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(54) Plough turning device

(57) Hydraulic operating device for a plough which can be turned and whose width can be adjusted, comprising a width-adjustment cylinder for adjusting the operating width of the plough, a turning cylinder for turning the plough between a first and a second turned position, and a hydraulic turning circuit for turning the plough. The device furthermore comprises a hydraulic sequencing circuit, which is designed such that, when pressurized hydraulic fluid is fed to the pressure port thereof, the plough moves to its narrowest position, so that, when a narrow position of the plough which is suitable for turning the plough is reached, the fluid flows to the pressure port of the turning circuit and, from there, to the turning cylinder, so that the plough moves from its one turned position to its other turned position, and so that, when the position of the turning cylinder which is associated with the desired turned position of the plough is reached, the fluid flows to the other connection port of the width-adjustment cylinder, so that the plough moves to its widest position.

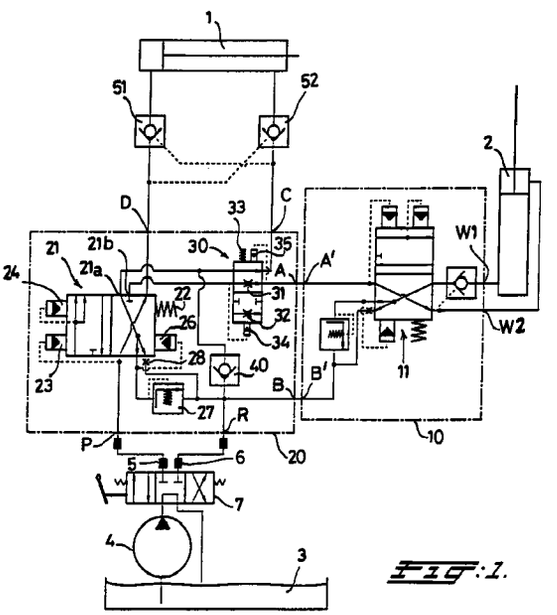

Fig. 1.

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Description

The invention relates to a hydraulic operating device for a plough which can be turned and whose width can be adjusted, according to the preamble of claim 1.

Much use is made in agriculture of so-called half-turn ploughs. A half-turn plough is fastened to the back of a tractor using a structure which makes it possible to plough on one of the two sides of the tractor as desired. For the purpose of turning a plough, in order to be able to plough on the other side of the tractor, it is desirable initially to move the plough into a position such that the centre of gravity of the part which is to be turned is as close as possible to the turning axis (which position corresponds to the narrowest plough width), before the plough is rotated about its turning axis, which lies essentially horizontally and in the longitudinal direction of the tractor. The plough then has to be readjusted to the desired plough width. The two abovementioned main movements of the half-turn plough are usually carried out by means of two hydraulic cylinders. The pressurized hydraulic fluid to be fed to these cylinders is usually supplied by a hydraulic pump unit which is present on the tractor and comprises a pump and a reservoir.

A known device of the type mentioned in the preamble comprises, for the purpose of actuating the turning cylinder, a hydraulic turning circuit as described in European Patent Specifications EP-0,434,531 and EP-0,438,936. In this known device, the driver of the tractor has to actuate the desired sequence of movements of the two hydraulic cylinders by operating a number of operating buttons in a specific order.

The present invention aims to provide a device which carries out the entire sequence of movements on the basis of one single operating command by the driver and can be installed for any desired hydraulic turning device. The present invention aims to achieve this using hydraulic means and in such a manner that only two hydraulic lines and associated releasable couplings are required to connect the hydraulic unit present on the tractor to the hydraulic operating device.

This object is achieved according to the present invention by means of a hydraulic operating device according to claim 1.

Further advantageous embodiments of the operating device according to the invention are described in the subclaims and in the following description with reference to the drawing, in which:

Figure 1 shows a hydraulics diagram of a preferred embodiment of the operating device according to the invention,

Figure 2 shows the sequencing circuit of the diagram in Fig. 1, constructed as a hydraulic valve block in a first switching state,

Figure 3 shows the sequencing circuit of the diagram in Fig. 1, constructed as a hydraulic valve block in a second switching state, and

Figure 4 shows the sequencing circuit of the diagram in Fig. 1, constructed as a hydraulic valve block in a third switching state.

