(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 3 205 889 A1**

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
16.08.2017 Bulletin 2017/33

(21) Application number: **17155506.3**

(22) Date of filing: **09.02.2017**

(51) Int Cl.:
F15B 11/16 *(2006.01)* ***F15B 11/20*** *(2006.01)*
F15B 13/06 *(2006.01)* ***F15B 13/08*** *(2006.01)*
F15B 18/00 *(2006.01)*

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME
Designated Validation States:
MA MD

(30) Priority: **09.02.2016 IT UB20160596**

(71) Applicant: **Walvoil S.p.A.**
42124 Reggio Emilia (IT)

(72) Inventors:
- **CERVI, Alessandro**
  42124 Reggio Emilia (IT)
- **FERRARI, Andrea**
  42124 Reggio Emilia (IT)
- **MESLIN, Philippe**
  42124 Reggio Emilia (IT)

(74) Representative: **Benelli, Cristian et al**
Ing. Dallaglio S.R.L.
Via Mazzini N. 2
43121 Parma (IT)

(54) SERIAL-PARALLEL HYDRAULIC VALVE WITH LOGIC SWITCHING ELEMENT

(57) Hydraulic directional valve, with mixed series (S) and parallel (P) hydraulic circuit consisting of two or more sections and one logic switching element (E, E1, E2), characterized in that said logic element (E, E1, E2) in neutral position involves connecting the series channel (S) of said mixed series and parallel hydraulic circuit with the branch downstream of pressure (P1), and at the same time isolates the pressure channel (P) of the parallel circuit and the discharge (T); when switching the distributor, the latter reaches a second position, which involves closing the channel (S) and simultaneously opening the parallel channel (P) towards the branch downstream of pressure (P1), and in this case channel (S) is set to discharge by the connection with (T); a control channel (1) copies the signal from the pressure channel (P) bringing it on one side of the logic element (E, E1, E2).

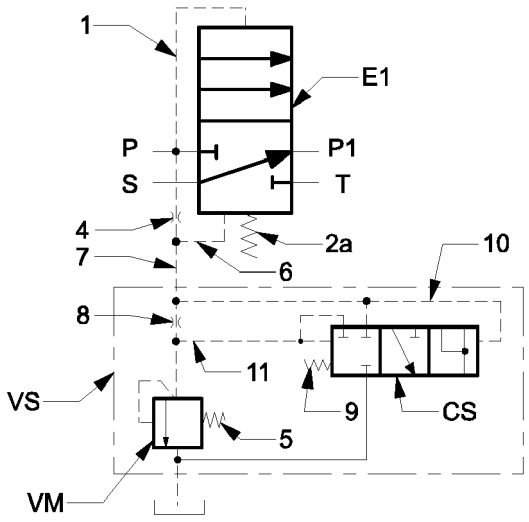

Fig. 4

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Description

SCOPE OF THE INVENTION

[0001] The present invention finds application in hydraulic valves and its object is the implementation of a dedicated hydraulic circuit for lifting applications in the presence of hydraulic valves with multiple functions intended for operating machines, such as front loaders, shovels, buckets.

[0002] More precisely, the invention relates to a logic element insertable inside said hydraulic circuit of control valves for utilities, wherein said logic element is capable of ensuring an overall operation of the circuit in series or in parallel depending on the operating conditions of the valve. The invention provides for multiple possibilities to solve and manage these operating conditions.

PRIOR ART

[0003] A common problem of the existing open center hydraulic circuits in "series" configuration (as shown in figure 1) is the following: let's assume that the elements of the hydraulic distributor actuate cylinders, in the case of simultaneous use of two or more sections, if one these cylinders reached the end of stroke, the others stop as well.

[0004] Similarly, for a hydraulic valve entirely in "parallel" configuration (see figure 2), in case of flow demand of multiple elements (utilities), the distribution of the same among the elements depends on the pressures generated by the loads and therefore potentially, in certain situations, simultaneous movements are not guaranteed.

[0005] Both series/parallel circuits, have advantages and drawbacks. The present invention aims to find a solution that allows, in a single circuit, the benefits of both configurations described to be obtained, as a function of the working conditions.

DISCLOSURE OF THE INVENTION

[0006] One object of the present invention is to solve the limits of circuits for hydraulic valves in "series" (fig. 1) and "parallel" (fig. 2) intended for front loading circuits described above, with a simple, rational and rather cost-effective solution.

[0007] These and other objects are achieved with the features of the invention described in the independent claim 1. The dependent claims describe preferred and/or particularly advantageous aspects of the invention.

