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(54) **CONTROL SYSTEM FOR AN ACTUATOR CYLINDER**

(57) The present invention relates to a Method for adjusting an actuator cylinder (10) of an operating machine, said actuator cylinder having a first and a second chamber (11, 12), a piston (13) separating said first chamber (11) from said second chamber (12) configured to move an element, said system comprising a first feed conduit (20) of said first chamber (11) of said cylinder (10), a second feed conduit (21) of said second chamber (12) of said cylinder (10), wherein said first feed conduit (20) and said second feed conduit (21) are connectable to a distribution valve (100) configured to control a feed operation and a discharge operation of said first feed conduit (20) and said second feed conduit (21), wherein said first supply conduit (20) is connected to said second supply conduit (21) by means of a regeneration conduit (22) configured to allow a flow of fluid from said second chamber (12) to said first chamber (11) via said first and said second supply conduit (20, 21), said method being characterized by the fact that the flow along said regeneration conduit (22) is regulated on the basis of the flow rate of fluid from said distribution valve (100) and directed to said first chamber (11) via said first supply conduit (20) or a quantity dependent thereon.

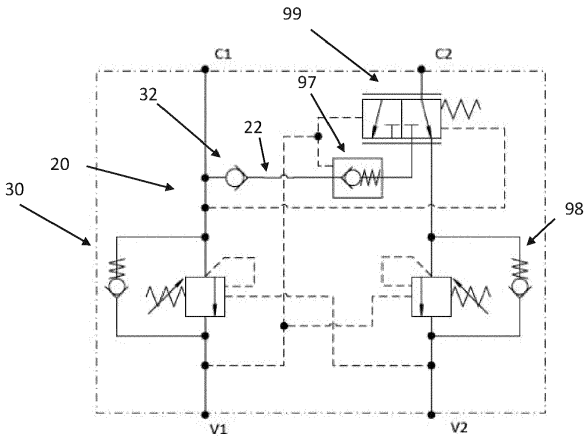

Fig. 3

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Description

TECHNICAL FIELD

[0001] The present invention relates to the field of a control system for controlling an actuator cylinder in a hydraulic application.

BACKGROUND

[0002] Control systems for hydraulic cylinders for moving the booms of telehandler and crane-type machines have evolved more and more over the years and require to fulfill an increasing number of functions. First, they require high safety so that in the event of a pipeline rupture, the system is able to control the actuator cylinder and stop it, preventing a possible load fall. Second, high stability of the system is required so that the user can ensure that he or she can control the system without generating sudden jerks, which could cause the user a sense of discomfort. In addition, last but not least, it is required that such systems be efficient in terms of consumption, so as to avoid waste such as throttling, and that the cost of implementing such systems be low in terms of price.

[0003] Control systems with a regenerative function are usually used to enable such a reduction in consumption and at the same time increase the speed of movement of the actuating cylinder. An example of such a system is shown in Figure 1.

[0004] As the following description will show, valves with a regenerative function are used to increase the supply flow rate of an hydraulic cylinder and, consequently, the output speed of the cylinder. In that figure, one can see the cylinder comprising a first chamber 11 and a second chamber 12 separated by a piston 13, which is configured to move an element, such as an end portion of a crane, at which a load can be attached. The system shown in the figure includes a first feed conduit 20 of said first chamber 11 of said cylinder 10, a second feed conduit 21 of said second chamber 12 of said cylinder 10. Said first supply conduit 20 and said second supply conduit 21 are connectable to a distribution valve 100 configured to control a feed operation and a discharge operation of said first supply conduit 20 and said second supply conduit 21. Said first supply conduit 20 is connected to said second supply conduit 21 by means of a regeneration conduit 22 configured to allow a flow of fluid from said second chamber 12 to said first chamber 11 via said first and said second supply conduits 20, 21. Along said regeneration conduit 22 is located a balancing valve 31 which is configured to regulate the flow of fluid along said regeneration conduit by means of pilot ports which, as shown in the figure, allow it to "see" the pressure present in both the first and second supply conduits. In addition, unidirectional valve 32 allows it to ensure fluid flow from the second to the first supply duct and prevent reverse flow. In contrast, the one-way valve 33 makes it possible to ensure that all the fluid leaving the second chamber 12 goes to the first chamber and does not go to the outlet of the distribution valve 100.