Figure 1 depicts a hydraulics diagram of a hydraulic operating device for a half-turn plough according to the invention. The device comprises a double-acting hydraulic cylinder 1, which is used for adjusting the plough width of the plough. In the context of the present invention, the cylinder 1 is referred to as width-adjustment cylinder 1. Furthermore, the device comprises a double-acting hydraulic cylinder 2, which is used for turning the plough between a first turned position, in which the plough is situated on one side of the tractor, and a second turned position, in which the plough is situated on the other side of the tractor. In the context of the present invention, the cylinder 2 is referred to as turning cylinder 2.

The pressurized hydraulic fluid required for operating the cylinders 1 and 2 is provided by a hydraulic unit on the tractor. This unit comprises an essentially depressurized reservoir 3 for the hydraulic fluid and a hydraulic pump 4. Also located on the tractor are two connections 5 and 6, preferably quick-coupling connections, for the hydraulic operating device according to the invention. A 4/3-way slide valve 7, which is designed to be operated by hand, is situated between the connections 5 and 6 on the one hand and the reservoir 3 and the pump 4 on the other hand. The valve 7 has a neutral central position, in which the connections 5 and 6 are closed off; in the other two positions, in each case one of the two connections 5 and 6 is connected to the reservoir 3 and the other to the pump 4.

The hydraulic operating device comprises a hydraulic turning circuit 10 (dashed line) of a design known per se. For a detailed description of the construction and action of the turning circuit 10, reference is made here to the European Patent Specifications EP-0,434,531 and EP-0,438,936.

The turning circuit 10 comprises a pressure port A', a return port B', as well as a first connection port W1 and a second connection port W2 for the turning cylinder 2 and a slide valve 11.

The turning circuit 10 ensures that, if pressurized hydraulic fluid is fed to the pressure port A', the turning cylinder 2 moves from its one limit position to its other limit position, irrespective of which limit position the turning cylinder 2 assumes at the start of the feed of liquid to the pressure port A'. The fluid displaced at the other side of the piston of the turning cylinder 2 flows away via the return port B'.

According to the present invention, the hydraulic operating device further comprises a hydraulic sequencing circuit 20.

Fig. 1 shows a preferred embodiment of the sequencing circuit in a hydraulics diagram. The sequencing circuit 20 comprises:

- a pressure port P which can be connected, for example via a quick-connection hydraulic pipe, to the connection 5 of the tractor,
- a return port R which can be connected, for example via a quick-connection hydraulic pipe, to the connection 6 of the tractor,
- a first connection port D, which is connected to the width-adjustment cylinder 1, so that, when hydraulic fluid flows from the first connection port D to the width-adjustment cylinder 1, the plough moves to its narrowest position,
- a second connection port C, which is connected to the width-adjustment cylinder 1, so that, when hydraulic fluid flows from the second connection port C to the width-adjustment cylinder 1, the plough moves to its widest position,
- a third connection port A, which is connected to the pressure port A' of the above-described turning circuit 10, - a fourth connection port B, which is connected to the return port B' of the turning circuit 10 and to the return port R of the sequencing circuit 20.

The hydraulic sequencing circuit 20 furthermore comprises a slide valve 21, which can assume two positions. In the first position, which is shown in Fig. 1, the slide valve 21 permits flow between the pressure port P and the first connection port D and between the second connection port C and the return port R. In the second position, the slide valve 21 permits flow between the pressure port P and the first connection port D and between the pressure port P and the third connection port A, which in turn is directly connected to the pressure port A' of the turning circuit 10. In the second position, the slide valve also permits flow from the second connection port C to the return port R.

The slide valve 21 is subjected to a number of forces for setting the desired position of the slide valve 21. These forces are:

- the force of the return spring 22, which drives the slide valve 21 into its first position,
- the action of the pump pressure fed via the port P, which engages either via a first surface (at 23) or via a second surface (at 24) on the sliding body of the slide valve 21, in order to move the slide valve 21 to its second position, or, when the slide valve 21 is situated in its first or its second position, respectively
- the action of the fluid pressure present on a third surface (at 26) of the sliding body of the slide valve 21, which pressure arises when fluid flows away via the port C to the return port R from the width-adjustment cylinder 1. This pressure is generated by a pressure-regulating device 27, which is preferably adjustable and is disposed in the relevant fluid path between the slide valve 21 and the return port R. A throttle element 28 is incorporated in the same path in parallel with the pressure-regulating device 27.