[0008] With this solution, the logic element ensures an overall operation of the circuit in series or in parallel depending on the plant operating conditions.

[0009] Another aspect of the invention is to provide a logic element controlled by a sequence valve or by a pressure relief valve.

[0010] With this solution, the circuit ensures a more stable operation upon switching from series to parallel circuit and vice versa, thereby delegating the calibration of the sequence valve or the cursor position as responsible for the switching of the logic element.

[0011] Said objects and advantages are all achieved by the valve and mixed series-parallel hydraulic circuit object of the present invention, which is characterized by the claims below.

BRIEF DESCRIPTION OF THE FIGURES

[0012] This and other features will become more apparent from the following description of some of the configurations, illustrated purely by way of example in the accompanying drawings, in which:

- FIG. 1 shows a hydraulic circuit for front loader with 2 sections in "series" configuration;
- FIG. 2 shows a hydraulic circuit for front loader with 2 sections in "parallel" configuration;
- FIG. 3 schematically shows the logic element to be included in the circuit;
- FIG. 3A shows the diagram of a hydraulic circuit for front loader with 2 sections with the integration of the logic element schematized in Fig. 3.
- FIG. 4 schematically shows the logic element controlled by a sequence valve;
- FIG. 4A shows the diagram of a hydraulic circuit for front loader with 2 sections with the integration of the logic element controlled by a sequence valve schematized in Fig. 4.
- FIG. 5 schematically shows the 6-way, 2-position logic element controlled by a pressure relief valve;
- FIG. 5A shows the diagram of a hydraulic circuit for front loader with 2 sections with the integration of the 6-way, 2-position logic element controlled by a pressure relief valve schematized in Fig. 5.
- FIG. 6 shows the diagram of a hydraulic circuit for front loader with the integration of the logic element controlled by a sequence valve shown in Fig. 4 but repeated for a 3-section circuit.

DESCRIPTION OF THE INVENTION

[0013] With reference to the accompanying figures, Fig. 3 shows the basic construction of the logic element E.

[0014] It is a 4-way, 2-position distributor, in which spring 2 keeps the logic element in the rest position, where channel S, or series, is connected with the branch named P1. At the same time, the pressure channel P, i. e. parallel, is isolated from the logic element E, as the discharge channel T is isolated.

[0015] In the switching step of the distributor, the latter reaches the second position, which involves closing between channel S and P1 and the simultaneous opening of the parallel channel P towards branch P1. In this case, channel S is set to discharge by the connection with T.

[0016] A control channel 1 is also part of the logic element E, which copies the signal from branch P and

brings it on one side of the logic element. Furthermore, spring 2, which has the function of keeping the logic element in that neutral position and the calibration of which determines the pressure value P required for the switching of the logic element E.

[0017] In Fig. 3A, this logic element E is inserted in a complete hydraulic circuit for front loader, implementing in this way the circuit shown in Fig. 1 and 2.

[0018] One can see where the various ways P, T, S, P1 of the logic element E described in Fig. 3 are connected.

[0019] Fig. 4 proposes the scheme in fig. 3 but with a different constructive solution. The logic element E1 is coupled with a sequence valve VS. Valve VS consists of a distributor CS associated with a spring 9, a pressure relief valve VM and relative connections. A control line 7 including two chokes 4 and 8 is added in the illustrated solution. Furthermore, spring 2a changes function with respect to spring 2 seen in fig. 3.

[0020] The logic element E1 in rest configuration involves the connection of S with P1, and since the pressure value on P is reported on both sides of the logic element by virtue of connections 1 and 6, this is guaranteed by the second spring 2a. Once the calibration value of valve VM set onto spring 5 is reached on P, this opens the connection of the control line 7 towards the discharge. Due to the pressure difference generated by choke 8, distributor CS opens in position to set both branch controls 10 and 11 to discharge. Likewise, the pressure difference generated by choke 4 causes the displacement of the logic element E1 to a second position, as the pressure value on channel 6 is lower than the value on channel 1.

[0021] If the pressure on branch 7 drops, VM is closed again, thereby interrupting the connection with the discharge. Closing the VM does not cause a new displacement of the logic element E1 since distributor CS remains in the discharge position of the signal due to the pressure difference on signals 10 and 11. Distributor CS only closes when the pressure value on signal 10 falls below the calibration of spring 9. In order for everything to work correctly, the pressure value of spring 9 must be lower than the value of spring 5 of the valve VM.

