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

(11) EP 1 522 740 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
13.04.2005 Bulletin 2005/15

(51) Int Cl.[7]: **F15B 13/042**

(21) Application number: **03425649.5**

(22) Date of filing: **06.10.2003**

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IT LI LU MC NL PT RO SE SI SK TR
Designated Extension States:
AL LT LV MK

(71) Applicant: **OIL CONTROL S.p.A.**
20122 Milano (IT)

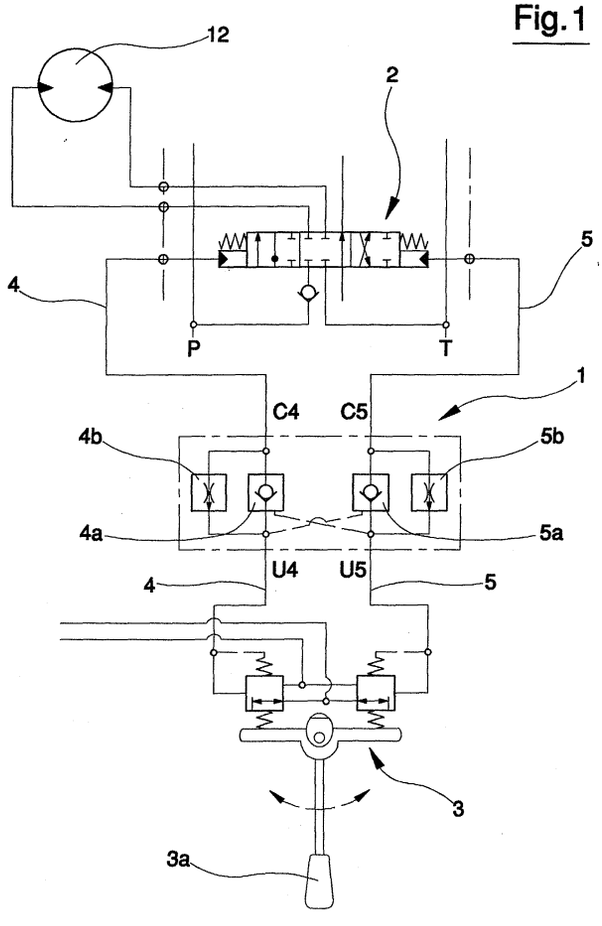
(72) Inventor: **Storci, Andrea**
41015 Nonantola (Modena) (IT)

(74) Representative: **Gotra, Stefano**
BUGNION S.p.A.
Via Emilia Est 25
41100 Modena (IT)

(54) A cushion valve for hydraulic remote controls of hydraulic directional valves

(57) A cushion valve is applied to a directional valve (2) of known type, and comprises, on each line (4, 5) which takes fluid from the joystick (3) to the directional valve (2), a check valve (4a, 5a) and a pressure compensated flow control valve (4b, 5b) arranged in parallel on a relative line (4, 5) in order to obtain, on each line, according to circumstances, free delivery and controlled return of the fluid; each check valve (4a, 5a) located on a line (4, 5) being piloted to open by a pilot pressure constituted by a fluid pressure entering the check valve present on another line (4, 5).

Fig.1



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Description

[0001] Specifically, though not exclusively, the invention is usefully applied in fluid distribution circuits in actuators or hydraulic motors for enactment in particular of lifting and lowering operations of booms of machine tools such as excavators or the like, or for rotation of parts or components of the machines. In excavators, the boom carrying the bucket is activated by means of a hydraulic actuator supplied with fluid through a hydraulic directional valve which manages the fluid delivery in the two directions. The directional valve is commanded by a hydraulic joystick, generally provided with a lever which is directly manipulated by the operator. The joystick commands the movement of the main directional spool in order to modulate the fluid sent to the actuator. A cushion circuit is provided between the joystick and the directional valve for controlling the speed of displacement of the latter, and thus for controlling the speed of the excavator. These cushion circuits are provided, on each line bringing fluid from the joystick to the directional valve, with a check valve, through which the fluid is delivered, and a compensated flow check valve (essentially a choke) through which fluid return is effected. The two valves are arranged in parallel on each line, as each line can function alternatively either as a delivery or return line, so as to obtain, on each line and according to needs, a free delivery flow rate and a controlled return of the fluid.

