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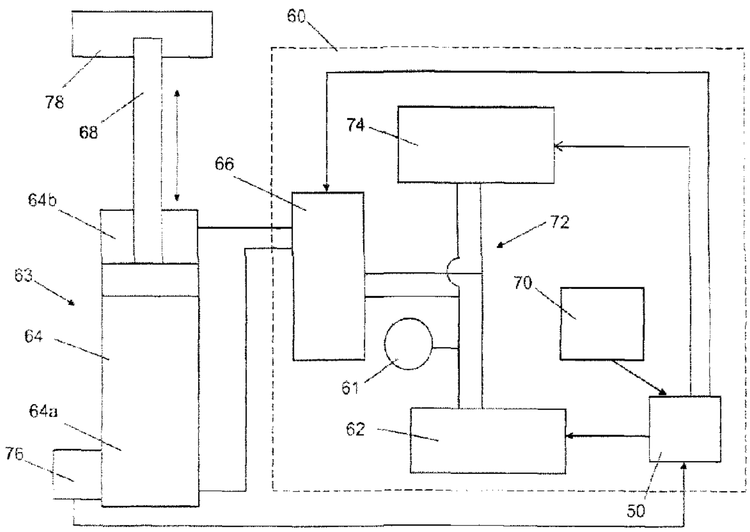
(54) Titre : UN MECANISME DE COMMANDE HYDRAULIQUE SERVANT A COMMANDER UN DISPOSITIF DEPLACABLE
(54) Title: A HYDRAULIC CONTROL SYSTEM FOR CONTROLLING A MOVEABLE DEVICE



(57) Abrégé/Abstract:
A control system for controlling a moveable device comprises: at least one hydraulic actuator associated with the moveable device, at least one position sensing device to determine the position of the moveable device or the actuator, or both, and a hydraulic control system, including an electronic control unit, for controlling the actuator. For performing a control method, the hydraulic control system is configured to deliver pressurized hydraulic fluid to the actuator, the hydraulic fluid being pressurized at most to a predetermined maximum pressure, and the control system is adapted to regulate the predetermined maximum pressure based on the determined position. According to an example, the moveable device is a boom of a working machine. According to a further example, the actuator is a hydraulic cylinder or motor.

Abstract

A control system for controlling a moveable device comprises: at least one hydraulic actuator associated with the moveable device, at least one position sensing device to determine the position of the moveable device or the actuator, or both, and a hydraulic control system, including an electronic control unit, for controlling the actuator. For performing a control method, the hydraulic control system is configured to deliver pressurized hydraulic fluid to the actuator, the hydraulic fluid being pressurized at most to a predetermined maximum pressure, and the control system is adapted to regulate the predetermined maximum pressure based on the determined position. According to an example, the moveable device is a boom of a working machine. According to a further example, the actuator is a hydraulic cylinder or motor.

A HYDRAULIC CONTROL SYSTEM FOR CONTROLLING A MOVEABLE DEVICE

Field of the Invention

The invention relates to a working machine vehicle being a forestry harvester or a forestry forwarder and having a moveable device which is an articulated boom connected to the working machine vehicle and having a tool attached to the articulated boom. The invention further relates to a method of controlling the moveable device in the working machine by using a hydraulic control system having an electronic control unit.

Background of the Invention

Working machines, in particular forestry equipment and forest machines, e.g. a harvester and a forwarder, have an articulated boom and a tool attached to the boom. The tool can be e.g. a harvester head, a felling head, a harvesting and processing head, or a log grapple. The tool can be used e.g. to cut standing trees, to process felled trees or to grab objects, such as logs or tree trunks. When using such a tool, it is moved under the control of an operator of the work machine to a desired position mainly by controlling the position of the boom and moving the tool with the boom.

The hydraulic control systems for controlling e.g. the boom are dimensioned for a predetermined highest maximum pressure requirement. In the previously known hydraulic control systems for e.g. the working machines with a boom, the force and especially the available net force for lifting loads or moving the boom can be perceived as too small when the boom is extended or the horizontal reach of the boom is reaching its maximum. On the other hand, the available net force for lifting loads or moving the boom can be perceived as unnecessarily high when the boom is retracted or the horizontal reach of the boom is reaching its minimum. In the former case it may be impossible to perform selected work functions and in the latter case hydraulic energy is wasted or the boom must be constructed unnecessarily durable to take long-term overload. Thus, there are conflicting design requirements because

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the available net force should be high and the boom should be constructed with long reach and a light structure.

Summary of the Invention

The solution to be presented is directed to overcoming one or more disadvantages noted above and associated with the above-mentioned articulated boom the position of which is controlled with hydraulic actuators generating forces necessary to perform work functions.

According to the presented solution, the working machine vehicle including the control system for controlling the moveable device comprises at least one hydraulic actuator associated with the moveable device for performing at least one work function, at least one position sensing device to determine the position of the moveable device, and the hydraulic control system, including the electronic control unit, for controlling the at least one hydraulic actuator.

The hydraulic control system is configured to deliver pressurized hydraulic fluid at a pressure to the at least one hydraulic actuator, the hydraulic fluid being pressurized at most to a predetermined maximum pressure, and the control system is adapted to regulate the predetermined maximum pressure on the basis of the reach R of the moveable device. The moveable device is the said articulated boom movable into several positions such that the reach R is dependent on the positions.

According to the presented solution, the method in the working machine vehicle of controlling the moveable device by using the hydraulic control system having the electronic control unit. The method provides the following steps: controlling the moveable device by using the hydraulic control system, moving the moveable device into the several positions, performing the work function with the moveable device controlled by the at least one hydraulic actuator associated with the moveable device, sensing the position of the moveable device, delivering the hydraulic fluid at a pressure to the at least one hydraulic actuator and

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pressurizing the hydraulic fluid at most to the predetermined maximum pressure, and regulating the predetermined maximum pressure on the basis of the reach R of the moveable device. The moveable device is the said articulated boom movable into the several positions such that the reach R is dependent on the positions.

