate the vehicle tires in order to dislodge debris from the vehicle.

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PORTABLE TRACK-OUT PREVENTION SYSTEMS

BACKGROUND

This invention relates to providing a track-out prevention system. More particularly, this invention relates to providing a portable system for preventing the "track out" of dust, mud, and similar debris by vehicles leaving a construction site.

It is often desirable for environmental and other reasons, or required by regulation, to remove dust, mud, or other materials that may be deposited on a public roadway by a vehicle leaving a construction site prior to such vehicle traveling on such public roadway. Currently, vehicles are manually cleaned of such debris using time-consuming and labor intensive processes; systems to increase the efficiency of this process would be of value to many.

OBJECTS AND FEATURES OF THE INVENTION

A primary object and feature of the present invention is to provide a system overcoming the above-mentioned problems.

It is a further object and feature of the present invention to provide such a system to efficiently remove dirt, mud, and debris that may be deposited on a public roadway from a vehicle prior to leaving a site from which such vehicle has acquired such matter.

It is a further object and feature of the present invention to provide such a system with a mobile apparatus that may be transported over public roadways and user-placed as needed on a site to efficiently remove dirt, mud, and debris from vehicles.

It is a further object and feature of the present invention to provide such a system that uses greatly reduced or zero water for such debris removal from vehicles.

It is a further object and feature of the present invention to provide such a system to efficiently remove dirt, mud, and other debris from the undercarriage of a vehicle.

A further primary object and feature of the present invention is to provide such a system that is efficient, inexpensive, and durable. Other objects and features of this

invention will become apparent with reference to the following descriptions.

SUMMARY OF THE INVENTION

In accordance with a preferred embodiment hereof, this invention provides a system relating to the removal of surface accumulations of debris from at least one vehicle having a plurality of rolling tires rotationally mounted thereon, such system comprising: at least one vehicle support structured and arranged to support the at least one vehicle in at least one substantially stationary position; wherein such at least one vehicle support comprises at least one tire rotator structured and arranged to essentially contemporaneously rotate substantially each one of the plurality of rolling tires of the at least one vehicle supported by such at least one vehicle support; wherein such at least one tire rotator comprises at least one power extractor structured and arranged to extract rotational power from the at least one vehicle; wherein such at least one tire rotator operates substantially by such rotational power derived from the at least one vehicle; and wherein rotation of the plurality of rolling tires by such at least one tire rotator assists in dislodging debris from the at least one vehicle.

Moreover, it provides such a system wherein such at least one vehicle support further comprises: at least one wheel-assisted towing assembly structured and arranged to assist wheeled towing of such at least one vehicle support; wherein such at least one wheel-assisted towing assembly comprises at least one wheel set structured and arranged to assist rolling movement of such at least one vehicle support; and at least one hitch coupler structured and arranged to assist hitch coupling of such at least one vehicle support to at least one towing vehicle. Additionally, it provides such a system wherein such at least one power extractor comprises at least one contact interaction between at least one powered rolling tire of the plurality of rolling tires and such at least one tire rotator.

Also, it provides such a system wherein such at least one vehicle support further comprises: at least one elevated platform structured and arranged to support the at least one vehicle above a ground surface; at least one vehicle entry ramp structured and arranged to provide ramp-assisted vehicle entry of the at least one vehicle onto such at least one vehicle support; and at least one vehicle exit ramp structured and arranged to provide ramp-assisted vehicle exiting of the at least one vehicle from such at least one vehicle support.

In addition, it provides such a system wherein such at least one vehicle entry ramp and such at least one vehicle exit ramp are substantially detachable from such at least one vehicle support to assist such wheel-assisting towing. And, it provides such a system wherein such at least one vehicle support further comprises: at least one secondary debris-dislodger structured and arranged to provide secondary dislodging of debris from the at least one vehicle; wherein such at least one secondary debris-dislodger comprises at least one vibration-inducing surface structured and arranged to induce debris-dislodging vibrations in the at least one vehicle during movement of the at least one vehicle over such at least one secondary debris-dislodger.

Further, it provides such a system wherein: such at least one vehicle entry ramp comprises at least one portion of such at least one secondary debris-dislodger; and such at least one vehicle entry ramp is further structured and arranged to dislodge debris from the at least one vehicle during such vehicle entry. Even further, it provides such a system wherein: such at least one vehicle exit ramp comprises at least one portion of such secondary debris-dislodger; and such at least one vehicle exit ramp is further structured and arranged to dislodge debris from the at least one vehicle during such vehicle exit.

Moreover, it provides such a system wherein such at least one vibration-inducing surface substantially comprises a

plurality of spaced-apart transverse bars located substantially within the drive path of the at least one vehicle. Additionally, it provides such a system wherein such at least one vibration-inducing surface substantially comprises at least one area of loose aggregate material located substantially within the drive path of the at least one vehicle. Also, it provides such a system wherein such at least one tire rotator comprises: at least one set of wheel-mounted road tires structured and arranged to support the plurality of rolling tires; at least one set of vehicle-drive-train differentials structured and arranged to rotationally support such set of wheel-mounted road tires; and at least one set of torque couplers structured and arranged to couple the torque received through at least one vehicle-drive-train differential to essentially all other vehicle-drive-train differentials of such at least one set.

In addition, it provides such a system wherein such at least one tire rotator further comprises at least one power take-off structured and arranged to extract usable power from a portion of the torque received through such at least one vehicle-drive-train differential. And, it provides such a system further comprising: at least one brake structured and arranged to brake such at least one tire rotator; and at least one user control structured and arranged to assist user control of such at least one brake. Further, it provides such a system further comprising: at least one air pump structured and arranged to pressurize air by pumping; at least one air-storage reservoir structured and arranged to store a volume of pressurized air; at least one pneumatically-powered brake actuator structured and arranged to assist pneumatic actuation of such at least one brake; at least one pneumatic circuit structured and arranged to operably couple such at least one air-storage reservoir and such at least one pneumatically-powered brake actuator; and at least one pneumatic control valve structured and arranged to control the application of such

pressurized air at such at least one pneumatically-powered brake actuator; wherein the operation of such at least one pneumatic control valve is substantially controlled by such at least one user control; and wherein the operation of such at least one air pump is enabled using the usable power provided at such at least one power take-off.

Even further, it provides such a system further comprising at least one positional restraint structured and arranged to restrain the at least one vehicle in a substantially fixed position relative to such at least one vehicle support. Moreover, it provides such a system further comprising at least one mechanically-powered lift structured and arranged to lift such at least one vehicle support to at least one position assisting placement of such at least one wheel-assisted towing assembly and coupling to the at least one towing vehicle.

In accordance with another preferred embodiment hereof, this invention provides a method relating to the removal of surface accumulations of debris from at least one vehicle having a plurality of rolling tires rotationally mounted thereon, such method comprising the steps of: supporting the at least one vehicle in at least one substantially stationary position; engaging the plurality of rolling tires within at least one tire rotator structured and arranged to essentially contemporaneously rotate substantially each one of the plurality of rolling tires; extracting rotational power from the at least one vehicle; operating such at least one tire rotator using such extracted rotational power; and dislodging debris from the at least one vehicle by rotation of the plurality of rolling tires by such tire rotator.

Even further, it provides such a system wherein such at least one tire rotator comprises: at least one plurality of supportive rollers structured and arranged to rotatably support the plurality of rolling tires; and at least one set of torque couplers structured and arranged to couple the torque received through at least one supportive roller of such at least one

plurality of supportive rollers to substantially all other such supportive rollers of such at least one plurality. Moreover, it provides such a system wherein each such at least one supportive roller comprises: at least one elongated bar comprising at least one first end portion, at least one second end portion, and at least one center portion situate therebetween; at least one centering assembly structured and arranged to assist in maintaining the at least one rolling tire in at least one supported position proximate to such at least one center portion.

Additionally, it provides such a system wherein such at least one centering assembly comprises: proximate with such at least one first end portion, at least one first frustoconical portion comprising a diameter increasing with distance from such at least one center portion; proximate with such at least one second end portion, at least one second frustoconical portion comprising a diameter increasing with distance from such at least one center portion; wherein such at least one elongated bar comprises at least one rotational axis; and wherein such at least one first frustoconical portion and such at least one second frustoconical portion are disposed substantially coaxially with such at least one rotational axis. Also, it provides such a system wherein such at least one set of torque couplers comprises at least one power-distributing chain drive structured and arranged to distribute rotary power between substantially each at least one rotatable bar of such at least one plurality.

In addition, it provides such a system wherein: such at least one elongated bar further comprises at least one portion of such at least one secondary debris-dislodger; and such at least one portion of such at least one secondary debris-dislodger comprises at least one uneven outer peripheral surface of such at least one rotatable bar. And, it provides such a system wherein such at least one tire rotator further comprises at least one power take-off structured and arranged to extract

usable power from a portion of the torque received through such at least one supportive roller of such at least one plurality of supportive rollers.

In accordance with another preferred embodiment hereof, this invention provides a system relating to prevention material track-out by at least one vehicle having a plurality of rolling tires rotationally mounted thereon, such system comprising: vehicle support means for supporting the at least one vehicle in at least one substantially stationary position; wherein such vehicle support means comprises tire rotator means for rotating substantially each one of the plurality of rolling tires of the at least one vehicle supported by such tire support means; wherein such tire rotator means comprises power extractor means for extracting rotational power from the at least one vehicle; wherein such tire rotator means substantially operates by such rotational power derived from the at least one vehicle; and wherein rotation of the plurality of rolling tires by such tire rotator means assists in dislodging debris from the at least one vehicle. Additionally, it provides such a system wherein such vehicle support means comprises: wheel-assisted towing means for wheel-assisting towing of such vehicle support means; wherein such wheel-assisted towing means comprises wheel means for assisting rolling movement of such vehicle support means; and hitch coupler means for hitch coupling such vehicle support means to at least one towing vehicle. Also, it provides such a system wherein such power extractor means comprises at least one contact interaction between at least one powered rolling tire of the plurality of rolling tires and such tire rotating means. In addition, it provides such a system wherein such vehicle support means further comprises: vehicle entry assister means for assisting vehicle entry of the at least one vehicle onto such vehicle support means; and vehicle exit assister means for assisting vehicle exiting of the at least one vehicle from such vehicle support means. And, it provides such a system wherein such vehicle entry assister means and such vehicle exit assister

means are substantially detachable from such vehicle support. Further, it provides such a system wherein such vehicle support means further comprises: secondary debris-dislodger means for providing secondary dislodging of debris from the at least one vehicle; wherein such secondary debris-dislodger means comprises vibration-inducing surface means for inducing debris-dislodging vibrations during movement of the at least one vehicle over such secondary debris-dislodger means.

Even further, it provides such a system wherein such vehicle exit assister means comprises at least one portion of such secondary debris-dislodger means. Even further, it provides such a system wherein such vehicle entry assister means comprises at least one portion of such secondary debris-dislodger means for dislodging debris from the at least one vehicle during such vehicle entry. Even further, it provides such a system further comprising: braking means for braking such tire rotator means; and user control means for assisting user control of such braking means. Even further, it provides such a system further comprising lifter means for mechanically lifting such vehicle support means to assist at least one reconfiguration of such vehicle support means for operation with such wheel-assisted towing means and the at least one towing vehicle. In addition it provides each and every novel feature, element, combination, step and/or method disclosed or suggested by this patent application.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 shows a schematic diagram, illustrating a preferred vehicle debris-removal operation of a portable track-out prevention apparatus, according to preferred embodiments of the present invention.

FIG. 2 shows an enlarged schematic diagram illustrating the preferred vehicle debris-removal operation of the portable track-out prevention apparatus of FIG. 1.

FIG. 3 shows an overall plan view, of a portable track-out prevention apparatus, according to a first preferred embodiment of the present invention.

FIG. 4 shows an overall side view of the portable track-out prevention apparatus of FIG. 3.

FIG. 5 shows the partial enlarged plan view 5 of FIG. 3 illustrating a portion of the portable track-out prevention apparatus of FIG. 3.

FIG. 6 shows the partial enlarged side view 6 of FIG. 4 illustrating a portion of the portable track-out prevention apparatus of FIG. 3.

FIG. 7 shows the partial enlarged plan view 7 of FIG. 3 illustrating a portion of the portable track-out prevention apparatus of FIG. 3.

FIG. 8 shows the partial enlarged side view 8 of FIG. 4 illustrating a portion of the portable track-out prevention apparatus of FIG. 3.

FIG. 9 shows the partial enlarged plan view 9 of FIG. 7 illustrating a wheel rotation assembly of the portable track-out prevention apparatus of FIG. 3.

FIG. 10 shows the partial enlarged plan view 10 of FIG. 7 illustrating a front-wheel rotation subassembly of the portable track-out prevention apparatus of FIG. 3.

FIG. 11 shows the sectional view 11-11 of FIG. 9 illustrating preferred structural arrangements of the portable track-out prevention apparatus of FIG. 3.

FIG. 12 shows the partial enlarged side view 12 of FIG. 8 illustrating a portion of the portable track-out prevention apparatus of FIG. 3.

FIG. 13 shows the sectional view 13-13 of FIG. 9 illustrating preferred structural arrangements of the portable track-out prevention apparatus of FIG. 3.

FIG. 14 shows a partial cut-away perspective view, of the main chassis of the portable track-out prevention apparatus, according to the preferred embodiment of FIG. 3.

FIG. 15 shows a schematic diagram illustrating the pneumatic control arrangements of the portable track-out prevention apparatus of FIG. 3.

FIG. 16 shows a side view, in partial section, illustrating the portable track-out prevention apparatus configured for relocation by truck, according to the preferred embodiment of FIG. 3.

FIG. 17 shows a partial enlarged plan view, illustrating a preferred coupler assembly used to rotationally couple sets of adjacent gear boxes of a wheel rotation assembly, of the portable track-out prevention apparatus of FIG. 3.

FIG. 18 shows a plan view illustrating the preferred coupler assembly of FIG. 17.

FIG. 19 shows a sectional view through the section 19-19 of FIG. 18 further illustrating the preferred coupler assembly of FIG. 17.

FIG. 20 shows an overall plan view, of an alternate portable track-out prevention apparatus, according to a second preferred embodiment of the present invention.

FIG. 21 shows an overall side view of the alternate portable track-out prevention apparatus of FIG. 20.

FIG. 22 shows the partial enlarged plan view 22 of FIG. 20 illustrating a portion of the alternate portable track-out prevention apparatus of FIG. 20.

FIG. 23 shows the sectional view 23-23 of FIG. 22 illustrating preferred structural arrangements of the alternate portable track-out prevention apparatus of FIG. 20.

FIG. 24 shows a side view of a single support roller of the wheel rotation assembly of the alternate portable track-out prevention apparatus of FIG. 20.

FIG. 25 shows a partial side view illustrating the preferred drive coupling arrangements of the alternate portable track-out prevention apparatus of FIG. 20.

FIG. 26 shows a partial plan view illustrating the preferred drive coupling arrangements of the alternate portable track-out prevention apparatus of FIG. 20.

FIG. 27 shows the sectional view 27-27 of FIG. 24 illustrating preferred structures and arrangements the support roller of the alternate portable track-out prevention apparatus of FIG. 20.

FIG. 28 shows a partial side view illustrating an onboard lift mechanism used to lift the alternate portable track-out prevention apparatus from a ground-supported position to a raised position.

FIG. 29 shows a side view, illustrating the alternate portable track-out prevention apparatus being configured for relocation by truck, according to the preferred embodiment of FIG. 20.

FIG. 30 shows a side view, illustrating the alternate portable track-out prevention apparatus being configured for relocation by truck, according to the preferred embodiment of FIG. 20.

DETAILED DESCRIPTION OF THE BEST MODES AND PREFERRED EMBODIMENTS OF THE INVENTION

FIG. 1 shows a schematic diagram, illustrating a preferred vehicle debris-removal operation of preferred embodiments of track-out prevention system **100**. FIG. 2 shows an enlarged schematic diagram, showing the preferred vehicle debris-removal operation of FIG. 1, according to the preferred embodiments of track-out prevention system **100**. Preferred embodiments of track-out prevention system **100** preferably function to remove dirt (mud, debris, etc.) from wheels **104** and chassis **106** of vehicle **108**. Preferred embodiments of track-out prevention system **100** preferably operate, in principle, by the simultaneous rotation of all road-going wheels **104** of vehicle **108**, as diagrammatically illustrated in FIG. 1 and FIG. 2. This preferred action dislodges and removes debris from the wheels and tires by centripetal forces generated by the wheel rotation.

Secondarily, debris is removed from vehicle **108** by preferred structures located along the path of the vehicle, as further described below.

