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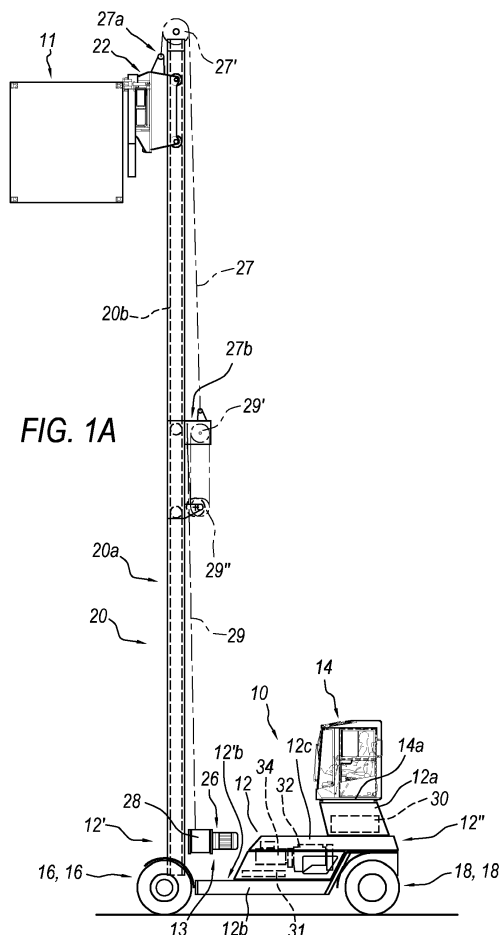
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(54) **AN APPARATUS FOR LIFTING AND TRANSPORTING A LOAD**

(57) An apparatus (10) for lifting and transporting a load, in particular in the form of an ISO container (11), comprises a supporting frame (12), means or wheels (16, 18) for moving the apparatus relative to the ground, means (20) for lifting the load comprising a respective mast having a first part (20a) connected to the frame (12) and a second part (20b) extendable relative to the first part (20a), and means (22) for gripping the load, able to move along the mast (20). The apparatus also comprising traction or movement driving means (24, 24) and means (26, 26) for driving the lifting of the load gripping means, the traction means (24, 24) and/or the means (26, 26) for driving the lifting being in the form of corresponding electric motor means which are powered by corresponding electricity accumulator means (30) through corresponding control means (314, 314, 316, 316). The apparatus is such that, advantageously, during the lowering strokes of the extendable part of the mast, the electric motor means (26, 26) of the lifting means (20) are designed to act as means for generating electricity, which is supplied to the electricity accumulator means (30).



Description

Technical Field

[0001] This invention relates to an apparatus for lifting and transporting a load.

Background Art

[0002] There are prior art apparatuses for lifting and transporting a load, in particular in the form of an ISO container, which comprise a supporting frame, means or wheels for moving the apparatus relative to the ground, means for lifting the load comprising a respective mast and means for gripping the load, able to move along the mast.

[0003] Moreover, in the prior art apparatuses, the apparatus comprises traction or movement driving means, which may be in the form of a respective electric motor, or in the form of a corresponding internal combustion engine.

[0004] Furthermore, in the prior art apparatuses, the means for driving lifting of the load, or the means for gripping the load itself, are in the form of corresponding hydraulic means, usually in the form of a respective first and second hydraulic cylinder.

[0005] In particular, in the field of apparatuses for lifting and transporting a load, or an ISO container, of the type referred to above, the need is felt for maximum savings in the energy used for apparatus propulsion.

Disclosure of the Invention

[0006] This invention proposes a novel solution, alternative to the solutions known up to now, and which may meet the above-mentioned need or overcome the disadvantages of the prior art.

[0007] Therefore, an apparatus for lifting and transporting a load is provided, the load being in particular in the form of an ISO container; the apparatus comprises a supporting frame, means for moving the apparatus relative to the ground, means for lifting the load comprising a respective mast, and means for gripping the load, which can move along the mast; the apparatus also comprising apparatus traction or movement driving means, and means for driving the lifting, characterised in that the mast comprises a first part connected to the frame and an extendable part connected to the first part, and also being characterised in that the means for driving the lifting are, in particular, in the form of corresponding electric motor means powered by corresponding electricity accumulator means, and also being characterised in that during the lowering strokes of the extendable part of the mast, there are means which generate electricity, in particular there are the electric motor means of the lifting means which are designed to act as means for generating electricity, and whose electricity produced is supplied to corresponding electricity accumulator means, in particular

to the electricity accumulator means which power the electric motor means.

[0008] In this way, there is an advantageous recovery of energy, in particular which can then be used for apparatus propulsion.

[0009] In particular, in this way it is possible to obtain an apparatus which operates by using less energy for its propulsion.

Brief Description of the Drawings

[0010] This and other innovative aspects are set out in the appended claims and the technical features and advantages are apparent from the detailed description which follows of non-limiting example embodiments of the invention with reference to the accompanying drawings, in which:

- Figure 1A is a schematic side view of a first preferred embodiment of an apparatus according to this invention in a load lifted condition with the extendable part of the mast fully extended upwards;
- Figure 1B shows an enlarged view of a detail from Figure 1A and relative to the upper part of the lifting mast;
- Figure 1C shows an enlarged view of a detail from Figure 1A and relative to the upper zone of the lower part of the apparatus lifting mast;
- Figure 2A is a cross-section of the first preferred embodiment of the apparatus, illustrating, in particular, the mast and the connection between the traction or movement driving electric motors and the apparatus front wheels;
- Figure 2B is an enlarged view of a detail from Figure 2A and relative to the connection between the traction or movement driving electric motor and the hub of the apparatus front wheels;
- Figure 3A is a schematic side view of the first preferred embodiment of an apparatus in a loading condition and with the extendable part of the mast lowered;
- Figure 3B is an enlarged view of a detail from Figure 3A relative to the lower zone of the lifting mast, showing the motor which drives lifting;
- Figure 3C is an enlarged view of a detail from Figure 3A relative to the upper part of the lifting mast in the retracted or lowered condition;
- Figure 4 is a schematic view of the transmission means of the means for driving lifting, in particular showing the transmission means between the motors and the extendable part of the lifting mast;
- Figure 5 is a block diagram relative to the means for driving traction and lifting of the first preferred embodiment of the apparatus;
- Figure 6 is a schematic side view of a second preferred embodiment of an apparatus according to this invention in a load lifted condition with the extendable

- part of the mast fully extended upwards;
- Figure 7 is a schematic side view of the second preferred embodiment of an apparatus in a loading condition and with the extendable part of the mast lowered;
- Figure 8 is a cross-section of the second preferred embodiment of the apparatus showing the mast in the lifted condition;
- Figure 9 is a block diagram relative to the means for driving traction and lifting of the second preferred embodiment of the apparatus.

Detailed Description of the Preferred Embodiments of the Invention

[0011] The accompanying drawings illustrate a preferred embodiment 10 of an apparatus for lifting and transporting a load, in particular for lifting and transporting an ISO container 11.

[0012] As illustrated, the apparatus comprises a supporting frame 12, in particular supporting a driver's cab 14 designed to accommodate a respective operator, means 16, 18 for moving the apparatus relative to the ground, in particular in the form of a first and a second front wheel 16, 16, which, as can be clearly inferred from Figure 2A, each comprise coupled wheels 16', 16', and a first and a second rear wheel 18, 18.

