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(54) **A SYSTEM FOR OPERATING A CYLINDER VALVE ASSEMBLY FOR AN INTERNAL COMBUSTION ENGINE**

EIN SYSTEM ZUM BETREIBEN EINER ZYLINDERVENTILBAUGRUPPE FÜR EINEN VERBRENNUNGSMOTOR

SYSTÈME D'ACTIONNEMENT D'UN ENSEMBLE DE SOUPAPE DE CYLINDRE POUR UN MOTEUR À COMBUSTION INTERNE

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Description

Field of the invention

[0001] The present invention relates to an auxiliary valve motion employing disablement of main Valve events, in particular in the field of large displacement internal combustion engines for trucks and work vehicles.

Description of the prior art

[0002] Cylinder deactivation (CDA) is an efficient measure to realise thermal management and improve fuel consumption at low loads. CDA is realised by deactivating the valve lifts and fuelling of some or all cylinders.

[0003] This is usually done by interrupting the connection of cam and valve. Very common are hydraulic lash adjusting (HLA) elements which can collapse or elements within the valve train which can open the connection (e.g. at the valve bridge). All these systems can lead to very high valve seating velocity, if the connection from cam to valve is interrupted during a period of large valve lift.

[0004] Efficient engine braking systems (e.g. 2-stroke) require also the deactivation of the valve lift profiles implemented for fired operation. The deactivation of the valve lift profiles is usually not crank angle synchronised per cylinder, which means the valve can close from any position. This can lead to extreme seating velocities and engine durability problems.

[0005] US2014251266 discloses a deactivation mechanism disposed within a main valve train capable to disable conveyance of main valve events from a main valve motion source to a valve via the main valve train.

[0006] Here, a rocker arm is arranged to swing over a rocker shaft. This shaft is provided with an oil passage to supply a rocker arm duct in any rocker arm positions. The rocker arm duct supplies a lost motion assembly arranged on the bridge of two exhaust valves.

[0007] The lost motion assembly includes an outer plunger arranged in a valve bridge opening/casing and arranged to be pushed downwards by the rocker arm through an inner plunger, arranged in a bore of the outer plunger.

[0008] The outer plunger has a side opening extending through the outer plunger wall for receiving a wedge lock pin or ball. The inner plunger includes one or more recesses shaped to securely receive the one or more wedge lock pins or ball when the inner plunger is pushed downward against an inner plunger spring IPS interposed between the bottom of the bore of the outer plunger and the inner plunger. The central opening of the valve bridge also includes one or more recesses for receiving the one or more wedge lock pins or ball in a manner that permits the wedge lock pins or ball to lock the outer plunger and the exhaust valve bridge together, as shown in figure 1. The outer plunger spring may bias the outer plunger upward in the central opening of the valve bridge. The inner plunger spring may bias the inner plunger upward in outer plunger bore.

[0009] When hydraulic oil is pressurized through the rocker arm, the inner plunger is pushed downwards, therefore, its recess permits the one or more wedge lock pins or balls to decouple or unlock the outer plunger from the valve bridge body. As a result, during this "unlocked" state, valve actuation motion applied by the lost motion assembly does not move the valve bridge body downward to actuate the exhaust valves. Instead, this downward motion causes the outer plunger to slide downward within the central opening of the valve bridge body against the bias of the outer plunger spring, whose bias force is less relevant than the exhaust valve springs one.

[0010] The hydraulic oil can be pressurized while the hump of the cam is forcing the rocker arm to push the lost motion assembly with the result that valves are immediately closed impacting against their seats. Means, the valves close uncontrolled starting from any valve lift, which can cause very high seating velocities.

[0011] A solution to avoid this problem is to synchronize the pressurization of the oil in such a way to disconnect the outer plunger from valve bridge only when the rocker arm is in released condition, namely when it is contacting the base circumference of the cam corresponding to no valve lift, namely, valve closed.

[0012] This synchronization should be carried independently for each of the deactivated/braked cylinders.

[0013] US10851682B2 from Jacobs discloses various configurations for locking a bridge piston to a bridge housing including substantially cylindrical locking pins that may be housed within a substantially cylindrical receptacles defined by a transverse bore in the bridge piston and actuated hydraulically.

[0014] At high rotation speed, it is difficult to obtain a satisfactory synchronization. In addition, the hydraulic circuit should be complicated due to the implementation of a fast solenoid valve for each cylinder, while usually 1 solenoid is used for 2 or 3 cylinders.

Summary of the invention

[0015] The main object of the present invention to provide an auxiliary valve motions employing disablement of main valve events, which overcomes the above problems/drawbacks.

[0016] The aim of the present invention is to design a system with an intrinsic mechanical fail-safe cylinder deactivation system, which does on depend any kind of synchronization and prevents high valve seating velocities.

[0017] The description of US2014251266 does not remark the role of the seat in the valve bridge body for the wedge lock pin or ball. Such seat is shaped in such a way to transform the axial force of the rocker arm on the outer plunger in a transversal force which naturally induces the ball or wedge to move transversally toward the inner plunger recess by disconnecting the outer plunger

from the valve bridge body. For convenience, the wedge or ball is whereinafter called as "locking element".

[0018] The basic idea of the present idea is to cause the sliding of the "locking element" through oil pressure. In particular, an oil duct which communicate the recess in the body of the valve bridge with the bore of the outer plunger. In addition, while in US2014251266 the sliding of the locking element is caused by the transmission of cut forces from the outer plunger to the valve bridge body, according to the present invention, such cut forces generate friction forces which oppose the sliding of the locking element, therefore, the disconnection of the outer plunger from the valve bridge body is permitted only when the rocker arm is in released condition.

[0019] Even if the present invention shares similar components of US2014251266, such as oil connections or wedge lock pin, their interaction is completely changed by achieving an intrinsic safe switching from the normal/-fired actuation to the braking/deactivation condition.

[0020] The present solution finds application in CDA systems, which are either on or off as disclosed in US2014251266, with no intermediate states.

[0021] Advantageously, no electronic system is implemented to synchronize the lost motion activation, which, according to the present invention happens naturally within one revolution of the camshaft.

[0022] The present invention does not find application only in the solution disclosed in US2014251266, but in any application where the lost motion assembly implements a latch pin corresponding to the locking element of the present invention.

[0023] Indeed, here, the solution is based on the pressurization of a latch pin seat which forces the pin to unlock the reciprocal movement of two components and the conformation of the pin itself such that

- not to cooperate with its seat in the sliding movement and
- to develop frictions contrasting its sliding toward its unlocking condition.

[0024] These and further objects are achieved by means of the attached claims, which describe preferred embodiments of the invention, forming an integral part of the present description.

