(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 4 112 929 A1**

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
04.01.2023 Bulletin 2023/01

(21) Application number: **22182709.0**

(22) Date of filing: **02.07.2022**

(51) International Patent Classification (IPC):
F04B 15/02 *(2006.01)* ***E04G 21/04*** *(2006.01)*
F04B 17/03 *(2006.01)* ***F04B 17/06*** *(2006.01)*
F04B 49/06 *(2006.01)* ***F04B 49/20*** *(2006.01)*

(52) Cooperative Patent Classification (CPC):
F04B 15/02; E04G 21/0436; E04G 21/0445; F04B 17/03; F04B 17/06; F04B 49/06; F04B 49/20

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME
Designated Validation States:
KH MA MD TN

(30) Priority: **02.07.2021 NL 2028622**

(71) Applicant: **RvR Betonpomp B.V.**
3461 AL Linschoten (NL)

(72) Inventor: **Van Rijs, Hendrik**
3461 AL Linschoten (NL)

(74) Representative: **van der Maarl, Arjan**
Gemeas Patents
Belleperenlaan 18
3452 EV Utrecht (NL)

(54) MOBILE CONCRETE PUMP

(57) The invention relates to a trailer assembly (100) comprising: a concrete pump (110) arranged for pumping liquid concrete and having a pumping speed; an electric motor (135) arranged for driving the concrete pump; a battery (130); an adaptive electrical controller (140) for converting a battery current from the battery to a motor current powering the electric motor; and an input configured for receiving a setting for adapting the motor current for controlling the pumping speed.

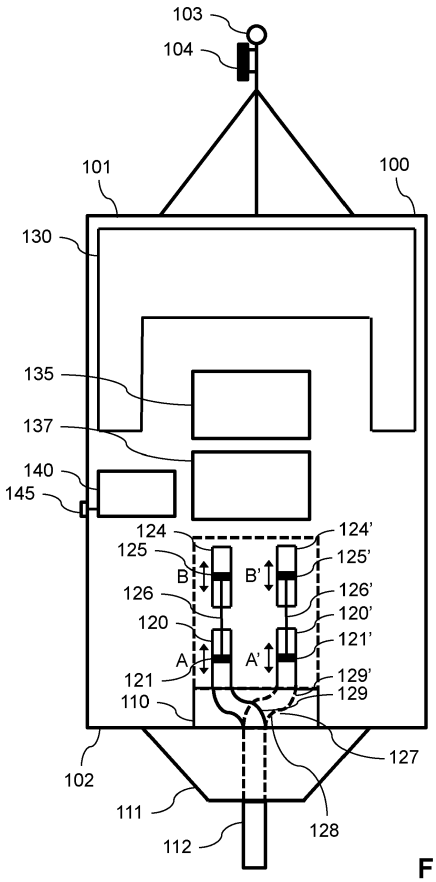

Fig. 1

EP 4 112 929 A1

Description

FIELD OF THE INVENTION

[0001] The invention relates to a trailer assembly comprising a concrete pump. The invention more specifically relates to a trailer assembly comprising an electrically powered concrete pump. The invention also relates to a method for a mobile concrete pump. The invention also relates to use of a trailer assembly comprising a concrete pump.

BACKGROUND OF THE INVENTION

[0002] Concrete pumps are machines for transporting liquid concrete by pumping. There are mainly two types of concrete pumps. The first type of concrete pump is built on top of a truck or semi-trailer. Typically, these types of concrete pumps have a boom extending from the truck or semi-trailer. The second type of concrete pump is built on top of a truck or mounted on a trailer. This second type is commonly referred to as a line pump. The concrete pump requires attaching a steel or flexible hose to the outlet of the machine. Typically, multiple coupled hoses are used to transport the liquid over the distance to the pouring location.

[0003] CN208329635 discloses a trailer concrete pump car, wherein the sensors and control box are powered by a car battery. A disadvantage of CN208329635 is that the car battery is not powerful enough to power the concrete pump.

[0004] CN211950768 discloses a hybrid system applying a diesel engine power supply and a battery power supply for powering the concrete pump. In CN211950768 the flow of concrete is adapted by changing the transmission in the gear box driving the concrete pump.

[0005] US4,298,288 discloses a mobile concreting apparatus and method which may be used, in particular, for on-site construction of swimming pools. It includes a vehicle supporting a plurality of containers, each adapted to contain one of the ingredients of concrete. Each container is provided with its own ingredient feeder which feeds the ingredients to a mixing device mounted on the vehicle to create a concrete slurry. The slurry is transferred from the mixing device to the surface to be coated by a structure including a slurry pump, a hose and a nozzle. Each ingredient feeder can be individually varied in the rate at which it feeds its ingredient so that the relative composition of the slurry, and the flow rate of the slurry, can be rapidly and selectively varied on the job site to meet the particular requirements for each job. In addition, feed rate settings which provide a desirable composition and overall feed rate can be noted and reproduced on subsequent occasions when the same composition and feed rate are desired. The disclosed mobile concreting apparatus uses a diesel engine for driving the concreting apparatus.

[0006] WO 2020/078040 A1 discloses a pump truck, comprising a battery assembly (12), an engine (14), and a power supply interface. Wherein the battery assembly (12) is connected to a motor module for driving the motor module; the engine (14) is connected to a walking driving axle (18); the power supply interface is connected to the battery assembly (12) and/or the motor module, in order to connect an external power source; and the motor module is used for supplying power to at least one of a main oil pump (16), an arm bracket pump (28), a water washing pump, turntable rotation, a cooling fan and a stirring mechanism of the pump truck. By the engine (14), the battery assembly (12) and the power supply interface, the pump truck realizes the effect that the pump mick is driven to operate by hybrid power.

SUMMARY OF THE INVENTION

[0007] An object of the invention is to overcome one or more of the disadvantages mentioned above.

[0008] According to a first aspect of the invention, a trailer assembly comprising:

- a concrete pump arranged for pumping liquid concrete and having a pumping speed;
- an electric motor arranged for driving the concrete pump;
- a battery;
- an adaptive electrical controller for converting a battery current from the battery to a motor current powering the electric motor; and
- an input configured for receiving a setting for adapting the motor current for controlling the pumping speed.