[0013] The frame 14 also supports means 20 for lifting the load, which comprise a load-bearing structure, formed by a corresponding mast, comprising a first part 20a of the mast which rises upwards and is connected to the frame 12, in particular to the front of the frame, and a second part 20b of the mast 20, which is vertically extendable relative to the first part 20a and allows the apparatus to reach a considerable lifting height.

[0014] As illustrated, the load-bearing structure or mast of the lifting means therefore comprises a first part 20a and a second part 20b which are substantially of the same length.

[0015] As may be inferred in particular from Figures 1A, 2A and 3A, the second part 20b of the mast can slide, thanks to corresponding rollers housed in respective side guides of the lower mast 20a, relative to the first, or fixed, part 20a of the mast 20a, moving telescopically relative to the latter.

[0016] The apparatus also comprises means 22 for gripping the load, which are supported by the mast 20 and can move along the mast 20, being placed in respective operating positions, between a maximum lifting position, in which the second part 20b of the mast is fully extended relative to the first part 20a of the mast (as shown in Figure 1A), and a maximum lowering position, in which the gripping means are at or close to the ground and the extendable second part 20b of the mast is retracted relative to the first, fixed part 20a of the mast, as illustrated in Figure 3A.

[0017] As illustrated, each part of the mast has respective longitudinal members 20', 20' and corresponding

crosspieces which are labelled 20" connecting to the longitudinal members 20', in Figure 2A. As illustrated, the longitudinal members 20' of the second part 20b of the mast can slide along and outside the longitudinal members 20' of the first part 20a of the mast, whose lower end is fixed to the apparatus frame 12.

[0018] The apparatus 10 also comprises traction or movement driving means 24, 24, in particular for transporting the load 11 or simply shifting or transferring the apparatus 10.

[0019] The apparatus 10 also comprises means 26, 26 for driving the lifting of the load gripping means, which drive a respective winch 28, 28, which in turn drives a corresponding cable, or chain, 29, 29, that slides on corresponding return pulleys 29', 29", and has an end 129 for fixing and attachment to the mobile part of the mast, as can be inferred from Figure 4.

[0020] In particular, the pulleys 29', comprising a first and a second pulley 29'a, 29'b located in vertical planes separated by angles of 90°, are supported at the upper end of the fixed part 20a of the mast, whilst the pulleys 29", comprising a first and a second pulley 29"a, 29"b located in vertical planes parallel with the first upper pulley 29'a, are supported by the lower end of the extendable part 20b of the mast, in such a way that with the respective winch 28 rotating to wind in the cable, or chain, lifting of the extendable part 20b of the mast is produced, whilst with the winch 28 rotating to pay out the cable, or chain, a lowering of the extendable part 20b of the mast is produced.

[0021] In turn, the means or fork 22 for gripping the load are connected by a respective cable or chain 27 to the fixed mast 20a by a corresponding return element, in the form of a pulley or a roller 27', at the upper free end of the extendable part 20b of the mast, in such a way that lifting and lowering of the extendable part 20b of the mast produces lifting and lowering of the load gripping means 22.

[0022] Therefore, with the winch 28 rotating to wind in the cable, lifting of the extendable part 20b of the mast is produced as well as lifting of the load gripping means 22 and of the load 11 supported by them if present, while with the winch 28 rotating in the opposite angular direction to pay out the cable, lowering of the extendable part 20b of the mast is produced, as well as of the gripping means 22 and of the load 11 supported by them, if present.

[0023] The traction means are in the form of corresponding electric motor means 24, 24, which are powered by corresponding electricity accumulator means 30 through corresponding control or inverter means 314, 314, as illustrated in the block diagram in Figure 5.

[0024] The means for driving the lifting are in the form of corresponding electric motor means 26, 26, which are powered by corresponding electricity accumulator means 30 through corresponding control or inverter means 316, 316, as illustrated in the block diagram in Figure 5.

[0025] In practice, shared electricity accumulator means 30 power both the electric motors means 24, 24 of the apparatus traction or movement driving means, and the electric motor means 26, 26 of the means for driving lifting.

[0026] In particular, as may be inferred from the diagram in Figure 5, the electricity accumulator means are connected through the corresponding inverters 314, 314, 316, 316 to the respective electric motors 24, 24 for traction and the electric motors 26, 26 for lifting the load by respective connections, or leads, respectively labelled 31a, 31b, 31b, 31c and 31c.

[0027] The apparatus also comprises main electricity generating means which comprise an internal combustion engine 32 that drives a corresponding electricity generator 34, which through a charge regulator 36 supplies electricity to the electricity accumulator means 30, via corresponding electrical connections, schematically illustrated and labelled 33 in Figure 5.

[0028] As shown, the frame 12 comprises a turret-shaped portion 12a, forming the driver's cab 14, which, in particular, comprises a lower treadable or supporting surface 14a for the operator.

[0029] The apparatus frame 12 comprises a platform 12b, which at its front end is fitted with the mast 20 and at the other end, that is to say its rear end, is fitted with the driver's cab or turret 14.

[0030] Therefore, as shown, the driver's cab 14 is located at one end of the apparatus platform 12b, in particular the driver's cab 14 being at the end opposite that where the lifting means 20 are located.

[0031] Thus, the platform 12b extends longitudinally, its length being less than the height of the mast in the lowered condition, that is to say, the first part of the mast 20a.

[0032] Advantageously, during the load 11 lowering strokes, the electric motor means 26 of the lifting means 20 are designed to act as, or switch their operation to, means for generating electricity, which is supplied, in particular via the electrical connections 31a, 31c and through the respective control devices 316, 316, to the electricity accumulator means 30.

[0033] According to another point of view, it is also evident that during the lowering strokes of the load gripping means, the electric motor means 26, 26 of the lifting means 20 are designed to act as means for generating electricity, which is supplied to the electricity accumulator means 30.

[0034] According to yet another viewpoint, during the load lowering strokes of the extendable part 20b of the mast 20, the electric motor means 26, 26 of the lifting means 20 are designed to act as means for generating electricity, which is supplied to the apparatus electricity accumulator means 30.

[0035] In practice, advantageously, the lowering of the load, of the gripping means 22 and of the extendable part 22b of the mast, due to their respective weight, is transmitted through the cables or chains 29 to the respective

winch 28 and to the respective motors 26, 26 which, braking their fall, convert the potential mechanical energy of said bodies 11, 22 and 20b into electricity which is supplied, through the corresponding control means or inverters 316, 316, to the apparatus electricity accumulator means 30.

[0036] In particular, in this way, there is a considerable conversion of mechanical energy into electricity, which recharges the electricity accumulator means 30, thanks to the numerous heavy bodies involved in the lowering movement.

[0037] However, it shall be understood that according to a different innovative solution, recovery of the mechanical energy may be provided for only one of said bodies 11, 22, 20b which can be lifted and lowered, or for any pair of them.

[0038] Also, advantageously, during the apparatus movement braking or slowing stretches, the electric motor means 24, 24 of the traction or movement driving means are designed to act as means for generating electricity which is supplied, in particular via the electrical connections 31a, 31b and through the respective control devices 314, 314, to the apparatus electricity accumulator means 30.