[0022] In Fig. 4A, this logic element E1 is inserted in a complete hydraulic circuit for front loader, implementing in this way the circuit shown in Fig. 1 and 2. The sequence valve VS described in fig. 4 is schematized.

[0023] In this circuit, one can see the connections of the various ways P, T, S, P1 of the logic element E1 described in fig. 4, in addition to valve VS.

[0024] In Fig. 5, the logic element E2 consists of a 6-way, 2 positions distributor. Connection 6a and 12 is added to channels P, S, T, P1, which remain the same as regards the connections as compared to the solutions shown above. In neutral position of the logic element, the two signals 6a and 12 are closed in the logic element. In switching position of element E2, channels 6a and 12 are connected through the element. Spring 2a is the same as in solution in fig. 4, as well as channel 7, choke 4 and also the pressure relief valve VM and relative spring 5.

[0025] The logic element E2 in rest configuration involves the connection of S with P1, and since the pressure value on P is reported on both sides of the logic element by virtue of connections 1 and 6, said connection is guaranteed by spring 2a. Once the calibration value of valve VM set onto spring 5 is reached on P, this opens the connection of the control line 7 towards the channel 14, not necessarily to discharge:

- if channel 14 is closed, the logic element E2 will not open on the cursor downstream of the VM,
- if channel 14 is set to discharge through the cursor, the pressure difference generated by choke 4 causes the displacement of the logic element E2 to a second position, as the pressure value on channel 6 is lower than the value on channel 1.

[0026] If the pressure on the control line 7 drops, VM is closed again, thereby interrupting the connection with channel 14. Closing the VM does not cause a new displacement of the logic element E2 as connection 6a with 12 in the logic element, which bypasses the VM, remains open.

[0027] If for some reason (that will be seen in fig. 5A), the connection of channel 14 is interrupted, the pressure increase on channels 14, 12, 6a, 6 results in the switching of the logic element E2 to neutral. Channel 13 is essential to prevent the increased pressure from reopening valve VM without having switched the logic element E2.

[0028] In Fig. 5A, this logic element E2 is inserted in a complete hydraulic circuit for front loader, implementing in this way the circuit shown in Fig. 1 and 2.

[0029] In this circuit, one can see the connections of the various ways P, T, S, P1 of the logic element E2 described in fig. 5.

[0030] From this image it is clear that operation is also associated with the position of cursor II. Channel 14 is in fact closed by cursor II when this is in the neutral position. Conversely, when cursor II is controlled in one of the two positions, connection 14 is connected to the discharge of the distributor.

[0031] In Fig. 6, the logic element E1 in fig. 4 is inserted in a complete hydraulic circuit for frontal loader similar to that in fig. 4A, but in this case repeated for a circuit with multiple sections, in this case 3.

[0032] The operation obtained for 2 sections is therefore extensible also to distributors with n-sections.

Claims

1. Hydraulic directional valve, with mixed series (S) and parallel (P) hydraulic circuit made of two or more sections and one logic switching element (E, E1, E2), **characterized in that** said logic element (E, E1, E2) in neutral position involves connecting the series

channel (S) of said mixed series and parallel hydraulic circuit with a branch downstream of pressure (P1), and at the same time isolates a pressure channel (P) of a parallel circuit and of a discharge (T); when switching the distributor, the latter reaches a second position, which involves closing the channel (S) and simultaneously opening the parallel channel (P) towards the branch downstream of pressure (P1), and in this case channel (S) is set to discharge by the connection with (T); a control channel (1) copies the signal from the pressure channel (P) bringing it on one side of the logic element (E, E1, E2).

2. Valve according to claim 1, **characterized in that** said switching of the logic element (s) is provided by a spring (2) located on the side opposite to which said control channel (1) operates; the spring (2) alone retains the logic element (E) in neutral position, a calibration value of said spring (2) determining the switching value of the logic element (E).

3. Valve according to claim 1, **characterized in that** said switching of the logic element (E1) is controlled by a sequence valve (VS) coupled with said logic element (E1), formed by a distributor (CS) associated with a spring (9) and a pressure relief valve (VM); said sequence valve (VS) defines two different switching pressures of the logic element (E1) and the distributor (CS):

a. it opens once the calibration value of a spring (5) of the pressure relief valve (VM) of said sequence valve (VS) is reached;
b. it only closes when the pressure value on a first control signal (10) drops below the calibration of a spring (9) associated with said distributor (CS), the control signal (10) being opposed to the spring (9), the pressure value of the spring (9) being lower than the value of the spring (5) of the valve (VM).

