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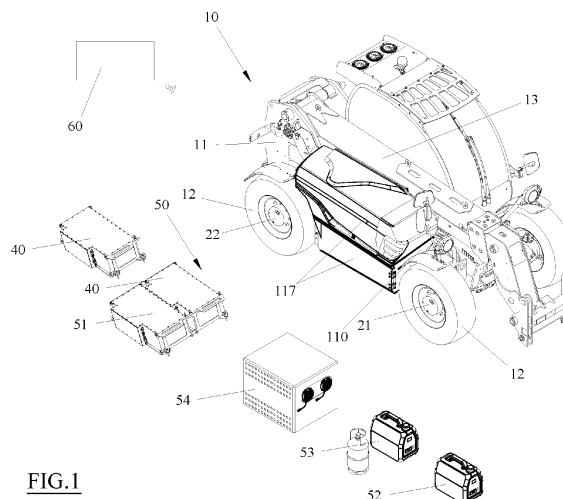
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(54) FULL ELECTRIC TELEHANDLER

(57) A telehandler (10) comprising:
- a supporting frame (11) provided with a front section and a rear section to which a crankcase (110) is attached;
- a lifting arm (13) articulated to the rear section of the supporting frame (11);
- a front axle (21) provided with two front wheels (12);
- a rear axle (22) provided with two rear wheels (12);
- an electric motor (31) to drive the rotation of the front wheels (12) and/or the rear wheels (12) and to handle the lifting arm (13);
wherein the electric motor (31) is connected to a main power supply battery (40);
- a housing (115) provided with an opening (116) closed by an openable hatch (117) made at the crankcase (110),

wherein the opening (116) is configured to make the housing (115) accessible from outside the crankcase (110), wherein the housing (115) is configured to house inside the main battery (40) and at least one generator unit (50) used as a charge extender for at least one of the operations selected between charging the main battery (40) and power supplying the electric motor (31), wherein the housing (115) comprises a detachable electrical connector to which the generator unit (50) and/or the main battery (40) may be detachably connected and the generator unit (50) and/or the main battery (40) is configured to be arranged in and/or extracted from the housing (115) through the opening (116).

**FIG.1****EP 4 491 567 A1**

Description

TECHNICAL FIELD

[0001] The present invention relates to a telescopic handler (so-called *telehandler*), preferably a full electric telehandler and a kit for extending the autonomy of a full electric telehandler.

PRIOR ART

[0002] As known, full electric telehandlers, i.e. wherein the drive wheels are driven in motion by an electric motor (battery-powered) and wherein the lifting arm is driven by a hydraulic pump that is in turn driven by an electric motor, are becoming commercially popular. There is a fair range of electric telehandlers on the market, but each of them is not able to fully meet the user's different use requirements. Electric machines are usually not as versatile as an ordinary internal combustion engine machine, especially when the user's work is seasonal, with very intense periods alternating with quiet ones.

[0003] As part of this solution, a need is perceived in the field to make available a telehandler that is suitable for or adaptable to the various processing circumstances it is intended for.

[0004] An object of the present invention is to meet the aforesaid needs of the prior art, within the framework of a simple, rational and cost-effective solution.

[0005] These objects are achieved by the features of the invention set forth in the independent claim. The dependent claims outline preferred and/or particularly advantageous aspects of the invention.

DISCLOSURE OF THE INVENTION

[0006] The invention, in particular, makes available a telehandler (preferably a full electric telehandler) comprising:

- a supporting frame with a front section and a rear section (aligned along a longitudinal axis of the supporting frame that are rigidly constrained and/or articulated to each other) to which a crankcase is attached;
 - a lifting arm articulated to the rear section of the supporting frame with the possibility of rotating around at least one swinging axis (and having a longitudinal axis parallel to the vertical plane containing the longitudinal axis of the supporting frame);
 - front wheels connected to the front section of the supporting frame (e.g. directly or via a front axle);
 - two rear wheels connected to the rear section of the bearing frame (e.g. directly or via a rear axle);
 - (a powertrain provided with) at least one electric motor to drive the rotation of the front and/or rear wheels;
- wherein the electric motor is supported by the sup-

porting frame and is connected to a main power supply battery (which is, for example, on board the telehandler, supported by the supporting frame);

- a housing provided with (at least) an opening closed by at least an openable hatch formed at the crankcase, wherein the opening is configured to make the housing accessible from outside the crankcase, wherein the housing is configured to house inside thereto the main battery, supported by the supporting frame, and at least one generator unit used as a charge extender (or *range extender*) for at least one of the operations selected from charging the main battery and power supplying the electric motor, wherein the housing comprises a detachable electrical connector, to which the generator unit and/or the main battery may be detachably connected, and the generator unit and/or the main battery is configured to be arranged in and/or extracted from the housing through the opening.

[0007] Thanks to such a solution, it is possible to meet the above-mentioned industry requirements.

[0008] Moreover, thanks to this solution, the user can choose or increase the working autonomy of the telehandler (i.e. the capacity of the battery thereof and/or the reach of the telehandler) on the spot / already purchased (through an integrated *retrofitting* solution specifically designed for the telehandler) to cope with the most intense periods of work (work peaks) while being able to reduce the autonomy of the telehandler (i.e. the capacity of the battery thereof) when an increased autonomy is not required.

[0009] Moreover, thanks to this solution it is possible to reduce the (initial) purchase cost of the telehandler, which can initially be purchased in the basic version (without *range extender*) and then purchase/rent a *range extender* only when needed.

[0010] In addition, this solution makes available a highly versatile telehandler - like the *telehandler* with an endothermic engine - which gives the buyer an incentive to purchase a full electric (i.e. environmentally friendly) telehandler.

[0011] The aforesaid telehandler solution with a "modular" power supply system allows the owner/user of the telehandler to easily change the machine characteristics to suit his or her needs, even after the purchase of the telehandler or with the telehandler in operating conditions (in the field).

[0012] Advantageously, the generator unit can be selected from the group consisting of an auxiliary battery, an internal combustion engine generating set and a fuel cell unit, e.g. gas, such as hydrogen or methane and/or methanol, and combinations thereof.

