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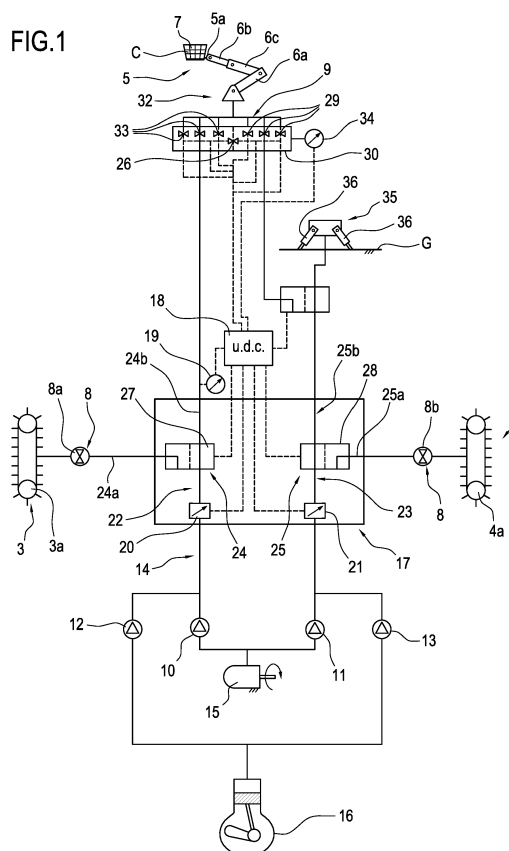
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(54) **LIFTING MACHINE**

(57) Described is a lifting machine, comprising a main frame (2), at least a first (3) and a second rolling element (4) rotatably associated with the frame (2) for moving it along the ground or a supporting surface (G), at least one arm (5) telescopically and/or rotatably associated with the frame (2), comprising at a free end (5a) an operating element (7), first (8) and second hydraulic actuating devices (9) associated respectively with the rolling elements (3, 4) and the arm (5) to move them, at least a first (10) and a second hydraulic pump (11) respectively associated with the first (8) and the second actuating devices (9) for feeding them with an operating fluid, a hydraulic circuit (14) designed to put in fluid communication the pumps (10, 11) and the first (8) and second actuating devices (9) and comprising a selecting unit (17) switchable between a first configuration in which it puts the pumps (10, 11) in fluid communication with first actuating devices (8) and a second configuration in which it puts at least the first pump (10) in fluid communication with the second actuating devices (9) and at least an electric motor (15) associated with the pumps (10, 11) for operating them. The machine also comprises a control unit (18) associated with the selecting unit (17) and designed to control it, when the selecting unit (17) is in the second configuration, in such a way as to also put the second pump (11) in fluid communication with the second actuating devices (9) and to vary the flow rate of operating fluid from the second pump (11) to the second actuating devices (9) depending on a trend of the pressure of the operating fluid in the first pump (10).

FIG.1



Description

[0001] This invention relates to a lifting machine, in particular of the hydraulic type, preferably an aerial platform.

[0002] This invention is applied in particular to the sector of operating machines, in particular in the production of small size aerial platforms and equipped with at least an electricity power supply.

[0003] For simplicity, but without limiting the scope of the invention, express reference will hereinafter be made but to lifting machines such as aerial platforms, as this invention is specifically, but not exclusively, addressed to that type of machinery.

[0004] As is known, in light of the compactness requested, for reasons of weight and space the tracked aerial platforms are often equipped with a double power supply (internal combustion engine and electrical), wherein both the motors involved are necessarily small in size and with limited outputs. Moreover, whilst for the internal combustion engine the limited outputs are in any case in the order of 10 HP or more, the limits are even more stringent with regard to the electric motor, since most times the machines are equipped with single-phase motors of 110 or 220V and 2.2 kW; this is mainly in order to make the motors easily powered using the electricity mains and not by expensive and bulky battery packs.

[0005] In this regard, it should be noted that both the embodiments are necessary to feed the hydraulic system, that is, the pumps which control them, both during the step for moving forward the platform, to move the tracks/wheels, and during the operating step, for lifting and moving the arms.

[0006] Disadvantageously, the two above-mentioned applications are diametrically opposite each other from the point of operation of the pumps, since they require a greater flow rate of oil, with limited pressure head, to move the tracks and a reduced flow rate of oil, with a high pressure head, for moving the arms.

[0007] Considering the fact that the available power generated by the motors is, as already highlighted, rather limited, it follows that the movement of the arms is determined by extremely limited flow rates and, consequently, it is particularly slow.

[0008] This obviously determines a certain lack of satisfaction by the operator, who perceives a clear distinction between the speed of movement of the arms in the "internal combustion" configuration and the speed of movement of the arms in the "electric" configuration, it being understood that on account of the limited dimensions neither of the configurations can be considered in absolute terms to be fast.

[0009] To overcome these drawbacks, the prior art uses various solutions, none not free of disadvantages.

[0010] Firstly, the prior art proposes aerial platforms equipped with lithium batteries which are able to supply electric motors with a greater output also maintaining limited dimensions; such a solution is shown, for example, in patent document IT1395446.

[0011] Disadvantageously, as is known, lithium batteries are expensive and are not widely used and of interest on all the markets.

