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(71) Applicant: **BFT SpA**
36015 Schio (VI) (IT)

(72) Inventor: **Treminio Rivas, Noel**
36015, Schio (Vicenza) (IT)

(74) Representative: **Bettello, Pietro**
Via Col d'Echele, 25
36100 Vicenza (IT)

(54) **Hydraulic actuation system for moving motorized gates and similar**

(57) A hydraulic actuation system for moving motorized gates and similar is made up of a double-acting piston (2) connected to an actuation stem (6), a supply circuit (7), a reservoir (9) and a distributor comprising a controlled opening duct (17), which allows a flow rate which is sufficient to compensate for the difference in volume of the two opposing expansion chambers (4, 5) to runoff during the gate opening manoeuvre.

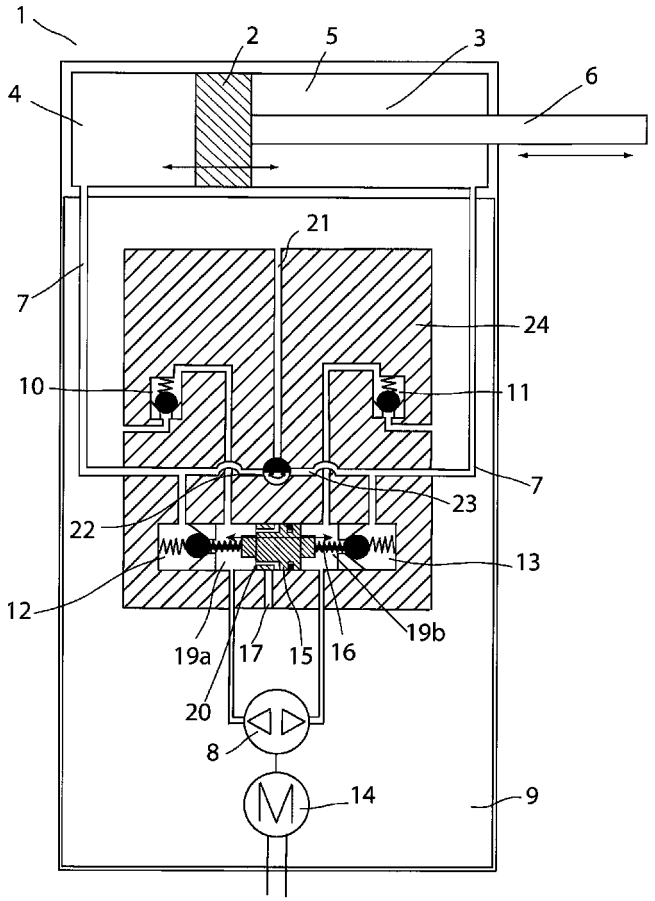

Fig.1

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Description

[0001] The present finding regards a hydraulic actuation system for moving motorized gates and similar, according to the general part of claim 1.

[0002] Automatic opening systems for hinged gates generally foresee electro-mechanic or hydraulic double-acting pistons. The latter are suitable for intensive applications, such as for apartment blocks, commercial and industrial buildings, and more. The recent introduction of IEC and EN product safety standards in the use of door and gate actuators makes it compulsory to apply an anti-crush safety function. Said function can be obtained, for example, by limiting the impact force peak against an obstacle, also normalized in its sizes and elasticity, within a limit of 400N, or 1400N. The value to choose from varies according to both the position of the wing with respect to the closure point, and according to whether the wing moves with a horizontal or vertical trajectory. The actuation system must stop and invert the motion of the wing within a time period of 0,75s, whereas an applied residual load of below 25N is allowed, once 5s have passed after the initial contact.

[0003] In gate hydraulic actuation systems, the adjustment of the thrust and traction dispensed by the piston is normally carried out through two by-pass valves, one for each of the two manoeuvre directions (opening and closing). The maximum thrust or traction force is set, in general, during the first installation, through two screws which can be accessed outside the oil distributor of the actuator. If the thrust or traction force limit is exceeded, the by-pass valves open and allow oil to flow parallel to the discharge valves from the circuit to the reservoir. In this situation the stem does not move any further, thus limiting the force transmitted to the gate or door. The aforementioned method has been used for decades in industry since it is effective and reliable, but it is not generally precise enough to limit the force acting upon an obstacle on its trajectory, pursuant to the safety regulations in force. Moreover, the restriction of load limitations to below 25N, after 5s, is hardly ever adhered to in practical applications which use the principle described above since said maximum thrust limitation is affected by variations in temperature. Consequently, the installer who desires to carry out the installation up to standard is often forced to apply additional safety systems acting at the edges of the gate, consequently increasing its cost. The increasing popularity of direct current motors applied to the gate actuations has allowed "intrinsic" safety devices to be made, based upon the estimated definition of a current threshold, above which the control unit commands a safety manoeuvre, which allows it to easily comply with the aforementioned time and force limits in situations where an impact occurs. This application is well known amongst electro-mechanical actuations, however it is not so well known amongst hydraulic actuations, in which it would have the further advantage of making the over-pressure valves, for limiting the maximum force exerted by the piston, almost useless.