[0013] The (type of) generator unit (i.e. the telehandler working autonomy extension kit) can be selected according to the needs of the owner/user of the telehandler, and can also be made available as a rental package, that the owner/user of the telehandler could simply rent to meet a

different momentary or transitional need.

[0014] All types of generator units are designed to fit perfectly on the telehandler, i.e. they are dedicated thereto, as a recessed part, i.e. housed within the designed and dedicated housing, with the possibility of being quickly removed or added, e.g. by means of a very quick method of replacing them, implemented using very cheap and, for example, commercial tools or equipment.

[0015] Preferably, the generator unit may comprise an auxiliary battery that can be added to or replace the main battery.

[0016] Thanks to this solution, it is possible to increase the autonomy and range of action of the *telehandler* while keeping a *full electric* ("zero-emission") vehicle.

[0017] Alternatively or additionally, the generator unit may comprise an internal combustion engine generating set, which may be selected from the group consisting of a diesel engine generating set, a gas engine generating set, such as LPG or CNG, and a petrol engine generating set.

[0018] In practice, the telehandler solution with an autonomy that can be extended if necessary (through a simple *retrofitting action*) makes it possible to have a zero-emission all-electric machine that can become a plug-in hybrid simply by adding an integrated kit. This is a perfect solution to deal with emergency situations, to absorb sporadic peaks of very hard work, increasing the versatility of the machine.

[0019] Alternatively or additionally, the generator unit may comprise a fuel cell unit, e.g. a gas unit, such as a hydrogen or methane and/or methanol unit, which may comprise at least one fuel cell and a gas tank (i.e. hydrogen or methane and/or methanol tank), wherein preferably the gas tank is fixed or replaceable/removable and arranged internally or externally to an enclosure, which may be housed within the housing and which contains the at least one fuel cell in a fixed or removable/replaceable manner.

[0020] Thanks to this solution, it is possible to keep the (full electric) telehandler a "zero-emission" vehicle.

[0021] Advantageously, e.g. to allow the use of internal combustion engines therein, the housing may comprise at least one air and/or ventilation intake.

[0022] According to an aspect of the invention, the housing may be arranged in a central section of the supporting frame interposed between the front section and the rear section, preferably between the front wheels and the rear wheels, (or axially interposed between the front axle and the rear axle where provided).

[0023] Advantageously, to improve accessibility to the housing and the generator unit enclosed therein, the hatch may be arranged at one side of the crankcase, between a front wheel and a rear wheel.

[0024] The invention, for the same purposes and advantages as set forth above, makes available a (*retrofitting*) kit for extending the autonomy of a full electric telehandler by means of an electric motor, wherein the kit comprises a generator unit that may be housed in and

removable from a dedicated telehandler housing (or generally associated with a supporting frame of the telehandler) and is provided with an electrical connector configured to connect, so as to be attached to and detached from an electrical connector of the housing for at least one of the operations between charging the main battery and power supplying the electric motor.

[0025] Advantageously, the generator unit can be selected from the group consisting of an auxiliary battery, an internal combustion engine generating set and a fuel cell unit, e.g. gas, such as hydrogen or methane and/or methanol, and a combination thereof.

[0026] Even more advantageously, the generator unit can comprise at least two of an auxiliary battery, an internal combustion engine generating set and a fuel cell unit, e.g. gas, such as hydrogen or methane and/or methanol, which can be interchanged and/or combined within the housing of the telehandler.

[0027] The autonomy of the telehandler with which the kit is associated can thereby be maximised.

BRIEF DESCRIPTION OF THE DRAWINGS

[0028] 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 an axonometric view of a telehandler according to the invention and a kit for extending autonomy thereof.

Figure 2 is an exploded axonometric view of the telehandler according to the invention with some elements of the autonomy extension kit thereof inserted into the proper housing.

Figure 3 is an exploded axonometric view of the telehandler according to the invention with other elements of the telehandler autonomy extension kit inserted into the proper housing.

BEST MODE TO IMPLEMENT THE INVENTION

[0029] With particular reference to these figures, a telehandler (or lifting vehicle) has been globally referred to as 10.

[0030] The telehandler 10 is provided with a supporting frame 11 moving on wheels 12, of which one pair of front wheels 12 and one pair of rear wheels 12, and supporting a lifting arm 13 (and, for example, a driver's cab, e.g. placed alongside the lifting arm 13) at the top.

[0031] The supporting frame 11 is substantially rigid (i.e. non-deformable under the usual work-loads to which it is subjected in use).

[0032] It is not excluded, however, that in certain applications the supporting frame 11 may be articulated, i.e. have several (singularly rigid) portions articulated to each other, e.g. jointed relative to a pivot axis (substantially vertical).

[0033] The supporting frame 11 has (overall) an elongated shape along a longitudinal axis (defining the longitudinal axis of the telehandler 10) and therefore has, at or near a first axial end thereof, a front section and at or near an opposite second axial end thereof, a rear section.

[0034] A central section is (axially) interposed between the rear and front sections.

[0035] In the present description, front refers to the portion of the telehandler 10 or of the supporting frame 11 which precedes (i.e. it is placed at the front) in a feed direction of the telehandler 10 on the ground in a usual and preferred forward run (i.e. wherein the free end of the lifting arm 13 is placed) and rear refers to the portion of the telehandler 10 or of the supporting frame 11 which follows (i.e. it is placed at the back) in a feed direction of the telehandler 10 on the ground in the usual and preferred forward run (or that precedes in a backward run).

[0036] A crankcase 110 or (protective) fairing, which defines therein a (hollow) volume for housing various operating members of the telehandler 10 which will be described hereinafter is attached to the supporting frame 11.

[0037] Preferably, the lifting arm 13 is preferably hinged - at its rear end - to the supporting frame 11, e.g., above it, preferably at the rear section thereof. The lifting arm 13 has, for example, an elongated shape along a longitudinal axis parallel to the longitudinal axis of the supporting frame 11 (i.e., lying in a vertical plane parallel to the longitudinal axis of the supporting frame itself) and has, therefore, one of its rear axial ends hinged to the rear section of the supporting frame 11 and an opposite front axial (distal) end free, which protrudes, for example, beyond the front end of the supporting frame 11.