Brief description of the drawings

[0025] The invention will become fully clear from the following detailed description, given by way of a mere exemplifying and non limiting example, to be read with reference to the attached drawing figures, wherein:

- Fig. 1 shows the lost motion system disclosed in US2014251266;
- Fig. 2 discloses the modification of such assembly in order to render such solution one of the possible embodiments of the present invention;
- Figs. 3 and 4 disclose a detail of the system according to figure 2;
- Figs. 5 and 6 disclose further embodiments of the present invention based on the one of figure 2.

[0026] The same reference numerals and letters in the figures designate the same or functionally equivalent parts.

[0027] According to the present invention, the term "second element" does not imply the presence of a "first element", first, second, etc.. are used only for improving the clarity of the description and they should not be interpreted in a limiting way.

Detailed description of the preferred embodiments

[0028] Figure 2 discloses a preferred embodiment of the invention. In particular such figure focus on the valve bridge VB and the lost motion assembly LMA, while the remaining components, such as, rocker arm, camshaft, adjusting screw can be similar to those disclosed in US2014251266 and in general are not relevant for the understanding of the present invention.

[0029] The valve stems VS are only partially disclosed because they are not relevant. For convenience the set of valve bridge and/or the valve(s) are labelled as valve assembly VAS.

[0030] As for US2014251266 the lost motion assembly LMA includes an outer plunger OP and an inner plunger IP arranged inside a bore in the outer plunger, such that the inner plunger can slide in the bore according to the X axis.

[0031] According to the same X axis, the rocker arm (not disclosed in figure 2) exerts its action, pushing downwards the swivel foot SFO arranged on the top of the outer plunger OP.

[0032] In other words, the inner plunger is encapsulated in the outer plunger and the swivel foot, which closes the outer plunger as a plug or cap.

[0033] Along with the swivel foot a first duct is disposed to permit pressurized oil to reach the inner bore, so as to push downwards the inner plunger IP against its bias spring IPS.

[0034] As in US2014251266, the inner plunger IP is provided with at least a recess IPR and the outer plunger has a passing through opening where a locking element LE is arranged and capable to slide transversally with respect to the X axis. The outer plunge, differently from US2014251266, includes a lateral duct LD communicating the inner bore of the outer plunger with at least one seat LES of the locking element LE defined in the valve bridge body. This lateral duct is arranged to pressurize the locking element seat in such a way to force the locking element to leave its seat by disengaging the outer plunger from the valve bridge.

[0035] According to the invention, the locking element LE has the shape of prism, such as a cylinder or a parallepiped, or the like and the end walls EW of the

locking element(S) seat LES are substantially transversal to the sliding axis. In figures 3 and 4 are disclosed two opposite conditions: according to figure 3 the locking element LE contacts the end wall EW while, according to figure 4 the locking element is in an intermediate condition with respect to the opposite walls leading LW and end wall EW.

[0036] The first situation, on figure 3, is typical while the rocker arm pushes the swivel foot SF, thus the outer plunger spring OPS is compressed, and the locking element LE contacts the end wall EW transferring the rocker arm force from the outer plunger to the valve bridge.

[0037] The second situation, on figure 4, is typical while the rocker arm is released and the spring OPS is expanded pushing upwards the outer plunger, and the locking element is substantially free to move in case the inner plunger is depressed.

[0038] Figures 3 and 4 disclose also the force exchanged in both the situations with the following labels:

- RAF: rocker arm force
- RF: Reaction force between the locking element and the end wall EW,
- PF: pressure force
- FF: friction force caused by the reaction force RF.

[0039] According to the present invention, when the rocker arm pushes against the swivel foot, see figure 3, PF < FF, therefore, the locking element remains still and the lost motion assembly remains fixedly connected with the valve bridge, while when the rocker arm is released, see figure 4, PF is not balanced by any friction force and the locking element is permitted to slide transversally in the recess IPR of the inner plunger disconnecting the lost motion assembly from the valve bridge.

[0040] It is clear that the pressurization of the lost motion assembly, while rocker arm is released, causes in succession:

- Downwards moving of inner plunger,
- Unlocking of the lost motion assembly from valve bridge due to locking element sliding.

[0041] Figures 2 and 4 disclose different embodiments of the lateral duct LD: according to the solution of figure 2, the lateral duct is always connected with the seat LES and the pressurized oil is free to reach the seat as the lost motion assembly is pressurized. In contrast, figure 5 discloses a lateral duct with its outflow arranged between the locking element and outer plunger spring such that the outflow communicate with the seat LS only when the spring OPS is expanded.

[0042] When a fast solenoid valve pressurizes the lost motion assembly, as in US2014251266, the inner plunger moves downwards compressing the spring IPS, thus the recess IPR face the locking element and the latter can slide inside such recess IPR only in case the force balance is positive, in the sense that the pressure force PF is larger than any opposite force, such as a friction force.

[0043] In particular, the wedge angle of the lock pin of US2014251266 is about 45°, thus the reciprocal contact of the wedge with the seat in the valve bridge develops a sliding force that here cannot be developed due to the transversal orientation of the contacting faces of the locking element and of the end wall EW with respect to the X axis.

[0044] When the pressurization falls, the inner plunger, under the force of the inner plunger spring IPS moves upwards and its recess IPR is shaped to force locking element to slide in the locking condition. Therefore, while the locking motion, towards the locking condition of the locking element, is caused by a mechanical interference, the unlocking motion, towards the unlocking condition of the locking element is essentially caused by the pressure.

[0045] Here the term "essentially" should be understood as follows: in order to render easier the understanding of the invention, the end wall EW is presented as perfectly transversal to the X axis. The interface end wall/locking element can produce a transversal force

- either in favor of the sliding of the locking element towards the unlocking condition
- or in favor of the braking of the locking element towards the unlocking condition.

[0046] What is really relevant, according to the present invention, is that the force caused by the pressurization of the seat LES exceed any opposing force only when the rocker arm is released.

[0047] Therefore, the system of the present invention includes

- a main event motion source configured to provide main event valve motions to a valve assembly, for example the camshaft of figure 1;
- a main rocker arm operatively connected to the main event motion source, for example the rocker arm of figure 1, in such a way to assume an active condition at main event and a released condition between two consecutive main events;
- a lost motion assembly LMA operatively connected to the valve of the combustion engine cylinder to the main rocker arm;

Wherein the lost motion assembly includes an outer plunger OP arranged to receive main rocker arm action and transmitting such action to the valve assembly through a locking element LE, wherein the locking element is arranged to assume

- a locking condition with a first portion disposed in a corresponding seat (LES) of the valve assembly and a second portion disposed in a passing through opening of the outer plunger,

- an unlocking condition where the locking element is completely inside the outer plunger,

wherein the outer plunger includes a duct arranged to pressurize the seat and wherein the force exerted on locking element exceeds frictions developed between the locking element and the corresponding seat only when the rocker arm is in released condition.