[0004] In the case in which an actuator with a double-acting piston uses a direct current motor, particularly if there are also no over-pressure valves, it can cause the opening manoeuvres to have problems of regularity, as observed in practice and described for example in the document EP-A-1832756. Indeed, the difference in volume between the two oil expansion chambers, due to the presence of the gate actuation stem in one of the two expansion chambers, means there is an excessive difference between the opening speed and the closing speed. In particular, the useful volume of the expansion chamber in the return step of the stem, which corresponds to the opening manoeuvre of the gate wing, is always less than the volume of the expansion chamber during the exit step of the stem, or rather, the closing step of the gate wing. The difference is given by the volume of the part of stem inside the expansion cylinder.

[0005] However, since the oil circulation pump in the circuit is a volumetric pump, the flow rate in the two operation directions (opening and closing), is practically constant and in any case, in proportion to the rotation speed of the pump. In the configuration generally used on the market, the circuit is made as follows: for each operative mode (opening and closing) there is a valve for discharging from the circuit to the expansion chamber, parallel to a by-pass valve from the circuit to the reservoir, the opening of which is controlled by the pressure upstream of the valve itself. A high load applied on the actuation stem, in the direction opposite to its movement, opens the by-pass valve, which makes part of the flow rate runoff from the circuit downstream of the pump towards the reservoir. Due to the difference in volume between the two expansion chambers it is not possible to have a complete closure of the by-pass valve in the returning direction of the stem, which would allow the maximum useful thrust to be dispensed. In this case the excess oil flow rate from one chamber to the other, does not have any branching towards the reservoir, the operation is irregular and a condition of over-pressure is created on the side of the circuit of the chamber containing the stem, causing an intermittent movement of the piston and the "drowning" of the pump, which remains the only useful way to compensate for the difference in volume. The opening manoeuvre is consequently irregular and slow with respect to the closing manoeuvre; on the other hand, by adjusting the by-pass valve which allows it to open, a substantial part of flow rate dispensed by the pump remains not used and is sent to the reservoir. In the case in which the limitation of the thrust of the piston is obtained by limiting the torque of the electric motor which actuates the pump and therefore there are no over-pressure valves, there are the same operative problems described above for systems in which the over-pressure valves are completely closed.

[0006] An operative dissymmetry is however obtained also in the case in which there are not completely closed over-pressure valves, since in the opening step of the

door or gate the pump operates anyway with a counter-pressure equal to the adjustment of the relative valve, whereas in the closing step of the gate or door it operates with just the counter-pressure due to the force required by the load.

[0007] In the aforementioned patent document a double-acting hydraulic system for actuating gates and similar is described, which partially solves the problem of excess flow rate in the return direction of the stem, which is obtained by opening the inlet valve from the reservoir upstream of the pump and making the excess oil flow with respect to the volume taken up by the piston. The opening is controlled by an over-pressure which is made in the circuit downstream of the pump, on the side of the circuit connected to the expansion chamber which contains the stem, through a duct which makes this part of the circuit communicate with the valve itself, which is thus actuated through a pressure difference, with an oil flow having a direction opposite to the normal inlet direction, i.e., from the circuit to the reservoir. The actuation of the valve is carried out opposing a contrast spring upon the elastic constant of which depends the over-pressure value which makes it open. The system proposed in document EP-A-1832756 adds constructive elements, complications and additional costs to the standard structure.

[0008] The solution described hereby proposes to make a system for compensating the volume through a controlled opening duct, made directly inside of the distributor of the actuator, without having to modify the inlet valve, according to what is described in the mentioned document, with simple modifications of the geometry of the distributor. The opening of the circuit towards the reservoir is controlled at the same moment in which the two oil circulation control valves open in order to ensure the flow rate in the circuit in the direction from the chamber without the stem, to the chamber with the stem. A duct puts the circuit upstream of the pump on the side of the cylinder without the stem into communication with the reservoir and allows the flow rate to be partialized through a flow of excess oil upstream of the circulation pump, but keeping the geometry of the inlet valves unchanged.

[0009] Such a solution, together with the adoption of a direct-current actuating motor, the torque adjustment of which is precise and accurate, also allows the two by-pass valves for adjusting the thrust to be eliminated, this function now being carried out directly by the control unit through variation of the electric parameters of the motor.