[0038] The lifting arm 13 is preferably of the telescopic type.

[0039] In particular, the lifting arm 13 has a plurality of sections that can be driven between a contracted position and an extended position by means of a first (double-acting) hydraulic actuator.

[0040] The lifting arm 13 is hinged to the supporting frame 11 so that it can swing around a (single) swinging axis by means of a second (double-acting) hydraulic actuator.

[0041] For example, the (only) swinging axis is substantially horizontal. In some embodiments, the swinging axis is fixed relative to the supporting frame 11 (and orthogonal to the longitudinal axis thereof), in other applications the swinging axis (and with it the lifting arm 13) is rotatable around a further substantially vertical axis of revolution (in such a case, the telehandler 10 is of the rotary type, i.e. it has a fifth wheel - motor-driven - on which the lifting arm 13 is mounted, and for example the driver's cab and/or the crankcase or part thereof, with a substantially vertical rotation axis, i.e. orthogonal to the longitudinal axis of the telehandler and to the swinging axis of the lifting arm 13).

[0042] The lifting arm 13 has, at its front free axial end,

a connecting member, such as a tool-holder plate, adapted to connect (in a releasable manner) to one or more working tools, such as buckets, forks, cabs or others.

[0043] The supporting frame 11 is supported on the ground by the wheels 12, such as by the interposition of a dampening unit (rigid, or jointed, e.g. free or actuated and/or dampened).

[0044] It is not excluded, however, that the supporting frame 11 is supported on the ground directly by the wheels 12 (without interposition of dampening units and/or axles).

[0045] The dampening unit 20 comprises a front (rigid) axle 21 supporting, at its opposite free ends (provided with respective hubs), the pair of front wheels 12.

[0046] The front axle 21 is supported by and/or attached to the front section of the supporting frame 11.

[0047] For example, the front axle 21 can be rigidly attached to the supporting frame 11 (below it) or be fixed in a swinging manner (i.e. be hinged to the supporting frame 21 around a swinging axis parallel to the longitudinal axis of the supporting and central frame 21, in which case, preferably, there is at least one actuator configured to command/control the swinging and thus the tilting of the front axle 21 or the transverse levelling of the supporting frame 11).

[0048] Again, the dampening unit 20 comprises a rear (rigid) axle 22 supporting, at the opposite free ends (provided with respective hubs), the pair of rear wheels 12.

[0049] The rear axle 22 is for instance independent of the front axle 21.

[0050] The rear axle 22 is supported by and/or attached to the rear section of the supporting frame 11.

[0051] At least one of the pair of front wheels 12 and the pair of rear wheels 12 or both can be steering and/or drive wheels.

[0052] In the present discussion, vertical refers to either the absolute vertical or any direction orthogonal to the plane on which the front wheels 12 and the rear wheels telehandler 10 rest. Furthermore, "horizontal" refers herein to either the absolute horizontal or any plane parallel to the plane on which the front wheels 12 and the rear wheels of the telehandler 10 rest.

[0053] The telehandler 10 further comprises a housing 115 enclosed within the crankcase 110. The housing 115 is defined by a portion of the empty volume enclosed by the crankcase 110 (and the supporting frame 11).

[0054] The crankcase 11 is provided with an opening 116 which makes the housing 115 accessible from outside the crankcase 11, which is (normally) closed by at least one openable hatch 117 made at the crankcase 11.

[0055] For example, the opening 116 is closed by a plurality of hatches 117 (e.g. two in number).

[0056] Each hatch 117 is movable to open and close the opening 116, e.g. hinged with respect to at least one hinge axis (e.g. vertical or horizontal).

[0057] In the example shown, the opening 116 is

closed by a first (lower) hatch 117 hinged to the crankcase 110 relative to a vertical hinge axis and a second hatch 117 (top or bonnet) hinged to the crankcase 110 relative to a horizontal hinge axis.

[0058] It is not excluded, however, that the opening 116 may be closed by a single hatch or by a different number of hatches, or that the housing 115 is divided into several compartments (separated from each other by partitions) each of which is made accessible from outside the crankcase 11 by a respective opening 116 closed, in an openable manner, by one or more hatches 117.

[0059] Furthermore, it is not excluded that the hatch 117 may be of the slide type, i.e. sliding with respect to a sliding direction (e.g. horizontal and orthogonal to the longitudinal axis of the telehandler or parallel to that longitudinal axis).

[0060] The housing 115 preferably comprises at least one air and/or ventilation intake, for example made at the hatch 117 (and preferably defined by a ventilation grid).

[0061] In the example shown, the housing 115 is arranged substantially at the central section of the telehandler 10, i.e. it is arranged between the front wheels 12 and the rear wheels 12, preferably it is axially interposed between the front axle 21 and the rear axle 22. Again, the hatch 117 is, for example, arranged at a sidewall of the crankcase 110, between a front wheel 12 and a rear wheel 12 (e.g. on the side opposite the driver's cab). Each hatch 117 further comprises locking means (such as a latch or other) configured to keep (releasably) the hatch in the closed configuration.

[0062] These closing means may be opened (manually and/or automatically) to release the hatch 117 to allow it to open.

[0063] The hatch 117 (such as the second hatch) may comprise at least one gas spring configured to push it open (once the closing means are released) and hold it in the open configuration.

[0064] The telehandler 10 further comprises a powertrain 30 for driving (in direct or indirect rotation) the front wheels 12 and/or the rear wheels 12 (i.e., the drive wheels 12 of the telehandler 10), i.e. designed (exclusively) for the traction function of the telehandler 10. The powertrain 30 is (directly or, preferably, indirectly) supported by the supporting frame 11.

[0065] For example, the powertrain 30 is at least partially (preferably totally) within an engine compartment enclosed within the crankcase 110 (i.e. within a portion of the internal volume enclosed within the crankcase 110) and supported (indirectly) by the supporting frame 11 itself.

[0066] The engine compartment is defined by a portion of the (empty) volume inside the crankcase 110, preferably distinct (at least functionally) and/or separated (by separating partitions) from the above-mentioned housing 115.