[0012] Alternatively, aerial platforms have been placed on the market wherein the only pump is associated with a flow diverter which is able to divide the flows, discharging excess operating fluid during the lower flow rate phases.

[0013] Alternatively, the current solutions most commonly used use two or more pumps in tandem controlled in such a way to be divide the flows in play. More specifically, in that solution, the two pumps each feed a track members and a part of the movements of the arms/stabilisers.

[0014] However, both the solutions described above, whilst they allow the movement speed of the tracks to be optimised, they do not allow such an optimisation for the speed of movement of the arms, the movements of which are connected to the flow rate of a single pump powered by a motor with a limited output.

[0015] The aim of this invention is to provide a lifting machine, in particular of the hydraulic type, which overcomes the above-mentioned drawbacks of the prior art.

[0016] More specifically, the aim of this invention is to provide a lifting machine, in particular of the hydraulic type, which is able to optimise the speed of movement of the arms also during the use of an electrical power supply. More precisely, the aim of this invention is to provide a lifting machine, in particular of the hydraulic type, which has high performance levels and limited costs.

[0017] These aims are achieved by a lifting machine with the features according to one or more of the subsequent claims, and in particular comprising a main frame, at least a first and a second rolling element rotatably associated with the frame for moving it along the ground or a supporting surface, at least one arm telescopically and/or rotatably associated with the frame, comprising at a free end an operating element, first and second hydraulic actuating devices associated respectively with the rolling elements and the arm to move them, at least a first and a second hydraulic pump respectively associated with the first and the second actuating devices for feeding them with an operating fluid, a hydraulic circuit designed to put in fluid communication the pumps and the first and second actuating devices and comprising a selecting unit switchable between a first configuration in which it puts the pumps in fluid communication with first actuating devices and a second configuration in which it puts at least the first pump in fluid communication with the second actuating devices and at least an electric motor associated with the pumps for operating them.

[0018] According to the invention, the machine comprises a control unit associated with said selecting unit and designed to control it, when said selecting unit is in said second configuration, in such a way as to also put said second pump in fluid communication with the second actuating devices and to vary the flow rate of operating fluid from the second pump to the second actuating de-

vices depending on a trend of the pressure of the operating fluid in the first pump.

[0019] Preferably, the control unit is designed to vary the flow rate of operating fluid from the second pump to the second actuating devices in inverse proportion to a trend of the pressure of the operating fluid in the first pump. In other words, thanks to the system according to this invention, with the decrease in the pressures involved the control unit drives the selecting unit in such a way as to increase the capacity and therefore the speed of movements of the arms.

[0020] Advantageously, in this way, the power available is used to the maximum extent in an almost constant manner.

[0021] In other words, by using a re-reading or closed loop system (software, hydraulic or other) the flow rates are balanced on the basis of the power actually requested from the motor.

[0022] The machine preferably comprises at least one pressure sensor associated with the first pump, set up to detect a parameter representative of the pressure at the first pump and designed to send to the control unit a signal representative of the parameter detected.

[0023] The pressure sensor is located at the first pump, or in any case in a zone of the hydraulic circuit whose pressure is correlated with that present at the first pump.

[0024] Advantageously, according to a detection of the pressure at the pump in a branch, the pump of the other branch is controlled, simplifying the adjustment of the movements, but at the same time making them fast and ready.

[0025] It should be noted that, order to avoid saturation of the system, the machine is equipped pressure detecting element located at the second actuating devices and set up to detect a pressure value of the operating fluid at the second actuating devices.

[0026] The control unit is associated with the detector element and configured to stop the first and/or the second pump when the pressure value measured by the detector element exceeds a predetermined threshold value.

[0027] In other words, in order to prevent a sudden rise of the pressure value at an end stop of the arm from causing an increase in the flow rate supplied from the second pump, the control unit is programmed for detecting (that is, recognising) when a preset pressure value (or pressure increase), or threshold value, is exceeded, stopping the pumps (at least one of the two, preferably the second).

[0028] These and further features and advantages of the present invention will become more apparent from the non-limiting description which follows of a preferred, non-limiting embodiment of lifting machine, in particular of the hydraulic type, as illustrated in the accompanying drawings, in which:

- Figure 1 shows a schematic functional view of a lifting machine according to this invention;
- Figures 2a and 2b show the lifting machine of Figure

1 in two different operating configurations.

[0029] With reference to the accompanying drawings, the numeral 1 denotes a lifting machine, in particular of the hydraulic type, according to this invention.

[0030] Preferably, but not exclusively, the lifting machine 1 is an aerial platform, that is, a device designed to lift persons or objects using a cage "C" located at an end of a telescopic arm.

[0031] However, this invention is applicable to any operating machine equipped with a hydraulic arm and movement means.

[0032] The machine 1 comprises at least a frame 2, or base structure, to which are connected movement means 3, 4 and at least one rotatable and/or telescopic arm 5.

[0033] In particular, the movement means 3, 4 are preferably of the rolling type.

[0034] Preferably, the movement means 3, 4 are defined by at least a first rolling element 3 and a second rolling element 4 which are rotatably associated with the frame 2 for moving it along the ground or a supporting surface "G".

[0035] Alternatively, in any case, other embodiments of movement means can be adopted, which fall within the spirit of this invention.

[0036] Wherever reference is made below to the first 3 and the second rolling element 4, it will be possible (where compatible) to make reference to generic movement means.

