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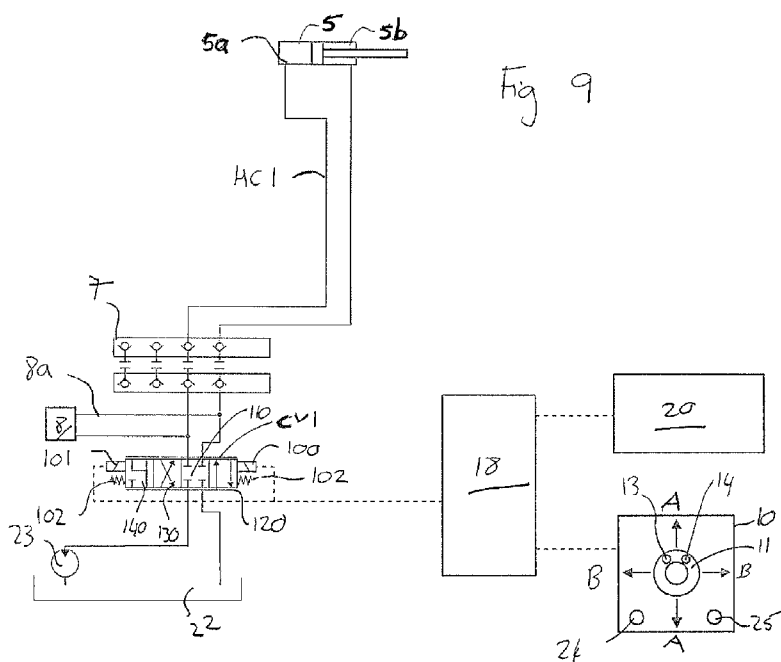
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(54) **Control valve for controlling an implement attached to a vehicle**

(57) A vehicle control means (10) for controlling movement of an implement attached to the vehicle (1) comprising a control valve (CV1) for moving the implement, or a tool attached to the implement. The control valve (CV1) has a first neutral position (110), a second position (120) for raising the implement or tool and a third position (130) for lowering the implement, or tool. In a

first mode of movement of the valve (CV1), the valve spool when moving between the second position (120) and third position (130) temporarily rests in the neutral position (110). In a second mode of movement of the valve (CV1), the valve spool when moving between the second position (120) to the third position (130) moves continuously through the neutral position (110).



Description

[0001] This invention relates to a control valve for controlling movement of a tool attached to an implement on a vehicle. More specifically, this invention relates to a control valve for controlling movement of a tool attached to an implement on an agricultural vehicle.

[0002] Agricultural vehicles are provided with driver operable control means inside the vehicle to control various functions on the vehicle. The control means is connected to a vehicle control unit.

[0003] For example, agricultural tractors may be provided with a lever and a terminal to input and display various parameters associated with the tractor such as air pressure of the tyres and the speed of the vehicle. The terminal is used to display various parameters associated with the tractor so that the driver can view in an instance what is happening.

[0004] An implement such as a front loader may be attached to the tractor and the hydraulic circuits on the loader connected to those on the tractor. Typically the front loader will have a first hydraulic circuit for moving a tool, for example a bucket attached to the loader and a second hydraulic circuit for controlling vertical movement of the boom of the loader and further circuits for moving further consumers associated with the tool.

[0005] Tools requiring further circuits to move an associated part are, for example: a grab bucket provided with forks which can be raised and lowered relative to the bucket to tear silage out of a silage silo during loading. In such a case a further circuit would raise and lower the forks.

[0006] Alternatively, a front loader may be provided with a bucket having a pivotable beater attached. In such a case the further hydraulic circuit would control pivotal movement of the beater support relative to the bucket whilst a yet further hydraulic circuit would control the rotary drive of the beater. This tool loosens compacted silage during loading prior to distribution as animal fodder.

[0007] First and second hydraulic circuits are each attached to two control valves on the tractor and the further circuit is connected to either the first hydraulic circuit or the second hydraulic circuit. Since the control valves are connected to the tractor control unit, first and second hydraulic circuits can be easily controlled by the driver using the joystick. It is typical that movement of the joystick forwards and backwards causes the loader to move up and down and movement of the joystick left and right causes the tool to pivot. Buttons may be provided on the joystick to switch control between the first, second and further hydraulic circuits.

[0008] If further programmed functions or sequences requiring these hydraulic circuits, for example shaking the tool to empty its load additional buttons must be provided on or close to the joystick. These additional buttons are not necessary for operating a standard front loader and therefore a tractor fitted with a standard front loader would not have a joystick with the additional buttons.

Therefore if control of further programmed functions associated with these hydraulic circuits is required with a standard front loader a further joystick must be fitted. This has cost and space implications.

[0009] Known control means do not allow the tool or implement to be pivoted quickly in one direction and then the other direction, thus the shaking function is unsatisfactory. This is owing to the mechanism of the control valve which is used to control the corresponding hydraulic circuit.

[0010] It is an aim of the present invention to provide a vehicle control means comprising a control valve which can be controlled to provide an improved shaking function of the tool.

[0011] In accordance with the present invention there is provided a vehicle control means as claimed in claim 1. Preferred features of the invention are set out in the dependent claims.

[0012] The invention will now be described, by example only, with reference to the following drawings in which:

Figure 1 is side view of a tractor fitted with a front loader,

Figure 2 is a circuit diagram showing the connection of the hydraulic circuits associated with the loader and the control means for controlling the loader, Figures 3 to 8 are screen shots from a terminal showing various parameters associated with the front loader and

Figure 9 is a detailed circuit diagram of figure 2 showing a control valve in accordance with the invention.

[0013] Figure 1 shows a tractor 1 which has a front loader 2. The front loader comprises a boom 4 which carries a tool 6. A first pair of hydraulic cylinders 5 moves a tool 6, for example a bucket so that it pivots about a substantially horizontal axis. A second pair of hydraulic cylinders 3 lift and lower the boom 4.

[0014] Figure 2 shows a circuit diagram of the hydraulic circuits on the front loader when they are connected to the tractor's hydraulic circuit. The dashed line shows which parts are located on the tractor 1 and which parts are located on the front loader 2.

[0015] The hydraulic cylinders 3, 5 are connected by a multicoupler 7 to two control valves CV1 and CV2 on the tractor. The control valves CV1 and CV2 are connected to a pump 23 and a fluid reserve 22 on the tractor. The control valves CV1, CV2 are connected to a tractor control unit 18 which is connected to a control means 10 and a terminal 20 in the tractor cab as shown by the dotted lines. The front loader may also be provided with its own control unit 26a which communicates with the tractor control unit 18. The control means 10 comprises the control valves CV1 and CV2 and a lever 11 with selector means 13, 14, 24 and 25. Lever 11 is a cross gate lever which can be moved in four directions (forwards and backwards along axis A and left and right along axis B) about a central, neutral position. Selector means 13,

14 may be, for example buttons or switches which can be activated whilst the driver moves lever 11. Selector means 24, 25 are provided on the base of the control means 10 and may also be for example, buttons or switches. Terminal 20 displays various parameters associated with the tractor and front loader and allows various parameters, associated with the hydraulic circuits, such as fluid flow to be set.

[0016] A first hydraulic circuit HC1 is connected to control valve CV1. The first hydraulic circuit HC1 comprises a first cylinder or first pair of cylinders 5. First cylinder 5 is used to move a tool attached to the front loader such as a bucket, or hay grab. A further consumer 8 such as a hydraulic cylinder on a trailed or mounted implement connected to the rear of the tractor may alternatively be connected to hydraulic circuit HC1 when the front loader is not being used. Consumer 8 is connected to circuit HC1 by circuit 8a. Since circuit 8a is only controlled by valve CV1 the fluid flow through it can only be changed if the fluid flow through circuit HC1 is changed.