[0067] The powertrain 30 is an electric or electrically driven powertrain.

[0068] In particular, the powertrain 30 comprises at

least one electric motor 31.

[0069] The electric motor 31 is configured to drive the rotation (directly or indirectly) of the drive wheels 12 of the telehandler 10.

[0070] In the example, the electric motor 31 is (integrally) attached/connected to either the front axle 21 (and movable relative to the supporting frame 21) or the rear axle 22.

[0071] It is not excluded, however, that the electric motor 31 may be connected to a mechanical transfer case/gearbox, which in turn is connected to the front or rear axle via a cardan joint.

[0072] It is also not excluded that the powertrain 30 comprises a plurality of electric motors 31, e.g. one for each wheel (which thus becomes a wheel motor) or for each axle or other possible configurations.

[0073] The powertrain 30 further comprises a (hydraulic) pumping unit 35 for driving the lifting arm 13.

[0074] The pumping unit 35 comprises a hydraulic pump and, for example, a hydraulic distributor (connected to a hydraulic circuit).

[0075] The hydraulic pump - e.g. by means of the interposition of a suitable hydraulic distributor - is configured to control the movement and/or functionality of the lifting arm 13, i.e. the actuation of a hydraulic circuit of a drive unit (of the oscillation of the lifting arm 13) and/or hydraulic circuits of hydraulic actuators designed to actuate the extension of the lifting arm 13 (not shown as being of a known type) and/or the gripping/release and/or use of the working tools.

[0076] The pumping unit includes an electric motor to drive the hydraulic pump.

[0077] For example, the electric motor driving the hydraulic pump is an additional electric motor (different from the electric motor 31 used to propel the telehandler 10), e.g. dedicated (exclusively) to the movement of the lifting arm 13 via the hydraulic pump (and hydraulic distributor), which is for example arranged at the rear section of the telehandler 10.

[0078] It is not excluded, however, that a possible configuration may provide that the electric motor 31 (which is responsible for the traction of the telehandler 10) may be connected to the pumping unit 35 to move the lifting arm 13, for example in this case a mechanical or hydraulic transmission (e.g. a hydrostatic transmission, a torque converter, clutches, etc.) is interposed between the electric motor 31 and the (front 21) axle such that the two traction/movement uses of the telescopic arm are mechanically separated.

[0079] The telehandler 10 further comprises a power supply system for the powertrain 30 placed on board the telehandler 10.

[0080] The supply system comprises an electric power source.

[0081] Preferably, the power supply system comprises (or consists of) a main battery 40 (or a battery pack) configured to electrically supply at least the electric motor 31 (or the various electric motors 31 designed to drive the

telehandler 10) of the powertrain 30 (to which it is connected, directly or indirectly, via a power line).

[0082] The main battery 40 is designed to electrically power the powertrain 30 (and any electrical accessories, such as air conditioning, lights, instrument panel and others) of the telehandler 10.

[0083] In addition, the main battery 40 is designed to electrically power the pumping unit 35, i.e. the electric motor driving the hydraulic pump designed to move the lifting arm 13. Again, the main battery 40 may be designed to electrically supply (all of) any electric motors (and other electrical utilities) on the telehandler 10.

[0084] The characteristics/operating parameters (in terms of capacity/autonomy and/or voltage and/or inrush current or others) of the main battery 40 define the minimum characteristics/operating parameters of the power supply system for power supplying the powertrain 30.

[0085] The main battery 40 (e.g. lithium-ion or other) is rechargeable and/or removable and/or replaceable, as better described hereinafter.

[0086] The main battery 40 is supported by the supporting frame 11 and, preferably, is arranged within the housing 115 (enclosed by the crankcase 110).

[0087] The main battery 40 is arranged so as to be accessible from outside the crankcase 110 through the opening 116 thereof (when the hatch 117 is open and inaccessible when the hatch 117 is closed).

[0088] The main battery 40 occupies a portion (lower than the total) of the inner volume of the housing 115 (e.g. lower than or equal to 1/3 of the total volume of the housing 115).

[0089] Preferably, but not limitedly, the main battery 40 (in addition to being rechargeable either when arranged within the housing 115, for example through a charging socket located at the external side of the crankcase 110, or outside it, for example in a suitable remote charging station) is configured to be removably housed in the housing 115, i.e., to be arranged in and/or extracted from the housing 115 by passing through the opening 116 described above.

[0090] The main battery 40 has an electrical connector configured to mechanically and electrically connect (in a detachable manner) to a joined electrical connector present in the housing 115 (following the insertion of the main battery 40 into the housing 115, through the opening 116, and its housing therein).

[0091] The electrical connectors are configured for the passage of the power line (for the electrical supply of the electric motor 31) and, advantageously, also for the passage of a service or interface line used for the recognition and/or diagnostics of the main battery 40.

[0092] The telehandler 10 further comprises an auxiliary power system or auxiliary generator unit 50.

[0093] The generator unit 50 is used as a charge and/or capacity and/or autonomy extender (so-called *range extended*) to perform at least one of the (two) operations selected from (i.e. selected from the group consisting of) the charging of the main battery 40 and the electrical

supply of the electric motor 31 (directly or indirectly, e.g. by means of a power line).

[0094] Preferably, the generator unit 50 is used as a charge and/or capacity and/or autonomy extender (so-called *range extender*) to perform (exclusively) charging of the main battery 40.

[0095] The generator unit 50 is adapted to be supported by the supporting frame 11 and, preferably, is adapted to be arranged within the housing 115 (enclosed by the crankcase 110), preferably in a removable manner, namely is adapted to be arranged within the same housing 115 wherein the main battery is adapted to be arranged or is arranged. The generator unit 50 is arranged (inside the housing 115) so as to be accessible from outside the crankcase 110 through the opening 116 thereof (when the hatch 117 is open and inaccessible when the hatch 117 is closed).

