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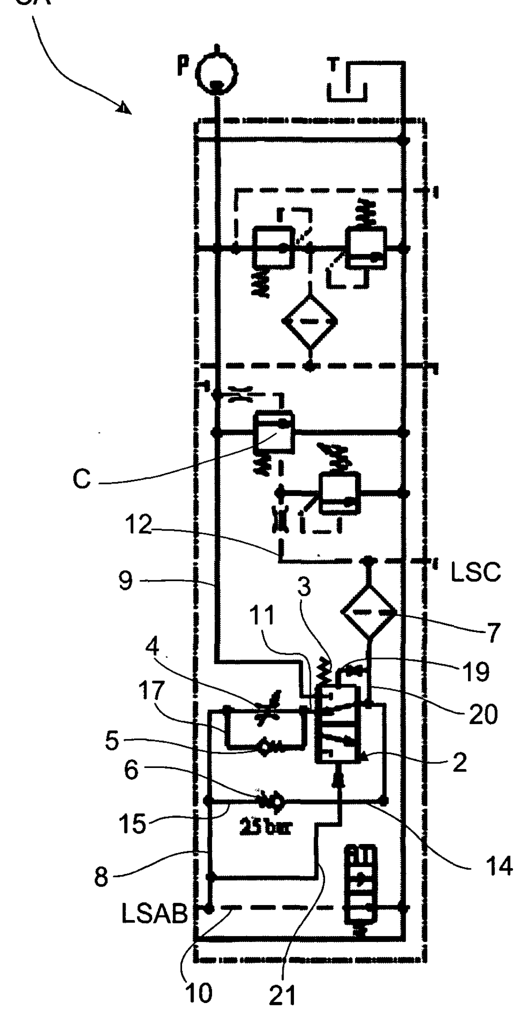
Amended claims in accordance with Rule 86 (2) EPC.

(54) Inlet section for load sensing directional control valves

(57) The invention falls within the field of load sensing directional control valves and in particular it refers to an inlet section for load sensing directional control valves operating with open centre and closed centre circuit, with or without a pressure reducer valve for internal pilot pressure supply, a load-sensing signal unloader valve, a load-sensing signal pressure relief valve, while always present is a three way flow compensator (C) and the internal pilot lines; said inlet section comprises in combination a variable area damper (4), a check valve (5), a copy-spool (2) and a calibrated check valve (6).

FIG. 3



EP 1 626 183 A1

Description

[0001] The present invention refers to an inlet section for Load Sensing Directional control valves.

[0002] Load Sensing systems are used in many applications, such as waste compactor trucks, concrete arms, truck cranes, winches, fork lifts; said directional control valves are Load Sensing compensated proportional directional control valves which can be used either with closed centre or open centre circuit according to the connected pump, i.e. variable displacement in the first case, fixed displacement in the second case.

[0003] In an open centre circuit, the Load Sensing signal taken off from the load is sent to the inlet section compensator, while in the closed centre circuit the signal is sent to the variable displacement pump compensator.

[0004] These directional control valves are available in one to ten working sections and can be used in systems for hydraulic transmissions with Load Sensing fixed or variable displacement pumps.

[0005] The purpose of the proportional Load-Sensing system is to maintain the pressure drop constant through the variable section, obtained with appropriate milling operations, on the spool of the directional control valve in delivery position and the corresponding sealing edge given by the polishing of the body.

[0006] The flow-rate sent to the actuator is substantially controlled by the opening area between the spool notch and the driving edge of the section.

[0007] The flow-rate of a fluid going through a passage area is forced to lose a determined amount of pressure because of the head losses generated when passing through the passage area itself.

[0008] The pressure established upstream and downstream of the passage area produces a differential pressure which is kept constant in all the operating conditions of the three-way flow-rate regulator, called flow-rate compensator, inserted in the inlet section (circuits with fixed displacement pumps, i.e. open centre), branched off the pressure line.

[0009] In the case of open centre circuit, the three way compensator situated in the inlet section, unloads the flow-rate exceeding the one required by the spool; its position is balanced by the pump pressure and the one coming from the signal taken off from workport, called Load Sensing signal.

[0010] When two or more working sections are actuated simultaneously, only the greater Load Sensing signal is sent to the inlet section compensator of the open centre directional control valve or to the variable displacement pump compensator, in closed centre directional control valves.

[0011] The working sections complete with two way pressure compensator have the ability to maintain the set flow-rate on multiple spools, even if they are actuated simultaneously, provided that the sum of the required flow rates is equal to or lower than the maximum flow of the pump, otherwise the system goes into flow saturation.

[0012] In the prior art, normally used circuits are those in which it is possible to use:

- Fixed displacement pump, i.e. open centre inlet section;
- Variable displacement pump with Load Sensing compensator, i.e. closed centre inlet section.

[0013] In a circuit for fixed displacement pump, with open centre side, when the spools are in central position the flow-rate of the pump passes through the inlet section compensator, towards the tank.

[0014] In this condition, the flowing of the fluid through the inlet section determines the pressure of the pump, nominal stand-by pressure, which is none other than the force of the spring opposing the pump pressure acting on the opposite side of the compensator.

[0015] When the spools are moved, the load pressure is selected by the logic sections (exchange or shuttle valves) and transferred to the chamber of the three way compensator spring located in the inlet section, which limits the flow to the tank.

[0016] In a circuit for variable displacement pump, the flow-rate compensator in the inlet section is used as a second stage of a pilot operated pressure relief valve, as it totally opens towards the tank only if the pressure value on the pump channel exceeds the setting value of the pressure relief valve of the Load Sensing.