4. Valve according to claim 3, **characterized in that** it comprises a control line (7) comprising two chokes (4) and (8); the choke (8) is placed between the two control signals (10, 11) of the distributor (CS); in resting configuration, said logic element (E1) connects the channel (S) with the branch downstream of pressure (P1) by the action of a spring (2a); the value of the pressure channel (P) is shown on both sides of the logic element (E1) by said control connection (1) and a second control (6); said valve (VM) is configured to open the connection of the control line (7) towards the discharge (T), once the calibration value of the valve (VM) set on the spring (5) is reached on the pressure channel (P):

- the distributor (CS) opens to discharge as a function of the pressure difference generated by the choke (8) on the controls (10) and (11),
- the pressure difference generated by the choke (4) causes the displacement of the logic element (E1) to a second position, as the pressure value on channel 6 is lower than the value on channel 1,
- closing the valve (VM) does not cause a new displacement of the logic element (E1); the distributor (CS) remains in the discharge position of the signal due to the pressure difference on the signals (10) and (11).

5. Valve according to claim 1, **characterized in that** said switching of the logic element (E2) is controlled:

a. in opening by a pressure relief valve (VM) with relative spring (5) coupled with said logic element (E2); said valve (VM) is configured to open a connection of a control line (7) towards a channel (14) set to discharge through the cursor (II) downstream of the logic element and to allow switching the logic element (E2);
b. in closing by a further connection (6a) and (12) on said logic element (E2) which bypasses the valve (VM) and by the interruption of the channel (14) which causes an increase in pressure on channels 14, 12, 6a, 6, causing the switching of the logic element E2 to neutral position;
c. a channel (13) associated with the valve (VM) and branching off said connection (12) prevents the increased pressure from reopening valve VM without having switched the logic element E2.

6. Valve according to claim 5, **characterized in that** said two signals (6a) and (12) are closed in the logic element (E2) when said logic element (E2) is in neutral position, while in the switching position of the element (E2), channels (6a) and (12) are connected through the element itself.

7. Valve according to claim 5, **characterized in that** it comprises a choke (4) on the relative connection channel (7) of (P) with said valve (VM).

8. Valve according to claim 5 and 7, **characterized in that** with the logic element (E2) switched and the pressure relief valve (VM) closed, the connection (6a) with (12) into the logic element which bypasses the VM remains open and no displacement of the logic element (E2) is caused.

9. Valve according to claim 5 and 7, **characterized in that** said logic element (E2) in resting configuration involves the connection of S with the downstream branch (P1); since the pressure value on the pressure channel (P) is shown on both sides of the logic

element due to the connections (1) and (6), said connection is ensured by the spring (2a), once the calibration value of the valve (VM) set on the spring (5) is reached on the channel (P), this opens the connection of the control line (7) towards the channel (14), the latter not necessarily set to discharge; in this configuration:

a. if the channel (14) is closed, the logic element (E2) will not open on the cursor downstream of the valve (VM),
b. if the channel (14) is set to discharge through the cursor, the pressure difference generated by the choke (4) causes the displacement of the logic element (E2) to a second position, as the pressure value on the channel (6) is lower than the value on the channel (1).

10. Valve device with multiple working sections, wherein said working sections are mutually connected by both series and parallel connections, **characterized by** comprising a logic element (E, E1, E2) for switching said serial or parallel circuit according to one of the preceding claims.