The hydraulic sequencing circuit 20 furthermore comprises a second slide valve 30. This slide valve 30 has a sliding body which can assume two positions. In the first position, shown in Figure 1, the slide valve 30 permits flow between the first port 21a of the slide valve 21 and the second connection port C and between the second port 21b of the slide valve 21 and the third connection port A. In the second position thereof, the slide valve 30 permits flow between the second port 21b of the slide valve 21 and the third connection port A, while no flow is possible between the port 21a and the second connection port C. The sliding body of the slide valve 30 has throttling elements 31 and 32, so that there is always throttling in the path between the port 21b and the third connection port A.

For adjusting the position of the slide valve 30, a number of forces are exerted on its sliding body. These forces are:

- the force of return spring 33, which drives the slide valve 30 into its first position,
- the fluid pressure prevailing in the connection between the port 21b of the slide valve 21 and the slide valve 30 which acts on a first surface (at 34) of the sliding body, and which force drives the slide valve 30 into its second position,
- the fluid pressure prevailing in the connection between the slide valve 30 and the third connection port A of the sequencing circuit 20 which acts on a second surface (at 35), which is opposite the first surface (at 34), of the sliding body.

Furthermore, a non-return valve 40 is incorporated in the sequencing circuit 20 according to the invention, in a parallel connection between the second connection port C and the return port R, which non-return valve closes in the direction of the return port R.

By means of the above-described hydraulic sequencing circuit 20, when pressurized hydraulic fluid is fed to the pressure port P, due to the action of the pump 4 and appropriate operating of the slide valve 7 by the driver of the tractor, the following phases are passed through in succession.

- Firstly, the fluid fed to pressure port P flows via the slide valve 21 situated in its first position to the first connection port D and, from there, to the width-adjustment cylinder 1. The fluid displaced at the other side of the piston of the width-adjustment cylinder 1 then flows via the second connection port C, through the slide valve 30 situated in its first position, to port 21a of the slide valve 21. This fluid then flows via the slide valve 21 to the return port R. This results in the plough moving into its narrowest position.
- When the limit position of the width-adjustment cylinder 1 which is associated with the narrowest position of the plough is reached, the pressure in the connection between the pressure port P and the

first connection D rises. By means of this pressure increase, the force exerted on the surface 23 of the sliding body of the slide valve 21 becomes so great that, as a result, the slide valve 21 moves into its second position. In the second position of the slide valve 21, fluid can flow from the pressure port P to the third connection port A of the sequencing circuit 20. Because this flow passes the throttle 31, a pressure difference is generated between the section of this fluid flow from port 21b to the slide valve 30, on the one hand, and from the slide valve 30 to the third connection port A, on the other hand. This pressure difference is such that the force exerted on the sliding body of the slide valve 30 via the surface 34 is greater than the counteracting force of the return spring 33 and the surface 35 together, so that the slide valve 30 assumes its second position. Hydraulic fluid thus flows from pressure port P to pressure port A' of the turning circuit 10 and, from there, to the turning cylinder 2, the fluid displaced at the other side of the piston of the turning cylinder 2 flowing via return port B' of the turning circuit 10 to the return port R. As a result, the plough moves from its one turned position to its other turned position.

- When its end position of the turning cylinder 2 associated with the desired turned position of the plough is reached, the fluid flow in the connection between the pressure port P and the pressure port A' will cease. The consequence of this is that there is no longer a pressure difference generated across the slide valve 30 and the slide valve 30 returns to its first position. In this first position of the slide valve 30, it is possible for fluid to flow from the pressure port P to the second connection port C and, from there, to the width-adjustment cylinder 1. The fluid displaced at the other side of the piston of the width-adjustment cylinder 1 flows via first connection port D to return port R, so that the plough moves back to its widest position. By operating the slide valve 7 at a suitable moment, the driver of the tractor can end the feed of pressurized hydraulic fluid to the hydraulic operating device, as a result of which the movement of the plough in the direction of its widest plough width stops at the desired plough width.