Below, the presented solution will be described in connection with the working machine vehicle in the form of a forestry harvester having the articulated boom. However, the forestry harvester is not a limiting application of the presented solution. The solution can also be used for a forestry forwarder.

A technical effect related to the presented solution is increased available net forces when handling a load with the extended articulated boom. Another technical effect related to the presented solution is reduced available net forces when handling a load with the retracted articulated boom. In the latter case, joint arrangements of the articulated boom experience less overload compared to traditional solutions.

Description of the Drawings

Figure 1 shows an example of a working machine having a boom and a tool.

Figure 2 shows a first example of a hydraulic control system.

Figure 3 shows a traditional method of controlling hydraulic control systems.

Figures 4 and 5 show methods of controlling hydraulic control systems.

Figure 6 shows a second example of a hydraulic control system.

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Detailed Description of the Invention

Reference will now be made to an example of the presented solution which is illustrated in the accompanying drawings.

Figure 1 shows an exemplary working machine 10 in which the presented solution can be applied. The working machine 10 is a forestry working machine, namely a forestry harvester, and comprises an articulated boom 20.

The working machine 10 may comprise a frame 12, a cabin 14 with an operator’s station, an engine 15 as the source of power, and a slewing apparatus 22. The working machine 10 may further comprise a tilting apparatus 21. A tool 30 may be connected to the boom 20.

The frame 12 may be articulated and have two or more frame sections 12a, 12b connected one after the other by means of a controlled joint 13. The frame 12 is wheeled and supported by several wheels 11. Alternatively or additionally, the frame 12 may have an endless track arrangement for supporting the frame 12 and to drive the work machine 10.

According to another example, the work machine 10 may have a load space located on the frame 12 or the frame section 12a, 12b. The load space may have several bunks for supporting a load. The load space is for carrying logs or tree trunks loaded into the load space.

The boom 20 is mounted onto the slewing apparatus 22 connected to the frame 12. By turning the slewing apparatus 22, the boom 20 can be rotated or slewed about a rotation axis N that is oriented vertically or substantially vertically. According to an example, the slewing apparatus 22 may be connected to the frame 12 via the tilting apparatus 21 for tilting the boom 20 such that the axis N is controllably tilted.

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The slewing apparatus 22 or the tilting apparatus 21 may include a linear actuator, e.g. a hydraulic cylinder, for rotating or tilting. The slewing apparatus 22 may include a rotary actuator, e.g. a hydraulic motor, for rotating or slewing.

The boom 20 may have two or more boom sections 24, 26, 28 connected one after the other. Two or more boom sections 24, 26, 28 are connected to each other by means of a joint arrangement 36, 38. The joint arrangement 36, 38 may provide rotation around a horizontal rotation axis. The joint arrangement 36, 38 may be controlled by means of one or several linear actuators 29 and 31, e.g. a hydraulic cylinder.

In the example of Fig. 1, the base boom section 28 is connected between the slewing apparatus 22 and the second boom section 26. The position of the second boom section 26 in relation to the base boom section 28 is controlled by the linear actuator 29. The linear actuator 29 is connected between the base boom section 28 and the second boom section 26. Alternatively, the second boom section 26 is pivotally connected to the slewing apparatus 22 without the base boom section 28 and the linear actuator 29 is connected between the second boom section 26 and the slewing apparatus 22. The first boom section 24 is connected to the second boom section 26. The position of the first boom section 24 in relation to the second boom section 26 is controlled by the linear actuator 31. The linear actuator 31 is connected between the second boom section 26 and, either directly or via the joint arrangement 38, the first boom section 24.

One or more boom sections of the boom 20 may operate telescopically and move linearly. The extension and the length of the telescopically operating boom section is controlled by means of two or more boom section parts arranged movably within each other. One or several linear actuators may be used to control the relative positions of the boom section parts. The linear actuator is connected to the boom section of the boom 20 provided with the boom section parts and the linear actuator is located either inside or outside the boom section. According to an example, the first boom section 24 is arranged telescopically operating.

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The tool 30 may be connected at the end of the boom 20 or the first boom section 24, or a boom section part of the boom 20, represented by a tip P of the boom 20 in Fig. 1.

The tool 30 may be rotatably connected to the tip P by means of an actuator 32, e.g. a rotator or a rotary actuator. With the actuator 32, the tool 30 suspended to the actuator 32 can be controllably rotated about a rotation axis X that is oriented vertically or substantially vertically. The position of the tool 30 is thus controlled with the actuator 32. According to an example and Fig. 1, the actuator 32 may be connected to the boom 20 via a connecting link 34 maintaining the upright position of the tool 30.

The tool 30 may be a harvester head, a felling head, a harvesting and processing head, a harvester head suitable to be used as a log grapple, or a log grapple.

The working machine 10 further comprises an actuator 63 associated with a moveable device 78 and the articulated boom 20 represents the moveable device 78 (see Fig. 2 and Fig. 6) performing a work function when controlled with the actuator 63 associated with the moveable device 78.

The actuator 63 may be a linear actuator 64, as exemplified in Fig. 2, or a rotary actuator 65, as exemplified in Fig. 6. The actuator 63 changes the position of the moveable device 78 when performing the work function. The moveable device 78 may be configured to rotate or turn about a rotation axis, e.g. a horizontal axis, or to move linearly.

One or more boom sections of the boom 20 operate by raising and lowering the tool 30 or another boom section of the boom 20 connected to the boom section. According to an example and Fig. 1, the second boom section 26 is pivotably connected to the base boom section 28. In this way, the reach Rb of the second boom section 26 can be controlled by turning the second boom section 26 about a horizontal or substantially horizontal rotation axis. The second boom 26 is pivotably connected to the first boom section 24. In this way, the

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reach Ra of the first boom section 24 can be controlled by turning the first boom section 24 about a horizontal or substantially horizontal rotation axis.

The reach R of the boom 20 or the tip P can be controlled by turning the first boom section 24 or the second boom section 26, or both. The reach R may be represented by a reach in a horizontal direction (see Fig. 1), in a substantially horizontal direction or in a sloping direction, as will be described below.