[0017] The Load Sensing signal is sent to the variable displacement pump compensator through the apposite connection present in the inlet section.

[0018] Unlike the open centre circuit, in this case the Load Sensing signal is no longer sent into the chamber of the inlet section compensator spring; but is stopped by placing a plug on the connection with the chamber itself, while the connection with the pump remains open.

[0019] Prior art drawbacks emerge in the following aspects:

- Load drop while switching with very long connection between directional control valve and variable displacement pump (said drawback is apparent when it is not possible to insert, due to the final users' explicit requirements, Overcenter valves);
- Load drop when the pump is off;
- Load up/down pitching with and without Overcenter valves, due to pressure oscillations;
- Hydraulic motor oscillations.

[0020] Object of the present invention is to introduce a new inlet section for Load Sensing directional control valves able to solve the aforesaid problems by introducing and arranging additional components, in particular it comprises a pump signal copying unit and a variable area adjustable damper unit, appropriately arranged, which act on the Load Sensing signal incoming from the work sections and directed to the pump and vice versa.

[0021] The copy-spool mainly serves the purpose of solving the problem of load drop while switching and the variable area adjustable damper serves the purpose of solving the problem of load up/down pitching, with and without Overcenter valves.

[0022] Specifically, to avoid load drops while switching, it is necessary to make as reactive as possible the pump positioned a long distance from the directional control valve, i.e. it is no longer the workport signal to go towards the pump, but it is the pump signal itself taken off from the directional control valve; in other words, the pump is short-circuited on itself.

[0023] Moreover, when the pump is off, the copy-spool prevents the workport signal (load sensing signal) from unloading through the pump once the spool is actuated.

[0024] The damper solves the problem of pitching, because the signal returning from the pump towards the inlet section of the directional control valve, usually with wide pressure oscillations, is stabilised and kept constant by the damper itself.

[0025] Said objectives and advantages are all achieved by the inlet section for Load Sensing directional control valves object of the present invention, which is characterised by the content of the below-listed claims.

[0026] These and other features will be better pointed out by the following description of some embodiments illustrated, merely as a non limiting example, in the enclosed tables of drawing , in which:

- Figure 1 shows a circuit diagram of the new side for an open centre system;
- Figure 2 shows a circuit diagram of the new side for a closed centre system;
- Figure 3 shows a variant of the circuit diagram for an open centre system of Figure 1;
- Figure 4 shows a variant of the circuit diagram for a closed centre system of Figure 2;
- Figure 5 shows a sectional view of the inlet section for load sensing directional control valves, in particolar for a closed centre system;
- Figure 6 shows the copy-spool system of the side of Figure 5.

[0027] With reference to Figure 1, the operating diagram can be observed of the new inlet section for open centre system CA.

[0028] The hydraulic circuit representing the inlet section comprises various components, some standard like a pressure reducer valve for pilot pressure supply, a load-sensing signal unloader valve, a load sensing signal pressure relief valve, whilst always present is the compensator C or three way flow-rate regulator and the internal pilot lines. In addition to the standard components, it can be observed a variable area damper 4, a check valve 5, a copy-spool 2 and a calibrated check valve 6.

[0029] When the spool on the element is in switching phase, i.e. it moves from the central position, the withdrawal, given by the load, of the signal LSAB, occurs and, through the work sections, the signal LSAB reaches the line 10, passes through the line 16 and the adjustable variable area damper 4 and arrives, through the line 12, directly at the compensator C of the inlet section CA.

[0030] The signal LSAB, in addition to passing through the variable area damper 4 can also pass through the check valve 5, travelling first through the line 17 and then reconnecting to the line 11 through the line 18; it can also reach the calibrated check valve 6 through the line 15, but it is not allowed to continue on the line 14 because of the presence of the check valve 6 itself.

[0031] The signal LSAB also traverses the line 13, travels through the copy-spool 2 and, following the line 20, goes to a filter 7, ending in a plugged port for drawing the signal, situated on the directional control valve.

[0032] The copy-spool 2 senses the same pressures on both sides: the pressure on the line 8 is equal to the one of the line 19, since both arrive respectively from the line 10 and from the line 20.

[0033] On the line 19 side the copy-spool also senses the force of a spring 3 so that, as long as the pressure on the line 8 is lower than that of the line 19 added to the spring 3, the copy-spool remains in the position shown in figure but, when the pressure on the line 8 increases and exceeds that on the line 19, the copy-spool 2 moves to the other position, shutting off the connection between the lines 20 and 13, whilst the connection between the lines 9 and 20 gets opened.

[0034] In this configuration, whether the copy-spool remains in the position shown in figure or it moves, the signal that passes through it always goes towards the filter 7 and against the plug located on the tongue and groove joint to connect the signal LS to the variable displacement pump.

[0035] Hence, in the case of open centre, this joint is always plugged: if the copy-spool moves by means of the difference in pressure between the line 8 and 19 (lower pressure), the signal that passes always goes against the plug and consequently the pressure on the line 19 is equalised to that on the line 8, the copy-spool returns to the position shown in figure thanks to the force of the spring 3.

[0036] With reference to Figure 2, the operating diagram can be observed of the new inlet section for closed centre system CC.

[0037] The signal LSAB reaches the line 30 and, passing through the lines 36, 33, 40 and 41, traverses both the variable area damper 4 and the copy-spool 2 and reaches the compensator of the variable displacement pump 21 through the filter 7.

[0038] The signal going to the pump is called LSC in order to differentiate it from the one that comes from the work sections LSAB.