Preferred embodiments of track-out prevention system **100** preferably comprise an elevated vehicle support platform **116** adapted to support vehicle **108** in a substantially stationary position, as shown. The preferred elevated arrangement of vehicle support platform **116** enables a preferred integration of a wheel rotation assembly **110** (at least embodying herein at least one tire rotator) within the platform structure, as shown. Wheel rotation assembly **110** preferably comprises a plurality of supportive wheel rotators **112** each preferably adapted to engage one or more rolling wheels **104** of vehicle **108**, as illustrated in FIG. 1. Except as noted below, it is preferred that each wheel rotator **112** of wheel rotation assembly **110** be rotationally coupled to preferably provide essentially contemporaneous coordinated rotation of all road-going wheels **104** of vehicle **108**, as shown in both FIG. 1 and FIG. 2. It is further preferred that the rotation of each wheel rotator **112** be power driven, most preferably power driven by rotational power extracted from the drive wheels **105** of vehicle **108**. It is noted that drive wheels **105** preferably comprise those wheels coupled to the drive axles and power plant of vehicle **108** and which normally function to propel vehicle **108** during over-the-road travel. Each wheel rotator **112** is preferably intercoupled by a series of torque couplers **122** adapted to distribute the rotational power (torque) received from drive wheels **105** between wheel rotators **112** of wheel rotation assembly **110**.

Wheel rotators **112** of wheel rotation assembly **110** are preferably located in positions within support platform **116** generally coinciding with the locations of the plurality of wheels **104** of vehicle **108**, as shown. The preferred use of multiple rotators functions to accommodate trucks of various lengths. Upon reading this specification, those with ordinary skill in the art will now appreciate that, under appropriate

circumstances, considering such issues as cost, operator preference, etc., other rotator arrangements such as, for example, utilizing a series of endless belts, rotating caterpillar-type tracks, etc., may suffice.

In addition to wheel rotation assembly **110**, support platform **116** may preferably comprise multiple secondary debris-dislodging regions **124** structured and arranged to provide secondary dislodging of debris from vehicle **108**. Each secondary debris-dislodging region **124** preferably comprises at least one vibration-inducing surface **126** structured and arranged to induce debris-dislodging vibrations within vehicle **108** during movement of vehicle **108** over support platform **116**. It is noted that vibration-inducing surfaces **126** may preferably be incorporated within the support structures of wheel rotation assembly **110**, as illustrated in the alternate preferred embodiment of FIG. 20.

The above-described system at least embodies herein a method relating to the removal of surface accumulations of debris from at least one vehicle having a plurality of rollable tires rotationally mounted thereon, such method comprising the steps of: supporting the at least one vehicle in at least one substantially stationary position; engaging the plurality of rolling tires within at least one tire rotator structured and arranged to essentially contemporaneously rotate substantially each one of the plurality of rollable tires; extracting rotational power from the at least one vehicle; operating such at least one tire rotator using such extracted rotational power; and dislodging debris from the at least one vehicle by rotation of the plurality of rollable tires by said tire rotator.

FIG. 3 shows an overall plan view of portable track-out prevention apparatus **102**, according to a first preferred embodiment of track-out prevention system **100**. FIG. 4 shows an overall side view of portable track-out prevention apparatus **102**. FIG. 3 and FIG. 4 are provided to more clearly illustrate the preferred physical structures and arrangements of a preferred embodiment of portable track-out prevention apparatus

102. Both FIG. 3 and FIG. 4 illustrate portable track-out prevention apparatus **102** in a preferred operable configuration. In this preferred configuration, portable track-out prevention apparatus **102** comprises an overall length **A** of about 124 feet. Of this length, each ramp portion comprises a length **B** of about 30 feet with the remaining distance **C** of about 64 feet extending along the length of support platform **116.** Portable track-out prevention apparatus **102** is also preferably capable of being shortened for road-going transport, as will be further explained in the descriptions of FIG. 16.

FIG. 5 shows the partial enlarged plan view 5 of FIG. 3 illustrating a portion of portable track-out prevention apparatus **102.** FIG. 6 shows the partial enlarged side view 6 of FIG. 4. FIG. 7 shows the partial enlarged plan view 7 of FIG. 3 illustrating a portion of portable track-out prevention apparatus **102.** FIG. 8 shows the partial enlarged side view 8 of FIG. 4 illustrating another side portion of portable track-out prevention apparatus **102.** It is noted that the following descriptions make specific reference to FIG. 3 through FIG. 8 with continued reference to FIG. 1 and FIG. 2.

In preferred use, vehicle **108** accesses support platform **116** by traversing an upwardly inclined entry ramp **114,** preferably positioned at first end **121** of support platform **116,** as shown. A downwardly sloping exit ramp **114** is preferably located at second end **123** of support platform **116** to provide ramp-assisted exiting of vehicle **108** from support platform **116.**

Both entry ramp **114** and exit ramp **114** preferably comprise secondary debris-dislodging regions **124,** as shown. As noted previously, secondary debris-dislodging regions **124** preferably comprise vibration-inducing surfaces adapted to induce debris-dislodging vibrations in vehicle **108** as it drives over portable track-out prevention apparatus **102.** Each secondary debris-dislodging region **124** preferably comprises a plurality of spaced-apart transverse bars **136** (see FIG.5) located substantially within the drive path **174** (see FIG. 3) of vehicle

108, as shown. Each transverse bar **136** preferably comprises a length of round tube steel having an outer diameter of about three inches and a wall thickness of about 1/4 inch. Each transverse bar **136** is preferably rigidly mounted to the underlying support structure at a center-to-center spacing of about eight inches. The preferred spacing between transverse bars **136** produces a vigorous shaking of wheels **104**, undercarriage, chassis **106**, and body of vehicle **108**, thus dislodging dirt, gravel and other debris from their surfaces. Furthermore, the open regions formed between adjacent transverse bars **136** preferably allows the dislodged debris to fall through the transverse bars **136** to the ground surface below, thus limiting the build-up of debris within the drive path **174** of vehicle **108**.

Alternately preferably, secondary debris-dislodging region **124** may comprise one or more vehicle-supporting trays **138** containing granular aggregate material **119**, such as crushed rock (or other gravel-like materials), preferably functioning to assist removal of dust and debris from the tires of vehicle **108** as they roll over structural tray **138**. In an alternate preferred embodiment of the present invention, exit ramp **118** preferably comprises structural tray **138** containing granular aggregate material **119**, as best illustrated in the partial cutaway view of FIG. 7 (at least embodying herein wherein such at least one vibration-inducing surface substantially comprises at least one area of loose aggregate material located substantially within the drive path of the least one vehicle).

Entry ramp **114** preferably comprises an open central region **152**, substantially devoid of transverse bar **136**, as best shown in FIG. 5. This open central region facilitates the transition of vehicle **108** between the incline of entry ramp **114** and the substantially horizontal support platform **116** and specifically addresses undercarriage interference issues in certain lower-clearance vehicles.

Wheel rotation assembly **110** is preferably divided into three separate wheel supporting regions identified herein as rear-wheel rotation subassembly **146**, mid-wheel rotation subassembly **148**, and front-wheel rotation subassembly **150**. Each of the above-noted wheel supporting regions comprises a set of wheel rotators **112**, as shown. The preferred spacing between the wheel rotation subassemblies is intended to accommodate a wide range of vehicle wheel bases, preferably including tractor and semitrailer combinations, as previously illustrated in the diagram of FIG. 1.

FIG. 9 shows the partial enlarged plan view 9 of FIG. 7 illustrating mid-wheel rotation subassembly **148** of portable track-out prevention apparatus **102**. FIG. 10 shows the partial enlarged plan view 10 of FIG. 7 illustrating front-wheel rotation subassembly **150** of portable track-out prevention apparatus **102**. FIG. 11 shows the sectional view 11-11 of FIG. 9 illustrating preferred structural arrangements of portable track-out prevention apparatus **102**. FIG. 12 provides a partial enlarged side view 12 of FIG. 8 illustrating mid-wheel rotation subassembly **148**. FIG. 13 shows the sectional view 13-13 of FIG. 9 illustrating preferred structural arrangements of mid-wheel rotation subassembly **148**. FIG. 14 shows a partial cut-away perspective view of the main chassis of portable track-out prevention apparatus **102** according to the preferred embodiment of FIG. 1.

Portable track-out prevention apparatus **102** is preferably constructed around a pair of elongated structural members **120**, preferably comprising a set of wide-flange-type beams **154**, as shown. Each elongated structural member **120** of support platform **116** is preferably formed by vertically stacking two wide-flange-type beams **154**, as shown. Both wide-flange-type beams **154** preferably comprise W 18 x 35 steel members. The vertically-stacked wide-flange-type beams **154** are preferably joined by thermally welding upper beam flange **156** of a lower wide-flange-type beam **154** to lower beam flange **158** of an upper wide-flange-

type beam **154**. Elongated structural members **120** are preferably terminated at first end **121** and second end **123** with a similarly vertically-stacked pair of perpendicularly oriented end beams **160**, preferably comprising wide-flange members of matching depth.

The longitudinal webs of the elongated structural members **120** comprise a preferred center-to-center spacing **J** of about 40 inches, as noted in FIG. 9. Upon reading the teachings of this specification, those of ordinary skill in the art will now understand that, under appropriate circumstances, considering such issues as intended use, cost, etc., other arrangements, such as locating such structural members toward the peripheral edges of the platform, utilizing alternate bridge-like structures, utilizing alternate box beam construction, etc., may suffice.

Both entry ramp **114** and exit ramp **118** each comprise a single pair of parallel wide-flange-type beams **162**, also preferably comprising W 18 x 35 members. The lower portion of each wide-flange-type beam **162** is taper cut, as shown, to allow the distal ends of the ramps to rest near ground level. The upper proximal ends of each wide-flange-type beam **162** are preferably modified to comprise bolted connection **164**, as shown. Bolted connection **164** provides a preferred means for removably attaching a ramp to a respective end of support platform **116** and is thus instrumental in facilitating the reconfiguration of portable track-out prevention apparatus **102** for transport. Bolted connection **164** preferably engages a complementary set of bolt apertures **166** located at the upper end beams **160** (see FIG. 14).

Transverse bars **136** of support platform **116** are preferably supported by the upper-most beam flange **168** of elongated structural members **120**, as shown, and are preferably affixed to the supporting flange surfaces by thermal welding. The preferred support and attachment of transverse bars **136** to wide-

flange-type beams **162** of entry ramp **114** and exit ramp **118** are substantially similar.

The outer ends of each transverse bar **136** are supported by a continuous elongated support member, more preferably an L-shaped metal angle, most preferably a 4 inch x 4 inch steel angle **170**, as shown. Steel angles **170** of support platform **116** are preferably supported by diagonal braces **172** extending between the horizontal leg of steel angle **170** and the lower wide-flange-type beam **154** of elongated structural members **120**, as shown. The diagonal braces **172** are preferably omitted within the preferred structures of entry ramp **114** and exit ramp **118**, as shown.

A protective guide rail **173** preferably extends along each side of support platform **116** to assist the vehicle operator in maintaining vehicle **108** in a safe supported position within the intended path of travel. Each guide rail **173** preferably comprises a length of round tube steel having an outer diameter of about three inches. Each guide rail **173** runs concurrently with steel angle **170** at an elevation about 14 inches vertically above the horizontal leg of the adjacent angle. A matching set of protective guide rails **172** preferably extend along the sides of entry ramp **114** and exit ramp **118**, as shown.

Protective guide rails **172** generally define a preferred drive path **174** having a clear width E of at least about **106** inches. This preferred width is preferably maintained along substantially the entire length **A** of portable track-out prevention apparatus **102**, as shown, and is of sufficient width to accommodate most road-going vehicles. Upon reading this specification, those with ordinary skill in the art will now appreciate that, under appropriate circumstances, considering such issues as vehicle type, nature of the local site operations, etc., other width arrangements such as, for example, wider drive paths to accommodate larger earth-moving apparatus, etc., may suffice.

Rear-wheel rotation subassembly **146**, mid-wheel rotation subassembly **148**, and front-wheel rotation subassembly **150** each preferably comprise a plurality of wheel rotators **112**, preferably comprising tandem sets of rotating wheels, more preferably tandem sets of wheel-mounted road tires **176** rotatably supported by tandem sets of torque-transmitting axles **178**, as shown. Both rear-wheel rotation subassembly **146** and mid-wheel rotation subassembly **148** preferably comprise a grouping of four torque-transmitting axles **178** rotationally supporting sixteen wheel-mounted road tires **176**, as shown. Front-wheel rotation subassembly **150** preferably comprises one torque-transmitting axle **178** and one idler axle **192** together rotationally supporting eight wheel-mounted road tires **176**, as shown.

Each torque-transmitting axle **178** preferably comprises a drive axle sourced from a heavy truck powertrain, such as, for example, tandem drive-axles produced by Freightliner Trucks (a division of Daimler Trucks North America LLC of Portland Oregon). Such heavy-truck drive axles preferably utilize a differential assembly, preferably a Rockwell® power-dividing differential assembly having a preferred gear ratio of about 3.73. The Rockwell® differential assembly is preferably modified to prevent differential rotation of the opposing wheel-mounted road tires **176**. This modification is preferably accomplished by welding the planetary spider gears within the differential carrier.

Wheel-mounted road tires **176** are preferably mounted to torque-transmitting axles **178** in pairs, in an arrangement commonly referred to as "dualies", preferably comprising dual-wheel assemblies bolt-mounted to the drum and hub assemblies **188** located at each side of the axle, as shown. This preferred arrangement closely corresponds to common wheel/axle combinations of vehicle **108**. Upon reading this specification, those with ordinary skill in the art will now appreciate that, under appropriate circumstances, considering such issues as cost, vehicle type/size, etc., other wheel rotator arrangements

such as, for example, the use of 24-inch wide caterpillar-type treads, endless belt assemblies, "super single" wheels, etc., may suffice.

The drum and hub assemblies **188** preferably comprise braking assemblies, which can be pneumatically operated to slow or stop the wheel-mounted road tires **176.** Wheel-mounted road tires **176** preferably comprise rubber truck tires, preferably commercial-type truck tires having a preferred size of 255/70R 22.5 with an outer diameter of about 40.5 inches.

Each torque-transmitting axle **178** is rigidly mounted to upper beam flange **156** of the lower wide-flange-type beam **154,** as shown. An approximately nine-inch high opening **180** is cut in the vertical web of the upper wide-flange-type beam **154** to allow torque-transmitting axles **178** to pass therethrough, as shown. Each torque-transmitting axle **178** preferably comprises an axle-to-axle spacing **F** of about 37-3/4 inches. This preferred spacing provides about a one-inch gap between adjacent wheel-mounted road tires **176.**

In a preferred arrangement of wheel rotation assembly **110** the center-to-center distance **X** between adjacent axles of front-wheel rotation subassembly **150** and mid-wheel rotation subassembly **148** is about 11 feet nine inches. The preferred center-to-center distance **Z** between adjacent axles of mid-wheel rotation subassembly **148** and rear-wheel rotation subassembly 146 is about 22 feet. This preferred arrangement accommodates vehicle wheel bases between about 210 and 260 inches.

As previously noted, it is preferred that each wheel rotator **112** of wheel rotation assembly **110** be rotationally coupled to provide essentially contemporaneous coordinated rotation of all road-going wheels **104** of vehicle **108.** Thus, each torque-transmitting axle **178** is preferably coupled by a set of torque couplers **122,** preferably comprising either a short inter-axle drive coupler **186** or longer drive shafts **134,** as shown (at least embodying herein at least one set of torque couplers structured and arranged to couple the torque received

through at least one vehicle-drivetrain differential to essentially all other vehicle-drivetrain differentials of such at least one set).

The short inter-axle drive couplers **186** are preferably used to couple the adjacent torque-transmitting axles **178** within rear-wheel rotation subassembly **146** and within mid-wheel rotation subassembly **148**, as shown. The preferred structures and arrangements of inter-axle drive couplers **186** are presented in FIG. 17 through FIG. 19.

The longer drive shafts **134** preferably span between rear-wheel rotation subassembly **146** and mid-wheel rotation subassembly **148** and between mid-wheel rotation subassembly **148** and front-wheel rotation subassembly **150**, as shown. Drive shafts **134** are of a conventional propeller-shaft design and preferably comprise customary universal-joint couplers, yokes, yoke straps, slip joints (to facilitate assembly), etc. Drive shafts **134** preferably comprise a maximum unsupported length of about 60 inches and are preferably supported at intermediate points by carrier bearings **190**, as best illustrated in FIG. 5 and FIG. 14. Thus, the rotation of the drive wheels of vehicle **108** (preferably coupled by supported contact with a set of rollers **112**) powers the rotation of the other rollers **112** (and, as a result, any other wheels **104** of vehicle **108** in contact with a set of rollers **112**).