A reference point, or reference points, for determining the reach R may, for example, be a predetermined point at the boom 20 or the working machine 10, the point where the boom 20 is connected to the working machine 10, the joint arrangement 36, the tip P of the boom 20, or the point where the tool 30 is connected to the boom 20.

Thus, the reach R relates to the moveable device 78 and the reference point may, for example, be one or both ends of the moveable device 78 or the point at which the moveable device 78 is connected to another device or structure, e.g. via a joint arrangement.

An exemplary hydraulic control system 60 of the working machine for controlling the actuator 63 associated with the moveable device 78 is shown in Figs. 2 and 6. The control system 60 comprises an electronic control unit 50.

The control system 60 may comprise an apparatus 62 for generating hydraulic energy and supplying pressurized hydraulic fluid, delivered via a hydraulic transmission line arrangement 72. The control system 60 may further comprise one or more directional control valve devices 66, and one or more pressure control devices 74, one or more control devices 70 for the use of an operator controlling the moveable device 78.

The hydraulic transmission line arrangement 72 may have channels, rigid lines or flexible hoses for delivering hydraulic fluid to the components of the control system 60.

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The apparatus 62 may be controlled by the electronic control unit 50 via electrical signals. According to an example the apparatus 62 is a hydraulic pump device. The hydraulic pump device may be a variable displacement pump. According to another example, the hydraulic pump device includes load-sensing functions.

The apparatus 62 may be based on electric energy stored in an accumulator or generated with a generator operatively connected to the engine 15 of the working device 10. Alternatively or additionally, the apparatus 62 is based on mechanical energy for converting it to hydraulic energy. The apparatus 62 may be operatively connected to the engine 15 of the working machine 10.

The control device 70 may be a joystick. Preferably, the control device 70 is located at the operator's station in the cabin 14. With the control device 70, the operator may move for example the boom 20, the tip P of the boom 20, a boom section of the boom 20, or the tool 30 either towards (with a movement Ma) or away from (with a movement Mb) the working machine 10 or the reference point of the example in Fig. 1. The control device 70 may be operably connected with the electronic control unit 50.

The directional control valve device 66 controls the actuator 63 by means of controlling the flow of the pressurized hydraulic fluid of the hydraulic transmission line arrangement 72. The directional control valve device 66 is controlled by the electronic control unit 50 via electrical signals. According to an example, the directional control valve device 66 may include a directional control valve having ports for the pressurized hydraulic fluid and preferably providing proportional flow control. According to another example, the directional control valve further includes pressure reducing functions.

The pressure control device 74 limit the pressure of the hydraulic fluid in the hydraulic transmission line arrangement 72 or in a part of the hydraulic transmission line arrangement 72. The pressure control device 74 may be electronically controlled by the electronic control unit 50 and it may include one or more pressure control valves, e.g. a relief valve or a pressure

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reducing valve. The pressure control device 74 may limit the pressure of the hydraulic fluid fed to the actuator 63.

According to an example in Fig. 2, the actuator 63 is a linear actuator 64. The linear actuator 64 may be a hydraulic cylinder utilizing hydraulic energy and pressurized hydraulic fluid which is transmitted to the linear actuator 64 by means of the hydraulic transmission line arrangement 72.

The hydraulic cylinder may be a single acting cylinder or a double acting cylinder as shown in Fig. 2. The hydraulic cylinder has a reciprocating piston rod 68 and at least a piston side chamber 64a connected with the hydraulic transmission line arrangement 72. The hydraulic cylinder may further have a piston rod side chamber 64b connected with the hydraulic transmission line arrangement 72.

The linear actuator 64 is connected to the moveable device 78. For example, the linear actuator 64 of Fig. 2 represents a linear actuator of the working machine 10 in Fig. 1, for example a linear actuator of the boom 20, the linear actuator 29, the linear actuator 31 or a linear actuator in the tilting apparatus 21. According to an example the linear actuator 64 is a lifting cylinder of the boom 20 in Fig. 1, for example the linear actuator 29.

The directional control valve device 66 is adapted to control the reciprocating piston rod 68 of the linear actuator 64. To extend the piston rod 68, pressurized hydraulic fluid is led to the piston side chamber 64a. To retract the piston rod 68, pressurized hydraulic fluid is led to the piston rod side chamber 64b. Hydraulic fluid returning from the linear actuator 64 may be led to a tank via the hydraulic transmission line arrangement 72. A force is generated in the linear actuator 64 as a function of the pressure of the hydraulic fluid.

According to another example in Fig. 6, the actuator 63 is a rotary actuator 65. The rotary actuator 65 may be a hydraulic motor utilizing hydraulic energy and pressurized hydraulic fluid which is transmitted to the rotary actuator 65 by means of the hydraulic transmission line

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arrangement 72. The rotary actuator 65 may be connected to the moveable device 78 to change its position.

The directional control valve device 66 is adapted to control the rotation of the rotary actuator 63. The rotary actuator 65 may be adapted to rotate the moveable device 78 about an axis. 1. A torque is generated in the rotary actuator 65 as a function of the pressure of the hydraulic fluid.

The control system 60 may further have one or more pressure sensing devices 61 for detecting pressures related to the hydraulic fluid in the hydraulic transmission line arrangement 72, in a part of the hydraulic transmission line arrangement 72 or led to the actuator 63 and controlled by the directional control valve device 66. The pressure sensing device 61 may be operably connected to the electronic control unit 50. The pressure sensing device 61 may be a pressure sensor.

The control system 60 may be load-sensing such that, based on signals received from the one or more pressure sensing devices 61, the apparatus 62 is controlled by the electronic control unit 50 to supply hydraulic fluid with regulated pressure. Alternatively or additionally, the one or more pressure sensing devices 61 may control the hydraulic pump device of the apparatus 62 to supply hydraulic fluid with regulated pressure dependent on the loading of the control system 60.

The control system 60 comprises a position sensing device 76 is adapted to determine the position of the moveable device 78. The position sensing device 76 is operably connected, via a wire or wirelessly, to the electronic control unit 50. The operational principle of the position sensing device 76 may vary and optical, electro-optical, mechanical, electro-mechanical, electrical, and resistive sensor types may be used as the position sensing device 76.