[0009] A trailer assembly may be a trailer with additional items placed on top of or integrated in the trailer. The items placed on top of the trailer are typically coupled or jointed to the trailer. These couplings or joints may have a more permanent character or may be releasable. A trailer may be any mobile object that can be placed behind a pulling vehicle, such as a car, a lorry, a van, or the like. A trailer may have a towing hook coupling with the pulling vehicle. In more specific cases the trailer may move under its own power, such as small distances under own power. In more generalised context, the invention may be generalised such that the features of the invention may also be placed on a vehicle, such as a lorry. In this generalised case, the invention is typically placed on a vehicle wherein the driving power of the vehicle

is obtained from an electrical battery, such as the same battery used as part of the invention.

[0010] The concrete pump is typically used to transport liquid concrete from an accessible location accessible to devices providing the liquid concrete to a less accessible location or a moving location where the liquid concrete is used as building material. The accessible location is typically accessible by a larger truck transporting the liquid concrete to the build location. The accessible location may also be a location where the liquid concrete is mixed or produced on site. The less accessible or moving location is the location where the liquid concrete is poured. This location typically moves around as the liquid concrete is in general not poured or needed at one location all the time. The liquid concrete is typically transported between the concrete pump and the less accessible or moving location with a pipe or tube. This pipe or tube has typically at least some flexible sections for easily adapting the location of the outflow of liquid concrete from the pipe or tube. The concrete pump pumps the liquid concrete with a pumping speed pushing the liquid concrete through the pipe or tube with this speed. The concrete pump may provide a pulsed pumping or periodical pumping of the liquid concrete, typically in this case the pumping speed is an average speed of the liquid concrete. The trailer assembly, more specifically the concrete pump, may be typed as a line pump.

[0011] The electric motor may be directly coupled to the concrete pump. The electric motor may have an axis providing a mechanical rotating force based on the electrical power provided to the electrical motor. The axis may be coupled to the concrete pump for pumping based on the rotation of the axis. Alternatively, the electric motor may be indirectly coupled to the concrete pump. As an example, the electric motor may have an axis providing a mechanical rotating force based on the electrical power provided to the electrical motor. The rotational force may be provided to a hydraulic system which may comprise a hydraulic pump and hydraulic valves converting the rotational force to a hydraulic force. The hydraulic system may in turn drive the concrete pump. Other indirect couplings between the electric motor and the concrete pump are envisioned.

[0012] The battery is an electric battery for storing and providing electrical power to an application. A battery storing electrical power is charging. A battery providing electrical power is discharging. A battery may comprise multiple electrical cells. The electrical cells may be regulated independent from each other. A battery management system may be present to manage or control the charging and discharging of the battery.

[0013] An adaptive electrical controller is arranged for converting a battery current from the battery to a motor current powering the electric motor. The battery current typically is a DC current at a particular voltage. This voltage may differ over time. Also, the electrical motor may not be suitable for receiving a DC current at that particular voltage or may not operate efficiently at that particular voltage. The adaptive electrical controller converts the battery current to a motor current having the properties to let the electrical motor run, such as rotate, at a particular speed and/or with a particular torque. When the adaptive electrical controller provides an AC current, the motor current may have one or more of the characteristics of a particular frequency, peak current, effective current and/or even a particular shape, such as sinusoidal, stepped, square, triangular or sawtooth shape. When the adaptive electrical controller provides a DC current, the motor current may have one or more of the characteristics of a particular voltage, and/or current level. The preceding characteristics are merely examples of the characteristics of the motor current that may be adapted by the electrical controller.

[0014] The input of the trailer assembly is configured for receiving a setting. This setting may be inputted through one or more of a touch display input, keyboard, lever, push-button, switch. This input is provided to the adaptive electrical controller. This input allows to adapt, change or manipulate one or more of the characteristics of the motor current outputted by the adaptive electrical controller. The adapted motor current characteristic adapts the electric motor, such that the running of the electric motor is adapted. This adaptation of the running of the electric motor may result in that the electric motor rotates faster or slower. The electric motor in turn drives the concrete pump. The adaptation of the running of the electric motor adapts the pumping speed of the concrete pump. Therefore, the input provides control over the volume of the concrete pumped over time. An advantage of the invention is that the electrification of the drive of the concrete pump, more specific the combination of features as presented, provides enhanced control over the pumped concrete volume over time. A further advantage is that the emission, such as exhaust fumes, of the trailer assembly is reduced or more or less void or null.

[0015] According to another aspect of the invention a method for a mobile concrete pump comprising the steps of:

- converting a battery current from a battery to a motor current powering an electric motor;
- driving the mobile concrete pump with the electric motor;
- pumping liquid concrete with the mobile concrete pump having a pumping speed;
- receiving a setting; and
- adapting the motor current for controlling the pumping speed based on the setting. The method provides the advantages as mentioned for the trailer assembly.

[0016] According to another aspect of the invention the use of a concrete pump according to any of the embodiments described throughout the description. The use provides the advantages as mentioned for the trailer assembly.

DETAILED DESCRIPTION OF EXEMPLARY EMBODIMENTS

[0017] In an embodiment of the trailer assembly, the adaptive electrical controller is a frequency generator; the electric motor is an AC motor; the motor current is an AC current having a frequency; and the input is arranged for receiving a frequency setting for setting the frequency of the AC current. AC motors are readily available. Regulating the frequency of the motor current provides improved control over the pumping speed.

[0018] In an embodiment of the trailer assembly, the AC motor is a synchronous AC motor. A synchronous AC motor improves the coupling between the set frequency of the motor current and the rotational speed of the axis of the AC motor. The pumping speed is based on the rotational speed of the AC motor. Thus, the improved control over the rotational speed provides improved control over the pumping speed.

[0019] In an embodiment of the trailer assembly, the trailer assembly is arranged for being towed by a car, a van, or a lorry. The arrangement for towing may comprise a towing hook. This advantageously provides improved flexibility of use of the trailer assembly.

[0020] In an embodiment of the trailer assembly, the trailer assembly comprises wheels, preferably joined by an axle, and a towing hook; the battery has a centre point of gravity; and the centre point of gravity of the battery is arranged between the towing hook and the wheels, preferably between the axle and the towing hook. The battery is typically one of the major components of the trailer assembly contributing to the weight of the trailer assembly. The centre point of gravity of the battery is typically arranged such that the battery advantageously contributes positively to the noise weight of the trailer assembly.

