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(54) VEHICLE FOR LOAD HANDLING

(57) A vehicle (10) for load handling, which comprises:
- a supporting chassis (20) having a front section (21) provided with a front axle (23) equipped with a pair of front wheels (230) and a rear section (22) provided with a rear axle (24) equipped with a pair of rear wheels (240);
- a load lifting arm (40) articulated to the rear section (22) of the supporting chassis (20) with the possibility of rotating around at least one swing axis (O) and having a longitudinal axis (B) parallel to a longitudinal axis (A) of the supporting chassis (20); and
- a driver's cab (30) supported by the supporting chassis (20) and positioned on the side of an axial portion of the lifting arm (40).

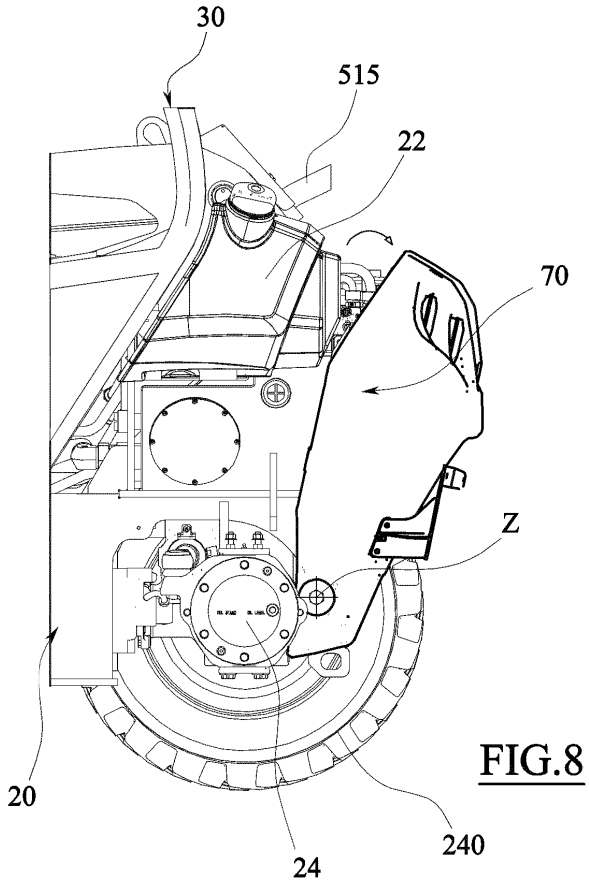

FIG.8

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Description

TECHNICAL FIELD

[0001] The present invention relates to a vehicle for load handling.

[0002] More specifically, the invention relates to a vehicle for load handling equipped with a lifting arm, preferably telescopic, articulated to the supporting chassis of the vehicle, which carries at the front end thereof tools of various type, such as for example a fork, a shovel, an aerial platform or other suitable tool.

PRIOR ART

[0003] As is known, there are vehicles for load handling which generally consist of a supporting chassis supported by four ground-resting wheels, which are equipped with a lifting arm articulated in a rear section of the supporting chassis and equipped with a free end to which one or more tools can be fixed, for example interchangeably.

[0004] The lifting arm develops longitudinally along the longitudinal axis of the vehicle and is flanked by a control and driver's cab of the vehicle, in which the driver and operator of the vehicle can be accommodated.

[0005] A need felt in such known vehicles is to allow the driver and operator of the vehicle to have good visibility, i.e. that this is not hindered by the lifting arm, especially when it is in the lowered position (i.e. the vehicle is in transfer configuration).

[0006] A further requirement in these generally compact vehicles is to optimize the spaces, for example, the spaces inside the engine compartment where the powertrain is accommodated and also allow an increasingly effective cooling of the powertrain.

[0007] Furthermore, a need felt in these vehicles is to allow easy and convenient access, when necessary, to the powertrain located in the engine compartment and to all the operating (hydraulic and/or electric) elements necessary for the correct operation of the vehicle and that are subject to periodic maintenance and overhaul.

[0008] Another need felt for these vehicles is to effectively reduce the exhaust gas emissions of the combustion of the internal combustion engines that equip these engines and, therefore, to make any exhaust gas treatment systems of the engine more and more efficient and so that they can act in the best possible way, that is under conditions of use close to optimal conditions for which they were designed.

[0009] An object of the present invention is to solve the aforementioned needs of the prior art, with a simple, rational and low-cost solution.

[0010] Such purposes are accomplished by the characteristics of the invention given in the independent claim. The dependent claims outline preferred and/or particularly advantageous aspects of the invention.

DISCLOSURE OF THE INVENTION

[0011] The invention particularly makes available a vehicle for load handling which comprises:

- a supporting chassis having a front section provided with a front axle equipped with a pair of front wheels and a rear section provided with a rear axle equipped with a pair of rear wheels;
- a load lifting arm articulated to the rear section of the supporting chassis with the possibility of rotating around at least one swing axis and having a longitudinal axis parallel to a longitudinal axis of the supporting chassis;
- a driver's cab supported by the supporting chassis and positioned on the side of an axial portion of the lifting arm; and
- a counterweight connected to the rear section of the supporting chassis, wherein the counterweight is hinged to the rear section of the supporting chassis around an articulation axis parallel to the swing axis of the lifting arm with the possibility of oscillating between two different predefined angular end positions.

[0012] Thanks to this solution, the requirements of the prior art are met, in particular the load acting on the lifting arm of the vehicle is effectively counterbalanced and access to an inspection compartment located in the supporting chassis is made possible, for example in front of the counterweight itself and, moreover, it is possible - in some cases when necessary - to move the centre of gravity of the counterweight to favour the correct position thereof as a function of the load acting on the lifting arm of the vehicle and/or the position of the vehicle and/or the lifting arm itself.

[0013] Advantageously, the articulation axis can be arranged below the centre of gravity of the counterweight.

[0014] Thanks to this solution, the overturning between the two end positions of the counterweight is facilitated.

[0015] According to a further aspect of the invention, in an angular end position of the counterweight the centre of gravity of the counterweight can be vertically aligned with the articulation axis.

[0016] Thanks to this solution, the counterweight in this end position is in an equilibrium position (for example unstable).

[0017] Advantageously, then, the rear section of the supporting chassis comprises fixing means adapted to temporarily block the counterweight in at least one of the angular end positions or both.

[0018] Thanks to this solution the counterweight can be securely fixed in safety in a desired angular end position.

[0019] According to an advantageous aspect of the invention, the vehicle can comprise a powertrain supported inside an engine compartment of the supporting chassis at least partially placed vertically below a (respective)

axial portion of the lifting arm, wherein the powertrain comprises an engine, a hydraulic pump and a hydrostatic pump.

[0020] According to an aspect of the invention, the lifting arm can be articulated (i.e. hinged) to the supporting chassis with respect to a single swing axis parallel to the rotation axis of a crankshaft of the engine.

[0021] According to an aspect of the invention, the engine may be an internal combustion engine.

[0022] Advantageously, the vehicle can comprise at least one exhaust gas treatment system of the internal combustion engine placed inside the engine compartment, for example comprising a catalytic converter and/or one particulate filter.

[0023] Thanks to this solution, the engine can comply with the strictest emission limits envisaged, and, for example, allow the classification of the engine as STAGE V of the agricultural machinery legislation.

[0024] Preferably, the exhaust gas treatment system can be at least partially positioned vertically below an (respective) axial portion of the lifting arm.

[0025] In practice, this position is optimal, as it does not excessively encumber the engine compartment and allows an effective proximity of the exhaust gas treatment system to the engine itself, which allows an excellent operation thereof, being able to exploit the heat developed by it, useful for efficient operation of the exhaust gas treatment system and for the periodic regeneration thereof.

BRIEF DESCRIPTION OF THE DRAWINGS

[0026] Further features and advantages of the invention will be more apparent after reading the following description provided by way of non-limiting example, with the aid of the accompanying drawings.

Figure 1 is a schematic side view of a vehicle according to the invention.

Figure 2 is a plan view from above of Figure 1.

Figure 3 is a schematic side view of the outline of the main components of the vehicle according to the invention.

Figure 4 is a plan view from above of Figure 3.

Figure 5 is an axonometric exploded view of the powertrain of the vehicle according to the invention.

Figure 6 is an axonometric rear view of a counterweight of the vehicle according to the invention.

Figure 7 is a side view of the rear section of the vehicle with the counterweight in a first angular closing end position.

Figure 8 is a side view of the rear section of the vehicle with the counterweight in a second angular opening end position.

BEST MODE OF THE INVENTION

[0027] With particular reference to these figures, 10 generally indicates a vehicle, particularly a vehicle for load handling (or a maintenance vehicle).