The position sensing device 76 generates signals indicative of the position of the moveable device 78. The position may be represented as a relative or absolute position. The position of

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the actuator 63 associated with the moveable device 78 may be dependent on the position of the moveable device 78. Therefore, the position of the moveable device 78 can be determined from the signals indicative of the position of the actuator 63, for example the linear actuator 64 and the rotary actuator 65 described above.

According to an example in Fig. 2, the position sensing device 76 is adapted to detect the stroke of the linear actuator 64or the position of the piston rod 68. According to another example and Fig. 6, the sensing device 76 is adapted to detect the angular position of the rotary actuator 65. The sensing device 76 may be located in or at the actuator 63.

An exemplary arrangement of the one or more position sensing devices 76 in relation to the control system 60 is presented referring to Fig. 1. The position sensing device 76 may represent one or more of the following sensing devices: a sensing device 42 arranged to determine the position of the boom 20, the tip P or the first boom section 24, a sensing device 44 for measuring an angle $\alpha3$ of the first boom section 24, a sensing device 45 for measuring an angle $\alpha2$ of the boom 20 or the second boom section 26, a sensing device 46 for measuring an angular position of the slewing apparatus 22 or an azimuth angle $\alpha1$ of the boom 20, the second boom section 26 or the base boom section 28, a sensing device 47 for measuring the length of a telescopic boom section of the boom 20, and a sensing device 48 for measuring the position of a boom section of the boom 20.

The electronic control unit 50 may be located in the cabin 14 or on the frame 12 of the work machine 10. A display may be connected to the electronic control unit 50 for showing information and data to the operator. Control signals from the control device 70 are communicated to the electronic control unit 50 and the electronic control unit 50 controls the control system 60 and its components to change the position of the moveable device 78.

The electronic control unit 50 may a programmable microprocessor-based device with a memory device and associated computer program code, for generating control signals to responsively control various actuators. The computer program code may be in a form of a

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control program or a control algorithm, or appropriate computer software, running or being executed under the control of the electronic control unit 50. The electronic control unit 50 may have a distributed configuration with several subunits communicating with each other. The electronic control unit 50 performs control methods based on the input information received by the control unit from the sensing device 76. The electronic control unit 50 utilizes the generated control signals to automatically implement control methods and strategies.

Based on signals received from the one or more position sensing devices 76, the electronic control unit 50 is able to select a control strategy in accordance with the determined position of the moveable device 78 or the actuator 63. The control unit 50 controls the control system 60 according to the selected control strategy.

According to an example, the electronic control unit 50 in particular controls the directional control valve device 66 or the apparatus 62 based on the control strategy. According to another example, the control unit 50 controls the pressure control device 74 based on the control strategy.

Figure 3 shows an exemplary control strategy based on a traditional method. The horizontal R axis relates to the position of the moveable device 78 and the vertical F axis relates to forces experienced by the moveable device 78. As explained above, the reach of the moveable device 78 depends on the position of the moveable device 78. In particular, the horizontal R axis relates to the reach R of the boom 20. A curve 80 shows the relationship between the reach and the predetermined maximum forces allowed when performing a work function. The relationship is traditionally linear. In particular, the vertical F axis relates to forces generated by the linear actuator 64, e.g. a hydraulic cylinder, and acting on the moveable device 78.

A parameter Fb shows a level of force above which the forces are considered to be too high. A particular example for this case is when the boom 20 is retracted and forces acting on the boom 20 load the structure or the joint arrangements of the boom 20. A parameter Fa shows a level of force above which the forces are considered to be too low for successfully performing

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a work function. A particular example for this case is when the boom 20 is extended and a load is lifted with the tool 30 attached to the boom 20.

A different approach is shown in the exemplary control strategy of Figure 4. Depending on the position of the moveable device 78, in particular the reach R, when a force acting on the moveable device 78 is considered to be too high and above a predetermined level defined by the parameter Fb, the force is limited to or below the parameter Fb. This control strategy is shown by a curve 52a.

Alternatively or additionally, depending on the reach R, when a force falling on the moveable device 78 is considered to be too low and below a predetermined level defined by the parameter Fa, the force is allowed to rise to or above the parameter Fb. This control strategy is shown by a curve 52c. The raised force is preferably short-termed to protect the moveable device 78 from long-term overload.

A curve 52b relates to intermediate values of force that are not limited nor affected by the parameter Fa or the parameter Fb, or both. The value of the parameter Fb is higher than the value of the parameter Fa.

The forces, or torque, acting on the moveable device 78 for performing work functions are generated in the actuator 63 as a function of hydraulic fluid pressure. Thus, the forces shown in Fig. 4 depend on the hydraulic fluid pressure. An exemplary control strategy based on the hydraulic fluid pressure in the actuator 63 is shown in Figure 5. Fig. 5 relates to the same work function as Fig. 4. In Fig. 5, the vertical P axis relates to the hydraulic fluid pressure regulated by the hydraulic control system 60 and acting on the actuator 63.

Depending on the position of the moveable device 78, in particular the reach R, when a force or torque acting on the moveable device 78 is considered to be too high, the hydraulic fluid pressure is limited. This control strategy is shown by a curve 56a representing a predetermined maximum pressure relating to the hydraulic fluid pressure. The hydraulic fluid

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is pressurized at most to the predetermined maximum pressure for performing work. According to an example, the shorter the reach R is the lower the predetermined maximum pressure is.

Alternatively or additionally, depending on the position of the moveable device 78, in particular the reach R, when a force or torque acting on the moveable device 78 is considered to be too low, the hydraulic fluid pressure is allowed to rise. This control strategy is shown by a curve 56c representing a predetermined maximum pressure relating to the hydraulic fluid pressure. The hydraulic fluid is pressurized at most to the predetermined maximum pressure for performing work. According to an example, the longer the reach R is the higher the predetermined maximum pressure is.

