(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
8 September 2017 (08.09.2017)

WIPO | PCT

(10) International Publication Number
WO 2017/149555 A1

(51) International Patent Classification:
F24D 3/10 (2006.01) *F16K 11/087* (2006.01)
G05D 23/19 (2006.01) *F16K 11/16* (2006.01)
F24D 19/10 (2006.01)

(21) International Application Number:
PCT/IT2016/000057

(22) International Filing Date:
4 March 2016 (04.03.2016)

(25) Filing Language: Italian

(26) Publication Language: English

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(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Published:

— *with international search report (Art. 21(3))*

(54) Title: VALVE GROUP FOR HYDRAULIC CIRCUITS

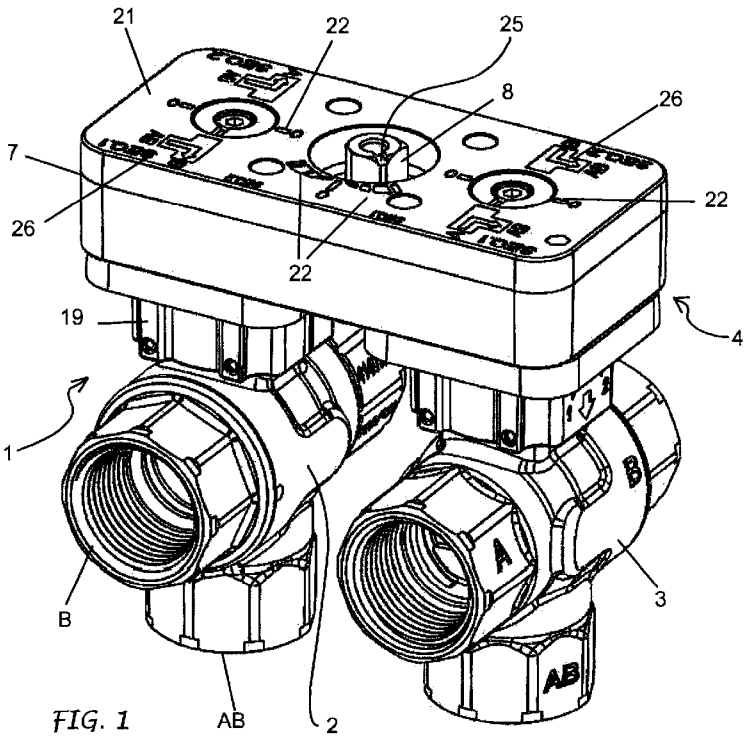

FIG. 1

(57) Abstract: A valve group for hydraulic circuits and a respective implementing method are described. The valve group comprises at least one first shut-off valve and one second shut-off valve, each provided with respective control means to cause its total or partial opening or closure. The valve group further comprises an adapter with connecting means for the connection to a control actuator of the valve group, linking means for the linkage to each of said first valve and second valve, and transmission means acting on said linking means in order to drive said control means of said first valve and second valve in response to controls of said actuator.

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VALVE GROUP FOR HYDRAULIC CIRCUITS

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DESCRIPTION

Field of the invention

Generally, the present invention relates to the field of shut-off valves for hydraulic circuits and, in particular, to a valve group.

State of the art

Multi-way valves, each driven by a respective actuator to control the total or partial opening or closing thereof, can be provided in hydraulic circuits.

In particular, air-conditioning systems provide for both room cooling and heating, usually by means of the same air-conditioning terminals being selectively supplied by a hot fluid or a cold fluid, which come from a fluid heating circuit or a fluid cooling circuit, respectively.

Such systems normally require two shut-off valves, one connected to the cooling circuit and the other to the heating circuit, so as to be able to deliver the hot fluid or cold fluid to the air-conditioning terminals. The words "air-conditioning terminal" refer to a heating and cooling element such as a convector, a radiant element, a fan-coil.

Such valves are usually of the three-way type, i.e. each provided with three ports and include a ball-shaped control element, the ball being provided with a fluid

passage channel and able to rotate around one of its axes. The ball can be rotated so as to block the ports of the valve, thereby closing the valve itself, or so that the channel openings are at least partially located at two ports in order to allow a total or partial fluid communication therebetween, thus causing the total or partial opening of the valve. The ball of each valve is caused to rotate by a respective rotary control actuator, with the related costs and installation time.

In order to reduce costs and simplify the installation step, a six-way valve has been proposed which, although having the same function of two three-way valves, it is driven by a single actuator. Basically, it is a single body comprising two three-way sub-valves mechanically coupled along a common actuating axis. In this six-way valve, the sub-valves are arranged in series with respect to the control actuator; this means that the actuator is only linked to the first of them, and the control of the actuator is transmitted from the first to the second sub-valves through mechanical coupling means transferring the rotary motion from the ball of the first valve to the ball of the second valve; therefore, this solution requires that the ball of each valve is adapted in order to be provided with coupling portions.

Usually, then, three-way valves have a substantially

T-shaped body, where a first port and a second port are aligned with each other and a third port is arranged along a transverse direction with respect to them. Usually, the actuator is positioned so that its actuation axis is orthogonal to the plane where the first port, the second port and the third port lie; as a result, the rotation axis of the ball is orthogonal to the plane where the channel of the ball itself lies. Disadvantageously, however with this arrangement, in order to obtain that a solid portion of the ball is able to block the ports, thereby determining the closing position of the valve, the section of the ball channel must be smaller than the section of the three ports, thereby resulting in a reduction of the fluid flow, thus causing a reduction of the effective flow rate of the valve.

Thus, disadvantageously, the six-way valve of the prior art suffers from such a drawback.

In addition, since the three-way valves may have different characteristics, this solution is particularly rigid. In fact, to meet the various needs of the market it would be necessary to provide a number of six-way valves, each corresponding to a different combination of three-way valves, or to provide only some combinations, thus resulting in less adaptability to various types of applications.

Furthermore, in a six-way valve the balls can be rotated among a first position in which the valve is totally or partially open and connected to a heating circuit, a second position in which the valve is totally or partially opened and connected to a cooling circuit, or vice versa, and a position in which the valve is closed. The actuators currently used to drive these valves have a 90° travel; therefore, in a six-way valve as currently designed, they are equally distributed among the afore said positions. Therefore, each opening position corresponds only to 30° of the total travel of the actuator, so that the different positions of partial opening of the valve, required to determine the flow rate of the fluid in the system, can be adjusted in a poorly gradual way.

Finally, in this six-way valve between the two flows heat exchange occurs, so that the fluid is undesirably heated/cooled.

Objects and summary of the invention

Object of the present invention is to overcome the drawbacks of the prior art by providing a valve group able to be composed case by case according to requirements of the specific system, with the maximum flexibility, thereby allowing to have a plurality of valve groups with different characteristics while, at the same time, reducing costs and components to be stocked.

It is another object to provide a valve group having a greater flow rate and characterized by a particularly gradual adjustment of its opening.

Thus, the present invention concerns a valve group for hydraulic circuits according to claim 1.

In particular, the valve group comprises at least two shut-off valves, each having control means to determine its total or partial opening or closure, and an adapter provided with connecting and linking means to connect and link it on one side to a control actuator of the valve group, and on the other side, to each valve, and provided with transmission means to drive the control means of the valves in response to actuator controls.

Advantageously, therefore, the group includes multiple valves, preferably two valves, which can be selected each time as required according to the application or type of circuit and which can be both connected to a single control actuator by the respective linking means and the transfer elements of the adapter. In this way, innumerable arrangements of the valve group can be obtained, starting from bulk components.

Moreover, advantageously, the valves are connected in parallel with each other instead of being connected in series with respect to the actuator, that is the motion is directly transmitted to each valve, via the transmission

means.

Preferably, the control actuator is of rotary type with manual or electric control and interacts with the transmission means, the latter comprising a rotary element; the linking means to the valves comprise motion transfer elements on which the rotating element operates in order to transmit the rotary motion to the valves. Therefore, thanks to this arrangement of the adapter of the valve group, the rotary motion of the actuator is transmitted in parallel to both valves, through the rotating element and the transfer elements.

Depending on the type of circuit in which the adapter group should be installed, it may have same or different valves, as for the number and/or the size of the ports. For example, the valve group may comprise two shut-off two-way valves so as to simultaneously control two parallel systems by means of a single actuator.