[0021] The trailer assembly typically has a stationary condition and a nonstationary condition. In the stationary condition, the trailer assembly is stationary and the concrete pump may be operated. In the nonstationary condition, the trailer assembly is towable and/or moveable from one place to the other, typically by a pulling vehicle, such as a car, lorry and/or van. The concrete pump of the trailer assembly is typically fed from an outside source with concrete, which is then pumped by the concrete pump.

[0022] In an embodiment of the trailer assembly, the battery has a U-shape having a base arranged proximal to the towing hook and legs extending towards or beyond the wheels, preferably in a substantially horizontal direction and/or preferably beyond the axle. The U-shape allows for other components of the trailer assembly to be arranged inside the U-shape. Furthermore, the U-shape allows the battery to be arranged along the circumference of the trailer assembly. Arranging the battery along the circumference of the trailer assembly provides the advantage of decreased thermal resistance with the environment providing for enhanced preventing overheating of the battery, typically in use.

[0023] In an embodiment of the trailer assembly, the concrete pump comprises a hopper arranged for receiving concrete to be pumped; and at least the hopper, preferably the concrete pump, is arranged on a side of the wheels, preferably the axle, distal from the towing hook. More preferably, the at least one hopper is arranged at a distal end of the trailer assembly distal from the towing hook. The hopper according to this embodiment is arranged advantageously arranged such that the liquid cement is easily poured in the hopper. Furthermore, this arrangement allows a liquid concrete providing device, such as a dump truck, to be placed inline with the trailer for advantageously allowing the complete set of trailer assembly and liquid concrete providing device to be arranged on the side of a road allowing other traffic to pass. Also, by arranging the hopper distal from the towing hook, the liquid concrete providing device can advantageously be arranged close or even over the hopper, as the towing hook is not in the way. Further, this embodiment balances the battery near the towing hook with the concrete pump at the other end of the wheels, preferably axis or axle.

[0024] In a further embodiment of the trailer assembly, the towing hook has a nose weight; the hopper is arranged for holding an amount of concrete residue; and the centre point of gravity of the battery is arranged such that despite of the amount of concrete residue the nose weight is at least 0 kg, preferably 10 kg, more preferably 20 kg, most preferably 25 kg, and/or at most 150 kg, preferably 125 kg, more preferably 100 kg, even more preferably 75 kg, most preferably 50 kg. The nose weight is advantageously within the legal limits for roadworthy trailers in all countries, such as most countries. A nose weight in the range specified allows to easily handle the trailer assembly with a single person. A nose weight in the range specified allows the application of a nose wheel which may be simple and lightweight and therefore easily adjustable.

[0025] In an embodiment of the trailer assembly, the trailer assembly has a weight of less than 5,000 kg, preferably 4,500 kg, more preferably 4,000kg, most preferably 3,500 kg. The electric motor is typically sized and/or dimensioned depending on the concrete pump. The battery is typically sized and/or dimensioned depending on the electric motor and/or the total time the concrete pump needs to operate without recharging. The battery of the trailer assembly is typically sufficient for providing power to the trailer assembly for one working day. The battery is typically recharged during out-of-office hours, such as during the evening and night. The total weight of the trailer assembly is typically substantially determined by the summation of the weight of the battery, electric motor and the concrete pump. Therefore, the sizing and capacity of the battery is such that the trailer assembly can operate a full working day and/or a substantial part of a working day.

[0026] In an embodiment of the trailer assembly, the concrete pump comprises: a pair of concrete cylinders arranged

for receiving liquid concrete in the pair of concrete cylinders; a pair of concrete pistons each concrete piston arranged for travelling inside a respective one of the pair of concrete cylinders and arranged for sucking liquid concrete into the concrete cylinder and pressing liquid concrete out of the concrete cylinder based on the motor current; and a pipe valve arranged for receiving the liquid concrete pressed out of the respective one of the pair of concrete pistons. This embodiment advantageously provides a rugged and/or dependable concrete pump. Typically, the pair of concrete pistons is configured to alternate. This embodiment advantageously allows to continuously or substantially continuously pump liquid concrete out of the concrete pump. The flow of liquid concrete is only briefly interrupted when the pipe valve switches from one concrete cylinder to the other concrete cylinder.

[0027] In an embodiment of the trailer assembly, the pipe valve has a first position receiving the liquid concrete pressed out of one of the pair of concrete cylinders and a second position receiving the liquid concrete pressed out of the other of the respective pair of concrete cylinders; and the concrete pump comprises a controller configured for controlling the position of the pipe valve. Typically, the pair of concrete pistons is configured to alternate inside the concrete cylinders with concrete pistons moving in opposite directions. This embodiment advantageously allows to continuously or substantially continuously pump liquid concrete out of the concrete pump. The flow of liquid concrete typically is only briefly interrupted when the pipe valve switches from one concrete cylinder to the other concrete cylinder.

[0028] In an embodiment of the trailer assembly, the pipe valve comprises an S-shaped tube having a first end swingable from a first position to a second position, and a second end at a stable position for coupling to a transport tube for transporting concrete to a site for pouring the liquid concrete. The S-shaped tube provides the advantage that only one end of the pipe valve swings, while the other end is stationary allowing a stable output of the trailer assembly. As the output of the trailer assembly is stable, a stiff and/or rugged pipe may be coupled to the output for transporting the liquid concrete to a site, such as a remote site, where the liquid concrete is poured and sets.

[0029] In an embodiment of the trailer assembly, the trailer assembly comprises: a pair of conveying cylinders; a pair of conveying pistons wherein each conveying piston arranged for travelling inside a respective one of the pair of conveying cylinders based on the motor current; a pair of conveying rods functionally coupling each of the conveying pistons to a respective one of the pair of concrete pistons; and a hydraulic system arranged for converting the rotational mechanical power from the AC motor to hydraulic power driving the pair of conveying pistons for driving the concrete pump. Hydraulic power advantageously provides the ease of coupling the electric power with the concrete pump. Hydraulic power advantageously allows to convert the rotational power of the electric motor to translational power for the cylinders, such as the conveying cylinders. The hydraulic system, preferably comprising hydraulic valves, advantageously allows to configure the hydraulic system to alternate the conveying pistons for alternating the concrete pistons. The respective conveying cylinder is typically aligned with a respective concrete cylinder for allowing a respective conveying piston to be functionally coupled with a respective concrete piston by a respective conveying rod, which may be a straight rod or bar.