[0028] The vehicle 10 comprises a supporting chassis 20, which is substantially rigid (i.e. non-deformable with the usual workloads to which it is subjected in operation).

[0029] The supporting chassis 20 has for example an elongated shape along a longitudinal axis A (defining the longitudinal axis of the vehicle 10) and therefore has, at or near a first axial end thereof, a front section 21, and at or near an opposing second axial end thereof, a rear section 22.

[0030] In the present description, front refers to the portion of the vehicle 10 or the supporting chassis 20 which precedes (that is, it is placed in front) in an advancement direction of the vehicle 10 on the ground in a usual and preferred forward gear and rear refers to the portion of the vehicle 10 or of the supporting chassis 20 which follows (that is, it is placed behind) in an advancement direction of the vehicle 10 on the ground in a usual and preferred forward gear (or that precedes in a reverse gear).

[0031] The supporting chassis 20 carries, in its front section 21, a front axle 23 supporting a front ground-resting unit, for example defined by a pair of front wheels 230.

[0032] Furthermore, the supporting chassis 20 carries, in its rear section 22, a rear axle 24 supporting a rear ground-resting unit, for example defined by a pair of rear wheels 240.

[0033] At least one of the pair of front wheels 230 and the pair of rear wheels 240 or both can be steering and/or drive wheels.

[0034] In the present discussion, vertical refers to either the absolute vertical or any direction orthogonal to the plane on which the front wheels 230 and the rear wheels 240 of the vehicle 10 rest. Furthermore, "horizontal" refers herein to either the absolute horizontal or any plane parallel to the plane on which the front wheels 230 and the rear wheels 240 of the vehicle 10 rest.

[0035] The supporting chassis 20 defines, on one side (for example the left side) a support seat, for example open at the top (and axially accommodated between the front axle 21 and the rear axle 22), which is configured to accommodate a driver's cab 30 fixed to the supporting chassis 20 (i.e. to the floor of the support seat of the same), for example through *silent-blocks*.

[0036] Inside the driver's cab 30, as is known, the driving controls of the vehicle 10 (such as for example the steering wheel supported by the steering column, the brake, clutch and accelerator pedals or others) are arranged in addition to a driver's place equipped with a seating and possibly a backrest, as well as all the commands and the mechanical, electrical, electronic and/or hydraulic control systems for the control and command of all vehicle functions 10 by a driver and vehicle operator 10 placed on board it inside the same driver's cab 30.

[0037] The driver's cab 30 stands above the floor of the support seat over a predetermined height.

[0038] For example, the driver's cab 30 develops in length along the longitudinal axis A of the supporting chassis 20, for example for a limited section with respect to the length of the supporting chassis itself.

[0039] In the illustrated example, the driver's cab 30 is placed behind the front wheel 230 (left) of the side of the supporting chassis 20 on which it is placed and at least partially aligned (vertically) in plan with the rear wheel 240 (left) of the same side of the supporting chassis 20 on which it is placed.

[0040] The driver's cab 30 does not protrude laterally beyond the external (minimum) dimensions of the front wheels 230 and/or the rear wheels 240.

[0041] Furthermore, the driver's cab 30 develops in width in a (horizontal) direction orthogonal to the longitudinal axis A of the supporting chassis 20 over a width that does not exceed the width of the vehicle 10, that is, the (maximum) wheelbase between the front wheels 230 (and/or the rear wheels 240), preferably the width of the driver's cab 30 is substantially equal to half the width of the vehicle 10 (whereby vehicle width means the distance between the external surface of the front wheels 230 and/or the rear wheels 240.

[0042] Preferably, the driver's cab 30 is arranged on the supporting chassis 20, so that it is secated by the vertical median plane which contains the longitudinal axis A of the supporting chassis itself (although most of the cab is arranged on one, left, side only of the supporting chassis 20).

[0043] Furthermore, the driver's cab 30 is substantially rigid (and/or stiffened by a roll-bar or other) and at least partially transparent and/or equipped with transparent front/side windows (on both sides) and rear windows.

[0044] On the side of the driver's cab 30, i.e. on the side opposite the vertical median plane of the supporting chassis 20 with respect to the side where the (most of) the same driver's cab 30 is located, the supporting chassis 20 comprises an engine compartment 25 for example delimited by a side wall (bordering on the driver's cab 30, a pair of frontal walls (a frontal front wall and a rear frontal wall, respectively), a lower base wall and an upper base wall.

[0045] The engine compartment 25 is then closed by a lateral door opposed to the aforesaid lateral wall, for example movable for opening and closing the engine compartment 25, for example hinged with respect to one or more hinging (for example horizontal and upper) axes.

[0046] The engine compartment 25 is placed, for example, entirely on the same (right) side of the supporting chassis 20 with respect to the longitudinal vertical median plane of the same.

[0047] Furthermore, the engine compartment 25 develops longitudinally along a longitudinal axis parallel to the longitudinal axis A of the supporting chassis 20, for example over a longitudinal section thereof interposed axially between the front wheel 23 and the rear wheel 24 on the same side.

[0048] The engine compartment 25 defines a predetermined internal empty volume V_0 (delimited by the aforesaid walls).

[0049] The upper wall of the engine compartment 25 is placed at a height (from the ground) lower than the predetermined height defined by the top of the driver's cab 30, in particular it is placed at a height substantially equal to or comparable to the seating height of the driver's seat placed inside the driver's cab 30 (on which the driver and operator of the vehicle 10 can sit).

[0050] Furthermore, the vehicle 10 comprises a load lifting arm 40, which is articulated to the supporting chassis 20, preferably above it, at the rear section 24 of the same.

[0051] The lifting arm 40 is rigid, i.e. non-deformable under bending or twisting under the usual workloads for which it is provided.

[0052] For example, the lifting arm 40 has an elongated shape along a longitudinal axis B parallel to the longitudinal axis A of the supporting chassis 20 (i.e. which lies on a plane parallel to the longitudinal axis A of the supporting chassis itself) and therefore has a rear axial end thereof constrained, as will be better described below, to the rear section 22 of the supporting chassis 20 and an opposed free front axial end, which protrudes for example beyond the front end 21 of the supporting chassis 20.

[0053] Tools of various type, such as a fork tool, a shovel, an aerial platform or other, can be mounted for example, by means of a suitable coupling, individually and selectively to the free front axial end of the lifting arm 40.

[0054] The lifting arm 40 is, for example, extensible, in a general direction, that is, it can be capable of extending its length, i.e. it can alternatively be actuated between a contracted configuration and an extended configuration, for example in a telescopic way, as is known to the person skilled in the art, having two or more sections telescopically coupled together, for example driven in extension and contraction by special (internal) cylinders.

[0055] The rear axial end of the lifting arm 40 (i.e. of the first section thereof) is articulated to the rear section 22 of the supporting chassis 20 (for example above it) so as to be able to swing with respect thereto around a (single) swing axis O, which is (always) orthogonal to the longitudinal axis A of the supporting chassis 20 (and therefore to the longitudinal axis of the lifting arm 40 itself) and, for example, it is horizontal.

[0056] In practice, the rear axial end of the lifting arm 40 is hinged to the rear section 22 of the supporting chassis 20 by means of a hinge pin defining said swing axis O.

[0057] The lifting arm 40 can be rotated around its swing axis O between two distinct end positions, of which:

- a first lower resting position (see Figures), wherein the lifting arm 40 is arranged with a substantially horizontal longitudinal axis B (in particular slightly inclined by a negative angle with respect to the horizontal plane, so that the front axial end is at a lower height than the rear axial end); and
- a second upper operating position (not shown in the

Figures), wherein the lifting arm 40 is arranged with a longitudinal axis B substantially inclined with respect to the horizontal one, that is, forming therewith a preferably acute (non-zero) inclination angle.

[0058] The vehicle 10 further comprises a drive unit configured to rotate the lifting arm 40 around its swing axis O between the two distinct end positions (and any intermediate position therebetween).

[0059] The drive unit comprises a first hydraulic jack, equipped with a rod slidingly movable inside a cylinder, in which the rod in the example is hinged to the supporting chassis around a hinging axis parallel and eccentric to the swing axis O and the cylinder is hinged to (the first section of) the lifting arm 40 about a hinging axis parallel and eccentric to the swing axis O.

[0060] The drive unit comprises a respective hydraulic circuit, for example at least partially contained in the rear section 22 of the supporting chassis 20 enclosed in a special inspection compartment, for actuating the first hydraulic jack, between an extended configuration, in which the rod is in a position extracted from the cylinder, and a retracted configuration. The variation of the first hydraulic jack between the extended configuration and the retracted configuration allows the rotation of the lifting arm 40 as a whole with respect to the supporting chassis 10 between the second upper position and the first lower position thereof, respectively.