[0048] Not according to the appended claims, the inner plunger could be optional, indeed, the return of the locking element in the locking condition can be achieved by a return spring RS which directly pushes the locking element outside the outer plunger towards the seat in the valve bridge. An example of such embodiment not according to the appended claims is disclosed on figure 6. In particular, a return spring pushes a couple of locking elements.

[0049] In this case, the cavity inside the outer plunger, where the return spring and the recesses are defined is isolated from the oil ducts LD in order to avoid pressurization of the cavity itself with a consequent generation of an additional pressure force directed as the return spring action.

[0050] Also in this case, in the balance of the forces not only the frictions and the pressure, also the return spring force should be considered.

[0051] Thanks to the present invention the lost motion assembly switches in the lost condition only when the rocker arm is released, this means that there is no risk for a sudden and uncontrolled closing of the valves.

[0052] Figure 5 discloses a slightly different solution with respect to the one of figure 2.

[0053] This solution is based on the fact that the seat has an end wall EW and a leading wall LW opposite to the end wall, such that the locking element contacts the end wall when the rocker arm is in active condition and contacts the leading wall when the rocker arm is in released condition, due to the spring OPS interposed between the outer plunger and the valve bridge VB. More in particular, the seat and the locking element are configured to define a play between the locking element and the end and leading walls and wherein the lateral duct LD is arranged in the outer plunger in such a way to communicate with the seat only when the rocker arm is released and the locking element contacts the leading wall LW.

[0054] The seat LES can include a ramp portion or any possible distancing element arranged to assure a certain clearance between the locking element and the side wall of the seat, so that at the pressurization of the seat, the locking element is ready to be pushed towards the inner plunger recess. It will be apparent to those skilled in the art that specific details need not be employed, that example embodiments may be embodied in many different forms and that neither should be construed to limit the scope of the disclosure. In some example embodiments, well known processes, well-known device structures, and well known technologies are not described in detail.

[0055] According to a preferred embodiment of the invention, said seat LES and said locking element (s) are shaped such that an action exerted on the outer plunger according to said direction X transversal to the locking element movement causes a force interaction between the recess and locking element which is circa parallel to said direction X transversal to the locking element movement. Therefore, no inward movement toward the unlocking condition can be caused by the interaction of the seat LES and the locking element LE. On the contrary, only the pressurization of the duct produces the release.

[0056] Preferably, the inner plunger is arranged to close said first duct (LD) when the locking element is in said unlocking condition, such that a pressurization first aims to lower the inner plunger and then to pressurize the first duct (LD). This succession of movements it particularly beneficial because the pressurization force is exerted to win first the frictions to lower the inner plunger and then to move the locking elements in the unlocked condition within the recess of the inner plunger.

[0057] Many changes, modifications, variations and other uses and applications of the subject invention will become apparent to those skilled in the art after considering the specification and the accompanying drawings which disclose preferred embodiments thereof as described in the appended claims.

[0058] The features disclosed in the prior art background are introduced only in order to better understand the invention and not as a declaration about the existence of known prior art. In addition, said features define the context of the present invention, thus such features shall be considered in common with the detailed description.

[0059] Further implementation details will not be described, as the man skilled in the art is able to carry out the invention starting from the teaching of the above description.

Claims

1. A system for operating a cylinder valve assembly for an internal combustion engine comprising:

- a main event motion source configured to provide main event valve motions to the valve assembly,
- a main rocker arm operatively connected to the main event motion source, in such a way to assume an active condition at main event and a released condition,
- a lost motion assembly (LMA) operatively associated to the valve assembly (VB),

wherein the lost motion assembly includes an outer plunger (OP) arranged to receive a main rocker arm action and to transmit such action to the valve assembly through a locking element (LE), wherein the locking element is arranged to assume

- a locking condition with a first portion disposed in a corresponding seat (LES) of the valve assembly and a second portion disposed in a passing through opening of the outer plunger,
- an unlocking condition where the locking element is completely outside the seat (LES) of the valve assembly,

wherein the outer plunger includes a first duct (LD) to convey a hydraulic medium, arranged to pressurize the seat (LES) and wherein the lost motion assembly is realized such that sliding force exerted on the locking element by the corresponding seat pressurization exceeds frictions developed between the locking element and the corresponding seat only when the rocker arm is in released condition, wherein the locking element is forced to return in the locking condition by a first spring (IPS, RS) acting directly or indirectly to the locking element, wherein said outer plunger includes a bore (B) to which an inner plunger (IP) is associated and charged by said first spring (IPS) according to a direction (X) transversal to the locking element movement between the locking and unlocking condition and wherein the inner plunger includes a recess (IPR) to receive the locking element to assume said unlocking condition and wherein said recess is shaped to force the locking element to assume said locking condition when a reciprocal movement of the inner plunger with respect to the outer plunger is caused by said first spring (IPS), the system **being characterized in that** said inner plunger is suitable to be actuated by pressure generated by a second duct (CD) suitable to convey the hydraulic medium, such that to push the inner plunger against said first spring (IPS) and **in that**, said first duct and said second duct are reciprocally communicating so that, when pressurization happens, the inner plunger lowers compressing the first spring (IPS) and facing the recess (IPR) to the locking element, such that the locking member slides in the recess causing the unlocking condition.

2. System according to claim 1, wherein the seat (LES) and said locking element are shaped such that an action exerted on the outer plunger according to said direction (X) transversal to the locking element movement causes a force interaction between the seat and locking element circa parallel to said direction (X) transversal to the locking element movement.

3. System according to claim 1 or 2, wherein said first spring (RS) in interposed between a couple of locking elements.

4. System according to claim 1, wherein said inner plunger is arranged to close said first duct (LD) when said locking element is in said unlocking condition, such that a pressurization first lowers the inner plunger and then pressurizes said first duct (LD).

5. System according to any of the previous claims 1 - 4, wherein the seat has an end wall (EW) and a leading wall (LW) opposite to the end wall, such that the locking element contacts the end wall when the rocker arm is in active condition and is in an intermediate position between the end and leading walls when the rocker arm is in released condition, due to a second spring (OPS) interposed between the outer plunger and the valve assembly (VB).

6. System according to claim 1, wherein said first duct (LD) is arranged in the outer plunger in such a way to communicate with the seat only when the rocker arm is released and the locking element is in said intermediate position.

7. System according to any one of the previous claims, wherein said valve assembly includes a valve bridge and at least two valves associated to the valve bridge in such a way the valve bridge is capable to lift the at least two valves at the same time.