[0037] The rolling elements 3, 4 can be defined by wheels or tracks. In the preferred embodiment, as well as in the illustrated embodiment, the first 3 and the second rolling element 4 are defined by a first 3a and a second track 4a, parallel to each other and located on opposite sides of the frame 2.

[0038] The arm 5 is, as mentioned, telescopically and/or rotatably associated with the frame 2, comprising at a free end 5a an operating element 7.

[0039] In the embodiment illustrated, the operating element 7 is a cage "C" designed to receive an operator.

[0040] Alternatively, however, the term operating element 7 may refer to any element located at the free end 5a of the arm 5 and designed to have an operating function, such as for example a blade, lifting forks, a pneumatic punch or the like.

[0041] Preferably, the arm 5 comprises a plurality of elements 6a, 6b, 6c which are movable relative to one another by translating and/or rotating.

[0042] More precisely, the arm 5 comprises at least a first element 6a rotatably coupled to the frame 2 and at least a second element 6b telescopically associated with the first element 6a.

[0043] Alternatively, or in addition, there is a third element 6c defining a further arm which is pivoted to the first 6a or to the second element 6b to allow a scissor type opening designed to allow the lifting of the operating element 7.

[0044] Moreover, auxiliary elements 31 may be asso-

ciated with the arm 5, to perform some "precision" movements, such as the rotation of the operating element 7 or the like.

[0045] Examples of these auxiliary elements are tower rotation, jib, cage rotation.

[0046] In some embodiments there are further elements or auxiliary elements, which are slidable or rotatable, designed to maximise the versatility of movement of the operating element 7.

[0047] The arm 5, and in particular the elements 6a, 6b, 6c, 31, as well as the rolling elements 3, 4 are powered hydraulically at least by respective first 8 and second hydraulic actuating devices 9.

[0048] The first actuating devices 8 are operatively associated with the rolling elements 3, 4 for moving them.

[0049] Similarly, the second actuating devices 9 are operatively associated with the arm 5, that is, the elements 6a, 6b, 6c, 6d, for operating them. Preferably, the auxiliary elements 31, if present, are moved by third hydraulic actuating devices 32.

[0050] It should be noted that the actuating devices (first 8 and/or second 9 and/or third 32) are defined by hydraulic, linear or rotary actuators.

[0051] In other words, the actuating devices are preferably defined by hydraulic and/or hydraulic cylinder motors.

[0052] More specifically, the first actuating devices 8, associated with the rolling elements 3, 4, are defined by at least a pair of hydraulic motors 8a, 8b. More specifically, the first actuating devices 8 comprise a first hydraulic motor 8a associated with the first rolling element 3 and a second hydraulic motor 8b associated with the second rolling element 4.

[0053] The second actuating devices 9, associated with the arm 5, comprise at least one hydraulic cylinder 9a, but preferably they are equipped with one or more hydraulic motors 9b (according to the number of elements and the movements required).

[0054] Similarly, if present, the third actuating devices 32 comprise at least a cylinder 32a and/or a hydraulic motor 32b.

[0055] For feeding the actuator devices 8, 9, the machine 1 comprises a plurality of hydraulic pumps 10, 11, 12, 13 associated to a water circuit 14.

[0056] The circuit hydraulic 14 is designed to put in fluid communication the pumps 10, 11, 12, 13 and the first 8 and the second actuating devices 9 (as well as the third 32, if present).

[0057] In detail, the pumps are of the fixed flow rate gear type.

[0058] It should be noted that, unless otherwise indicated, when reference is made to the actuating devices, reference is made in general, without distinction, to embodiments equipped solely with the first 8 and second 9 actuating devices, as well as to embodiments which are also equipped with third hydraulic actuating devices 32.

[0059] For operating the above-mentioned pumps 10, 11, 12, 13, and the respective actuating devices 8, 9, 32,

the machine 1 comprises motor means associated with them.

[0060] Preferably, the machine comprises two types of motor means; electric and internal combustion.

[0061] More in detail, at least a part of the plurality of pumps 10, 11 is driven by at least an electric motor 15.

[0062] Preferably, the electric motor 15 is a single-phase motor, preferably with the following specifications:

- voltage 230V;
- frequency 50Hz
- output 2.2 kW (3 HP).

[0063] Alternatively, the motor might have a voltage of 110 V and a frequency of 60 Hz.

[0064] Also, the machine 1 preferably comprises at least an internal combustion engine 16, also associated with at least a part of the pumps 12, 13 for operating them.

[0065] The internal combustion engine 16 is preferably of the single-cylinder type with air or water cooling, and with an output preferably less than or equal to 15 HP.

[0066] The electric motor 15 and the internal combustion engine 16 are configured to operate in parallel, that is, alternatively, according to a command issued by an operator.

[0067] Typically, the internal combustion engine 16 is used in outdoor conditions and the electric motor 15 in used in indoor conditions.

[0068] Preferably, each type of motor (electrical 15 or internal combustion 16) is connected to one or more dedicated pumps 10, 11, 12, 13.

[0069] In the preferred embodiment, the plurality of pumps comprises at least a first pump 10 and a second pump 11 associated with the electric motor 15. Moreover, there are a third 12 and a fourth pump 13 associated with the internal combustion engine 16.