[0005] As can be seen from the schematic shown in the figure, which represents the state of the art, regeneration (regeneration flow rate QR) takes place using fluid exiting from the "stem side" (i.e., from the second chamber 12) that is sent to the bottom side (first chamber 11) in addition to the QP flow rate supplied by the machine's supply system.

[0006] Going on to specify that Qp is the flow rate supplied by the distribution valve 100, Qr is the regenerated flow rate, and Qt is the supply flow rate to the first chamber 11, the following flow rate balancing equation results:

$$Q_T = Q_P + Q_R.$$

Wherein

$$Q_T = D^2 \partial x.$$

$$Q_R = (D^2 - d^2)\partial x$$

In which, as shown in the figure, D represents the diameter of the piston on the bottom side and d represents the diameter of the piston rod, respectively, and ∂x represents the infinitesimal displacement of the piston.

[0007] Going to solve the above three equations for ax will result in the following.

$$\partial x = \frac{Q_P}{d^2}$$

[0008] Therefore, rewriting the first equation will yield that

$$Q_T = Q_P \frac{D^2}{d^2}$$

[0009] This equation was derived by assuming that in regenerative phase all fluid from the second chamber 12 is routed to the first chamber 11 through the regeneration duct 22, since the one-way valve 33 is present on duct 21.

[0010] The problem often encountered in the field is poor accuracy when fine outlet movements are required. Currently, the solution employed to mitigate this problem is variable wringing that allows slowed piloting of the valve 31 that opens the regeneration duct. Specifically, at an early stage valve 31 goes to throttle the piloting duct such that the incoming flow rate to the first chamber 11 is slightly throttled. Such throttling is a purely temporal function.

[0011] However, this solution is often inadequate both because of the lack of variability of the delay setting and

because of the variability of the oil temperature (which implies different behavior of the machine depending on the operating conditions).

[0012] In addition, it should be emphasized that because of the one-way valve 33 that ensures the presence of regeneration, regeneration is always present and has the fixed value due to the geometry of cylinder 10. In fact, against a minimum opening of the pilot valve 31, there is still the effect of an increase in flow rate seen from the previous relations, thus losing the possibility of having fine tuning in the first acceleration phase. As shown in Figure 2, which shows the trend of the two flow rates QP (dotted) and QT (dashed), the flow rate supplied to the first chamber increases proportionally with the QP flow rate coming in from distribution valve 100. The solution described above about the initial throttling provided by valve 31 can only slow down the initial arrival of regenerative flow but does not affect the flow balance in any way, and is therefore only a partial solution.

[0013] Therefore, in view of the above, the present invention addresses the problem of realizing method of regulating the actuator cylinder that can overcome the disadvantages of the solutions adopted so far and thus provide particularly sophisticated initial control.

SUMMARY

[0014] The present invention relates to a method of adjusting an actuator cylinder according to the characteristics listed in claim 1.

[0015] The object of the invention is achieved by a method of providing a variable regeneration ratio according to the flow rate sent by the distributor and, therefore, the required output speed.

[0016] This solution allows for great definition and control in the slow motion phase and maximum regeneration utilization in the steady-state (fast) motion phase.

BRIEF DESCRIPTION OF THE FIGURES

[0017] The present invention will be described with reference to the attached figures in which the same numbers and/or reference marks indicate the same and/or similar and/or corresponding parts of the system.

Figure 1 shows a hydraulic circuit diagram of a control system for an actuator cylinder with a regeneration duct according to the state of the art;

Figure 2 shows a flow rate pattern in a regeneration condition according to the state of the art;

Figure 3 shows a hydraulic circuit diagram of a control system for an actuator cylinder with regeneration duct according to a form of embodiment of the present invention;

Figure 4 shows a flow rate pattern in a regeneration condition according to a form of embodiment of the present invention.

DETAILED DESCRIPTION

[0018] In the following, the present invention is described by reference to particular forms of embodiment as illustrated in the accompanying drawing plates. However, the present invention is not limited to the particular embodiments described in the following detailed description and depicted in the figures, but rather the embodiments described simply exemplify the various aspects of the present invention, the scope of which is defined by the claims. Further modifications and variations of the present invention will appear clear to the person skilled in the art.