A curve 56b relates to values of force or torque that are allowable and represents predetermined maximum pressures the hydraulic fluid is pressurized at most. However, the predetermined maximum pressure need not be dependent on the position of the moveable device 78. For comparison, a control strategy based on the traditional method is represented by a curve 82 showing no dependence on the position of the moveable device 78.

The predetermined maximum pressure may be set lower for positions (see the curve 56a) different from other, basic positions represented by the curve 56b.

Alternatively or additionally, the predetermined maximum pressure is set higher for positions (see the curve 56c) different from other, basic positions represented by the curve 56b.

The control system 60 is adapted to allow hydraulic fluid pressures with a value at or below the predetermined maximum pressure. The predetermined maximum pressure represents the pressure the hydraulic fluid delivered to the actuator 63 is at most pressurized.

For comparison, in the traditional method, the predetermined maximum pressure is not dependent on the position of the moveable device 76, which is shown by the curve 82

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representing a predetermined maximum pressure and defined by a parameter Pr having a constant or fixed value. The predetermined maximum pressure represented in the curve 82 of Fig.5 allows a force represented in the leftmost part of the curve 80 of Fig.4 to raise above the parameter Fb in some predetermined positions of the moveable device 78. Alternatively or additionally, in the traditional method, the predetermined maximum pressure and defined by the parameter Pr represented in the curve 82 of Fig.5 does not allow a force represented in the rightmost part of the curve 80 of Fig.4 to raise above the parameter Fa in some predetermined positions of the moveable device 78.

The control strategy according to an example may be based on a linear relationship as shown by the curve 52 or the curve 56. Alternatively or additionally, the control strategy may be based on a mathematical relationship, a function, linear or nonlinear relationship, or tabulated values, as shown by a curve 54 in Fig. 4, or on any combination of these.

The presented solution is not limited to the examples and embodiments explained above or presented with reference to the figures. The presented solution is defined by the appended claims.

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CLAIMS:

1. A working machine vehicle being a forestry harvester or a forestry forwarder, comprising:

an articulated boom connected to the working machine vehicle,

a tool connected to the articulated boom, and

a control system for controlling a moveable device which is the articulated boom moveable into several positions such that a reach (R) of the moveable device is dependent on the positions,

wherein the control system includes

at least one hydraulic actuator associated with the moveable device for performing at least one work function,

at least one position sensing device to determine the position of the moveable device, and

a hydraulic control system, including an electronic control unit, for controlling the at least one hydraulic actuator, wherein the hydraulic control system is configured to deliver pressurized hydraulic fluid at a pressure to the at least one hydraulic actuator, the hydraulic fluid being pressurized at most to a predetermined maximum pressure, and

wherein the control system is adapted while performing the work function to regulate the predetermined maximum pressure on the basis of the reach R.

2. The working machine according to claim 1, wherein

the at least one hydraulic actuator is a hydraulic linear actuator or a hydraulic rotary actuator connected to the moveable device, and

the at least one hydraulic actuator is adapted to rotate the moveable device about an axis or to linearly move the moveable device.

3. The working machine according to claim 1 or 2, wherein the reach R of the articulated boom is determined in a horizontal direction.

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4. The working machine according to any one of claims 1 to 3, wherein

the moveable device is movable into several basic positions and at least one retracted position, wherein when in the at least one retracted position the reach R of the moveable device is less than when in the basic positions, and

the control system is adapted to regulate the predetermined maximum pressure to be lower in the at least one retracted position than in the basic positions.

5. The working machine according to claim 3 or 4, wherein the shorter the reach R is the lower the regulated predetermined maximum pressure is.

6. The working machine according to any one of claims 1 to 5, wherein

the moveable device is movable into several basic positions and at least one extended position, wherein when in the at least one extended position the reach R of the moveable device is longer than when in the basic positions, and

the control system is adapted to regulate the predetermined maximum pressure to be higher in the at least one extended position than in the basic positions.

7. The working machine according to claim 1 or 6, wherein the longer the reach R is the higher the regulated predetermined maximum pressure is.

8. The working machine according to claim 6, wherein the work function is a load lifting work function performed while in the at least one extended position by means of the tool attached to a tip of the articulated boom.

9. The working machine according to any one of claims 1 to 8, wherein

the control system comprises at least one directional control valve device with pressure reducing functions and controlling the flow of the pressurized hydraulic fluid to the at least one hydraulic actuator, and

the at least one directional control valve device is regulated by the electronic control unit in accordance with the predetermined maximum pressure.

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10. The working machine according to any one of claims 1 to 9, wherein

the control system comprises at least one hydraulic pump device with load-sensing functions and adapted to supply the at least one hydraulic actuator with the pressurized hydraulic fluid, and

the at least one hydraulic pump device is regulated by the electronic control unit in accordance with the predetermined maximum pressure.

11. The working machine according to any one of claims 1 to 10, wherein the position sensing device comprises a sensor adapted to transmit a signal indicative of the position of the moveable device.

12. A method in a working machine vehicle being a forestry harvester or a forestry forwarder and including an articulated boom connected to the working machine vehicle and movable into several positions such that reach R of the articulated boom is dependent on the positions, a tool connected to the articulated boom, and a hydraulic control system having an electronic control unit, the method comprising:

controlling the articulated boom by using the hydraulic control system,

moving the articulated boom into the several positions,

performing a work function with the articulated boom controlled by at least one hydraulic actuator associated with the articulated boom,

sensing the position of the articulated boom,

delivering hydraulic fluid at a pressure to the at least one hydraulic actuator and pressurizing the hydraulic fluid at most to a predetermined maximum pressure, and

regulating the predetermined maximum pressure on the basis of the reach R while performing the work function.