Once the value of the plough width has been set, it is maintained by the hydraulic locking of the position of the piston rod of the width-adjustment cylinder 1 by means of the two hydraulically operated non-return valves 51 and 52.

As soon as the feed of pressurized hydraulic fluid to the pressure port P is interrupted, the pressure on the surface 24 of the slide valve 21 ceases, as a result of which the slide valve 21 assumes its first position again. To turn the plough again, the driver simply has to operate the slide valve 7 such that the connection 5 is connected to the pump 4 on the tractor.

To adapt the plough width to a different plough width without carrying out a turn of the plough, i.e. moving the piston of the width-adjustment cylinder 1 between the two limit positions, all the driver has to do is operate the slide valve 7 for a short time. When the functioning pump 4 is connected to the connection 5, the plough will move to a narrower plough width, whereas in the position of the valve 7 in which the pump is connected to the connection 6, the plough in fact moves to a wider plough width. In the latter situation, the hydraulic fluid flows via the non-return valve 40. This non-return valve 40 prevents hydraulic fluid from flowing from the connection line between the slide valves 21 and 30 to the return port R in other situations.

An important aspect of the hydraulic operating device is that only two connections to the hydraulic unit (pump 4, reservoir 3) are required. Furthermore, the device is constructed so as to operate completely hydraulically, which provides a high reliability and durability. Furthermore, it is possible to use components which already exist and have been tested, such as the turning circuit 10.

Figures 2, 3 and 4 show the hydraulic sequencing circuit 20 of Figure 1, constructed as a valve block. The valve block 60 comprises ports P, R, D, C, A, B corresponding to the ports of the hydraulic sequencing circuit 20 indicated in Figure 1.

When, in the situation shown in Figure 2, pressurized hydraulic fluid is fed to pressure port P, this fluid flows via the annular chamber 63 formed in the outer circumference of the sliding body 61 of slide valve 62 (corresponding to slide valve 21 in Fig. 1) to the first connection port D. The slide valve 62 is in this case situated in its first position (corresponding to Fig. 1). The flow of fluid then passes from port D to the width-adjustment cylinder which is connected thereto. The return flow from the width-adjustment cylinder passes via second connection port C to the annular chamber 72 formed in the outer circumference of sliding body 70 of slide valve 71 (corresponding to slide valve 30 in Fig. 1), which is at that moment in its first position. The return flow proceeds from the annular chamber 72 to the chamber 64 and, from there, it can flow to the return port R connected to the reservoir.

When the width-adjustment cylinder has reached its limit position which is associated with the narrowest plough width, the pressure in the annular chamber 63 will increase. The annular chamber 63 is connected via a radial passage 65 in the sliding body 61 to a blind bore 66 extending axially in the sliding body 61. A correspondingly displaceable pin 67 projects into the bore 66. The increase in the pressure in the annular chamber 63 and, as a result, between the bottom of the blind bore 68 and the head of the pin 67, results in the counteracting force of the return spring 68 on the sliding body 61 being overcome and the sliding body 61 moving to its second position, shown in Figure 3.

In Figure 3, the hydraulic fluid fed to pressure port P flows to chamber 69 at the end of sliding body 61 and,

from there, to the bore 75 formed in the valve block 60, in which the sliding body 70 can be appropriately displaced. A passage 76, which functions as the throttling element for the flow of fluid, extends from the one end to the other end of the essentially cylindrical sliding body 70 of the slide valve 71. The flow of fluid through this passage 76 acting as the throttle generates a pressure difference which moves the sliding body 70 into the position shown in Figure 3, counter to the force of the return spring 77 (corresponding to return spring 33 in Figure 1). This flow then reaches the third connection port A of the hydraulic sequencing circuit 20. From there, the flow arrives at the turning cylinder in the manner described with reference to Figure 1. The return flow from the turning cylinder flows via port B directly to port R.