A bearing-mounted rolling bar **182** is preferably located between each tandem axle pair of rear-wheel rotation subassembly **146** and mid-wheel rotation subassembly **148**, as shown. Rolling bar **182** preferably functions to limit the vertical drop experienced by the wheels **104** of vehicle **108** as they move between wheel-mounted road tires **176**. They also assist in accommodating vehicles **108** of intermediate wheel base lengths. The ends of rolling bar **182** are preferably supported within pillow block-type bearings **184**, as shown. The inboard pillow block-type bearings **184** are preferably bolted to upper beam flange **156**, as shown. The outboard pillow block-type bearings

184 are preferably supported within a rigid pocket mounted to steel angle **170**, as shown. The axis of rotation of each pillow block-type bearings **184** is substantially parallel to the rotational axes of the wheel-mounted road tires **176**.

Front-wheel rotation subassembly **150** preferably comprises a torque-transmitting axle **178** and a forward-positioned free-wheeling idler axle **192**, as shown. Torque-transmitting axle **178** is preferably coupled to mid-wheel rotation subassembly **148** by drive shafts **134**, as shown. Torque-transmitting axle **178** of front-wheel rotation subassembly **150** preferably comprises a power take-off **194** functioning to extract usable power from a portion of the torque received through torque-transmitting axle **178**. Power take-off **194** is preferably coupled to equipment unit **196**, preferably containing an onboard air compressor **198** to supply pressurized air to operate the wheel-braking system of portable track-out prevention apparatus **102** (see FIG. 15).

A symmetrical set of side guards **200** preferably flank each side of front-wheel rotation subassembly **150**, mid-wheel rotation subassembly **148**, and rear-wheel rotation subassembly **146**, as shown. Side guards **200** are preferably used to maintain vehicle **108** in a preferred generally centered position over wheel rotators **112**. Side guards **200** further preferably function to prevent sidewall scrubbing and tire damage within wheels **104** as they are rotated. Each side guard **200** preferably comprises an elongated plate **202** rigidly mounted to guide rail **173** in a substantially parallel orientation, as shown. Each side guard **200** preferably supports a plurality of rollers **204** positioned to protectively engage the side walls of the vehicle tires should they drift in a transverse direction during rotation. Each roller **204** preferably comprises a 360-degree conveyor-type ball transfer unit mounted closely adjacent wheel-mounted road tires **176**, as shown.

FIG. 15 shows a schematic diagram illustrating preferred pneumatic control arrangements of portable track-out prevention apparatus **102**. At least one wheel rotator **112** of wheel rotation

assembly **110** preferably comprises an air brake **206** to allow an operator control the rotation of wheel rotators **112.** More preferably, each tandem axle comprises an air brake **206** preferably coupled to pneumatic braking subsystem **208,** as shown (at least embodying herein at least one brake structured and arranged to brake such at least one tire rotator). Preferably, air pressure used to operate the braking subsystem is supplied by the onboard air compressor **198** powered by power takeoff **194.** Upon reading this specification, those with ordinary skill in the art will now appreciate that, under appropriate circumstances, considering such issues as cost, user preference, etc., other equipment arrangements such as, for example, utilizing a gas-powered compressor, utilizing an onboard alternator and battery to generate electrical power derived from the power takeoff, etc., may suffice. Air compressor **198** preferably supplies pressurized air to an onboard air storage tank **210,** as shown (at least embodying herein at least one air-storage reservoir structured and arranged to store a volume of pressurized air). Distribution of the pressurized air to air brakes **206** is preferably routed from air tank **210** through at least one pneumatic circuit **214** preferably comprising pneumatic piping routed throughout support platform **116.** Airflow within pneumatic circuit **214** is preferably controlled by at least one electrically operated valve unit **212** electrically coupled with post-mounted control unit **140,** as shown. Post-mounted control unit **140** preferably comprises one or more user controls and is preferably located in a position accessible to the operator of vehicle **108,** thus allowing the vehicle operator to brake and release the wheel rotators **112.** Upon reading this specification, those with ordinary skill in the art will now appreciate that, under appropriate circumstances, considering such issues as cost, user preference, etc., other control arrangements such as, for example, providing automated brake-control functionality, providing visual indicators including warning lights, providing auditory indicators including warning

annunciators, providing closed circuit video to allow the operator to observe the cleaning operations from the cab of the vehicle, utilizing remote control devices to allow remote operation of the system, etc., may suffice.

In preferred use vehicle **108** drives onto the system by driving up vehicle entry ramp **114** onto support platform **116**, as shown. Preferably, the operator of vehicle **108** moves forward until the wheels **104** of vehicle **108** are engaged within wheel rotators **112** of wheel rotation assembly **110**, as best illustrated in FIG. 1 and FIG. 2. Preferably, the operator of vehicle **108** engages a mechanical restraining hook **180** (preferably adapted to engage at least one portion of the chassis of vehicle **108** to assure that the vehicle will remain stationary during a subsequent debris removal operation) and releases the air brakes restraining the rotation of rollers **112** by manipulating user controls **216** of post-mounted control unit **140** (preferably located near the cab of vehicle **108**). Preferably, each wheel rotator **112** of wheel rotation assembly **110** is then free to rotate (in a rotationally coordinated manner). Next, the operator of vehicle **108** preferably initiates operation of the vehicle as in normal driving. Preferably, rotation of the drive wheels **105** of vehicle **108** initiates rotation of all other wheels **104** in contact with wheel rotation assembly **110**. Preferably, the operator of vehicle **108** continues the rotation until a sufficient amount of debris has been removed from the wheels. Preferably, the operator of vehicle **108** then re-engages the brakes (controlling the rotation of rollers **112**) and releases the restraining hook **180** allowing the vehicle to move forward exiting support platform **116** by passing over exit ramp **118**. During passage over portable track-out prevention apparatus **102**, further debris is removed from the wheels by contact with the vibration-inducing surfaces **126**. Upon reading this specification, those with ordinary skill in the art will now appreciate that, under appropriate circumstances, considering such issues as environmental regulations, cost, etc., other

features and arrangements such as, for example, providing an arrangement of dust-suppressing misters along the system chassis, etc., may suffice.

FIG. 16 shows a side view, in partial section, illustrating portable track-out prevention apparatus **102** configured for relocation by towing vehicle **130**, preferably a semi-type tractor **220**, according to the preferred embodiment of FIG. 1. Portable track-out prevention apparatus **102** is preferably designed to be reconfigured for towing between deployment sites. Portable track-out prevention apparatus **102** preferably comprises a set of pneumatically-operated (or alternately preferably, hydraulically-operated) telescoping support legs **143** adapted to raise and lower support platform **116** (see FIG. 15). Support legs **143** are preferably used to lift support platform **116** to an elevation sufficiently high to allow the placement of wheel assembly **145** and to allow the attachment of king-pin **222** to a fifth wheel coupling assembly **224** of the towing vehicle **130** (such as a semi-type tractor), as shown in FIG. 2. Upon reading the teachings of this specification, those of ordinary skill in the art will now understand that, under appropriate circumstances, considering such issues as intended use, size, etc., other hitch arrangements, such as pintle hooks, drawbar, pin hitch, permanent connections, etc., may suffice. Furthermore, upon reading the teachings of this specification, those of ordinary skill in the art will now understand that, under appropriate circumstances, considering such issues as intended use, etc., other wheel arrangements, such as utilizing permanently affixed on-board wheels, deployed by hydraulics or other means, etc., may suffice.

To facilitate movement, it is preferred that entry ramp **114** and exit ramp **118** be removable so that they may be stacked on support platform **116** during transport, as shown. Upon reading the teachings of this specification, those of ordinary skill in the art will now understand that, under appropriate circumstances, considering such issues as intended use, etc.,

other arrangements, such as hinged arrangements, multi-part chassis arrangements, etc., may suffice.

FIG. 17 shows a partial enlarged plan view illustrating a preferred inter-axle drive coupler **186** used to rotationally couple sets of adjacent torque-transmitting axles **178** of a wheel rotation assembly of portable track-out prevention apparatus **102**. FIG. 18 shows a plan view illustrating the preferred inter-axle drive coupler **186** of FIG. 17. FIG. 19 shows a sectional view through the section 19-19 of FIG. 18 further illustrating the preferred inter-axle drive coupler **186** of FIG. 17.

Inter-axle drive coupler **186** preferably comprises first plate **230** and a spaced apart second plate **232**, as shown. A first set of teeth **234** preferably project outwardly from first plate **230**, as shown. The first set of teeth **234** are preferably structured and arranged to inter-engage with a second set of teeth **236** preferably projecting outwardly from second plate **232**. Rotation of first plate **230** results in the rotation of second plate **232** as a result of the contact engagement between the first set of teeth **234** and the second set of teeth **236**. Rotational forces are thus transferred between the two plates by interference between the opposing teeth. A set of rubber attenuators **231** are preferably bolted between first plate **230** and the second plate **232** to attenuate sudden loading of the teeth during torque transfer. Each plate is rigidly welded to a yoke member **240** compatible with the input and output shafts of the adjacent torque-transmitting axles **178**.

FIG. 20 shows an overall plan view of alternate portable track-out prevention apparatus **300** according to a second preferred embodiment of track-out prevention system **100**. FIG. 21 shows an overall side view of the same alternate portable track-out prevention apparatus **300** of FIG. 20.

Alternate portable track-out prevention apparatus **300** preferably operates by the simultaneous rotation of all road-going wheels **104** of vehicle **108** (as diagrammatically illustrated

in FIG. 1 and FIG. 2). This preferred action serves to dislodge and remove debris from the wheels and tires by centripetal forces generated during wheel rotation. Secondarily, debris is removed from vehicle **108** by secondary debris-dislodging regions **124** located along the path of the vehicle.

Alternate portable track-out prevention apparatus **300** preferably comprises an elevated vehicle support platform **116** adapted to support vehicle **108** in a substantially stationary position, as shown. Vehicle support platform **116** preferably comprises a wheel rotation assembly **110** (at least embodying herein at least one tire rotator) based on a substantially continuous arrangement of "low profile" wheel rotators **112**. Each wheel rotator **112** is preferably adapted to engage one or more rolling wheels **104** of vehicle **108** (as generally illustrated in FIG. 1). Except as noted below, it is preferred that each wheel rotator **112** of wheel rotation assembly **110** be rotationally coupled to preferably provide essentially contemporaneous coordinated rotation of all road-going wheels **104** of vehicle **108**, as shown in both FIG. 1 and FIG. 2. It is again preferred that the rotation of each wheel rotator **112** be power driven, most preferably power driven by rotational power extracted from the drive wheels **105** of vehicle **108**. Each wheel rotator **112** is preferably intercoupled by a series of torque couplers (see FIG. 25) adapted to distribute the rotational power (torque) received from drive wheels **105** between the wheel rotators **112** of wheel rotation assembly **110**.

Wheel rotators **112** of wheel rotation assembly **110** are preferably located in positions within support platform **116** generally coinciding with the locations of the plurality of wheels **104** of vehicle **108**. The preferred use of many adjacent rotators functions to accommodate vehicles of various lengths.

In addition to wheel rotation assembly **110**, support platform **116** preferably comprises multiple secondary debris-dislodging regions **124** structured and arranged to provide secondary dislodging of debris from vehicle **108**. Each secondary

debris-dislodging region **124** preferably comprises at least one vibration-inducing surface **126** structured and arranged to induce debris-dislodging vibrations within vehicle **108** during movement of vehicle **108** over support platform **116.**

Vehicle **108** preferably accesses support platform **116** by traversing an upwardly inclined entry ramp **352.** A downwardly sloping exit ramp **354** is preferably located at the opposing end of support platform **116** to provide ramp-assisted exiting of vehicle **108.** Both entry ramp **352** and exit ramp **354** comprise shorter lengths than their respective counterparts servicing portable track-out prevention apparatus **102.** This is due to the preferred "low profile" support height of support platform **116.**

Both entry ramp **352** and exit ramp **354** preferably comprise secondary debris-dislodging regions **124,** as shown. As noted previously, secondary debris-dislodging regions **124** preferably comprise vibration-inducing surfaces **126** adapted to induce debris-dislodging vibrations in vehicle **108** as it drives over alternate portable track-out prevention apparatus **300.** Each secondary debris-dislodging region **124** of the entry and exit ramps preferably comprises a plurality of spaced-apart transverse bars **136** located substantially within the drive path **174** of vehicle **108,** as shown. Each transverse bar **136** preferably comprises a length of round tube steel having an outer diameter of about three inches and a wall thickness of about 1/4 inch. Each transverse bar **136** is preferably rigidly mounted to the underlying support structure at a center-to-center spacing of about eight inches. The preferred spacing between transverse bars **136** produces a vigorous shaking of wheels **104,** undercarriage, chassis **106,** and body of vehicle **108,** thus dislodging dirt, gravel and other debris from their surfaces. Furthermore, the open regions formed between adjacent transverse bars **136** preferably allows the dislodged debris to fall through the transverse bars **136** to the ground surface below, thus limiting the build-up of debris within the drive path **174** of vehicle **108.**

FIG. 22 shows the partial enlarged plan view 22 of FIG. 20 illustrating a portion of alternate portable track-out prevention apparatus **300** of FIG. 20. Alternate portable track-out prevention apparatus **300** preferably comprises a plurality of supportive rollers **302** structured and arranged to rotatably support the plurality of wheels **104** of vehicle **108**. Rollers **302** are preferably rotatably supported within support platform **116** and are preferably disposed in closely-adjacent spaced relation, as shown. The preferred close interspacing of rollers **302** forms a substantially continuous rolling surface for vehicle **108**. This preferred arrangement allows alternate portable track-out prevention apparatus **300** to accommodate vehicles of many differing wheel base lengths and track widths. For example, alternate portable track-out prevention apparatus **300** is capable of servicing a short-wheelbase 3/4-ton pickup truck (of sufficient horsepower) as well as long wheelbase semi-type tractor trailer rigs. Each roller **302** preferably comprises a central longitudinal axis **304** about which each roller **302** rotates. Preferred roller-to-roller spacing **W**, as preferably measured between longitudinal axes **304**, is preferably between about six inches and about ten inches. A roller-to-roller spacing **W** of about eight inches is most preferred as this spacing has been found to accommodate most wheels/tire combinations.

FIG. 23 shows the sectional view 23-23 of FIG. 22 illustrating preferred structural arrangements of alternate portable track-out prevention apparatus **300**. FIG. 24 shows a side view of a single support roller **302** of wheel rotation assembly **110** of alternate portable track-out prevention apparatus **300**. Each roller **302** preferably comprises a first end **308**, a second end **310**, and a center portion **312** situate between first end **308** and second end **310**, as shown. Each roller **302** preferably comprises a central elongated bar **306** preferably extending continuously between first end **308** and second end **310**, as shown. Elongated bar **306** preferably comprises at least one

metallic composition, most preferably steel. Elongated bar **306** most preferably comprises a substantially solid and substantially cylindrical bar having an outer diameter **G** of about two inches.

Each elongated bar **306** is fitted with wheel-centering assembly **314** to assist in maintaining the vehicle's plurality of wheels **104** in a preferred position supported over center portion **312**. Wheel-centering assembly **314** preferably comprises a first frustoconical portion **316** proximate to first end **308**, as shown, and a second frustoconical portion **318** proximate to second end **310**. Both first frustoconical portion **316** and second frustoconical portion **318** are substantially coaxial with longitudinal axis **304** (the rotational axis of roller **302**), as shown. Both first frustoconical portion **316** and second frustoconical portion **318** each have a diameter preferably increasing with distance from center portion **312**, as shown. The large diameter ends **327** of first frustoconical portion **316** and second frustoconical portion **318** each comprise the largest practical diameter **D** accommodated by the selected roller-to-roller spacing (a diameter **D** preferably approaching about eight inches).

The preferred distance **M** between first frustoconical portion **316** and second frustoconical portion **318** is about **116** inches. The overall track width **N**, as measured between the distal (large-diameter) faces of first frustoconical portion **316** and second frustoconical portion **318**, preferably is about ten feet.

For durability, both first frustoconical portion **316** and second frustoconical portion **318** are preferably formed from a substantially rigid metal, most preferably steel. Upon reading this specification, those with ordinary skill in the art will now appreciate that, under appropriate circumstances, considering such issues as cost savings, vehicle model, etc., other wheel-centering arrangements such as, for example, providing an alternating arrangement of frustoconical portions

wherein each roller comprises only one frustoconical portion, wherein the frustoconical portions of adjacent rollers alternate between right and left positions, etc., may suffice.