[0070] Preferably, the first 10 and the third pump 12 are connected to each other in parallel and can be operated respectively by the electric motor 15 and by the internal combustion engine 16 as a function of the configuration set by the operator.

[0071] Similarly, the second 11 and the fourth pump 13 are also connected to each other in parallel and can be operated respectively by the electric motor 15 and by the internal combustion engine 16 as a function of the configuration set by the operator.

[0072] For this reason, preferably, when the machine 1 is set up by the operator in such a way that the electric motor 15 is active, the first 10 and the second pump 11 feed the hydraulic circuit 14 (and thus the first 8 and second actuating devices 9).

[0073] Similarly, when the machine 1 is set up by the operator in such a way that the internal combustion engine 16 is active, the third 12 and the fourth pump 13 feed the hydraulic circuit 14 (and thus the first 8 and second actuating devices 9).

[0074] Preferably, and irrespective of the configuration set, the hydraulic circuit 14 comprises a selecting unit 17

switchable between a first configuration in which it puts the pumps (in particular the first pump 10 and the second pump 11) in fluid communication with first actuating devices 8 and a second configuration in which it puts at least the first pump 10 (and the third pump 12) in fluid communication with the second actuating devices 9. The selecting unit 17 is configured for diverting the flow of operating fluid (oil) from one actuator unit to another according to a command issued by the operator.

[0075] It should be noted that the machine 1 comprises a control unit 18 associated with the selecting unit 17 and configured for switching it at least between the first and second configuration.

[0076] According to one aspect of the invention, when the selecting unit 17 is in the second configuration, the control unit 18 is configured (that is, programmed) in such a way as to also put the second pump 11 (and the fourth pump 13) in fluid communication with the second actuating devices 9 and to vary the flow rate of operating fluid from the second pump 11 (and from the fourth pump 13) to the second actuating devices 9 depending on a trend of the pressure of the operating fluid in the first pump 10 (and in the third pump 12).

[0077] It should be noted that express reference will be made hereinafter to the first pump 10 and to the second pump 11; however, the considerations made with regard to the first pump 10 and second pump 11 apply *mutatis mutandis*, to the third pump 12 and the fourth pump 13 respectively. Advantageously, thanks to the functionality of the control unit 18 described, the machine 1 is able to optimise the relative operation both in the first configuration of the selecting unit 17, that is to say, in the configuration for forward movement of the machine 1, and in the second configuration of the selecting unit 17, that is to say, in the lifting configuration of the machine.

[0078] In other words, thanks to the presence of the control unit which is able to vary in *real time* the contribution of the second pump 11 to the movement of the second actuating devices 9 depending on the request for pressure, the machine 1 is able to perform in a fast and efficient manner both the initial transient movement of the arms (where a very high pressure is required) and the steady state movements (when the required pressure drops considerably with an increase in the flow rate).

[0079] The control unit 18 is designed to vary the flow rate of operating fluid from the second pump 11 to the second actuating devices 9 in inverse proportion to a trend of the pressure of the operating fluid in the first pump 10.

[0080] In other words, when the selecting unit 17 is in the second configuration, as the pressure at the first pump 10 increases the control unit 18 drives the selecting unit in such a way as to reduce (until cancelling) the contribution (in terms of flow rate) of the second pump 11.

[0081] On the other hand, in this second configuration, with the decrease in the pressure at the first pump 10 the control unit 18 drives the selecting unit in such a way as to increase the contribution (in terms of flow rate) of the

second pump 11.

[0082] In this regard, the machine 1 (and in particular the selecting unit 17) comprises at least one pressure sensor 19 associated with the first pump 10 and set up to detect a parameter representing the pressure at the first pump 10.

[0083] In other words, the pressure sensor 19 is located at the first pump 10 or a half-part of the hydraulic circuit 14 in fluid communication with the first pump 10.

[0084] This pressure sensor 19 is configured to send to the control unit 18 a signal representing the parameter measured.

[0085] For this reason, the control unit 18 designed to receive the signal and configured to drive the selecting unit 17 as a function of it.

[0086] More specifically, the selecting unit 17 comprises at least an adjusting unit 20 interposed between the second pump 11 and the first actuating devices 8 and second actuating devices 9.

[0087] The adjusting unit 20 is operatively associated with the control unit 18 and designed to vary the flow rate of the operating fluid from the second pump 11 to the first actuating devices 8 and/or second actuating devices 9 depending on a control signal sent by said control unit 18.

[0088] Preferably, the adjusting unit 20 is defined by a proportional valve (or solenoid valve) which is able to proportionally vary the flow rate of operating fluid passing through it.

[0089] It should be noted that the control signal is correlated with the signal received from the pressure sensor 19.

[0090] The control unit 18 is in effect operatively associated the adjustment unit 20 and with the pressure sensor 19.

[0091] More specifically, the control unit 18 is designed to send to the adjusting unit 20 a signal correlated with a variation in flow rate in inverse proportion to a corresponding variation in pressure detected by the pressure sensor 19 (at the first pump 10).

[0092] It should be noted that, for maximising efficiency of the hydraulic circuit 14, the selecting unit 17 comprises a further adjusting unit 21 operatively associated with the control unit 18 and designed to vary the flow rate of the operating fluid from the second pump 11 to the first actuating devices 8 and/or second actuating devices 9 depending on a control signal sent by the control unit 18. The further adjustment unit 21 is also preferably defined by a proportional valve (or solenoid valve).