[0030] In an embodiment of the trailer assembly, the trailer assembly comprises a battery management system comprising: an output port arranged for providing electrical power to the electrical motor; a battery port arranged for charging and discharging the battery; and an external port arranged for receiving electrical power from an external source; wherein the battery management system is configured for depending on the received electrical power and while providing electrical power charging, discharging, holding stable the battery. The trailer assembly equipped with the external port advantageously allows to charge the battery and/or power the electric motor. Furthermore, the external port may advantageously also support the battery powering the electric motor when pumping concrete. The battery may therefore be advantageously selected smaller while still powering the electric motor for a predefined time, such as a complete working day. The trailer assembly may as a result be lighter due to the presence of the external port.

[0031] In an embodiment of the method for a trailer assembly, the method comprises the steps of: providing a trailer; arranging the mobile concrete pump, the electric motor, the battery, and the adaptive electrical controller on the trailer. This method is effectively constructing the trailer assembly.

BRIEF DESCRIPTION OF THE DRAWINGS

[0032] The invention will be apparent from and elucidated further with reference to the embodiments described by way of example in the following description and with reference to the accompanying drawings, in which:

Figure 1 schematically shows a top view of an embodiment of a trailer assembly;
Figure 2 schematically shows a side view of an embodiment of a trailer assembly;
Figure 3 schematically shows a front view of an embodiment of a trailer assembly; and
Figure 4 schematically shows a perspective view of an embodiment of a trailer assembly.

[0033] The figures are purely diagrammatic and not drawn to scale. In the figures, elements which correspond to elements already described may have the same reference numerals.

LIST OF REFERENCE NUMERALS

100	trailer assembly
101	fronts ide
102	backside
103	tow hook
104	nose wheel
105, 105’	front wheel
106	front axle
107, 107’	rear wheel
108	rear axle
109	base
110	concrete pump
111	hopper
112	outflow pipe
120, 120’	concrete cylinder
121, 121’	concrete piston
124, 124’	conveying cylinder
125, 125’	conveying piston
126, 126’	rod
127	concrete valve
128	S-shaped part
129	S-shaped part in first position
129’	S-shaped part in second position
130	battery
135	electric motor
137	hydraulic system
140	adaptive electrical controller
145	input
A, A’	direction of travel of the concrete pistons
B, B’	direction of travel of the conveying pistons

DETAILED DESCRIPTION OF THE FIGURES

[0034] The following figures may detail different embodiments. Embodiments can be combined to reach an enhanced or improved technical effect. These combined embodiments may be mentioned explicitly throughout the text, may be hint upon in the text or may be implicit.

[0035] Figure 1 schematically shows a top view of an embodiment of a trailer assembly 100. The trailer assembly comprises a concrete pump 110, an electric motor 135, a battery 130, an adaptive electrical controller 140, and an input 145.

[0036] The concrete pump is arranged for pumping liquid concrete. The concrete pump has a pumping speed. The electric motor is arranged for driving the concrete pump. This driving may be direct or indirect via another system. The adaptive electrical controller is arranged for converting a battery current from the battery to a motor current powering the electric motor. The input is configured for receiving a setting for adapting the motor current for controlling the pumping

speed. The trailer assembly provides the advantage of an improved control over the pumping speed. Furthermore, the trailer assembly does not produce any exhaust fumes and is therefore advantageously suitable for use in urban environments having environmental restrictions, such as limitations or even prohibiting expelling exhaust fumes.

[0037] The trailer assembly typically has a front side 101 and a back side 102. At the front side a tow hook 103 and a nose wheel 104 may be arranged. When the tow hook is not hooked to a towing vehicle, the nose wheel may be arranged to carry the nose weight. The concrete pump may advantageously be arranged at the back side. This arrangement provides the advantage that liquid concrete may be provided to the concrete pump by a vehicle, such as a liquid concrete truck, parked directly behind the trailer assembly, such that the vehicle and the trailer assembly occupy a slender and/or small area.

[0038] The concrete pump may comprise a hopper 111, an outflow pipe 112, a first concrete cylinder 120, a second concrete cylinder 120', a first concrete piston 121, a second concrete piston 121', and a concrete valve 127. The first concrete piston is arranged in the first concrete cylinder for travelling up and down the cylinder in a direction A for sucking concrete into the cylinder and pushing concrete out of the first concrete cylinder. The second concrete piston is arranged in the second concrete cylinder for travelling up and down the cylinder in a direction A' for sucking concrete into the cylinder and pushing concrete out of the second concrete cylinder. The concrete pistons are typically arranged to move in opposite directions. The concrete valve typically is synchronised with the motion of the concrete pistons to allow an outflow out of one of the concrete cylinders to flow into the outflow pipe and typically at the same time allows an inflow into the other of the concrete cylinders to flow form the hopper. The concrete valve 127 may comprise an S-shaped part 128. The S-shaped part may have a first end rotationally coupled to the outflow pipe. The S-shaped part may have a second end having a first position 129 indicated with a solid line and a second position 129' indicated with a dashed line. In the first position, the S-shaped part is coupled with the output of the first concrete cylinder for receiving an outflow of liquid concrete and directing this outflow to the outflow pipe. In the first position, the output of the second concrete cylinder is not coupled to the S-shaped part. In this position any liquid concrete sucked in into the second cylinder comes from the hopper. In the second position, the S-shaped part is coupled with the output of the second concrete cylinder for receiving an outflow of liquid concrete and directing this outflow to the outflow pipe. In the second position, the output of the first concrete cylinder is not coupled to the S-shaped part. In this position any liquid concrete sucked in into the first cylinder comes from the hopper. This arrangement of the concrete pump provides the advantage of a more continuous flow of liquid concrete with minimized interruption of the flow. Together with the input, this concrete valve provides an optimization of liquid concrete flow and/or liquid concrete pumping speed particularly at lower flows and/or pumping speeds.