When the turning cylinder has reached its other limit position, the flow through the passage 76 ceases and return spring 77 drives the sliding body 70 back into its first position shown in Figure 4. The fluid fed to pressure port P will now reach the annular chamber 72 from chamber 69 through passage 80 in the sliding body 61 and, from there, flow to the second connection port C. The fluid fed through port C to the width-adjustment cylinder ensures that the plough moves back in the direction of its widest plough position. The return flow from the width-adjustment cylinder passes via port D and the annular chamber 63 to return port R.

If the feed of pressurized hydraulic fluid to the pressure port P is terminated, the valve block 60 returns to its position shown in Figure 2.

The ball non-return valve 90 which is visible in Figures 2, 3 and 4 corresponds to the non-return valve 40 in Figure 1.

Claims

1. Hydraulic operating device for a plough which can be turned and whose width is adjustable, comprising:

   - a width-adjustment cylinder (1) for adjusting the operating width of the plough,
   - a turning cylinder (2) for turning the plough between a first and a second turned position,
   - a hydraulic turning circuit (10) for turning the plough, comprising:

     - a pressure port (A'), which can be connected to means for supplying pressurized hydraulic liquid,
     - a return port (B'), which can be connected to an essentially depressurized reservoir,
     - a first and a second connection port (W1, W2) for the turning cylinder, the hydraulic turning circuit (10) being designed to connect the pressure port (A') selectively to one of the two connection ports (W1, W2) for the turning cylinder, so that, when hydraulic fluid flows from the pressure port (A') to the turning cylinder, the plough turns from its one turned position to its other turned position,

     characterized by:

   - a hydraulic sequencing circuit (20) comprising:

     - a pressure port (P), which can be connected to means (4) for feeding pressurized hydraulic fluid to this pressure connection,
     - a return port (R), which can be connected to an essentially depressurized reservoir (3),
     - a first connection port (D), which is connected to the width-adjustment cylinder (1), so that, when hydraulic fluid flows from the first connection port (D) to the width-adjustment cylinder, the plough moves to its narrowest position,
     - a second connection port (C), which is connected to the width-adjustment cylinder, so that, when hydraulic fluid flows from the first connection port (C) to the width-adjustment cylinder (1), the plough moves to its widest position,
     - a third connection port (A), which is connected to the pressure port (A') of the turning circuit (10),
     - a fourth connection port (B), which is connected to the return port (B') of the turning circuit (10) and to the return port (R), this hydraulic circuit being designed such that:

     - when pressurized hydraulic fluid is fed to the pressure port (P), this fluid flows to the first connection port (D) and, from there, to the width-adjustment cylinder (1), the fluid which is displaced at the other side of the piston of the width-adjustment cylinder flowing via the second connection port (C) to the return port (R), so that the plough moves to its narrowest position,
     - when a narrow position of the plough which is suitable for turning the plough is reached, the connection between pressure port (P) and first connection port (D) is broken and the hydraulic fluid flows from pressure port (P) to pressure port (A') of the turning circuit and, from there, to the turning cylinder, the fluid which is displaced at the other side of the piston of the turning cylinder flowing via return port (B') of the turning circuit to the return port (R), so that the plough moves from its one turned position to its other turned position,
     - when it reaches the position of the turning cylinder (2) which is associated with the desired turned position of the plough, the connection

between pressure port (P) and pressure port (A') of the turning circuit is broken and the hydraulic fluid flows from pressure port (P) to second connection port (C) and, from there, to the width-adjustment cylinder, the fluid displaced at the other side of the piston of the width-adjustment cylinder flowing via first connection port (D) to return port (R), so that the plough moves to its widest position.

2. Hydraulic operating device according to claim 1, in which the position of the width-adjustment cylinder which is suitable for turning the plough corresponds to a limit position of said cylinder, and the hydraulic sequencing circuit comprises means which, when this limit position of the width-adjustment cylinder (1) is reached, break the connection between pressure port (P) and first connection port (D), on the basis of the increased pressure of the hydraulic fluid in the section of pressure port (D) and the width-adjustment cylinder which then occurs, and connect the pressure port (P) to pressure port (A') of the turning circuit (10).