[0002] In machine tools, for example excavators, it is often necessary to make rapid out-and-in movements of the boom in order to carry out certain operations, such as for example a rapid movement of the bucket of an excavator when pressing down underlying earth, which is achieved through rapid up and down movements of the excavator boom. The cushion valve, as described above, does not allow for such rapid movements, and therefore the overall performance of the machine is limited.

[0003] To solve this problem the prior art teaches a hydraulic device which enables free discharge of the fluid coming from the main spool valve when two-way rapid movement commands are sent to the directional valve. These known devices comprise an auxiliary spool, commanded by the existing pressure in the line functioning as the delivery line between the joystick and the main spool, which auxiliary spool enables the flow control valve to be by-passed and discharge of the fluid coming from the main spool to be made directly; it is thus possible to make rapid alternating two-way movements of the main spool, and consequently the actuator and the machine operated thereby.

[0004] A drawback of the above-described solution is that the realization thereof is complex and requires the inclusion of an auxiliary spool; and in turn the auxiliary valve requires oil-inlet lines and sometimes even an additional line of its own for direct fluid discharge, with a consequent complication in the hydraulic pipe system of the machine.

[0005] The main aim of the present invention is to provide a cushion valve for hydraulic remote controls which can obviate the above-mentioned drawback in the prior art, i.e. by simplifying the realization of the cushion valves and the hydraulic circuits connected thereto.

[0006] An advantage of the invention is that it provides a construction system which is particularly simple and compact for the cushion valve.

[0007] These aims and advantages and more besides are all attained by the present invention, as it is characterised in the appended claims.

[0008] Further characteristics and advantages of the present invention will better emerge from the detailed description that follows of a preferred but non-exclusive embodiment of the invention, illustrated purely by way of a nonlimiting example in the accompanying figures of the drawings, in which:

figure 1 is a diagram of the cushion valve applied to a known-type hydraulic remote control;
figure 2 is a section view of a possible constructional realization of the cushion valve.

[0009] With reference to figure 1 of the drawings, 12 schematically denotes a hydraulic actuator which is supplied with fluid through a hydraulic directional valve 2 which manages fluid delivery in two directions. The directional valve 2 is commanded by a hydraulic joystick 3 provided with a lever 3a, directly activated by the operator. The lever 3a controls the travel of the directional valve 2 in order to modulate fluid delivery to the actuator. Both the directional valve 2 and the joystick 3 are provided with elastic return systems (in the absence of a manual command) to return the direction valve 2 into a central neutral position. Also provided are two lines 4 and 5 which carry and return the fluid from the joystick to the directional valve 2, and which, according to the direction of movement of the lever 3a, function alternatively as delivery line or return line. All the above-described elements are however of widely known types.

[0010] A cushion circuit, denoted in its entirety by 1, is provided between the joystick 3 and the directional valve 2; the cushion circuit controls fluid return from the directional valve 2. Connection between the cushion circuit and the remaining components is obtained through two inlets, respectively V4 located on line 4 and V5 located on line 5, and two outlets, respectively C4 located on line 4 and C5 located on line 5.

[0011] The cushion circuit 1 comprises, on each of the lines 4 and 5, a check valve, respectively 4a located on line 4 and 5a located on line 5, and a pressure compensated flow control valve, relatively 4b located on line 4 and 5b located on line 5. The valves are arranged in parallel circuit on the relative line in order that according to need free delivery or controlled return of fluid is obtained. The pressure compensated flow control valves 4b and 5b are effectively chokes, and limit the outflow

speed through their passage apertures by dint of not allowing flow rates through which are above a certain constant and predetermined limit.

[0012] Each of the check valves 4a and 5a, respectively located on lines 4 and 5, is piloted to open by a pilot pressure, which pilot pressure is constituted by the pressure of the fluid delivered through the check valve on the other line. The pilot pressures of the check valves act on the valves through respective pilot pistons 4c and 5c.

[0013] As can be seen in figure 2, the cushion is a compact element enclosed in a metal block 6.

[0014] A threaded through-hole 7 is made in the metal block 6, with the check valves 4a and 5a being associated to the ends thereof; the valves 4a and 5a are cartridge-shaped and of known type. The valves 4a and 5a are screwed to the ends of the through-hole 7. The pilot pistons 4c and 5c are arranged and sealedly calibrated to slide in the central zone of the through-hole 7; in particular, the pilot pistons are made in a single piece S which exhibits a common central zone S1, which is sealedly slidable in the through-hole 7; the pistons 4c and 5c are made on opposite sides of the central portion S1 and interact respectively with the check valve 4a and the check valve 4b to open them.