However, preferably, the valve group comprises two three-way valves, each having a first port and a second port aligned with each other and a third port orthogonal thereto, and in which the valves are of the ball type, i.e. having ball-shaped control means able to rotate around their own axis, in response to rotation of the rotating element of the adapter. According to this preferred arrangement, the valve group has the same functions of a

six-way valve controlled by a single actuator, though having the above listed advantages.

Each valve of the valve group is provided with respective means to actuate the control means, i.e. a respective member to operate the balls, on which the linking means of the adapter act in order to cause the control means to rotate in response to the rotation of the rotating element of the adapter.

In a preferred arrangement, the third port of each valve of the valve group is in line with the rotation axis of the control means; thus, also the means to actuate the control means are arranged in line, but on the opposite side with respect to the third port of the respective valve. Advantageously, this allows the valves to be provided with balls having a section of the passage channel substantially equal to that of the ports of the respective valve, resulting in an increase of the actual flow rate of each three-way valve and consequently of the valve group, compared to traditional valves.

Preferably, the valves are arranged parallel to each other but are oriented in the opposite way relative to one another, with the first port and the second port of a valve arranged in the opposite direction with respect to the first port and second port of the other valve. This arrangement is particularly important because

characterizing discs can be used to control the fluid flow rate in the circuit, so as to determine an equal percentage curve operating in response to the curve determined by each air-conditioning terminal. On each valve same or different characterizing discs can be mounted, depending on the system requirement.

Advantageously, the rotating element has a circular toothed edge and the transfer elements have respective circular toothed edges, which interact with the toothed edge of the rotating element in order to transmit the rotary motion to the control means. Substantially, the central element acts as central gear and the transfer elements act as side gears of a mechanical transmission which allows to split the rotary motion of the control element caused by the actuator, in order to control both valves by a single actuator without having to arrange them in series.

Preferably, the circular toothed edge of the rotating element has a size larger than the sizes of the circular toothed edges of the transfer elements; specifically, the circular toothed edge of the rotating element and the circular toothed edges of the transfer elements are sized so that each angular degree of rotation of the rotating element of the adapter corresponds to multiple angular degrees of rotation of the control means of each valve,

preferably two degrees. In this way, 90° travel of the actuator corresponds to 180° rotation of the control elements of the valves, thereby allowing the valves to be more gradually adjusted at the two opening positions and allowing the use of balls having an L-shaped passage channel, instead of a T-shaped one as in conventional valves, i.e. provided with only two openings, a first opening being able to be rotated, by a 180° rotation of the ball, from a start position in which it coincides with the first port, to a final position in which it coincides with the second port. The second opening always remains coincident with the third port of the valve, thereby preventing overpressure phenomena when the valve group is closed.

Advantageously, the linking means are connected to the respective valves directly or with the interposition of a flange; preferably the flange is made of plastic so as to insulate the valve from the adapter, thereby limiting the transmission of heat.

Advantageously, the valve group may be provided with an outer shell housing the valves in order to keep them in the proper position, so as to avoid problems of bending and/or torsion thereof, as they are fastened to pipes during the installation step of the valve group in the system. Preferably, the shell is made of a material

suitable to insulate the valves, so that the installer does not have to create insulation during the installation of the valve group.

The invention also concerns an adapter for a valve group for hydraulic circuits according to claim 11.

Specifically, the adapter comprises means for connecting it to a control actuator of the valve group, linking means for its linkage to each valve of the valve group and transmission means for driving the control means of each valve, in response to controls of the actuator, through the linking means. Advantageously, such an adapter can also be installed in already existing systems provided with multiple valves, preferably two, individually driven by means of a dedicated actuator, to allow them to be driven by means of a single control actuator.

Advantageously, on an outer surface of the adapter there are display elements interacting with indicators combined with the linking means of the valves and which can be seen from outside the adapter itself, in order to signal the position of the control means and, therefore, the total or partial opening or closure of the valves, and graphic items representative of the linking/operation diagram of the valve group, so as to assist the operator during the installation step of the valve group and to limit the possibility of error.

Finally, the invention also concerns a controlling method according to claim 13, for controlling a valve group in a hydraulic system, comprising a first circuit and a second circuit. The valve group comprises an adapter combined with at least one first valve and one second valve by proper linking means.

Specifically, the method provides the adapter to be linked, by proper connecting means, to the control actuator and the rotating element, which the adapter is provided with, to be rotated in order to lead the valve group in a closing position, wherein the control means block the ports of the respective valve; or in a first opening sequence or position, in which the control means define an at least partial fluid communication between the first port and the third port of a valve and between the third port and the second port of the other valve, so that the fluid circulates among every air-conditioning terminal and the first circuit; and a second opening sequence or position, in which the control means define an at least partial fluid communication between the second port and the third port of a valve and between the third port and the first port of the other valve, so that the fluid circulates among every air-conditioning terminal and the second circuit.

Advantageously, thanks to this controlling method the valve unit performs the same function of a six-way valve,

but in an improved manner due to the above described characteristics.

List of figures

Further characteristics and advantages of the invention will be more evident by the review of the following specification of a preferred, but not exclusive, embodiment, depicted for illustration purposes only and without limitation, with the aid of the attached drawings, in which:

- figure 1 is a perspective view of a valve group according to the present invention;
- figure 1a is a front view of the valve group of figure 1;
- figure 1b is a perspective view of the valve group of figure 1 provided with a containing shell;
- figure 2 shows the valve group combined with a control actuator;
- figure 3 shows an exploded view of a member the valve group of figure 1;
- figures 4a, 4b and 4c each show a top view and a perspective view of the valve group at three different working sequences;
- figures 5a and 5b each show a sectional view of part of the valve group in two different working sequences;
- figures 6a and 6b respectively show a sectional view

of a first valve and a second valve of the valve group in a first working sequence;

- figures 7a and 7b respectively show a sectional view of the first valve and the second valve of the valve group in a second working sequence; and

- figures 8a and 8b respectively show a sectional view of the first valve and the second valve of the valve group at a closing position.

Detailed description of the invention

Figure 1 shows a valve group 1, according to the present invention, for hydraulic circuits in which a working fluid circulates.

The valve group comprises at least one first shut-off valve 2, a second shut-off valve 3 and an adapter 4 having the two shut-off valves 2, 3 linked thereto. Preferably, the valve group comprises two shut-off valves, as shown in figures.

The first valve 2 and the second valve 3 are each provided with two or more ports and respective control means 5 so that they can be arranged in total or partial fluid communication or blocked, thereby causing the total or partial opening or closure of the respective first valve or second valve. The valves can have the same or different number of ports; preferably, the first valve and the second valve are both of three-way type, i.e. each provided with a

first port A and a second port B aligned with each other along a longitudinal direction, and with a third port AB orthogonal to said longitudinal direction. According to requirements and to the specific hydraulic circuit where the valve group has to be installed, the first valve can have the same flow rate as the second valve, or a different one.

The valve group is designed to be connected to a control actuator 6, preferably of rotary type, electrically or manually operated.

For this purpose, the adapter 4 comprises a box-shaped body 7 in which connecting means 8 are housed for the connection to the control actuator of the valve group, which are designed to arise from the box-shaped body to allow the connection to the actuator.

The adapter 4 also comprises linking means 9, 10 designed to arise from the box-shaped body, on the opposite side with respect to the connecting means, for the linkage to the first valve 2 and second valve 3, respectively.

The adapter is also provided with transmission means 11 acting on the linking means 9, 10 to drive the control means 5 of the valves, in response to actuator controls.

The transmission means 11 are combined with a rotating element 12 the actuator being active thereon; preferably the transmission means are made in one piece with the

rotating element. The linking means 9, 10 each comprise a transfer element 13, 14 to transmit motion to the first valve 2 and the second valve 3, respectively.

In a preferred arrangement, the rotating element is provided with a first circular toothed edge 15 and the transfer elements 13, 14 are provided with respective second circular toothed edges 16 interacting with the first circular toothed edge in order to transmit the motion of the rotating element to the respective valve. In this way, the rotating element acts as a central gear to transmit the rotary motion to both the transfer elements in the form of side gears.