[0039] The concrete pump may further comprise a first conveying cylinder 124, a second conveying cylinder 124', a first conveying piston 125, a second conveying cylinder 125', a first rod 126, and a second rod 126'. The first conveying piston is arranged in the first conveying cylinder for travelling up and down the cylinder in a direction B. The second conveying piston is arranged in the second conveying cylinder for travelling up and down the cylinder in a direction B'. The conveying pistons are typically arranged to move in opposite directions. The first conveying piston is via the first rod mechanically coupled to the first concrete piston for synchronously moving up and down. The second conveying piston is via the first rod mechanically coupled to the second concrete piston for synchronously moving up and down. The trailer assembly may comprise a hydraulic system 137. The conveying cylinders may be powered by the electric motor via the hydraulic system, hence indirectly.

[0040] The input is typically user operable. The input may be a lever, one or more buttons, a slider, or the like for receiving from the user and providing a setting to the adaptive electrical controller for adapting the motor current for controlling the pumping speed of the concrete pump. This input provides the enhanced control over the pumping speed as mentioned throughout the text.

[0041] Figure 2 schematically shows a side view of an embodiment of a trailer assembly 100. This may be the same trailer assembly as shown in Figure 1 except for that the towing hook is left out of Figure 2. The trailer assembly has a frontside 102. The trailer assembly may comprise a base 109, a first wheel 105, a second wheel 105', and an axle 106. The axle joins the first wheel and the second wheel. The axle may further be coupled to the base. The base may provide a support and installation surface for most of or even all the other features of the trailer assembly. The double axle configuration provides the advantage of more stability or control over the nose weight for a wider range of weight or momentum of the concrete residue that may be left in the hopper between uses and especially during transport of the trailer assembly.

[0042] Figure 3 schematically shows a front view of an embodiment of a trailer assembly. This may be the same trailer assembly as shown in Figure 1 and/or 2 except for that the towing hook is left out of Figure 3. The trailer assembly has a frontside 102. The trailer assembly may comprise a base 109, a front first wheel 105, and a first rear wheel 107. Not shown are the second front wheel 105' and the front axle 106 joining them. Not shown are the second rear wheel 107' and the rear axle 108 joining them. The axles may further be coupled to the base. The base may provide a support and installation surface for most of or even all the other features of the trailer assembly.

[0043] Figure 4 schematically shows a perspective view of an embodiment of a trailer assembly. This may be the

same trailer assembly as shown in Figure 1, 2, and/or 3 except for that the towing hook is left out of Figure 4. The trailer assembly has a frontside 102. The trailer assembly may comprise a base 109, a front second wheel 105', and a second rear wheel 107'. Not shown are the first front wheel 105 and the front axle 106 joining them. Not shown are the first rear wheel 107 and the rear axle 108 joining them. The axles may further be coupled to the base. The base may provide a support and installation surface for most of or even all the other features of the trailer assembly.

[0044] Examples, embodiments or optional features, whether indicated as nonlimiting or not, are not to be understood as limiting the invention as claimed. It should be noted that the figures are purely diagrammatic and not drawn to scale. In the figures, elements which correspond to elements already described may have the same reference numerals.

[0045] The term "substantially" herein, such as in "substantially all emission" or in "substantially consists", will be understood by the person skilled in the art. The term "substantially" may also include embodiments with "entirely", "completely", "all", etc. Hence, in embodiments the adjective substantially may also be removed. Where applicable, the term "substantially" may also relate to 90% or higher, such as 95% or higher, especially 99% or higher, even more especially 99.5% or higher, including 100%. The term "comprise" includes also embodiments wherein the term "comprises" means "consists of.

[0046] The term "functionally" will be understood by, and be clear to, a person skilled in the art. The term "substantially" as well as "functionally" may also include embodiments with "entirely", "completely", "all", etc. Hence, in embodiments the adjective functionally may also be removed. When used, for instance in "functionally parallel", a skilled person will understand that the adjective "functionally" includes the term substantially as explained above. Functionally in particular is to be understood to include a configuration of features that allows these features to function as if the adjective "functionally" was not present. The term "functionally" is intended to cover variations in the feature to which it refers, and which variations are such that in the functional use of the feature, possibly in combination with other features it relates to in the invention, that combination of features is able to operate or function. For instance, if an antenna is functionally coupled or functionally connected to a communication device, received electromagnetic signals that are receives by the antenna can be used by the communication device. The word "functionally" as for instance used in "functionally parallel" is used to cover exactly parallel, but also the embodiments that are covered by the word "substantially" explained above. For instance, "functionally parallel" relates to embodiments that in operation function as if the parts are for instance parallel. This covers embodiments for which it is clear to a skilled person that it operates within its intended field of use as if it were parallel.

[0047] Furthermore, the terms first, second, third and the like in the description and in the claims, are used for distinguishing between similar elements and not necessarily for describing a sequential or chronological order. It is to be understood that the terms so used are interchangeable under appropriate circumstances and that the embodiments of the invention described herein are capable of operation in other sequences than described or illustrated herein.

[0048] The devices or apparatus herein are amongst others described during operation. As will be clear to the person skilled in the art, the invention is not limited to methods of operation or devices in operation.

[0049] It should be noted that the above-mentioned embodiments illustrate rather than limit the invention, and that those skilled in the art will be able to design many alternative embodiments without departing from the scope of the appended claims. In the claims, any reference signs placed between parentheses shall not be construed as limiting the claim. Use of the verb "to comprise" and its conjugations does not exclude the presence of elements or steps other than those stated in a claim. The article "a" or "an" preceding an element does not exclude the presence of a plurality of such elements. The invention may be implemented by means of hardware comprising several distinct elements, and by means of a suitably programmed computer. In the device or apparatus claims enumerating several means, several of these means may be embodied by one and the same item of hardware. The mere fact that certain measures are recited in mutually different dependent claims does not indicate that a combination of these measures cannot be used to advantage.

[0050] The invention further applies to an apparatus or device comprising one or more of the characterising features described in the description and/or shown in the attached drawings. The invention further pertains to a method or process comprising one or more of the characterising features described in the description and/or shown in the attached drawings.

[0051] The various aspects discussed in this patent can be combined in order to provide additional advantages. Furthermore, some of the features can form the basis for one or more divisional applications.