8. System according to claim 7, wherein said valve bridge includes a central seat (CS) arranged to receive the lost motion assembly, wherein a development axis of the central seat (CS) is parallel or coaxial with a direction defined by said action transmission from the rocker arm and the lost motion assembly.

9. System according to any one of the previous claims 1 - 8, wherein the rocker arm includes a third duct to convey the hydraulic oil to the first and second ducts through a swivel foot (SF) arranged on the top of the outer plunger (OP).

10. Internal combustion engine including a cylinder, a piston and a head associated to the cylinder and at least a valve assembly to selectively open and close the head and a system for operating the valve assembly according to any one of claims 1 - 9.

Patentansprüche

1. System zum Betreiben einer Zylinderventilbaugruppe für einen Verbrennungsmotor, umfassend:

- eine Hauptereignisbewegungsquelle, die dazu konfiguriert ist, Hauptereignisventilbewegungen an die Ventilbaugruppe zu übermitteln,
- einen Hauptkipphebel, der operativ mit der Hauptereignisbewegungsquelle verbunden ist, um während des Hauptereignisses einen aktiven Zustand und einen freigegebenen Zustand

einzunehmen,

- eine Totgangbaugruppe (LMA), die betriebsmäßig mit der Ventilbaugruppe (VB) verbunden ist,

wobei die Totgangbaugruppe einen externen Kolben (OP) umfasst, der so angeordnet ist, dass er eine Hauptkippbewegung aufnimmt und diese Bewegung über ein Verriegelungselement (LE) an die Ventilbaugruppe überträgt, wobei das Verriegelungselement so angeordnet ist, dass es

- einen Verriegelungszustand mit einem in einem entsprechenden Sitz (LES) der Ventilbaugruppe angeordneten ersten Teil und einem in einer entsprechenden Durchgangsöffnung des äußeren Kolbens angeordneten zweiten Teil, einnimmt,
- einen entriegelten Zustand einnimmt, in dem sich das Verriegelungselement vollständig außerhalb des Sitzes (LES) der Ventilbaugruppe befindet,

wobei der äußere Kolben eine erste Leitung (LD) zum Fördern einer Hydraulikflüssigkeit aufweist, die so angeordnet ist, dass sie den Sitz (LES) unter Druck setzt, und wobei die Totgangbaugruppe so ausgebildet ist, dass die auf das durch Drucksetzen des entsprechenden Sitzes verriegelte Element ausgeübte Gleitkraft die Reibung zwischen dem Verriegelungselement und dem entsprechenden Sitz nur übersteigt, wenn sich der Kipphebel im gelösten Zustand befindet, in dem das Verriegelungselement durch eine erste Feder (IPS, RS), die direkt oder indirekt auf das Verriegelungselement einwirkt, zurück in den verriegelten Zustand gezwungen wird, wobei der äußere Kolben eine Bohrung (B) aufweist, mit der ein innerer Kolben (IP) verbunden ist, der durch die erste Feder (IPS) in einer Richtung (X) quer zur Bewegung des Verriegelungselements zwischen dem Verriegelungszustand und dem Entriegelungszustand befindet und wobei der innere Kolben eine Aussparung (IPR) zur Aufnahme des Verriegelungselements zum Einnehmen des Entriegelungszustands aufweist und wobei die Aussparung so geformt ist, dass sie das Verriegelungselement zum Einnehmen des Verriegelungszustands zwingt, wenn eine Hin- und Herbewegung des inneren Kolbens relativ zum äußeren Kolben durch die erste Feder (IPS) verursacht wird, wobei das System **dadurch gekennzeichnet ist, dass** der innere Kolben durch den Druck betätigt werden kann, der durch eine zweite Leitung (CD) erzeugt wird, die in der Lage ist, die Hydraulikflüssigkeit zu leiten, um den inneren Kolben gegen die erste Feder (IPS) zu drücken, und dadurch, dass die erste Leitung und die zweite Leitung wechselseitig kommunizieren, so dass, wenn ein Druck ausgeübt wird, wird der innere Kolben durch Zusammendrücken der ersten Feder (IPS) abgesenkt und weist die Aussparung (IPR) in Richtung des Verriegelungselements, so dass das Verriegelungselement in die Aussparung gleitet und den Entriegelungszustand bewirkt.

2. System nach Anspruch 1, wobei der Sitz (LES) und das Verriegelungselement so geformt sind, dass eine auf den äußeren Kolben gemäß der Richtung (X) quer zur Bewegung des Verriegelungselements ausgeübte Wirkung eine Kraftwechselwirkung zwischen dem Sitz und dem Verriegelungselement bewirkt, die ungefähr parallel zur Richtung (X) quer zur Bewegung des Verriegelungselements verläuft.

3. System nach Anspruch 1 oder 2, wobei die erste Feder (RS) zwischen einem Paar von Verriegelungselementen eingefügt ist.

4. System nach Anspruch 1, wobei der innere Kolben so angeordnet ist, dass er die erste Leitung (LD) verschließt, wenn sich das Verriegelungselement im verriegelten Zustand befindet, so dass ein Drucksetzen zunächst den inneren Kolben abhebt und dann die erste Leitung (LD) mit Druck beaufschlägt.

5. System nach einem der vorhergehenden Ansprüche 1-4, wobei der Sitz eine Endwand (EW) und eine der Endwand gegenüberliegende vordere Wand (LW) aufweist, so dass das Verriegelungselement die Endwand berührt, wenn sich der Kipphebel in aktivem Zustand befindet, und sich in einer Zwischenposition zwischen der Endwand und der vorderen Wand befindet, wenn sich der Kipphebel in einem gelöstem Zustand befindet, und zwar aufgrund einer zweiten Feder (OPS), die zwischen dem äußeren Kolben und der Ventilbaugruppe (VB) angeordnet ist.

6. System nach Anspruch 1, wobei die erste Leitung (LD) im äußeren Kolben so angeordnet ist, dass er nur dann mit dem Sitz kommuniziert, wenn der Kipphebel gelöst ist und sich das Verriegelungselement in der Zwischenposition befindet.

7. System nach einem der vorhergehenden Ansprüche, wobei die Ventilbaugruppe eine Ventilbrücke und mindestens zwei Ventile umfasst, die der Ventilbrücke so zugeordnet sind, dass die Ventilbrücke in der Lage ist, die mindestens zwei Ventile gleichzeitig anzuheben.

8. System nach Anspruch 7, wobei die Ventilbrücke einen zentralen Sitz (CS) umfasst, der so angeordnet ist, dass er die Totgangbaugruppe aufnimmt, wobei eine Entwicklungsachse des zentralen Sitzes (CS) parallel oder koaxial zu einer Richtung ist, die durch die Wirkungsübertragung vom Kipphebel und

der Totgangbaugruppe definiert ist.