[0019] As will be clear from the remainder of this description, Figures 3 and 4 show two examples where the present invention may be used. However, there are other examples of systems in which this invention may be used. Therefore, it is clear that the present invention is not limited to the particular application examples shown in the figures.

[0020] Figure 3 shows a schematic of a control system for an actuator cylinder 10 according to a form of embodiment of the present invention. The cylinder 10 is the same as shown in Figure 1 and thus comprises a first and second chambers 11, 12 and a piston 13 separating said first chamber 11 from said second chamber 10. Said actuator cylinder is configured to allow direct or indirect displacement of an element, to which a load can be attached. In fact, said actuator cylinder may be configured to move a mechanical arm such as the lifting arm of a telehandler or the boom of a crane, which is configured so as to be able to move loads (it is clear, however, that the load may be represented by the weight of the mechanical arm itself, which is moved unloaded and does not require the presence of an external body).

[0021] At points C1 and C2, as shown in Figures 1 and 3, the first and second chambers 11, 12 of the cylinder are located, respectively. The first and second chambers are fed by the first and second supply ducts 20, 21, respectively, which are connected to each other by regeneration duct 22.

[0022] A balancing valve 30 is located along the first supply duct, which is completely similar to the one shown in Figure 1. Notably, balancing valve 30 includes a one-way valve placed parallel to a balancing valve itself. A balancing valve was referred to generically because the one-way valve can be placed internally to the balancing valve itself. Therefore, two separate and distinct elements are not necessary But the two elements can be integrated into the same element.

[0023] In contrast, a balancing valve 98 is positioned along the second supply duct 21 which is configured to regulate the flow rate leaving the second chamber 12 and directed toward the distribution valve 100 and the flow rate directed in the opposite direction. Again, bal-

ancing valve 98 consists of two elements: a one-way valve placed parallel to a balancing valve itself. Again, however, the two elements can be integrated into a single element having as its function that of the balancing valve. The balancing valve 98 receives the pressure at point V1 that will allow it to open the discharge to the distribution valve 100 in the event that a pressure is detected at point V1 of the first supply duct 20. Similarly, in the event that the pressure in the second chamber 12 exceeds a predetermined value, the balancing valve 98 has an integrated pressure limiting function. In addition, the one-way valve makes it possible to ensure that a flow from the distribution valve 100 reaches the second chamber 12.

[0024] Between the second chamber 12, the regeneration duct 22 and the balancing valve 98 is an adjusting element 99. In the particular example shown in the figure, the control element 99 consists of a single valve having two positions and three ways that can be adjusted proportionally between said two positions. In a first position (shown on the left of figure 3) the valve 99 allows a flow of fluid between the second chamber 12 and the first duct 20 via the regeneration duct and prevents a flow of fluid between the second chamber and the second duct 21. In a second position (shown on the right of Figure 3), valve 99 prevents a flow of fluid between the second chamber 12 and the first conduit 20 via the regeneration conduit and instead allows a flow of fluid between the second chamber and the second conduit 21. As mentioned, valve 99 is capable of taking intermediate positions between the two described allowing partial fluid passage in either direction.

[0025] Valve 99 receives inlet pressures upstream and downstream of balancing valve 30. Specifically, the two pressures are routed through pilot channels at opposite ends of valve 99 so that an increase in flow rate will go to increase the flow area of valve 99, so that the flow rate passing from the second chamber 12 to the first chamber 11 via regeneration duct 22 will increase. In fact, one-way valve 97 also receives the pilot signal from V1 so that an increase in pressure along the first supply duct will go to promote a regeneration. With the opening of the regeneration duct 22 will then go to regeneration by going to decrease the pressure at the balancing valve 98 which will then gradually go to close.

[0026] Thanks to the invention described above and in particular thanks to the regulation of the valve 99 on the basis of the flow rate passing on said first duct 20 it is possible, as shown in particular in figure 4, to go and limit or more particularly even regulate the flow rate at an early stage. In fact, figure 4 shows, as also figure 2, the trend of the two flow rates QP (dotted) and QT, where the dotted line shows the trend of QT according to the state of the art while the solid line shows a possible trend of QT according to a form of embodiment of the present invention. QT grows proportionally with the incoming QP flow rate from the distribution valve 100. However, the proportionality varies with time and in particular increases with increasing QP flow rate.