11. A front loader comprising a valve device according to at least one of the preceding claims.

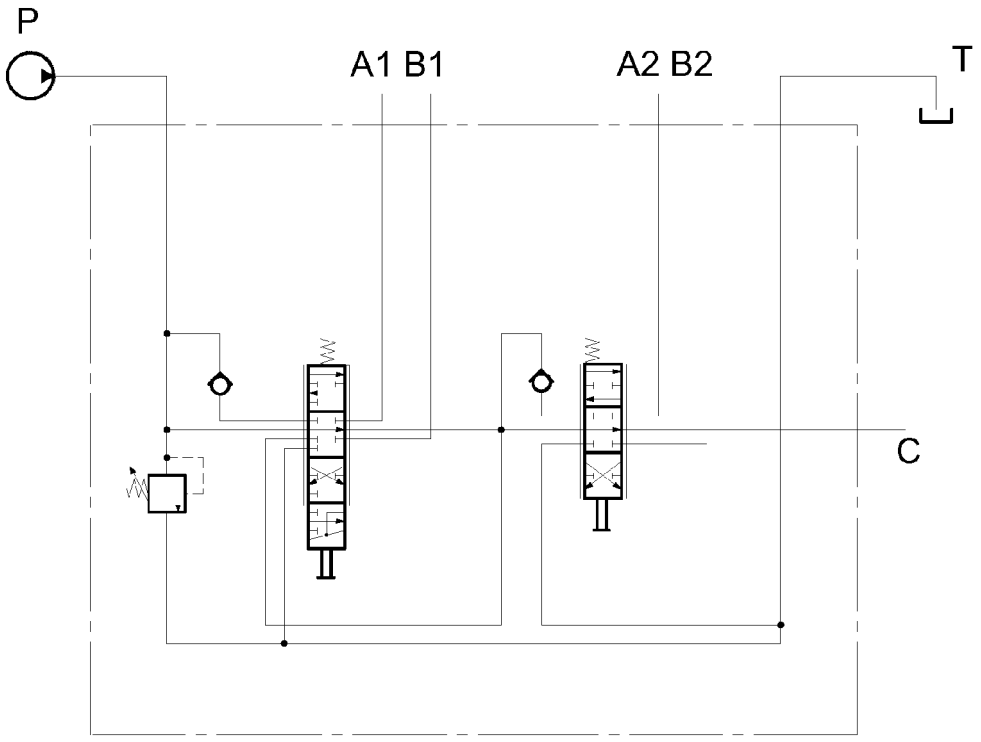

Fig. 1

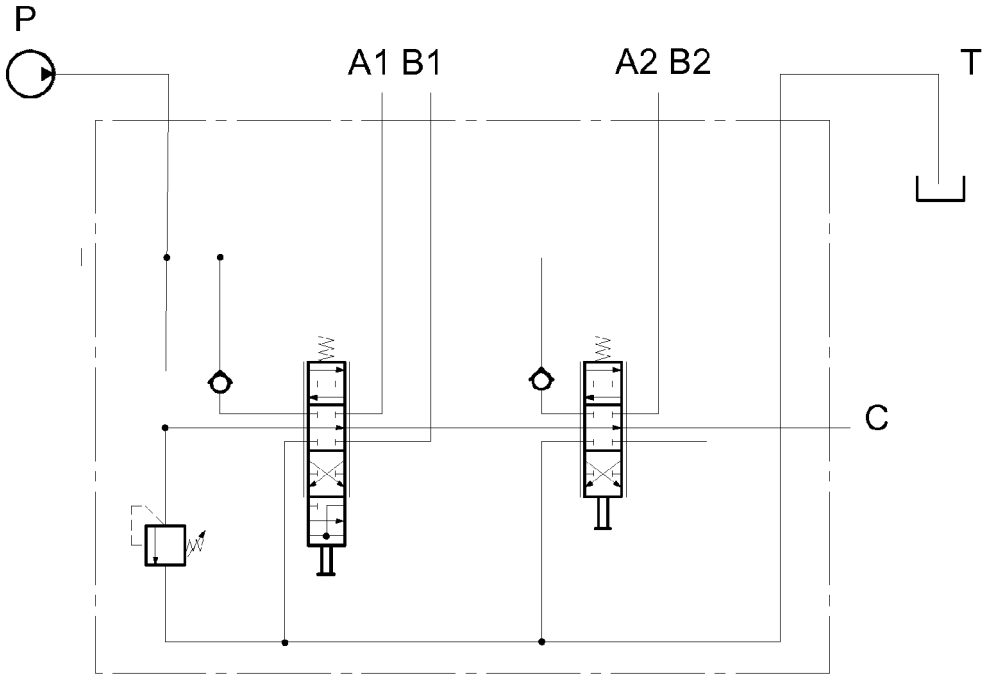

Fig. 2

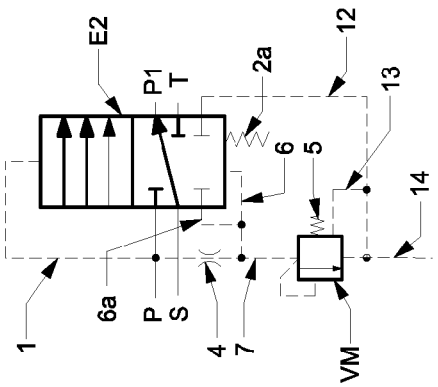