Alternate portable track-out prevention apparatus **300** is preferably constructed using multiple elongated structural members **320**, each preferably comprising a steel structural member, more preferably a wide-flange-type beam **154**, as shown. Each wide-flange-type beam **154** preferably extends substantially the full length **L** of support platform **116** in substantially parallel orientation. Structural cross members **322** (shown by the dashed line designations of FIG. 23) preferably extend between wide-flange-type beams **154** to maintain the respective members in a geometrically fixed relationship. Upon reading this specification, those with ordinary skill in the art will now appreciate that, under appropriate circumstances, considering such issues as cost, user preference, etc., other structural support arrangements such as, for example, using four parallel structural wide-flange members, using four parallel open truss members etc., may suffice.

Each roller **302** is preferably supported at multiple points by pillow block-type bearings **184**, as shown. The pillow block-type bearings **184** are preferably mounted to respective upper surfaces of the upper beam flanges **156** of the middle and outer wide-flange-type beams **154**, as shown. Translational movement of rollers **302**, along their longitudinal axes **304**, is preferably controlled by one piece or two-piece set-screw type shaft collars **324** mounted thereon.

During preferred operation, the torque received through one supportive roller **302** of support platform **116** is preferably transmitted to substantially all other rollers **302** of the apparatus. In alternate portable track-out prevention apparatus **300** rotational "coupling" of the rollers is preferably accomplished by an alternating arrangement of torque couplers **325** organized to distribute torque received from drive wheels **105** of vehicle **108** to the full plurality of rollers **302**. Torque

couplers **325** preferably comprise an arrangement of power-distributing chain drives **326**, as shown.

Braking of rollers **302** is preferably accomplished by an arrangement of inboard brakes **328** preferably mounted to the central wide-flange-type beam **154**, as shown. Brakes **328** preferably comprise one or more air-actuated disc-type brakes preferably derived from an automotive application. Each brake **328** preferably comprises disc-type rotor **330** rotatably engaged within at least one air-actuated caliper body **332**, as shown. A set of flanged adapters **334** may be used to rigidly engage disc-type rotor **330** with elongated bar **306**. Upon reading this specification, those with ordinary skill in the art will now appreciate that, under appropriate circumstances, considering such issues as cost, user preference, etc., other braking arrangements such as, for example the use of outboard brake positions, drum-type brakes, brakes coupled to the chain drive, etc., may suffice.

To improve service life and promote safety, chain drives **326** and brakes **328** are preferably partially enclosed within protective shrouding **333**, as shown. Protective shrouding **333** may preferably comprise a sheet metal assembly adapted for easy removal during servicing. Portions of the shrouding may preferably function as a drip pan to collect lubricating oil/grease associated with chain drives **326**.

FIG. 25 shows a partial side view illustrating the preferred power-distributing chain drives **326** of the alternate portable track-out prevention apparatus **300**. FIG. 26 shows a partial plan view illustrating the preferred alternating coupling arrangements of the chain drives **326** of FIG. 25.

In a preferred arrangement of torque couplers **325**, first end **308** and second end **310** of each roller **302** are preferably fitted with at least one roller-chain sprocket **336**, as shown. Each sprocket **336** is adapted to engage at least one continuously looped roller chain **338**, as shown, most preferably a single strand No. 60 ("RS60"-type) roller chain.

Each sprocket **336** preferably comprises an outer sprocket diameter of about four inches and a pitch diameter matched to roller chain **338.** Roller chains **338** are preferably engaged on alternating pairs of adjacent sprockets **336,** as best illustrated in FIG. 26. This preferred arrangement enables a simultaneous unidirectional rotation of all rollers **302.** Upon reading this specification, those with ordinary skill in the art will now appreciate that, under appropriate circumstances, considering such issues as cost, user preference, etc., other rotational coupling arrangements such as, for example drive belts, multiple gear trains, double roller chains, etc., may suffice.

Preferably, at least one chain drive **326** is coupled to equipment unit **396,** preferably containing an onboard air compressor, air tank, and pneumatic valves used to supply pressurized air and operate the wheel-braking system in addition to other pneumatic apparatus of the embodiment. It is noted that the pneumatic subsystem of alternate portable track-out prevention apparatus **300** preferably operates in a manner substantially similar to the pneumatic subsystem of portable track-out prevention apparatus **102** (see FIG. 15). Upon reading this specification, those with ordinary skill in the art will now appreciate that, under appropriate circumstances, considering such issues as cost, user preference, etc., other power arrangements such as, for example, coupling the chain drive to a prime mover, such as a motor or engine, etc., may suffice.

FIG. 27 shows the sectional view 27-27 of FIG. 24 illustrating preferred structures and arrangements of elongated bar **306** of roller **302.** Each roller **302** preferably comprises at least one uneven outer peripheral surface **340** preferably adapted to generate within support platform **116,** an integral secondary debris-dislodging region **124.** Uneven outer peripheral surface **340** of each roller **302** is preferably produced by attaching, more preferably thermally welding, a set of small-diameter rumble bars **342** to the outer circumference of elongated bar **306,** as

shown. In a preferred arrangement, 1/2-inch diameter steel rumble bars **342** are welded to elongated bar **306** at about an equal 120-degree spacing, as shown. The axis of each rumble bar **342** is preferably oriented substantially parallel to longitudinal axis **304**, as shown. Each rumble bar **342** may preferably comprise a segment of No. 4 steel-reinforcing bar. During preferred operation, rumble bars **342** generate a debris-removing vibration as the rollers rotate beneath wheels **104** of vehicle **108**. Upon reading this specification, those with ordinary skill in the art will now appreciate that, under appropriate circumstances, considering such issues as cost, user preference, etc., other cleaning arrangements such as, for example, mounting one or more wheel-cleaning brushes within the vehicle drive path, mechanically rotating one or more wheel-cleaning brushes using power derived from the wheel rotation mechanism, etc., may suffice.

FIG. 28 shows a partial side view illustrating an onboard lift mechanism **344** used to lift alternate portable track-out prevention apparatus **300** from ground-supported position **346** (see FIG. 21)to raised position **348**. FIG. 29 shows a side view, illustrating alternate portable track-out prevention apparatus **300** being configured for relocation by towing truck **130**, according to the preferred embodiment of FIG. 20.

Alternate portable track-out prevention apparatus **300** is preferably designed to be reconfigured for towing between deployment sites. Lift mechanism **344** of alternate portable track-out prevention apparatus **300** preferably comprises a set of pneumatically-operated (or alternately preferably, hydraulically-operated) support legs **343** adapted to raise and lower alternate portable track-out prevention apparatus **300**. Support legs **343** are preferably used to lift support platform **116** to an elevation sufficiently high to allow the placement of wheel assembly **145** and to allow the attachment of a forward goose neck assembly **350**, as shown.

Goose neck assembly **350** preferably comprises king-pin **222** adapted to engage a fifth wheel coupling assembly **224** of towing vehicle **130**. Upon reading the teachings of this specification, those of ordinary skill in the art will now understand that, under appropriate circumstances, considering such issues as intended use, size, etc., other hitch arrangements, such as pintle hooks, drawbar, pin hitch, permanent connections, etc., may suffice. Furthermore, upon reading the teachings of this specification, those of ordinary skill in the art will now understand that, under appropriate circumstances, considering such issues as intended use, etc., other wheel arrangements, such as utilizing permanently affixed on-board wheels, deployed by hydraulics or other means, etc., may suffice.

To facilitate movement, it is preferred that entry ramp **352** and exit ramp **354** be removable so that they may be stacked on support platform **116** during transport, as shown. Upon reading the teachings of this specification, those of ordinary skill in the art will now understand that, under appropriate circumstances, considering such issues as intended use, etc., other arrangements, such as hinged arrangements, multi-part chassis arrangements, etc., may suffice.

FIG. 30 shows a side view, illustrating alternate portable track-out prevention apparatus **300** configured for relocation by towing vehicle **130**, according to the preferred embodiment of FIG. 20.

Although applicant has described some of applicant's preferred embodiments of this invention, it will be understood that the broadest scope of this invention includes modifications such as diverse shapes, sizes, and materials. Such scope is limited only by the below claims as read in connection with the above specification. Further, many other advantages of applicant's invention will be apparent to those skilled in the art from the above descriptions and the below claims.

What is claimed is:

1) A system relating to the removal of surface accumulations of debris from at least one vehicle having a plurality of rollable tires rotationally mounted thereon, said system comprising:
   a) at least one vehicle support structured and arranged to support the at least one vehicle in at least one substantially stationary position;
   b) wherein said at least one vehicle support comprises at least one tire rotator structured and arranged to essentially contemporaneously rotate substantially each one of the plurality of rollable tires of the at least one vehicle supported by said at least one vehicle support;
   c) wherein said at least one tire rotator comprises at least one power extractor structured and arranged to extract rotational power from the at least one vehicle;
   d) wherein said at least one tire rotator operates substantially by such rotational power derived from the at least one vehicle; and
   e) wherein rotation of the plurality of rollable tires by said at least one tire rotator assists in dislodging debris from the at least one vehicle.

2) The system according to Claim 1 wherein said at least one vehicle support further comprises:
   a) at least one wheel-assisted towing assembly structured and arranged to assist wheeled towing of said at least one vehicle support;
   b) wherein said at least one wheel-assisted towing assembly comprises
      i) at least one wheel set structured and arranged to assist rolling movement of said at least one vehicle support, and

ii) at least one hitch coupler structured and arranged to assist hitch coupling of said at least one vehicle support to at least one towing vehicle.

3) The system according to Claim 2 wherein said at least one power extractor comprises at least one contact interaction between at least one powered rolling tire of the plurality of rollable tires and said at least one tire rotator.

4) The system according to Claim 3 wherein said at least one vehicle support further comprises:

a) at least one elevated platform structured and arranged to support the at least one vehicle above a ground surface;

b) at least one vehicle entry ramp structured and arranged to provide ramp-assisted vehicle entry of the at least one vehicle onto said at least one vehicle support; and

c) at least one vehicle exit ramp structured and arranged to provide ramp-assisted vehicle exiting of the at least one vehicle from said at least one vehicle support.

5) The system according to Claim 4 wherein said at least one vehicle entry ramp and said at least one vehicle exit ramp are substantially detachable from said at least one vehicle support to assist such wheel-assisting towing.

6) The system according to Claim 5 wherein said at least one vehicle support further comprises:

a) at least one secondary debris-dislodger structured and arranged to provide secondary dislodging of debris from the at least one vehicle;

b) wherein said at least one secondary debris-dislodger comprises at least one vibration-inducing surface structured and arranged to induce debris-dislodging vibrations in the at least one vehicle during movement

of the at least one vehicle over said at least one secondary debris-dislodger.

7) The system according to Claim 6 wherein:

a) said at least one vehicle entry ramp comprises at least one portion of said at least one secondary debris-dislodger; and

b) said at least one vehicle entry ramp is further structured and arranged to dislodge debris from the at least one vehicle during such vehicle entry.

8) The system according to Claim 7 wherein:

a) said at least one vehicle exit ramp comprises at least one portion of said secondary debris-dislodger; and

b) said at least one vehicle exit ramp is further structured and arranged to dislodge debris from the at least one vehicle during such vehicle exit.

9) The system according to Claim 8 wherein said at least one vibration-inducing surface substantially comprises a plurality of spaced-apart transverse bars located substantially within the drive path of the at least one vehicle.

10) The system according to Claim 8 wherein at least one of said at least one vibration-inducing surface substantially comprises at least one area of loose aggregate material located substantially within the drive path of the at least one vehicle.

11) The system according to Claim 6 wherein said at least one tire rotator comprises:

a) at least one plurality of supportive rollers structured and arranged to rotatably support the plurality of rollable tires; and

b) at least one set of torque couplers structured and arranged to couple the torque received through at least one supportive roller of said at least one plurality of supportive rollers to substantially all

other such supportive rollers of said at least one plurality of supportive rollers.

12) The system according to Claim 11 wherein each such at least one supportive roller said at least one plurality of supportive rollers comprises:

a) at least one elongated bar comprising at least one first end portion, at least one second end portion, and at least one center portion situate therebetween; and

b) at least one centering assembly structured and arranged to assist in maintaining the at least one rollable tire in at least one supported position proximate to said at least one center portion.

13) The system according to Claim 12 wherein said at least one centering assembly comprises:

a) proximate with said at least one first end portion, at least one first frustoconical portion comprising a diameter increasing with distance from said at least one center portion; and

b) proximate with said at least one second end portion, at least one second frustoconical portion comprising a diameter increasing with distance from said at least one center portion;

c) wherein said at least one elongated bar comprises at least one rotational axis; and

d) wherein said at least one first frustoconical portion and said at least one second frustoconical portion are disposed substantially coaxially with said at least one rotational axis.

14) The system according to Claim 12 wherein said at least one set of torque couplers comprises at least one power-distributing chain drive structured and arranged to distribute rotary power between substantially each at least one rotatable bar of said at least one plurality of supportive rollers.

15) The system according to Claim 12 wherein:
    a) said at least one elongated bar further comprises at least one portion of said at least one secondary debris-dislodger; and
    b) said at least one portion of said at least one secondary debris-dislodger comprises at least one uneven outer peripheral surface of such at least one rotatable bar.

16) The system according to Claim 11 wherein said at least one tire rotator further comprises at least one power take-off structured and arranged to extract usable power from a portion of the torque received through such at least one supportive roller of said at least one plurality of supportive rollers.

17) The system according to Claim 16 further comprising:
    a) at least one brake structured and arranged to brake said at least one tire rotator; and
    b) at least one user control structured and arranged to assist user control of said at least one brake.

18) The system according to Claim 17 further comprising:
    a) at least one air pump structured and arranged to pressurize air by pumping;
    b) at least one air-storage reservoir structured and arranged to store a volume of pressurized air;
    c) at least one pneumatically-powered brake actuator structured and arranged to assist pneumatic actuation of said at least one brake;
    d) at least one pneumatic circuit structured and arranged to operably couple said at least one air-storage reservoir and said at least one pneumatically-powered brake actuator; and
    e) at least one pneumatic control valve structured and arranged to control the application of such pressurized air at said at least one pneumatically-powered brake actuator;

f) wherein the operation of said at least one pneumatic control valve is substantially controlled by said at least one user control; and

g) wherein the operation of said at least one air pump is enabled using the usable power provided at said at least one power take-off.

19) The system according to Claim 18 further comprising at least one positional restraint structured and arranged to restrain the at least one vehicle in a substantially fixed position relative to said at least one vehicle support.

20) The system according to Claim 18 further comprising:

a) at least one mechanically-powered lift structured and arranged to lift said at least one vehicle support to at least one position assisting placement of said at least one wheel-assisted towing assembly and coupling to the at least one towing vehicle.

21) The system according to Claim 6 wherein said at least one tire rotator comprises:

a) at least one set of wheel-mounted road tires structured and arranged to support the plurality of rollable tires;

b) at least one set of vehicle-drivetrain differentials structured and arranged to rotationally support said set of wheel-mounted road tires; and

c) at least one set of torque couplers structured and arranged to couple the torque received through at least one vehicle-drivetrain differential to substantially all other vehicle-drivetrain differentials of said at least one set.

22) The system according to Claim 21 wherein said at least one tire rotator further comprises at least one power take-off structured and arranged to extract usable power from a portion of the torque received through such at least one vehicle-drivetrain differential.

23) The system according to Claim 22 further comprising:

a) at least one brake structured and arranged to brake said at least one tire rotator; and

b) at least one user control structured and arranged to assist user control of said at least one brake.

24) A method relating to the removal of surface accumulations of debris from at least one vehicle having a plurality of rollable tires rotationally mounted thereon, such method comprising the steps of:

a) supporting the at least one vehicle in at least one substantially stationary position;

b) engaging the plurality of rolling tires within at least one tire rotator structured and arranged to essentially contemporaneously rotate substantially each one of the plurality of rollable tires;

c) extracting rotational power from the at least one vehicle;

d) operating such at least one tire rotator using such extracted rotational power; and

e) dislodging debris from the at least one vehicle by rotation of the plurality of rollable tires by said tire rotator.

25) A system relating to prevention material track-out by at least one vehicle having a plurality of rollable tires rotationally mounted thereon, said system comprising:

a) vehicle support means for supporting the at least one vehicle in at least one substantially stationary position;

b) wherein said vehicle support means comprises tire rotator means for rotating substantially each one of the plurality of rollable tires of the at least one vehicle supported by said tire support means;

c) wherein said tire rotator means comprises power extractor means for extracting rotational power from the at least one vehicle;

d) wherein said tire rotator means substantially operates by such rotational power derived from the at least one vehicle; and

e) wherein rotation of the plurality of rollable tires by said tire rotator means assists in dislodging debris from the at least one vehicle.