3. Hydraulic operating device according to claim 1 or 2, in which the hydraulic sequencing circuit comprises means which, when the limit position of the turning cylinder (2) which is associated with the desired turned position of the plough is reached, break the connection between pressure port (P) and pressure port (A') of the turning circuit (10), on the basis of the flow of fluid in the section between the pressure port (D) and the turning cylinder (2) ceasing, and connect the pressure port (P) to the second connection port (C) of the width-adjustment cylinder (1).

4. Hydraulic sequencing circuit (20) for a hydraulic operating device according to one or more of the preceding claims.

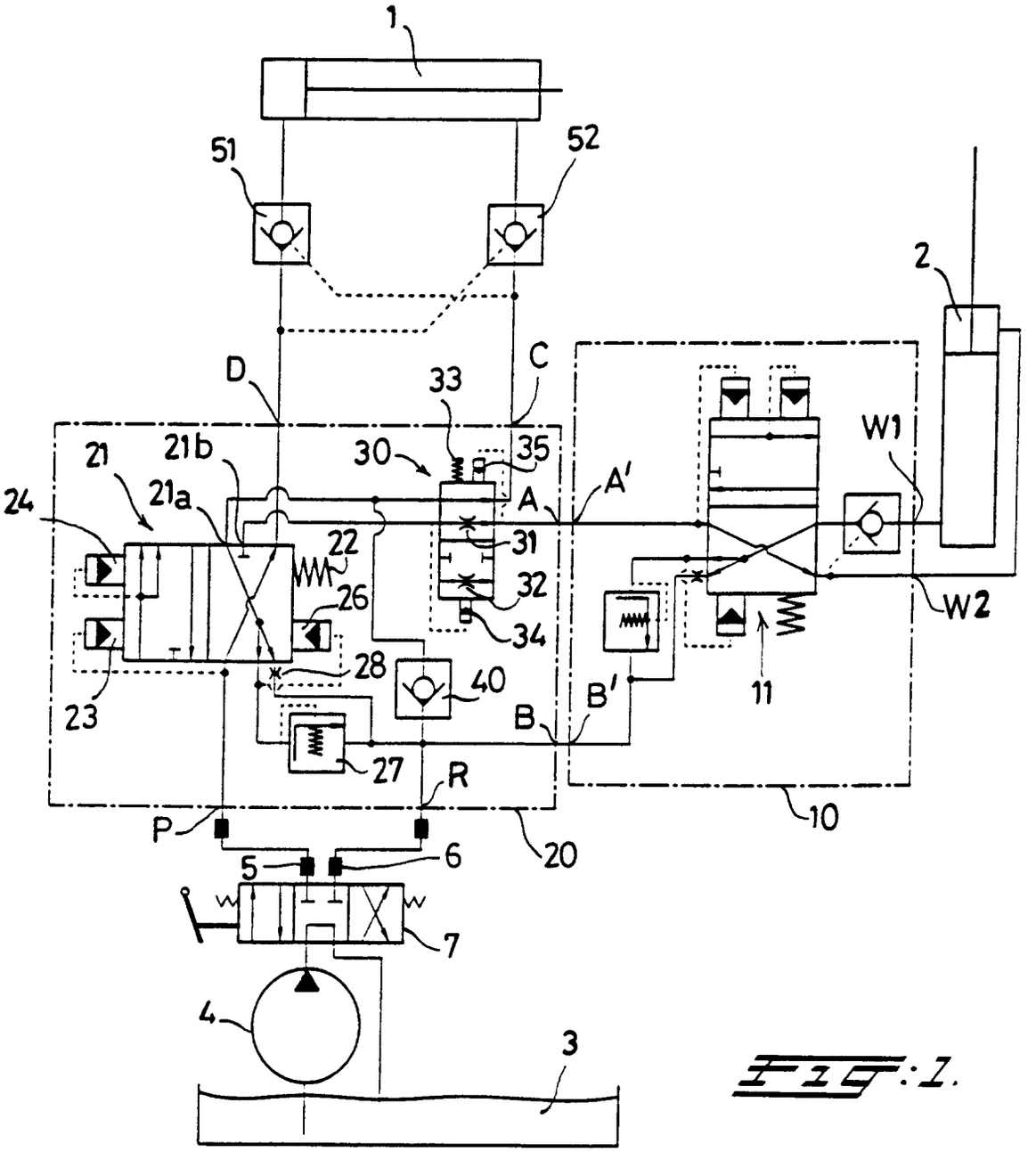
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Fig. 1.