[0010] The finding shall now be described in detail, with reference to one of its particular embodiments, given as an example and not for limiting purposes, with the help of the attached drawing tables, where:

- fig. 1 represents the actuation system, according to the finding and the elements required for its operation;
- fig. 2 represents said system and the circulation direction of the oil during the closing step;
- fig. 3 represents said system and the circulation direction of the oil during the opening manoeuvre;
- fig. 4 represents a three-dimensional view of a possible embodiment of the small discharge valve opening piston;
- fig. 5 represents an advantageous variant obtained through connecting the compensation duct to the auxiliary manual release circuit.

[0011] With reference to figure 1, it can be seen that the gate actuation piston 2 slides in the cylinder 3 separating it into two expansion chambers 4 and 5 of the oil provided by the circuit 7. The piston 2 acts upon a stem 6 passing inside the volume 5 in outlet from the right bulkhead of the cylinder 3 towards the fixing brackets of the gate wing. The oil is let into the two expansion chambers 4 and 5, through the two discharge valves (12 and 13, respectively), by the reversible volumetric circulation pump 8, actuated by the motor 14. The circuit is in turn connected to a compensation reservoir 9, through two inlet valves 10 and 11, one for each branch of the circuit.

[0012] In the closing step of the gate (fig. 2) the piston 2 actuates the stem 6 in the direction out from the chamber 5. The oil circulates after the two discharge valves 12 and 13 are opened. The start up of the pump, according to the direction which goes from the chamber 5 to the chamber 4, causes an over-pressure in the volume 19a which, simultaneously, opens the valve 12 and, through the displacement of the small piston 15 and of its pin 16b, opens the valve 19b. Thus the supply circuit 7 is completely opened and a flow rate of oil goes from the expansion chamber 5 to the expansion chamber 4. Since the flow rate let in by the chamber 5 through the circuit 7 is in shortfall, the inlet valve 11 from the reservoir 9 to the circuit section upstream of the pump, or rather, in the volume 19b represented in fig.1, opens.

[0013] In the opening step of the gate, the piston 2 actuates the stem 6 according to the entrance direction of the chamber 5. The oil circulates after the two valves 12 and 13 are simultaneously opened. The actuation pump, according to the direction which goes from the chamber 4 to the chamber 5, causes an over-pressure in the volume 19b which, simultaneously, opens the valve 13 and through the small piston 15 and the pin 16a, opens the valve 19a.

[0014] The supply circuit opens and determines the oil circulation from the expansion chamber 4 to the expansion chamber 5.

[0015] In fig.1 a release tap 22 is also represented which, through an auxiliary duct 23, positioned parallel to the main circuit 7, puts the two expansion chambers into communication and allows a manual emergency manoeuvre to be carried out. Branching off from the release valve 22 there is a duct 21 for compensating the flow rate: during the opening of the gate the duct 21 makes the excess flow rate flow from the circuit to the reservoir

and vice versa during the closure, to compensate for the volume difference between the two chambers 4 and 5.

[0016] Indeed, although the operation of the two branches of the circuit may seem symmetrical, the expansion chambers 4 and 5 have different useful volumes, the difference being determined by the part of piston 6 inside the chamber 5. The asymmetry between the volumes causes slow and irregular operation during the opening manoeuvre. In order to compensate for what has been described, the small control piston 15 represented in fig. 2, which slides inside the cylinder 19 and separates the two circuit branches, is modified in order to obtain a circular groove 18 on the outer surface of the cylinder, at the ends of which there are two pins for actuating the balls of the two valves 12 and 13, said circular groove 18 allowing the excess oil to runoff from the circuit to the reservoir, which only happens during the return step of the stem. As can be seen in fig. 4, the small piston 15 has two grooves formed on its outer surface, the first of which (ref. 25) constitutes a seat for a sealing gasket, whereas in the other (ref. 18) some holes 20 are formed to put the volume 19a into communication with the groove itself. During the return step of the stem, in the opening step of the gate, the over-pressure acting in 19b pushes the small piston 15 and the door in such a position as to open a duct 17 made directly in the head of the distributor 24 and communicating with the reservoir 9.

[0017] The geometry described for the small piston 15 and the position of the duct entrance 17 are such that during the gate opening manoeuvre, or rather the return of the stem into the cylinder, the part of excess fluid, determined by the presence of the stem 6, can be drawn towards the compensation reservoir 9. The sections of duct 17 and of the through holes 20 formed in the groove 18 of the small piston 15 are sized so as to ensure a flow rate which is sufficient to compensate for the difference in volume between the chamber 4 and 5 inside the cylinder 3 during the opening manoeuvre. Otherwise, during the closing manoeuvre, i.e., during the exit of the stem from the cylinder, the small piston 5 slides in the opposite direction blocking the duct 17. The geometry of the small piston 15 and the position of the duct entrance 17 thus allow the communication between the circuit and reservoir along the duct 17 to alternatively open and close. During the opening manoeuvre, in the return step of the stem, the excess flow rate passes from the cylinder to the reservoir in order to compensate the presence of the stem 6, whereas during the closing manoeuvre and of exit of the stem, the compensation of the flow rate shortfall is carried out through the opening of the inlet valve 11, when the duct 17 is completely closed. It can easily be observed that the aforementioned embodiment, does not imply any modification of the inlet valves, whereas a modest and suitable modification of the small piston 15 and of the distributor 24 is sufficient to obtain the compensation of the volume of oil in just the return direction of the stem 6.