The length of the first circular toothed edge can be greater than that of the second circular toothed edges; in particular, the length of the first circular toothed edge 15 is twice that of each of the second circular toothed edges 16, so that each angular degree of rotation of the rotating element 12 of the adapter corresponds to two angular degrees of rotation of the control means 9, 10 of each valve. Thanks to this arrangement, as the actuator causes a 90° rotation of the rotating element, the balls of each valve correspondingly rotate by 180°, thereby resulting in an extremely gradual adjustment of the partial opening positions.

Each valve has preferably ball-shaped control means 5

able to rotate around their own rotation axis X orthogonal to the longitudinal direction in which the first port A and second port B are aligned, in response to rotation of the rotating element 12 of the adapter. For this purpose, each valve 2, 3 is provided with a respective actuating member 17 of the control means 5 having the corresponding linking means 9, 10 of the actuator active thereon in order to transfer the motion of the rotating element to the respective control means 5; in other words, the actuation means cause the ball to rotate in response to a rotation of the rotating element. The ball of each valve is provided with a respective passage channel 18 which, depending on the rotation of the ball, arranges in total or partial communication alternately the first port A with the third port AB (see Figures 6a, 7b), or the second B port with the third port AB (see figures 6b, 7a), to allow the working fluid to totally or partially pass through, thereby defining a first or a second opening state of the valve, otherwise it blocks both the first port A and the second port B (see figures 8b, 8a), preventing the fluid from passing through, so as to define a closing condition of the valve.

Preferably, the third port AB of each valve 2, 3 of the valve group is arranged in-line with the rotation axis X of the respective control means, and the linking means 9,

10 of the adapter are combined with the respective valve at the opposite side with respect to the third port AB.

Thanks to this particular arrangement of the ports, the passage channel 18 of each ball can have substantially the same section of the ports A, B, AB of the respective first valve 2 or second valve 3, so that no throttling is formed and the passage of a greater fluid flow is allowed. The channel has at least one first opening 18' and one second opening 18", the second opening 18" always coinciding with the third port AB of the respective valve and the first opening 18' may totally or partially coincide with the first port A, totally or partially with the second port B, or be at an intermediate position between the first port A and second port B, in which it does not intercept any port, depending on the rotation of the ball.

When the first and the second valve are combined with the adapter, they are arranged parallel to one another but rotated by 180° relative to one another with respect to the respective third port AB, i.e. so that the first port A and the second port B of the first valve are arranged in the opposite way with respect to the direction of the first port A and second port B of the second valve, with reference to the respective third ports AB.

The linking means 9, 10 can be linked to the respective first valve 2 and second valve 3 directly or by

interposing a flange 19; the flange can be made of metal, such as brass as usual or, advantageously, of a plastic material so as to insulate the valve from the actuator, thus helping to preserve the electrical circuits over time.

The first and the second valves can be enclosed within a containing shell 20 having the function of keeping the valves in the proper position, so as to avoid problems of bending and/or torsion in the installation step of the valve group. Furthermore, the containing shell may be made of a material suitable to insulate the valves during their operation.

In addition, on a top outer surface 21 of the box-shaped body 7 of the adapter, display elements 22 can be provided, the linking means can have respective top portions 23 arising from the box-shaped body, in order to be visible from outside, each provided with a respective indicator 24 interacting with the display means 22 in order to signal the position of the control means 5 of each valve 2, 3 and, therefore, the closing state or the total or partial opening state of the valves themselves. Also the connecting means 8 for the connection to the control actuator can be provided with an indicator element 25 interacting with the display elements 22 in order to indicate the angle of rotation of the rotating element 12.

Moreover, to facilitate the mounting and installing

steps of the valve group, on the top outer surface 21 of the adapter graphic items 26 can be posted indicating the linking and operation diagram of the valve group.

Both the indicators 24 of the linking means and the indicator element 25 advantageously are shaped as notches respectively formed level with the top portions 23 and the connecting means 8.

In addition, the adapter 4 comprises a central screw 27 for fastening the rotating element 12 and side screws 28 for fastening the connecting means 9, 10.

Finally, for controlling the total flow rate and generating an equal-percentage curve, a respective characterizing disc 29 can be combined with the first port A of the first valve and/or the first port A of the second valve. Preferably, the characterizing discs 29 are made of brass so as not to deform due to the thrust and temperature of the working fluid.

The above described valve group is designed for use in hydraulic systems provided with a first circuit and a second circuit, each having a supply source of a working fluid - not shown -, for cooling and heating such fluid, or vice versa, and it is intended to connect at least one air-conditioning terminal 30 case by case to the first or second circuit.

Depending on the valve status, three different

positions or working sequences are possible for the valve group:

- closing position, in which both the valves are closed. In this position there is no fluid passage nor between the first circuit and the air-conditioning terminal neither between the latter and the second circuit - as shown in figures 4c, 8a and 8b. The control element 5 is rotated so as to block the first port A and the second port B of the valve and, therefore, there is no fluid flow, neither incoming nor outgoing from the third ports AB of the valves;

- first total or partial opening sequence, in which there is at least a partial passage of the working fluid from the first port A to the third port AB of the first valve and from the third port AB to the second port B of the second valve - as shown in figures 4a, 5a, 6a and 6b. The control element of the first valve is rotated so that the first opening of the channel at least partially coincides with the first port A and the third port AB, so that fluid passes from the first circuit to the air-conditioning terminal 30 and, simultaneously, the control element of the second valve is rotated so that the first opening of the channel at least partially coincides with the second port B, the second opening coinciding with the third port AB, so that fluid passes from the air-

conditioning terminal 30 to the first circuit, as indicated by arrows in figures. In this way the fluid coming from the source of the first circuit passes into the first valve, through the air-conditioning terminal and goes back to the source of the first circuit, passing through the second valve.

- second total or partial opening sequence, in which there is at least a partial passage of the working fluid from the second port B to the third port AB of the first valve and from the third port AB to the first port A of the second valve - as shown in figures 4b, 5b, 7a and 7b. The control element of the first valve is rotated so that the first opening of the channel coincides with the second port B, the second opening coinciding with the third port AB, so that a fluid passes from the second circuit to the air-conditioning terminal 30 and, simultaneously, the control element of the second valve is rotated so that the first opening of the channel coincides with the first port A, the second opening coinciding with the third port AB, so that a fluid passes from the air-conditioning terminal 30 to the second circuit, as indicated by arrows in figures. In this way the fluid coming from the source of the second circuit passes into the first valve, through the air-conditioning terminal and goes back to the source of the second circuit, passing through the second valve.

Thanks to the controlling method of the valve group it is possible to drive both valves to lead them to the above described positions, by means of a single actuator.

In fact, once the adapter of the valve group is linked to the control actuator, the rotations of the rotating element of the adapter operated by the actuator will cause the valve group to close or open towards the first circuit, or to open to the second circuit of the valve group.

In particular, when the actuator is in the mid-travel position corresponding to a 45° travel angle, the total closing position of the valve group is caused, in which both valves are closed and there is no passage of fluid through the valves. In this situation, the hydraulic system is stopped.

By rotating counterclockwise the actuator from the mid-travel position, the first opening sequence of the valve group is activated, starting from a partial opening condition of the valve group up to a total opening, when the actuator reaches the travel start position at 0°, in which both valves are fully open to and from the first circuit.

By rotating clockwise the actuator from the mid-travel position, the second opening sequence of the valve group is activated, starting from a partial opening condition of the valve group up to a total opening, when the actuator

reaches the limit position at 90°, in which both valves are fully open to and from the second circuit.

The two views of the valve group of figure 4a show the fluid flows, represented by respective arrows, and the position of the indicators 24 of the linking means and the indicator element 25 of the connecting means in the position where the valve group is totally open to the first circuit; the two views of figure 4b show the fluid flows, represented by respective arrows, and the position of the indicators 24 of the linking means and the indicator element 25 of the connecting means in the position where the valve group is totally open to the second circuit; and the two views of figure 4c show the position of the indicators 24 of the linking means and the indicator element 25 of the connecting means in the position where the valve group is totally closed, where there is no fluid flow.