[0015] Two holes 8a and 8b are afforded in the block 6, having threaded ends to which are associated the pressure compensated flow control valves 4b and 5b, also cartridge-type, of known type and screwed into the respective holes 8a and 8b.

[0016] Two inlet ports V4 and V5 are also afforded in the block 6, as well as two outlet ports C4 and C5 for the fluid; all the ports are arranged on either side of the block 6 with respect to the through-hole 7.

[0017] The inlet port V4, located on the line 4, is directly connected to the through-hole 7 and opens into the through-hole 7 from the posterior part of the pilot piston 5c, in particular in the zone of the through-hole 7 comprised between the common central zone S1 of the element S and the check valve 4a. The inlet port V4 is also connected to the outlet port C4 by means of the pressure compensated flow control valve 4b and the check valve 4a.

[0018] The inlet port V5, located on the line 5, is directly connected to the through-hole 7 and opens into the through-hole 7 from the posterior part of the pilot piston 4c, in particular in the zone of the through-hole 7 which is comprised between the common central zone S1 of the element S and the check valve 5a; the inlet port V5 is also connected to the outlet hole C5 by means of the pressure compensated flow control valve 5b and the check valve 5a.

[0019] The device operates as described herein below.

[0020] By switching the lever 3a, for example leftwards with reference to figure 1, pressurised fluid is supplied to the line 4; flow-rate pressure on the line 4 causes, obviously, the opening of the check valve 4a present on the line itself, enabling free flow of fluid through the valve 4a; this pilot pressure also pilots the opening of the check valve 5a on the line 5, enabling a free outflow of the fluid and by-passing, in effect, the pressure compensated flow control valve 5b on the line 5.

[0021] By bringing the lever 3a into the central position, fluid delivery to the line 4 is stopped; the directional valve 2 is returned (by the elastic elements it is provided with) into the central position with a gradual action due to the fact that the fluid slowly discharges from the line 5 through the pressure compensated flow control valve 5b.

[0022] Obviously the above-described sequences are repeated, in inverted direction, displacing the lever 3 a towards the right (see figure 1) instead of the left.

[0023] If it is wished to make rapid out and in movements, obtainable with rapid and consecutive displacements of the lever 3a from right to left without stopping it in the central closed position, the device of the invention enables both check valves to be kept open, constantly by-passing the cushion valve and enabling rapid movements, in both directions, of the slide valve of the directional valve 2, with consequent consecutive rapid movements in both directions of the actuator 12.

[0024] The invention provides a cushion valve that performs operations which in themselves are known, but the circuit layout of the cushion valve is extremely simple and is extremely simple to construct.

Claims

1. A cushion valve for hydraulic remote controls of hydraulic directional valves, of a type applicable to a known-type directional valve (2), controlled by a hydraulic joystick (3) of known type and comprising, on each of lines (4, 5) delivering a fluid from the joystick (3) to the directional valve (2), a check valve (4a, 5a) and a pressure compensated flow control valve (4b, 5b) arranged in parallel on each line of the lines (4, 5) in order to obtain on each line of the lines (4, 5), according to need, a free delivery and a controlled return of the fluid, **characterised in that** each check valve (4a, 5a) located on each line of the lines (4, 5) is opened by a pilot pressure constituted by a pressure of the fluid entering another check valve (4a, 5a) present on another line of the lines (4, 5).

2. The cushion valve of claim 1, **characterised in that** the pilot pressures act on the check valves (4a, 5a) through a pilot piston (4c, 5c); the check valves (4a, 5a) and pressure compensated flow control valves (4b, 5b) being of known type cartridge-construction.

3. The cushion valve of claim 2, **characterised in that** it comprises a metal block (6) affording a through-hole (7) having threaded ends, to which ends are

associated the check valves (4a, 5a), the pilot pistons (4c, 5c) being sealedly calibrated and slidable in a central portion of the through-hole (7); the metal block (6) further affording two holes (8a, 8b) having threaded ends to which threaded ends are connected the pressure compensated flow control valves (4b, 5b); two inlet ports (V4, V5) and two outlet ports (C4, C5) for the fluid being arranged on either side of the through-hole (7), the inlet port (V4) being directly connected to the through-hole (7) at a posterior part of the pilot piston (5c) and, through the pressure compensated flow control valve (4b) and the check valve (4a), to the outlet port (C4); the inlet port (V5) being directly connected at the through-hole (7) at a posterior part of the pilot piston (4c) and, through the pressure compensated flow control valve (5b) and the check valve (5a), to the outlet port (C5).