[0027] The following paragraphs will briefly summarize the method described above so as to increase clarity and better delineate the advantages provided by the present invention.

[0028] In a first step of the method according to a particular embodiment of the present invention, a request for displacement of said element is received, wherein displacement of said element results in an increase in volume of said first chamber 11 and a subsequent decrease in volume of said second chamber 12.

[0029] In a second step, as a result of said request (detected for example by means of a joystick) a flow of fluid is provided from said distribution valve 100 through said first supply conduit to said first chamber 11 so as to be able to increase the volume of said first chamber 11 and to decrease the volume of said second chamber 12. During this second step, and particularly at an early stage of this step, regeneration conduit 22 is at least partially closed and at the same time said second supply conduit is opened so as to allow a discharge of fluid from said second chamber 12 to said distribution valve 100. Said regeneration conduit 22 is then gradually opened so as to allow at least partially an increase in fluid flow of the fluid contained in said second chamber 12 to said first chamber 11 based on said fluid flow rate coming from said distribution valve 100 and directed to said first chamber 11 via said first supply conduit 20 or said magnitude dependent thereon. Simultaneously said second supply conduit 21 is then progressively closed, going to decrease the discharge flow rate to distribution valve 100.

[0030] In addition, after a certain condition is met, it may be required that all flow leaving said second chamber 12 be directed to said first chamber 11 through said regeneration conduit 22. In fact, this makes it possible to ensure full regeneration of the fluid, thus enabling optimization of consumption. Said condition may, for example, consist in the attainment of a predetermined speed of said piston 13 or a magnitude dependent thereon or a predetermined time interval elapsed since the opening of said regeneration duct 22.

[0031] It is clear to the branch expert that valve 99 can be replaced by two or more smaller valves capable of performing the same function. Furthermore, it is clear that as an alternative to the first hydraulic-type valve 99 shown in the figure, it can be a solenoid valve, which then receives an electrical actuation command based on the measured flow rate or said quantity dependent on it. Furthermore, although two pressure values were measured upstream and downstream of balancing valve 30 to measure the flow rate, it is clear to the branch expert that pressure can be detected at any other points, for example, both points may be upstream or both downstream of balancing valve 20. Furthermore, although an example was shown for which the flow rate was measured indirectly by means of pressure at two different points, it is clear that alternatively the flow rate can be detected directly by means of a flow detector.

[0032] The above-described solution is particularly advantageous in that it allows not only to limit at an early stage the speed of piston displacement but likewise to allow superfluous flow rate that is not required for regeneration to be discharged through the balancing valve 98.

[0033] The present invention also relates to a computational unit containing means for performing a method according to one of the previously described forms of embodiment.

[0034] The present invention further relates to an actuator system of an actuator cylinder 10 of an operating machine, said actuator cylinder having a first and a second chamber 11, 12, a piston 13 separating said first chamber 11 from said second chamber 12 configured to move an element, said actuator system comprising a first feed conduit 20 of said first chamber 11 of said cylinder, a second feed conduit 21 of said second chamber 12 of said cylinder 10, wherein said first feed conduit 20 and said second feed conduit 21 are connectable to a distribution valve 100 configured to control a feed operation and a discharge operation of said first feed conduit 20 and said second feed conduit 21, wherein said first feed conduit 20 is connected to said second feed conduit 21 by means of a regeneration conduit 22 configured to allow a flow of fluid from said second chamber 12 to said first chamber 11 via said first and said second feed conduit 20, 21, wherein said actuation system comprises a previously described computing unit.

[0035] Part of the present invention also comprises a computer program comprising instructions which, when the program is executed by a computer, cause the computer to execute the method steps of one of the previously described embodiments. Further, a computer-readable storage medium comprising instructions which, when executed by a computer, cause the computer to execute the method steps of one of the described forms of embodiment is also part of the present invention.

[0036] Although the present invention has been described with reference to the forms of embodiment described above, it is clear to the person skilled in the art that various modifications, variations, and improvements of the present invention in light of the teaching described above and within the scope of the appended claims are possible without departing from the subject matter and scope of protection of the invention.

[0037] Finally, those areas that are believed to be known by experts in the field have not been described to avoid overshadowing the described invention unnecessarily.