CLAIMS

1. A valve group (1) for hydraulic circuits, comprising at least one first shut-off valve (2) and one second shut-off valve (3), each provided with respective control means (5) to cause its total or partial opening or closure, **characterized in that** it comprises an adapter (4) provided with:

- connecting means (7) for the connection to a control actuator (6) of the valve group,
- linking means (9, 10) for the linkage to each of said first valve (2) and second valve (3), and
- transmission means (11) acting on said linking means (9, 10) in order to drive said control means (5) of said first valve and second valve, in response to controls of said actuator.

2. Valve group according to claim 1, wherein the control actuator (6) is of rotary type, said transmission means (11) are combined with a rotating element (12) having the actuator active thereon, and said linking means (9, 10) comprise respective transfer elements (13, 14) for transferring the motion to each of said first (2) and second (3) valves.

3. Valve group according to claims 1 or 2, wherein said first valve (2) and said second valve (3) are three-way valves, each provided with a first port (A) and a

second port (B) aligned with each other along a longitudinal direction and a third port (AB) orthogonal to said longitudinal direction, and wherein said control means (5) are ball-shaped and able to rotate around its own axis (X), in response to the rotation of the rotating element of the adapter.

4. Valve group according to claim 3, wherein the third port (AB) of each valve of the valve group is arranged in-line with the rotation axis (X) of the control means, and wherein the linking means (9, 10) of the adapter are combined with the respective valve at the opposite side with respect to the third port (AB).

5. Valve group according to claim 4, wherein each control means (5) of the first valve and the second valve have a passage channel (18) provided with at least one first opening (18') and one second opening (18") that have a size substantially equal to the section size of the ports (A, B, AB) of the respective first valve (2) or second valve (3).

6. Valve group according to one of the preceding claims, wherein said first and second valves are combined with the adapter in parallel, the first port (A) and the second port (B) of the first valve being arranged in a direction opposite to the direction of the first port (A) and the second port (B) of the second valve with respect to

the respective third ports (AB).

7. Valve group according to one of the preceding claims, wherein said rotating element comprises a first circular toothed edge (15) interacting with the respective second circular toothed edges (16) provided on said transfer elements.

8. Valve group according to claim 7, wherein the size of said first circular toothed edge (15) is greater than the sizes of said second circular toothed edges (16) so that, preferably, each angular degree of rotation of the rotating element of the adapter corresponds to two angular degrees of rotation of the control means of each valve.

9. Valve group according to one of the preceding claims, wherein the linking means (9, 10) are linked to the respective first valve and second valve in a direct way or by interposing a flange (19), said flange being preferably made of plastic material.

10. Valve group according to one of the preceding claims, comprising an outer shell (20) for containing said first valve and second valve and for keeping them in the proper position, where said shell can be made of an insulating material.

11. An adapter (4) of a valve group (1) comprising at least two shut-off valves (2, 3) each provided with respective control means (5) for controlling the opening

thereof, said adapter comprising:

- connecting means (8) for the connection to a control actuator (6) of the valve group,

- linking means (9, 10) for the linkage to each of said first valve (2) and second valve (3) and

- transmission means (11) acting on the linking means (9, 10) in order to drive said first and second control means (5) of said first valve and second valve, in response to controls of said actuator.

12. Adapter for valve groups according to claim 11, wherein the linking means have a first top portion and a second top portion, respectively, both designed to be visible from the outside, wherein said first top portion and said second top portion are provided with a respective indicator interacting with display elements arranged on a top surface of the adapter in order to signal the position of the control means (5) of each valve (2, 3) and wherein, on the top surface of the adapter, graphic items are shown representative of the linking/operation diagram of the valve group.

13. Controlling method to control a valve group according to one of claims 1-10 in a hydraulic system having a first circuit and a second circuit for heating and cooling a working fluid, or vice versa, to be supplied to at least one radiant element, said valve group comprising

at least one first shut-off valve, one second shut-off valve and one adapter provided with connecting means for the connection to a control actuator of the valve group and provided with a rotating element, the method being characterized by the steps of:

- linking the connecting means of the valve group to the control actuator, so that the rotating element is able to rotate in response to controls of the actuator;

- causing the rotating element of the adapter to rotate in order to lead the valve group to one of the following conditions:

o closing position, wherein the control means of each valve block the ports of the respective valve;

o first sequence of total or partial opening, in which the control means allow the working fluid to at least partially pass from the first port (A) to the third port (AB) of the first valve and from the third port (AB) to the second port (B) of the second valve, thereby making the fluid circulating between the at least one air-conditioning terminal and the first circuit;

o second sequence of partial or total opening, in which the control means allow the working fluid to at least partially pass from the second port (B) to the third port (AB) of the first valve and from the third port (AB) to the first port (A) of the second valve, thereby making the

fluid circulating between the at least one air-conditioning terminal and the second circuit.