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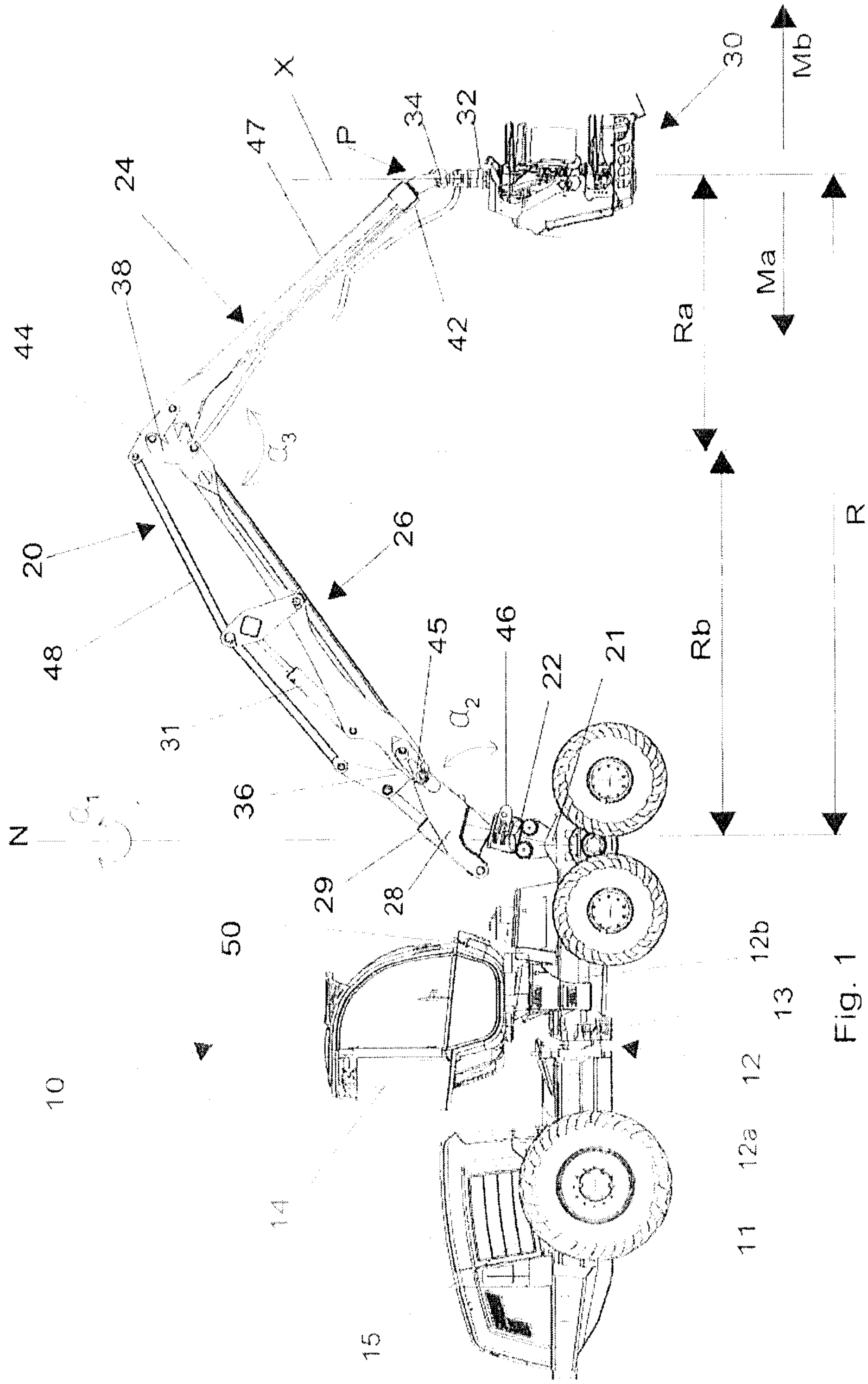
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α_3