[0017] By fluid flow it is meant the volume flow rate, that is the volume of fluid flowing through the circuit per unit time and also the amount of time the fluid is flowing through the circuit. The latter is controlled by how long an associated circuit valve is activated.

[0018] The first hydraulic circuit HC1 is connected to at least one further hydraulic circuit HC2 or HC3 by respective switch means, switch valves SV1, SV2. These switch valves are connected to the tractor control unit 18 and front loader control unit 26a if present. Switch valves SV1, SV2 may be integrated into one single valve.

[0019] In figure 2, two further hydraulic circuits are shown, a second further hydraulic circuit HC2 and a third further hydraulic circuit HC3. Each further circuit HC2, HC3 is connected to HC1 circuit by respective switch valves SV1 and SV2. Circuits HC2 and HC3 are connected to consumers 16 and 17 respectively which may be needed, for example to control a grab bucket, or a bucket with a pivotable beater as described above. Further circuits could be connected to HC1 by further switch means.

[0020] A fourth further hydraulic circuit HC4 is connected to a consumer or hydraulic cylinder 19 in parallel to first hydraulic circuit HC1. Circuit HC4 is provided with a switch valve SV3 which is connected to the control unit 18 and front loader control unit 26a if it is present. The hydraulic circuit HC4 may be used, for example to control an automatic locking means for connecting the boom 4 to the tool 6 to make attachment of the tool to the boom simple.

[0021] An additional hydraulic circuit HC5 on the front loader comprises a hydraulic cylinder or pair of cylinders 3 connected to a second control valve CV2 on the tractor by a multicoupler 7. Hydraulic cylinder 3 is used to lift and lower the boom of the front loader.

[0022] When it is desired to move the boom up and down, lever 11 is moved along axis A which controls the hydraulic circuit HC5. Pushing the lever forwards lowers the boom and pulling the lever backwards raises the

boom. Moving the lever along axis B controls hydraulic circuit HC1. Moving the lever left pivots the bucket upwards and moving the lever right pivots the bucket downwards. In this position switch valves SV1 and SV2 are in a position so that fluid flows from and to the fluid reserve 22 to cylinder 5 and switch valve SV3 is closed. By pressing button 13 and moving the lever along the B axis further hydraulic circuit HC2 is controlled. By pressing button 13 and moving the lever along axis B, the further circuit HC2 is activated. Button 13 controls switch valve SV1 so when it is pushed fluid flows to and from the fluid reserve 22 to consumer 16. By pressing button 14 and moving the lever along the B axis further hydraulic circuit HC3 is controlled. Button 14 controls switch valve SV2 so when it is pushed fluid flows to and from the fluid reserve 22 to consumer 17.

First Mode of Operation of the Control Means:

[0023] When button 13 is pressed on control means 10, control valve CV1 automatically moves to a set position at the same time as switch valve SV1 is switched. The same occurs for circuits HC3 and HC4 and switches SV2 and SV3 when the respective buttons 14 and 25 are pressed on control means 10, that is button 14 controls hydraulic circuit HC3 and button 25 controls hydraulic circuit HC4. This means that each circuit HC1, HC2, HC3 and HC4 can have its own fluid flow independent of the other circuits.

[0024] These control movements are in a first mode of operation of the lever 11 and allow the amount of movement of the hydraulic consumer or hydraulic cylinder of the respective hydraulic circuits HC1, HC2, HC3 and HC5 to be manually controlled by the driver by movement of the lever 11

[0025] To activate hydraulic cylinder 19 using hydraulic circuit HC4, button 25 is pushed and thereby hydraulic circuit HC1 and hydraulic circuit HC4 are supplied in parallel. As hydraulic cylinder 19 is smaller than cylinder 5 connected to HC1, the locking means (not shown) is closed very fast, so supplying both the first cylinder 5 and consumer 19 at the same time does not cause any problems.

[0026] A damping circuit 21 is connected to hydraulic circuit HC5 and controlled by control means 10 by pressing button 24.

Second Mode of Operation of the Control Means:

[0027] A second mode of operation, which controls programmed sequences or functions associated with the hydraulic circuits HC1, HC2, HC3 and HC5, is activated by pushing button 32b (see Figure 4). In this mode further hydraulic circuit HC3 cannot be controlled by lever 11. Movement along axis A in the second mode moves cylinder 3, the front loader to pre-determined positions which are described in more detail later. Movement of the lever to the right along axis B causes the bucket to shake by continuously pressurising and de-pressurising

cylinder 5 automatically. Movement of the lever to the left in the second mode initiates a weighing process of the load carried by the front loader which is described later. Damping button 24 and locking button 25 are de-activated in the second mode.

[0028] Consumer 8 and 9 are only supplied when the front loader is hydraulically disconnected from the supply system. These consumers 8, 9 are controlled by the settings of CV1 and CV2 respectively.

[0029] Various settings for control valves CV1 and CV2 can be entered into the terminal 20 for each of the circuits HC1, HC2, HC3, HC4 and HC5 which therefore affects the fluid flow through each circuit. The length of time switch valves SV1, SV2 and SV3 are activated for each circuit, as well as the volume flow rate of the fluid through each circuit can be set.

[0030] The invention means that various hydraulic circuits associated with the front loader, or those associated with another implement attached to a tractor can be controlled by the same control means in the cab of a tractor and each circuit can be operated with its own fluid flow parameters suitable for the consumer concerned.

[0031] In the figure 1 the further hydraulic circuits HC2, HC3 and HC4 are connected to the first hydraulic circuit HC1 whilst hydraulic circuit HC5 has only one additional circuit 9a. It is also possible that either of the first hydraulic circuit HC1 or hydraulic circuit HC5 may be connected to any of the further circuits HC2, HC3, HC4.

[0032] Figure 3 shows a screen shot of the image seen on the terminal by the driver when it is turned on. The screen is provided with a column of buttons or other selector means on the right hand side which relate to functions and parameters associated with the tractor. By selecting the front loader button 26, the driver is taken to the screen shot in figure 4. (The other buttons are not described here since they do not relate to the present invention). Button 47 takes the driver back to the previously viewed screen.

[0033] On the front loader screen (as seen in figure 4) buttons 32a and 32b are associated with the first and second modes of the control means respectively. In figure 4, button 32a changes the function of button 13 on lever 11 from hydraulic circuit HC2 to hydraulic circuit HC4 to replace the function of button 25. This may be advantageous when tools have to be changed frequently and no additional consumer on the tool needs to be controlled by hydraulic circuit HC2. The top portion of the screen 27 shows the lever directions along the A and B axes in the first mode of operation and the corresponding movement of the tool or front loader. (Forwards and backwards for moving the loader up and down and left and right for pivoting the bucket.)

[0034] The middle portion of the screen 28 allows the type of material to be carried in the tool to be selected from a drop down menu 29. More than one material can be stored in the terminal at one time. If, therefore the driver is carrying different materials throughout the day or week, the driver simply selects the material being cur-

rently carried and changes the mode on the control means to mode 2 and moves the lever to initiate the weighing process. The terminal will display the weight of that selected material in box 30. The terminal will also display the total weight of the selected material over a period of time in which more than one load of selected material has been carried. The total weight is shown in box 31. By selecting button 34, the screen as shown in figure 5 is displayed which shows the weight of 4 different materials in boxes 34a, 34b, 34c and 34d and the total weight of all these materials in boxes 35a and 35b for a given period of time and a given type of material. If the material is changed via drop down menu 29 shown in figure 4, boxes 35a, 35b show the overall weight of the selected material. In addition, the driver can enter a target value for the overall weight in box 36. This overall weight represents the sum of all selected materials loaded during a given period of time. Alternatively, more than one box 31 may be provided to show the overall weight of various selected materials simultaneously. The weights of each material carried can be saved onto a USB stick by pressing button 37.