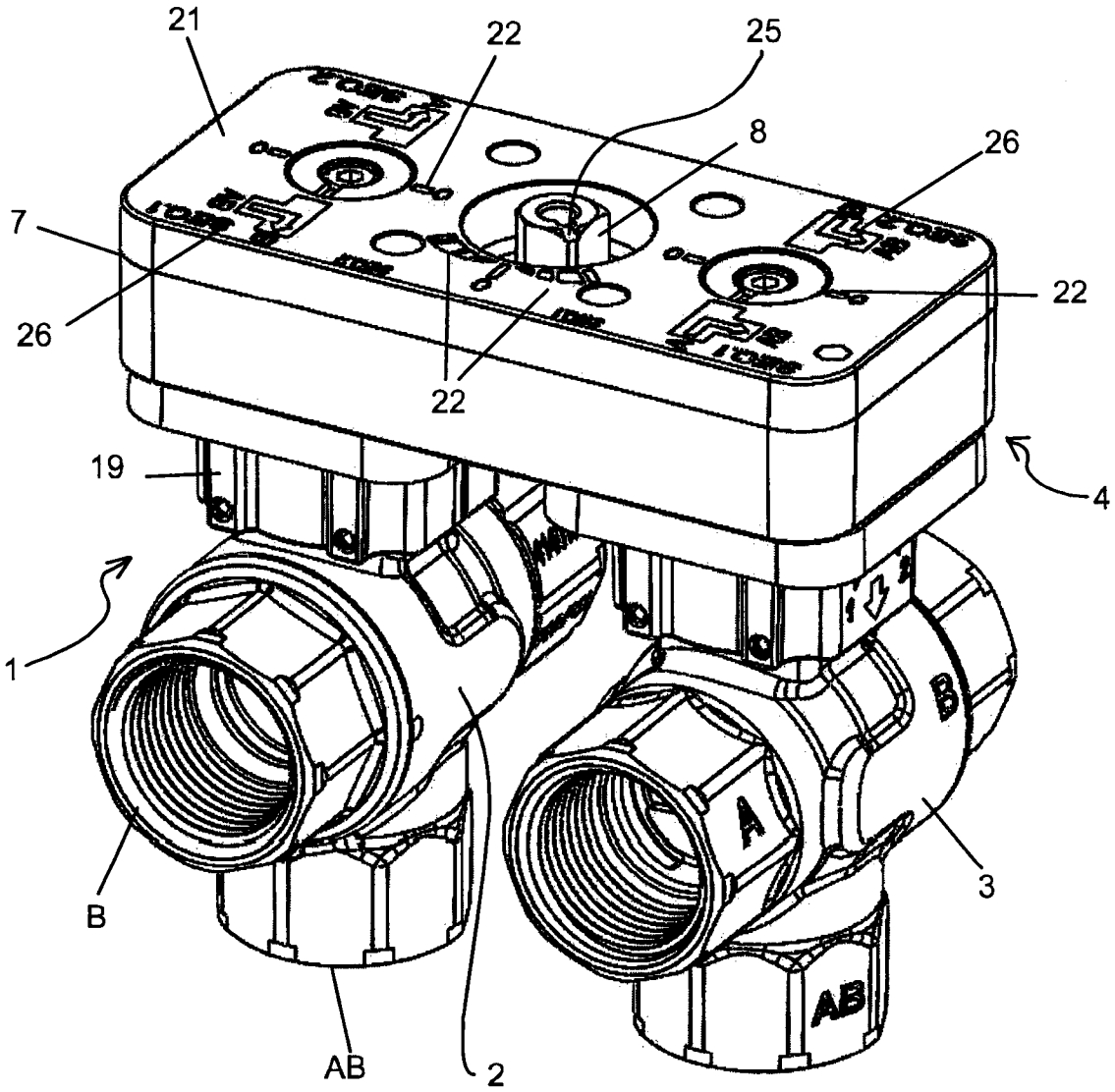


FIG. 1

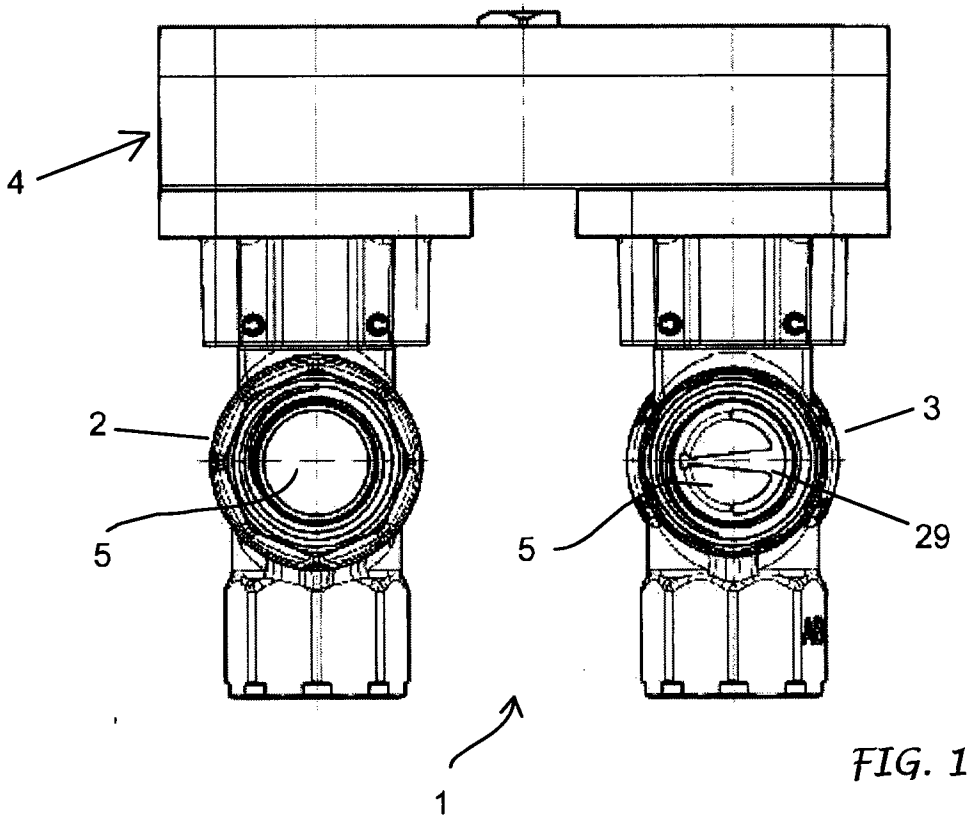


FIG. 1a

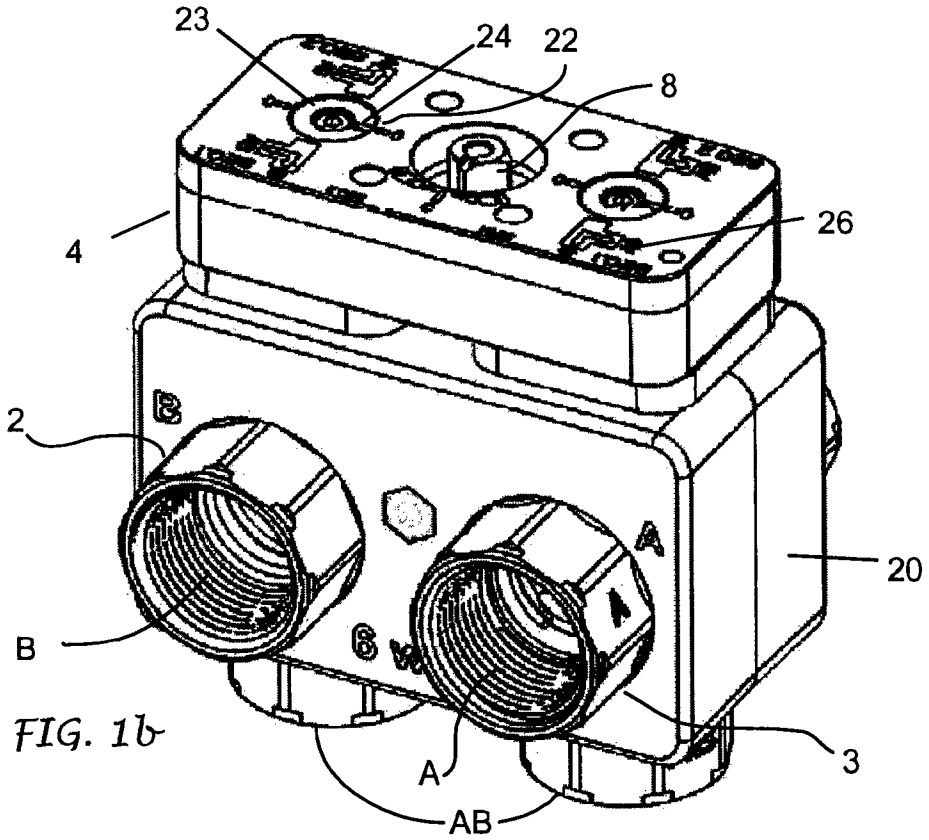


FIG. 1b

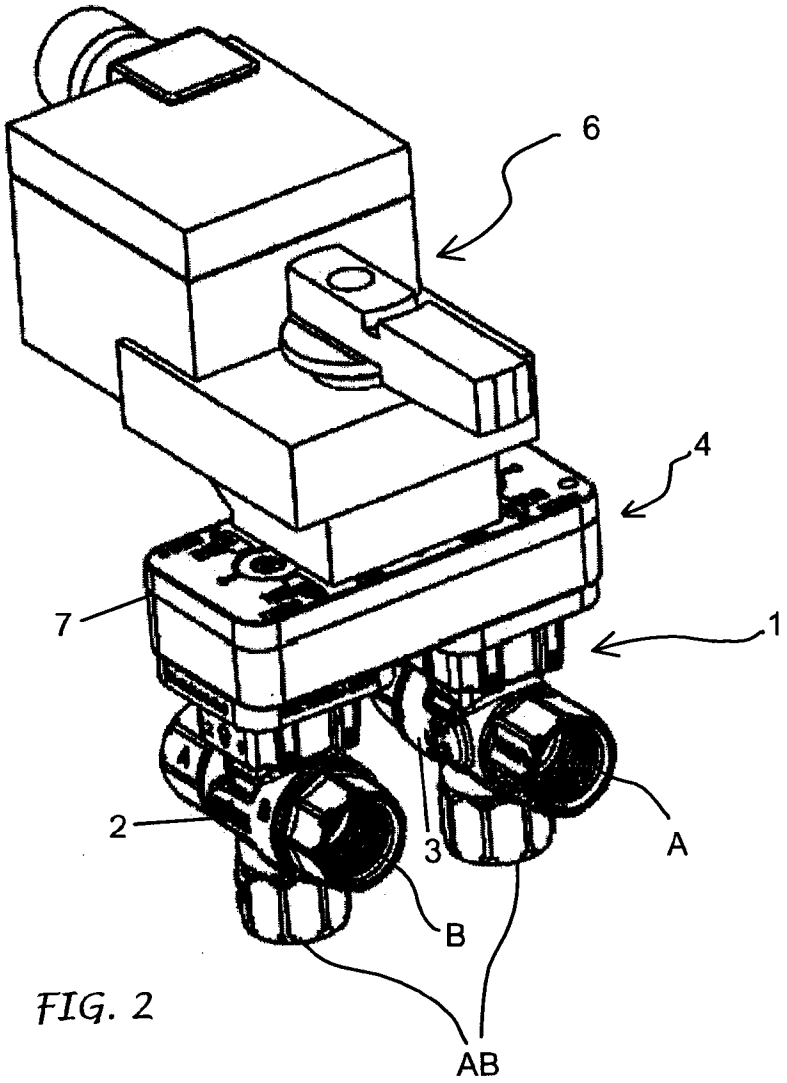


FIG. 2

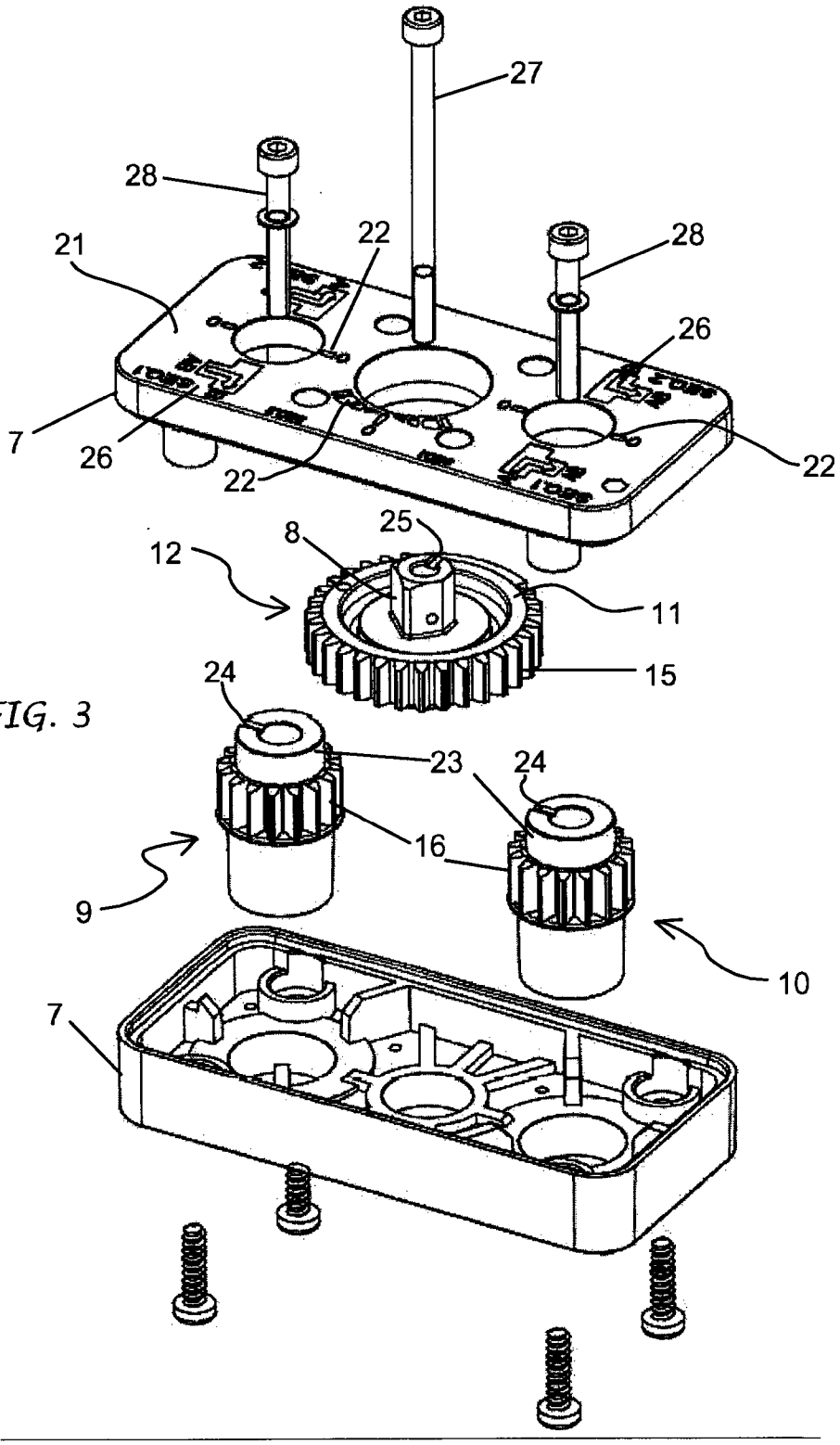


FIG. 3