[0038] Accordingly, the invention is not limited to the forms of embodiment described above, but is only limited by the scope of protection of the appended claims.

Claims

1. Method for adjusting an actuating system of an actuator cylinder (10) of an operating machine, said actuator cylinder having a first and a second chamber (11, 12), a piston (13) separating said first chamber (11) from said second chamber (12) configured to move an element connected thereto, said system comprising a first supply conduit (20) of said first chamber (11) of said cylinder (10), a second supply conduit (21) of said second chamber (12) of said cylinder (10), wherein said first supply conduit (20) and said second supply conduit (21) are connectable to a distribution valve (100) configured to control a feeding operation and an exhaust operation of said first supply conduit (20) and said second supply conduit (21), wherein said first supply conduit (20) is connected to said second supply conduit (21) by means of a regeneration conduit (22) configured to allow a flow of fluid from said second chamber (12) to said first chamber (11) via said first and said second supply conduits (20, 21), said method being **characterized in that** said method comprises the following steps:
   detecting a flow rate of fluid from said distribution valve (100) and directed to said first chamber (11) via said first supply conduit (20) or a quantity dependent thereon adjusting the flow along said regeneration conduit (22) based on said flow rate of fluid coming from said distribution valve (100) and directed to said first chamber (11) via said first supply conduit (20) or said quantity dependent thereon.

2. Method according to claim 1, wherein said flow rate is detected indirectly through the pressure present along said first supply conduit (21) at two separate points.

3. Method according to any one of claims 1 to 2, wherein said regulation of said flow through said regeneration conduit (22) is accomplished by means of a first valve (99) positioned between said second supply conduit (21) and said regeneration conduit (22), wherein said first valve (99) regulates said flow along said regeneration conduit (22) based on said detected flow rate or said quantity dependent thereon.

4. Method according to claim 3, wherein said first valve (99) allows to regulate a flow from said second chamber (12) and to send it at least partially to said distribution valve (100) via said second supply conduit (21) and at least partially to said first supply conduit (20) via said regeneration conduit (22).

5. Method according to any of claims 3 or 4, wherein said actuating system further comprises a second valve (98) positioned along said second supply conduit (21) and configured to proportionally regulate an opening of said second supply conduit (21).

6. Method according to claim 5, wherein said second valve (98) receives a signal corresponding to the

pressure in said first supply conduit (20) and is configured to increase an opening of said second supply conduit (20) as said detected pressure increases.

7. Method according to any of claims 5 or 6, wherein said second valve (98) is configured to increase the flow rate passing along said second supply conduit as the pressure of fluid exiting said second chamber (12) increases.

8. Method according to any one of claims 1 to 7, wherein said method comprises the following steps:

a. Receiving a request for displacement of said element, wherein displacing said element results in an increase in volume of said first chamber (11) and a consequent decrease in volume of said second chamber (12);
b. Providing a flow of fluid from said distribution valve (100) through said first supply conduit to said first chamber (11) so as to be able to increase the volume of said first chamber (11) and to decrease the volume of said second chamber (12);

wherein at an early stage of said step b. said regeneration conduit (22) is at least partially closed and wherein at the same time said second supply conduit is at least partially open so as to allow a discharge of fluid from said second chamber (12) to said distribution valve (100), wherein in a second stage, subsequent to said early stage, said regeneration conduit (22) is gradually opened on the basis of said flow of fluid from said distribution valve (100) and directed to said first chamber (11) via said first supply conduit (20) or said quantity dependent thereon and wherein at the same time said second supply conduit (21) is gradually closed.

9. Method according to claim 8, wherein after a certain condition is verified all the outflow from said second chamber (12) is directed to said first chamber (11) through said regeneration conduit (22).

10. Method according to claim 9, wherein said condition consists in achieving a predetermined velocity of said piston (13) or a quantity dependent thereon.

11. Method according to claim 9, wherein said condition is a predetermined time interval elapsed since the opening of said regeneration conduit (22).