4. The cushion valve of claim 3, **characterised in that** the pilot pistons (4c, 5c) are made in a single piece (S) having a common central zone (S1), sealedly calibrated and slidable in the through-hole (7), on opposite sides of which the pistons (4c, 5c) are fashioned, which pistons (4c, 5c) interact respectively with the check valve (4a) and the check valve (5a).

Fig. 1

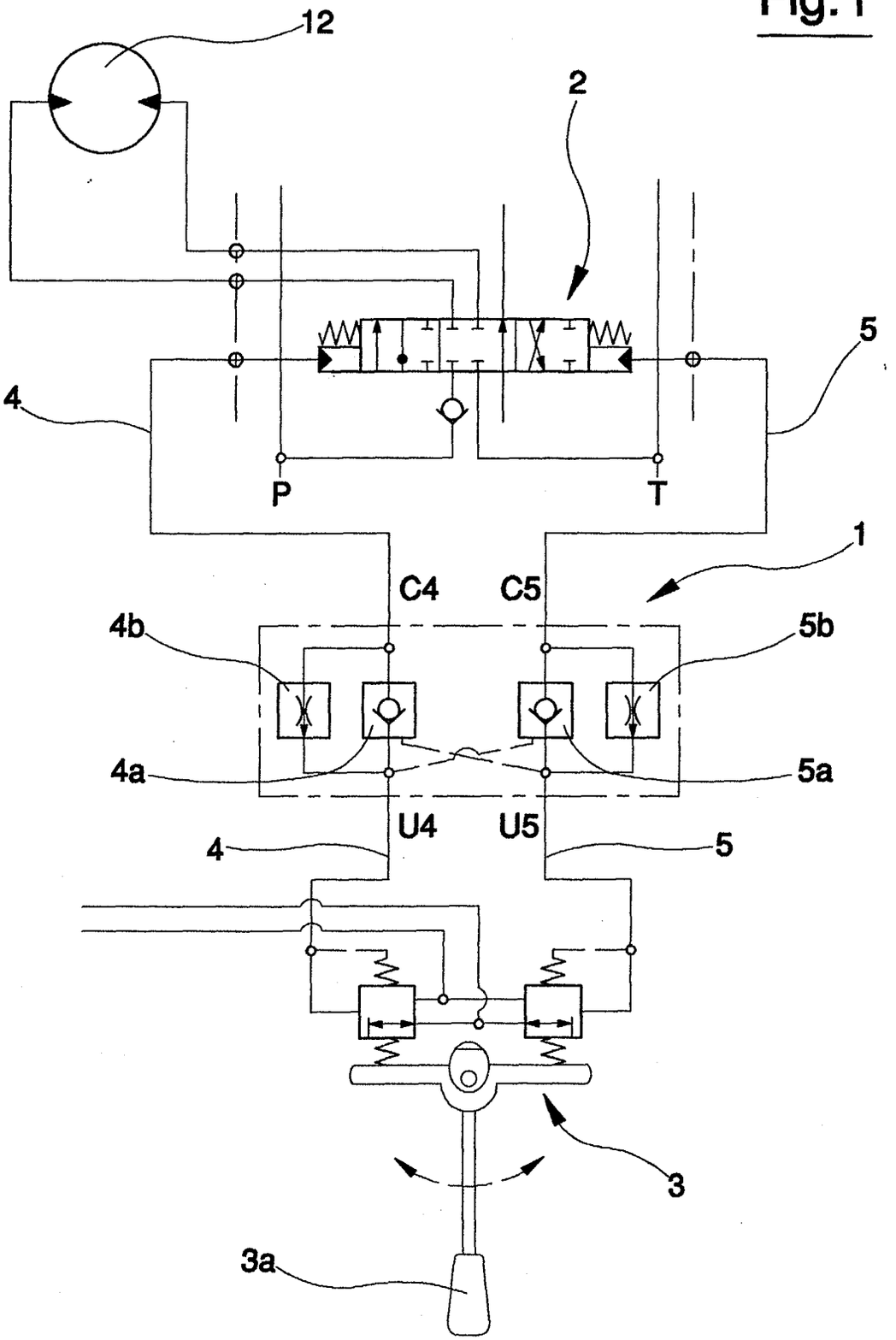