Claims

1. Trailer assembly (100) comprising:

- a concrete pump (110) arranged for pumping liquid concrete and having a pumping speed;
- an electric motor (135) arranged for driving the concrete pump;
- a battery (130);
- an adaptive electrical controller (140) for converting a battery current from the battery to a motor current

powering the electric motor; and
- an input (145) configured for receiving a setting for adapting the motor current for controlling the pumping speed.

2. Trailer assembly according to the preceding claim,

wherein the adaptive electrical controller is a frequency generator;
wherein the electric motor is an AC motor;
wherein the motor current is an AC current having a frequency; and
wherein the input is arranged for receiving a frequency setting for setting the frequency of the AC current.

3. Trailer assembly according to any of the preceding claims, wherein the AC motor is a synchronous AC motor.

4. Trailer assembly according to any of the preceding claims, wherein the trailer assembly is arranged for being towed by a car, a van, or a lorry.

5. Trailer assembly according to the preceding claim,

wherein the trailer assembly comprises wheels, preferably joined by an axle (106, 108), and a towing hook (103);
wherein the battery has a centre point of gravity; and
wherein the centre point of gravity of the battery is arranged between the towing hook and the wheels, preferably between the axle and the towing hook.

6. Trailer assembly according to the preceding claim, wherein the battery has a U-shape having a base arranged proximal to the towing hook and legs extending towards or beyond the wheels, preferably in a substantially horizontal direction and/or preferably beyond the axle.

7. Trailer assembly according to any of the preceding claims 5-6,

wherein the concrete pump comprises a hopper arranged for receiving concrete to be pumped; and
wherein at least the hopper, preferably the concrete pump, is arranged on a side of the wheels, preferably the axle, distal from the towing hook.

8. Trailer assembly according to the preceding claim,

wherein the towing hook has a nose weight;
wherein the hopper is arranged for holding an amount of concrete residue; and
wherein the centre point of gravity of the battery is arranged such that despite of the amount of concrete residue the nose weight is at least 0 kg, preferably 10 kg, more preferably 20 kg, most preferably 25 kg, and/or at most 150 kg, preferably 125 kg, more preferably 100 kg, even more preferably 75 kg, most preferably 50 kg.

9. Trailer assembly according to any of the preceding claims, wherein the concrete pump comprises:

- a pair of concrete cylinders arranged for receiving liquid concrete in the pair of concrete cylinders;
- a pair of concrete pistons, wherein each concrete piston arranged for travelling inside a respective one of the pair of concrete cylinders and arranged for sucking liquid concrete into the concrete cylinder and pressing liquid concrete out of the concrete cylinder based on the motor current; and
- a pipe valve arranged for receiving the liquid concrete pressed out of the respective one of the pair of concrete pistons.

10. Trailer assembly according to the preceding claim,

wherein the pipe valve has a first position receiving the liquid concrete pressed out of one of the pair of concrete cylinders and a second position receiving the liquid concrete pressed out of the other of the respective pair of concrete cylinders; and
wherein the concrete pump comprises a controller configured for controlling the position of the pipe valve.

11. Trailer assembly according to the preceding claim, wherein the pipe valve comprises an S-shaped tube having a first end swingable from a first position to a second position, and a second end at a stable position for coupling to

a transport tube for transporting concrete to a site for pouring the liquid concrete.

12. Trailer assembly according to any of the preceding claims 9-11, comprising:

- a pair of conveying cylinders;
- a pair of conveying pistons wherein each conveying piston arranged for travelling inside a respective one of the pair of conveying cylinders based on the motor current;
- a pair of conveying rods functionally coupling each of the conveying pistons to a respective one of the pair of concrete pistons; and
- a hydraulic system arranged for converting the rotational mechanical power from the AC motor to hydraulic power driving the pair of conveying pistons for driving the concrete pump.

13. Trailer assembly according to any of the preceding claims, comprising a battery management system comprising:

- an output port arranged for providing electrical power to the electrical motor;
- a battery port arranged for charging and discharging the battery; and
- an external port arranged for receiving electrical power from an external source;

wherein the battery management system is configured for depending on the received electrical power and while providing electrical power charging, discharging, holding stable the battery.

14. Method for a mobile concrete pump comprising the steps of:

- converting a battery current from a battery to a motor current powering an electric motor;
- driving the mobile concrete pump with the electric motor;
- pumping liquid concrete with the mobile concrete pump having a pumping speed;
- receiving a setting; and
- adapting the motor current for controlling the pumping speed based on the setting;

wherein the method preferably further comprises the steps of:

- providing a trailer;
- arranging the mobile concrete pump, the electric motor, the battery, and the adaptive electrical controller on the trailer.