[0061] The lifting arm 40 is arranged on the side of the driver's cab 30, in practice the lifting arm 40 is placed on the opposite side with respect to the vertical median plane of the supporting chassis 20 with respect to the side where the (most of) the driver's cab 30 is located.

[0062] In particular, the lifting arm 40 is at least partially superimposed in plan (vertically) on the engine compartment 25, i.e. it is arranged at least partially above the upper wall thereof.

[0063] In particular, at least an axial section (intermediate, i.e. interposed between its rear axial end and its front axial end) of the lifting arm 40 is at least partially superimposed in plan (vertically) on the engine compartment 25 (when this is in its first lower position).

[0064] When the lifting arm 40 is in its first lower position, its upper end does not exceed in height the height of the backrest of the driver's seat, i.e. it does not obstruct the lateral view for the driver and operator of the vehicle 10 that occupies the driver's seat.

[0065] The lifting arm 40 extends in width in a (horizontal) direction orthogonal to the longitudinal axis A of the supporting chassis 20 over a width that does not exceed the width of the vehicle 10, i.e. the (maximum) wheelbase between the front wheels 230 (and/or the rear wheels 240), preferably the width of the lifting arm 40 is smaller than the distance between the longitudinal vertical median plane of the supporting chassis 20 and (the inner flank of) the front wheels 230 (and/or the rear wheels 240) of the (right) side which contains the lifting arm 40, more preferably (slightly) smaller than the distance between the cab wall proximal to the longitudinal vertical median plane of the supporting chassis 20 and (the inner flank of) the front wheels 230 (and/or the rear wheels 240) of the (right) side which contains the lifting arm 40.

[0066] The lifting arm 40, in its contracted configuration (and without tools attached thereto), has a length that (little) exceeds the length of the supporting chassis 20.

[0067] Alternatively, it is not excluded that the (only) front axial end of the lifting arm 40, in its contracted configuration (and without tools attached thereto), may protrude axially anteriorly with respect to the supporting chassis 20 (and to the front wheels 23).

[0068] The vehicle 10 comprises a powertrain 50, which is arranged inside the engine compartment 25 of the supporting chassis 20 and fixed to/supported by the supporting chassis 20 itself.

[0069] The powertrain 50 comprises in particular an engine 51, preferably an internal combustion engine.

[0070] In the example, the engine 51 is a diesel or gasoline, preferably diesel, engine, for example with three cylinders.

[0071] The engine 51 comprises a crankcase and a crankshaft 510, a free end of which comes out of the crankcase, which crankshaft 510 rotates around a central rotation axis R1.

[0072] The engine 51 is arranged in the engine compartment 25 with the rotation axis R1 of its crankshaft 510 preferably inclined with respect to the longitudinal axis A of the supporting chassis 20, particularly orthogonal to the longitudinal axis A of the supporting chassis 20 itself.

[0073] Into more detail, the rotation axis R1 of the crankshaft 510 of the engine 51 is orthogonal to the longitudinal vertical median plane of the supporting chassis 20 (i.e. of the vehicle 10).

[0074] In other words, the rotation axis R1 of the crankshaft 510 of the engine 51 is parallel (and eccentric) to the swing axis O of the lifting arm 40.

[0075] In a preferred embodiment, the engine 51 is arranged inside the engine compartment 25 in a front area thereof, i.e. proximal to the front section 21 of the supporting chassis 20, preferably arranged on the same (front) part with respect to a vertical transverse median plane (i.e. orthogonal to the longitudinal axis A) of the supporting chassis 20.

[0076] The engine 51 has a volumetric encumbrance or overall volume V_m smaller than the internal volume V_0 of the engine compartment 25, preferably smaller than half of the internal volume V_0 of the engine compartment 25.

[0077] The engine 51 as a whole is at least partially placed vertically below the lifting arm 40, i.e. placed below its vertical projection on the horizontal plane.

[0078] In the illustrated example, the projection on the horizontal plane of the engine 51 is intersected/overlaps with the projection on the same horizontal plane of the lifting arm 40, in particular a percentage comprised be-

tween 20% and 50%, preferably less than 40%, of the projection on the horizontal plane of the engine 51, overlaps with the projection on the same horizontal plane of the lifting arm 40.

[0079] The crankshaft 510 of the engine 51 has a power take-off (at one end thereof) which comes out of the engine crankcase and is turned towards the longitudinal vertical median plane of the supporting chassis 20 (for example, at a non-zero distance therefrom).

[0080] The powertrain 50 further comprises a hydrostatic pump 52.

[0081] The hydrostatic pump 52 is configured to control the transmission of the vehicle 10, i.e. the rotation of the front wheels 230 and/or the rear wheels 240, as is known to the person skilled in the art.

[0082] The hydrostatic pump 52 comprises a crankcase and a rotary shaft 520, the free ends of which, an inlet end and an outlet end thereof, are accessible from the outside from the crankcase, which rotary shaft 520 rotates around a central rotation axis R2.

[0083] The hydrostatic pump 52 is arranged in the engine compartment 25 with the rotation axis R2 of its rotary shaft 520 preferably inclined with respect to the longitudinal axis A of the supporting chassis 20, particularly orthogonal to the longitudinal axis A of the supporting chassis 20 itself.

[0084] Into more detail, the rotation axis R2 of the rotary shaft 520 of the hydrostatic pump 52 is orthogonal to the longitudinal vertical median plane of the supporting chassis 20 (or of the vehicle 10).

[0085] Preferably, the rotation axis R2 of the rotary shaft 520 of the hydrostatic pump 52 is parallel and eccentric with respect to the rotation axis R1 of the crankshaft 510 of the engine 51.

[0086] The rotary shaft 520 of the hydrostatic pump 52 has its free inlet end turned towards the longitudinal vertical median plane of the supporting chassis 20 (for example, at a non-zero distance therefrom), preferably substantially lying on a plane (parallel to the aforesaid longitudinal vertical median plane) on which also the power take-off of the crankshaft 510 of the engine 51 lies.

[0087] In a preferred embodiment, the hydrostatic pump 52 is arranged inside the engine compartment 25 in a median area thereof, i.e. at the rear of the engine 51, preferably secated (ideally) by the vertical transverse median plane (i.e. orthogonal to the longitudinal axis A) of the supporting chassis 20 or arranged for the most part on the same front part (with respect to this vertical transverse median plane) in which the engine 51 is placed.

[0088] The hydrostatic pump 52 has a volumetric encumbrance or overall volume V_{p1} smaller than the internal volume V_0 of the engine compartment 25, preferably smaller than a quarter of the volume V_m of the engine 51.

[0089] The hydrostatic pump 52 as a whole is at least partially placed vertically below the lifting arm 40, i.e. placed below its vertical projection on the horizontal plane.

[0090] In the illustrated example, the projection on the horizontal plane of the hydrostatic pump 52 is intersected/overlaps with the projection on the same horizontal plane of the lifting arm 40, in particular a percentage comprised between 60% and 100%, preferably comprised between 80% and 90 % of the projection on the horizontal plane of the hydrostatic pump 52 overlaps with the projection on the same horizontal plane of the lifting arm 40.

[0091] The hydrostatic pump 52, i.e. its rotary shaft 520, takes the rotary motion from the engine 51, i.e. from the crankshaft 510 of the same, as will be better described below.

[0092] The powertrain 50 further comprises a hydraulic pump 53.

[0093] The hydraulic pump 53 is configured to control the actuation of the hydraulic circuit of the drive unit (of the swing of the lifting arm 40) and/or the hydraulic circuits of the cylinders for actuating the extension of the lifting arm 40 (not shown as they are of a known type).

[0094] The hydraulic pump 53 comprises a crankcase and a rotary shaft 530, a free end of which, i.e. an inlet end, is accessible from the outside from the crankcase, which rotary shaft 530 rotates around a central rotation axis R3.

[0095] The hydraulic pump 53 is arranged in the engine compartment 25 with the rotation axis R3 of its rotary shaft 530 preferably inclined with respect to the longitudinal axis A of the supporting chassis 20, particularly orthogonal to the longitudinal axis A of the supporting chassis 20 itself.

[0096] Into more detail, the rotation axis R3 of the rotary shaft 530 of the hydraulic pump 53 is orthogonal to the longitudinal vertical median plane of the supporting chassis 20 (i.e. of the vehicle 10).

[0097] Preferably, the rotation axis R3 of the rotary shaft 530 of the hydraulic pump 53 is parallel and eccentric with respect to the rotation axis R1 of the crankshaft 510 of the engine 51.