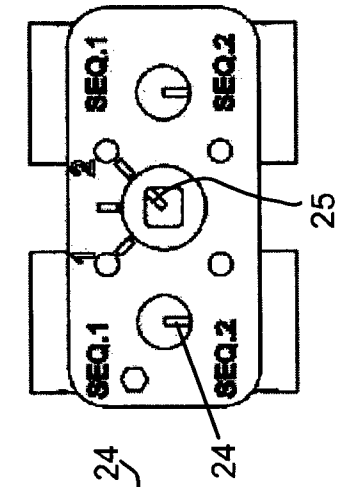
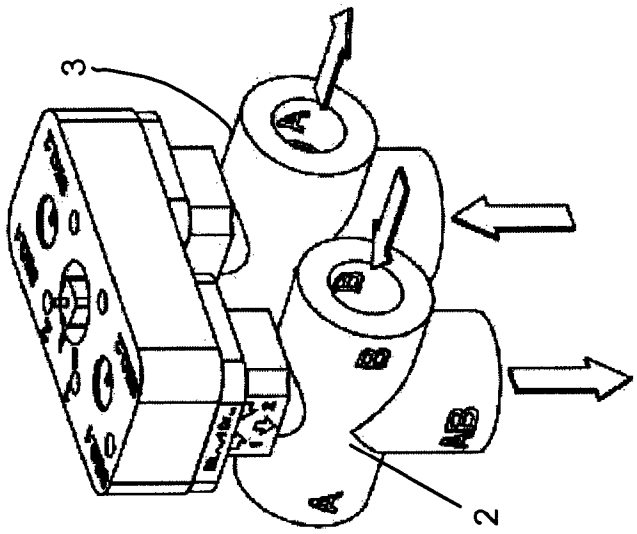
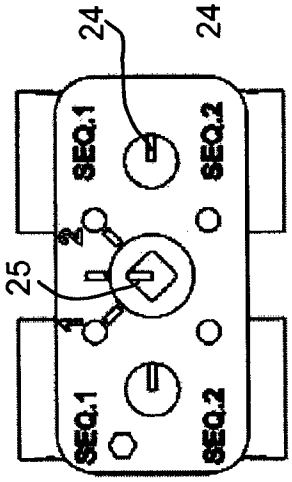


FIG. 4b





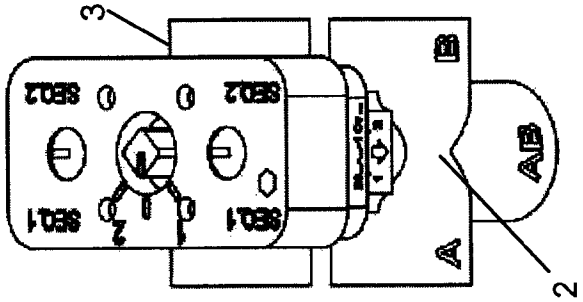


FIG. 4c

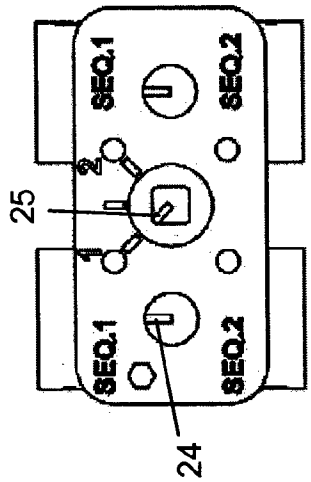
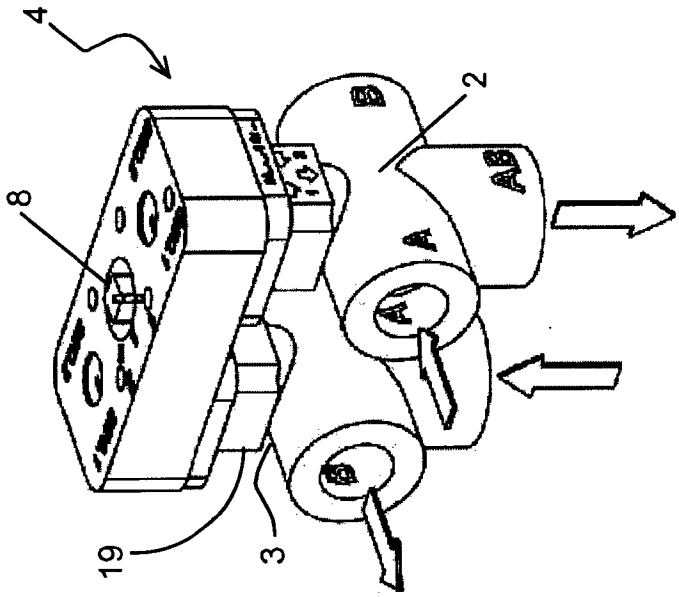


