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(54) Title
AN ARRANGEMENT FOR OPERATING HYDRAULIC ACTUATING MEANS IN A ROCK DRILLING BOOM AND THE LIKE BOOM CONSTRUCTION

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(57) Claim

1. An arrangement for operating a plurality of hydraulic actuating means in a rock drilling boom and the like boom construction, said actuating means each being provided with two overcenter valves connected to pressure fluid conduits of the actuating means and to control conduits for the valves in such a manner that the valves stop the flow of the pressure fluid in the conduits in a direction away from the actuating means when no pressure fluid is supplied to the actuating means, and when pressure fluid is supplied to one of the conduits, the overcenter valve connected to the other conduit opens when the pressure of the supplied pressure fluid acts on its control conduit, allowing the flow of the pressure fluid therethrough away from the actuating means, the arrangement further comprising hoses for pressure fluid extending from the carrier of a rock drilling apparatus in the longitudinal direction of the boom for supplying pressure

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fluid to the actuating means in the boom and for removing it therefrom, and regulating valves for controlling each one of the actuating means, characterised in that, the arrangement comprises for the supply of pressure fluid to the actuating means a supply hose common to at least two actuating means and extending longitudinally of the boom, and a common return hose for removing pressure fluid from the actuating means, respectively, both hoses being branched at suitable points for connection to each one of the actuating means;

that at the most two remote-controlled cartridge-type valves connected to each one of the actuating means are used as regulating valves in each one of the actuating means connected to the same pressure fluid supply hose;

that the regulating valves in each one of the actuating means are connected between the pressure fluid conduits of the actuating means and the pressure fluid supply hose;

that the overcenter valves are connected between the pressure fluid conduits of the actuating means and the pressure fluid return hose; and

that the control conduit of each overcenter valve is arranged to obtain control pressure when the regulating valve connected to the same pressure fluid conduit as the other overcenter valve passes pressure fluid into said pressure fluid conduit.

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COMPLETE SPECIFICATION

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Complete Specification for the invention entitled:

AN ARRANGEMENT FOR OPERATING HYDRAULIC ACTUATING MEANS IN A ROCK DRILLING BOOM AND THE LIKE BOOM CONSTRUCTION

The following statement is a full description of this invention, including the best method of performing it known to us:

Our Ref: #3123 PS:WB 22oyt

The invention relates to an arrangement for operating hydraulic actuating means provided with overcenter valves in a rock drilling boom and the like boom construction, the overcenter valves being connected to pressure fluid conduits of the actuating means and to control conduits for the valves in such a manner that the valves stop the flow of the pressure fluid in the conduits in a direction away from the actuating means when no pressure fluid is supplied to the actuating means, and when pressure fluid is supplied to one of the conduits, the overcenter valve connected to the other conduit opens when the pressure of the supplied pressure fluid acts on its control conduit, allowing the flow of the pressure fluid therethrough away from the actuating means, the arrangement further comprising hoses for pressure fluid extending from the carrier of a rock drilling apparatus in the longitudinal direction of the boom for supplying pressure fluid to the actuating means in the boom and for removing it therefrom, and regulating valves for controlling each one of the actuating means

Hydraulic actuating means, such as cylinders and hydraulic motors, are used widely in a rock drilling equipment. Prior art actuating means are operated by means of two robust hoses for pressure fluid. The pressure fluid is introduced into the different chambers of each one of the actuating means by means of control or regulating valves placed in front of the operator. As a result, as the boom of a rock drilling machine may comprise eight or even more cylinders or actuating means, the number of requisite hoses is usually two times that of the actuating means. With

high-pressure hydraulics, such a large bunch of hoses is very heavy. The hoses extend from the carrier to the boom and are liable to damage during operation. The construction of the equipment cannot be optimized due to the fact that the space requirement of the bunch of hoses always has to be taken into account as well as the movements and weight of the hoses.