[0098] In greater detail, the rotation axis R3 of the rotary shaft 530 of the hydraulic pump 53 is coaxial with the rotation axis R2 of the rotary shaft 520 of the hydrostatic pump 52.

[0099] The rotary shaft 530 of the hydraulic pump 53 has its free inlet end turned towards the longitudinal vertical median plane of the supporting chassis 20 (for example, at a non-zero distance therefrom).

[0100] In a preferred embodiment, the hydraulic pump 53 is arranged inside the engine compartment 25 in a median area thereof, i.e. at the rear of the engine 51, preferably secated (ideally) by the vertical transverse median plane (i.e. orthogonal to the longitudinal axis A) of the supporting chassis 20 or arranged for the most part on the same front part (with respect to this vertical transverse median plane) in which the engine 51 is placed.

[0101] The hydraulic pump 53 has a volumetric encumbrance or overall volume V_{p2} smaller than the internal volume V_0 of the engine compartment 25, preferably smaller than a quarter of the volume V_m of the engine 51

(substantially equal to or smaller than the volume V_{p1} of the hydrostatic pump 52).

[0102] The hydraulic pump 53 as a whole is at least partially misaligned in (vertical) plan with respect to the lifting arm 40, i.e. it is (totally) external with respect to its projection on the horizontal plane.

[0103] The hydraulic pump 53, i.e. its rotary shaft 530, takes the rotary motion from the engine 51, or from the crankshaft 510 of the same, as will be better described below.

[0104] Into more detail, the hydraulic pump 53, i.e. its rotary shaft 530, takes the rotary motion from the rotary shaft 520 of the hydrostatic pump 52 (i.e. they are connected directly in line).

[0105] In particular, the free inlet end of the rotary shaft 530 of the hydraulic pump 53 is directly connected (engaged) with the free outlet end of the rotary shaft 520 of the hydrostatic pump 52.

[0106] The powertrain 50 further comprises a transmission device 54, which is configured to transfer the rotary motion of the crankshaft 510 of the engine 51 to the rotary shafts 520 and 530 of the pumps, i.e. to the rotary shaft 520 of the hydrostatic pump 52 .

[0107] The transmission device 54 has, for example, a 1:1 transmission ratio, i.e. the rotation speed of the rotary shafts 520 and 530 is equal to the rotation speed of the crankshaft 510.

[0108] The transmission device 54 comprises a box-shaped crankcase inside which two kinematically coupled rolling elements are rotatably associated, such as for example two (or more) gears or two toothed pulleys/crowns connected by means of a flexible member (belt or chain or similar).

[0109] In practice, the transmission device 54 comprises an inlet shaft, keyed on one of the two rolling elements, which is accessible from the outside of the box-shaped crankcase and is adapted to be connected (rigidly, i.e. engaged) to the crankshaft 510 of the engine 51 and an outlet shaft, keyed on the other one of the two rolling elements, which is accessible from the outside of the box-shaped crankcase and is adapted to be connected to the rotary shaft 520 of the hydrostatic pump 52.

[0110] In practice, the inlet shaft (female or male) and the outlet shaft (female or male) are parallel and eccentric between them and distant by a distance equal to the distance between the rotation axis R1 and the rotation axis R2.

[0111] In practice, the rolling elements are rotatably coupled to the box-shaped crankcase with respect to respective rotation axes, each of which is coaxial to one of the rotation axis R1 and the rotation axis R2.

[0112] The transmission device 54 has an overall limited axial encumbrance, i.e. in the direction parallel to the rotation axis of the rolling elements of the same, for example smaller than (or equal to) the axial length of the hydraulic pump 53.

[0113] The engine 54 has a volumetric encumbrance or overall volume Vt smaller than the internal volume V_0 of the engine compartment 25, preferably smaller than an eighth of the internal volume V_0 of the engine compartment 25.

[0114] The volume encumbrance or overall volume Vtot of the powertrain 50 is given by the sum of the volume V_m of the engine 51, of the volume V_{p1} of the hydrostatic pump 52, of the volume V_{p2} of the hydraulic pump 53 and, possibly, of the volume Vt of the transmission device 54.

[0115] Preferably, the overall volume Vtot of the powertrain 50 is smaller than the internal volume V_0 of the engine compartment 25, preferably smaller than or equal to (or in any case comparable) to half of the internal volume V_0 of the engine compartment 25.

[0116] In practice, the powertrain 50 as a whole occupies a front half of the engine compartment 25 (or in any case most of it is located in the front half of the engine compartment 25, arranged in front of the vertical transverse median plane of the supporting chassis 20.

[0117] The engine 51 comprises a system for the discharge of the combustion exhaust gases, which comprises an exhaust manifold (which connects to the combustion chamber of each cylinder of the engine 51) and which connects to a longitudinal exhaust pipe 515, the (only) free end portion thereof comes out of the engine compartment 25, for example in a rear (and raised) area thereof, through a special opening made therein.

[0118] The longitudinal development of the exhaust pipe 515 is mainly parallel or substantially parallel to the longitudinal axis A of the supporting chassis 20.

[0119] The exhaust system also comprises an exhaust gas treatment system 516 of the engine 51, which is configured to vary (chemically and/or mechanically) the composition of the exhaust gases, for example through filtrations and/or oxidation reactions and/or reduction of the same.

[0120] The exhaust gas treatment system 516, as a whole, is arranged inside the engine compartment 25, for example interposed between the exhaust manifold (downstream of this in the direction of flow of the exhaust gases from the combustion chambers towards the free end portion of the exhaust pipe 515) and the exhaust pipe 515 itself.

[0121] Preferably, the exhaust gas treatment system 516 (as a whole or one or more of its components) is placed near the engine 51, i.e. the exhaust manifold thereof, preferably closer to the engine than it is to the free end portion of the exhaust pipe 515.

[0122] In the example, the exhaust gas treatment system 516 comprises a catalytic converter 517, for example a Diesel Oxidation Catalist (DOC) and/or a Selective Catalytic Reduction (SCR).

[0123] Furthermore, the exhaust gas treatment system 516 can comprise a particulate filter 518 (DPF), which is for example placed downstream of the catalytic converter 517, for example substantially adjacent thereto.

[0124] The exhaust gas treatment system 516 could be enclosed in a single box-like casing which contains

the catalytic converter 517 and the particulate filter 518.

[0125] The exhaust gas treatment system 516, i.e. the box-like casing thereof, has an elongated shape with a longitudinal axis, which can be substantially parallel to the longitudinal axis A of the supporting chassis 20 or inclined with respect thereto, for example by an acute or right angle, in the illustrated example preferably by an acute angle comprised between 5° and 30°, preferably equal to 12°.

[0126] The exhaust gas treatment system 516 has a volumetric encumbrance or overall volume V_s (given by the volumetric encumbrance of the catalytic converter 517 and of the particulate filter 518) smaller than the internal volume V_0 of the engine compartment 25, preferably smaller than an eighth of the internal volume V_0 of the engine compartment 25.

[0127] For example, the volume V_s of the exhaust gas treatment system 516 is substantially equal to the sum of the volume V_{p1} of the hydrostatic pump 52 and the volume V_{p2} of the hydraulic pump 53.

[0128] The exhaust gas treatment system 516 as a whole is at least partially placed vertically below the lifting arm 40, i.e. placed below its vertical projection on the horizontal plane.

[0129] In the illustrated example, the projection on the horizontal plane of the exhaust gas treatment system 516 is intersected/overlaps with the projection on the same horizontal plane of the lifting arm 40, in particular a percentage comprised between 40% and 100%, preferably comprised between 80% and 90% of the exhaust gas treatment system 516 overlaps with the projection on the same horizontal plane of the lifting arm 40.

[0130] Furthermore, the exhaust gas treatment system 516 as a whole is at least partially placed vertically above at least one portion of the powertrain 50, in the example of one or both pumps, preferably of the hydrostatic pump 52, i.e. the vertical projection on the horizontal plane of the exhaust gas treatment system 516 intersects with the vertical projection on the same horizontal plane of the powertrain 50, i.e. of one or both pumps, preferably of the hydrostatic pump 52.

[0131] Still, in a preferred embodiment, the exhaust gas treatment system 516 is arranged inside the engine compartment 25 in a rear area of the engine compartment 25 which is at the rear (for the most part) of the powertrain 50, i.e. to the engine. 51 of the same, i.e. proximal to the rear section 22 of the supporting chassis 20, preferably arranged on the same (rear) part with respect to a vertical transverse median plane (i.e. orthogonal to the longitudinal axis A) of the supporting chassis 20 or secated by it near a front end of the same.