9. System nach einem der vorhergehenden Ansprüche 1-8, wobei der Kipphebel eine dritte Leitung umfasst, um das Hydrauliköl durch einen Schwenkfuß (SF), der auf der Oberseite des Kipphebels (OP) angeordnet ist, zu der ersten und zweiten Leitung zu leiten.

10. Verbrennungsmotor, einen Zylinder, einen Kolben und einen Kopf umfassend, die mit dem Zylinder und mindestens mit einer Ventilbaugruppe verbunden sind, um den Kopf selektiv zu öffnen und schließen, und ein System zum Steuern der Ventilbaugruppe nach einem der Ansprüche 1-9.

Revendications

1. Système de fonctionnement d'un ensemble soupape de cylindre pour un moteur à combustion interne comprenant:

- une source de mouvement d'événement principal configurée pour fournir des mouvements de soupape d'événement principal à l'ensemble soupape,
- un culbuteur principal relié de manière opérationnelle à la source de mouvement d'événement principal, de manière à adopter un état actif lors de l'événement principal et un état libéré,
- un ensemble de mouvement perdu (LMA) associé de manière opérationnelle à l'ensemble soupape (VB),

dans lequel l'ensemble de mouvement perdu comprend un piston externe (OP) agencé pour recevoir une action de culbuteur principal et pour transmettre cette action à l'ensemble soupape par l'intermédiaire d'un élément de verrouillage (LE), dans lequel l'élément de verrouillage est agencé pour adopter

- un état de verrouillage avec une première partie disposée dans un siège correspondant (LES) de l'ensemble soupape et une deuxième partie disposée dans une ouverture traversante du piston externe,
- un état de déverrouillage où l'élément de verrouillage est complètement à l'extérieur du siège (LES) de l'ensemble soupape,

dans lequel le piston externe comprend un premier conduit (LD) pour véhiculer un fluide hydraulique, agencé pour pressuriser le siège (LES) et dans lequel l'assemblage de mouvement perdu est réalisé de telle sorte que la force de coulissement exercée sur l'élément de verrouillage par la mise sous pression du siège correspondant dépasse les frottements développés entre l'élément de verrouillage et le siège correspondant uniquement lorsque le culbuteur est en état de libération, dans lequel l'élément de verrouillage est forcé de revenir en état de verrouillage par un premier ressort (IPS, RS) agissant directement ou indirectement sur l'élément de verrouillage, dans lequel ledit piston externe comprend un trou (B) auquel est associé un piston interne (IP) chargé par ledit premier ressort (IPS) selon une direction (X) transversale au mouvement de l'élément de verrouillage entre la condition de verrouillage et la condition de déverrouillage et dans lequel le piston interne comprend un évidement (IPR) pour recevoir l'élément de verrouillage pour assumer ladite condition de déverrouillage et dans lequel ledit évidement est formé pour forcer l'élément de verrouillage à assumer ladite condition de verrouillage lorsqu'un mouvement réciproque du piston interne par rapport au piston externe est provoqué par ledit premier ressort (IPS), le système **étant caractérisé en ce que** ledit piston interne est apte à être actionné par la pression générée par un deuxième conduit (CD) apte à véhiculer le fluide hydraulique, de manière à pousser le piston interne contre ledit premier ressort (IPS), et **en ce que** ledit premier conduit et ledit deuxième conduit communiquent réciproquement de manière à ce que, lorsque la pressurisation se produit, le piston interne s'abaisse en comprimant le premier ressort (IPS) et en faisant face à l'évidement (IPR) vers l'élément de verrouillage, de telle sorte que l'élément de verrouillage glisse dans l'évidement provoquant la condition de déverrouillage.

2. Système selon la revendication 1, dans lequel le siège (LES) et ledit élément de verrouillage sont formés de telle sorte qu'une action exercée sur le piston externe selon ladite direction (X) transversale au mouvement de l'élément de verrouillage provoque une interaction de force entre le siège et l'élément de verrouillage sensiblement parallèle à ladite direction (X) transversale au mouvement de l'élément de verrouillage.

3. Système selon la revendication 1 ou 2, dans lequel ledit premier ressort (RS) est interposé entre une paire d'éléments de verrouillage.

4. Système selon la revendication 1, dans lequel ledit piston interne est apte à fermer le premier conduit (LD) lorsque ledit élément de verrouillage se trouve dans ladite condition de déverrouillage, de telle sorte qu'une pressurisation dans un premier temps abaisse le piston interne et ensuite pressurise ledit premier conduit (LD).

5. Système selon l'une quelconque des revendications précédentes 1-4, dans lequel le siège présente une paroi d'extrémité (EW) et une paroi de conduction (LW) opposée à la paroi d'extrémité, de telle sorte que l'élément de verrouillage entre en contact avec la paroi d'extrémité lorsque le culbuteur est dans un état actif et se trouve dans une position intermédiaire entre les parois d'extrémité et avant lorsque le culbuteur est dans un état relâché, en raison d'un deuxième ressort (OPS) interposé entre le piston externe et l'ensemble soupape (VB).

6. Système selon la revendication 1, dans lequel ledit premier conduit (LD) est disposé dans le piston externe de manière à communiquer avec le siège uniquement lorsque le culbuteur est relâché et que l'élément de verrouillage se trouve dans ladite position intermédiaire.

7. Système selon l'une quelconque des revendications précédentes, dans lequel ledit ensemble soupape comprend un pont de soupape et au moins deux soupapes associées au pont de soupape, de telle sorte que le pont de soupape soit capable de soulever les au moins deux soupapes en même temps.

8. Système selon la revendication 7, dans lequel ledit pont de soupape comprend un siège central (CS) agencé pour recevoir l'ensemble à mouvement perdu, dans lequel un axe de développement du siège central (CS) est parallèle ou coaxial à une direction définie par ladite transmission d'action du culbuteur et de l'ensemble à mouvement perdu.

9. Système selon l'une quelconque des revendications précédentes 1-8, dans lequel le culbuteur comprend un troisième conduit pour acheminer l'huile hydraulique vers les premier et deuxième conduits par l'intermédiaire d'un pied pivotant (SF) disposé sur le dessus du piston externe.

10. Moteur à combustion interne comprenant un cylindre, un piston et une tête associée au cylindre et au moins un ensemble soupape pour ouvrir et fermer sélectivement la tête et un système pour actionner l'ensemble soupape selon l'une quelconque des revendications 1-9.