[0035] Returning to figure 4 the bottom portion of the screen 33 shows the current position of the front loader 36 and the current position of the tool 37. The current positions are shown as percentages 36a and 37a of the total movement of the associated hydraulic cylinder(s) which move the boom of the front loader and the tool respectively, as well as by shading upto the dotted lines. Alternatively, the percentages could reflect an amount of the total pivotal movement of the boom and an amount of the total pivotal movement of the bucket. The bottom portion also shows two stored positions of each of the front loader and bucket, displayed as triangles 38. The two positions indicate a higher and a lower position for each of the loader and the bucket. As described earlier the boom can be moved to one of these stored positions automatically by moving the lever in the second mode along axis A.

[0036] The driver can easily see the current positions of the boom 36a and bucket 37a relative to the stored positions 38 on the terminal. Furthermore, markings 39 indicate the preferred range of where the loader and bucket should be carried. In this example, it is preferable that the loader and bucket are carried between 25% and 80% of their minimum and maximum positions. Again, this assists the driver in programming the stored positions and showing the current positions relative to this range. By pressing button 40 the driver is taken to a further screen figure 6 in which two stored positions can be entered for each of the loader and tool. The two positions for the loader 41 must be different and the two positions for the tool 42 must be different. If any of the stored positions are not to be used during the second mode of operation of the lever along the A axis, they can be deactivated by deselecting the appropriate box 43 on the terminal. When these stored positions are de-selected, triangles 38 change colour. When the stored positions

are to be used during the second mode of operation of the lever along the A axis, the stored positions are selected using boxes 43 on the terminal.

[0037] Returning back to figure 4. If button 32b is pressed the second mode is activated while hydraulic circuit HC 3 is deactivated. Terminal 20 displays parameters associated with the second mode. If button 32b is pressed, the driver is taken to the screen shown in figure 7. Here the top portion of the screen shows the lever directions along the A and B axes for the second mode of operation and the corresponding automated functions associated with the movements. Moving the lever in the A axis takes the loader to the first or second stored position 38. Moving the lever to the rights shakes the bucket so that any material stuck in the bucket can be emptied. Moving the lever to the left initiates the material weighing process. The remainder of the screen stays the same as in figure 4.

[0038] Returning to the screen shot in figure 4. When button 44 is pressed, the driver is taken to the screen shown in figure 8. In figure 8 the screen is divided into an upper portion 45 and a lower portion 46. Upper portion 45 allows the driver to input fluid flow parameters for each of hydraulic circuits HC5, HC1, HC2 and HC3.

[0039] The minimum and maximum flow rates can be entered for circuit hydraulic HC5 by entering values along the line 48, for circuit HC1 by entering values along line 49, for hydraulic circuit HC2 by entering values along line 50 and for hydraulic circuit HC4 by entering values along line 51. The length of time the associated control valve is opened can be entered (as shown along line 50). Boxes 48a, 49a, 50a and 51 a show additional information relating to the valve settings.

[0040] Lower portion 46 concerns the damping of the loader. Over rough ground it is necessary for hydraulic circuit HC5 to be dampened to prevent undue movement of the boom. Damping circuit 21 is controlled by button 53 on the terminal 20 which controls valve 21a. The terminal allows the speed of the vehicle to be entered for when damping is to be automatically activated. The vehicle speed is entered in box 52 and the automatic damping function is activated by pressing button 53. Button 53 controls valve 21 a in damping circuit 21. Button 54 activates the end position damping for the hydraulic cylinders to avoid hard sticking of the cylinders when reaching their end position. The damping circuit 21 shown is placed in hydraulic circuit HC5 to dampen movement of the boom. A further damping circuit could be placed in hydraulic circuit HC1 to dampen movement of the tool.

[0041] If the front loader is not being used a further consumer 9 such as a hydraulic cylinder on a trailed or mounted implement connected to the rear of the tractor may be alternatively connected to the hydraulic circuit 3. Consumer 9 is connected to hydraulic circuit HC5 by hydraulic circuit 9a. The fluid flow through hydraulic HC5 is regulated by control valve CV2 which is controlled by control means 10 located in the tractor cab. Since circuit 9a is only controlled by valve CV2 the fluid flow through

it can only be changed if the flow rate through circuit HC2 is changed.

[0042] In the shown embodiment the further hydraulic circuits HC2, HC3 and HC4 are connected to the first hydraulic circuit HC1 whilst hydraulic circuit HC5 has only one additional circuit 9a. It is also possible that either of the first hydraulic circuit HC1 or hydraulic circuit HC5 may be connected to any of the further hydraulic circuits HC2, HC3, HC4.

[0043] Figure 9 shows details of the circuit diagram of Figure 2 in which components not related to the control of hydraulic circuit HC1 are left out for better clarity. In comparison with Figure 2 control valve CV1 is diagrammatically shown in Figure 9 to explain the control system relating to control valve CV1. The same reference numerals in figure 9 refer to the same component in Figure 2.

[0044] As already explained, control valve CV1 is connected to hydraulic circuit HC1 to control movement of first cylinder 5. Alternatively, if no front loader is attached, control valve CV1 is connected via circuit 8a to a further consumer 8, which may, for example be the lifting cylinder of a rear or front three-point linkage.

[0045] Control valve CV1 is a proportional 4-way control valve which has three ports, a port P for supply of oil from a pump 23, a return port R in connection with the pump 23 and two outlet port A, B for connection with a consumer or a hydraulic circuit connected to a consumer. Furthermore, control valve CV1 is provided with two solenoids 100,101 which are controlled by tractor control unit 18. The two solenoids 100, 101 are move the valve spool (not shown) to provide 4 different valve positions:

[0046] In a first neutral position 110 all ports P, T, A and B are blocked and cylinder 5 remains held in a position. The first position 110 is supported by two valve springs 102 to ensure that in case of breakage of a cable the line to the solenoids 100,101, control valve CV1 is returned to first neutral position without any unmeant movement of loads attached to cylinder 5.

[0047] In a second position 120 for controlling movement of the tool or implement in one direction fluid is supplied to a first chamber 5a to extend cylinder 5.. For example if the tool is a bucket it can be pivoted in one direction, or if a consumer 8 is to be used, such as a three point linkage, the lower links can be raised. Second chamber 5b is connected to tank 22.

[0048] In a third position 130 for controlling movement of the tool or implement in another direction a fluid is supplied to a second chamber 5b to retract cylinder 5. The movement may be for example, to pivot a bucket in an opposite direction, or lower the lower links of a three-point linkage. First chamber 5a is connected to tank 22.

[0049] In a fourth position 140 of valve CV1 both chambers 5a, 5b are connected via ports A, B to port T and thus to tank 22. This position is used to enable movement of cylinder 5 by an external load. For example, in the case of an implement attached to the lower links of a three-point linkage driven by cylinder 5, the implement could

move upwards when contacting the ground and move downwards under its own weight to adapt its position to uneven ground.

[0050] To switch between the different positions, solenoids 100,101 are controlled by tractor control unit 18 in dependency of the condition of control means 10.

[0051] In the First Mode of Operation of the Control Means described above a movement of lever 11 in a direction B from, for example the second position 120, to the third position 130 would result in the lever 11 passing through a non operative position.. The CAN controller (not shown) of control means 10 would send a message to the tractor control unit 18 that lever 11 has reached this non operative position and the control unit 18 would bias the valve spool (not shown) via solenoids 100,101 to the first neutral position 110 where it would temporarily rest for about 100 milli seconds. This provision is made to reset the hydraulic circuit before reversing the movement of cylinder 5, or consumer 8 to avoid failure or damages. Furthermore, this interruption may avoid injury of persons.