[0132] The exhaust gas treatment system 516 is placed in the aforesaid rear area in an upper area, i.e. proximal to the upper base wall of the engine compartment 25 (for example with a substantially horizontal longitudinal axis).

[0133] The internal volume V_0 of the engine compartment 25 is occupied, in essence, by the overall volume Vtot of the powertrain 50 and by the volume V_s of the exhaust gas treatment system 516, leaving a volume V_L empty (free, i.e. not occupied), which is substantially given by the following relationship:

$$V_L = V_0 - V_{tot} - V_s.$$

[0134] The free, i.e. not occupied, volume V_L of the engine compartment 25 is mostly (or totally) located next to the engine 51 (and/or the powertrain 50), preferably at the rear thereof.

[0135] In particular, the free, i.e. not occupied, volume V_L of the engine compartment 25 is located in a rear area of the engine compartment 25 which is at the rear (for the most part) of the powertrain 50, i.e. to the engine 51 of the same, i.e. proximal to the rear section 22 of the supporting chassis 20, preferably arranged on the same (rear) part with respect to a vertical transverse median plane (i.e. orthogonal to the longitudinal axis A) of the supporting chassis 20.

[0136] The vehicle 10 further comprises a cooling system 60 configured to cool the powertrain 50, for example the engine 51, and/or the exhaust system.

[0137] The cooling system 60 is arranged inside the engine compartment 25 and communicates with the outside thereof, for example through slits, openings or grids made in one of its delimitation walls, preferably in the side door of the same.

[0138] The cooling system 60 is arranged on a support which is rotatable around a rotation axis which is substantially vertical, for example placed at the rear near a rear wall of the engine compartment 25.

[0139] The cooling system 60 comprises one or more heat exchangers and one or more cooling fans.

[0140] The cooling system 60 is placed in a rear area of the engine compartment 25 which is at the rear (for the most part) of the powertrain 50, i.e. to the engine 51 of the same, i.e. proximal to the rear section 22 of the supporting chassis 20, preferably arranged on the same (rear) part with respect to a vertical transverse median plane (i.e. orthogonal to the longitudinal axis A) of the supporting chassis 20.

[0141] In practice, the cooling system 60 laterally flanks the free volume V_L of the engine compartment 25, so as to push a flow of cooled air into it, such as to effectively flood the powertrain 50 and/or the exhaust system enclosed in the engine compartment 25 for cooling thereof.

[0142] In the rear section 22 of the supporting chassis 20, the vehicle 10 comprises a counterweight 70 (or ballast), which is configured to counterbalance the imbalance due to the loads on the lifting arm 40.

[0143] The counterweight 70, for example, is defined by a shaped body 71, for example as a rounded plate, preferably made of a material with a high specific weight, such as a metal, preferably cast iron.

[0144] The counterweight 70 has a predetermined

weight, for example substantially comprised between 200 kg and 280 kg, preferably comprised between 210 kg and 230 kg, for example substantially equal to 220 kg.

[0145] The counterweight 70 defines, as a whole, a rear wall of the vehicle 10 and is anchored to the rear section 22 of the supporting chassis 20.

[0146] The counterweight 70, i.e. the shaped body 71 of the same, comprises for example seats 72 within which the headlights or rear lights of the vehicle 10 are arranged and, for example, the license plate holder 73 of the vehicle 10 can be fixed to the counterweight 70, i.e. in the external face of the shaped body 71 turned rearwards.

[0147] The counterweight 70 comprises a centre of gravity centred on the shaped body 70, that is, it belongs to a vertical median plane of the same coinciding with the longitudinal vertical median plane of the supporting chassis 20.

[0148] According to an aspect of the invention, the counterweight 70 is articulated to the rear section 22 of the supporting chassis 20, for example with respect to at least one articulation axis Z.

[0149] In a preferred embodiment, the counterweight 70 is hinged to the rear section 22 of the supporting chassis 20, so as to be able to swing around an (single) articulation axis Z, which is orthogonal to the longitudinal vertical median plane of the supporting chassis 20 (i.e. of the vehicle 10).

[0150] Preferably, this articulation axis Z is parallel and eccentric to the swing axis O of the lifting arm 40 and placed below it.

[0151] Advantageously, the articulation axis Z is placed near a lower end of the counterweight 70, i.e. of the shaped body 71 which defines it, preferably below the level at which the centre of gravity of the counterweight itself is placed.

[0152] The counterweight 70, therefore, has the possibility of swinging between two different predefined angular end positions, of which a first angular closing position - in which the upper end of the counterweight 70 posteriorly rests against the rear portion 22 of the supporting chassis 20 - and a second angular opening position - in which the upper end of the counterweight 70 is posteriorly detached from the rear portion 22 of the supporting chassis 20 (i.e. the counterweight 70 is tipped over backwards) -.

[0153] For example, in the first angular closing position the centre of gravity of the counterweight is vertically aligned with the articulation axis Z of the counterweight itself.

[0154] The angular travel of the counterweight 70 between the first angular closing position and the second angular opening position is equal to an acute (non-zero) angle, for example smaller than 20°, preferably equal to 13°.

[0155] The rear section 22 of the supporting chassis 20 comprises fastening means, for example brackets and threaded or stationary fastening members, adapted to temporarily block the counterweight 70 in at least one of the first angular closing position and the second angular opening position.

[0156] Preferably, the rear section 22 of the supporting chassis 20 comprises brackets and threaded fastening elements adapted to block the counterweight 70 in the first angular closing position in a resolvable way and a mechanical stop (on which the counterweight 70 stably rests under the effect of the weight force only) to stop the counterweight 70 in the second angular opening position.

[0157] When the counterweight 70 is in its first angular closing position, it closes the aforesaid inspection compartment, when - on the other hand - it is in its second angular opening position, it opens the aforesaid inspection compartment and makes it accessible from the outside of the vehicle 10, creating an interspace turned upwards between the upper end of the counterweight 70 and the rear section 22 of the supporting chassis 20, thereby allowing access - for maintenance or the like, to the hydraulic circuit contained in the inspection compartment.

[0158] The counterweight 70 is for example contained between the rear wheels 240 and actually defines a part of the rear hull (bumper) of the vehicle 10.

[0159] The invention thus conceived is susceptible to several modifications and variations, all falling within the scope of the inventive concept.

[0160] Moreover, all the details can be replaced by other technically equivalent elements.

[0161] In practice, the materials used, as well as the contingent shapes and sizes, can be whatever according to the requirements without for this reason departing from the scope of protection of the following claims.

Claims

1. A vehicle (10) for load handling, which comprises:

- a supporting chassis (20) having a front section (21) provided with a front axle (23) equipped with a pair of front wheels (230) and a rear section (22) provided with a rear axle (24) equipped with a pair of rear wheels (240);
- a load lifting arm (40) articulated to the rear section (22) of the supporting chassis (20) with the possibility of rotating around at least one swing axis (O) and having a longitudinal axis (B) parallel to a longitudinal axis (A) of the supporting chassis (20);
- a driver's cab (30) supported by the supporting chassis (20) and positioned on the side of an axial portion of the lifting arm (40); and
- a counterweight (70) connected to the rear section (22) of the supporting chassis (20), wherein the counterweight (70) is hinged to the rear section (22) of the supporting chassis (20) around a swivel axis (Z) parallel to the swing axis (O) of the lifting arm (40) with the possibility of oscillat-

ing between two different predefined angular end positions.

2. The vehicle according to claim 1, wherein the swivel axis is positioned below the barycentre of the counterweight.

3. The vehicle according to claim 2, wherein in an angular end position of the counterweight the barycentre of the counterweight is vertically aligned with the swivel axis.

4. The vehicle according to claim 1, wherein the rear section of the supporting chassis comprises fastening means adapted to temporarily lock the counterweight in at least one of the angular end positions or both.

5. The vehicle according to claim 1, which comprises a powertrain supported inside an engine compartment of the supporting chassis at least partially placed vertically below an axial portion of the lifting arm, wherein the powertrain comprises an engine, a hydraulic pump and a hydrostatic pump.

6. The vehicle according to claim 5, wherein the lifting arm is articulated to the supporting chassis with respect to a single swing axis parallel to a rotation axis of an engine crankshaft.

7. The vehicle according to claim 5, wherein the engine is an internal combustion engine.

8. The vehicle according to claim 7, which comprises at least one exhaust gas treatment system of the internal combustion engine positioned inside the engine compartment.

9. The vehicle according to claim 8, wherein the exhaust gas treatment system is at least partially placed vertically below an axial portion of the lifting arm.