Fig. 1

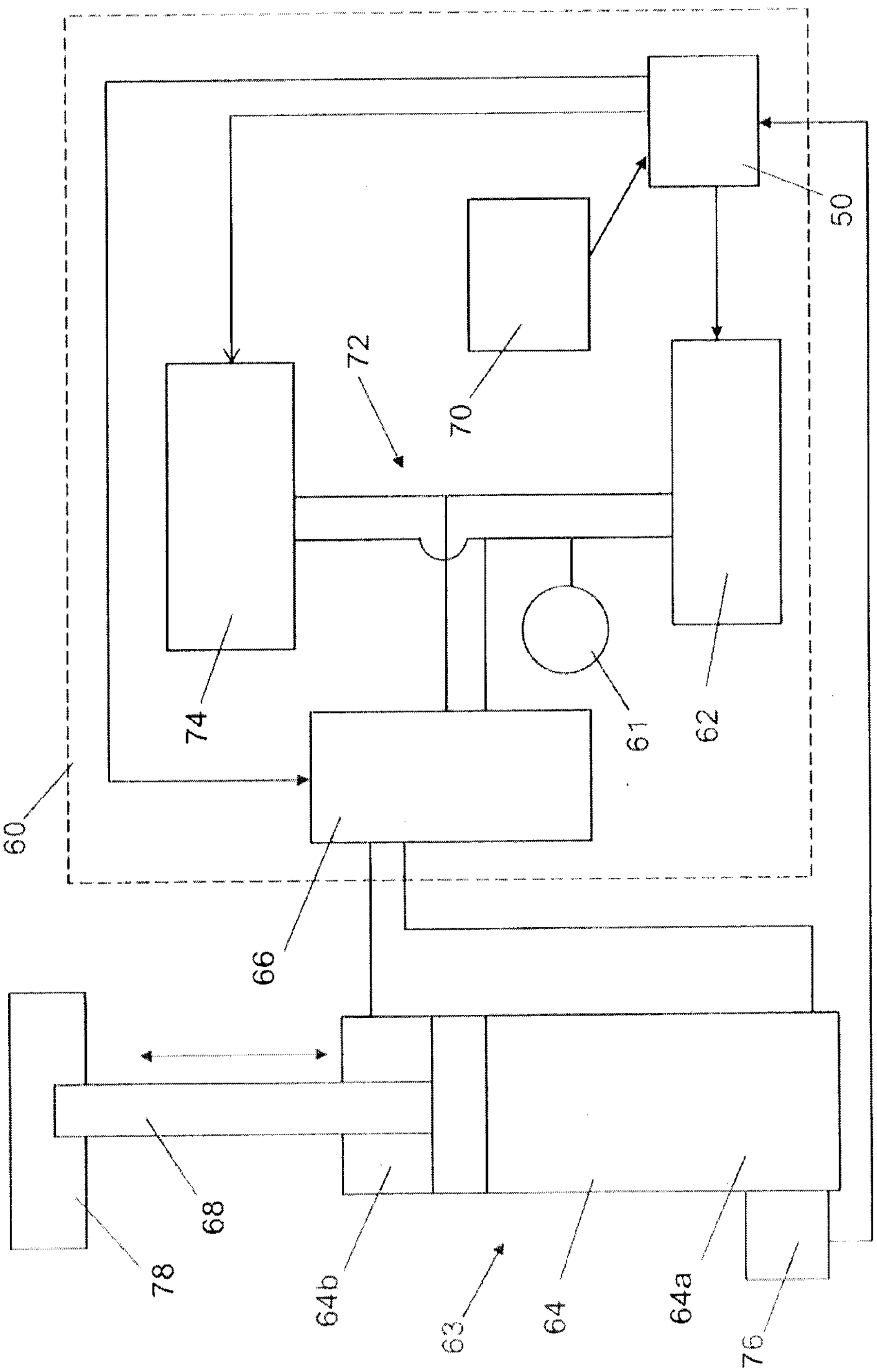


Fig. 2

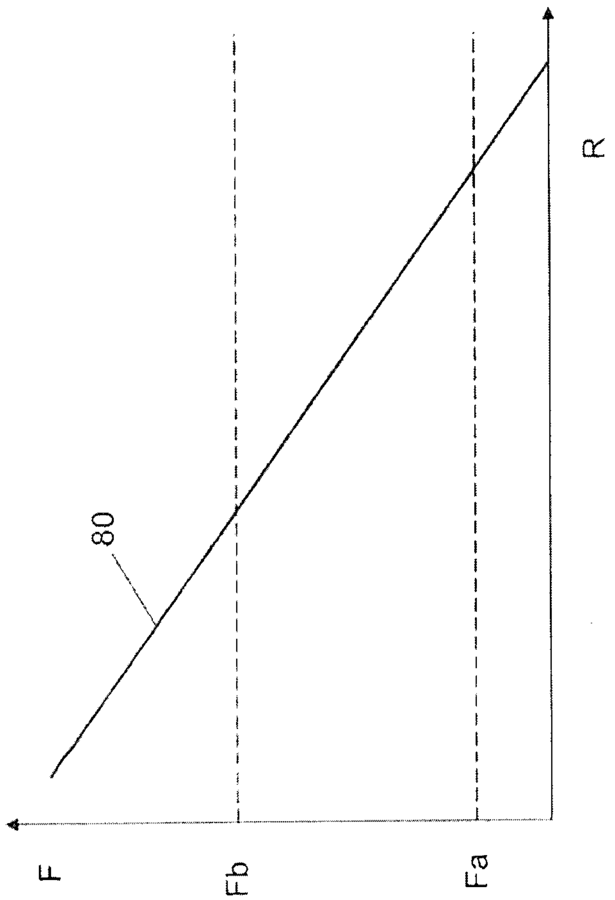


Fig. 3

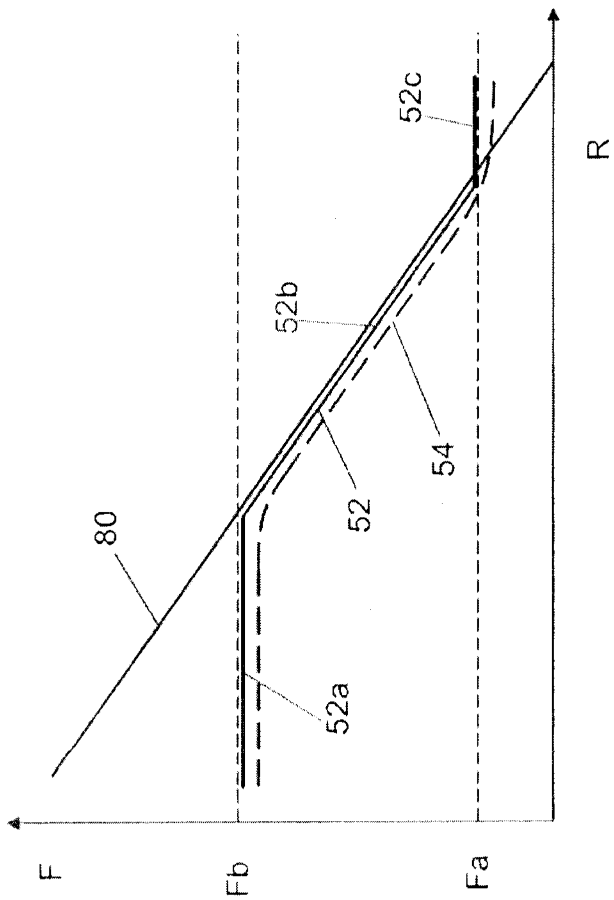


Fig. 4

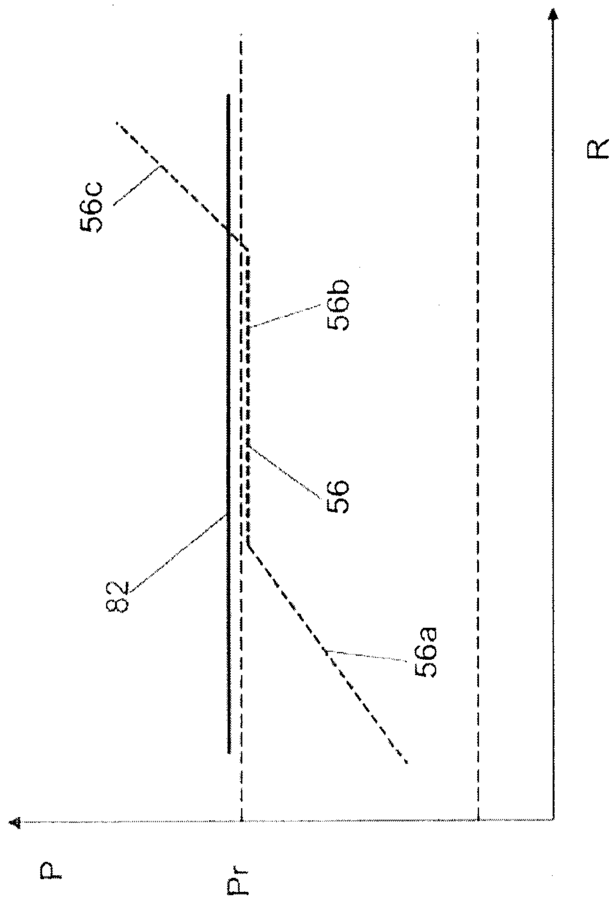


Fig. 5

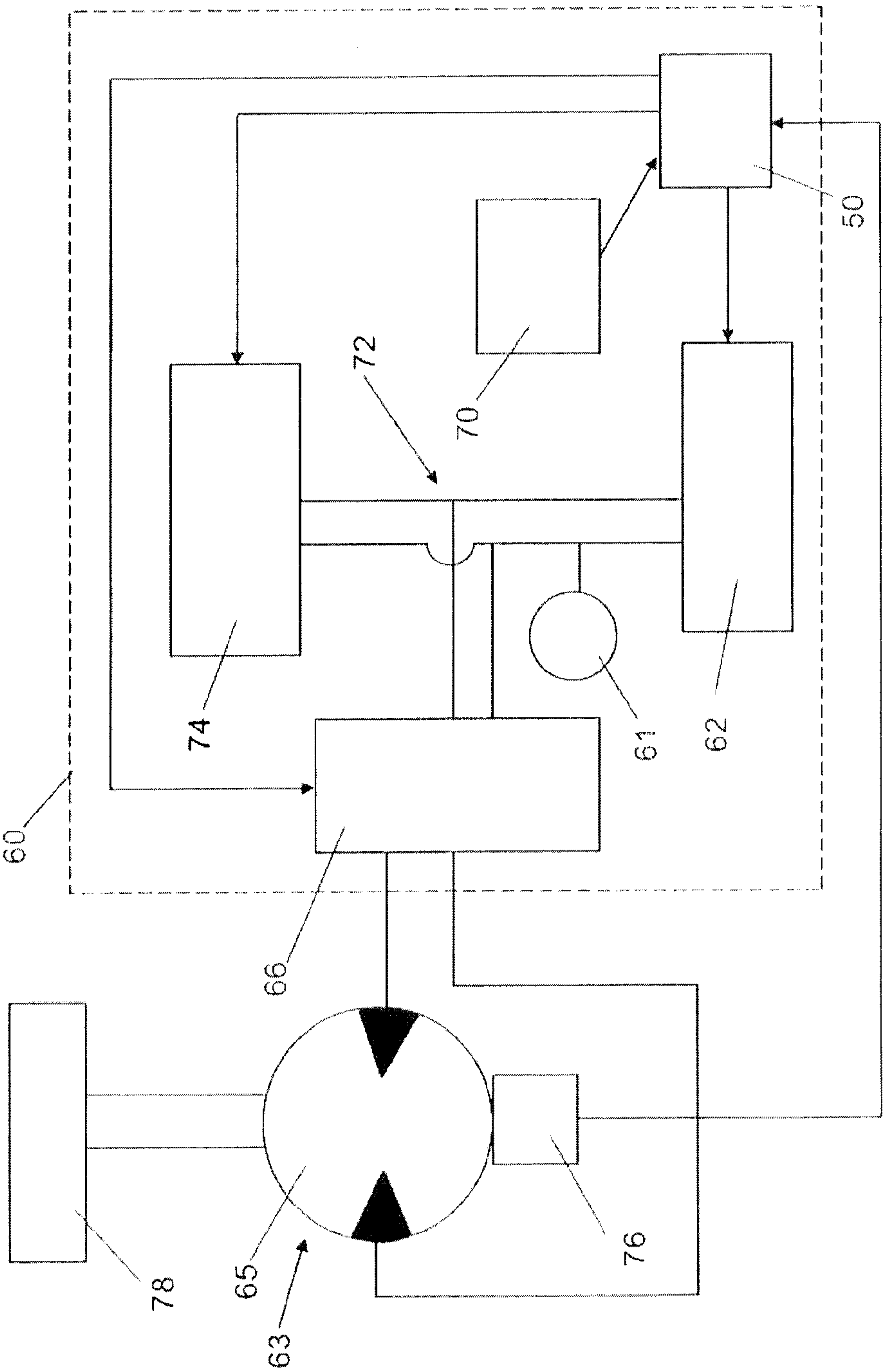