[0052] This procedure to move the control valve CV1 to a first neutral position 110 before reversing fluid flow is very common and suitable for most applications.

[0053] With reference to the Second Mode of Operation of the Control Means described above and especially the function to shake the bucket, the movement of the valve to temporarily rest in the first neutral position 110 results in an unsatisfactory shaking function.

[0054] In accordance with the present invention, the control valve CV1 is not biased into a first neutral position 130 in a respective mode of operation, for example, the mode described in the Second Mode of Operation of the Control Means, before the fluid flow is reversed. This enables a very fast shaking of the bucket without interruption.

[0055] In figure 9, control valve CV1 is simplified in a manner to show the relevant functions. Details of the valves may be different, for example a valve with load sensing means having additional ports may be provided instead.

[0056] In the shown embodiment a front loader and a tractor are described. Other implements, in particular a trailed or mounted implement also fall within the scope of the present invention. In this case, the hydraulic circuits HC1, HC2, HC3 and HC4 and respective consumers shown in figure 2 would instead be installed on a trailed or mounted implement.

[0057] Furthermore, the invention may be applicable to any vehicle (not just a tractor) which can carry an implement and/or tool.

tached to the implement, said control valve having a first neutral position, a second position for controlling movement of the implement or tool one direction and a third position, for controlling movement of the implement, or tool in another direction whereby in a first mode of movement of the valve, the valve spool when moving between the second position and the third position temporarily rests in the neutral position, **characterised in that** in a second mode of movement of the valve, the valve spool when moving between the second position and the third position moves continuously through the neutral position.

2. A vehicle control means as claimed in claim 1 wherein the control valve is a proportional control valve.
3. A vehicle control means as claimed in claim 2 wherein valve spool is controlled by a solenoid.
4. A vehicle control means as claimed in claim 3 wherein the solenoid is controlled by a vehicle control unit.
5. A vehicle control means according to claim 4 wherein the vehicle control unit is connected to a control means.
6. A vehicle control means as claimed in claim 4 or claim 5 wherein the vehicle control unit is connected to the control means.
7. A vehicle control means according to any preceding claim wherein the control means comprises a lever.
8. A vehicle control means as claimed in any preceding claim wherein the vehicle is an agricultural tractor.

Claims

1. A vehicle control means for controlling movement of an implement attached to the vehicle comprising a control valve for moving the implement, or a tool at-