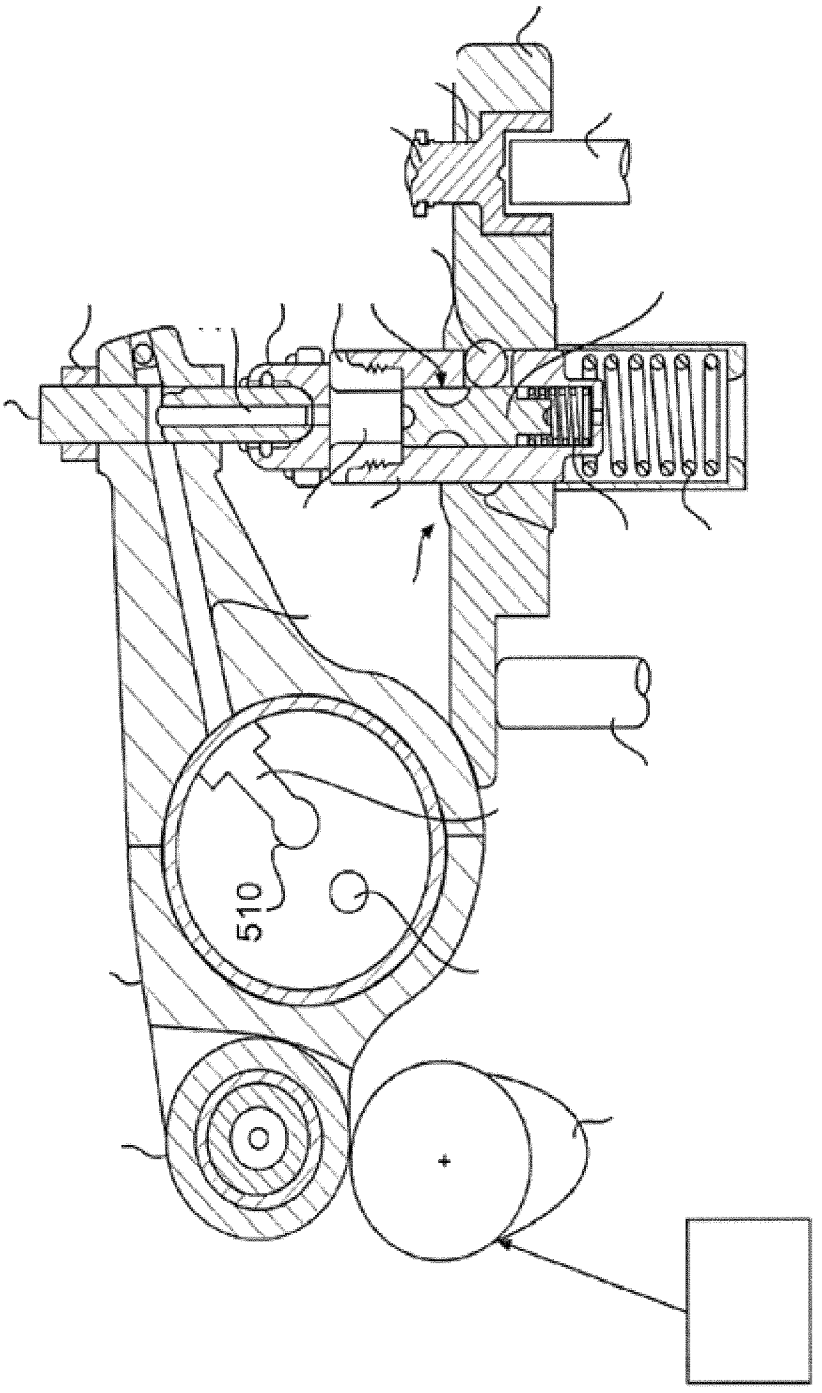
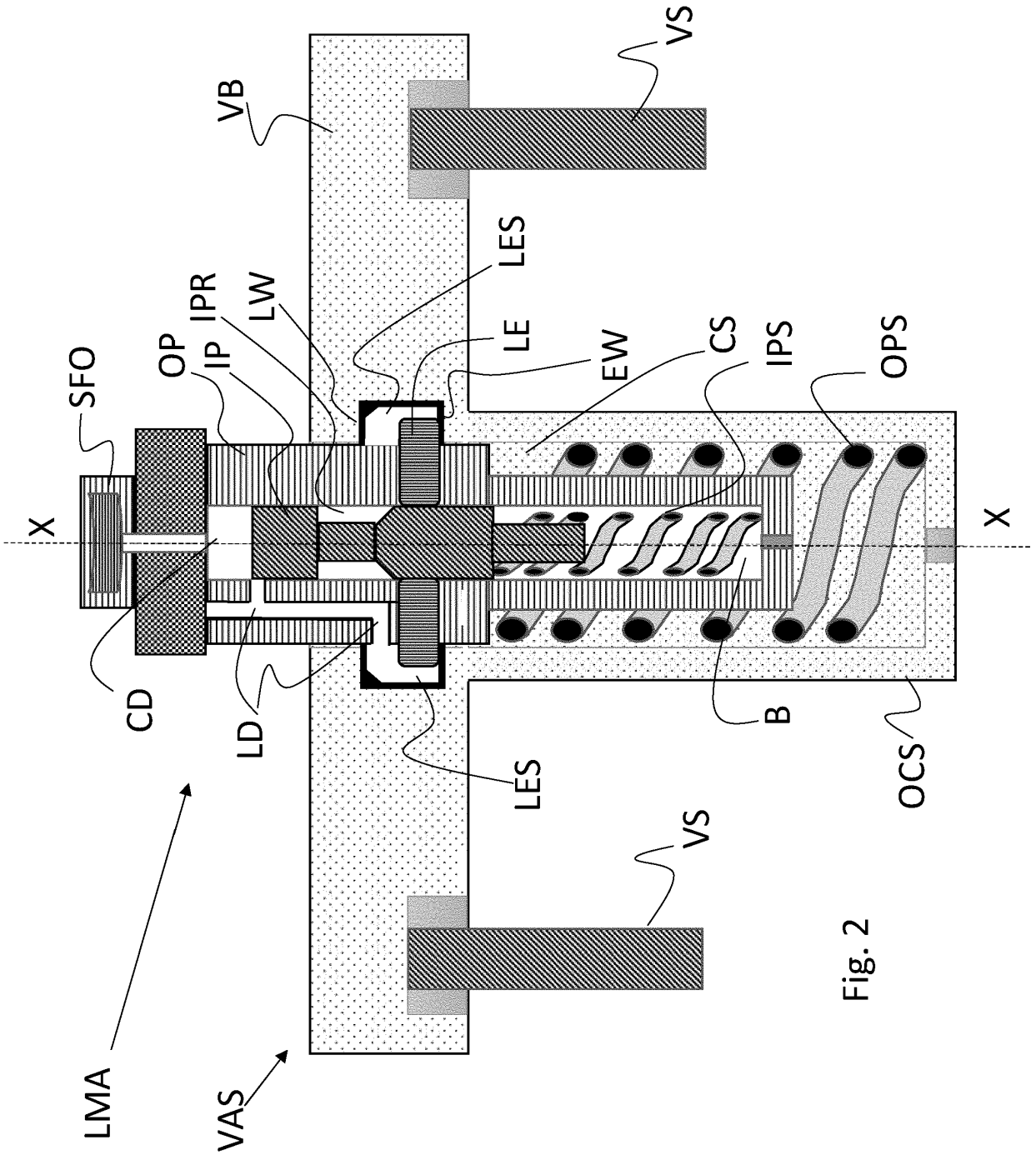