Fig. 5

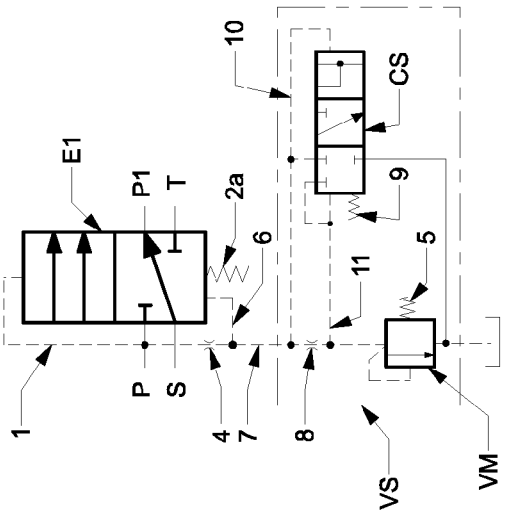

Fig. 4

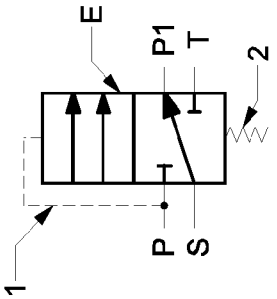

Fig. 3

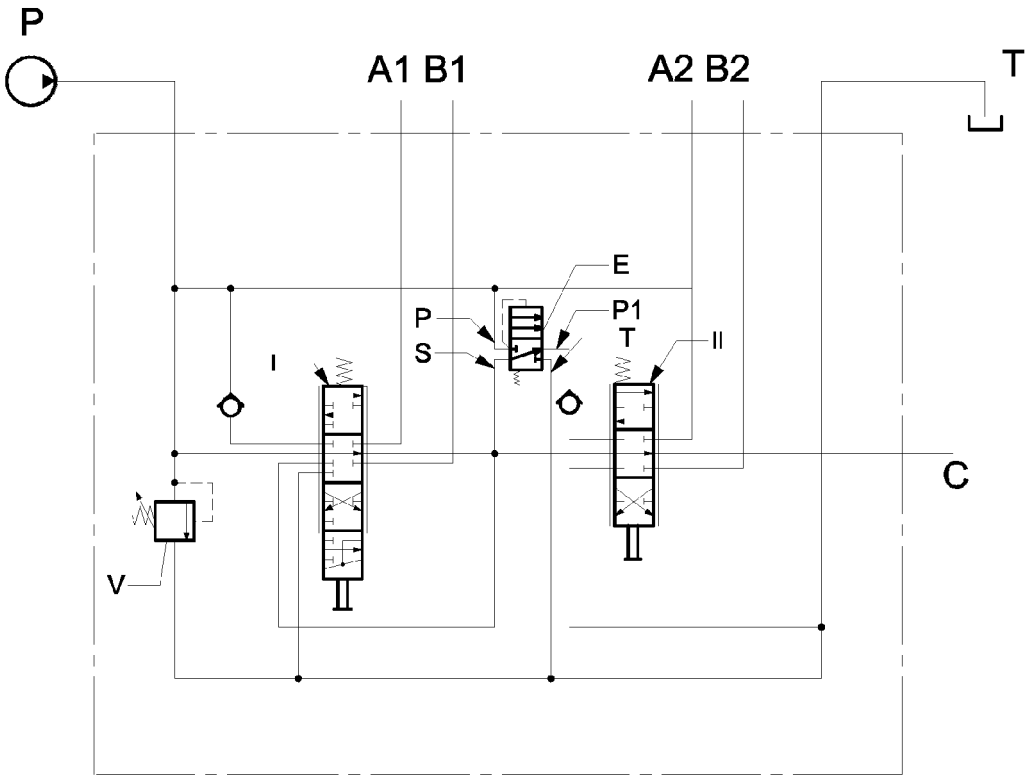

Fig. 3A

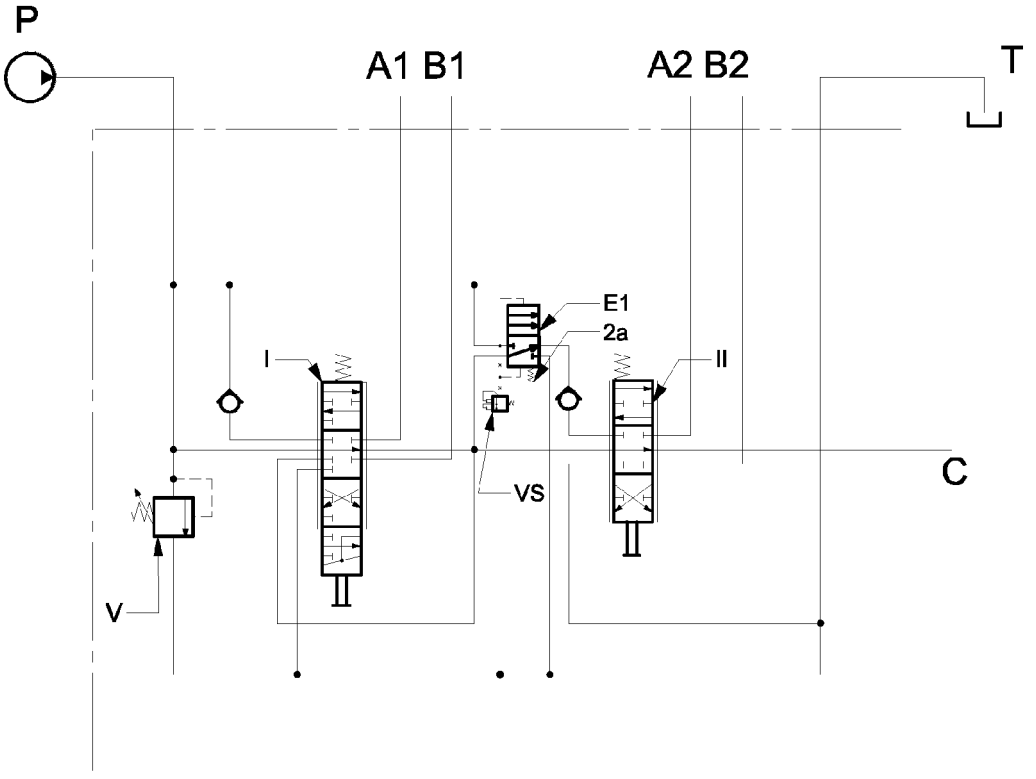

Fig. 4A