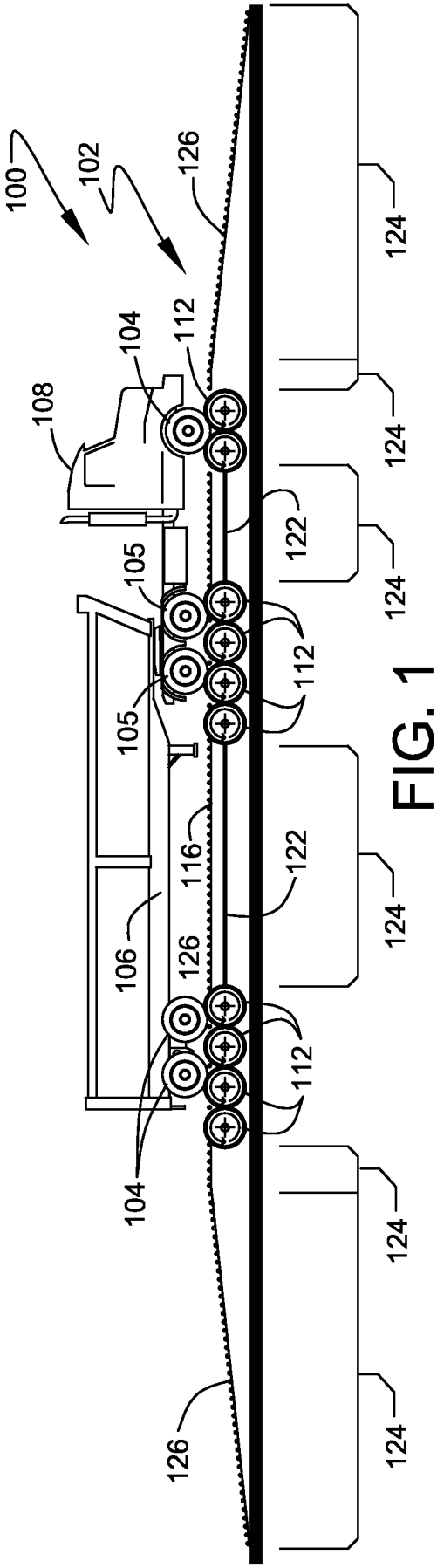

FIG. 1

FIG. 2

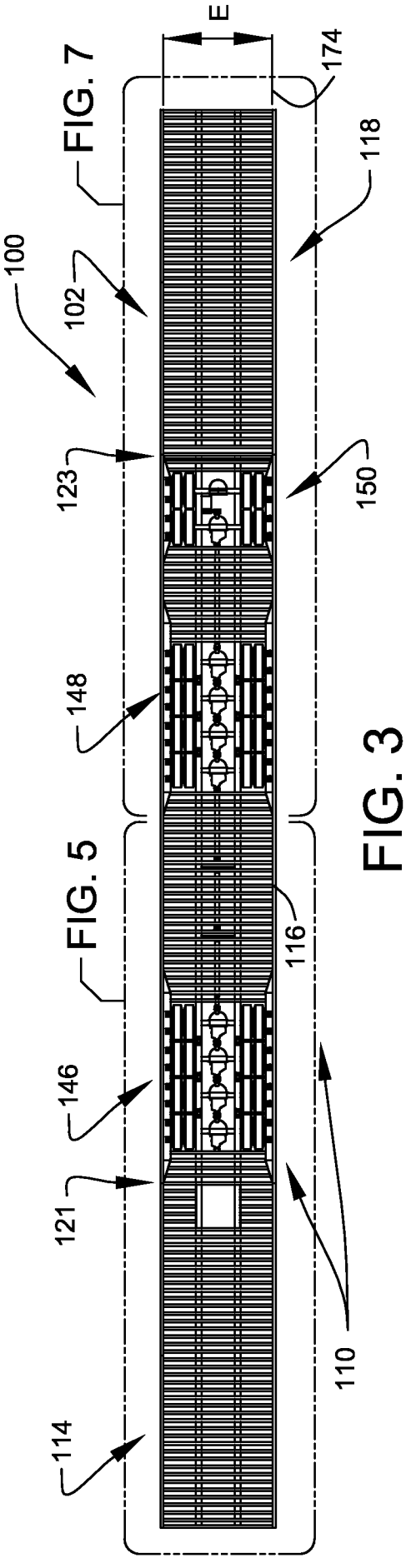

FIG. 3

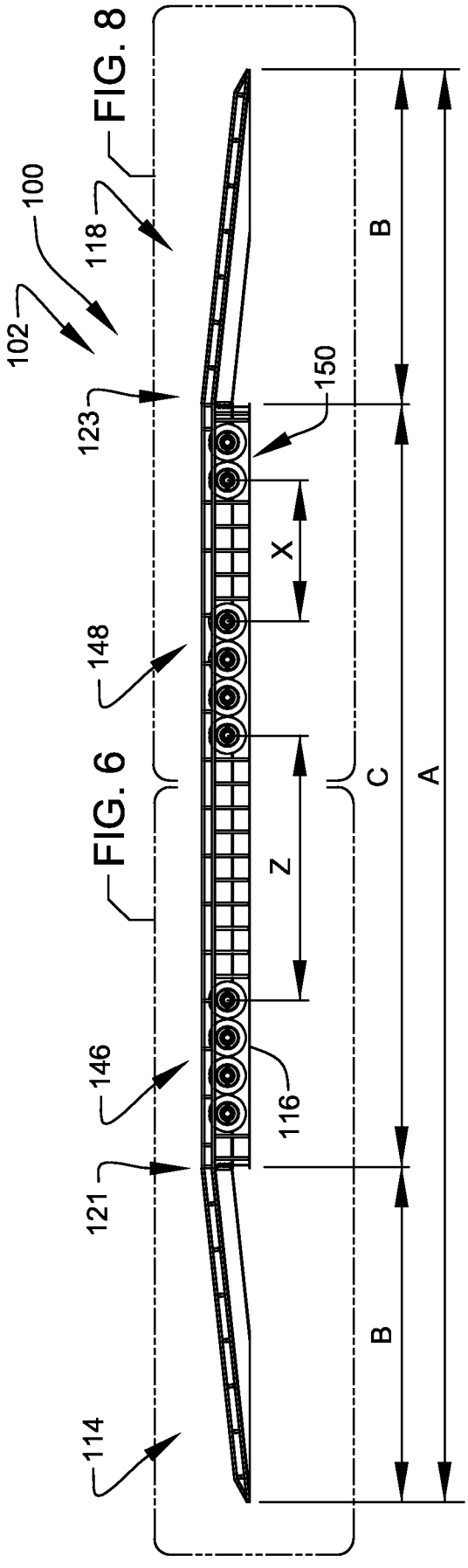

FIG. 4

FIG. 5

FIG. 6

FIG. 7

FIG. 8

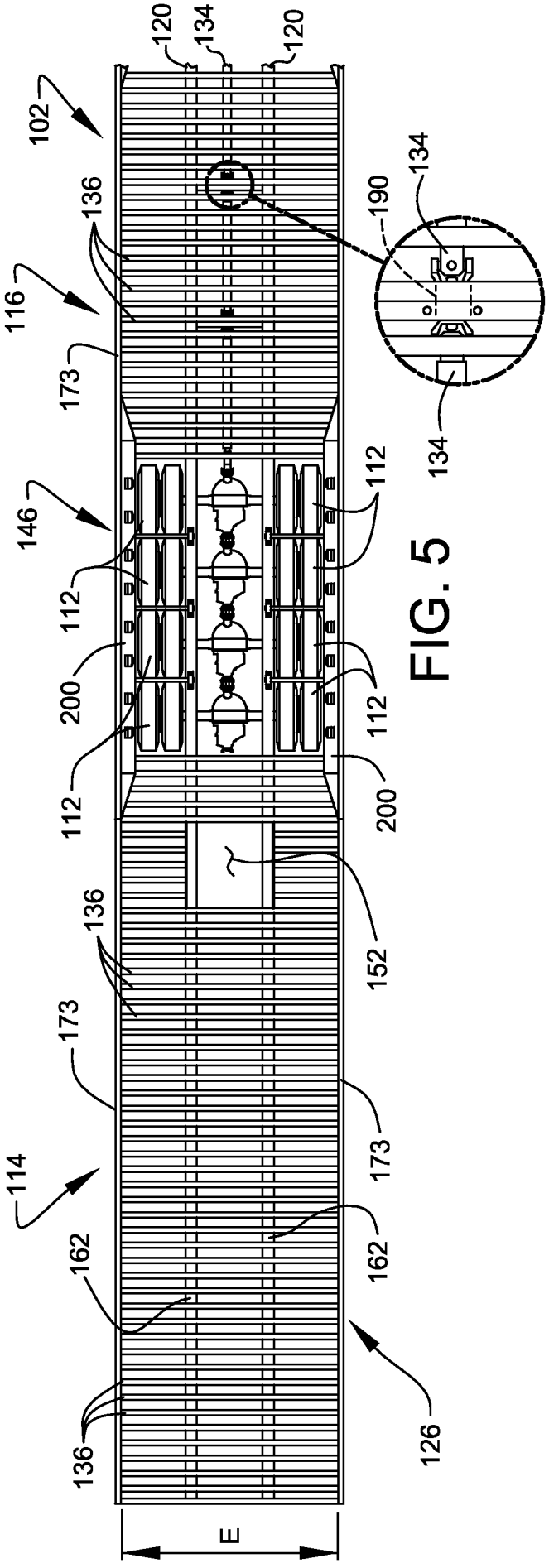
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FIG. 5

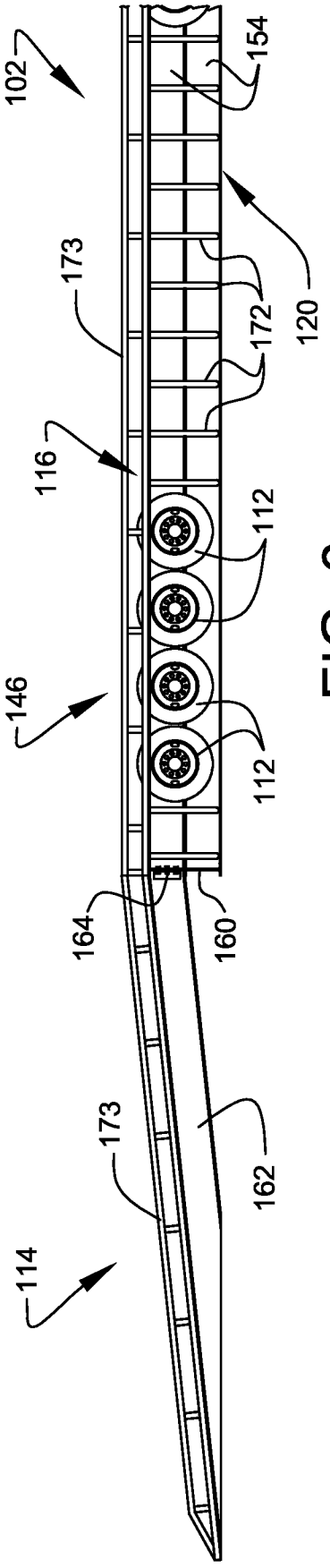
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FIG. 6