12. A computing unit containing means for performing a method according to any of the preceding claims.

13. An actuator system of an actuator cylinder (10) of an operating machine, said actuator cylinder having a first and a second chamber (11, 12), a piston (13) separating said first chamber (11) from said second chamber (12) configured to move an element, said actuator system comprising a first supply conduit (20) of said first chamber (11) of said cylinder (10), a second supply conduit (21) of said second chamber (12) of said cylinder (10), wherein said first supply conduit (20) and said second supply conduit (21) are connectable to a distribution valve (100) configured to control a feed operation and an exhaust operation of said first supply conduit (20) and said second supply conduit (21), wherein said first supply conduit (20) is connected to said second supply conduit (21) by means of a regeneration conduit (22) configured to allow a flow of fluid from said second chamber (12) to said first chamber (11) via said first and said second supply conduit (20, 21), wherein said actuation system comprises a computing unit according to claim 12.

14. A computer program comprising instructions which, when the program is executed by a computer, cause the computer to perform the steps of the method of any one of claims 1 to 11.

15. A computer-readable storage medium comprising instructions which, when executed by a computer, cause the computer to execute the method steps of any one of claims 1 to 11.

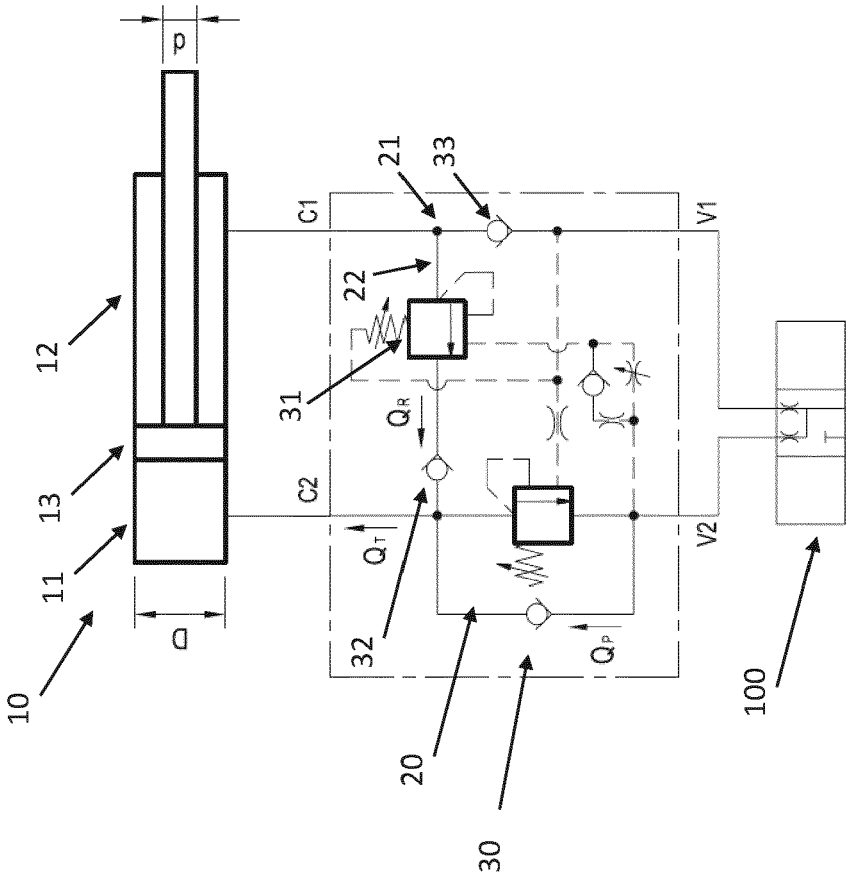

Fig. 1

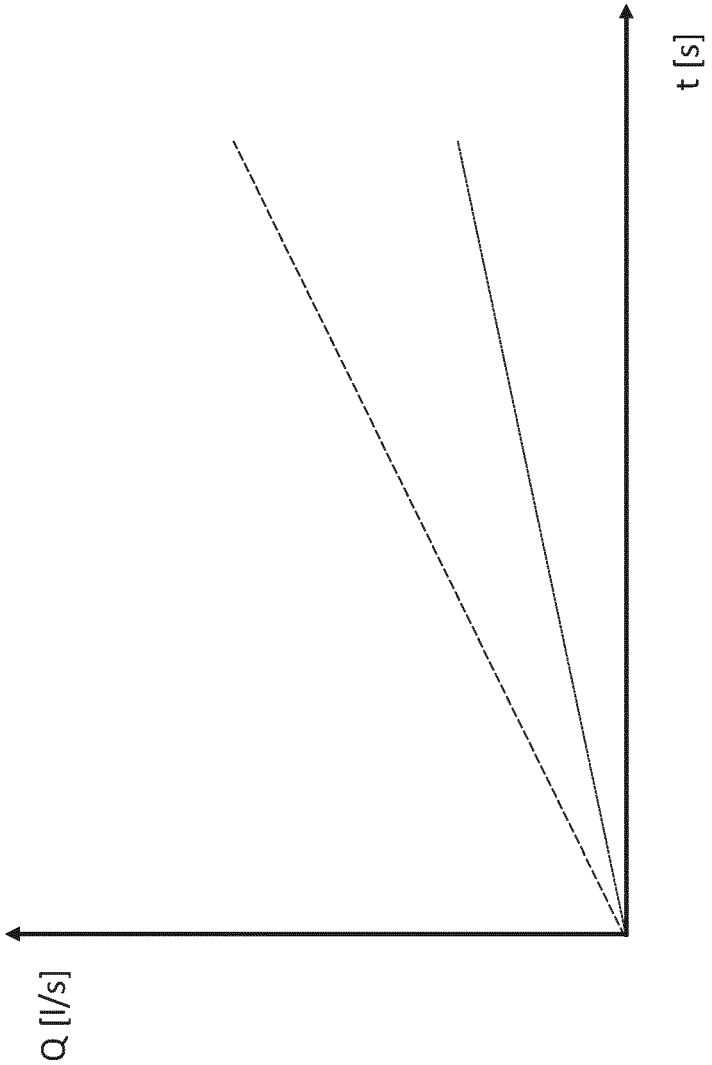

Fig. 2

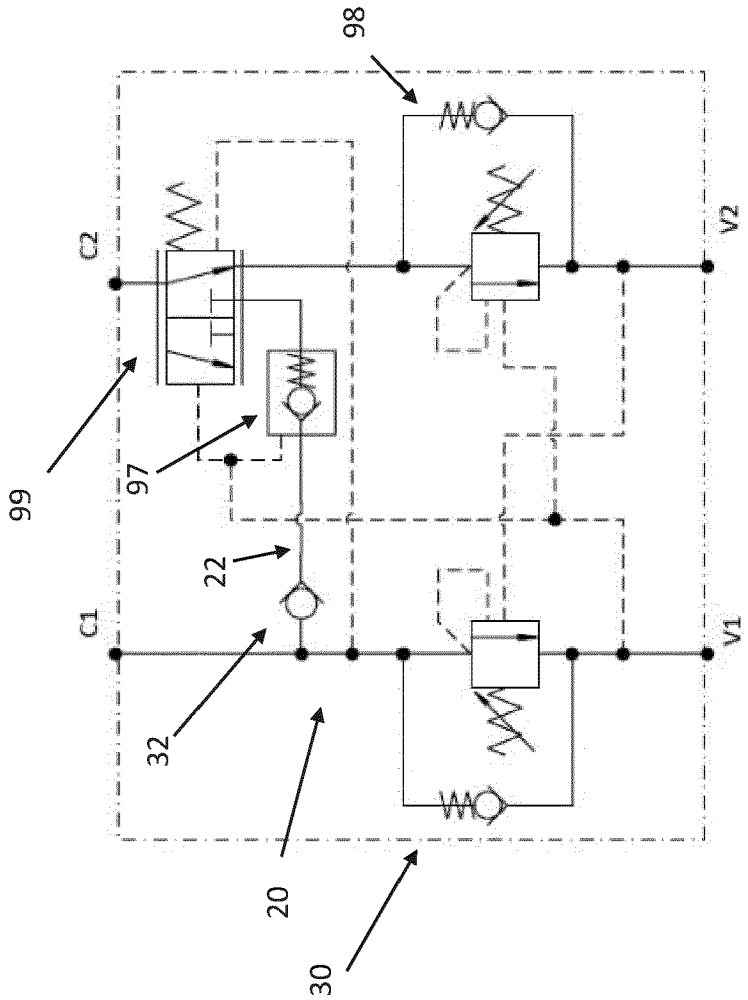

Fig. 3

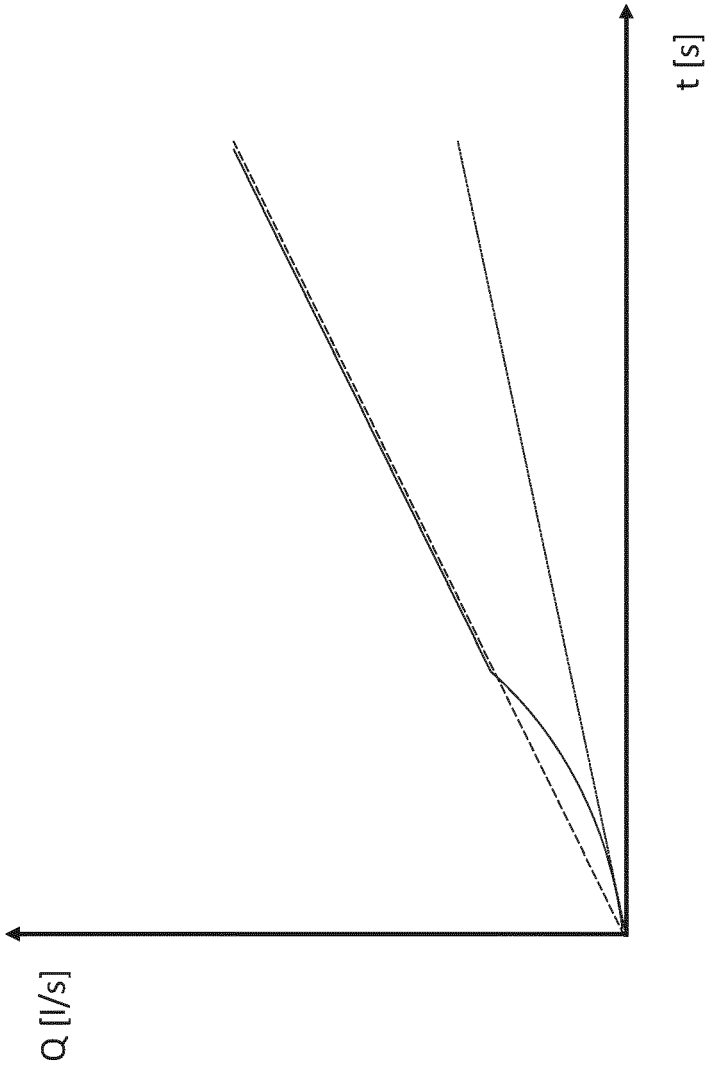

Fig. 4

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EUROPEAN SEARCH REPORT

Application Number
EP 24 17 5624

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X A	US 4 397 221 A (FRIESEN HENRY [CA] ET AL) 9 August 1983 (1983-08-09) * column 2, line 18 - column 4, line 31; figures 1-3 *	1-4,8-15 5-7	INV. F15B11/024