[0096] The generator unit 50 occupies a portion (lower than the total) of the inner volume of the housing 115 (e.g. lower than or equal to 1/3 of the total volume of the housing 115). Preferably, but not limitedly, the generator unit 50 is configured to be removably housed in the housing 115, i.e., to be arranged in and/or extracted from the housing 115 by passing through the above-described opening 116 (with the hatch 117 open).

[0097] The generator unit 50 further has detachable fastening means, e.g. quick-release fasteners, adapted to be mechanically connected (in a detachable manner) with conjugate fasteners provided in the housing 115, which define a fixed position of the generator unit 50 in the housing 115 and hold them in position during use of the telehandler 10.

[0098] The generator unit 50 has an electrical connector configured to mechanically and electrically connect (in a detachable manner) to a joined electrical connector (e.g. different from the one to which the main battery 40 is connectable) present in the housing 115 (following the insertion of the generator unit 50 into the housing 115, through the opening 116, and its housing therein).

[0099] The electrical connectors are configured for the passage of the power line for charging the main battery 40 (and/or the power supply of the electric motor 31) and, advantageously, also for the passage of a service or interface line used for the recognition and/or diagnostics of the generator unit 50.

[0100] The generator unit 50 is selected from the group consisting of an auxiliary battery 51, an internal combustion engine generating set 52, 53 and a fuel cell (electricity-generating) unit 54, e.g. gas (such as hydrogen or methane and/or methanol), and combinations thereof.

[0101] The case where the generator unit 50 comprises (or consists of) an auxiliary battery 51 is described below.

[0102] In a first (and preferred) embodiment, the auxiliary battery 51 may be added/addable to the main battery 40 (which is always present in the housing 115), e.g. placed alongside thereto relative to a horizontal side-by-side direction (or stacked relative to it with re-

spect to a vertical stacking direction) or variously arranged within the housing 115).

[0103] For example, in such a case, the auxiliary battery 51 (or battery pack) is, for example, connected in parallel to the main battery 40 via a suitable pair of (electrical) connectors, defining, for example, a battery block.

[0104] For example, the auxiliary battery 51 is identical to the main battery 40 (i.e. it has the same characteristics/operating parameters (in terms of capacity/autonomy and/or voltage and/or inrush current or others) as the main battery 40.

[0105] In practice, the addition of the auxiliary battery 51 in the housing 115 (to the power supply system of the telehandler 10) increases, preferably doubles, the operating characteristics/parameters (in terms of capacity/autonomy and/or voltage and/or inrush current or others) of the main battery 40, in particular it doubles the autonomy of the telehandler 10.

[0106] In a second embodiment, the auxiliary battery 51 can replace the main battery 40 (to increase the autonomy of the telehandler 10).

[0107] In such a case, the auxiliary battery 51 may have characteristics/operating parameters (in terms of capacity/autonomy and/or voltage and/or inrush current or others) that are greater (e.g. double) or, at the limit, the same as the main battery 40 originally mounted on the telehandler 10.

[0108] For example, the auxiliary battery 51 may be defined as the union of two identical batteries (or battery packs), e.g. individually equal to a main battery 40 originally mounted on the telehandler 10.

[0109] In practice, the auxiliary battery 51 replacing the main battery 40 in the housing 115 increases, preferably doubles, the autonomy of the telehandler 10.

[0110] The auxiliary battery 51 (e.g. Li-ion or other) is rechargeable and/or removable and/or replaceable.

[0111] Preferably, but not limitedly, the auxiliary battery 51 (in addition to being rechargeable either when arranged inside the housing 115, for example through a charging socket located at the external side of the crankcase 110, or outside it, for example in a suitable remote charging station) is configured to be removably housed in the housing 115, i.e., to be arranged in and/or extracted from the housing 115 by passing through the opening 116 described above.

[0112] The case wherein the generator unit 50 comprises (or consists of) an internal combustion engine generating set 52, 53 (provided with a respective alternator) is described hereinafter.

[0113] In this case, the generator unit 50 (i.e. internal combustion engine generating set 52, 53) is used (as *range extender*) exclusively to recharge the main battery 40 (i.e. to extend the autonomy thereof).

[0114] The internal combustion engine generating set 52, 53 is of small displacement, sufficient only for its function of charging the main battery 40 (and is unsuitable for propelling the telehandler 10).

[0115] The internal combustion engine generating set 52, 53 is selected from the group consisting of a diesel engine generating set 52, a petrol engine generating set 52, and a gas engine generating set 53, such as LPG or CNG, e.g. provided with a fixed or removable/replaceable tank for such fuel gas.

[0116] In such an embodiment, the internal combustion engine generating set 52, 53 may be added/addable within the housing 115 (wherein the main battery 40 is already present), e.g. stacked relative thereto with respect to a vertical stacking direction (or placed alongside thereto relative to a horizontal side-by-side direction) or variously arranged within the housing 115.

[0117] In practice, the addition of the internal combustion engine generating set 52, 53 in the housing 115 (to the power system of the telehandler 10) increases (by an amount that is a function of the amount of fuel that can be processed by it with a full refuelling) the operating characteristics/parameters (in terms of capacity/autonomy and/or voltage and/or inrush current or others) of the main battery 40, in particular it increases the autonomy of the telehandler 10.

[0118] The internal combustion engine generating set 52, 53 may be refilled/refuelled (via a filler neck through which the fuel can be introduced into a special tank serving the engine) and/or removable and/or replaceable.

[0119] Preferably, but not limitedly, the internal combustion engine generating set 52, 53 (in addition to being refuellable both when arranged within the housing 115 and outside it) is configured to be removably housed in the housing 115, i.e., to be disposed in and/or extracted from the housing 115 by passing through the opening 116 described above. The case in which the generator unit 50 comprises (or consists of) a fuel cell (electricity-generating) unit 54 is described hereinafter.

[0120] In such a case, the generator unit 50 (i.e. the fuel cell unit 54) is used (as *range extender*) exclusively to recharge the main battery 40 (i.e. to extend autonomy thereof).

[0121] The fuel cell unit 54 comprises at least one fuel cell and a gas (fuel) tank, such as hydrogen or methane and/or methanol, wherein preferably the gas tank is arranged (in a removable/replaceable or fixed manner) internally or externally to an enclosure, which is in turn housed within the housing 115 and which contains the at least one fuel cell in a fixed or removable/replaceable manner.