Another problem presented by the long hoses and the control of the actuating means with valves placed next to the operator is that the cylinders as well as other actuating means usually comprise a so called overcenter valve the function of which is to prevent the boom, e.g., from falling down in case of hose damage or when the pressure of the pressure fluid drops abruptly for some other reason. In order that the overcenter valve could operate properly, its control conduits have to be depressurized, which takes place through a long hose and a regulating valve into a pressure fluid tank. This makes the operation of the valve slow and less effective. The overcenter valve also often performs a load limiting function which suffers from the long hose and is inoperative in known solutions when pressure fluid is being introduced into the actuating means.

The object of the invention is to provide an arrangement for operating hydraulic actuating means in a rock drilling boom, which avoids the above drawbacks and is simple and easy to realize both in existing and new apparatuses. This is achieved according to the invention is such a manner that the arrangement comprises for the supply of pressure fluid to the actuating means a supply hose common to at least two actuating means and extending longitudinally of the boom, and a common return hose for removing pressure fluid from the actuating means, respectively, both hoses

being branched at suitable points for connection to each one of the actuating means; that at the most two remote-controlled, cartridge-type valves connected to each one of the actuating means are used as regulating valves in each one of the actuating means connected to the same pressure fluid supply hose; that the regulating valves in each one of the actuating means are connected between the pressure fluid conduits of the actuating means and the pressure fluid supply hose; that the overcenter valves are connected between the pressure fluid conduits of the actuating means and the pressure fluid return hose; and that the control conduit of both overcenter valves is arranged to obtain control pressure when the regulating valve connected to the same pressure fluid conduit of the actuating means as the other overcenter valve passes pressure fluid into said conduit.

The basic idea of the invention is that the regulating valve(s) of each one of the actuating means is(are) remote-controlled cartridge-type valves mounted fixedly in the actuating means or in a block integral with the actuating means. The regulating valves are connected between the pressure fluid supply hose and the pressure fluid conduits of the actuating means while the overcenter valves are connected between the pressure fluid conduits of the actuating means and the pressure fluid return hose. By controlling the regulating valves, e.g., electrically, by means of high-pressure or low-pressure pressure fluid, pressurized air or in some other way, the actuating means can be operated in a desired direction by applying pressure fluid into the desired pressure fluid conduit of the actuating means, while a required amount of pressure fluid is discharged from another pressure fluid conduit of the actuating means by the respective over-

center valve in response to the pressure of the pressure fluid applied through the regulating valves. In the arrangement according to the invention, all hydraulically operated actuating means required in the boom, for instance, can be operated by means of a single pressure fluid supply hose for introducing pressure fluid into the boom, and a single return hose for returning the pressure fluid into the pressure fluid tank. A distributor is provided at the upper end of the boom, whereby a short pressure hose and return hose can be branched from the distributor for each one of the actuating means. The control of the actuating means does not additionally require but a light bunch of electric conductors, for instance, which is easy to pass along the boom in such a manner that it is not liable to damage and without any special construction of the boom.

The invention will be described in more detail in the attached drawings, wherein

Figure 1 is a schematical view of one embodiment of the invention;

Figure 2 is a schematical view of another embodiment of the invention; and

Figure 3 is a schematical cross-sectional view of a valve assembly suitable for the realization of the arrangement according to the invention.

Figure 1 shows a hydraulic cylinder 1 acting as an actuating means. A piston 2 disposed within the hydraulic cylinder divides the inner space of the cylinder into two separate chambers 3 and 4 for pressure fluid. A conduit 5 for pressure fluid is connected to the chamber 3, and a conduit 6 for pressure fluid to the chamber 4, respectively. A pressure-controlled overcenter and overload valve 7 is connected to the pressure fluid conduit 5, and a similar valve 8 is