[0039] Advantageously, the electric motor means of the lifting means comprise a respective electric motor, and in particular are in the form of a first and a second electric motor 26, 26.

[0040] In particular, as can be clearly inferred from Figure 4, each electric motor 26, 26 drives a corresponding winch 28, 28 operating on a respective cable or chain 29, whose free end 129 is fixed to the lower part of the extendable mast 20b.

[0041] In turn, the cable or chain 27 is fixed at 27a to the load 11 gripping means 22 and at 27b to the upper part of the fixed mast 20a, as can be clearly inferred from the details of Figures 1B and 1C.

[0042] In turn, the traction or movement driving electric motor means comprise a respective electric motor, and in particular are in the form of a first and a second electric motor 24, 24.

[0043] Advantageously, as can be inferred from Figure 2B, the respective traction electric motor comprises a respective shaft 24', which is fixed to the hub 16" of the wheel 16, in particular through a corresponding connection comprising a flange 24", fixed to the end of the rotation shaft 24' and fixed, by corresponding screws 24"', to the hub 16".

[0044] As illustrated, the hub 16" of the wheel 16 forms the hub of both of the coupled wheels 16', 16' for apparatus traction.

[0045] In practice, the first and second electric motors 24, 24 operate directly on a respective front wheel 16, 16 of the apparatus.

[0046] Advantageously, the electricity accumulator means 30 are in the form of super-capacitor means.

[0047] In practice, the electricity accumulator means 30 are in the form of a super-capacitor, or a set of them,

which, as is known, is formed by a capacitor which accumulates a significant electric charge.

[0048] However, it shall be understood that, a simple battery may also be used for the electricity accumulator means 30, although the preferred solution is to accumulate the energy in a super-capacitor or a set of them.

[0049] In practice, the respective electric motor 26 of the lifting means drives a corresponding winch 28 for winding in and paying out a corresponding cable 29 or the like, which, through corresponding return or pulley means 29', 29", operatively connects the fixed part 20a and the extendable lifting part 20b of the mast 20, in such a way that the extendable part 20b can move relative to the fixed part 20a of the mast. By means of the cable or chain 27, whose ends are connected respectively to the means or fork 22 for gripping the load or ISO container 11, and to the fixed part 20a of the mast, the motor or winch 26 lifts the load 11 and the gripping means 21, which support the load 11.

[0050] As indicated, the frame 12 comprises a longitudinal platform 12b, which at a front end 12' of the apparatus comprises the lifting means 20 and which supports a driver's cab 14, in particular at the rear end 12" of the longitudinal platform 12b.

[0051] As illustrated, the driver's cab 14, and in particular its lower surface 14a, is positioned above the upper surface or upper face 12'b of the platform 12b.

[0052] According to a particularly advantageous configuration, the energy accumulator means 30 are positioned below the driver's cab 14, in particular below the latter's supporting surface 14a, also being vertically aligned with the driver's cab and housed in the corresponding supporting turret 12a for the cab 14.

[0053] In practice, the energy accumulator means 30 are at a longitudinal end of the supporting frame, in particular being at a rear end of the frame 12, being at an end opposite that where the lifting means are located.

[0054] As illustrated, in particular in Figure 1A, the internal combustion engine means 32 are on the platform 12b between the cab 14 and the lifting mast 20.

[0055] In turn, the electricity generator 34 is, on the frame platform 12b, between the driver's cab 14 and the lifting mast 20.

[0056] In particular, the electricity generator 34 is on the platform 12b in front of the driver's cab 14.

[0057] In turn, the means 26 for driving the lifting means are substantially at the same height as the internal combustion engine 32 and/or the main electricity generator 34.

[0058] In the accompanying drawings, the numeral 31 denotes means for housing the motor control means 314, 314, 316, 316.

[0059] In practice, the control inverters 314, 314, 316, 316 are housed in the housing 31, that is to say, at a single zone or control panel.

[0060] In turn, the height of the electricity accumulator means 30 is greater than that of the means for driving the lifting means, the internal combustion engine 32, the

generator 34 and the control means 31, or they are higher up than one or more of the latter.

[0061] As illustrated, the control means 31 are on the frame platform 12b in front of the driver's cab 14.

[0062] In particular, as shown, the control means 31 are positioned below the main electricity generator 34.

[0063] Advantageously, the respective electric motor 26 of the lifting means is positioned opposite the main electricity generator 34.

[0064] As illustrated, on the apparatus platform 12b there is a containment body or cover 12c, in particular for the main electricity generator 34, the internal combustion engine means 32 and the control means 31, or for one or more of the latter.

[0065] As illustrated, the containment body 12c extends from the rear zone in which the driver's cab is located, in particular from the driver's turret 12a, to a respective intermediate zone of the longitudinal platform 12b, in practice extending only over a part of the length of the frame longitudinal platform 12b.

[0066] As illustrated, between the containment body 12c and the lifting means 20 there is a space 13 for accommodating the means 26, 28 for driving the lifting means.

[0067] As illustrated, the driver's cab 14, and/or the turret 12a on which the cab 14 is positioned, is vertically aligned with the rear wheels 18, in particular the turret 12a being slightly angled towards the front of the apparatus or the frame 12.

[0068] The above-mentioned advantageous layout of the respective components of the apparatus allows not just optimum distribution of the weights and use of the spaces available, but also easy maintenance, repairs and, if necessary, substitution, of the various components.

[0069] In particular, the positioning of the rather heavy accumulator means 30 at the rear zone or rear free end of the apparatus is advantageous, particularly because their substitution and maintenance are facilitated, and because their weight is directly discharged on the rear wheels of the apparatus.

[0070] In practice, this embodiment of the apparatus comprises a respective electric motor 26 of the lifting means which is designed to drive a corresponding winch 28, which through corresponding transmission means 27, 29 lifts the load gripping means 22, any load 11 present, and/or the extendable part 20b of the lifting mast 20.

[0071] Figures 6 to 9 show a second preferred embodiment 100 of the apparatus according to this invention, comprising components similar to those of the previous embodiment, labelled with the same reference characters, and which are not described again in detail to avoid making this description too long.

[0072] This second preferred embodiment differs from the first due to the fact that the frame 14 supports means 120 for lifting the load, which comprise a load-bearing structure, formed by a corresponding mast, the mast

comprising a first part 20a rising upwards and connected to the frame 12, in particular to the front of the frame, and an extractable part of the mast consisting of a second part 20b of the mast 20, which is vertically extendable relative to the first part 20a and a third part 120c of the mast, which is vertically extendable relative to the second part 20b of the mast, and which allow the apparatus to reach a considerable lifting height.

[0073] As illustrated, the load-bearing structure or mast of the lifting of this second preferred embodiment therefore comprises a first, a second and a third part 20a, 20b, 120c, which are substantially of the same length or height.

[0074] As may be inferred, the second part 20b of the mast can slide, thanks to corresponding rollers housed in respective side guides of the lower mast 20a, relative to the first, or fixed, part 20a of the mast 20a, moving telescopically relative to the latter.