Fig. 1
(prior art)


VS
VB
LES
IPR
LW
LE
EW
CS
IPS
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SFO
OP
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X
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CD
LD
B
OCS
LES
VS
LMA
VAS

Fig. 2

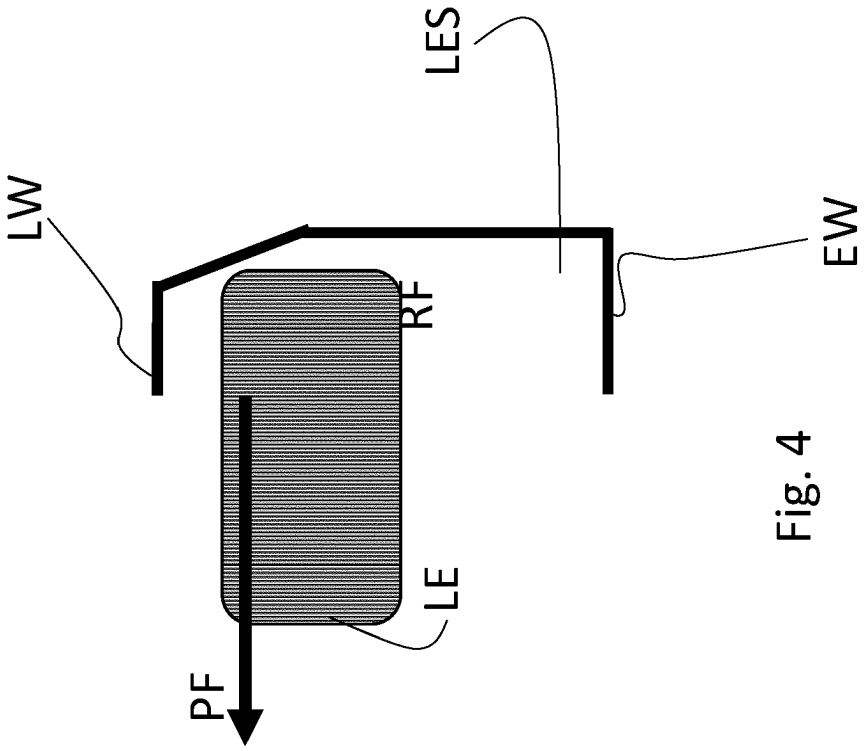

Fig. 4

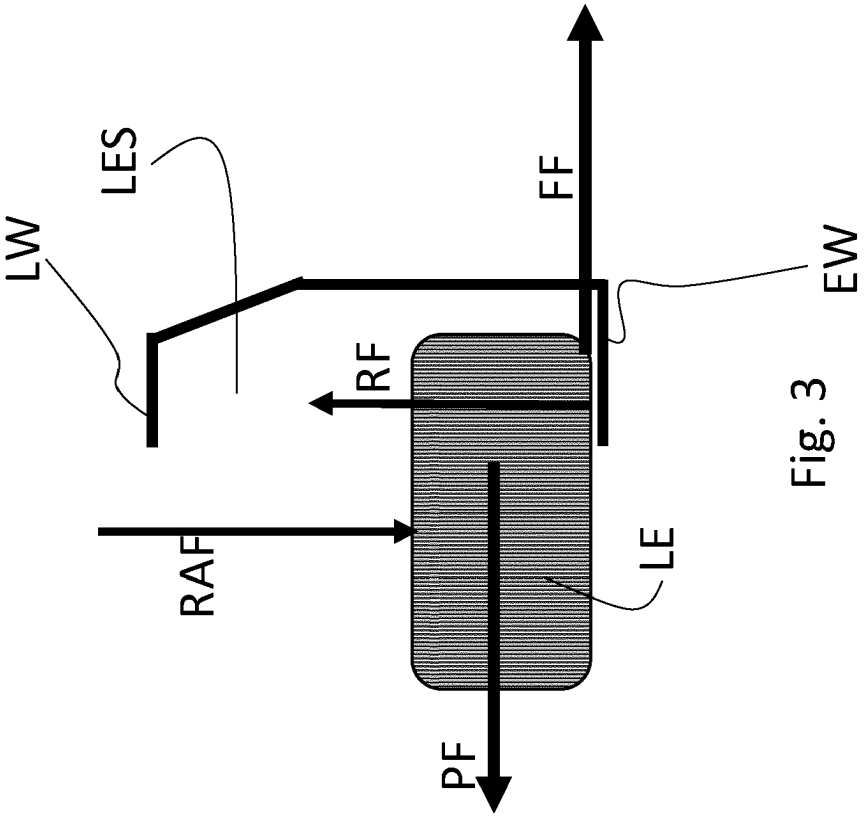

Fig. 3

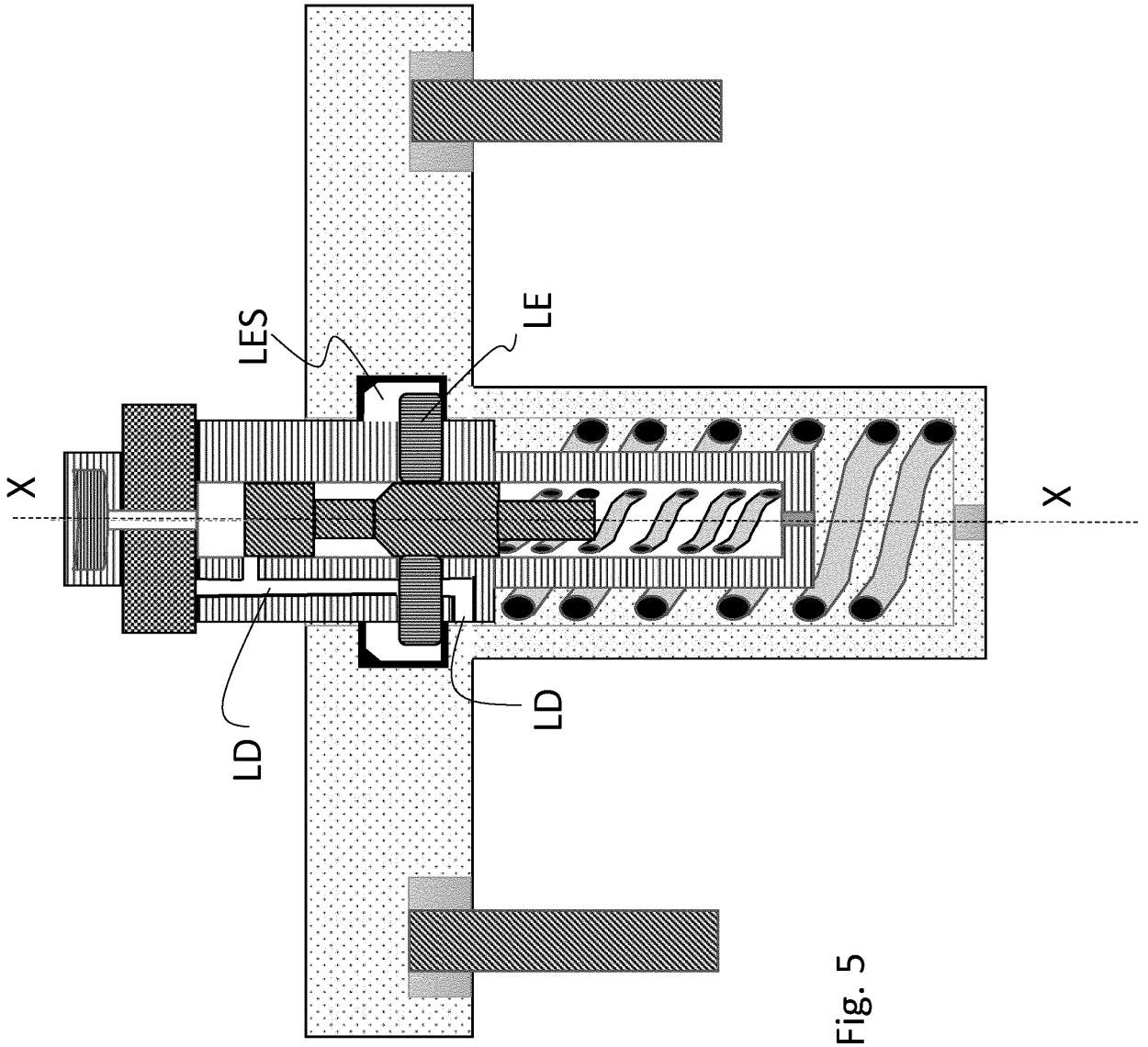

Fig. 5

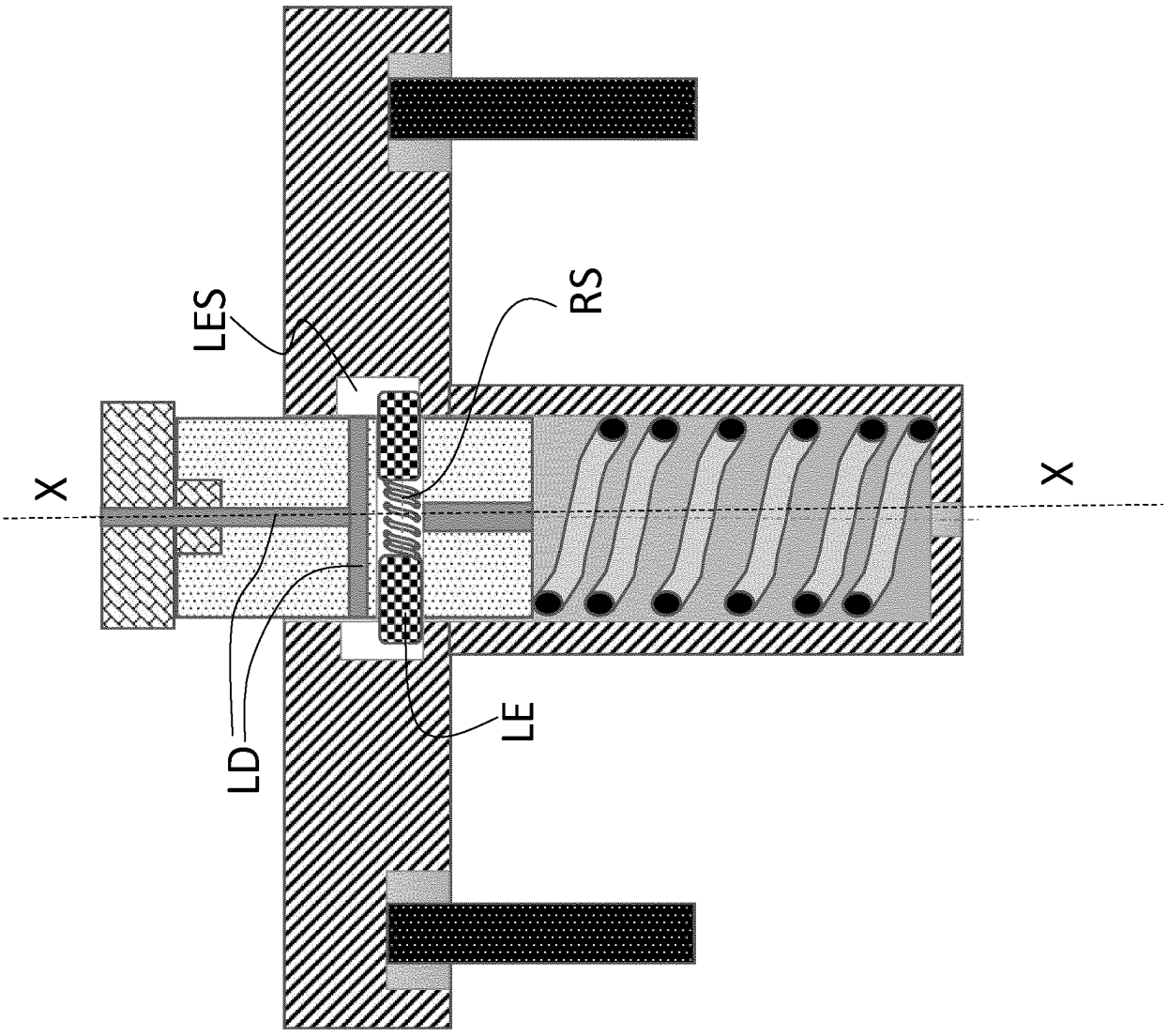

Fig. 6

REFERENCES CITED IN THE DESCRIPTION

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