connected to the conduit 6. At the other side, the valves 7 and 8 are connected to a return hose 9 for returning pressure fluid into a tank 10. Non-return valves 11 and 12 are connected in parallel with the valves 7 and 8. The operation of the non-return valves will be described more closely below. The figure further shows a pressure fluid supply hose 13 which is connected to controllable valves 14 and 15. The valve 14, in turn, is connected through a non-return valve 16 to the conduit 5, and the valve 15 is at the other side connected to the conduit 6 through a non-return valve 17. A control conduit 18 for the valve 7 connected to the conduit 5 is connected to that side of the valve 15 which faces the conduit 6, and a control conduit 19 for the valve 8 correspondingly to that side of the valve 14 which faces the conduit 5. The valve 7 further comprises an overload control conduit 20 extending from it to the conduit 5, and the valve 8 comprises an overload control conduit 21 extending from it to the conduit 6. Control signal lines 22 and 23 are connected to the controllable valves 14 and 15, respectively. The broken line 24 indicates schematically that the entire assembly of Figure 1 is fitted substantially integrally with the body of the cylinder 1 so that only the pressure fluid hose 13 and the return hose 9 and the control signal lines 22 and 23 are attached to the cylinder.

With the connection of Figure 1 and in the position of the control valves 14 and 15, the fluid pressures are equal in the chambers 3 and 4, whereby the piston 2 has assumed a determined positioned with respect to the cylinder 1. Under normal conditions, the fluid contained in the chambers 3 and 4 is not able to escape through the conduits 5 and 6, because the pressure-controlled valves 7 and 8 on one hand

and the non-return valves 11, 12, 16, 17 on the other hand prevent the flow of the fluid, and the cylinder is thereby locked in position. Correspondingly, when the valves 14 and 15 are in the position shown in the figure, the pressure in the pressure fluid supply hose 13 is not able to advance due to the non-return valves disposed internally in the valves, and the pressure of the fluid is not able to act on either one of the valves 7 or 8. Nor is the fluid able to flow into the conduits 5 and 6 in the downstream direction of the non-return valves 16 and 17. When the valve 14 is controlled by means of a control signal applied through the signal cable 22 so that it is displaced to a position in which the pressure fluid from the pressure fluid hose 13 is able to flow straight therethrough, the pressure fluid enters the conduit 5 through the non-return valve 16 and passes further into the chamber 3 while the pressure prevailing in the control conduit 19 opens the pressure-controlled valve 8, allowing the flow of pressure fluid from the chamber 4 through the conduit 6 via the valve 8 into the return hose 9. When the control signal to the valve 14 is cut off, the valve returns to the position shown in the figure, and the control pressure in the control conduit 19 is released through small leakages of the valves, whereby the valve 8 is closed and the piston 2 is again locked in position. The operation is fully identical in cases where the valve 15 is controlled similarly as the valve 14 except that the piston 2 moves in the opposite direction. An overload situation, e.g., when an excessive pressure prevails in the chamber 3, causes the valve 7 to be opened through the conduit 5 and the overload conduit 20 so that pressure fluid enters through the valve 7 into the return hose. When the piston is displaced, fluid

from the return hose enters the conduit 6 through the non-return valve 12 and passes further into the chamber 4 of the cylinder 1, thus allowing the piston to move until the overload is compensated for. If the pressure in the conduits 18 and 19 cannot drop due to the fact that the valves 7, 8, 14 and 15 do not allow any leakages, the pressure from the conduits 18 and 19 has to be led into the return hose through a separate passage e.g. through a conduit provided with a throttle. The pressure drop can be similarly effected in such a manner that the valves 14 and 15 are e.g. three-way valves which at the rest state connect the auxiliary conduits attached to the conduits 18 and 19 to the return hose 9.