[0075] As may be inferred, in turn, the third part 120c of the mast can slide, thanks to corresponding rollers housed in respective side guides of the intermediate mast 20b, relative to the second, or mobile intermediate, part 20b of the mast, moving telescopically relative to the latter.

[0076] The apparatus also comprises means 22 for gripping the load 11, which are supported by the mast 20 and can move along the mast 120, being placed in respective operating positions, between a maximum lifting position, in which the second and third parts 20b, 120c of the mast are fully extended, and a maximum lowering position, in which the gripping means are at or close to the ground and the extendable second and third parts 20b, 120c of the mast are retracted relative to the first, fixed part 20a of the mast.

[0077] As illustrated, each part of the mast has respective longitudinal members 20', 20' and corresponding crosspieces which are labelled 20" connecting to the longitudinal members 20'. As illustrated, the longitudinal members 20' of the second part 20b of the mast can slide along and outside the longitudinal members 20' of the first part 20a of the mast, whose lower end is fixed to the apparatus frame 12. In turn, the longitudinal members 20' of the third, upper part 120c of the mast can slide along and outside the longitudinal members 20' of the second part 20b of the mast.

[0078] This second preferred embodiment 100 of the apparatus comprises, like the first embodiment, respective traction or movement driving means 24, 24, in particular for transporting the load 11 or simply shifting or transferring the apparatus 10.

[0079] As illustrated relative to the first preferred embodiment, the apparatus 100 comprises means 26, 26 for driving the lifting of the load gripping means, which drive a respective winch 28, 28, which in turn drives a corresponding cable or chain 29, 29, that slides on corresponding return pulleys 29', 29", and has an end 129 for fixing and attachment to the mobile part of the mast, in particular to the second, or mobile intermediate part

20b of the mast.

[0080] In particular, the pulleys 29', comprising a first and a second pulley 29'a, 29'b located in vertical planes separated by angles of 90°, are supported at the upper end of the fixed part 20a of the mast, whilst the pulleys 29", comprising a first and a second pulley 29"a, 29"b located in vertical planes parallel with the first upper pulley 29'a, are supported by the lower end of the extendable part 20b of the mast, in such a way that with the respective winch 28 rotating to wind in the cable, lifting of the extendable part 20b of the mast and of the extendable part 120c connected to it is produced, whilst with the winch 28 rotating to pay out the cable, a lowering of the extendable parts 20b, 120c of the mast is produced.

[0081] In turn, the upper, or third part 120c of the mast is connected by a respective cable or chain 127 to the fixed, or lower part 20a of the mast, by a corresponding return element, in the form of a pulley or a roller 127', at the upper end of the second part 20b of the mast, in such a way that lifting and lowering of the second part 20b of the mast produces lifting and lowering of the third, or upper part 120c of the mast.

[0082] The cable or chain 127 is fixed, at 127a, to the lower part of the third, or upper part 120c of the mast and, at 127b, to the upper part of the fixed mast 20a, as can be clearly inferred from Figure 7.

[0083] In turn, the means or fork 22 for gripping the load are connected by a respective cable or chain 27 to the second part of the mast, or the mobile intermediate part, 20a by a corresponding return element, in the form of a pulley or a roller 27', at the upper free end of the third part or upper part 120c of the mast, in such a way that lifting and lowering of the extendable upper part 120c of the mast produces lifting and lowering of the load gripping means 22.

[0084] The cable or chain 27 is fixed, at 27b, to the load 11 gripping means 22 and, at 27b, to the upper part of the second part, or mobile intermediate part 20b of the mast, as can be clearly inferred from Figure 7.

[0085] Therefore, with the winch 28 rotating to wind in the cable, lifting of the extendable parts 20b, 120c of the mast is produced as well as lifting of the load gripping means 22 and of the load 11 supported by them if present, while with the winch 28 rotating in the opposite angular direction to pay out the cable, lowering of the extendable parts 20b, 120c of the mast is produced, as well as of the gripping means 22 and of the load 11 supported by them, if present.

[0086] As in the first preferred embodiment, the traction means are in the form of corresponding electric motor means 24, 24, which are powered by corresponding electricity accumulator means 30 through corresponding control or inverter means 314, 314, as illustrated in the block diagram in Figure 9.

[0087] Moreover, the means for driving the lifting are in the form of corresponding electric motor means 26, 26, which are powered by corresponding electricity accumulator means 30 through corresponding control or

inverter means 316, 316, as illustrated in the block diagram in Figure 9.

[0088] As in the first preferred embodiment, shared electricity accumulator means 130 power both the electric motors means 24, 24 of the apparatus traction or movement driving means, and the electric motor means 26, 26 of the means for driving lifting.

[0089] In particular, as may be inferred from the diagram in Figure 9, the electricity accumulator means are connected through the corresponding inverters 314, 314, 316, 316 to the respective electric motors 24, 24 for traction and the electric motors 26, 26 for lifting the load, in particular by respective connections, or leads, respectively labelled 31a, 31b, 31b, 31c and 31c.

[0090] The apparatus also comprises main electricity generating means which comprise an internal combustion engine 32 that drives a corresponding electricity generator 34, which through a charge regulator 36 supplies electricity to the electricity accumulator means 30, via corresponding electrical connections, schematically illustrated and labelled 33 in Figure 9.

[0091] Advantageously, during the load 11 lowering strokes, the electric motor means 26 of the lifting means 20 are designed to act as, or switch their operation to, means for generating electricity, which is supplied, in particular via the electrical connections 31a, 31c and through the respective control devices 316, 316, to the electricity accumulator means 30.

[0092] Moreover, during the lowering strokes of the load gripping means, the electric motor means 26, 26 of the lifting means 20 are designed to act as means for generating electricity, which is supplied to the electricity accumulator means 30.

[0093] According to yet another viewpoint, during the lowering strokes of the extendable parts 20b, 120c of the lifting means mast 20, the electric motor means 26, 26 of the lifting means 20 are designed to act as means for generating electricity, which is supplied to the apparatus electricity accumulator means 30.

[0094] It shall be understood that electricity could be generated by the lowering of just one of the extendable parts 20b, 120c of the mast.

[0095] In practice, advantageously, the lowering of the load, of the gripping means 22 and of the extendable parts 20b, 120c of the mast, due to their respective weight, is transmitted through the cables or chains 29 to the respective winch 28 and to the respective motors 26, 26 which, braking their fall, convert the potential mechanical energy of said bodies 11, 22, 20b and 120c into electricity which is supplied, through the corresponding control means or inverters 316, 316, 36, to the apparatus electricity accumulator means 30.

[0096] In particular, in this way, there is a considerable conversion of mechanical energy into electricity, which recharges the electricity accumulator means 30, thanks to the numerous heavy bodies involved in the lowering movement.

[0097] However, it shall be understood that according

to a different innovative solution, recovery of the mechanical energy may be provided for only one of said bodies 11, 22, 20b and 120c which can be lifted and lowered, or for any combination of them.

[0098] In the wiring diagram, the electricity accumulator means 130 are, advantageously, connected to respective circuits and/or means 24, 24, 26, 26, to be electrically powered or by which they are electrically powered, through the charge regulator means 136.

[0099] In practice, the electricity accumulator means 130 are in the form of a super-capacitor, or a set of them, which, as is known, is formed by a capacitor which accumulates a significant electric charge.