[0018] A variant of the solution just described (see fig. 5) uses a by-pass duct 21 which, in *per se* known ways, is normally already in the distribution head of the oil. Indeed, as it has already been described and represented in fig. 1, in the distributor 24 there is an auxiliary circuit 23, positioned parallel to the circuit 7 to allow a manual release manoeuvre to be carried out. The duct 21, made inside the distributor 24, branching off from the circuit 23, has the function of allowing compensation of the flow rate during the manual and emergency release. In the case in which the manual manoeuvre is carried out according to the return direction of the stem, the duct 21 makes the flow rate of the excess oil runoff into the reservoir; vice versa, in the direction of exit of the stem, the duct takes in the flow rate shortfall directly from the reservoir. The tap 22 is made so that its opening puts the duct 21 into communication with the circuit 23.

[0019] In light of what has been described above it should be clear how the finding allows the mentioned operation problems to be avoided, without upsetting the scheme of the original circuit, by adding the advantages of a fully tested solution to the regularity of the opening and closing manoeuvres, without making the actuating more complex and costly.

[0020] The implementation of the finding can vary as far as the shape, sizes, materials and arrangements of the construction elements are concerned, without for this reason departing from the finding and remaining covered by the scope of protection accorded by the patent.

Claims

1. HYDRAULIC ACTUATION SYSTEM FOR MOVING MOTORIZED GATES AND SIMILAR, made up of:

- a double-acting piston (2), which slides inside the cylinder (3) connected to a stem (6) for transmitting motion to the wing of a gate;
- a supply circuit (7) for transferring a hydraulic fluid from a first expansion chamber (4) to a second expansion chamber (5) and vice versa, comprising a reversible circulation pump (8), actuated by a motor (14);
- a reservoir (9) connected to the circuit (7) by two inlet valves (10, 11), one on each side of the circuit opposite the circulation pump (8);
- two discharge valves (12, 13), which connect each of the two sides of the circuit and the chambers (4, 5), respectively;
- a device for simultaneously opening the two discharge valves (12, 13) at the actuation of the pump (8), made up of a small control piston (15), the system being **characterized in that**,

when the stem (6) is returning into the expansion chamber (5), the actuation of the control piston (15), in the opening direction of the valve (13) causes the connecting duct (17) to open between the part of circuit upstream of the pump

and the reservoir (9), so as to allow the flow of the excess flow rate due to the presence of the stem (6) inside the expansion chamber (5).

2. SYSTEM, according to claim 1, **characterized in that** the duct (17) communicates with the reservoir (9) through a duct (21) of the auxiliary release circuit (23), for compensating the excess flow rate, according to the returning direction of the stem (6) during the manual releasing manoeuvre.

3. SYSTEM, according to one or more of the previous claims, **characterized in that** on the outer surface of the piston (15) there is a groove (18), which allows the excess flow rate to runoff towards the connecting duct (17), through some holes (20), according to the direction of the returning manoeuvre of the stem (6) inside the cylinder (5).

4. SYSTEM, according to one or more of the previous claims, **characterized in that** the adjustment of the thrust and of the maximum traction exerted by the gate actuation piston is carried out through variation of the electrical parameters of the pump actuation motor.