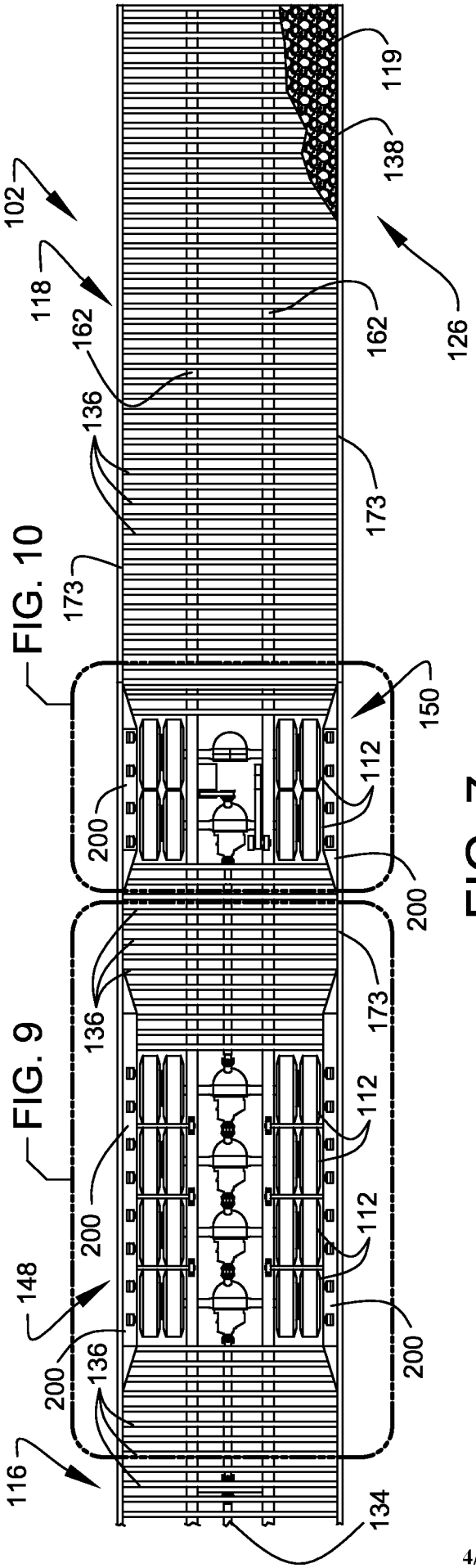

FIG. 10

FIG. 9

FIG. 7

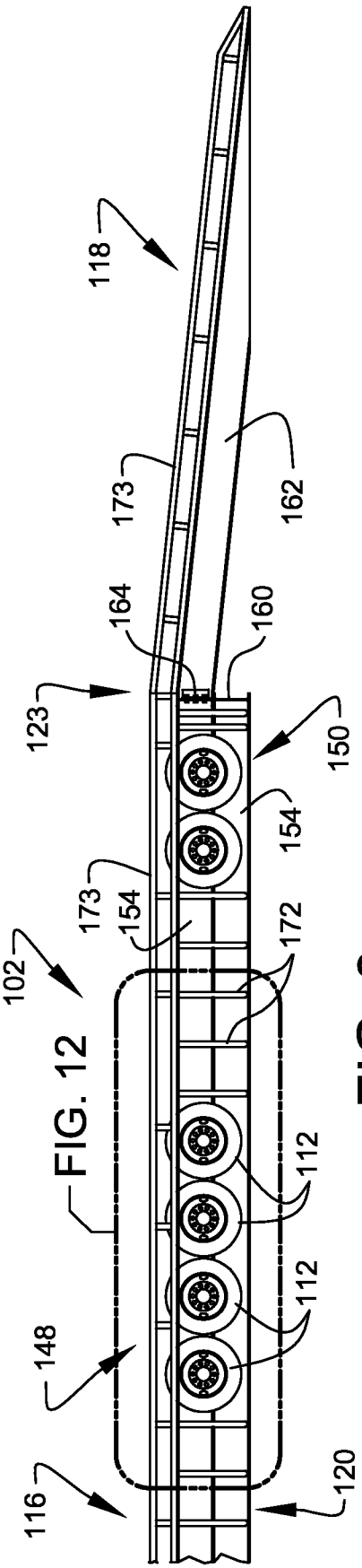

FIG. 12

FIG. 8

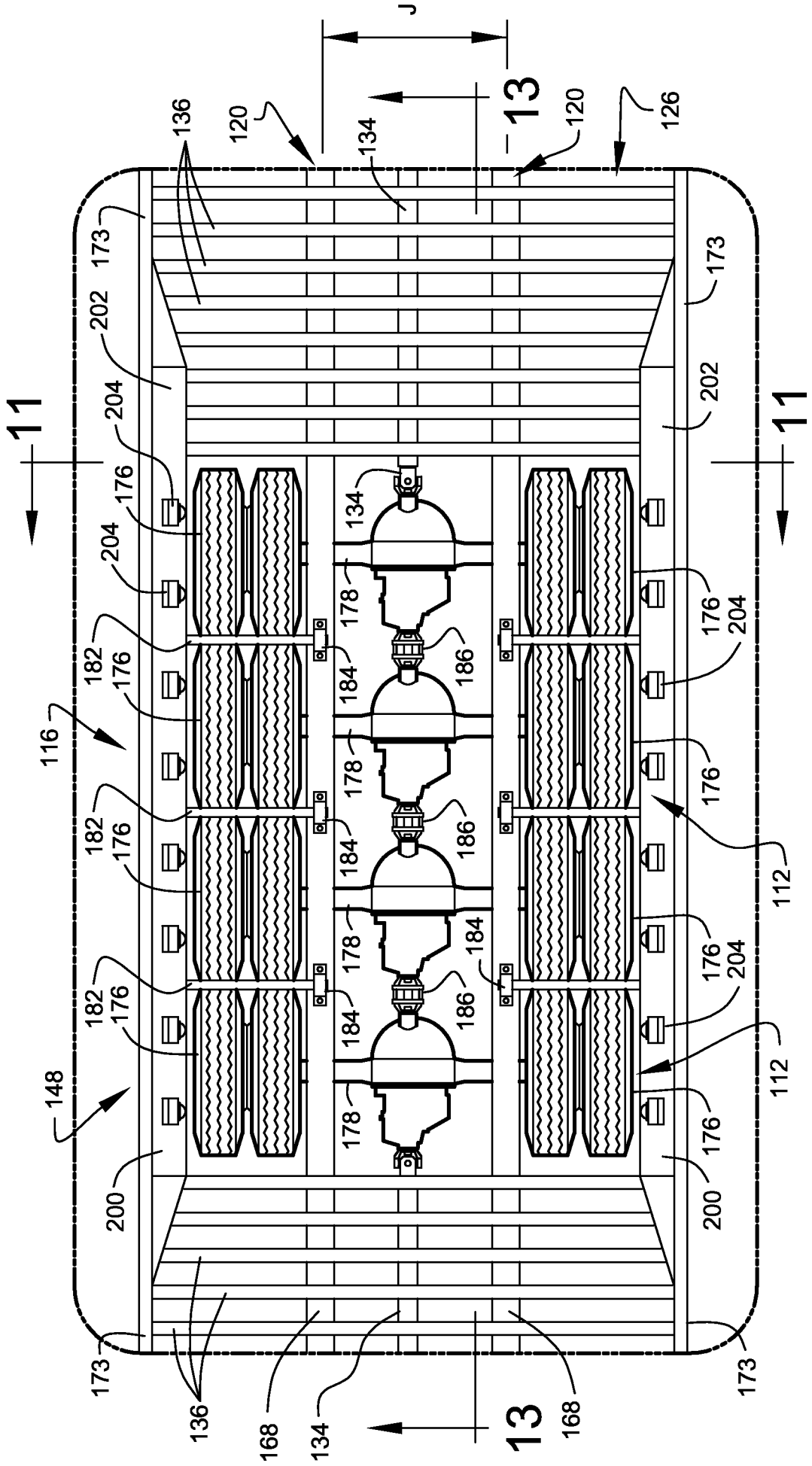
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FIG. 9

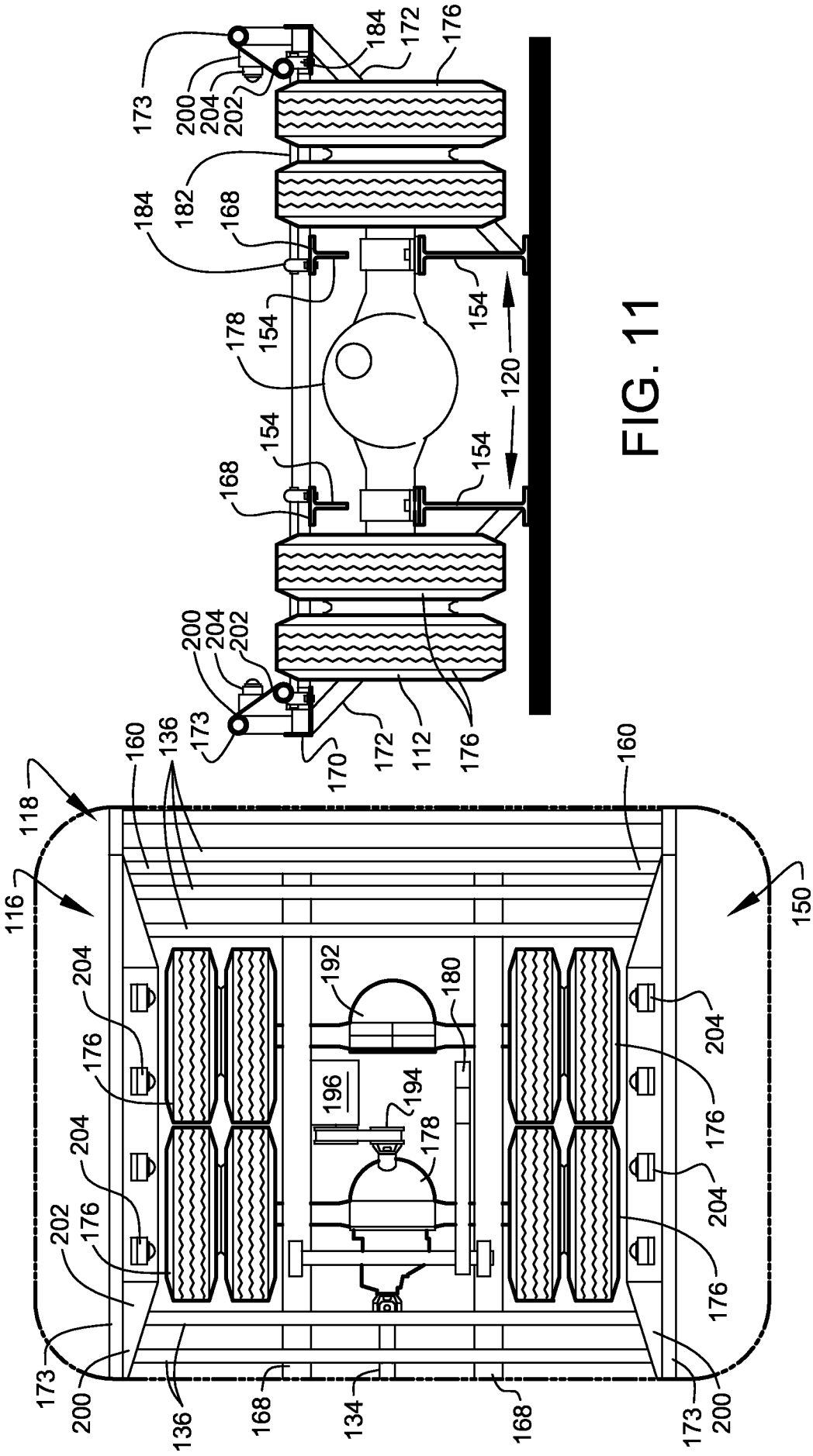
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FIG. 10

FIG. 11

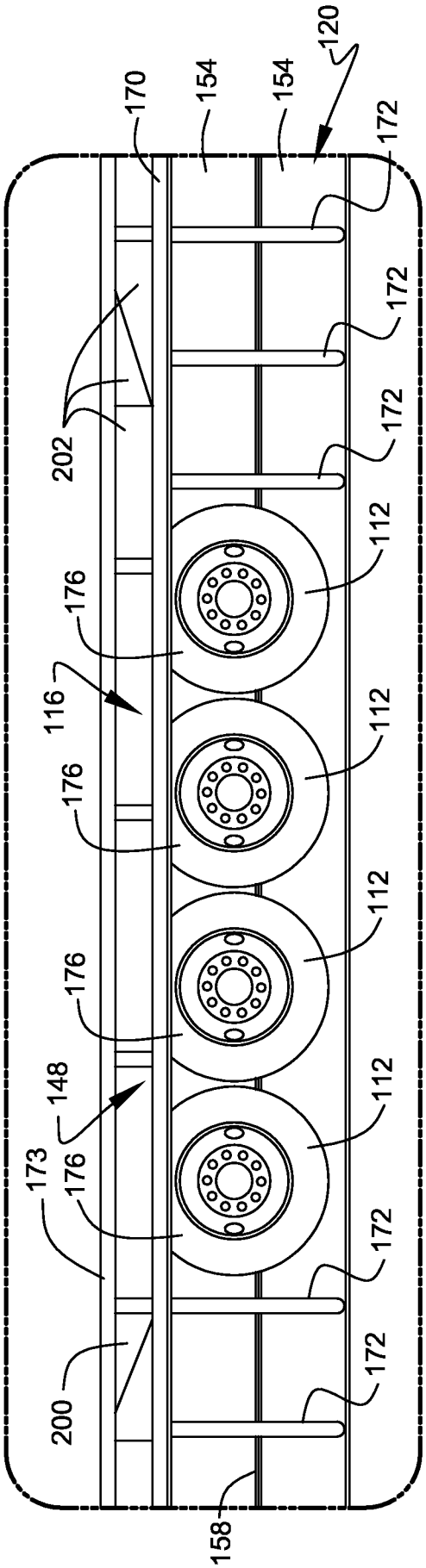
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FIG. 12

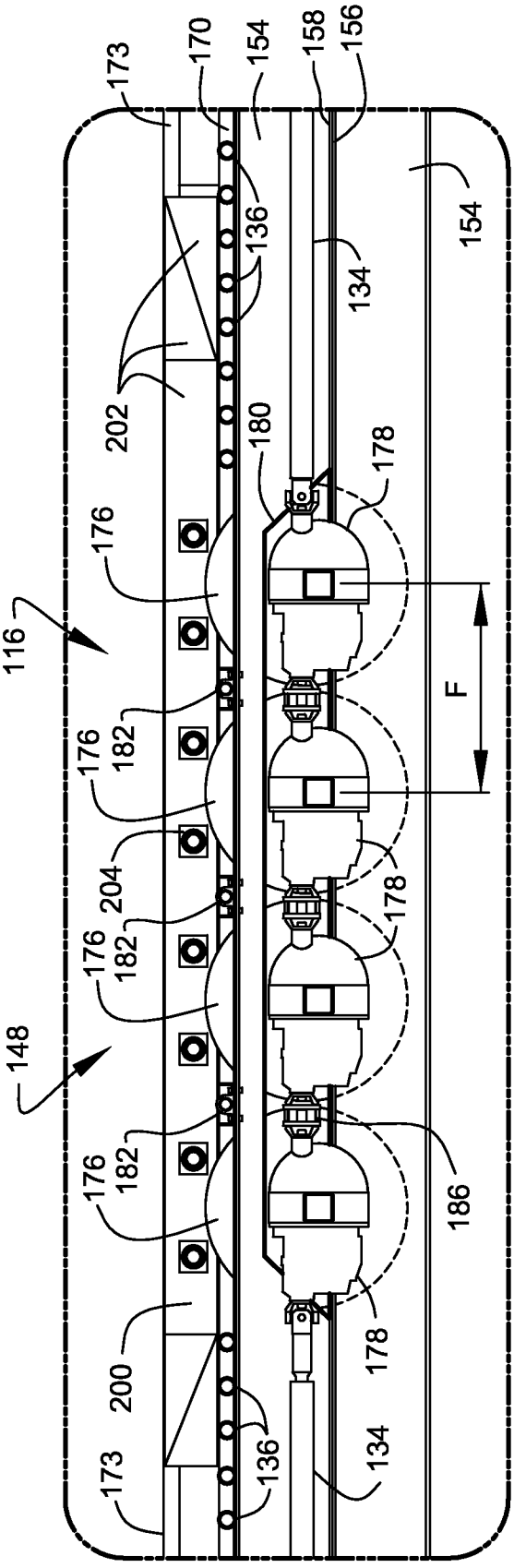
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FIG. 13

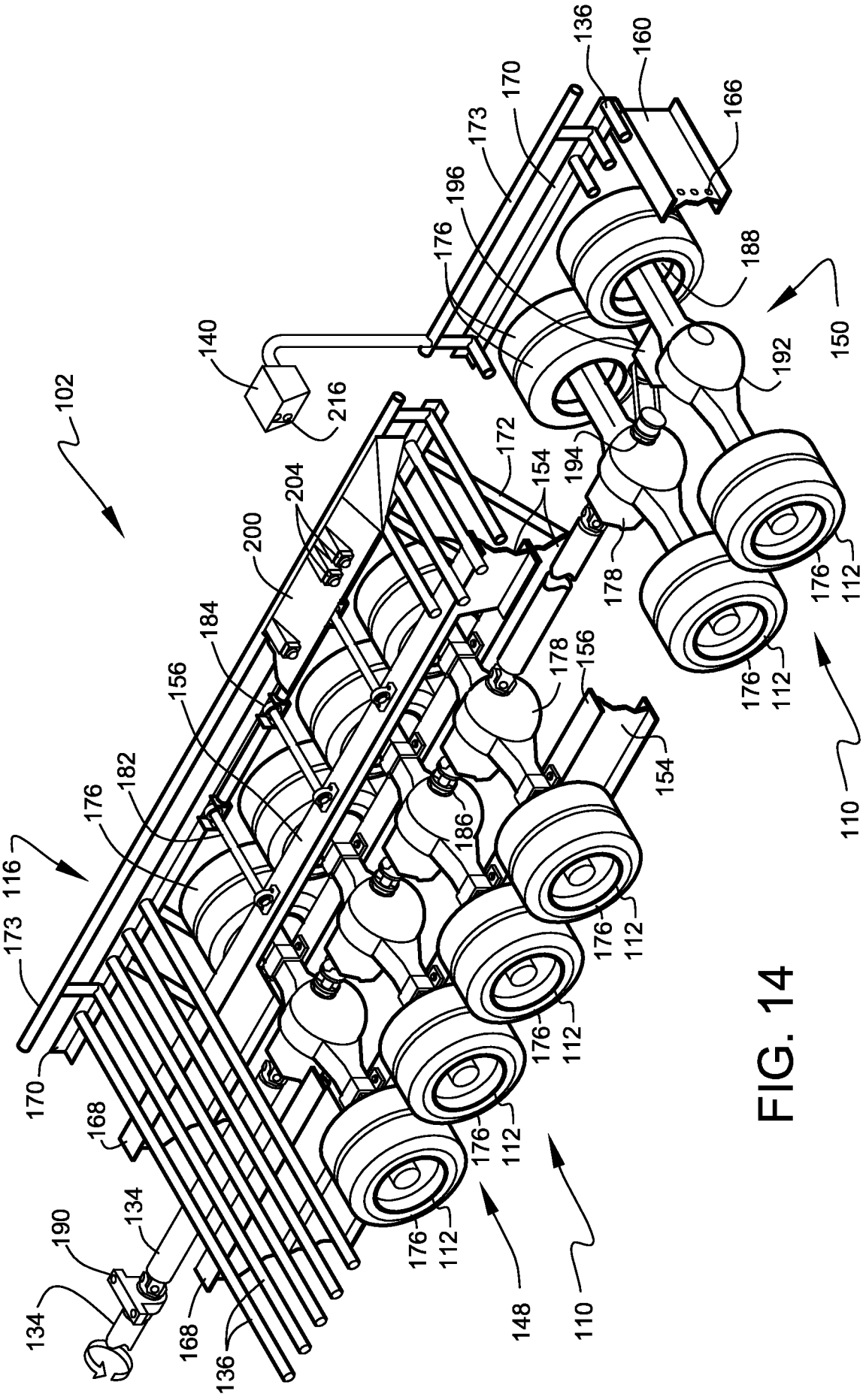
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FIG. 14