[0122] In such an embodiment, the fuel cell unit 54 may be added/addable within the housing 115 (wherein the main battery 40 is already present), e.g. stacked relative thereto with respect to a vertical stacking direction (or placed alongside thereto relative to a horizontal side-by-side direction) or variously arranged within the housing 115.

[0123] In practice, the addition of the fuel cell unit 54 in the housing 115 (to the power supply system of the telehandler 10) increases (by an amount that is a function

of the amount of gas, such as hydrogen or methane and/or methanol, processable by it with a full refuelling) the operating characteristics/parameters (in terms of capacity/autonomy and/or voltage and/or inrush current or others) of the main battery 40, in particular it increases the autonomy of the telehandler 10.

[0124] The fuel cell unit 54 may be refilled/refuelled (via a filler neck through which the (fuel) gas can be introduced into the gas tank serving the fuel cell) and/or removable and/or replaceable.

[0125] Preferably, but not limitedly, the fuel cell unit 54 (in addition to being refuellable both when arranged within the housing 115 and outside it) is configured to be removably housed in the housing 115, i.e., to be arranged in and/or extracted from the housing 115 by passing through the opening 116 described above.

[0126] It is possible to provide that more than one generator unit 50 (e.g. of a different nature) can be housed in the housing 115 (as described above), for example an auxiliary battery 51 and an internal combustion engine generating set 52, 53 or a fuel cell unit 54, thereby further increasing the autonomy of the telehandler 10.

[0127] For example, the generating unit 50 is part of a (*retrofitting*) kit to extend the autonomy of a full electric telehandler 10.

[0128] This kit consists of a generator unit selected from the group consisting of an auxiliary battery 51 (as described above), an internal combustion engine generating unit 52, 53 (as described above) and a fuel cell unit (as described above) and a combination thereof.

[0129] More preferably, the kit may consist of at least two elements between an auxiliary battery 51, an internal combustion engine generating set 52, 53 and a fuel cell unit 54 that are interchangeable with each other within the housing 115 of the telehandler 10 and/or otherwise combinable with each other within the housing 115 (such as, for example, the combination of an auxiliary battery 51 and one of an internal combustion engine generating set 52, 53 and a fuel cell unit 54).

[0130] For example, it is possible to provide that the (*retrofitting*) kit comprises both an auxiliary battery 51, an internal combustion engine generating set 52, 53 (e.g. both a diesel engine generating set and a gas engine generating set) and a fuel cell unit 54, and the user can choose which one(s) to use to extend the charge of the main battery 40 of the telehandler 10 according to the contingent needs.

[0131] The telehandler 10 further comprises an electronic control unit 60, which is configured, for example, to control and/or command the operating steps of the telehandler 10.

[0132] The electronic control unit 60, for example, is operationally connected to the electrical connector connectable to the main battery 40 (e.g. via the service/interface line) and/or the connector connectable to the generator unit 50.

[0133] Preferably, the electronic control unit 60 may be

configured to recognise the presence (and the electrical/mechanical connection) in the housing 115 of the generator unit 50 (when an electrical connection thereof is stable with the corresponding electrical connector present in the housing 115) and activate a charging cycle of the main battery 40 and/or the power supply of the electric motor 31 (in the event that the generator unit comprises the auxiliary battery 50) by means of that generator unit 50 (i.e. by switching on/using that generator unit).

[0134] The invention thus conceived is susceptible to several modifications and variations, all falling within the scope of the inventive concept.

[0135] Moreover, all details can be replaced by other technically equivalent elements.

[0136] 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 telehandler (10) comprising:

- a supporting frame (11) with a front section and a rear section to which a crankcase (110) is attached;
- a lifting arm (13) articulated to the rear section of the supporting frame (11) with the ability to rotate around at least one swinging axis;
- two front wheels (12) connected to the front section of the supporting frame (11);
- two rear wheels (12) connected to the rear section of the supporting frame (11);
- at least one electric motor (31) to drive the rotation of the front wheels (12) and/or the rear wheels (12), wherein the electric motor (31) is connected to a main power supply battery (40);
- a housing (115) provided with an opening (116) closed by at least an openable hatch (117) formed at the crankcase (110), wherein the opening (116) is configured to make the housing (115) accessible from outside the crankcase (110), **characterised in that** the housing (115) is configured to house inside thereto the main battery (40), supported by the supporting frame (11), and at least one generator unit (50) used as a charge extender for at least one of the operations selected between charging the main battery (40) and power supplying the electric motor (31), wherein the housing (115) comprises a detachable electrical connector, to which the generator unit (50) and/or the main battery (40) may be detachably connected, and the generator unit (50) and/or the main battery (40) is configured to be arranged in and/or extracted from the housing (115) through the open-

ing (116).

2. The telehandler (10) according to claim 1, wherein the generator unit (50) is selected from the group consisting of an auxiliary battery (51), an internal combustion engine generating set (52, 53) and a fuel cell unit (54) and combinations thereof. 5
3. The telehandler (10) according to claim 2, wherein the auxiliary battery (51) may be added or replaced to the main battery (40). 10
4. The telehandler (10) according to claim 2, wherein the internal combustion engine generating set is selected from the group consisting of a diesel engine generating set (52), a gas engine generating set (53), such as LPG or CNG, a petrol engine generating set (52). 15
5. The telehandler (10) according to claim 2, wherein the fuel cell unit (54) comprises at least one fuel cell and a gas tank, such as hydrogen or methane and/or methanol, wherein preferably the gas tank is fixed or replaceable/removable and arranged internally or externally to an enclosure, which may be housed within the housing (115) and containing the at least one fuel cell in a fixed or removable/replaceable manner. 20 25
6. The telehandler (10) according to claim 1 or 2, wherein the housing (115) comprises at least one air and/or ventilation intake. 30
7. The telehandler (10) according to claim 1, wherein the housing (115) is arranged in a central section of the supporting frame (11) interposed between the front section and the rear section, preferably between the front wheels (12) and the rear wheels (12). 35
8. The telehandler (10) according to claim 1, wherein the hatch (117) is arranged at a sidewall of the crankcase (110), between a front wheel (12) and a rear wheel (12). 40
9. The telehandler (10) according to any of the preceding claims, comprising a driver's cab, preferably placed alongside the lifting arm (13). 45
10. The telehandler (10) according to claims 8 and 9, wherein the hatch (117) is arranged at the sidewall of the crankcase (110) on the opposite side with respect to the sidewall where the driver's cab is arranged. 50