[0039] The signal, in addition to going through the variable area damper 4 can also pass through the check valve 5, travelling first through the line 37 and then reconnecting to the line 31 through the line 38; in this case the signal passes free towards the pump 21 and it can also reach the calibrated check valve 6 through the line

35, but it is not allowed to continue on the line 14 because of the presence of the check valve 6 itself.

[0040] The signal LSAB coming from the line 31 cannot arrive to the inlet section compensator C through the line 32 because a plug prevents its connection.

[0041] The signal LSC coming from the pump 21 returns towards the inlet section of the directional control valve and hence towards the work sections whereon the load gravitates.

[0042] Its path starts from the pump 21 through the line 41, the filter 7, the line 40, the copy-spool 2, the line 34, the calibrated check valve 6, the lines 33, 31, the variable area damper 4, the lines 36 and 30 and continues towards the work sections.

[0043] Therefore, the signal that is dampened is the one that comes from the pump 21 and goes towards the work sections.

[0044] The copy-spool 2 assumes the position shown in figure because the pressure on the line 39 is greater than that on the line 28, so it lets the signal go towards the variable area damper 4 through the lines 31 and 33.

[0045] The signal on the line 31, in addition to going to the variable area damper 4, goes both towards the check valve 5 through the line 38, without continuing because the check valve 5 prevents its connection with the line 37, and towards the check valve 6 calibrated at twenty-five bars: this means that, until the pressure on the line 34 reaches twenty-five bars, the check valve 6 remains shut and the signal is forced to pass through the variable area damper 4.

[0046] Once the calibration of the check valve 6 is exceeded, the signal gets connected to the line 35 rejoining the line 36 to continue on the line 30 towards the work sections.

[0047] The copy-spool 2 is maintained in the position shown in figure due to the different pressures on the lines 28 and 39; as long as the pressure on the line 39 is greater than that on the line 28 the copy-spool will not move.

[0048] In this example, too, on the copy-spool 2 there is a spring 3 on the line 39 side.

[0049] If the pressure on the line 28 is greater than the one existing on the line 39 the copy-spool 22 moves to the opposite position, thereby shutting off the connection between the line 33 and the line 40; at the same time, the connection between the line 29, 40 and 41 gets opened.

[0050] In this case, copied signal conditions exist: to the variable displacement pump compensator 21 is sent the signal taken off from the line 29, which comes from the pump 21 itself.

[0051] As is readily apparent from the tables of drawing described herein, the copy-spool 2 is piloted by the signals LSAB and LSC, respectively arriving from the work sections and from the pump whilst the spring 3 is positioned on the signal LSC side.

[0052] Said signals LSAB and LSC are throttled to produce such a differential pressure that, at the start (instant when the spool is actuated), the switch of the copy-spool 2 can take place and the signal can thus be copied.

[0053] Figures 3 and 4 show a different solution applying the same principle of operation seen for the previous figures.

[0054] In particular, the signal LSAB passes first through the variable area damper 4, the check valve 5 and subsequently through the copy-spool 2 and then goes either to the pump, in the case of closed centre circuit CC, or to the 3-way compensator C, in the case of open centre circuit CA.

[0055] During the return of the signal from the pump, a minimal part of it travels back through the copy-spool 2, whilst most of it passes through the check valve 6 calibrated at twenty-five bars.

[0056] With reference to Figure 3, when the spool on the element is in switching phase the signal LSAB is taken off , reaches the line 8, traverses the variable area damper 4 and arrives through the lines 11, 20 and 12 directly to the compensator C of the open circuit inlet section CA, after traversing both the copy-spool 2 and the filter 7.

[0057] The signal LSAB, in addition to traversing the variable area damper 4, can also pass through the check valve 5, first through the line 17 and then reconnecting to the line 11 through the line 18; it can also reach the check valve 6 through the line 15, but it is not allowed to continue on the line 14 because of the presence of the check valve 6 itself.

[0058] It can be observed that the passage from the line 14 to the line 15 is allowed only upon exceeding the calibration pressure of the spring, in this case, twenty-five bars.

[0059] The copy-spool 2 remains in the position shown in figure as long as the pressure on the line 20 added to the force generated by the spring 3, exceeds the pressure on the line 21; in this case the signal LSAB coming from the lines 8, 16, 13 and 17, is able to pass through the check valve 5, the copy-spool 2 itself and to go towards the 3 way compensator C, traversing first the line 20, the filter 7 and the line 12.

[0060] When the pressure on the line 21 exceeds that of the line 20 added to the force of the spring 3, the copy-spool 2 moves to the other position in respect to that of the figure, shuts off the line 11 and opens the line 9 sending it on the lines 20 and 12, specifically at the spring side of the compensator C.

[0061] In this case the Load Sensing signal is said to be copied.

[0062] With reference to Figure 4, the signalLSAB arrives at the line 31, passes through the variable area damper 4 and reaches the variable displacement pump 21 passing through the lines 32, 40 and 41, traversing the copy-spool 2 and the filter 7.

[0063] The copy-spool 2 is maintained in the position shown in figure due to the different pressures on the lines 39 and 42.

[0064] As long as the pressure on the line 39 is greater than the one on the line 42 the copy-spool does not move; when instead the pressure on the line 42 exceeds that of the line 39 the copy-spool 24 moves to the opposite position, thus shutting off the connection between the line 32 and the line 40; at the same time, the connection between the line 30, 40 and 41 gets opened.

[0065] When the copy-spool 2 is in this position we are in copied signal conditions: to the compensator of the pump 21 is sent the signal taken off from the line 30, which comes from the pump 21 itself.