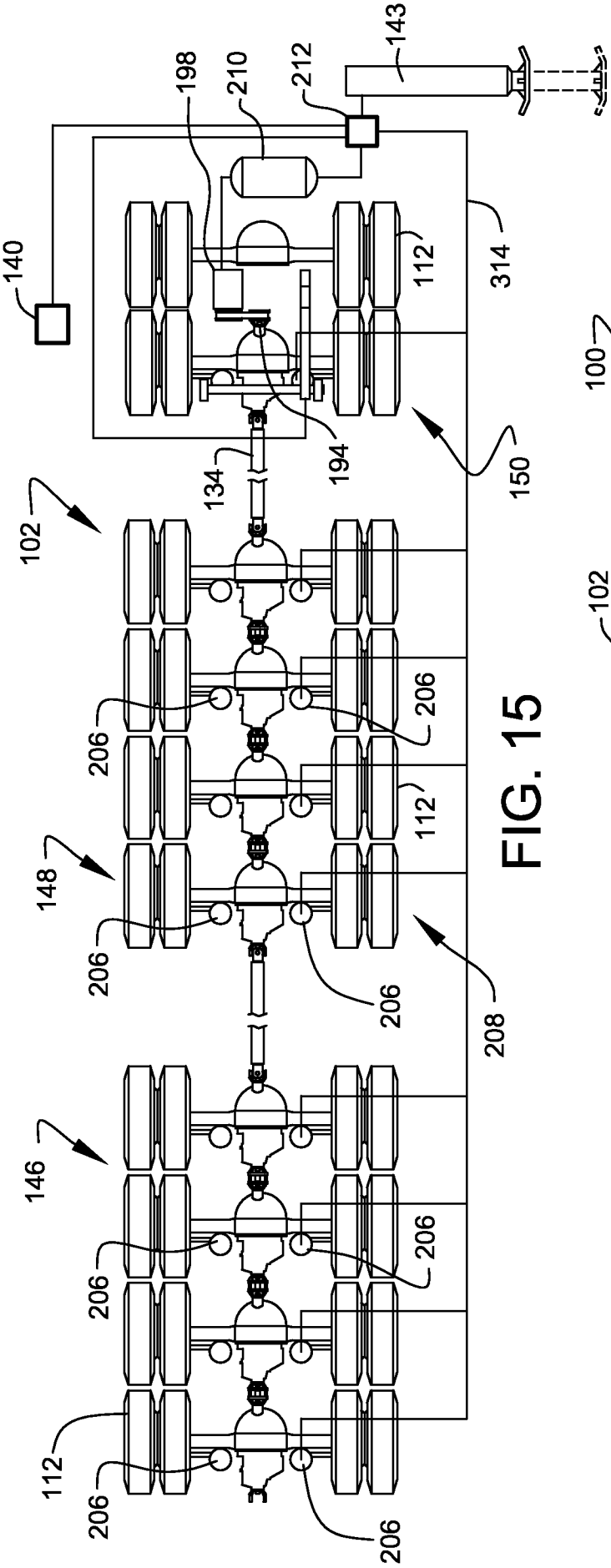
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FIG. 15

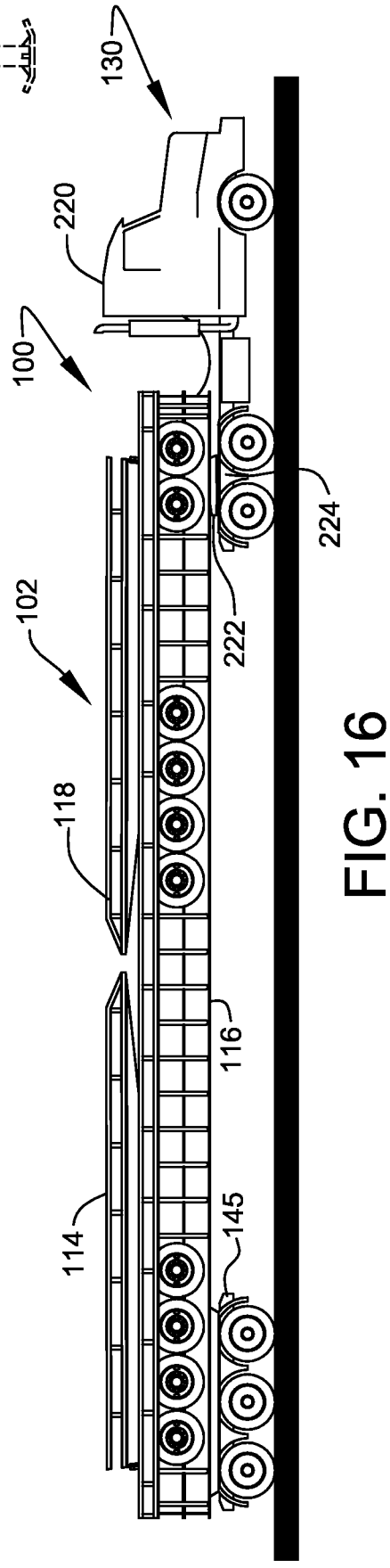
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FIG. 16

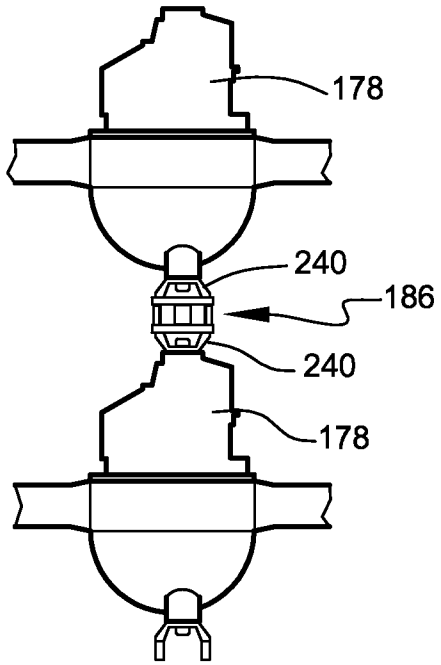

FIG. 17

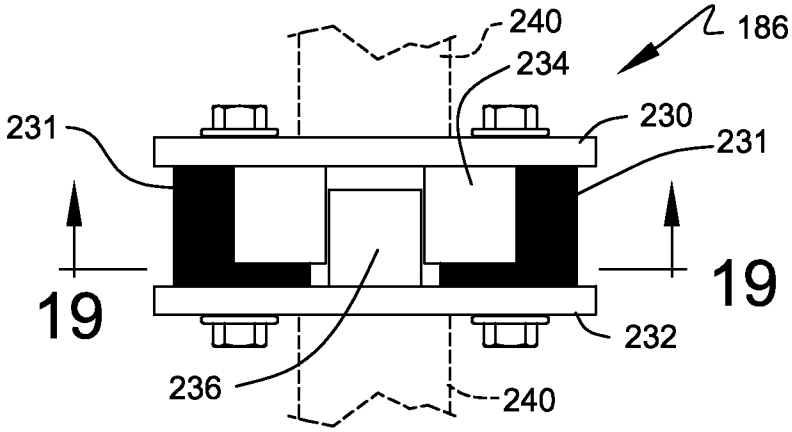

FIG. 18

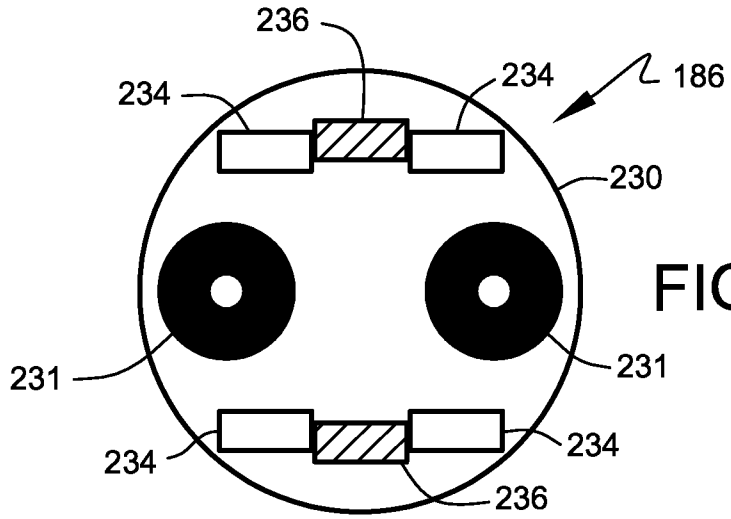

FIG. 19

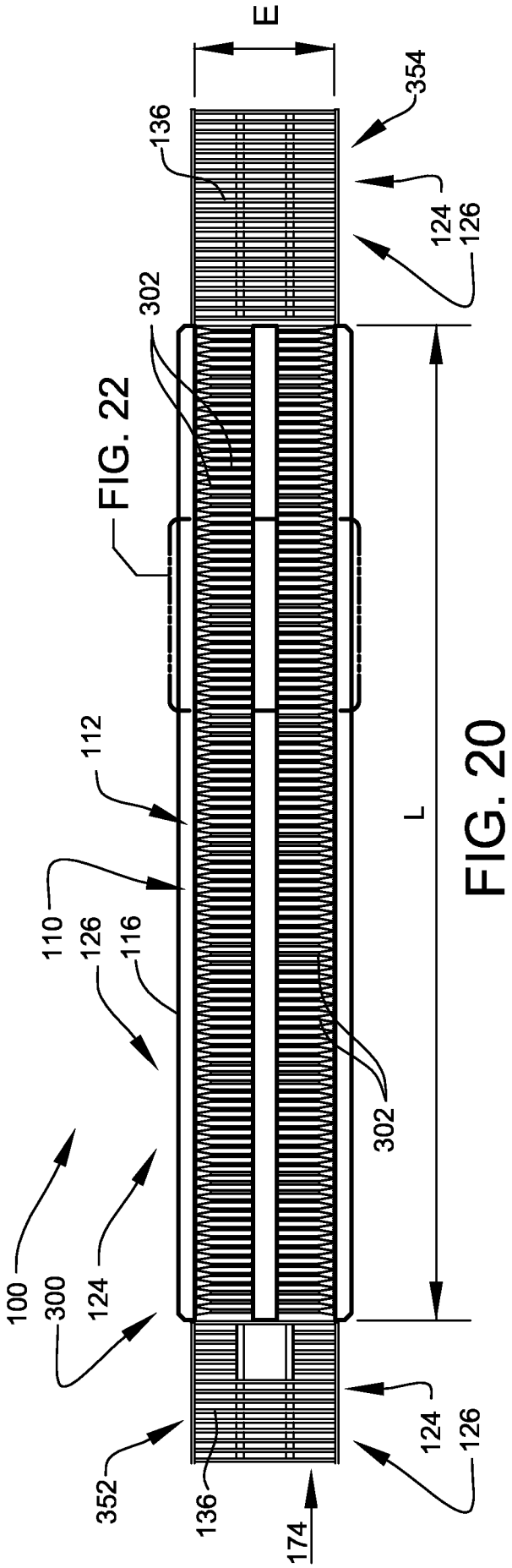

FIG. 20

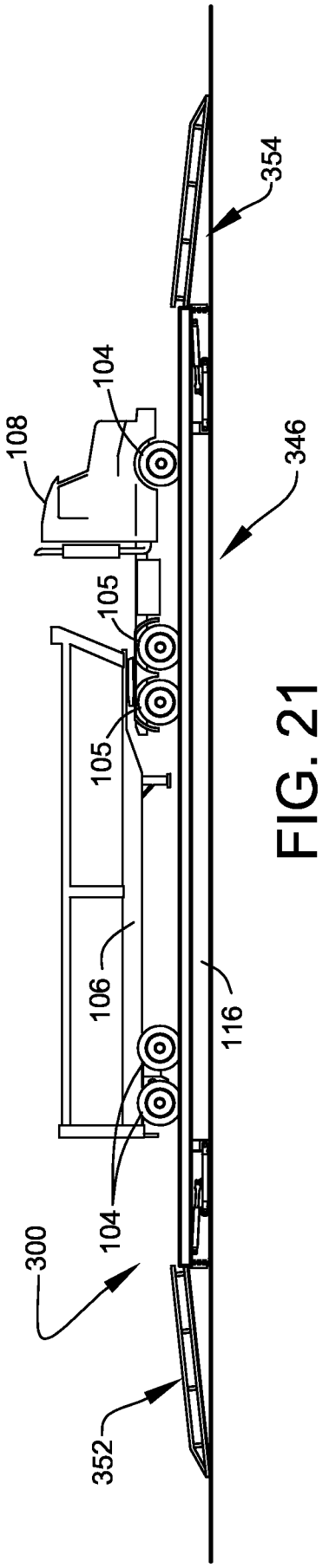

FIG. 21

FIG. 22

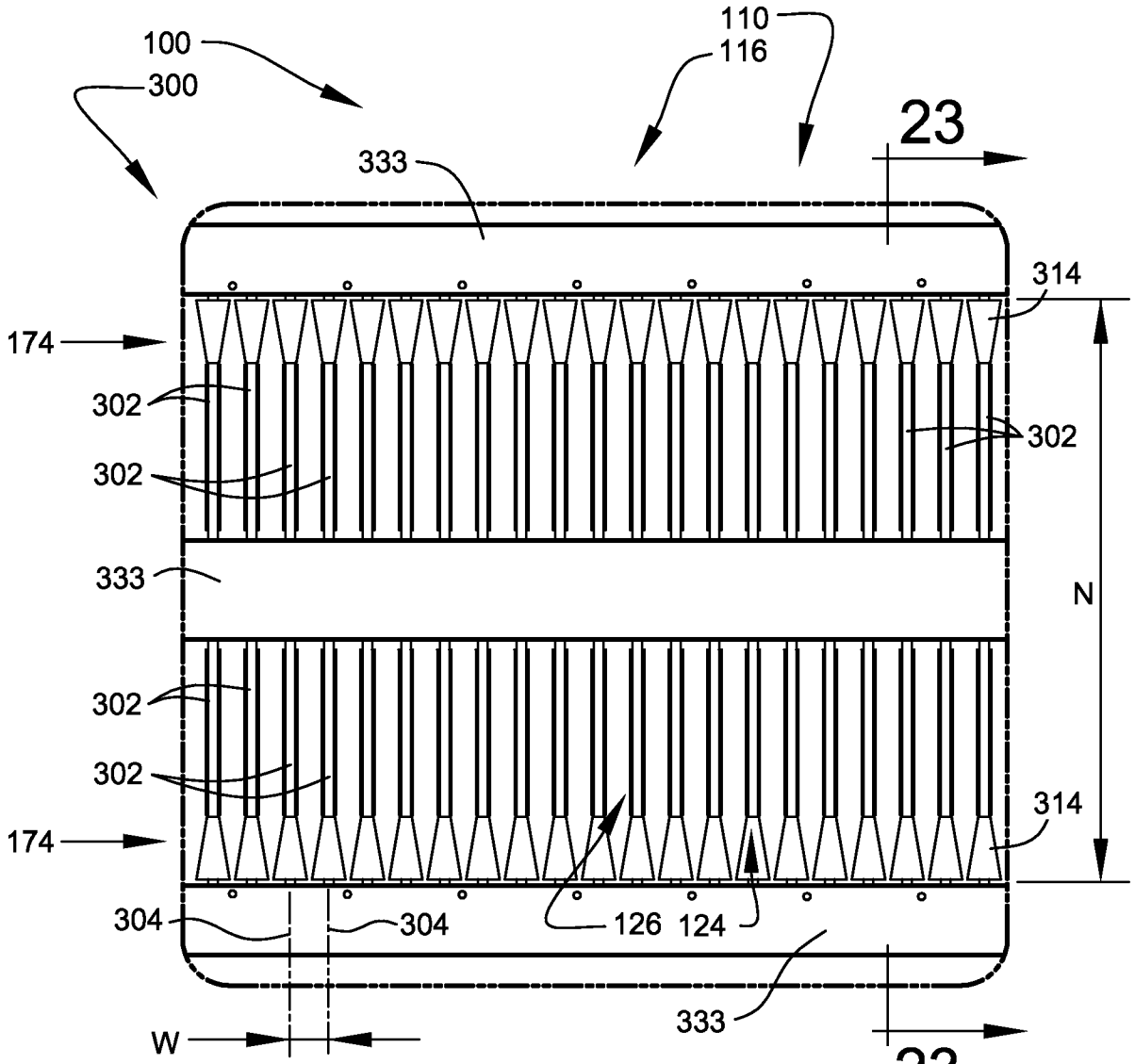
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FIG. 22