[0100] However, it shall be understood that, a simple battery may also be used for the electricity accumulator means 130, although the preferred solutions is to accumulate the energy in a super-capacitor or a set of them.

[0101] In practice, in this second preferred embodiment, the extendable part of the mast comprises at least a second 20b and a third 120c part of the mast, which are extendable respectively relative to the first part 20a of the mast and relative to the second part 20b of the mast.

[0102] Advantageously, the apparatus comprises means which generate electricity, in particular in the form of the electric motor means 26, 26 of the lifting means 20 which are designed to act as electricity generating means, and which operate, during the lowering strokes of these second and third parts 20b, 120c of the mast, or in particular of at least one of these, and whose electricity produced is supplied to the apparatus electricity accumulator means 30.

[0103] During their lowering strokes, or in particular the lowering strokes of at least one out of the second and third parts 20b, 120c of the mast, the electric motor means 26, 26 of the lifting means 120 are designed to act as means for generating electricity, which is supplied to the electricity accumulator means 130.

[0104] As illustrated above, in both of the above-mentioned preferred embodiments, there are therefore means (particularly in the form of elongate elements - consisting of cables or chains - and corresponding pulleys or rollers), for operatively connecting the extendable part 20b, 120c of the mast to the respective means for driving lifting, in particular to the respective electric motor for driving lifting 26, 26, and particularly to the respective lifting winch 28, 28.

[0105] In particular, an apparatus for lifting a load is provided, in which during the lowering strokes of the extendable part 20b of the mast, there are means which generate electricity, in particular there are the electric motor means 26, 26 of the lifting means 20 which are designed to act as electricity generating means, and whose electricity produced is supplied to corresponding electricity accumulator means 30, in particular to the electricity accumulator means 30 which power the electric motor means 26, 26.

[0106] In particular, an apparatus for lifting a load is

also provided, in which during the lowering strokes of the load gripping means, there are means which generate electricity, in particular there are the electric motor means 26, 26 of the lifting means 20 which are designed to act as electricity generating means, and whose electricity produced is supplied to corresponding electricity accumulator means 30, in particular to the electricity accumulator means 30 which power the electric motor means 26, 26.

[0107] In particular, an apparatus for lifting a load is also provided, in which during the load lowering strokes, there are means which generate electricity, in particular there are the electric motor means 26, 26 of the lifting means 20 which are designed to act as electricity generating means, and whose electricity produced is supplied to corresponding electricity accumulator means 30, in particular to the electricity accumulator means 30 which power the electric motor means 26, 26.

[0108] The invention described is susceptible of industrial application.

[0109] It would be obvious to one skilled in the art that several changes and/or modifications can be made to the preferred embodiment of the invention without departing from the spirit and scope of the invention, described in depth above. In particular, one skilled in the art could easily imagine further preferred embodiments of the invention comprising one or more of the features described herein. It will also be understood that all the details of the invention may be substituted by technically equivalent elements.

Claims

1. An apparatus (10) for lifting and transporting a load, in particular in the form of an ISO container (11), comprises a supporting frame (12), means (16, 18) for moving the apparatus relative to the ground, means for lifting the load comprising a respective mast (20), and means (22) for gripping the load, which can move along the mast (20); the apparatus also comprising apparatus traction or movement driving means (24, 24), and means (26, 26) for driving the lifting, **characterised in that** the mast comprises a first part (20a) connected to the frame (12) and an extendable part (20b) connected to the first part (20a), and also being **characterised in that** the means (26, 26) for driving the lifting are, in particular, in the form of corresponding electric motor means powered by corresponding electricity accumulator means (30), and also being **characterised in that** during the lowering strokes of the extendable part (20b) of the mast, there are means which generate electricity, in particular there are the electric motor means (26, 26) of the lifting means (20) which are designed to act as means for generating electricity, and whose electricity produced is supplied to corresponding electricity accumulator means (30), in par-

ticular to the electricity accumulator means (30) which power the electric motor means (26, 26).

2. The apparatus according to claim 1 or according to the preamble to claim 1, **characterised in that** during the lowering strokes of the load gripping means, there are means which generate electricity, in particular there are the electric motor means (26, 26) of the lifting means (20) which are designed to act as electricity generating means, and whose electricity produced is supplied to corresponding electricity accumulator means (30), in particular to the electricity accumulator means (30) which power the electric motor means (26, 26).
3. The apparatus according either of the foregoing claims or according to the preamble to claim 1, **characterised in that** during the load (11) lowering strokes, there are means which generate electricity, in particular there are the electric motor means (26, 26) of the lifting means (20) which are designed to act as electricity generating means, and whose electricity produced is supplied to corresponding electricity accumulator means (30), in particular to the electricity accumulator means (30) which power the electric motor means (26, 26).
4. The apparatus according to any of the foregoing claims or according to the preamble to claim 1, **characterised in that** during the apparatus movement braking or slowing stretches, there are electric motor means (24, 24) of the traction or movement driving means which are designed to act as means for generating electricity which is supplied to the electricity accumulator means (30).
5. The apparatus according to any of the foregoing claims or according to the preamble to claim 1, **characterised in that** it comprises electric motor means of the lifting means which are powered by corresponding electricity accumulator means (30, 130) through corresponding control means (314, 314).
6. The apparatus according to claim 5, **characterised in that** it comprises electric motor means of the lifting means in the form of an electric motor, in particular in the form of a first and a second electric motor (26, 26).
7. The apparatus according to any of the foregoing claims or according to the preamble to claim 1, **characterised in that** it comprises traction means (24, 24) in the form of corresponding electric motor means which are powered by corresponding electricity accumulator means (30, 130) through corresponding control means (314, 314).
8. The apparatus according to claim 7, **characterised**

in that the electric motor means of the traction and movement driving means are in the form of an electric motor, in particular in the form of a first and a second electric motor (24, 24).

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9. The apparatus according to any of the foregoing claims or according to the preamble to claim 1, **characterised in that** it comprises traction means (24, 24) and means for driving the lifting means which are powered by shared electricity accumulator means (30, 130). 10

10. The apparatus according to any of the foregoing claims or according to the preamble to claim 1, **characterised in that** it comprises main electricity generating means which comprise an internal combustion engine (32) that drives a corresponding electricity generator (34) connected so as to transmit power to the electricity accumulator means (30, 130). 15
20