[0066] The signal LSAB, in addition to traversing the variable area damper 4 can also pass through the check valve 5, travelling first through the line 37 and then reconnecting to the line 32 through the line 38; in this case the signal passes free towards the pump 21; moreover, it can reach the calibrated check valve 6 through the line 35, but it is not allowed to continue on the line 34 because of the presence of the check valve 6 itself.

[0067] Vice versa, the signal from the line 34 can pass to the line 35 only when the pressure exceeds the value of twenty-five bars, i.e. the calibration value of the calibrated check valve 6 spring.

[0068] The signal, once passed the filter 7, cannot go to the compensator C of the inlet section, because a plug prevents its connection.

[0069] The signal LSC from the pump 21 returns towards the inlet section of the directional control valve and hence towards the work sections whereon the load gravitates.

[0070] Its path starts from the pump 21 through the line 41, the filter 7, the line 40, the copy-spool 2, the line 32, the variable area damper 4, the lines 33, 36, 29, 31 and continues towards the work sections.

[0071] Moreover, from the line 34 the signal LSC traverses the check valve 6 calibrated at twenty-five bars, the lines 36, 29, 31 and continues towards the work sections.

[0072] The signal LSC that is dampened is the one that comes from the pump 21 and goes towards the work sections; the copy-spool 2 assumes the position shown in figure.

[0073] The pressure on the line 39 is greater than that on the line 42, so it allows the signal to pass towards the variable area damper 4 through the line 32, but the signal cannot traverse the check valve 5 because the check valve 5 itself prevents its connection with the line 37.

[0074] The signal LSC, in addition to traversing the copy-spool 2, can continue towards the check valve 6 calibrated at twenty-five bars.

[0075] Until the pressure on the line 34 reaches twenty-five bars, the check valve remains shut and the signal LSC is forced to pass through the copy-spool 2 and the variable area damper 4.

[0076] Once the calibration of the calibrated check valve 6 is exceeded, the signal LSC is connected to the line 35 rejoining the line 36 to continue on the lines 29, 31 towards the work sections.

[0077] The solution shown in Figures 1 and 2 allows to solve the problem of hydraulic motors oscillation and the problem of the pitching of the crane arm in the presence of overcenter valves.

[0078] Additionally, with the pump off the copy-spool allows to block the signal LSAB and not to let it continue towards the pump (for the closed centre system CC).

[0079] The signal LSAB, when the directional control valve is in resting conditions, i.e. no spool is actuated, must be at the unloading pressure T.

[0080] As soon as the spool is placed in central position, the signal LSAB is connected to tank and, in the open centre system CA, in addition to passing through the standard components, it has also to go through the variable area damper 4 and the calibrated check valve 6, so it takes a slight longer time.

[0081] For the closed centre system CC the time required by the signal LSAB increases even more because it also has to go through the copy-spool 2.

[0082] Therefore, for both the described examples (Figures 1 and 2) the head losses on the signal LSAB inside the inlet section increase slightly because the signal has to traverse both the variable area damper 4 and the copy-spool 2.

[0083] In the examples of Figures 3 and 4 the only difference is in the position assumed by the check valve 6 calibrated at twenty-five bars.

[0084] Moreover, this valve maintains a pressure difference of twenty-five bars between the line of the LSAB signal that comes from the work sections and goes to the damper and the line of the LSC at the output of the copy-spool.

[0085] The resulting advantage is that when the spool returns to the central position, the return signal LSC is unloaded very quickly, especially in extreme conditions, i.e. when the oil is very cold and dense or every time the system is first started.

[0086] In other words the signal does not have to pass through the copy-spool 2 or through the variable area damper 4 but directly go towards the work sections and hence to unload.

[0087] Common to all illustrated examples is the fact that the check valve 6 calibrated at twenty-five bars is also used in particular conditions, such as when starting the system with low temperatures and very dense oil.

[0088] In this case it allows to bypass the variable area damper 4 and lets the load sensing signal reach the work sections very quickly in order to have a reactive system even when the directional control valve is cold.

[0089] If the dense oil were to pass only inside the damper, it would be late in reaching the work sections, so there would be a delay in the system until it reaches the ideal operating temperature.

[0090] With reference to Figure 5, it can be observed a sectional view of the inlet section for load sensing directional control valves.

[0091] The number 51 designates the line of the signal that goes towards the pump, i.e. LSC, whilst the number 52 designates the signal arriving from the work sections, described previously as LSAB.

[0092] In the sectional view the variable area damper unit is designated by the number 53 and the check valve calibrated at twenty-five bars is designated by the number 54.

[0093] The number 55 designates the copy-spool unit, also shown in the following Figure 6: in the latter depiction, behind the copy-spool passes the line of the pump which in Figure 5 was not shown for the sake of illustrative clarity.

[0094] The number 61 designates the subject copy-spool.

Claims

1. An inlet section for load sensing directional control valves operating with open centre and closed centre circuit, with or without a pressure reducing valve for internal pilot line pressure supply, a load-sensing signal unloader valve, a load-sensing signal pressure relief valve, while always present is the compensator (C) or three way flow regulator and the internal pilot lines, **characterised in that** it comprises in combination a variable area damper (4), a check valve (5), a copy-spool (2) and a calibrated check valve (6).

2. Inlet section for load sensing directional control valves, as claimed in claim 1, **characterised in that** the check valve (5) is in parallel to the variable area damper (4).

3. Inlet section for load sensing directional control valves, as claimed in claim 1, **characterised in that** the copy-spool (2) is positioned after the variable area damper (4), before the compensator (C).