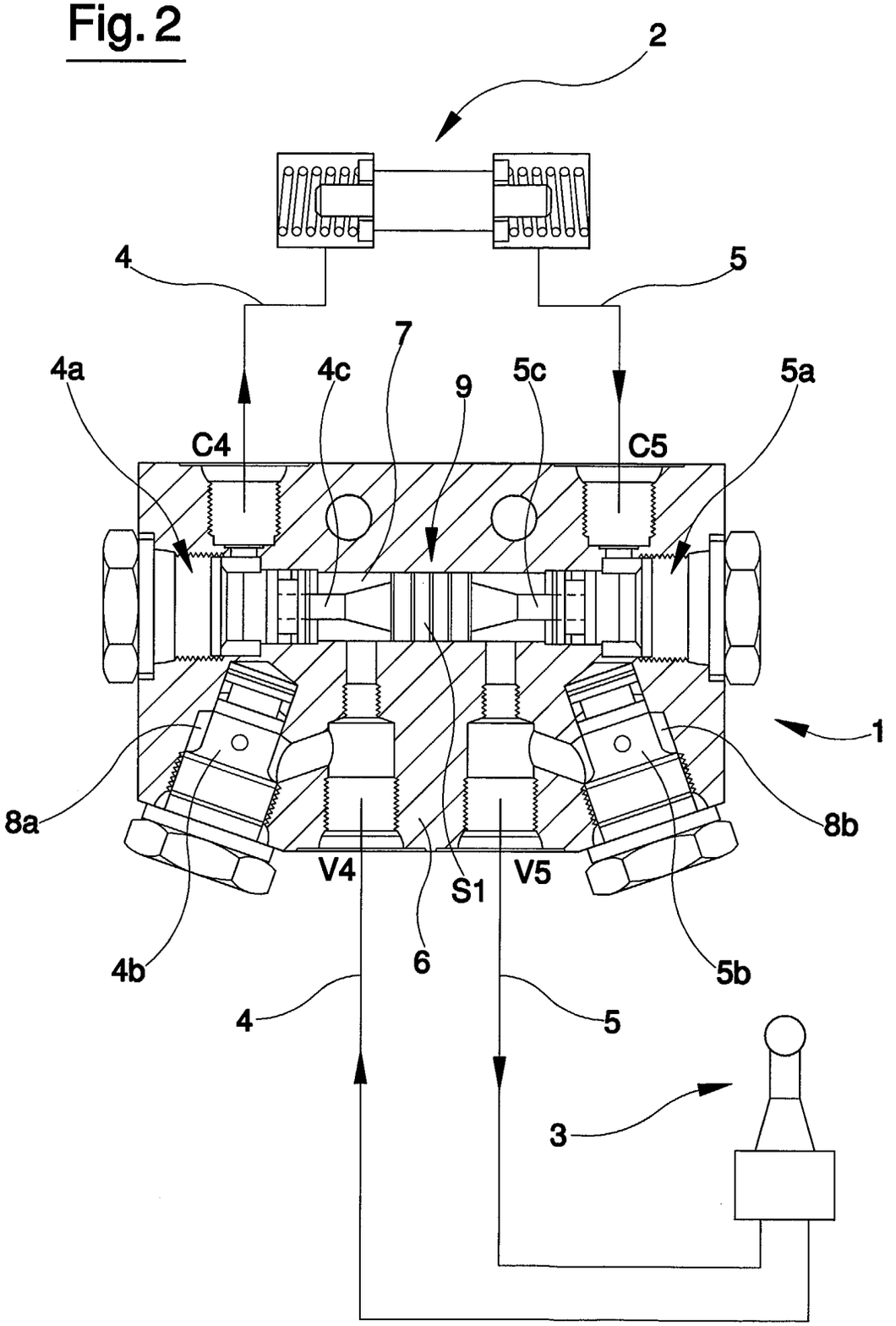


Fig. 2



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EUROPEAN SEARCH REPORT

Application Number
EP 03 42 5649

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
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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	4 February 2004	Busto, M

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