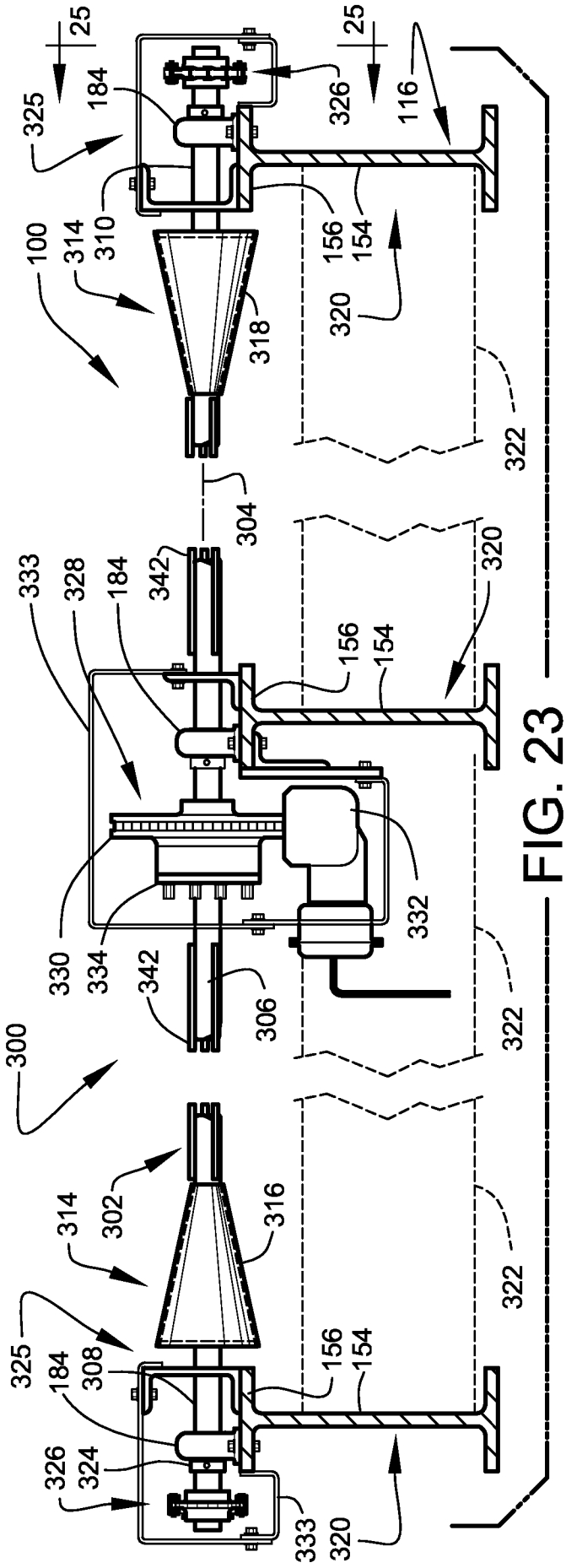
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FIG. 23

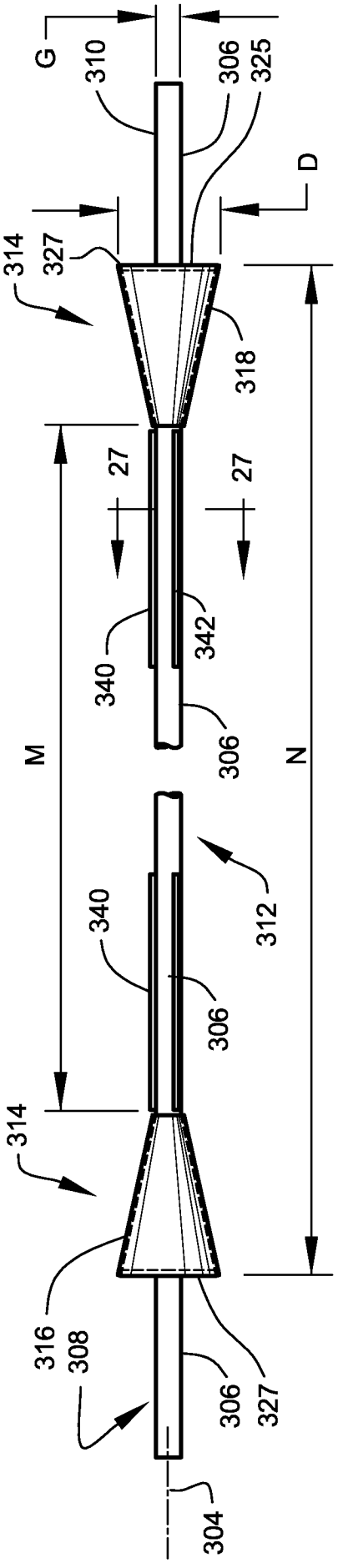
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FIG. 24

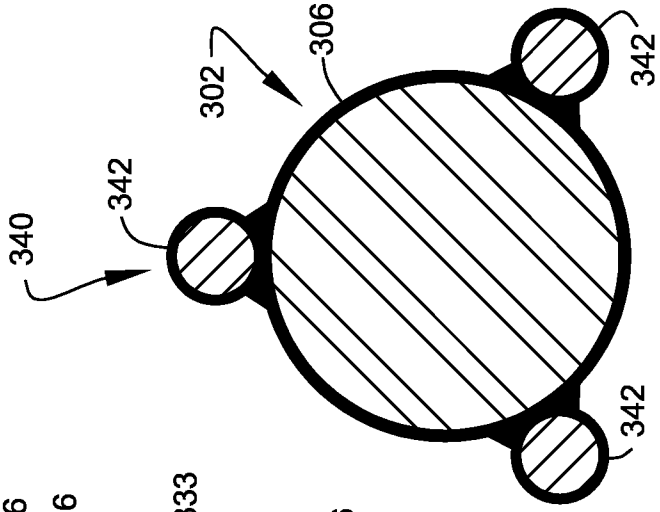

FIG. 27

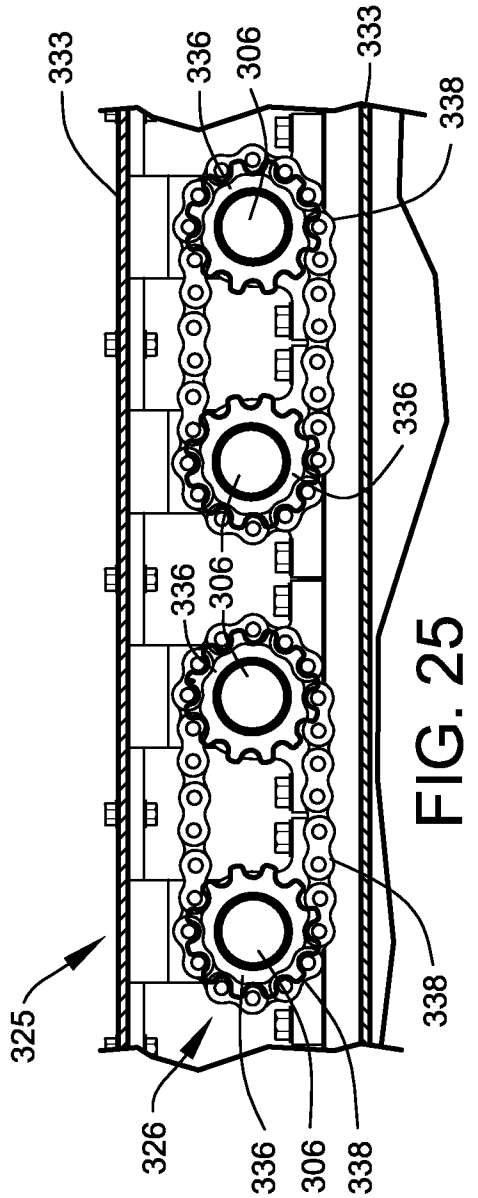

FIG. 25

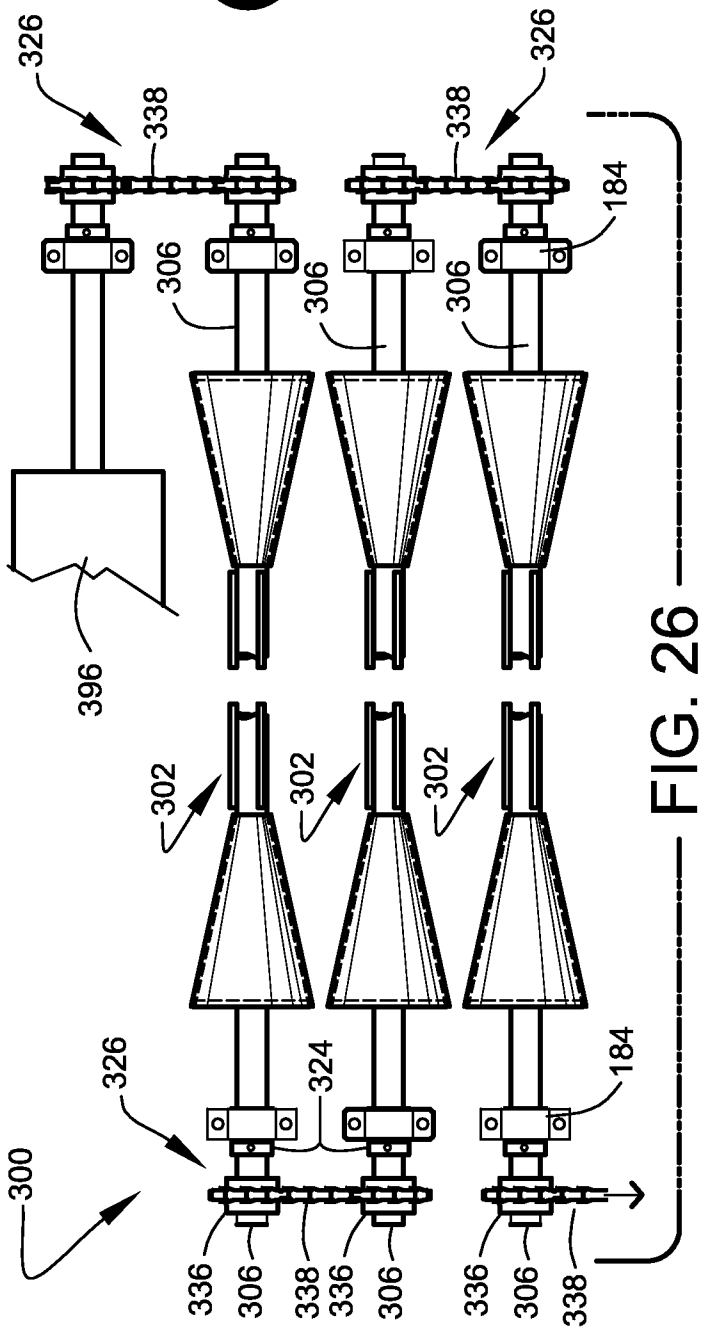

FIG. 26

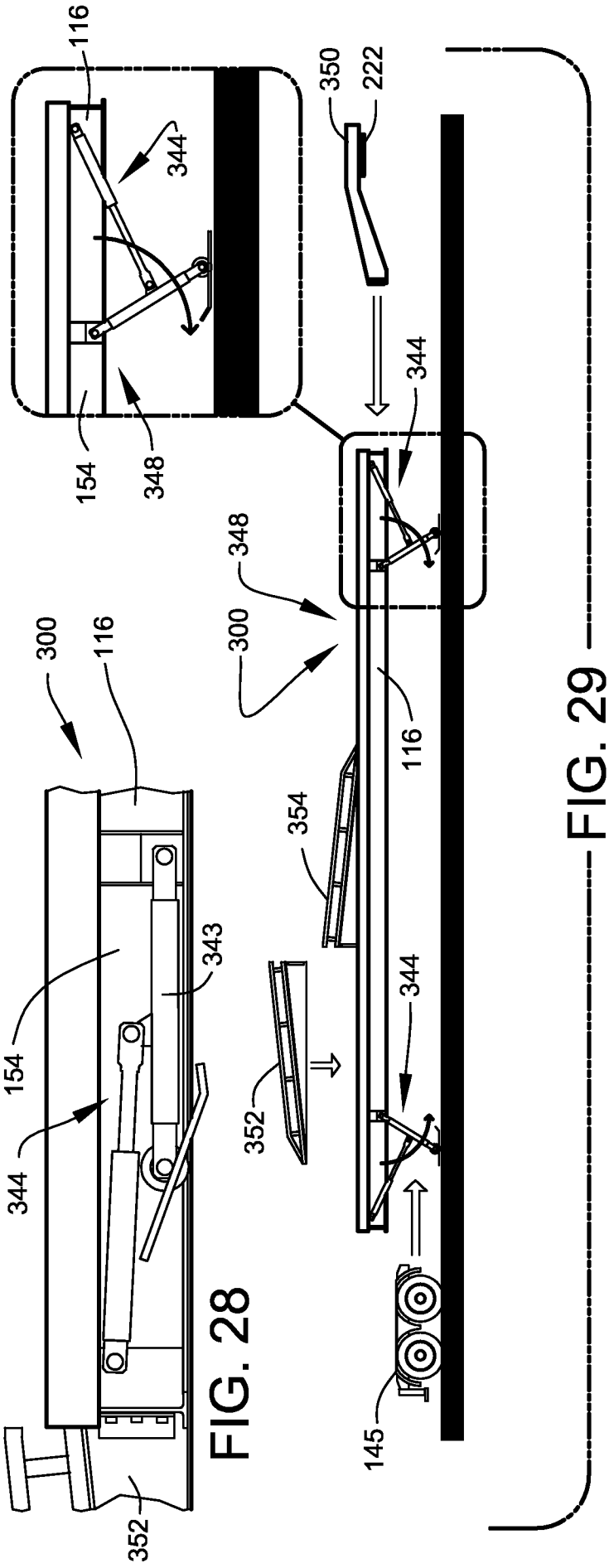

FIG. 28

FIG. 29

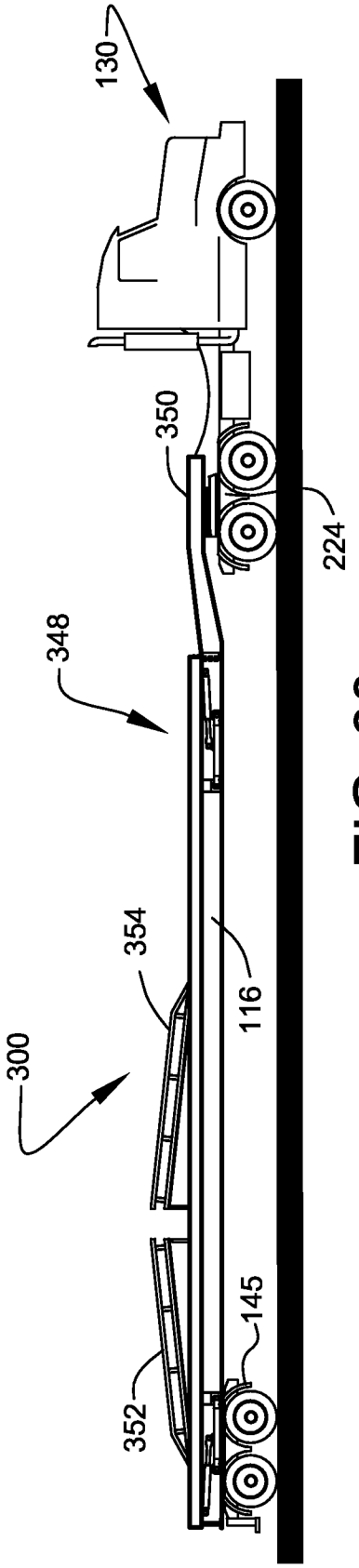

FIG. 30

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2009/043398

A. CLASSIFICATION OF SUBJECT MATTER

B60S 1/68(2006.01)i, B60S 3/04(2006.01)i, B08B 7/02(2006.01)i

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: B60S 1/68, B60S 3/04, B08B 7/02

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Korean Utility models and applications for Utility Models since 1975
Japanese Utility models and applications for Utility Models since 1975

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
eKOMPASS (KIPO internal) & Keywords : vehicle, tire, wheel, dust, mud, debris, washing, rotator, portable, and similar terms

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	JP 09-286308 A (NIPPON DENSHI TSUSHIN KK) 04 November 1997 See abstract, paragraph 31, and figures 1-7.	1, 24-25 2-23
Y	US 4979536 A (MIDKIFF, DAVID G.) 25 December 1990 See abstract, column 2 lines 25-29, 46-50, column 3 line 63-column 4 line 4, column 4 lines 18 -21, 32-49, column 5 line 6-column 6 line 49, and figures 1-21.	1-25
X Y	JP 2000-190823 A (ONODERA KK) 11 July 2000 See abstract, paragraphs 8-40, and figures 1-14.	1, 24-25 2-23
Y	JP 2002-079921 A (TSURUMI MFG CO., LTD.) 19 March 2002 See abstract, paragraphs 7-10, and figures 1-8.	1-25
Y	JP 07-052757 A (NANBI KOGYO KK) 28 February 1995 See abstract, paragraphs 10-27, and figures 1-8.	1-25

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" 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
"X" 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
"Y" 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

Date of the actual completion of the international search	Date of mailing of the international search report
29 OCTOBER 2009 (29.10.2009)	**29 OCTOBER 2009 (29.10.2009)**
Name and mailing address of the ISA/KR Korean Intellectual Property Office Government Complex-Daejeon, 139 Seonsa-ro, Seo-gu, Daejeon 302-701, Republic of Korea Facsimile No. 82-42-472-7140	Authorized officer LEE, Eunju Telephone No. 82-42-481-5469

Form PCT/ISA/210 (second sheet) (July 2008)

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/US2009/043398

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
JP 09-286308 A	04.11.1997	None	
US 4979536 A	25.12.1990	US 4917125 A	17.04.1990
JP 2000-190823 A	11.07.2000	None	
JP 2002-079921 A	19.03.2002	None	
JP 07-052757 A	28.02.1995	None	