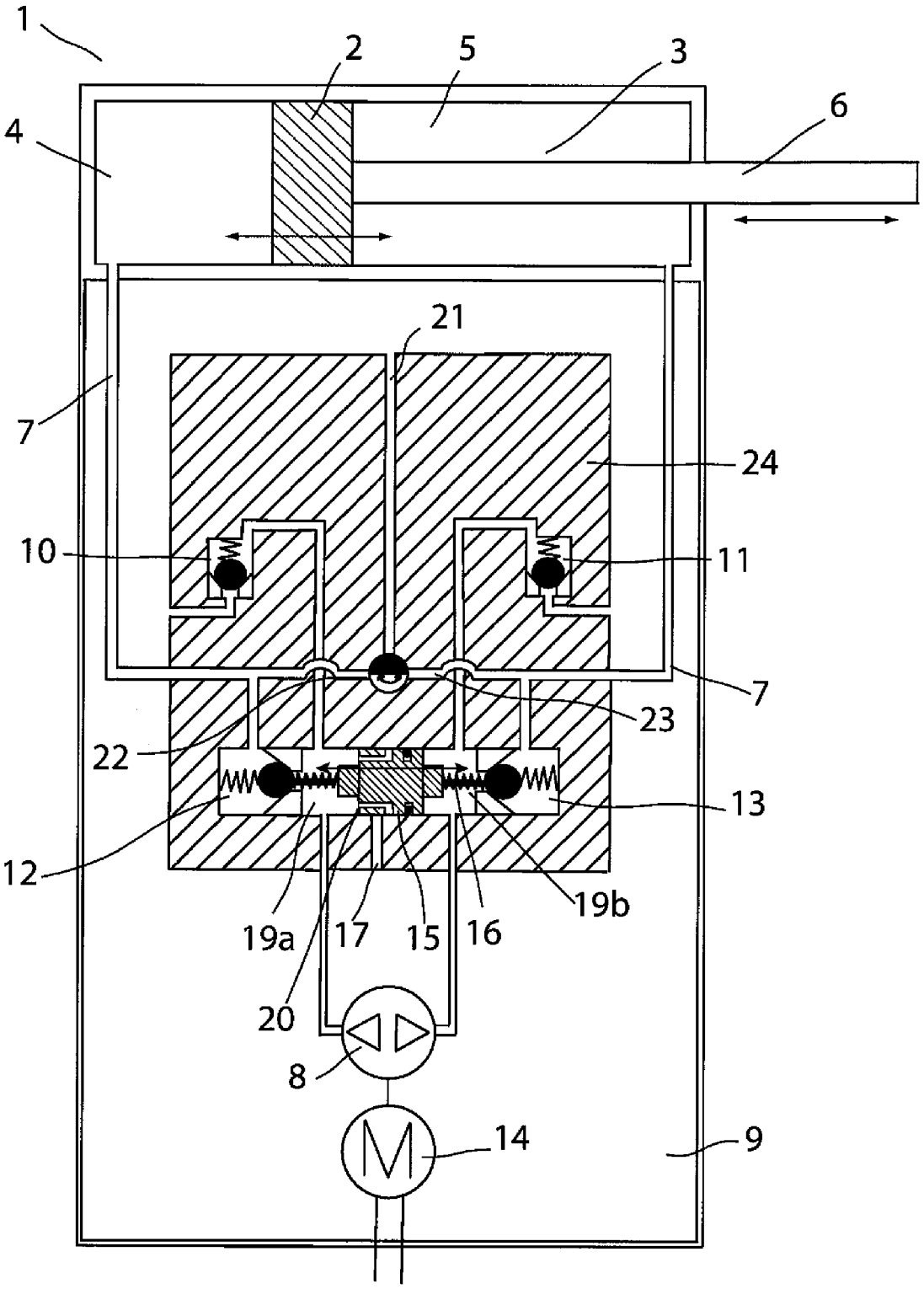

Fig.1

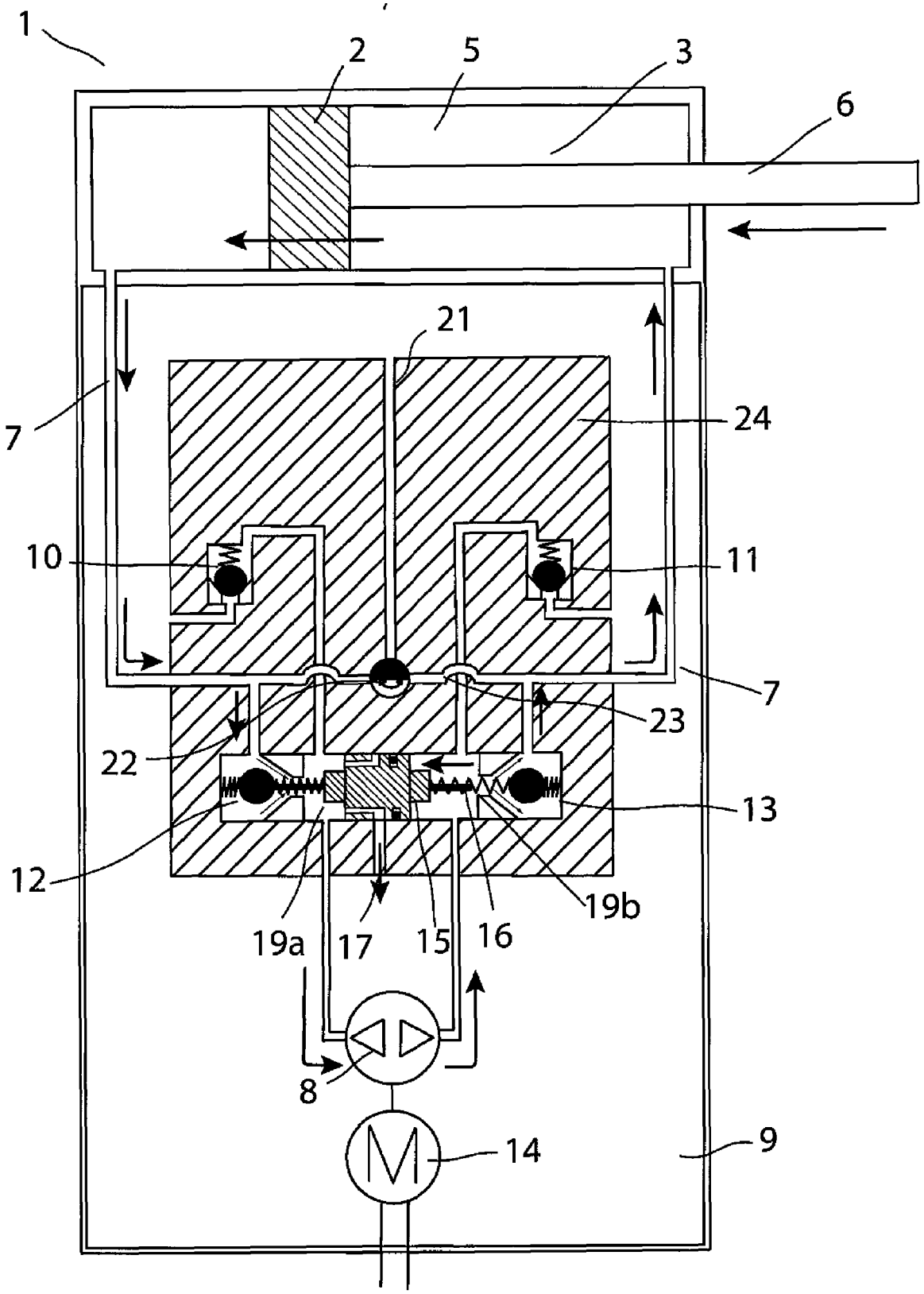

Fig.2

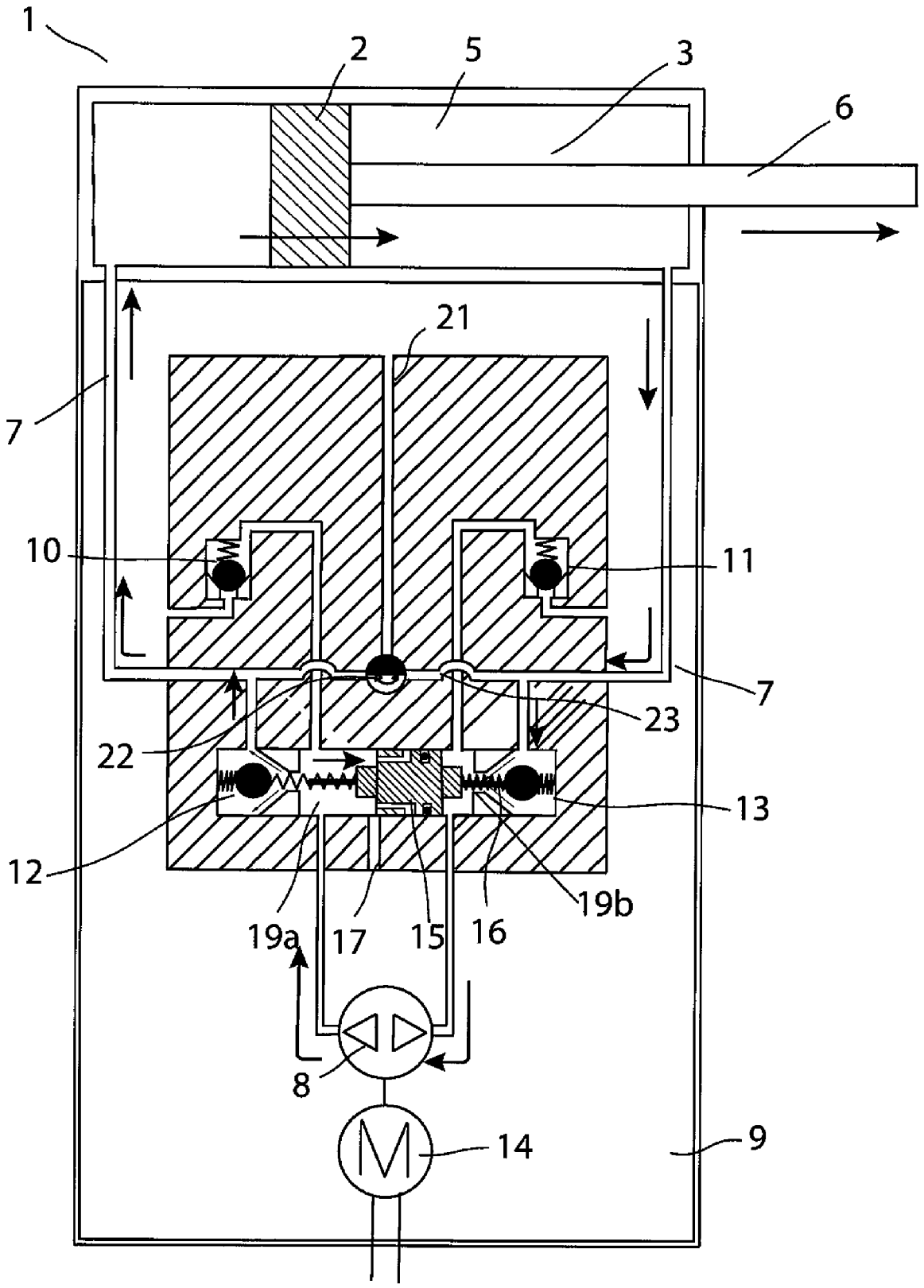

Fig. 3

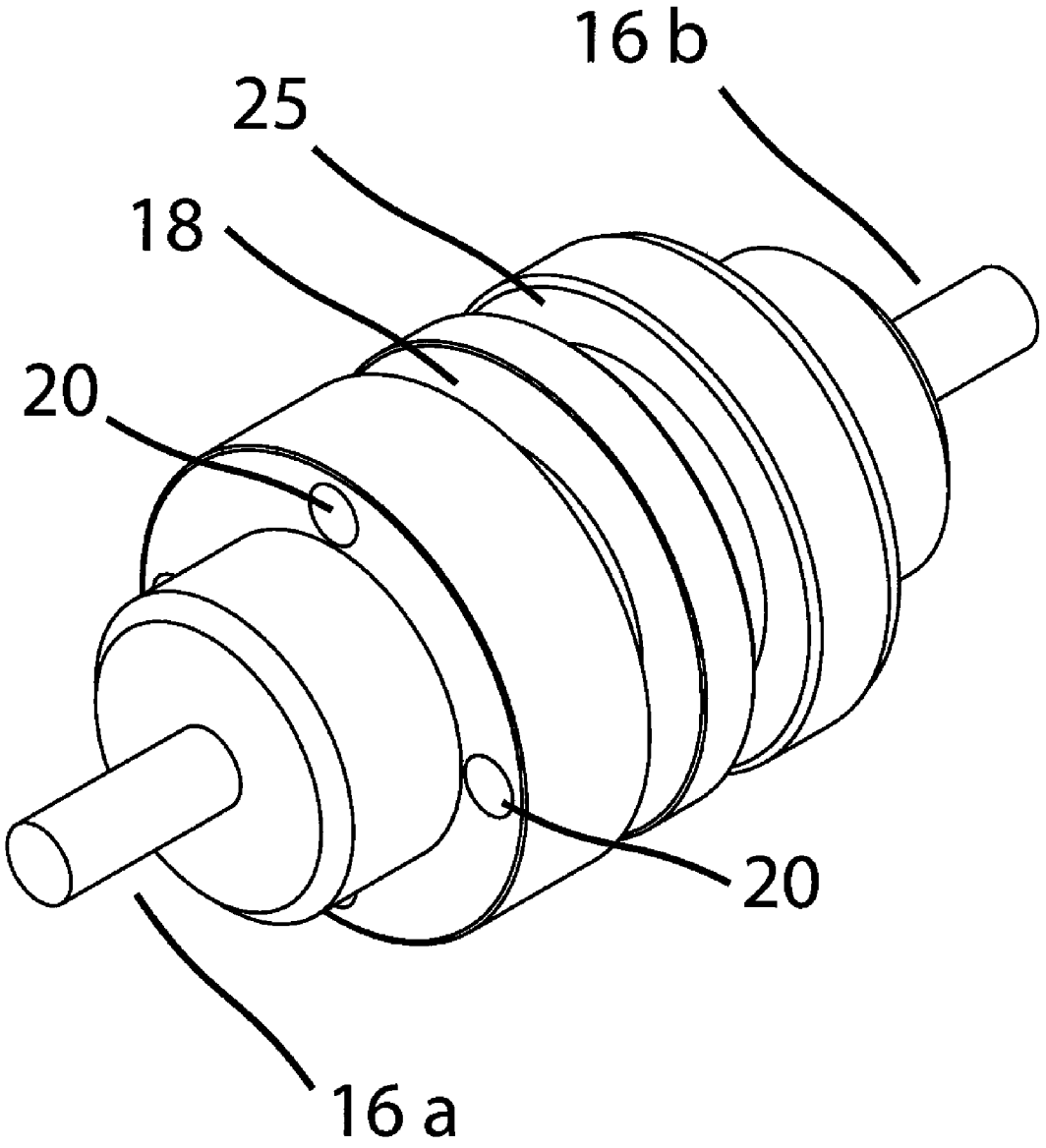

Fig.4

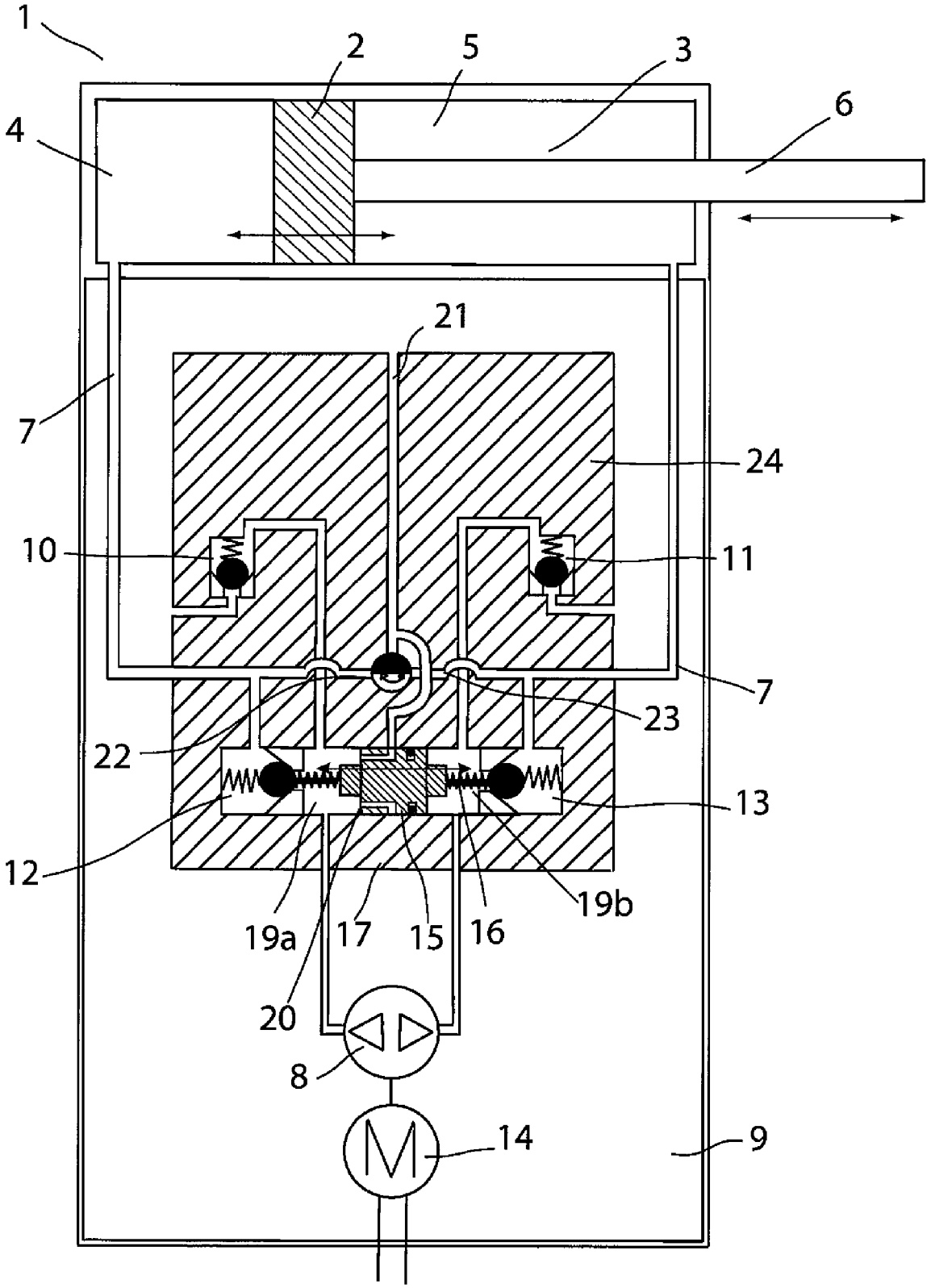

Fig. 5

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EUROPEAN SEARCH REPORT

Application Number
EP 09 17 0250

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	US 2007/199437 A1 (SAKAI YOSHITAKE [JP] ET AL) 30 August 2007 (2007-08-30) * paragraphs [0046], [0077], [0109] - [0123]; figures 1,2a,2b,10,11 *	1,2,4	INV. F15B7/00
X	US 4 343 153 A (KERN CALVIN V ET AL) 10 August 1982 (1982-08-10) * column 4, lines 14-24 * * column 4, line 51 - column 5, line 43; figure 2 *	1,3,4	
A,D	EP 1 832 756 A (FAAC SPA [IT]) 12 September 2007 (2007-09-12) * paragraphs [0012] - [0017]; figures 1,2 *		
			TECHNICAL FIELDS SEARCHED (IPC)
			E05F F15B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	22 October 2009	Rechenmacher, M

CATEGORY OF CITED DOCUMENTS

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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 09 17 0250

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22-10-2009

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

REFERENCES CITED IN THE DESCRIPTION

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- EP 1832756 A **[0004] [0007]**