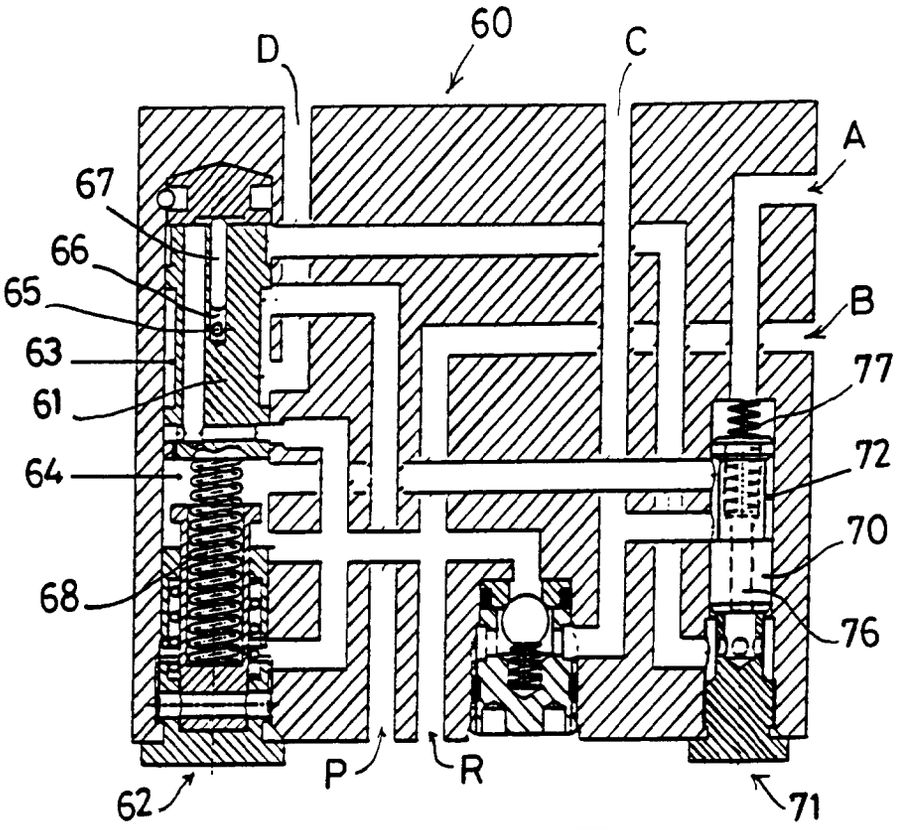
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Fig. 2.

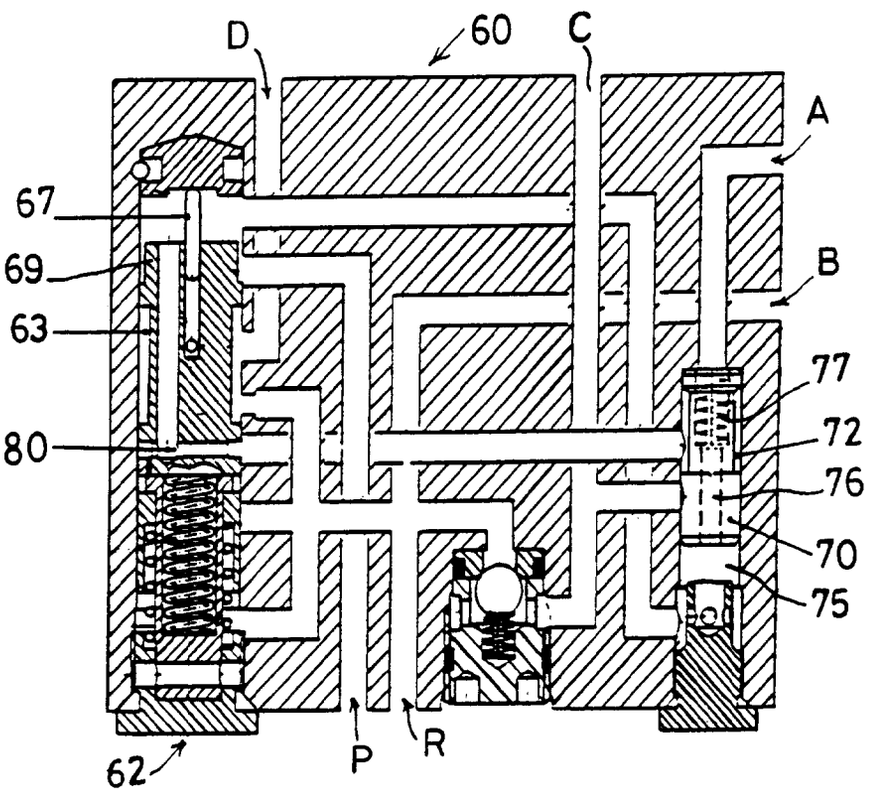
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Fig. 3.