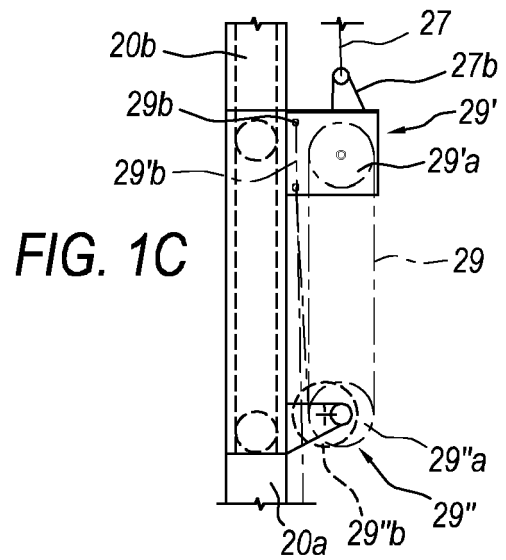
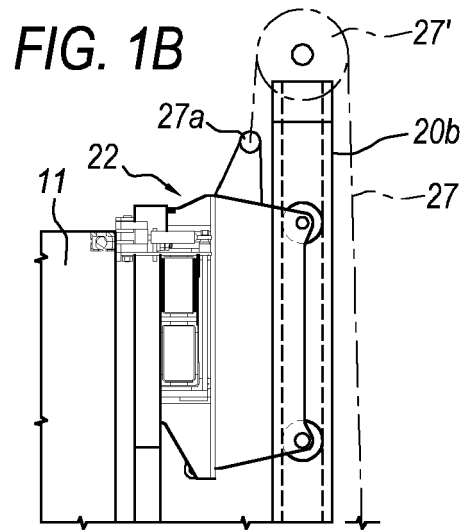
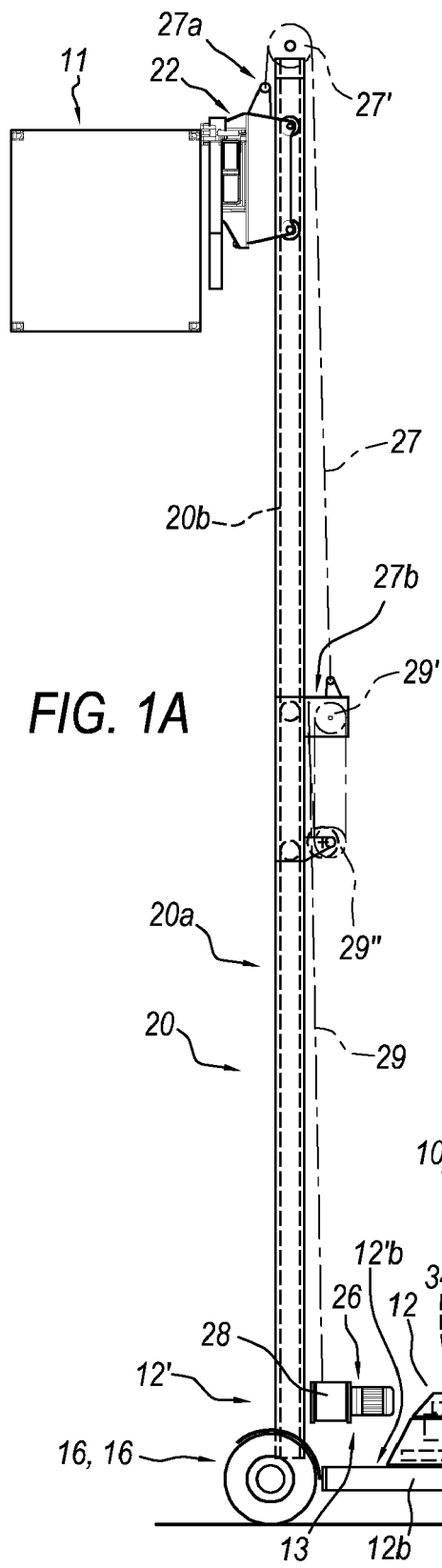
11. The apparatus according to any of the foregoing claims, **characterised in that** the electricity accumulator means (30, 130) are in the form of supercapacitor means or if necessary a battery. 25

12. The apparatus according to any of the foregoing claims from 6 to 11, **characterised in that** the respective electric motor (26) of the lifting means drives a corresponding winch (28) which through corresponding transmission means (27, 29) lifts the load gripping means (22), any load (11) present and/or the respective extendable part (20b) of the lifting mast (20). 30

13. The apparatus according to any of the foregoing claims from 8 to 12, **characterised in that** the respective electric motor (24) for traction comprises a respective shaft which is fixed to the hub of the wheel (16). 35
40

14. The apparatus according to any of the foregoing claims or according to the preamble to claim 1, **characterised in that** it comprises means for operatively connecting the extendable part (20b, 120c) of the mast to the respective means for driving lifting, in particular to the respective electric motor for driving lifting (26, 26), and particularly to the respective lifting winch (26, 26). 45

15. The apparatus according to any of the foregoing claims, **characterised in that** the respective electric motor (26) of the lifting means drives a corresponding winch (28) for winding in and paying out a corresponding cable or chain (29), which, through corresponding return or pulley means (29', 29"), operatively connects the fixed part (20a) and the extendable lifting part (20b) of the mast (20). 50
55



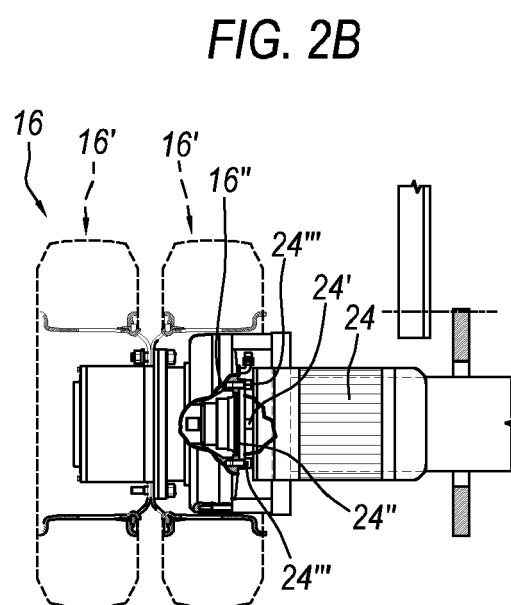
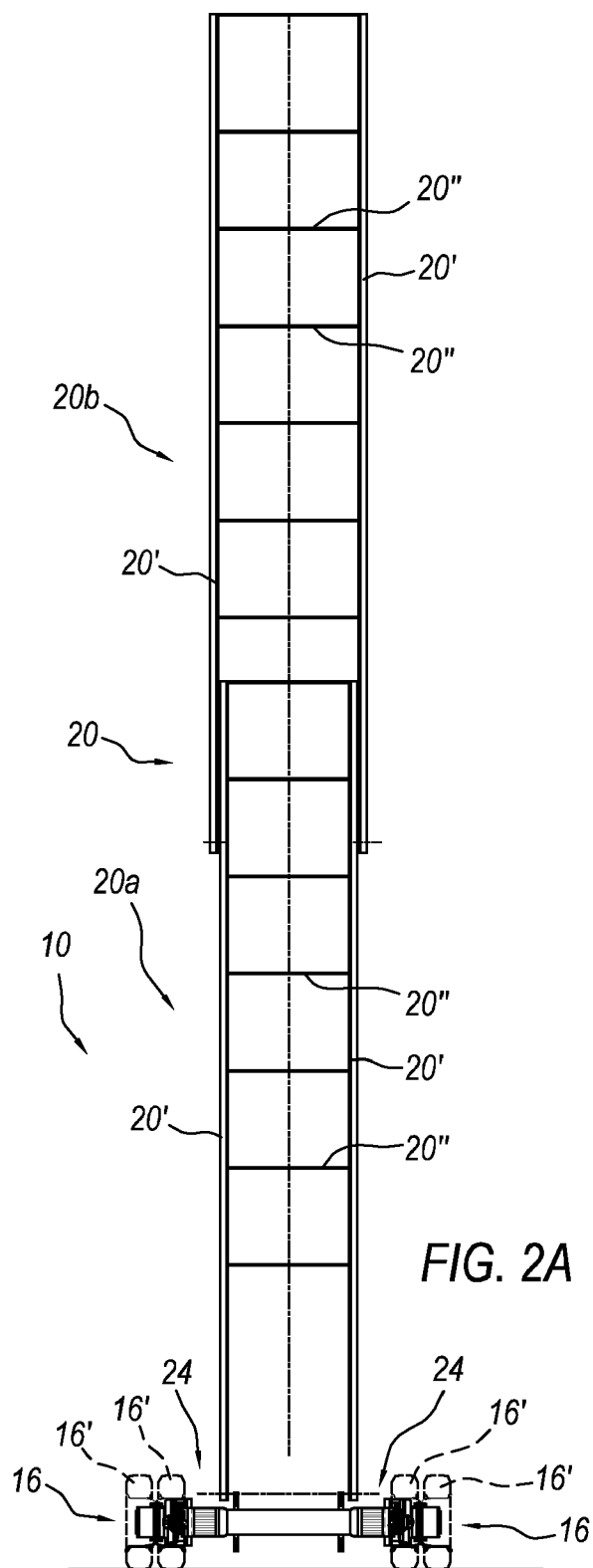