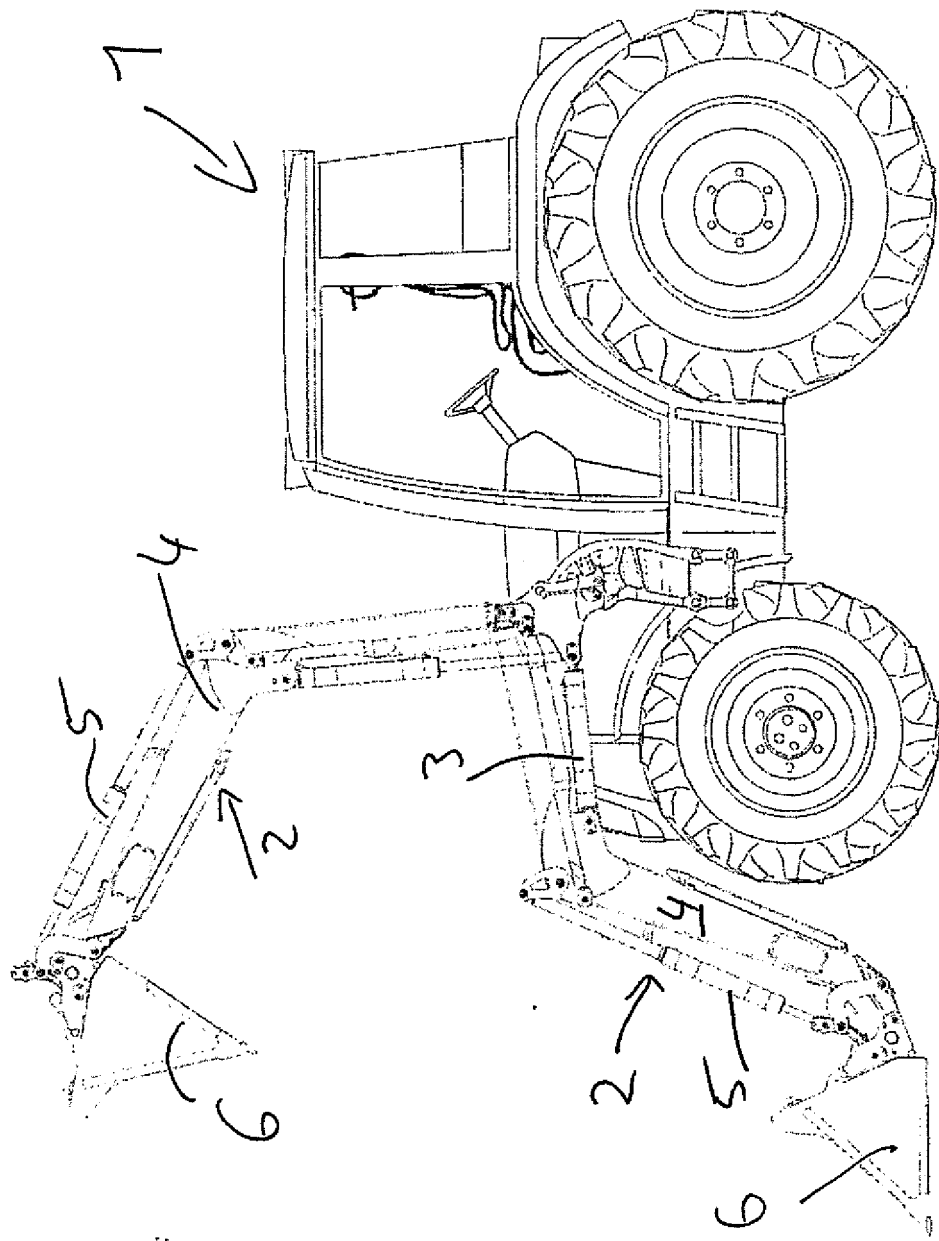


Fig 1

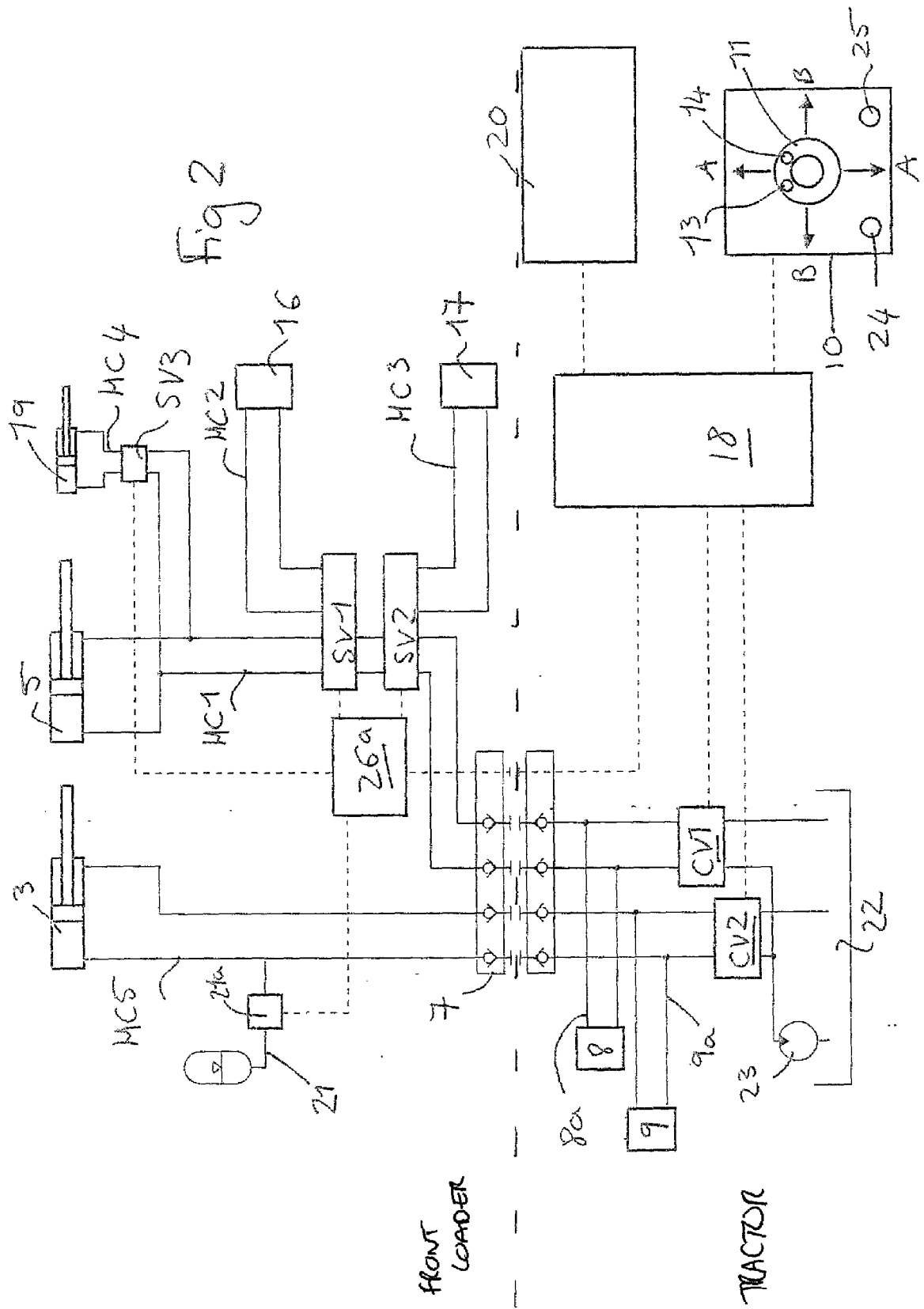


Fig 3

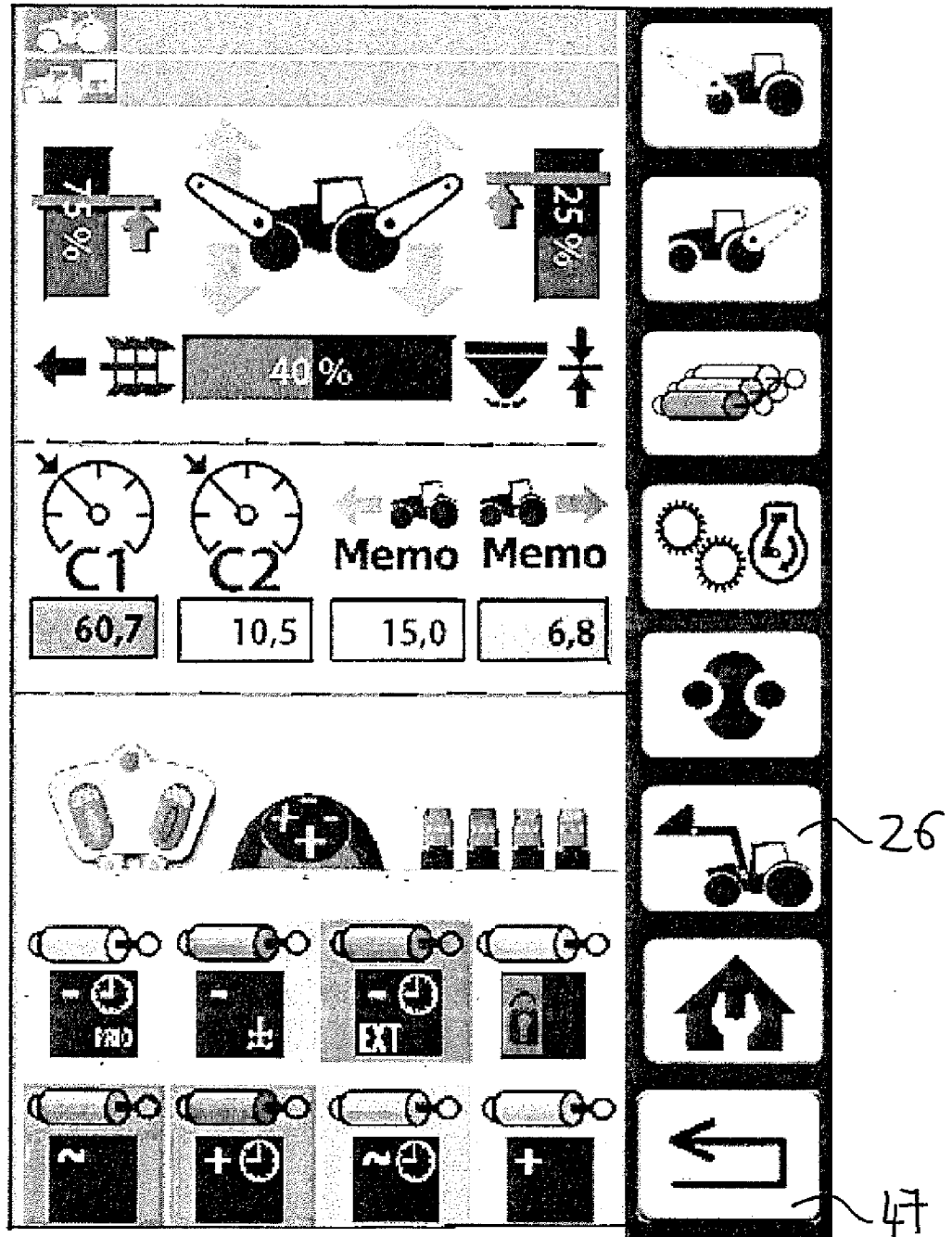


Fig 4

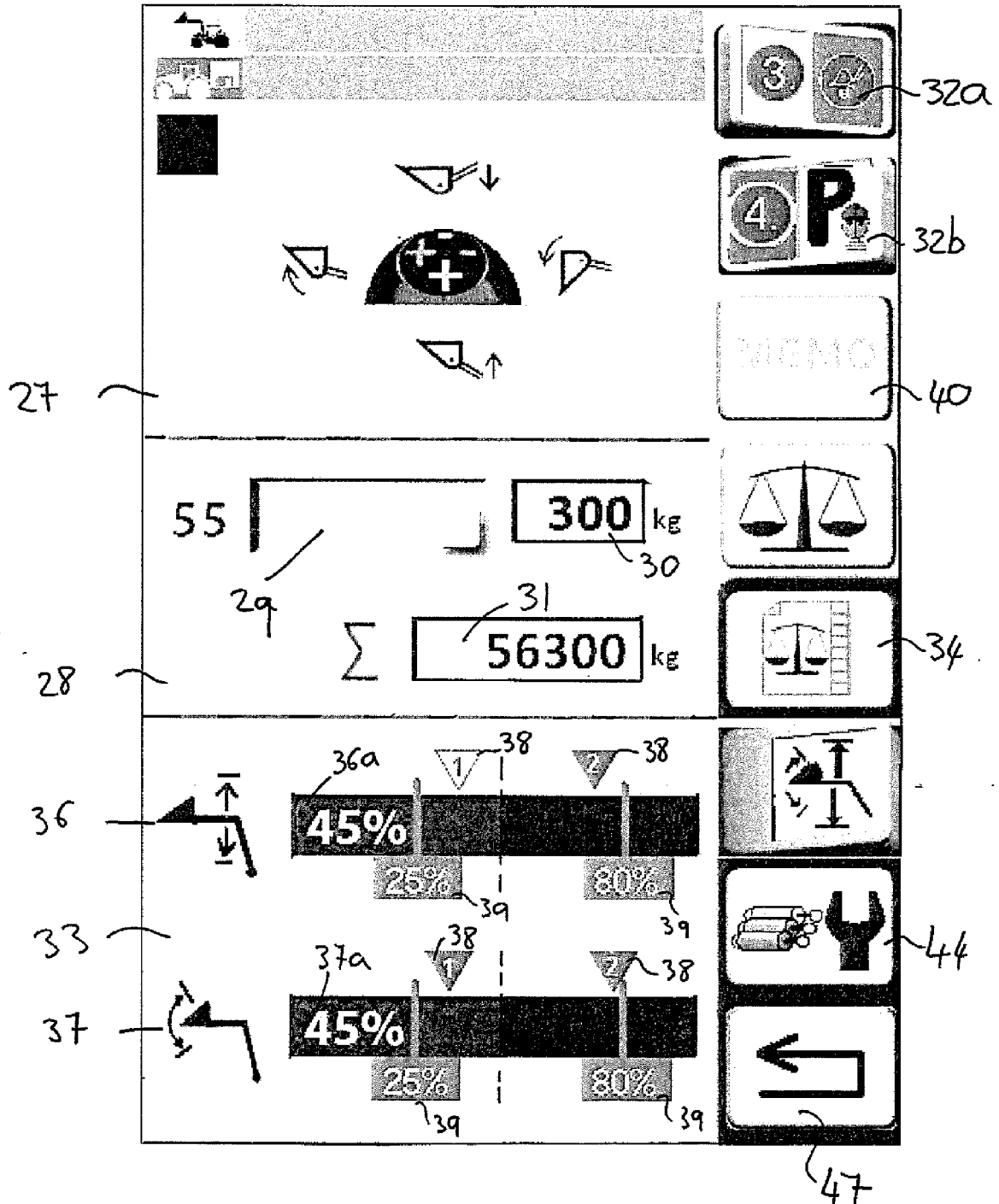


Fig 5

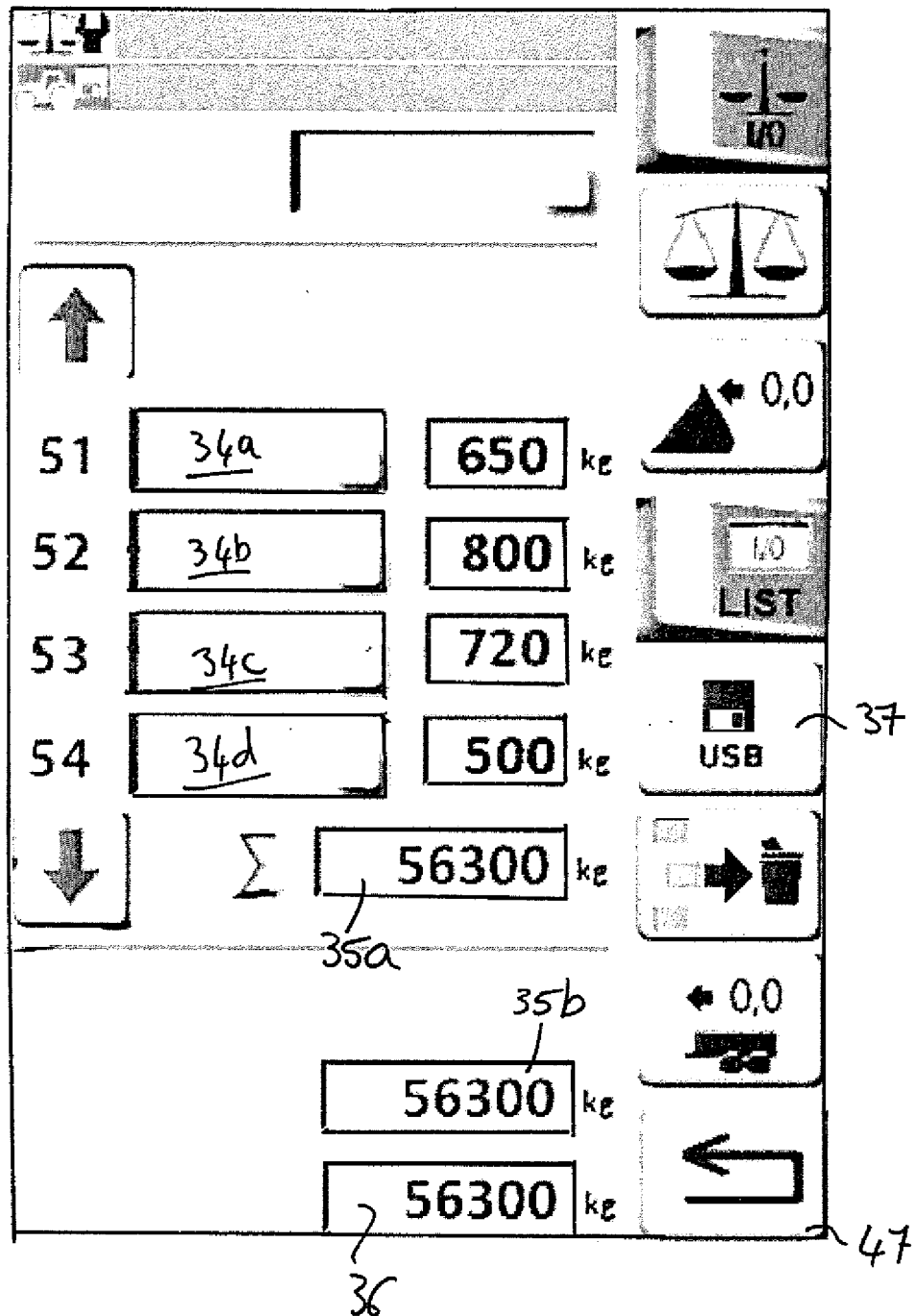


Fig 6

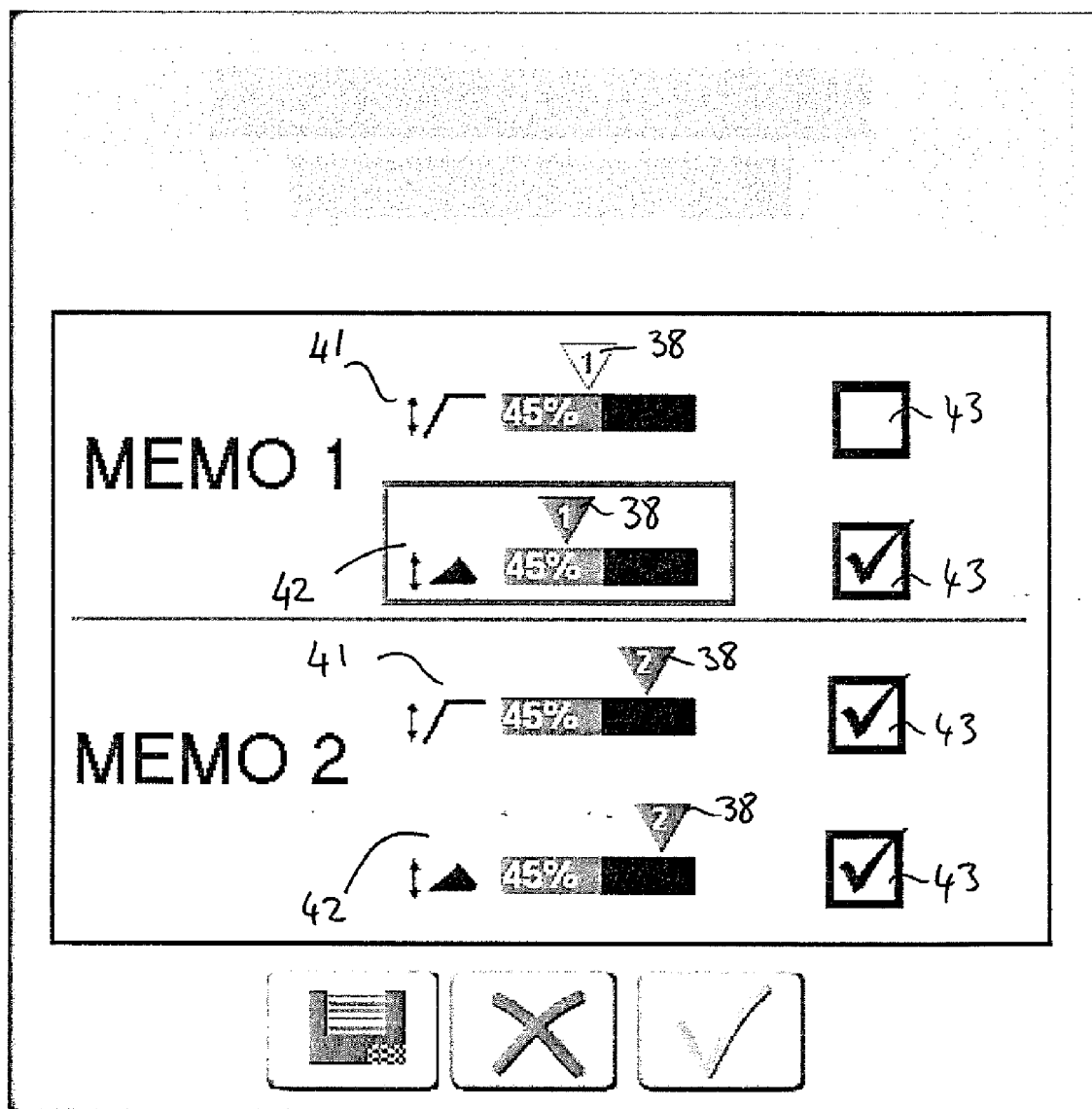


Fig 7

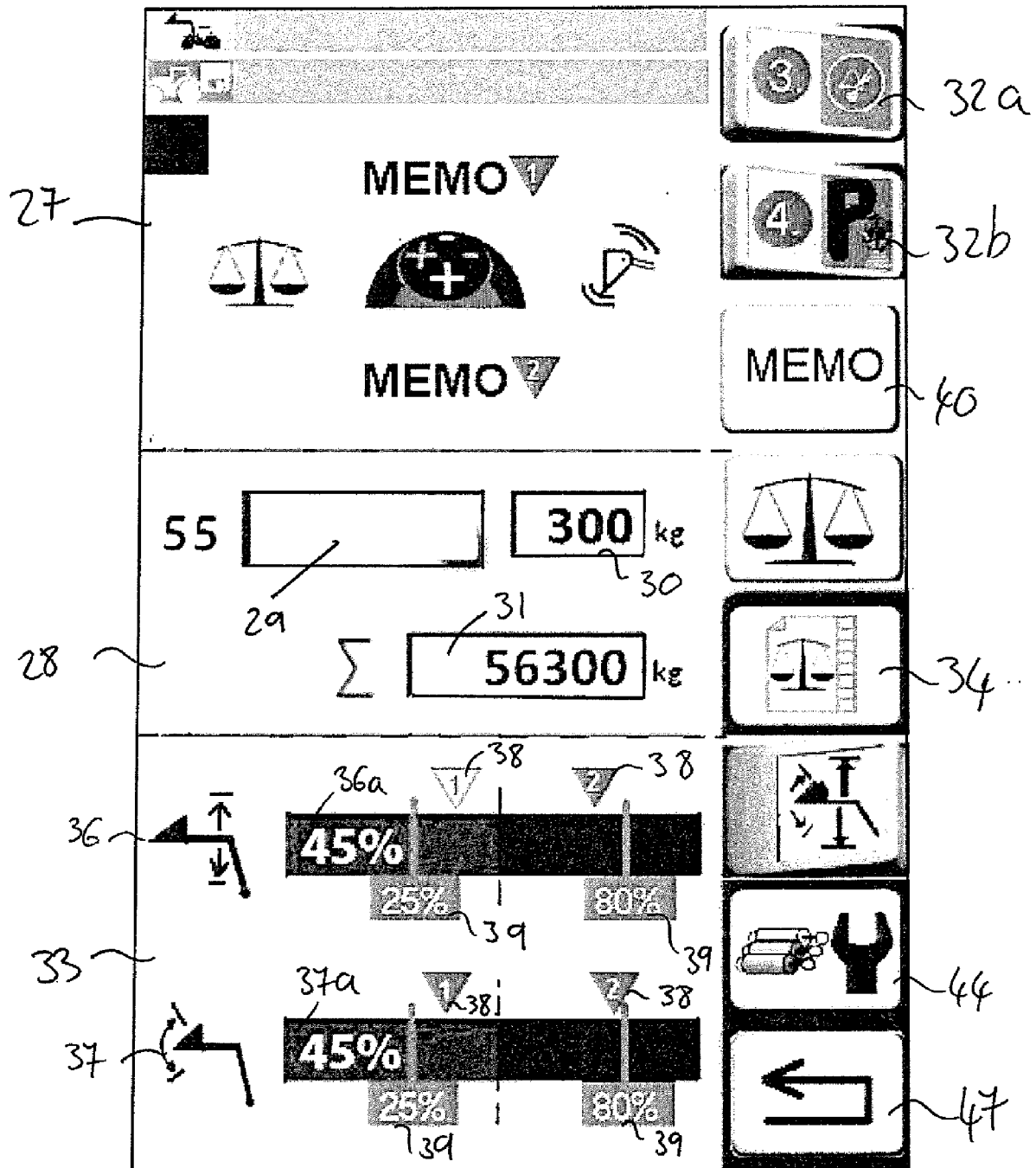
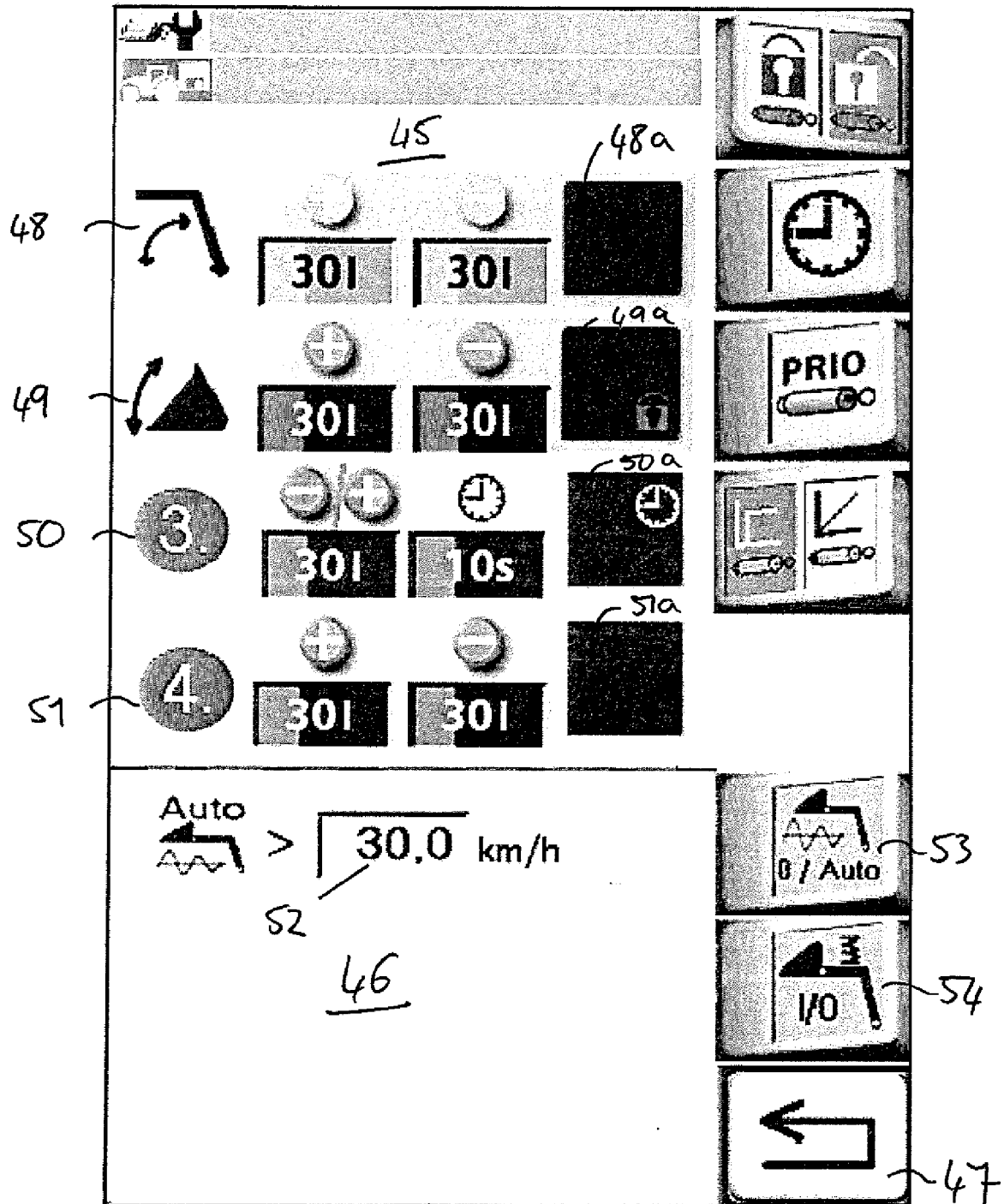
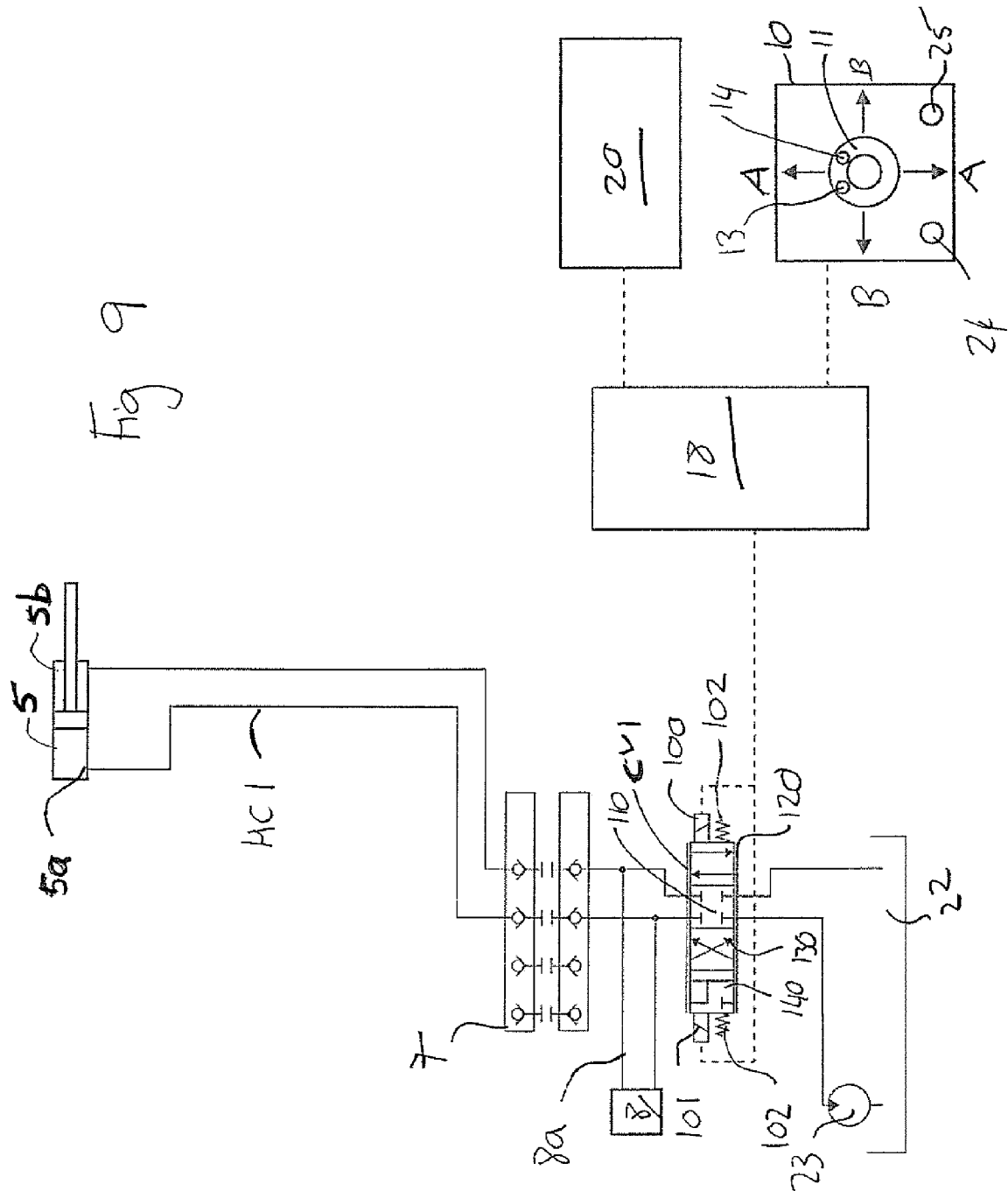


Fig 8







EUROPEAN SEARCH REPORT

Application Number
EP 12 17 7045