4. Inlet section for load sensing directional control valves, as claimed in claim 1 and 2, **characterised in that**, in open centre circuits (CA), the check valve (5) lets the signal (LSAB) incoming from workports pass free and it routes said signal first to the compensator (C) or to the copy-spool (2), thence to a filter (7), then to the compensator (C) itself.

5. Inlet section for load sensing directional control valves, as claimed in claim 1 and 2, **characterised in that**, in closed centre circuits (CC), the check valve (5) lets the signal (LSAB) incoming from workports pass free and it routes said signal to the variable displacement pump (21).

6. Inlet section for load sensing directional control valves, as claimed in claim 1, **characterised in that** the calibrated check valve (6) excludes both the copy-spool (2) and the variable area damper (4) taking the return signal (LSC) from the pump before it enters the copy-spool (2) and connecting to the line (10) of the work sections.

7. Inlet section for load sensing directional control valves, as claimed in claim 1 and 6, **characterised in that** the signal (LSC) in part passes through the copy-spool (2) and through the variable area damper (4) and the remainder goes directly towards the work sections and thence to tank (under resting conditions, i.e. with no spool actuated) when the pressure on the line of the calibrated check valve (6) reaches the calibration value of the check valve (6).

8. Inlet section for load sensing directional control valves, as claimed in claim 1, **characterised in that** the calibrated check valve (6) excludes the copy-spool (2) taking the return signal (LSC) from the pump before it returns into to the copy-spool (2) and connecting to the line (10) of the work sections.

9. Inlet section for load sensing directional control valves, as claimed in claims 1 and 8, **characterised in that** the signal (LSC) returning from the pump (P) passes through the copy-spool (2) and through the variable area damper (4) until the pressure on the line of the calibrated check valve (6) reaches the calibration value of the check valve (6).

10. Inlet section for load sensing directional control valves, as claimed in claims 1, 6 and 8, **characterised in that** the calibrated check valve (6) prevents the signal from passing through the variable area damper (4) letting the signal (LSAB) reach the work sections very quickly even when the directional control valve is cold.

11. Inlet section for load sensing directional control valves, as claimed in claims 1 and 3, **characterised in that** the copy-spool (2) is driven by the signals (LSAB) and (LSC), respectively arriving from the work sections and from the pump, and a spring (3) is positioned on the signal (LSC) side.

12. Inlet section for load sensing directional control valves, as claimed in claim 1, **characterised in that**, when the pump is off, the copy-spool (2) allows to block the signal (LSAB) and not to let it continue to the pump under closed centre system (CC) conditions.

13. Inlet section for load sensing directional control valves, as claimed in claim 1, **characterised in that** the calibrated check valve (6) has a calibration range of between 15 and 35 bars of pressure.

Amended claims in accordance with Rule 86(2) EPC.

1. An inlet section for load sensing directional control valves operating with open centre (CA) and closed centre circuit (CC), with or without a pressure reduc-

ing valve for internal pilot line pressure supply, a load-sensing signal unloader valve, a load-sensing signal pressure relief valve, while always present is the compensator (C) or three way flow regulator and the internal pilot lines, comprising a variable area damper (4), a check valve (5), a copy-spool (2) and a calibrated check valve (6); said the check valve (5) being in parallel to the variable area damper (4) **caracterised in that** in open centre circuits (CA), the check valve (5) lets the signal (LSAB) incoming from workports pass free and it routes said signal first to the compensator (C) or to the copy-spool (2), thence to a filter (7), then to the compensator (C) itself, while in closed centre circuits (CC), the check valve (5) lets the signal (LSAB) incoming from workports pass free and it routes said signal to the variable displacement pump (21).

2. Inlet section for load sensing directional control valves, as claimed in claim 1, **characterised in that** the signal (LSAB), in addition to passing free through the check valve (5), passes first through the variable area damper (4), and subsequently through the copy-spool (2) and then goes either to the pump (21), in the case of closed centre circuit (CC), or to the compensator (C), in the case of open centre circuit (CA).

3. Inlet section for load sensing directional control valves, as claimed in claim 1, **characterised in that** the calibrated check valve (6) excludes both the copy-spool (2) and the variable area damper (4) taking the return signal (LSC) from the pump before it enters the copy-spool (2) and connecting to the line (10) of the work sections.

4. Inlet section for load sensing directional control valves, as claimed in claim 1 and 3, **characterised in that** the return signal (LSC) starts from the pump (21) and is forced to pass through the copy-spool (2) and the variable area damper (4) until the pressure on the line of the calibrated check valve (6) reaches the calibration value of calibrated check valve (6).

5. Inlet section for load sensing directional control valves, as claimed in claim 1, **characterised in that** the calibrated check valve (6) excludes the copy-spool (2) taking the return signal (LSC) from the pump before it returns into to the copy-spool (2) and connecting to the line (10) of the work sections.

6. Inlet section for load sensing directional control valves, as claimed in claims 1 and 5, **characterised in that** the signal (LSC) returning from the pump (21) passes through the copy-spool (2) and through the variable area damper (4) until the pressure on the line of the calibrated check valve (6) reaches the calibration value of the check valve (6).

7. Inlet section for load sensing directional control valves, as claimed in claims 1, 3 and 5, **characterised in that** the calibrated check valve (6) prevents the signal from passing through the variable area damper (4) letting the signal (LSC) reach the work sections very quickly even when the directional control valve is cold.