X A	DE 10 2015 209659 A1 (BOSCH GMBH ROBERT [DE]) 15 December 2016 (2016-12-15) * paragraph [0033] - paragraph [0036]; figures 1,3 *	1-4, 11-15 5-10	
X A	DE 197 35 482 A1 (MANNESMANN REXROTH AG [DE]) 18 February 1999 (1999-02-18) * paragraph [0030]; figure 1 *	1,3-6, 11-15 2,7-10	
X A	US 6 267 041 B1 (SKIBA RICHARD J [US] ET AL) 31 July 2001 (2001-07-31) * column 4, line 42 - column 6, line 24; figures 1-2 *	1,3-6,8, 9,11-15 2,7,10	
			TECHNICAL FIELDS SEARCHED (IPC) F15B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	10 September 2024	Díaz Antuña, Elena

CATEGORY OF CITED DOCUMENTS

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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 4397221 A	09-08-1983	AT E15253 T1	15-09-1985
		CA 1169742 A	26-06-1984
		EP 0066274 A1	08-12-1982
		ES 8306235 A1	01-05-1983
		US 4397221 A	09-08-1983
		ZA 823823 B	25-01-1984
DE 102015209659 A1	15-12-2016	NONE	
DE 19735482 A1	18-02-1999	DE 19735482 A1	18-02-1999
		WO 9909323 A1	25-02-1999
US 6267041 B1	31-07-2001	NONE	

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82