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 6 757 992 B1 (BERGER JOHN G [US] ET AL) 6 July 2004 (2004-07-06) * abstract; figures 1-4 * * column 1, line 33 - column 2, line 63 * * column 5, line 53 - column 7, line 10 * * column 7, line 46 - column 8, line 55 * * column 9, line 3 - column 10, line 21 * -----	1-8	INV. E02F3/40 E02F9/22
A	US 2009/031891 A1 (BRINKMAN JASON L [US] ET AL) 5 February 2009 (2009-02-05) * abstract; figures 1-2 * * paragraph [0002] * * paragraph [0004] * * paragraph [0007] * * paragraph [0012] - paragraph [0016] * * paragraph [0022] * * paragraph [0027] * * paragraph [0032] - paragraph [0036] * -----	1-8	
A	WO 2005/100701 A1 (VOLVO CONSTR EQUIP HOLDING SE [SE]; VIGHOLM BO [SE]; BAANKESTAD NILS-E) 27 October 2005 (2005-10-27) * abstract; figure 1 * -----	1-8	TECHNICAL FIELDS SEARCHED (IPC) E02F
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A	US 2008/010981 A1 (PATEL SAUJESH [US]) 17 January 2008 (2008-01-17) * abstract; figure 1 * -----	1-8	
A	EP 1 361 312 A1 (HUSCO INT INC [US]) 12 November 2003 (2003-11-12) * abstract; figures 1-4 * -----	1-8	
		-/--	
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 31 October 2012	Examiner Balzar, Maarten
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	

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EPO FORM 1503 03.82 (P04C01)



EUROPEAN SEARCH REPORT

Application Number
EP 12 17 7045

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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