[0093] In order to allow the separate and parallel management of the two pumps 10, 11, the hydraulic circuit 14 comprises at least a first half-part 22 and a second half-part 23 at least partly (hydraulically) parallel with each other. The first half-part 22 connects the first pump 10 with the first actuating devices 8 and/or the second actuating devices 9.

[0094] Similarly, the second half-part 23 connects the second pump 11 with the first actuating devices 8 and/or with the second actuating devices 9.

[0095] Both half-parts 22, 23, following separate paths, are designed to place in communication the respective pump with the respective actuators.

[0096] The first half-part 22 puts in communication the first pump 10 with the first motor 8a and/or with the second actuating devices 9, whilst the second half-part 23 puts in communication the second pump 11 with the second motor and/or with the second actuating devices 9.

[0097] It should be noted that the adjusting unit 20 of the selecting unit 17 is associated with the second half-part 23 and the further adjusting unit 21 is associated with the first half-part 22 of the hydraulic circuit 14.

[0098] Preferably, each first half-part 22 or second half-part 23 of the hydraulic circuit 14 comprises at least one fork 24, 25 formed by a first stretch 24a, 25a, putting in communication the respective pump 10, 11 and the first actuating devices 8, and a second stretch 24b, 25b which puts in communication the first actuating devices 8, and a second stretch 24b, 25b which puts in communication the respective pump 10, 11 with the second actuating devices 9.

[0099] It should be noted that the selecting unit 17 is located at the forks 24, 25.

[0100] In this regard, the selecting unit 17 comprises at least a first diverter unit 27 and a second diverter unit 28 respectively associated with the first half-part 22 and the second half-part 23 of the hydraulic circuit 14, at the forks 24, 25.

[0101] Each first diverter unit 27 or second diverter unit 28 is operatively associated with the control unit 18 and is selectively switchable between an advancing configuration, in which it puts in fluid communication the respective pump 10, 11 with the first stretch 24a, 25a of the respective half-part 22, 23, and a lifting configuration in which it puts in fluid communication the respective pump 10, 11 and the second stretch 24b, 25b of the respective half-part 22, 23.

[0102] For this reason, the forward movement and lifting configurations of the diverter units 27, 28 correspond, respectively, to the first and the second configuration of the selecting unit 17.

[0103] More specifically, the control unit 18 is operatively associated with the first diverter unit 27 and second diverter unit 28 and is designed to switch them from the advancing configuration to the lifting configuration depending on a command issued by an operator (using a control panel, for example with levers, or a pushbutton panel).

[0104] Preferably, each diverter unit 27, 28 is defined by a diverting valve with at least two paths.

[0105] Moreover, the selecting unit 17 comprises at least one communication valve 26 operatively interposed between the second stretches 24b, 25b of the first half-part 22 and the second half-part 23 (and in particular of the half-parts 24, 25) of the hydraulic circuit 14.

[0106] More specifically, the communication valve 26 is operatively associated with the control unit 18 for being controlled between a locked configuration, in which it pre-

vents communication between the second stretches 24b, 25b at least in one direction, and a released configuration, in which it allows communication between the second stretches 24b, 25b at least in that direction.

[0107] The communication valve 26 is designed to prevent the second pump 11 from contributing when it is in the locked configuration, whilst it allows the flow rate in the second pump 11 supporting the first pump 10 when the pressure sensor 19 communicates to the control unit 18 an increase in the pressure.

[0108] In the preferred embodiment, as already mentioned, there are a plurality, preferably at least three, second actuating devices 9.

[0109] In light of this, the hydraulic circuit 14 is equipped with as many feed valves 29 as there are second actuating devices 9.

[0110] These feed valves 29 are preferably switchable between at least three configurations, and in particular:

- a neutral, or lock, configuration, in which the flow of operating fluid towards the respective actuating devices is prevented;
- an active, or load, configuration, in which the flow of operating fluid towards the respective actuation devices is allowed;
- a passive, or unloading, configuration, in which the flow of operating fluid from the respective actuation devices is allowed.

[0111] The second stretch 24b, 25b of the two half-parts 22, 23 is placed in fluid connection (or not) with each second actuating device 9a as a function of the configuration of the feeding valves 29 (preferably defined by 3-way valves).

[0112] In the preferred embodiment, as mentioned above, the machine is equipped with third actuating devices 32, which are also associated with the arm 5, in particular with the auxiliary elements 31 (which require a limited force for moving them).

[0113] Preferably, the third actuating devices 32 are also associated with respective feed valves 33, which are the same as those of the second actuating devices 9.

[0114] Preferably, the third actuating devices 32, that is, their feed valves 33, are put in fluid connection with the second stretch 25b of the fork 25 of the second half-part 23.

[0115] In other words, the third actuating devices 32 are configured to be fed and moved only with the contribution of the second pump 11.

[0116] Preferably, the feed valves 29, 33 are all grouped in a box 30 (or box-shaped body), in order to render the distribution of the fluids more compact and ordered.

[0117] It should be noted that the second stretch 24b of the fork 24 of the first half-part 22 is continuously in fluid connection with all the feed valves 29 of the second actuating devices 9.