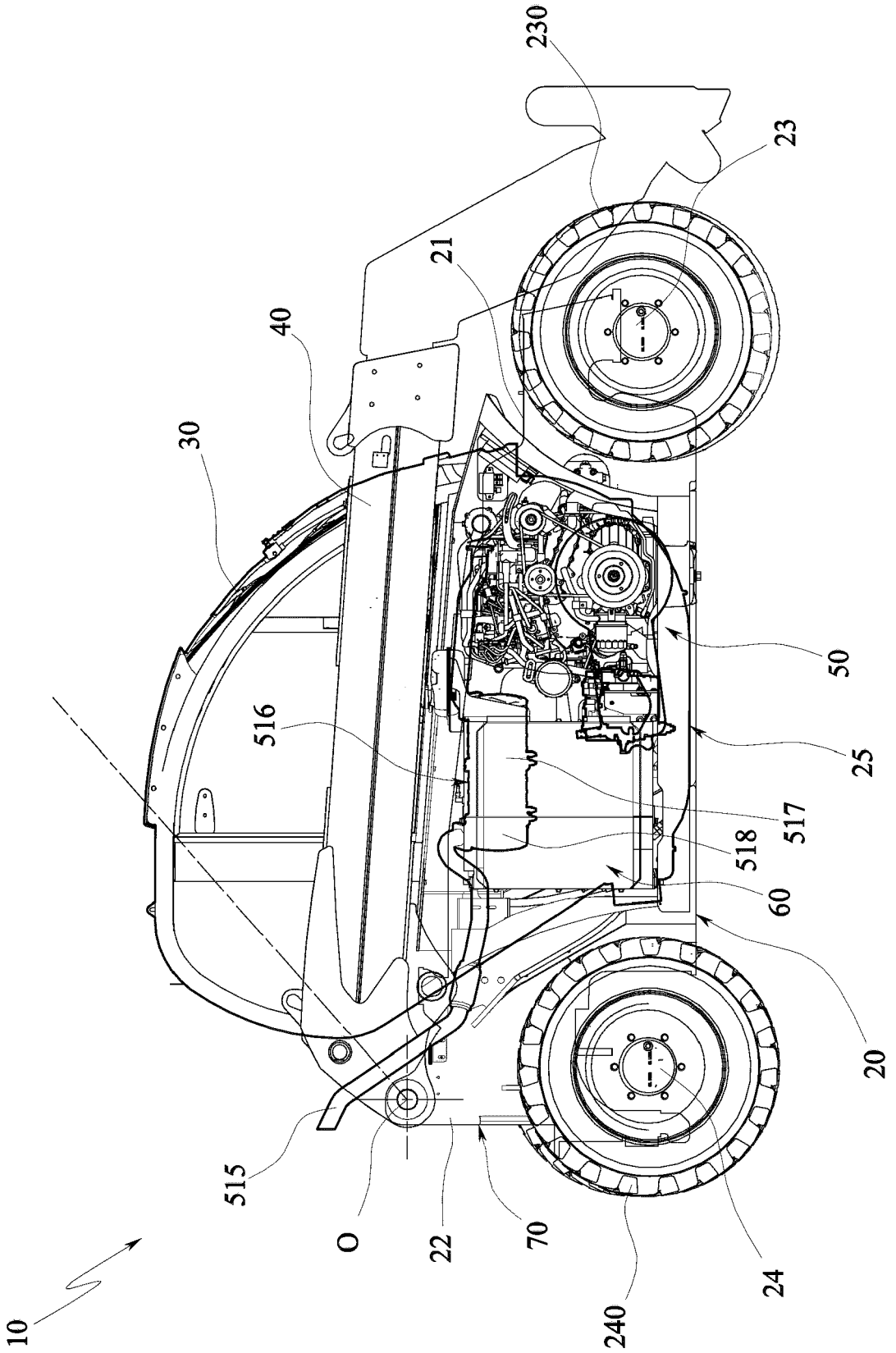


FIG.1

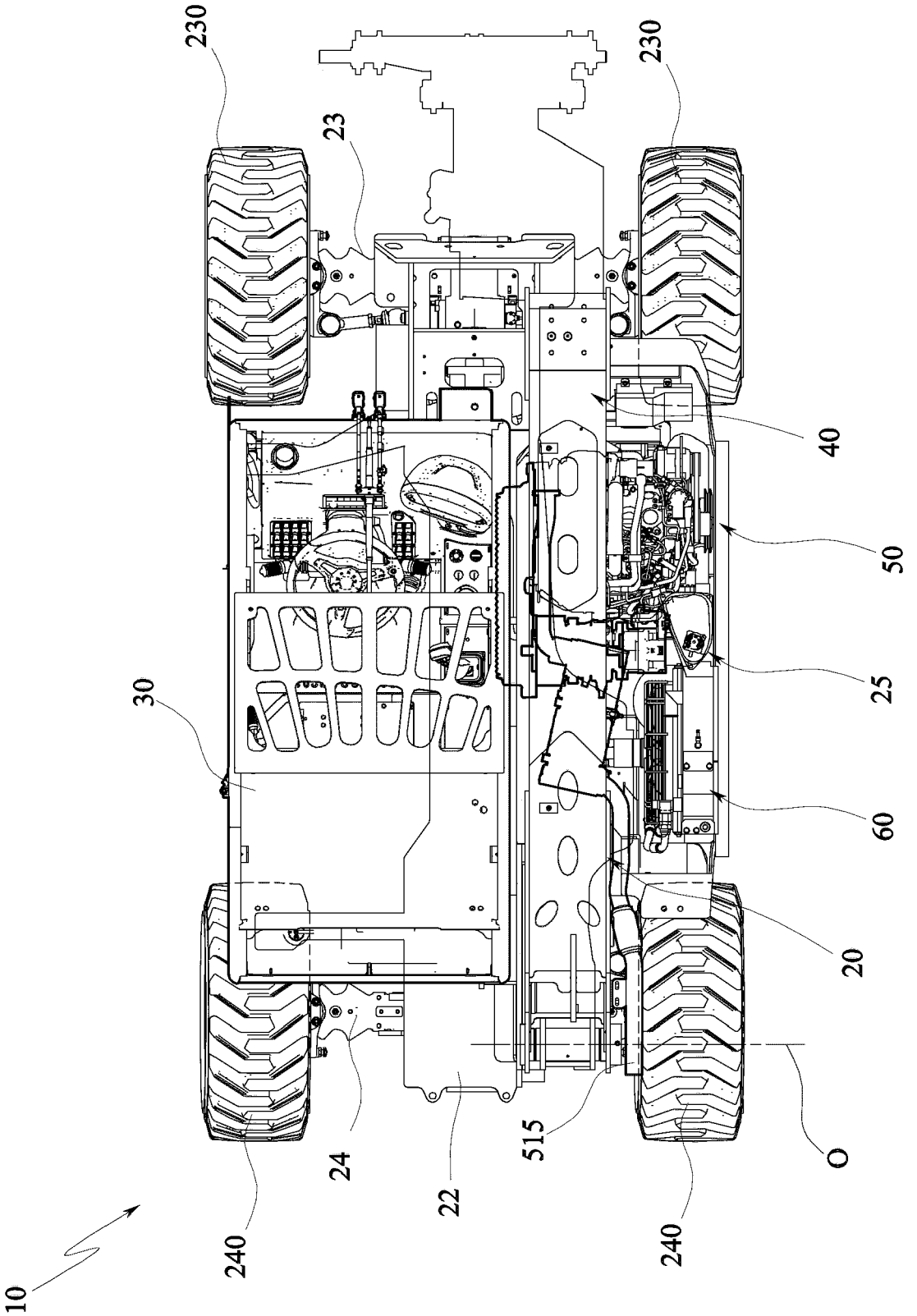
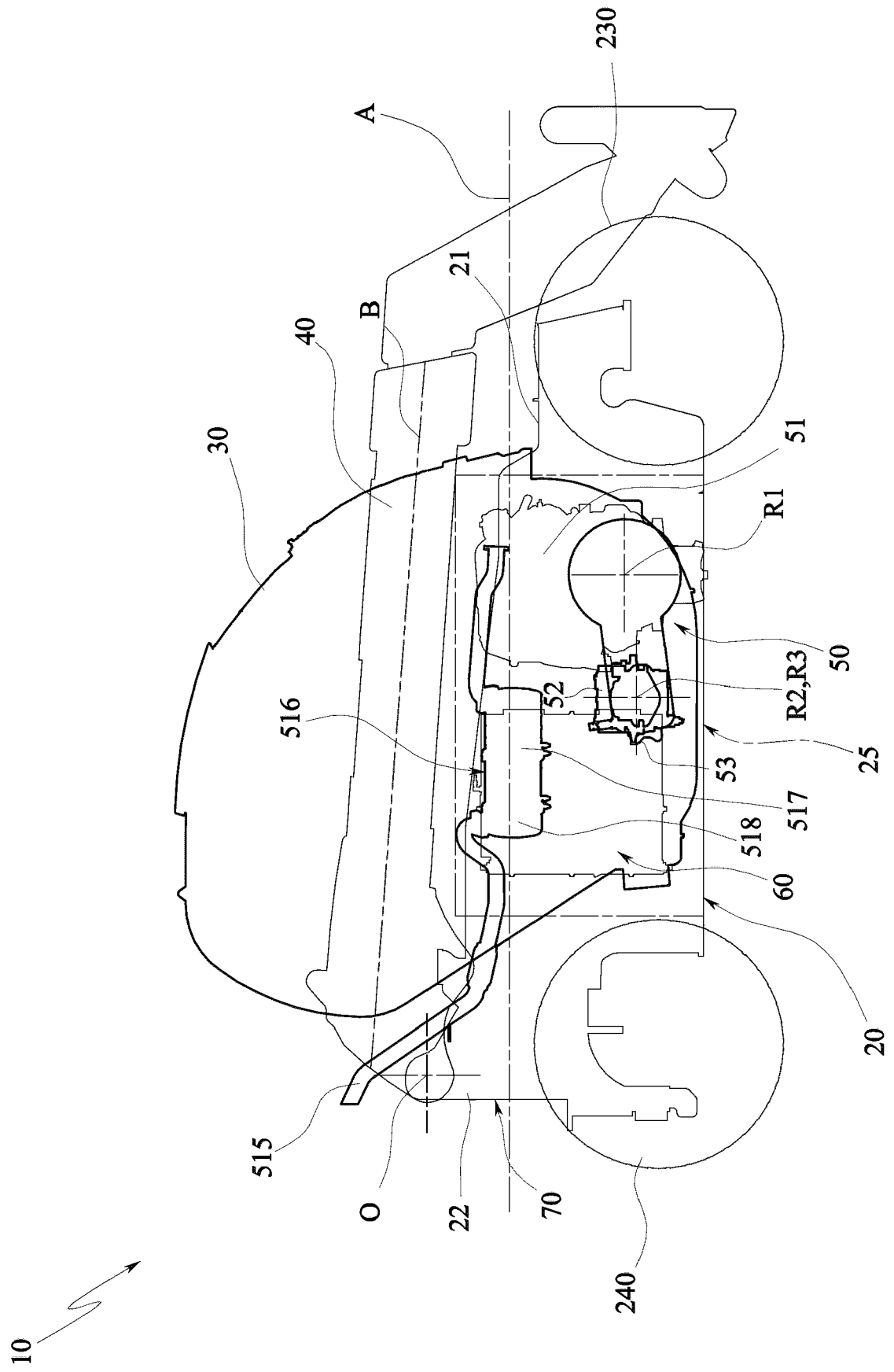