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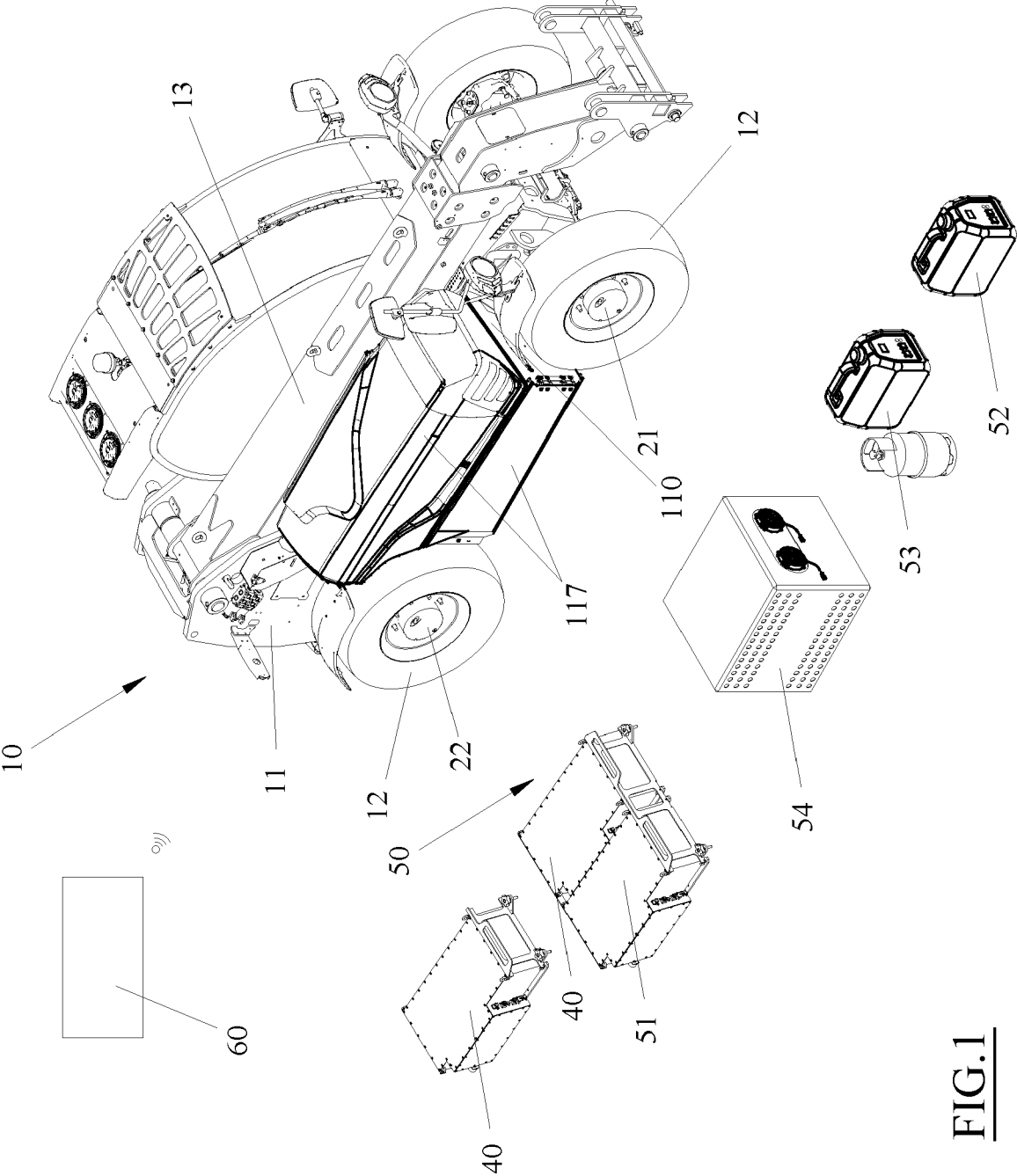