The operation and structure of the valves 7 and 8 and the valves 11 and 12 are generally known, and the valves are standard fittings in hydraulic cylinders, being usually of the cartridge type and formed either in the body of the cylinder or fastened as a separate valve assembly at the end of the cylinder. According to the invention, the control valves previously positioned at the end of long pressure hoses beside the operator are replaced with the cartridge type control valves 14 and 15 mounted fixedly to the cylinder in the form of and integral assembly and with the non-return valves 16 and 17 likewise forming an integral assembly therewith. The entire valve assembly is thereby mounted as an integral part of the cylinder or the like actuating means, and the actuating means can be controlled simply by means of an electric signal or other similar control signal applied to the valves 14 and 15. A single pressure fluid hose and a single return hose are required for the operation of all the actuating means and cylinders positioned at the end of the boom of the rock drilling machine, for

instance. The hoses are branched from one actuating means to another at the end of the boom. In this way, no large bunches of hoses are formed because the valves required for the control of the entire actuating means are attached to each particular actuating means and the control is effected by means of thin electric conductors, a thin pneumatic hose or the like.

The solution shown in Figure 2 corresponds to that of Figure 1 except that a so called proportional valve 25 is used in the case of Figure 2 in place of the two separate ON/OFF type valves of Figure 1. In the proportional valve, the flow amount of the pressure fluid can be adjusted continuously in such a manner that the fluid flows to either conduit or to neither one of them. The valve 25 is controlled by means of a control signal 26. When no control signal is applied, the valve is in the position of Figure 2, whereby the flow of the pressure fluid into the cylinder is completely prevented. When the control signal is connected, it displaces the spindle of the valve to the left in Figure 2 so that each one of the conduits still does not allow the flow of the pressure fluid. By adjusting the intensity of the control signal, the spindle of the valve 25 is displaced farther to the left or back to the right, whereby pressure fluid is able to enter either one of the conduits, respectively.

Figure 3 is a schematical cross-sectional view of a valve assembly with two cartridge-type valves suitable for realizing the invention. It comprises cartridge-type overcenter valves 7 and 8 mounted in borings formed in the body of the actuating means 1. The overcenter valves comprise non-return valves 11 and 12, respectively, connected in parallel therewith.

The structure and manufacture of such overcenter valves as well as the mounting of then in the body of the actuating means and the formation of the requisite conduits are known per se and quite obvious to one skilled in the art, wherefore they are not described more precisely herein. Cartridge-type regulating valves 14 and 15 are further mounted in the borings formed in the body of the actuating means 1, which valves are provided with solenoids 28 and 29, respectively, for electric control. The overcenter valves 7 and 8 are connected by means of conduits not shown to the pressure fluid conduits of the actuating means 1 and to the return hose 9 for the pressure fluid. The regulating valves 14 and 15, in turn, are connected by means of conduits not shown to the pressure fluid conduits 5 and 6 of the actuating means 1 and to the supply hose 9 of the pressure fluid, respectively. Conduits 18 and 19 extend from the overcenter valves 7 and 8 to the regulating valves 15 and 14 and non-return valves 17 and 16 are provided between the conduits 18 and 19 and 6 and 5, respectively. The structure of the valves and the connection and manufacture of the conduits are known per se and will not be described more closely herein.

The invention has been described above only schematically, and only a few practical embodiments have been presented. However, the invention can be realized in various ways and with various connections, depending on the requirements in each particular case and the desired mode of operation. In place of the ON/OFF type valves 14 and 15 of Figure 1, for instance, it is possible to use two individual proportionally operating valves. In the embodiment of the invention, it is essential that the valves required for the control of the entire cylinder or actuating

means are cartridge-type valves mounted in valve housings formed fixedly in the body of the cylinder or the actuating means, or in a separate valve block mounted integrally with the body of the actuating means or the cylinder. The apparatus is thereby controlled electrically or in some other remote-controlled manner, and pressure fluid can be supplied to several actuating means through a single primary supply hose and returned to the tank through a single primary return hose. In certain cases, it is possible to use a pressure-controlled non-return valve in place of the overcenter valve.

The claims form part of the disclosure of this specification.