8. Inlet section for load sensing directional control valves, as claimed in claims 1, **characterised in that** the copy-spool (2) is driven by the signals (LSAB) and (LSC), respectively arriving from the work sections and from the pump, and a spring (3) is positioned on the signal (LSC) side.

9. Inlet section for load sensing directional control valves, as claimed in claim 1, **characterised in that,** when the pump is off, the copy-spool (2) allows to block the signal (LSAB) and not to let it continue to the pump under closed centre system (CC) conditions.

10. Inlet section for load sensing directional control valves, as claimed in claim 1, **characterised in that** the calibrated check valve (6) has a calibration range of between 15 and 35 bars of pressure.

FIG. 2

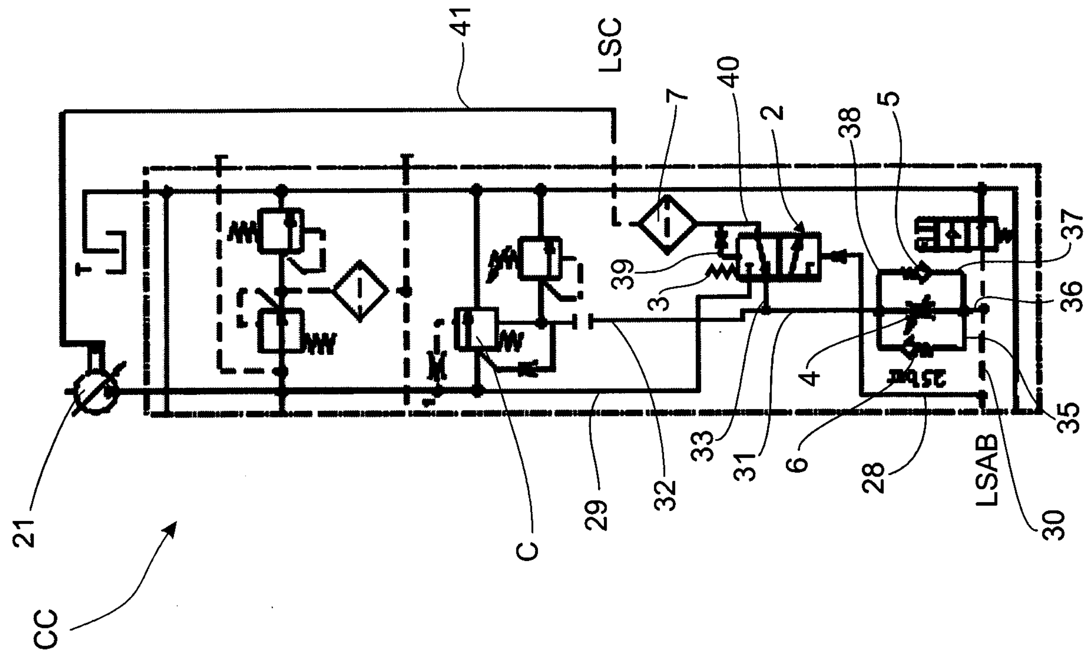

41
LSC
7
40
2
38
5
37
36
35
39
3
33
31
4
6
28
LSAB
30
21
C
29
32
CC
T

FIG. 1

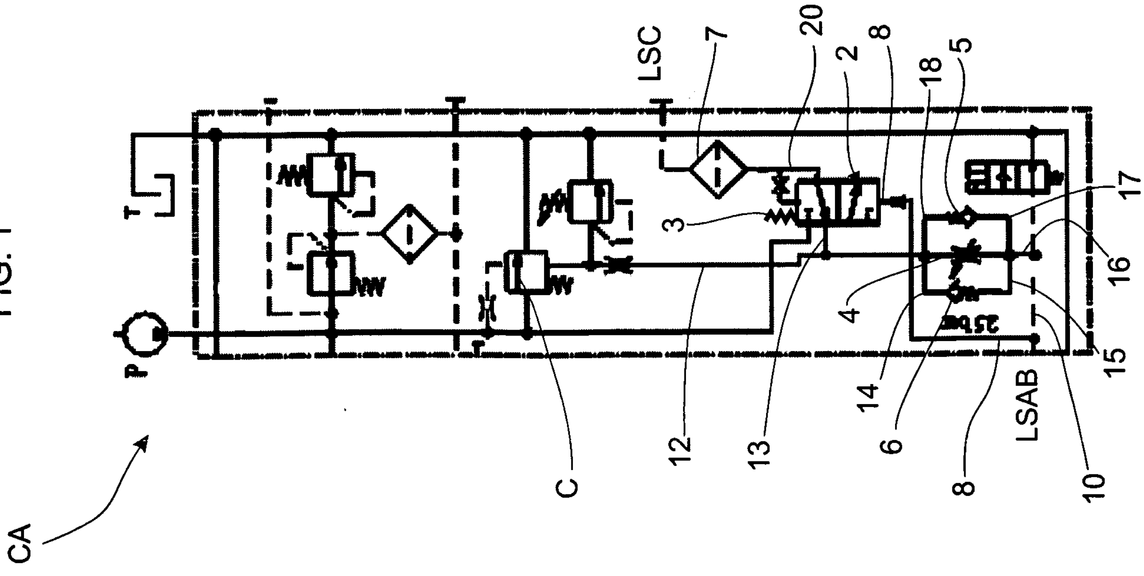

LSC
7
20
2
8
18
5
17
16
15
3
4
14
6
8
LSAB
10
C
12
13
CA
P
T

FIG. 4

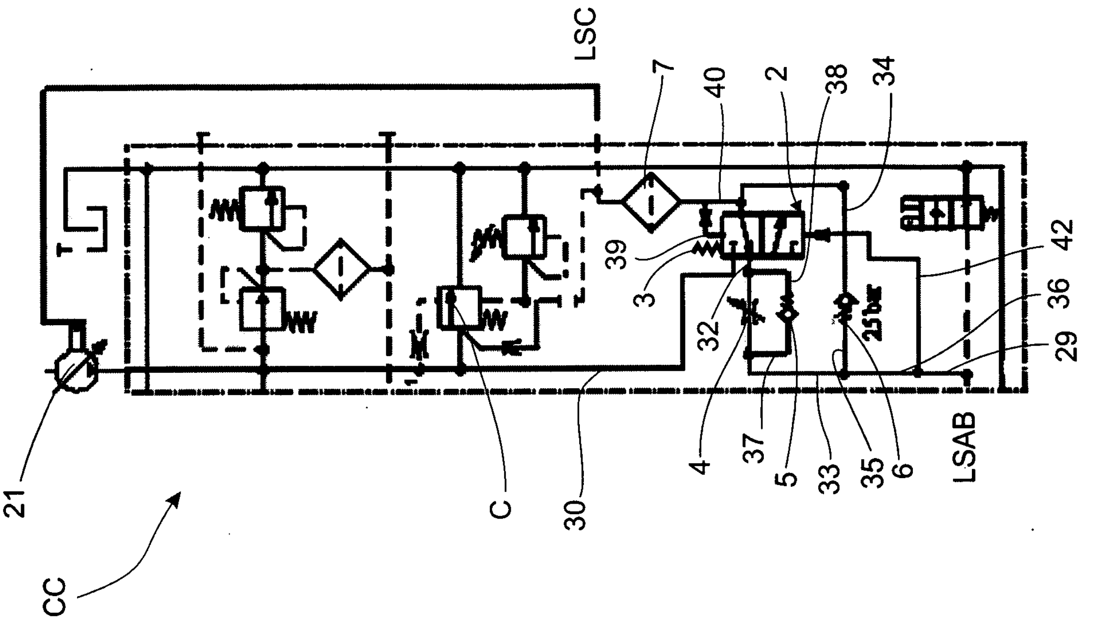
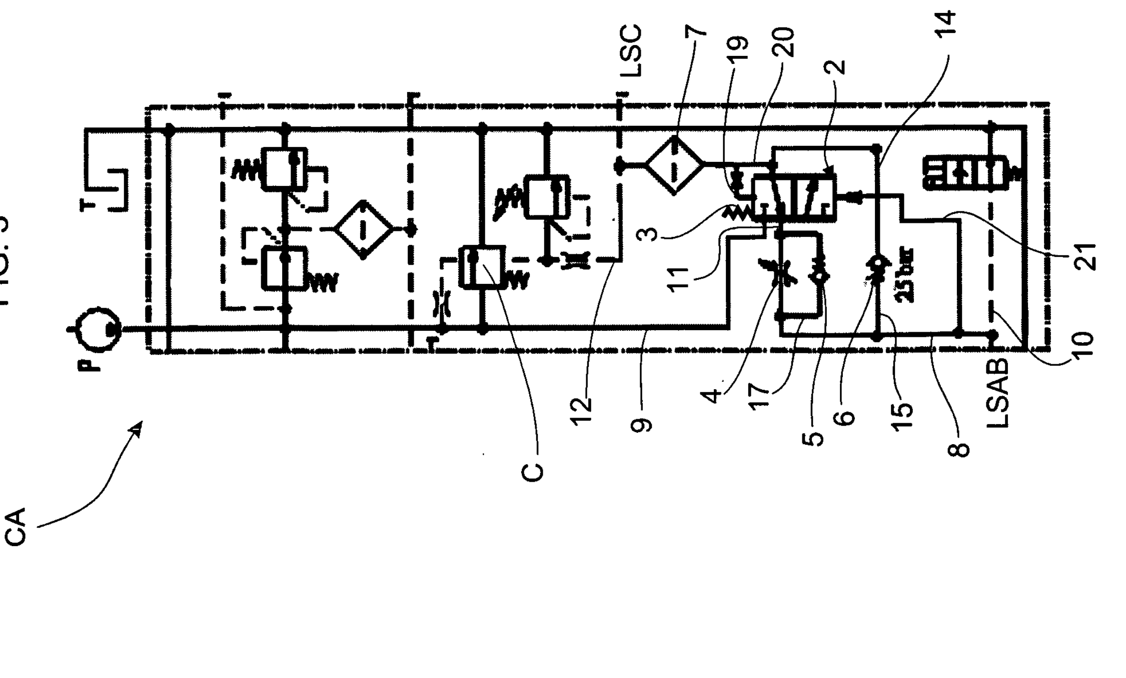

LSC
7
40
2
38
34
T
39
3
42
32
36
29
21
4
37
5
33
35
6
LSAB
C
30
CC
25 bar

FIG. 3


LSC
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19
20
2
14
T
P
3
11
21
10
4
17
5
6
15
8
LSAB
12
9
C
CA
25 bar