FIG.2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A
B
O
21
22
230
240
30
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50
51
515
516
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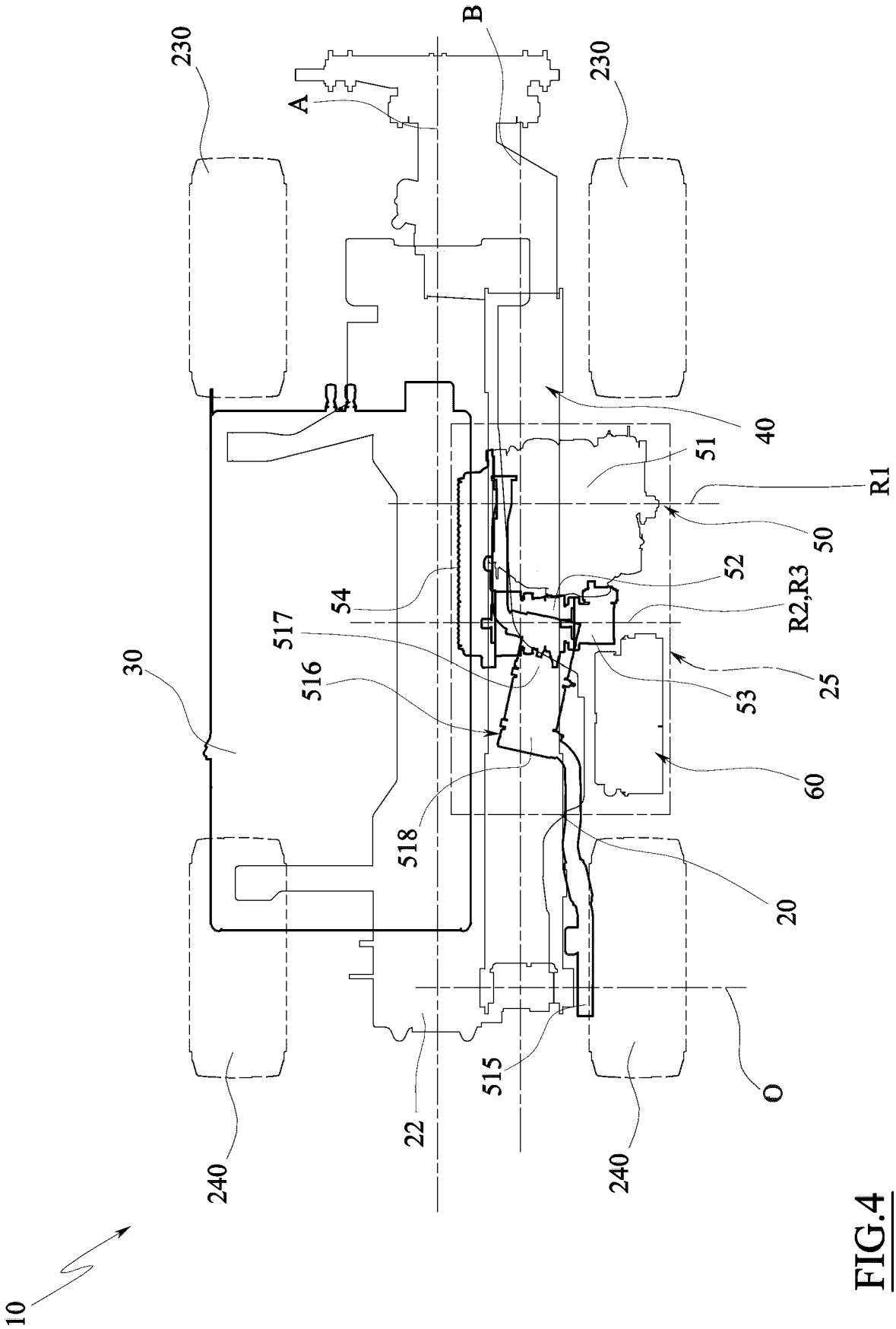
518
52
53
60
70
20
25
R1
R2,R3

FIG.3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51
R1
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22
240
240