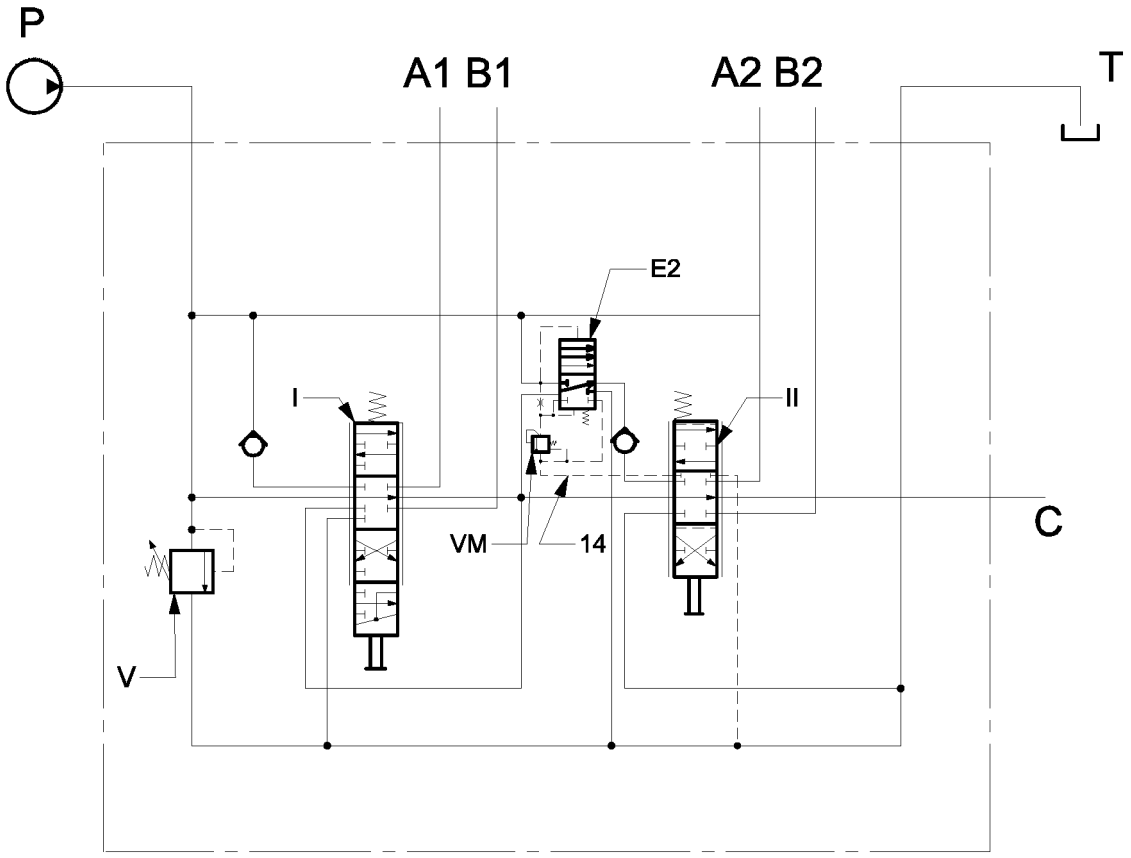

Fig. 5A

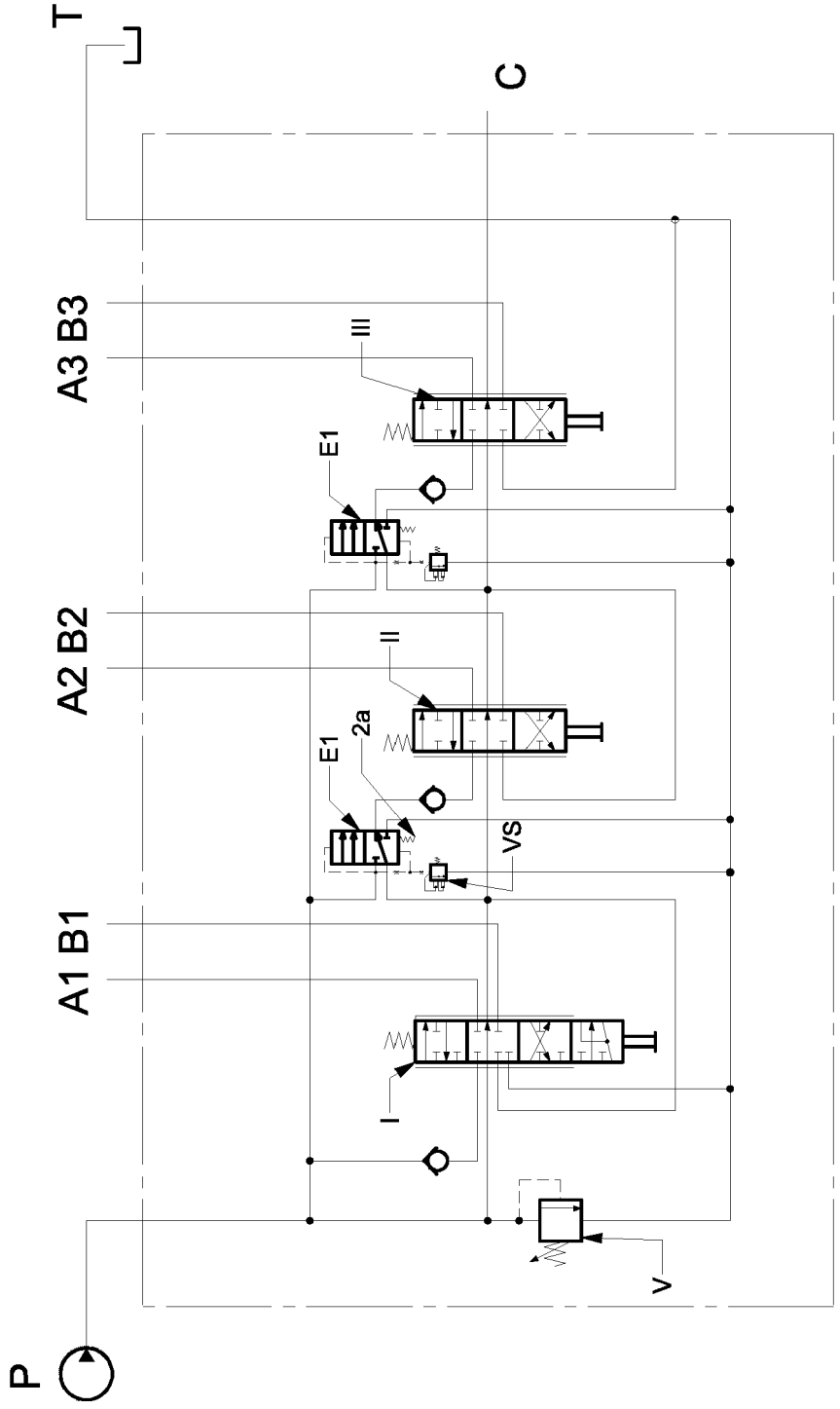

Fig. 6

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EUROPEAN SEARCH REPORT

Application Number
EP 17 15 5506

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	19 June 2017	Heneghan, Martin

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X : particularly relevant if taken alone
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