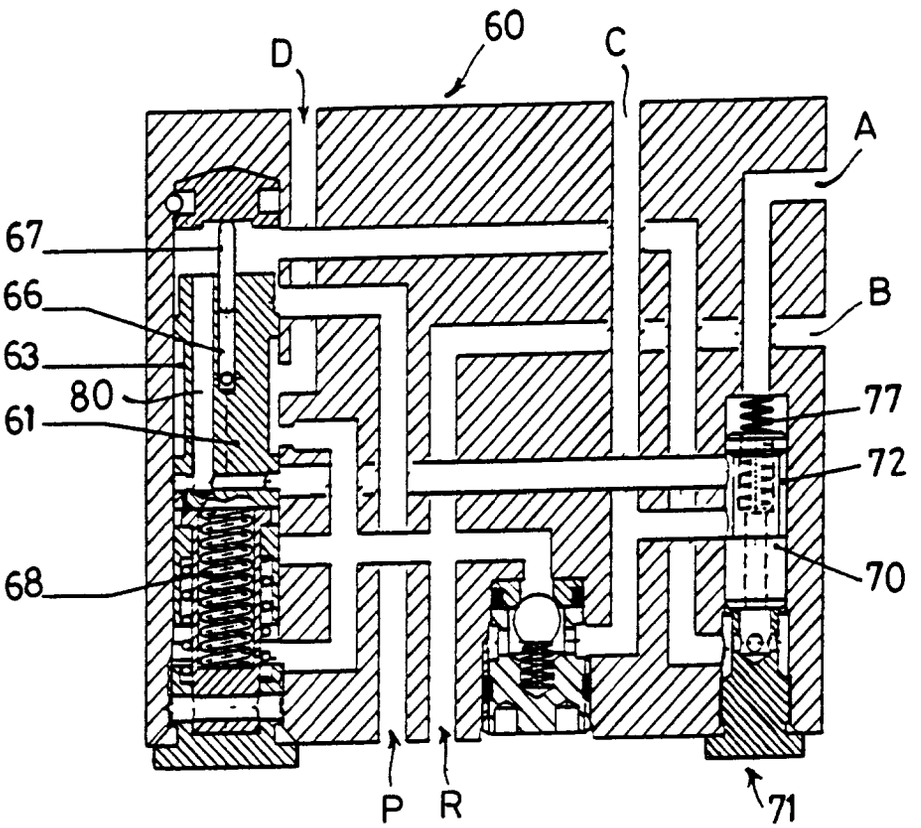

Fig. 4.

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 96 20 2196

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.6)
P,A	FR-A-2 720 123 (POWER PACKER FRANCE) 24 November 1995 * the whole document *	1-4	F15B11/20
D,A	EP-A-0 438 936 (TESSIER) 31 July 1991 * the whole document *	1-4	
D,A	EP-A-0 434 531 (TESSIER) 26 June 1991 * the whole document *	1-4	

TECHNICAL FIELDS SEARCHED (Int.Cl.6)

F15B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	15 November 1996	Christensen, C

CATEGORY OF CITED DOCUMENTS

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