[0118] The second stretch 25b of the fork 25 of the

second half-part 23 is, on the other hand, positioned in fluid communication with these feed valves 29 of the second actuating devices 9 only when the communication valve 26 is in the released configuration.

[0119] In the preferred embodiment, the second stretch 25b of the fork 25 of the second half-part 23 is put in fluid communication with all the valves of feeding 33 of the third actuating devices 32.

[0120] Preferably, moreover, the machine comprises a pressure detecting element 34 (or further pressure sensor) located at the second actuating devices 9 and set up to detect a pressure value of the operating fluid at the second actuating devices 9.

[0121] The control unit 18 is also associated with the detector element 34 and configured to stop the first 10 and/or the second pump 11 when the pressure value measured by the detector element 34 exceeds a predetermined threshold value.

[0122] Advantageously, the presence of this detection element 34 allows the control unit 18 to identify the reaching, by the second actuating devices 9, of a limit position, preventing a stalling of the motors and/or of the pumps of the system.

[0123] With reference to the embodiment illustrated, the machine 1 also comprises a stabilising device 35 associated with the frame 2 and comprising a plurality of hydraulic actuators 36 associated with the second half-part 23 of the hydraulic circuit 14.

[0124] More specifically, the hydraulic actuators 36 of the stabilising device 35 are associated with the second stretch 25b of the second half-part 23 of the hydraulic circuit 14 and are operatively interposed between the fork 25 and the second actuating devices 9.

[0125] The stabilising device 35 preferably constitutes a plurality of hydraulic cylinders (at least four) which can be extended independently to allow a complete support of the frame on the ground irrespective of the conditions or the angle of it.

[0126] The invention achieves the preset aims and provides major advantages.

[0127] In effect, the presence of a continuous and "smart" control of the pressures and the flow rates involved maximises the efficiency of the lifting machine, allowing both the lifting of major loads and the fast movement of the arms.

[0128] Moreover, the presence of devices for detecting the limit stops prevents the overloading, that is, the stalling of the motors, guaranteeing the complete reliability of the system.

[0129] Moreover, the structure equipped with a single control unit and a pressure sensor makes it possible to obtain excellent performance levels (99% use of the motor performance) with a minimum complication of existing systems.

Claims

1. A lifting machine, comprising:

- a main frame (2);
 - movement means (3, 4) associated with the frame (2) for moving it along the ground or a supporting surface (G);
 - at least one arm (5) telescopically and/or rotatably associated with the frame (2), comprising at a free end (5a) an operating element (7);
 - first hydraulic actuating devices (8) and second hydraulic actuating devices (9) respectively associated with movement means (3, 4) and with said at least one arm (5) for moving them;
 - at least a first hydraulic pump (10) and a second hydraulic pump (11) respectively associated with the first actuating devices (8) and the second actuating devices (9) for feeding them with an operating fluid;
 - a hydraulic circuit (14) designed to put in fluid communication said pumps (10, 11) and said first actuating devices (8) and second actuating devices (9) and comprising a selecting unit (17) switchable between a first configuration in which it puts said pumps (10, 11) in fluid communication with first actuating devices (8) and a second configuration in which it puts at least said first pump (10) in fluid communication with the second actuating devices (9);
 - at least an electric motor (15) associated with said pumps (10, 11) for operating them;
- characterised in that** it comprises a control unit (18) associated with said selecting unit (17) and designed to control it, when said selecting unit (17) is in said second configuration, in such a way as to also put said second pump (11) in fluid communication with the second actuating devices (9) and to vary the flow rate of operating fluid from the second pump (11) to the second actuating devices (9) depending on a trend of the pressure of the operating fluid in the first pump (10).

2. The machine according to claim 1, **characterised in that** the control unit (18) is designed to vary the flow rate of operating fluid from the second pump (11) to the second actuating devices (9) in inverse proportion to a trend of the pressure of the operating fluid in the first pump (10).

3. The machine according to claim 1 or 2, **characterised in that** it comprises at least one pressure sensor (19) associated with said first pump (10), set up to detect a parameter representative of the pressure at said first pump (10) and designed to send to the control unit (18) a signal representative of said parameter detected.