FIG. 3C

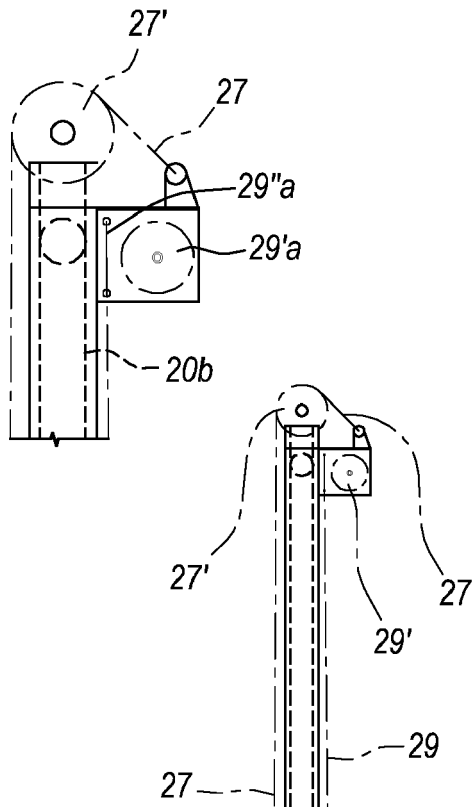


FIG. 3B

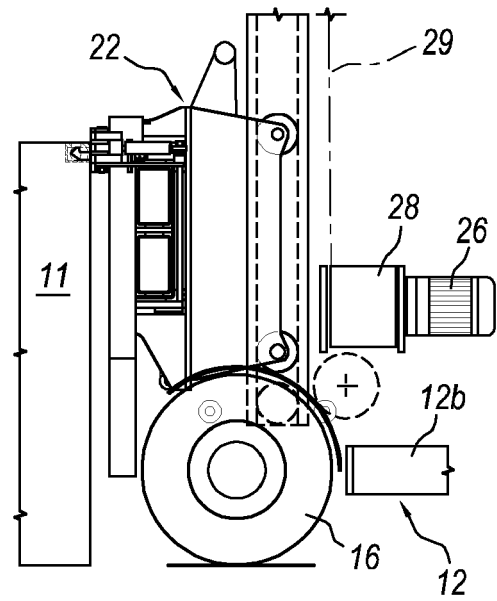
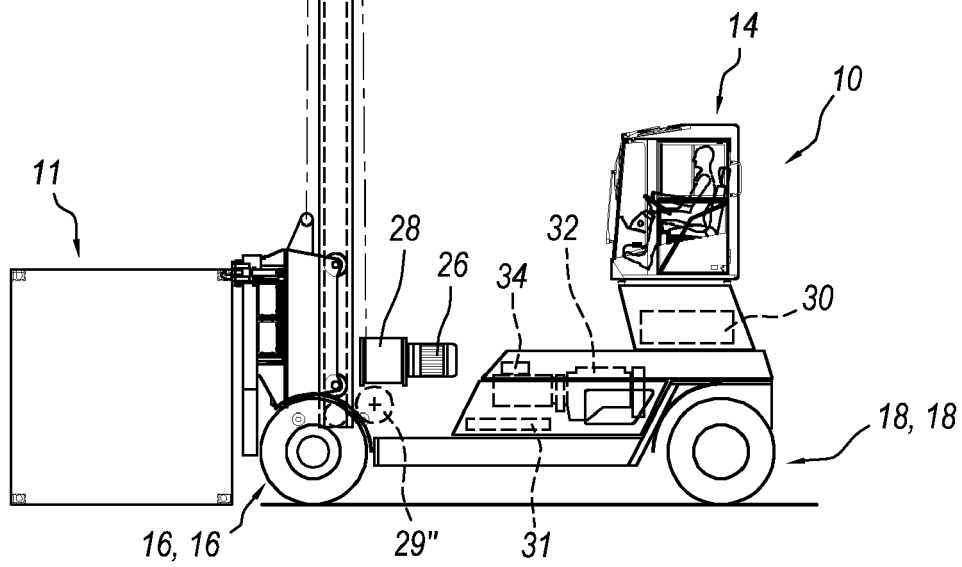