FIG. 5

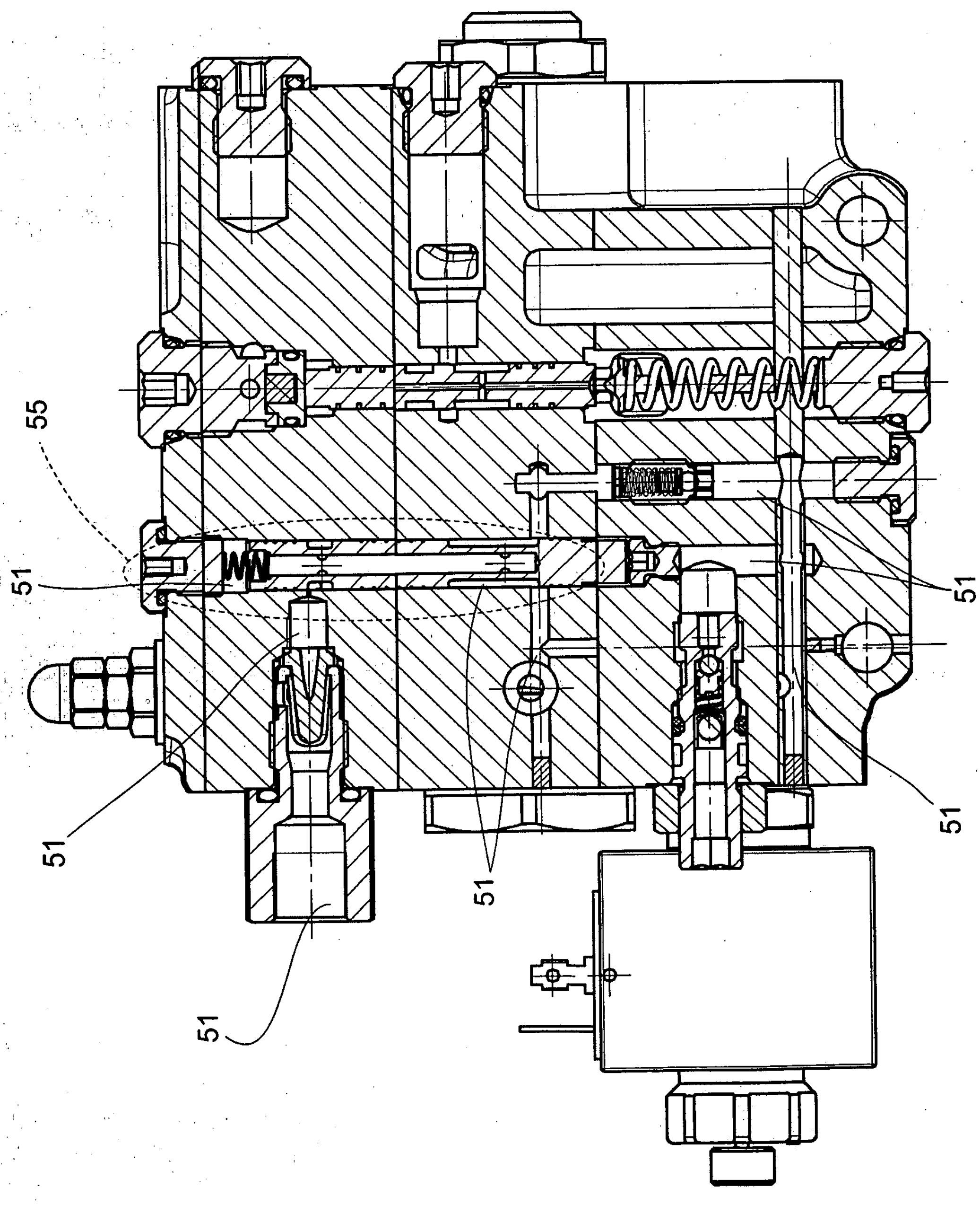
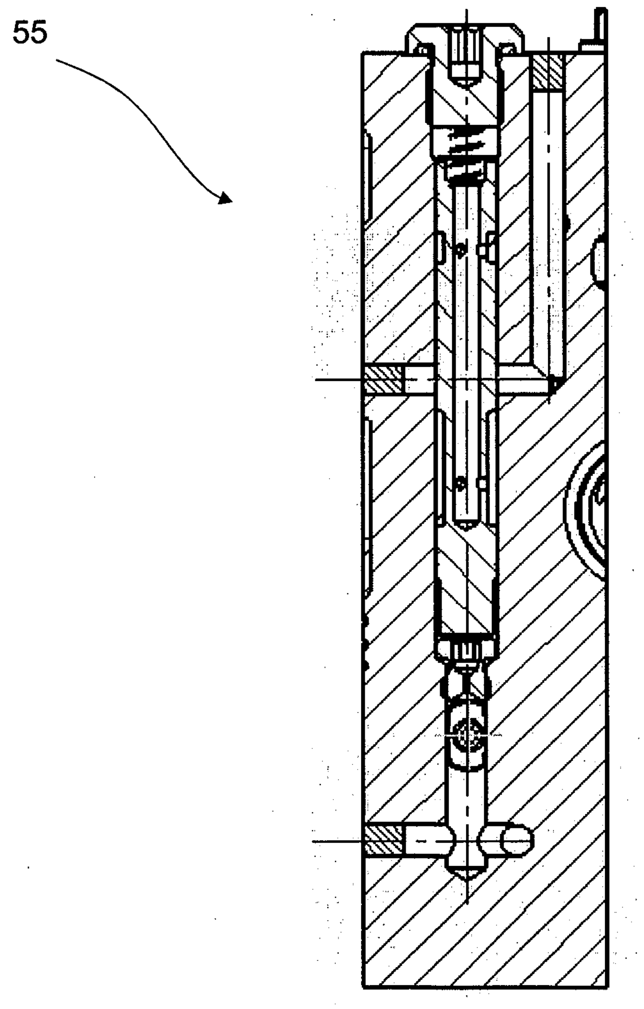


FIG. 6



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Application Number
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Place of search	Date of completion of the search	Examiner
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