4. The machine according to any one of claims 1 to 3, **characterised in that** said selecting unit (17) comprises at least one adjusting unit (20):
 - interposed between said second pump (11) and the first actuating devices (8) and second actuating devices (9),
 - operatively associated with said control unit (18) and
 - designed to vary the flow rate of the operating fluid from the second pump (11) to the first actuating devices (8) and/or second actuating devices (9) depending on a control signal sent by said control unit (18).
5. The machine according to claim 4, **characterised in that** said control unit (18) is operatively associated with said adjusting unit (20) and with said pressure sensor (19); said control unit (18) being designed to send said adjusting unit (20) a signal correlated with a variation in flow rate in inverse proportion to a corresponding variation in pressure detected by said pressure sensor (19).
6. The machine according to any one of the preceding claims, **characterised in that** said hydraulic circuit (14) comprises at least a first half-part (22) which connects said first pump (10) with the first actuating devices (8) and/or the second actuating devices (9), and a second half-part (23) which connects said second pump (11) with the first actuating devices (8) and/or with the second actuating devices (9).
7. The machine according to claims 4 and 6, **characterised in that** the adjusting unit (20) of the selecting unit (17) is associated with the second half-part (22) of the hydraulic circuit (14) and said selecting unit (17) comprises at least one further adjusting unit (21) associated with the first half-part (22) of the hydraulic circuit (14).
8. The machine according to claim 6 or 7, **characterised in that** each first half-part (22) or second half-part (23) of the hydraulic circuit (14) comprises at least one fork (24, 25) formed by a first stretch (24a, 25a), putting in communication the respective pump (10, 11) and the first actuating devices (8), and a second stretch (24b, 25b) putting in communication the respective pump (10, 11) and the second actuating devices (9); said selecting unit (17) being positioned at said forks (24, 25).
9. The machine according to claim 8, **characterised in that** said selecting unit (17) comprises at least one communication valve (26) operatively interposed between the second stretches (24b, 25b) of the first half-part (22) and the second half-part (23) of the hydraulic circuit (14); said communication valve (26) being operatively associated with the control unit (18) for being controlled between a locked configuration, in which it prevents communication between said second stretches (24b, 25b) at least in one direction, and a released configuration, in which it allows communication between said second stretches (24b, 25b) at least in said direction.
10. The machine according to any one of claims 6 to 9, **characterised in that** said selecting unit (17) comprises at least a first diverter unit (27) and a second diverter unit (28) respectively associated with the first half-part (22) and the second half-part (23) of the hydraulic circuit (14), at said forks (24, 25); each first diverter unit (27) or second diverter unit (28) being operatively associated with said control unit (18) and selectively switchable between an advancing configuration, in which it puts in fluid communication the respective pump (10, 11) and the first stretch (24a, 25a) of the respective half-part (22, 23), and a lifting configuration in which it puts in fluid communication the respective pump (10, 11) and the second stretch (24b, 25b) of the respective half-part (22, 23).
11. The machine according to claim 10, **characterised in that** said control unit (18) is operatively associated with said first diverter unit (27) and second diverter unit (28) and is designed to switch them from the advancing configuration to the lifting configuration depending on a command issued by an operator.
12. The machine according to any one of claims 6 to 11, **characterised in that** said first actuating devices (8) comprise at least a first hydraulic motor (8a) and a second hydraulic motor (8b) respectively associated with the first rolling element (3) and the second rolling element (4); said first half-part (22) of the hydraulic circuit (14) being shaped to put in fluid communication said first pump (10) and the first hydraulic motor (8a) and said second half-part (23) of the hydraulic circuit (14) being shaped to put in fluid communication said second pump (11) and the second hydraulic motor (8b).
13. The machine according to any one of claims 6 to 12, **characterised in that** it comprises at least one stabilising device (35) associated with the frame (2) and comprising a plurality of hydraulic actuators (36) associated with the second half-part (23) of the hydraulic circuit (14).
14. The machine according to claim 13, **characterised in that** said hydraulic actuators (36) of the stabilising device (35) are associated with the second stretch (25b) of the second half-part (23) of the hydraulic circuit (14) and are operatively interposed between the fork (25) and the second actuating devices (9).

15. The machine according to any one of the preceding claims, **characterised in that** it comprises a pressure detecting element (34) located at the second actuating devices (9) and set up to detect a pressure value of the operating fluid at said second actuating devices (9); said control unit (18) being associated with said detecting element (34) and designed to stop said first pump (10) and/or said second pump (11) when said pressure value detected by the detecting element (34) exceeds a predetermined threshold value.