15. Use of a concrete pump according to any of the preceding claims 1- 13.

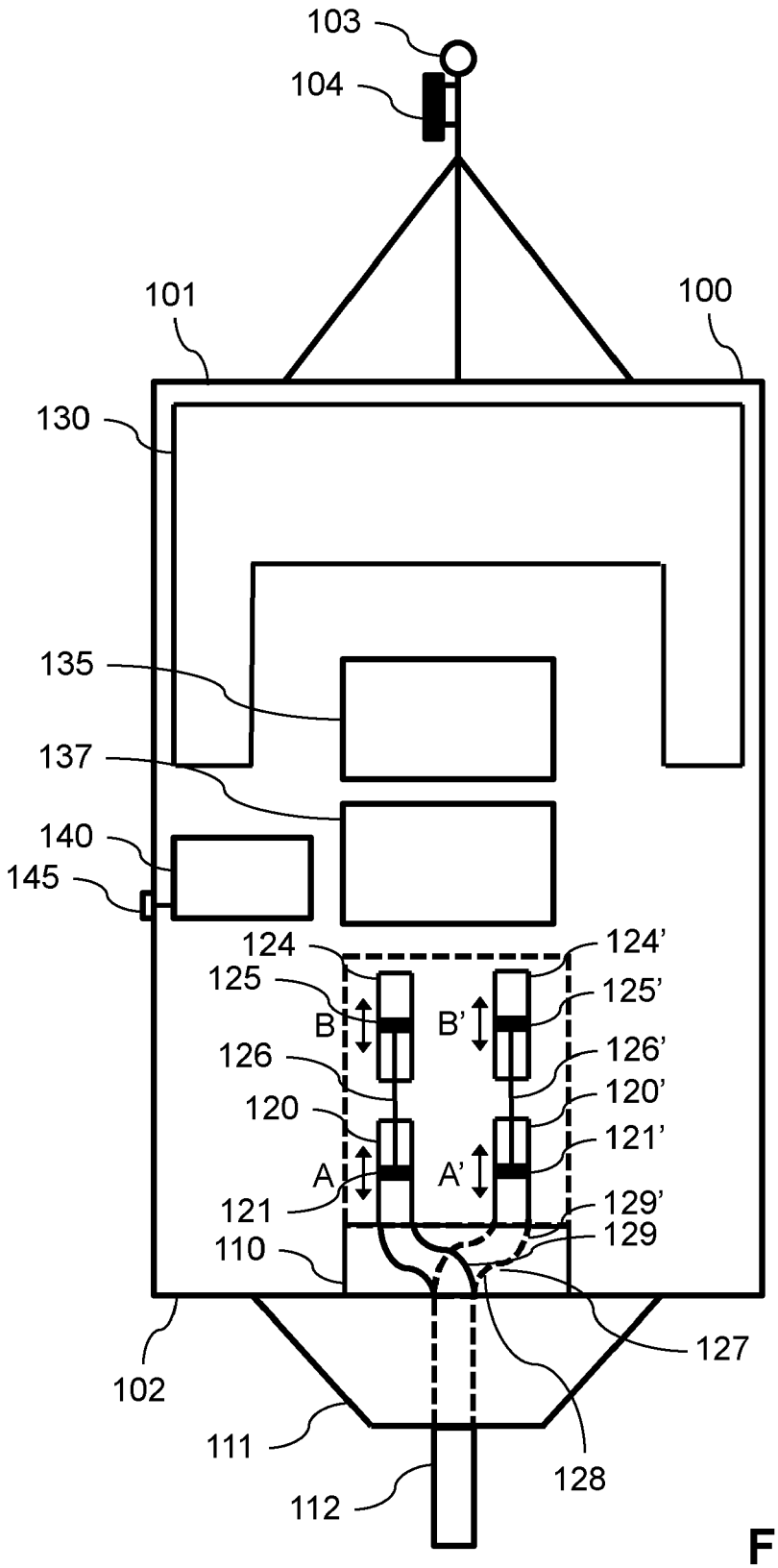
103
104
101
100
130
135
137
140
145
124
124'
125
125'
B
B'
126
126'
120
120'
121'
A
A'
121
129'
129
110
127
102
111
128
112