The claims defining the invention are as follows:

1. An arrangement for operating a plurality of hydraulic actuating means in a rock drilling boom and the like boom construction, said actuating means each being provided with two overcenter valves connected to pressure fluid conduits of the actuating means and to control conduits for the valves in such a manner that the valves stop the flow of the pressure fluid in the conduits in a direction away from the actuating means when no pressure fluid is supplied to the actuating means, and when pressure fluid is supplied to one of the conduits, the overcenter valve connected to the other conduit opens when the pressure of the supplied pressure fluid acts on its control conduit, allowing the flow of the pressure fluid therethrough away from the actuating means, the arrangement further comprising hoses for pressure fluid extending from the carrier of a rock drilling apparatus in the longitudinal direction of the boom for supplying pressure fluid to the actuating means in the boom and for removing it therefrom, and regulating valves for controlling each one of the actuating means, characterised in that, the arrangement comprises for the supply of pressure fluid to the actuating means a supply hose common to at least two actuating means and extending longitudinally of the boom, and a common return hose for removing pressure fluid from the actuating means, respectively, both hoses being branched at suitable points for connection to each one of

the actuating means;

that at the most two remote-controlled cartridge-type valves connected to each one of the actuating means are used as regulating valves in each one of the actuating means connected to the same pressure fluid supply hose;

that the regulating valves in each one of the actuating means are connected between the pressure fluid conduits of the actuating means and the pressure fluid supply hose;

that the overcenter valves are connected between the pressure fluid conduits of the actuating means and the pressure fluid return hose; and

that the control conduit of each overcenter valve is arranged to obtain control pressure when the regulating valve connected to the same pressure fluid conduit as the other overcenter valve passes pressure fluid into said pressure fluid conduit.

2. An arrangement according to claim 1, characterised in that non-return valves are provided between the regulating valves and the pressure fluid conduits of the actuating means so as to prevent the flow of pressure fluid from the conduits toward the regulating valves and that the control conduits of the overcenter valves are connected between the regulating valves and non-return valves.

3. An arrangement according to claim 1 or 2, characterised in that at least one of the actuating means

comprises two regulating valves arranged to control the actuating means so that it moves in two opposite directions, respectively.

4. An arrangement according to claim 1 or 2, characterised in that at least one of the actuating means comprises a single regulating valve which is arranged to be connected to control the actuating means in both directions.

5. An arrangement according to any of the claims 1 to 4, characterised in that each regulating valve is mounted in borings formed in the body of the actuating means.

6. An arrangement according to any of the claims 1 to 4, characterised in that each one of the regulating valves is mounted in a separate valve block attached integrally to the body of the actuating means.

7. An arrangement according to any of the preceding claims, characterised in that the regulating valves are arranged to be controlled electrically.

8. An arrangement according to any of the preceding claims, characterised in that the regulating valves are arranged to be controlled by means of pressure fluid.

9. An arrangement for operating hydraulic actuating means provided with overcenter valves in a rock drilling boom and the like boom constuction substantially as hereinbefore described with reference to Figures 1 and 3 or 2 and 3.

DATED this 5 July 1991

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Patent Attorneys for the Applicant:

OY TAMPELLA AB

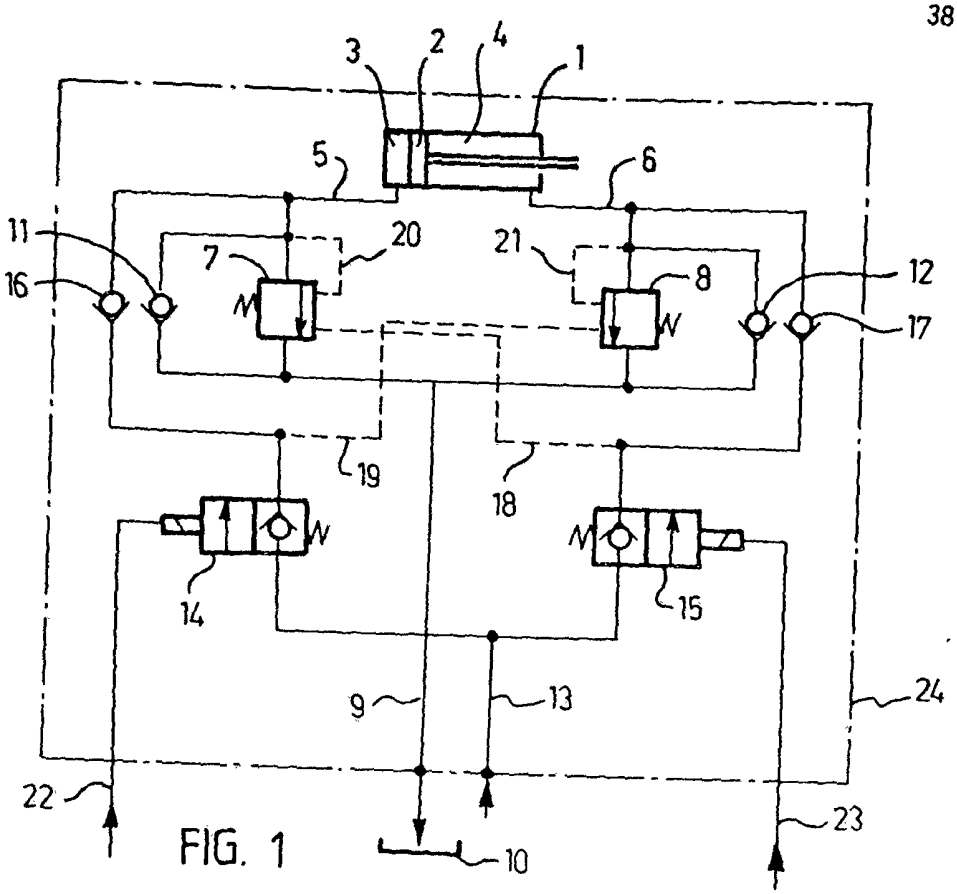
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FIG. 1

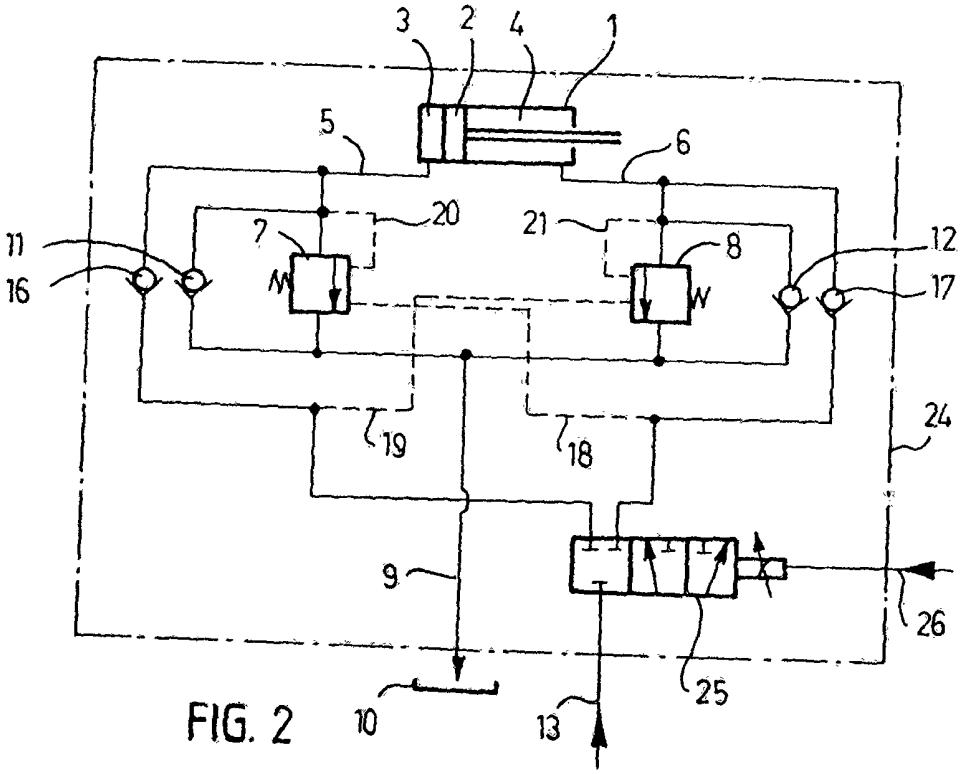
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FIG. 2