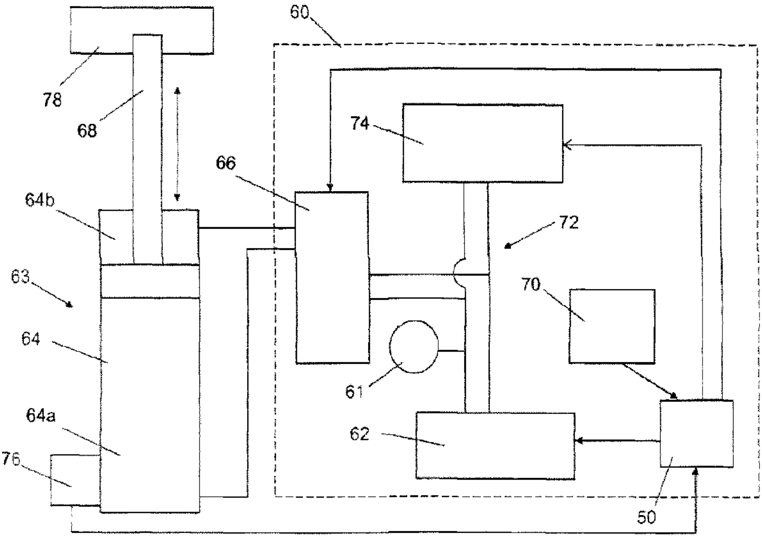


Fig. 6



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64b
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64a
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