FIG.1

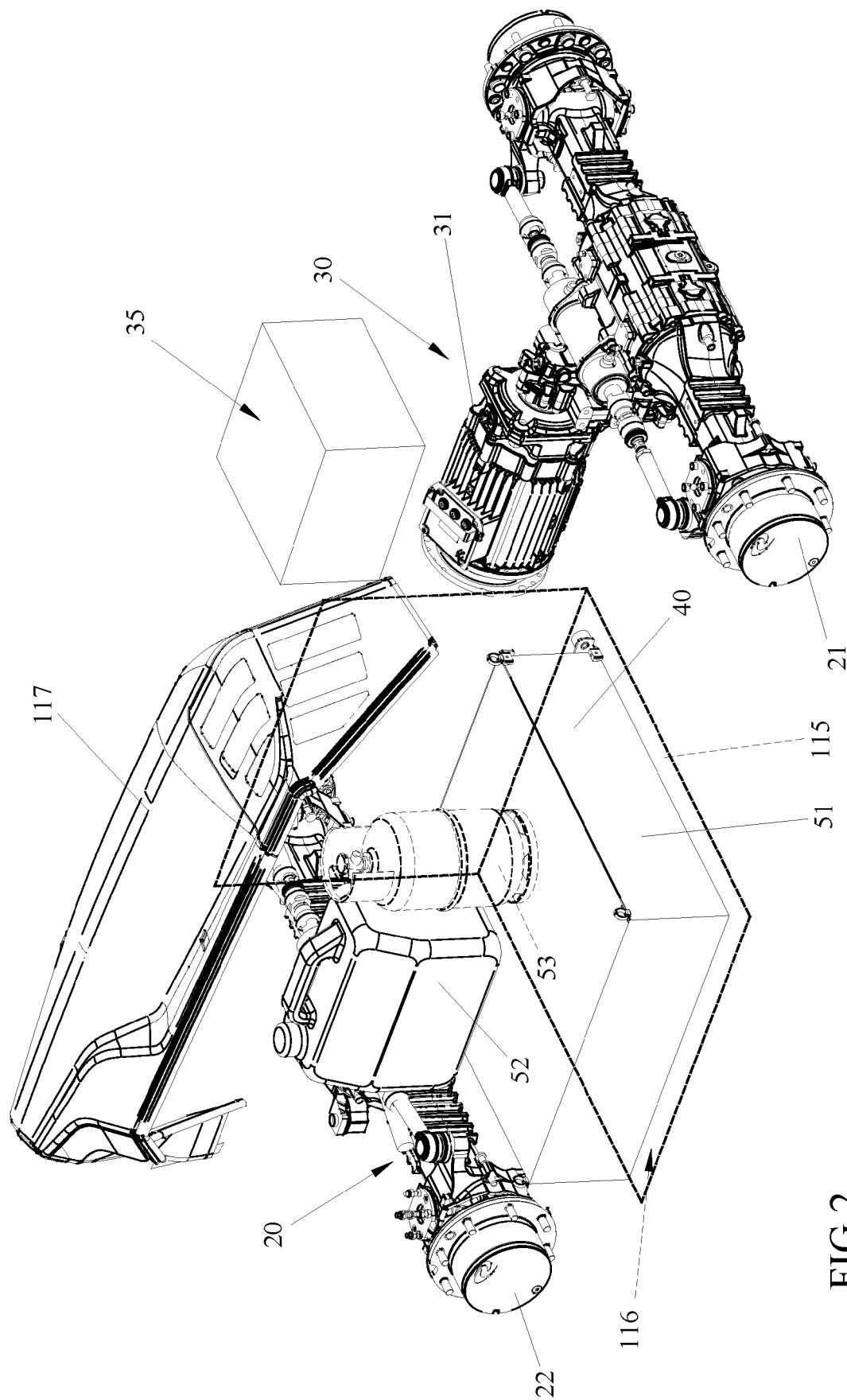


FIG.2

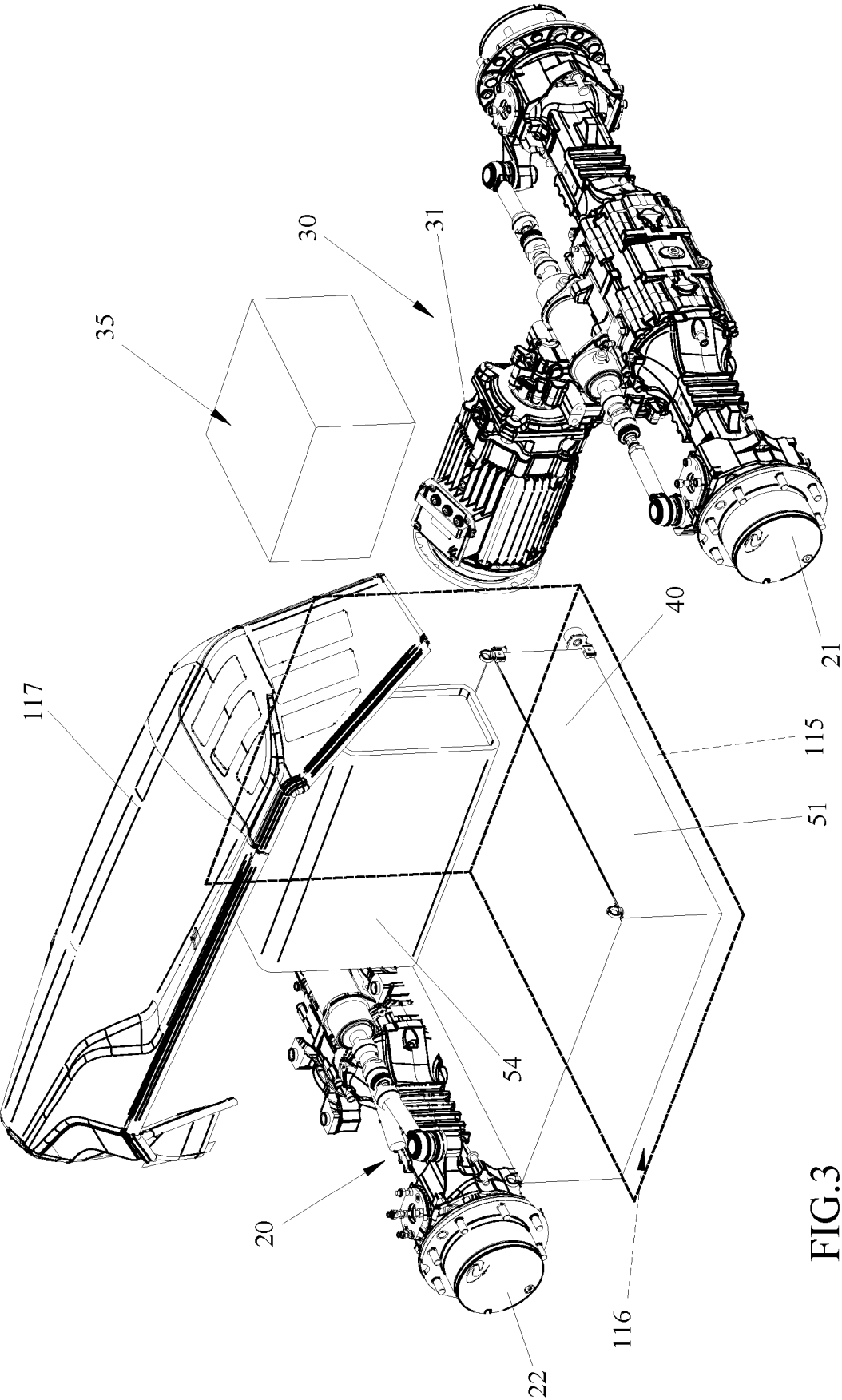


FIG.3



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