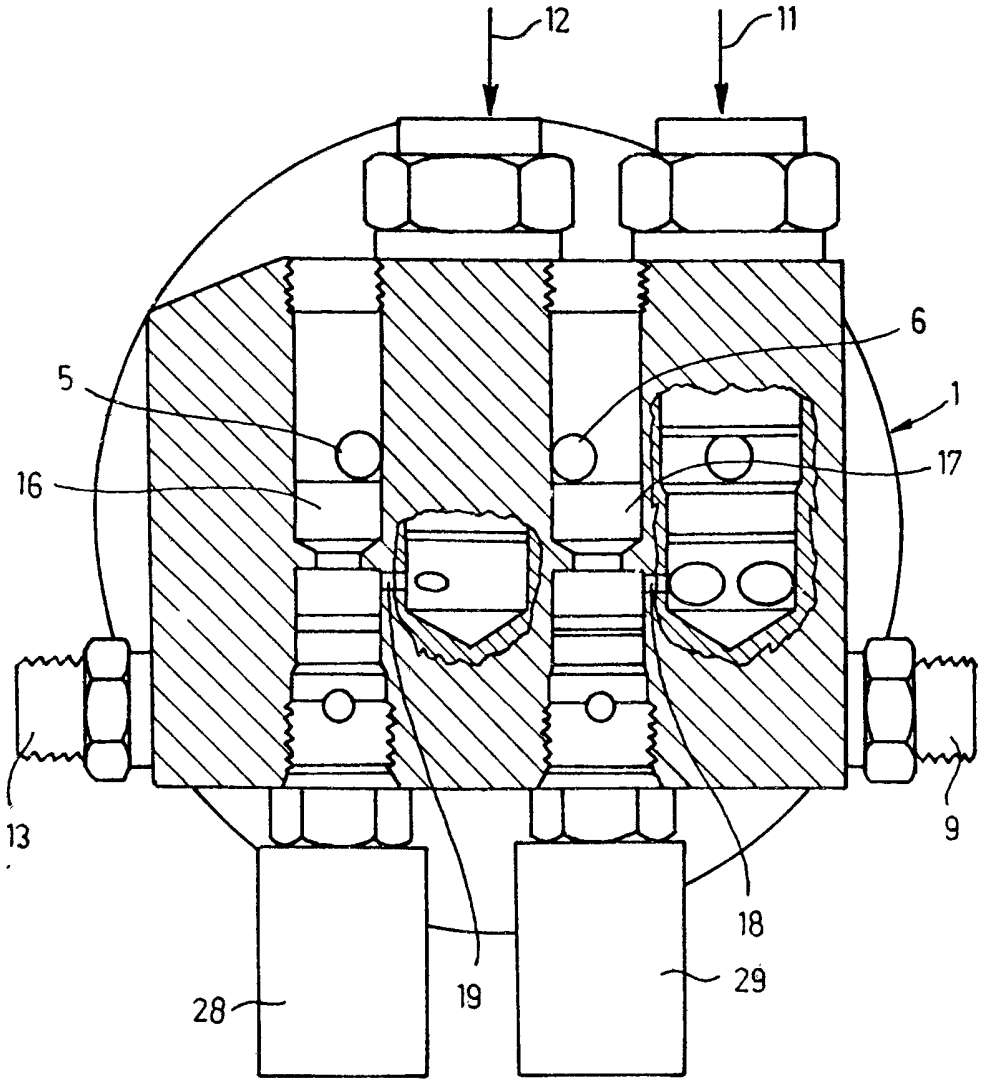

FIG. 3