FIG. 3A



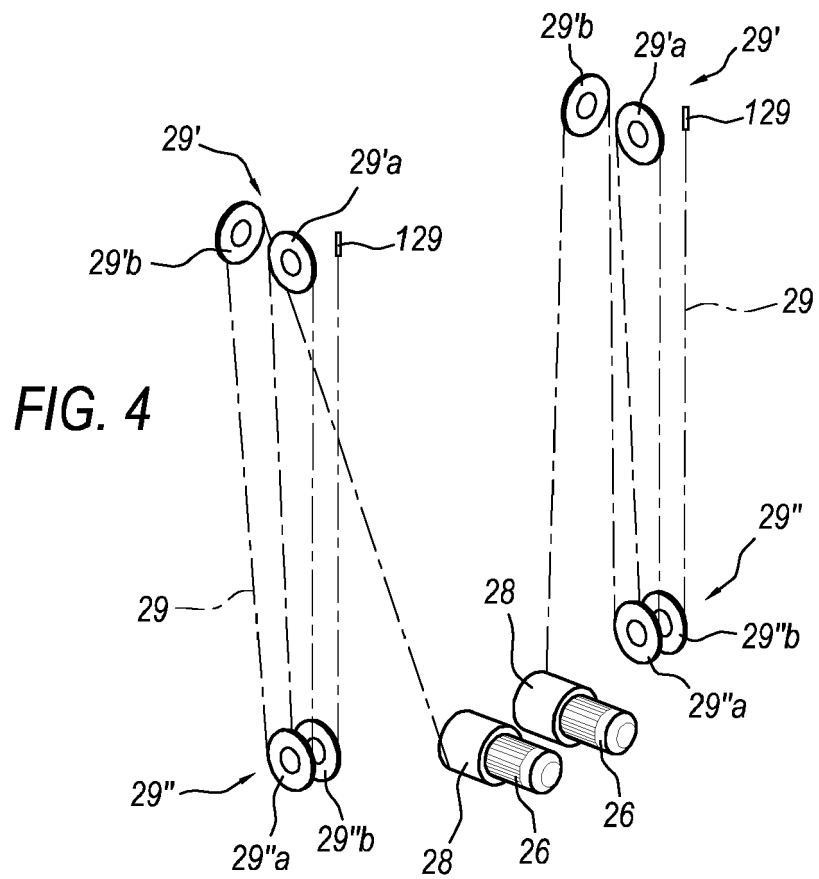


FIG. 5

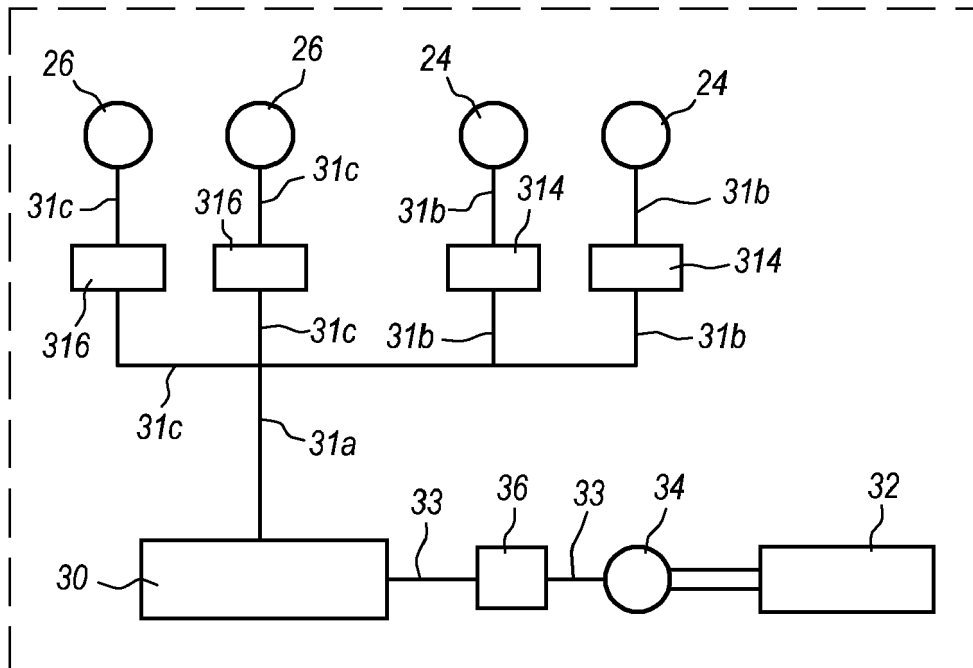


FIG. 7

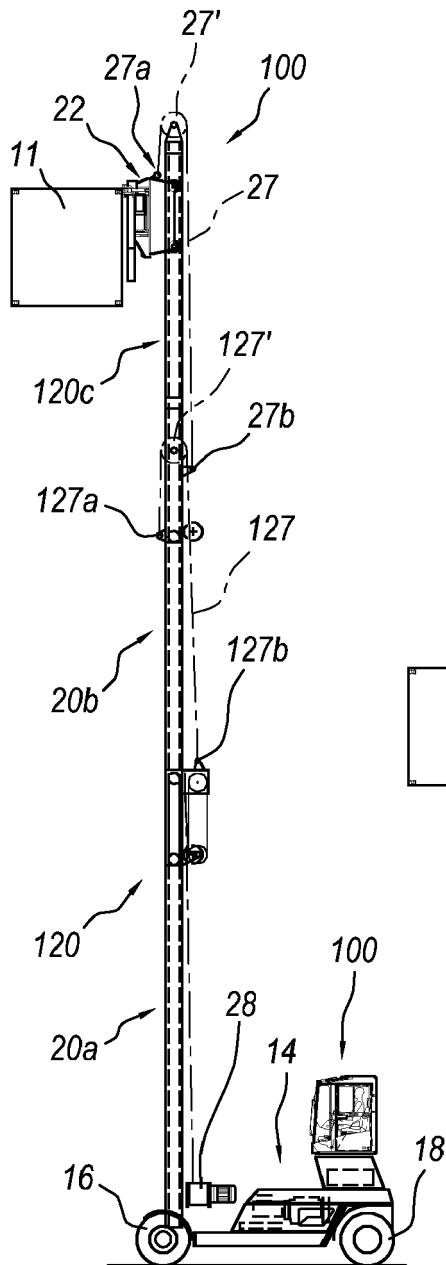


FIG. 6

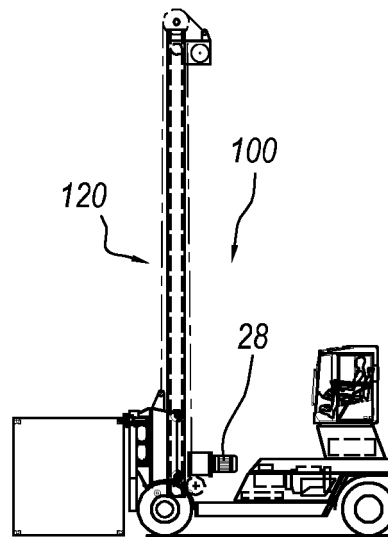


FIG. 8

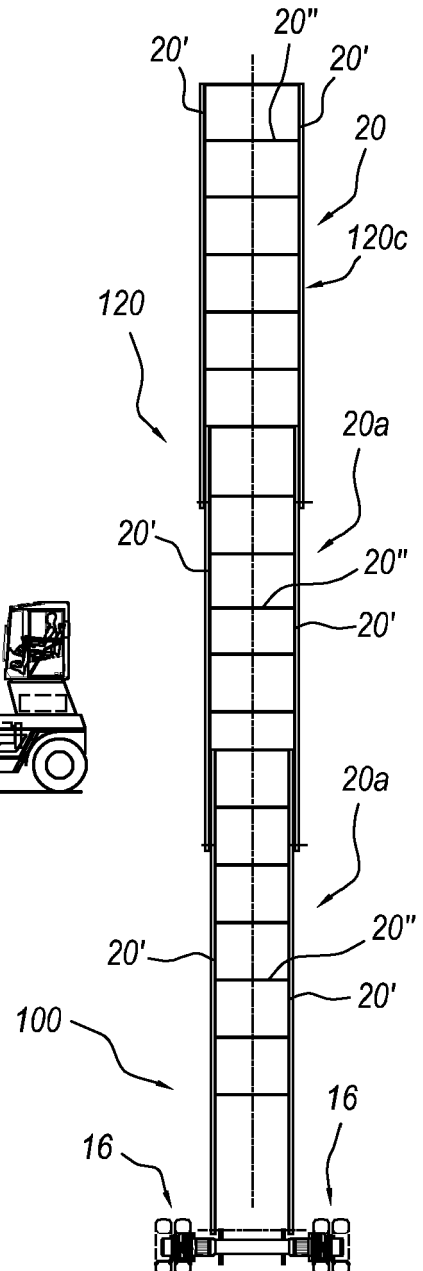


FIG. 9