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FIG.1

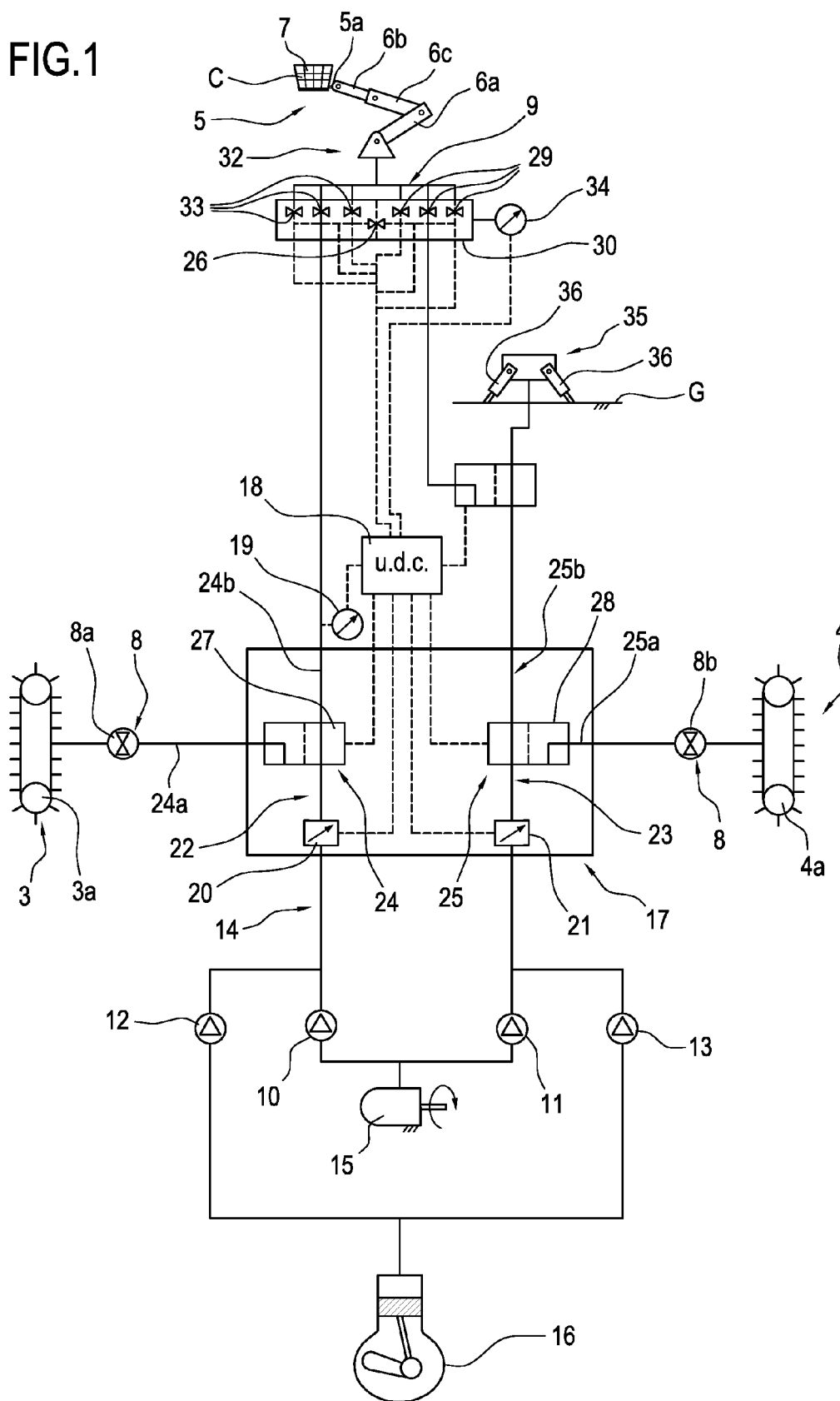


FIG. 2a

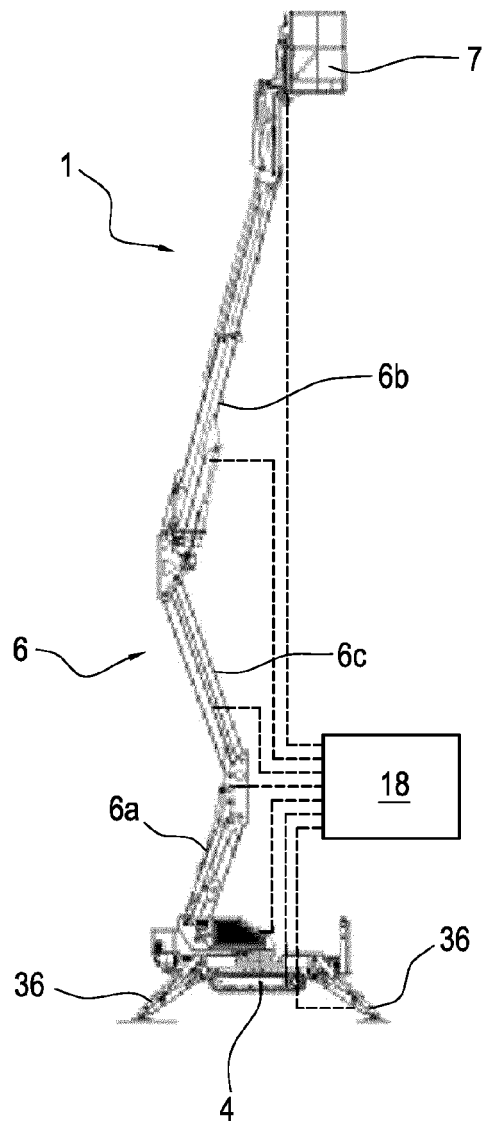
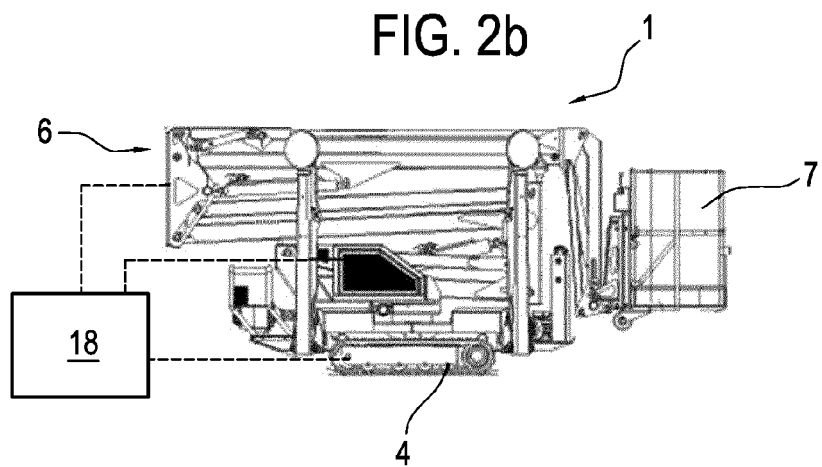


FIG. 2b





EUROPEAN SEARCH REPORT

Application Number
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Place of search The Hague		Date of completion of the search 27 November 2015	Examiner Rupcic, Zoran
CATEGORY OF CITED DOCUMENTS		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	
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