Fig. 1

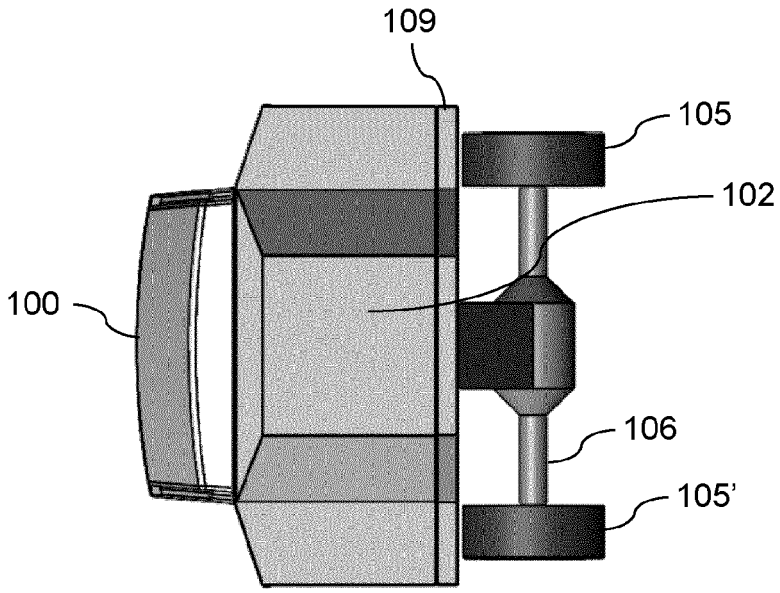

Fig. 2

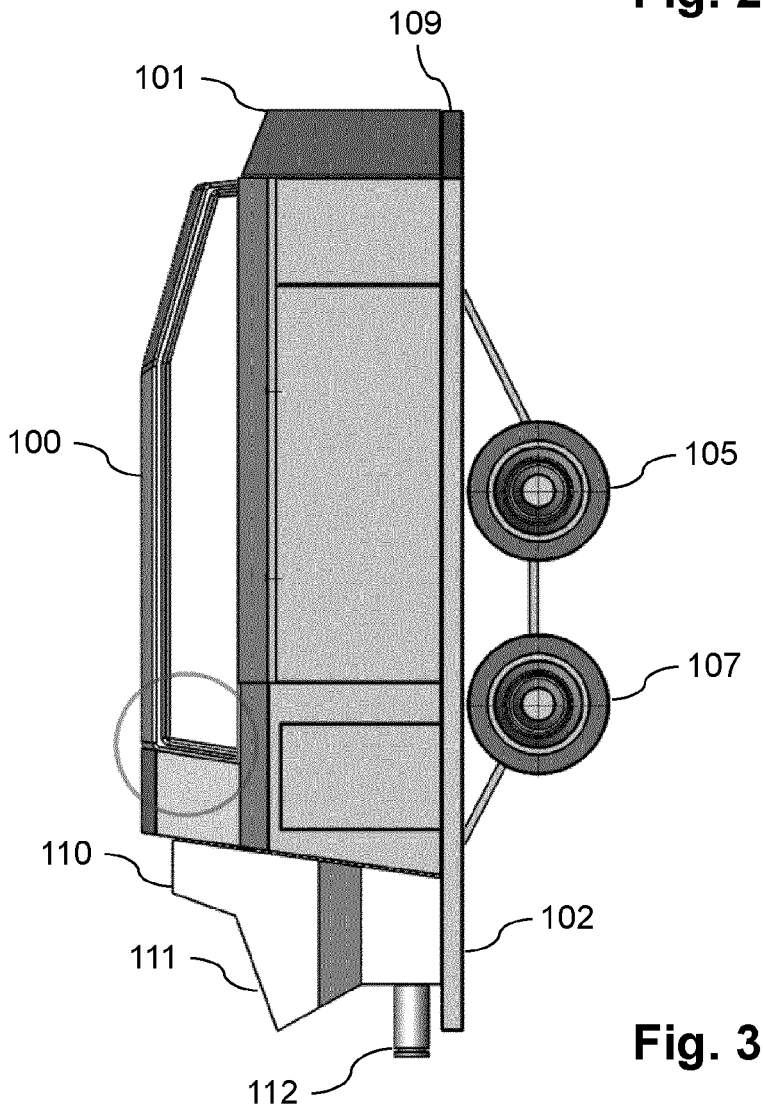

Fig. 3

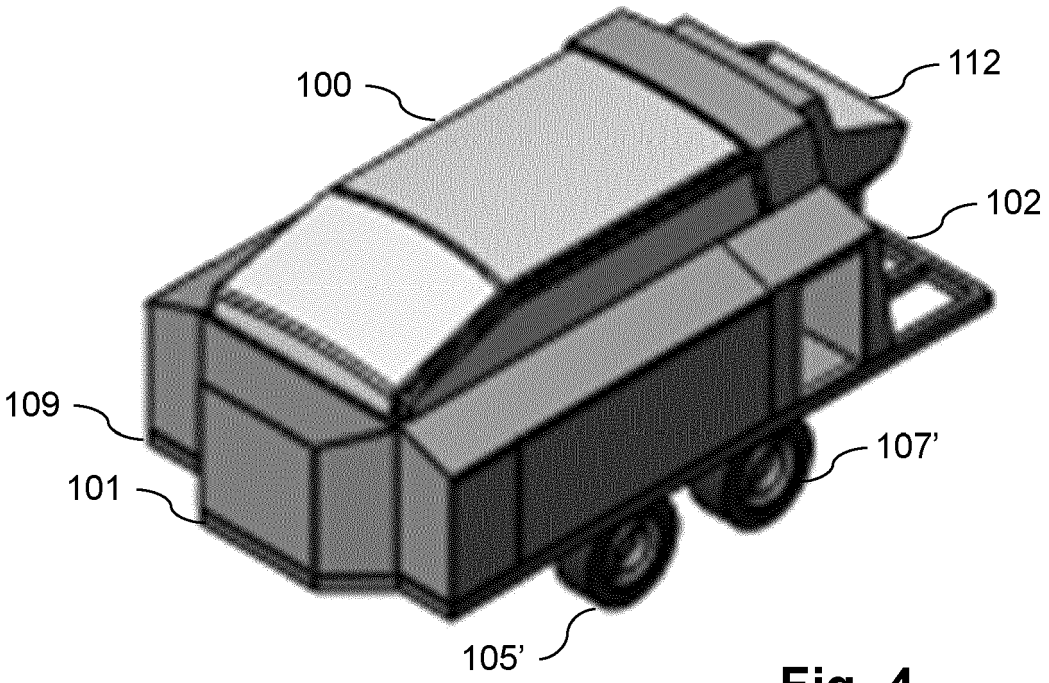

Fig. 4

Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 22 18 2709

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
Y	US 4 298 288 A (WEISBROD ALVIN J) 3 November 1981 (1981-11-03)	1-5, 7-10, 13-15	INV. F04B15/02 E04G21/04
A	* column 4, line 62 - column 5, line 47 * * figures 1,2 *	6,11,12	F04B17/03 F04B17/06 F04B49/06
Y	WO 2020/078040 A1 (SANY AUTOMOBILE MFG CO LTD [CN]) 23 April 2020 (2020-04-23)	1-5, 7-10, 13-15	F04B49/20
A	* the whole document *	6,11,12	
A	CN 110 219 466 A (XUZHOU COLLEGE IND TECHNOLOGY) 10 September 2019 (2019-09-10) * the whole document *	1-15	
A	US 2021/010465 A1 (HANCOCK JR DOUGLAS L [US] ET AL) 14 January 2021 (2021-01-14) * paragraphs [0038], [0039] * * figures 1,2,3 *	1-15	
A	DE 10 2017 222949 A1 (PUTZMEISTER ENGINEERING GMBH [DE]) 19 June 2019 (2019-06-19) * paragraphs [0021], [0060] * * figures 1,3 *	1-15	TECHNICAL FIELDS SEARCHED (IPC) F04B E04G
A	US 3 279 382 A (BENNETT MARVIN D) 18 October 1966 (1966-10-18) * column 12, line 15 - column 13, line 39 *	1-15	
A	US 10 829 946 B2 (CIFA SPA [IT]) 10 November 2020 (2020-11-10) * the whole document *	1-15	
A	JP H09 250448 A (ISHIKAWAJIMA CONSTR MACH) 22 September 1997 (1997-09-22) * paragraph [0003] * * figures 2,6 *	1-15	

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	31 October 2022	Lange, Christian

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 22 18 2709

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

31-10-2022

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 4298288 A	03-11-1981	NONE	
WO 2020078040 A1	23-04-2020	CN 109057346 A	21-12-2018
		WO 2020078040 A1	23-04-2020
CN 110219466 A	10-09-2019	NONE	
US 2021010465 A1	14-01-2021	US 2021010465 A1	14-01-2021
		US 2022258661 A1	18-08-2022
DE 102017222949 A1	19-06-2019	DE 102017222949 A1	19-06-2019
		EP 3498518 A1	19-06-2019
US 3279382 A	18-10-1966	DE 1296524 B	29-05-1969
		DE 1703886 A1	20-04-1972
		DE 1780018 A1	13-01-1972
		GB 1068863 A	17-05-1967
		GB 1068864 A	17-05-1967
		GB 1068865 A	17-05-1967
		JP S5211441 B1	31-03-1977
		JP S5211442 B1	31-03-1977
		JP S5211443 B1	31-03-1977
		US 3279382 A	18-10-1966
		US 3507347 A	21-04-1970
US 10829946 B2	10-11-2020	CN 110670881 A	10-01-2020
		DK 3591142 T3	28-03-2022
		EP 3591142 A1	08-01-2020
		FI 3591142 T3	14-04-2022
		US 2020002961 A1	02-01-2020
JP H09250448 A	22-09-1997	NONE	

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- CN 208329635 **[0003]**
- CN 211950768 **[0004]**
- US 4298288 A **[0005]**
- WO 2020078040 A1 **[0006]**