FIG.4

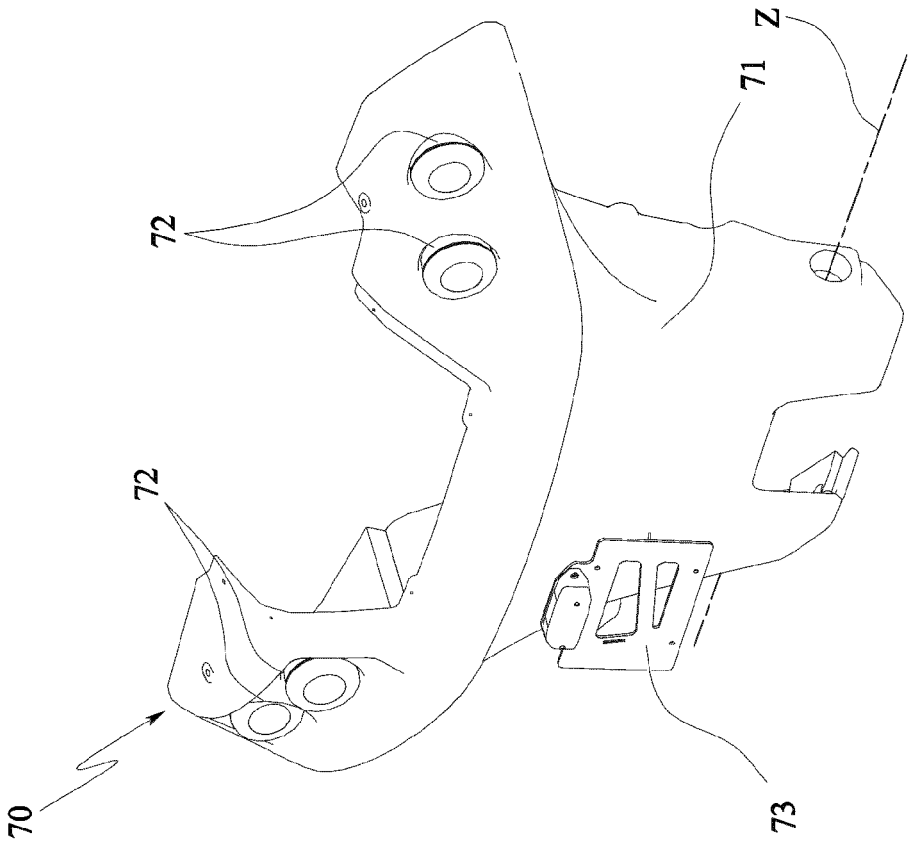

FIG.6

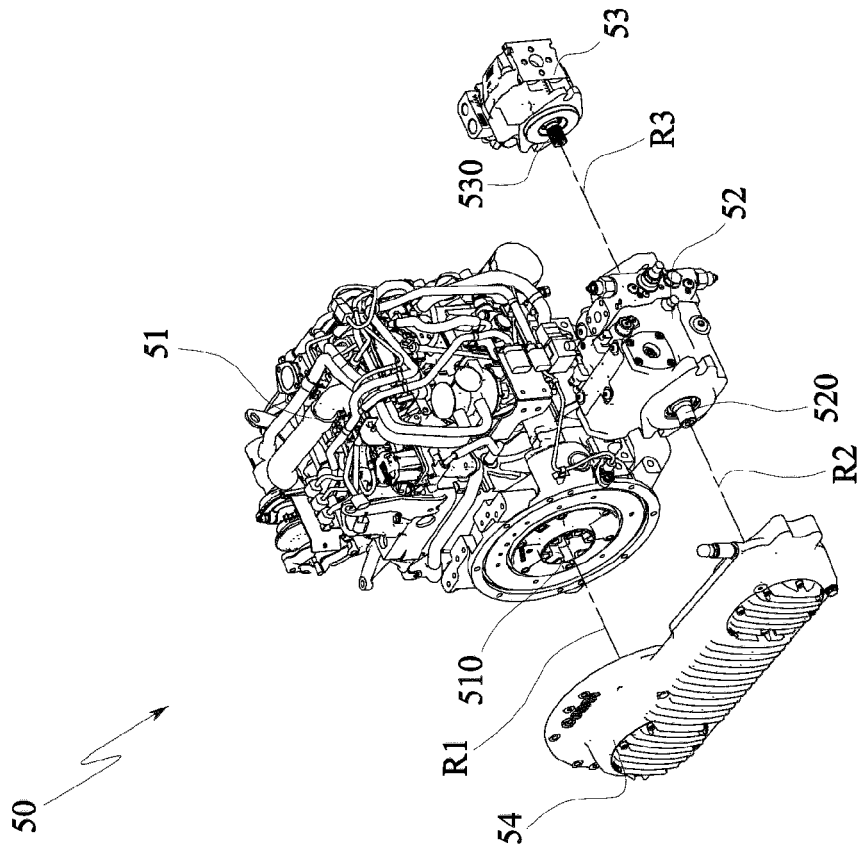

FIG.5

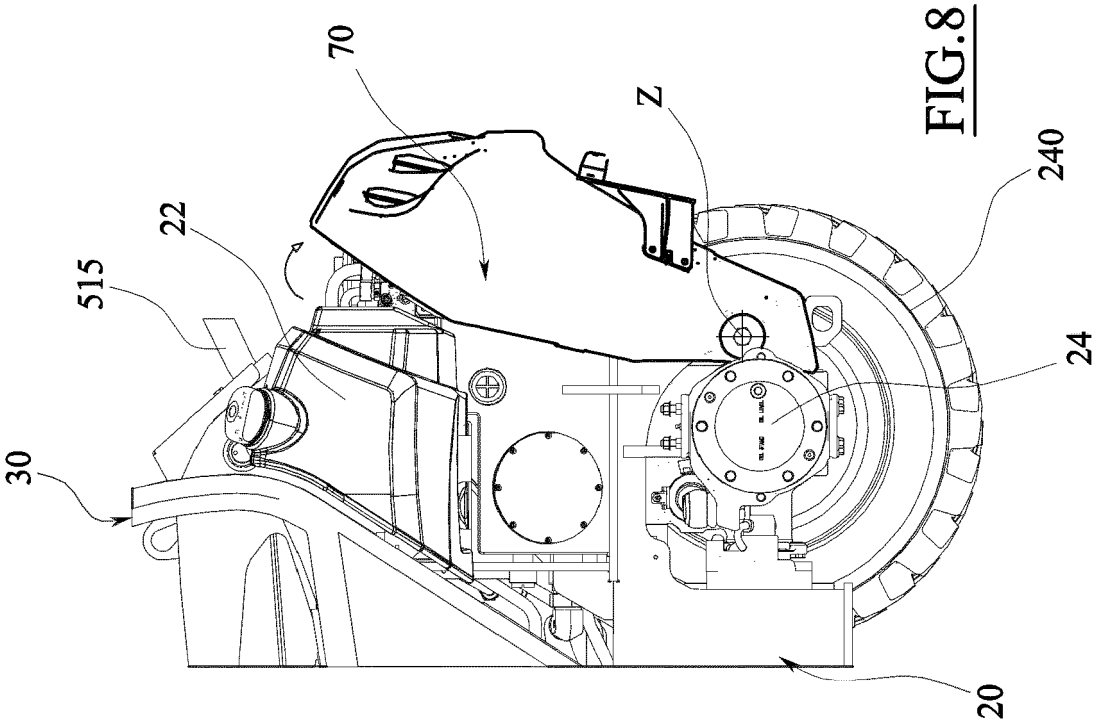

FIG.8

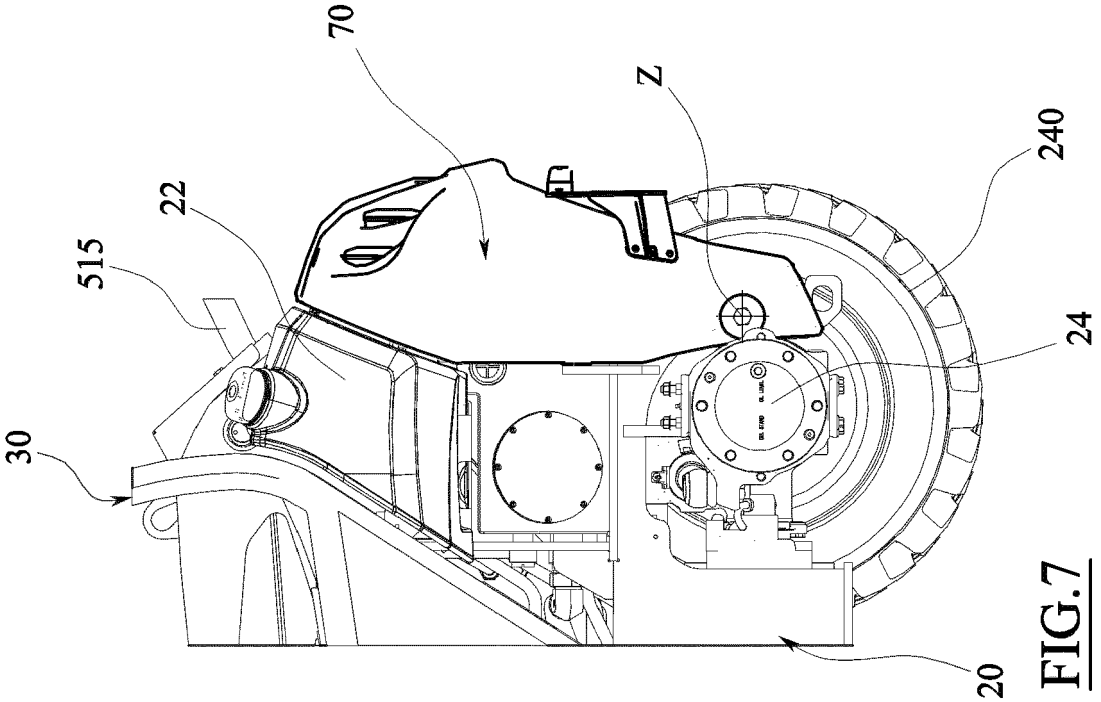

FIG.7

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Application Number
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	27 May 2020	Colletti, Roberta

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EUROPEAN SEARCH REPORT

Application Number
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