FIG. 4a



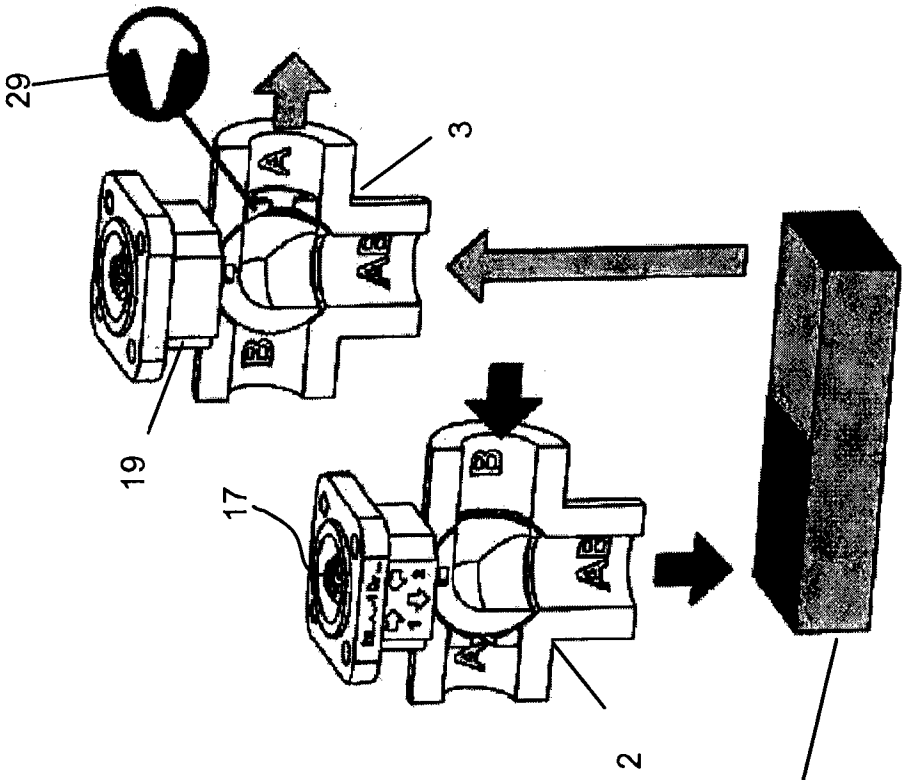


FIG. 5b

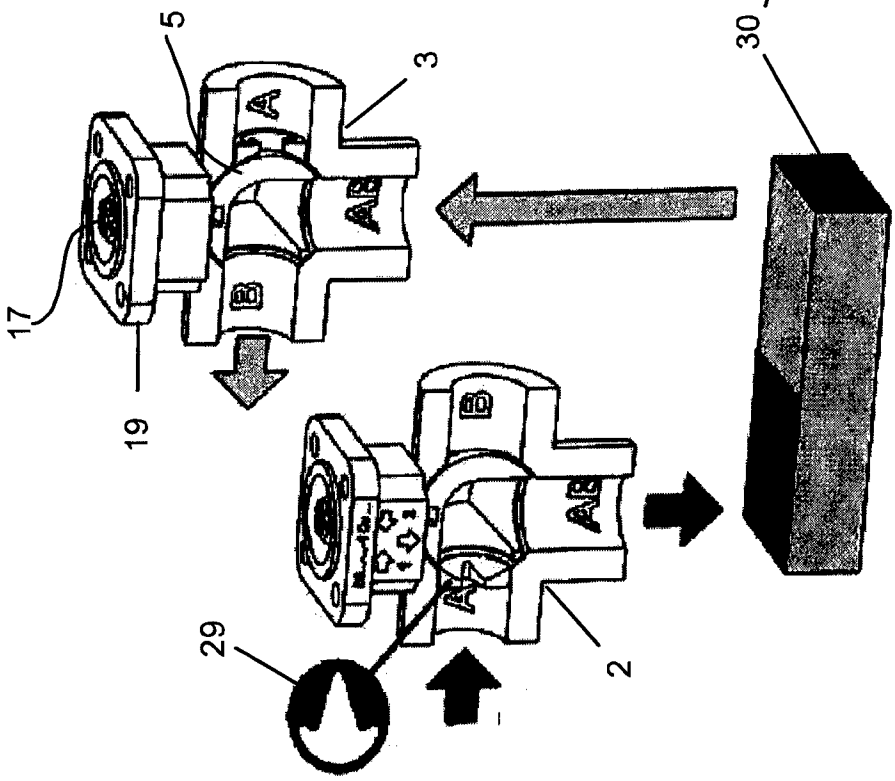


FIG. 5a

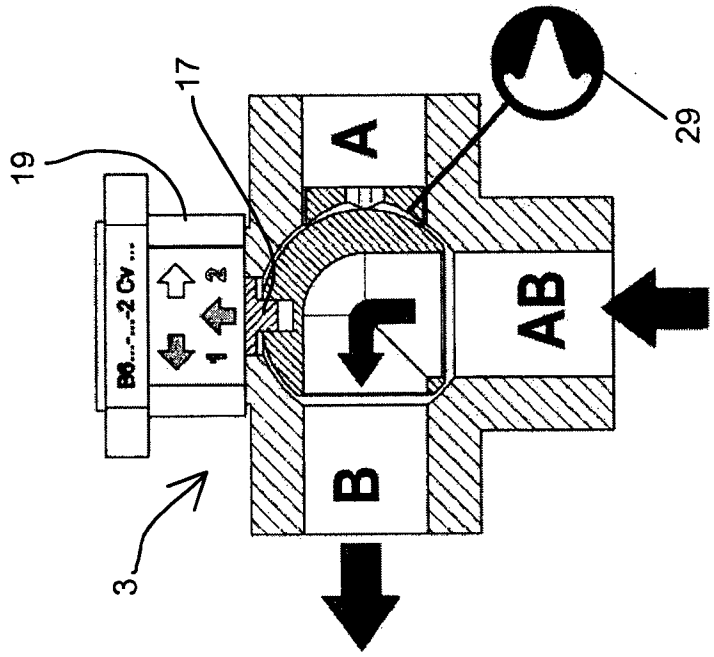


FIG. 6b

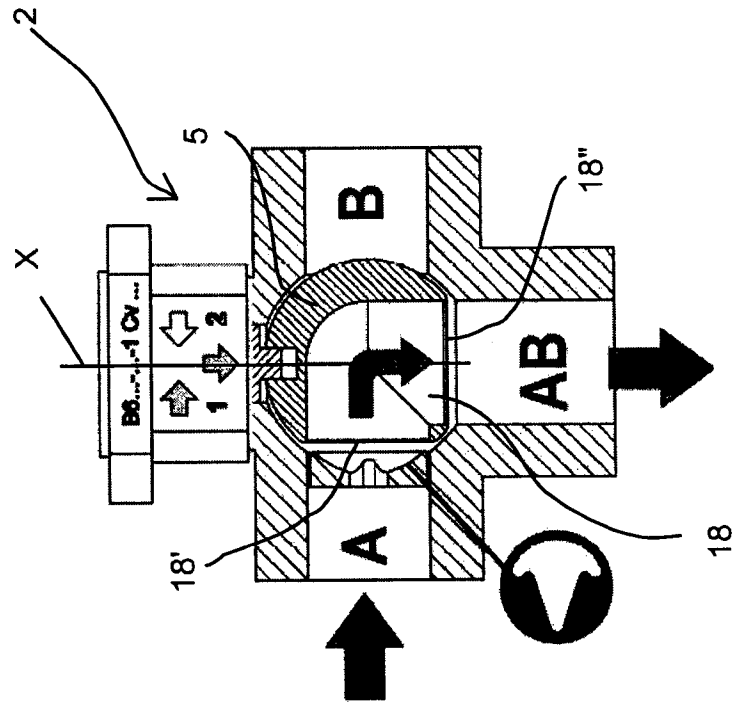


FIG. 6a

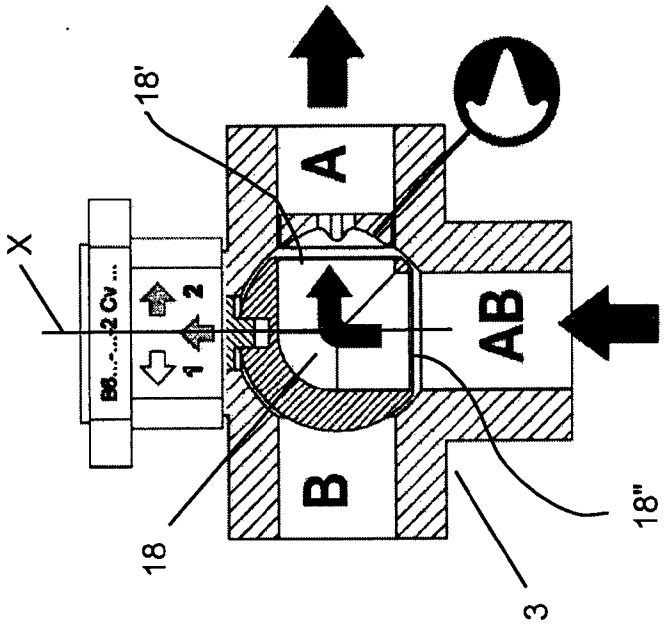


FIG. 7b

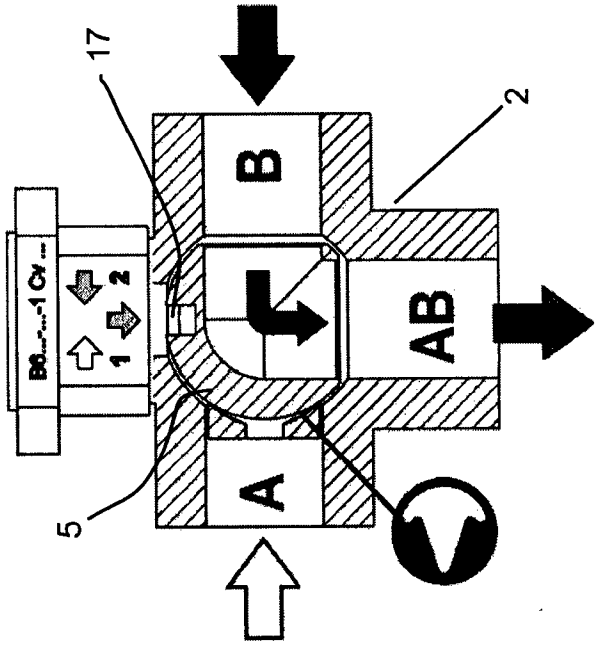


FIG. 7a

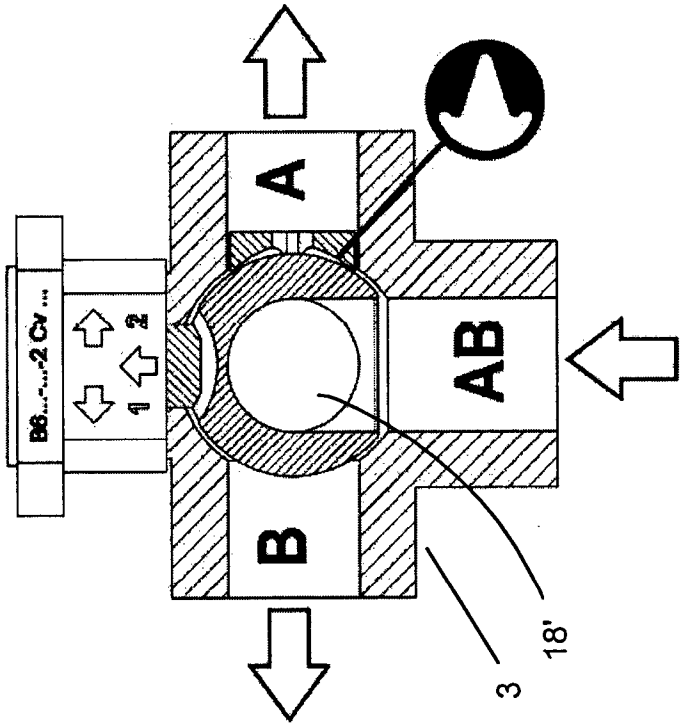


FIG. 8b

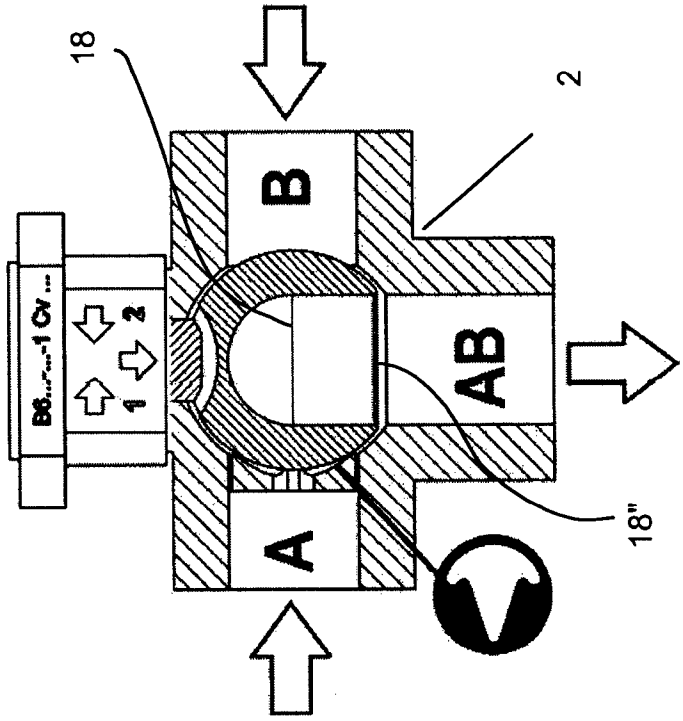


FIG. 8a

INTERNATIONAL SEARCH REPORT

International application No
PCT/IT2016/000057

A. CLASSIFICATION OF SUBJECT MATTER
INV. F24D3/10 G05D23/19 F24D19/10 F16K11/087 F16K11/16
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
F24D G05D F16K

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2012/291901 A1 (HOLLEY ERIC [US] ET AL) 22 November 2012 (2012-11-22) page 2, paragraph 24 - page 4, paragraph 35; figures 1,4,5,6	1-13
A	EP 2 818 776 A1 (VIR VALVOINDUSTRIA ING RIZZIO S P A [IT]) 31 December 2014 (2014-12-31) the whole document	1
A	GB 2 514 187 A (V UNITED KINGDOM LTD SA [GB]) 19 November 2014 (2014-11-19) the whole document	1
A	US 2010/059128 A1 (RECK MICHAEL E [US]) 11 March 2010 (2010-03-11) the whole document	1

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[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
10 November 2016	17/11/2016

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Hoffmann, Stéphanie

Form PCT/ISA/210 (second sheet) (April 2005)

INTERNATIONAL SEARCH REPORT

International application No
PCT/IT2016/000057

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP 0 312 505 A1 (GIORDANO VINCENZA) 19 April 1989 (1989-04-19) the whole document -----	1

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/IT2016/000057

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2012291901 A1	22-11-2012	US 2012291901 A1	22-11-2012
		WO 2012158534 A1	22-11-2012
EP 2818776 A1	31-12-2014	DK 2818776 T3	24-10-2016
		EP 2818776 A1	31-12-2014
GB 2514187 A	19-11-2014	NONE	
US 2010059128 A1	11-03-2010	CA 2780364 A1	19-05-2011
		US 2010059128 A1	11-03-2010
		WO 2011059964 A1	19-05-2011
EP 0312505 A1	19-04-1989	DE 3860659 D1	25-10-1990
		EP 0312505 A1	19-04-1989
		GR 3000984 T3	10-12-1991
		IT 1211400 B	18-10-1989
		US 4890648 A	02-01-1990