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(54) **A CONTROL DEVICE FOR THE VALVE OF AN INTERNAL-COMBUSTION ENGINE**

STEUERVORRICHTUNG FÜR DAS VENTIL EINES VERBRENNUNGSMOTORS

DISPOSITIF DE COMMANDE POUR LA SOUPAPE D'UN MOTEUR À COMBUSTION INTERNE

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Description

TECHNICAL FIELD

[0001] The present invention relates to a control device for controlling the valve of an internal-combustion engine, and an engine-valvetrain assembly comprising said control device.

[0002] In particular, a heavy-duty internal-combustion engine comprises an engine-valvetrain assembly which in turn comprises at least one valve, preferably a valve assembly, comprising the valve and another valve and a control device of the at least valve. In particular, the at least valve is an exhaust or intake valve of the internal-combustion engine, consequently the valve assembly consists of two exhaust or intake valves. The valve control device comprises a shaped shaft and a rocker arm coupled to the shaped shaft and oscillating about an axis for opening or closing the valve.

BACKGROUND ART

[0003] Generally, heavy-duty internal-combustion engines provide the motor brake function. For this purpose, the shaped shaft comprises a first cam having two protrusions; and a second cam having a main lobe, wherein the first cam and the second cam are located on two different axial positions of the shaped shaft. In addition, the protrusions have a smaller radial size than the main lobe. Thanks to the protrusions it is possible, in certain circumstances, to open and close the exhaust valves so that the internal-combustion engine functions as a motor brake dissipating external kinetic energy, in particular acting as a compressor.

[0004] US 2016/281612 A1 discloses a valve-actuating device for varying the valve lift.

[0005] WO 2017/197044 A1 discloses a modular exhaust rocker arm assembly system comprising first and second rocker arm assemblies configured to each selectively receive a hydraulic lash adjustment assembly or a mechanical lash adjustment assembly.

[0006] US 2019/0055861 A1 discloses a device for controlling at least one valve in an internal combustion engine.

[0007] US 2016/305293 A1 discloses a compression-release engine brake system for lost motion rocker arm assembly.

[0008] WO 2016/184495 A1 discloses a rocker arm having oil release valve that operates as an accumulator. A problem of the prior art is that the control device is very sensitive to malfunctions, in particular it can present malfunctions when activating and deactivating the motor brake function in short times or it can take too long between the activation and subsequent deactivation of the motor brake function.

DISCLOSURE OF INVENTION

[0009] The object of the present invention is to obtain a control device for controlling the valve of an internal-combustion engine which reduces the drawbacks of the prior art.

[0010] In accordance with the present invention, a control device according to claim 1 is obtained.

[0011] Thanks to the present invention, the rocker arm is hydraulically controlled to interrupt or not the kinematic chain that goes from the shaped shaft to the valve through the rocker arm. The control device can selectively enable the reading of protrusions through the actuation duct in a simple and reliable way and reduce malfunctions. In other words, the control device can control whether the passage of the rocker arm over the protrusion has an effect or not on the valve through a hydraulic control.

[0012] The rocker arm comprises a first chamber, preferably a compensation chamber which houses part of a driving piston which in turn defines the position of the driving foot; a driving valve and a second chamber, preferably the second chamber is housed in the driving valve; the actuation duct is connected to the first chamber via the actuation valve; preferably the actuation valve is arranged between the first chamber and the actuation duct.

[0013] According to a preferred embodiment, the actuation device comprises a piston which defines the position of the driving foot; in particular the driving piston comprises the driving foot; the driving piston is movable within the first chamber so that the distance between the driving piston and the valve can vary, in particular the driving piston is slidable with respect to the body of the rocker arm and along an axis that is parallel to an axis orthogonal to the first axis of the rocker arm.

[0014] According to a preferred embodiment, the driving piston is movable within the first cavity between a first position and a second position as a function of the pressure of the actuation duct; and when the driving piston is in the first position, it pushes the foot towards the valve.

[0015] According to a preferred embodiment, the driving valve comprises a shutter arranged between the second chamber and the first chamber; and a piston coupled to the shutter to push the shutter into an open position.

[0016] The driving valve comprises a third chamber in communication with the second chamber via a protection element interposed between the second chamber and the third chamber.

[0017] According to a preferred embodiment, the protection element comprises an opening which sets the second chamber in communication with the third chamber.

[0018] According to a preferred embodiment, the piston comprises an elongated element which extends from the third chamber to the second chamber passing through the opening, preferably the opening has a minimum diameter which is greater than the diameter of the elongated element so that a flow of liquid can flow between the opening and the elongated element from the

second chamber to the third chamber and vice versa; preferably along the outer walls of the elongated element and the inner walls of the opening.

[0019] According to a preferred embodiment, the protection element has a funnel shape with a portion having a minimum diameter and a portion having a maximum diameter, and wherein the portion having the smaller diameter is turned towards the second chamber preferably towards the shutter.

[0020] According to a preferred embodiment, the actuation valve comprises a first elastic element coupled to the piston for pushing the piston along a direction and a first sense; and a second elastic element coupled to the shutter for pushing the shutter along the direction and a second sense opposite to the first sense; wherein the elastic force of the first elastic element is greater than the elastic force of the second elastic element.

[0021] According to a preferred embodiment, the control device comprises another rocker arm configured to be coupled to a valve assembly comprising the valve.

[0022] Another object of the present invention is to obtain an engine-valvetrain assembly which reduces the drawbacks of the prior art.

[0023] According to the present invention, an engine-valvetrain assembly comprising at least one valve of an internal-combustion engine and a control device of a valve according to any one of the claims 1 to 12 is obtained; the engine-valvetrain assembly comprising a shaped shaft coupled to the rocker arm.

[0024] In a preferred embodiment, the valve is an exhaust valve or an intake valve.

[0025] According to a preferred embodiment, the engine-valvetrain assembly comprises at least one valve assembly comprising the valve and another valve; and wherein the rocker arm is coupled to the valve, preferably so as to act exclusively on the valve; and the other rocker arm is coupled to the valve assembly via a bridge so as to act simultaneously on both valves.

[0026] In accordance with the present invention, the other valve is of the same type as the valve, consequently if the valve is an intake valve, the other valve is also an intake valve, if the valve is an exhaust valve, the other valve is also an exhaust valve.

[0027] According to a preferred embodiment, the engine-valvetrain assembly comprises at least one shaped shaft having a first cam having a plurality of protrusions and a second cam having a main lobe having a radial dimension greater than each radial dimension of the protrusions; and wherein the first cam is coupled with the first rocker arm and the second cam is coupled with the second rocker arm, preferably the first cam and the second cam have two different axial positions along the shaped shaft.

BRIEF DESCRIPTION OF THE DRAWINGS

[0028] Further characteristics and advantages of the present invention will become clear from the following

description of a non-limiting embodiment thereof, with reference to the figures of the attached drawings, wherein:

- 5 - Figure 1 is a top view, with parts removed for clarity, of an engine-valvetrain assembly made according to the present invention;
- Figure 2 is an enlarged perspective view, and with parts removed for clarity, of the engine-valvetrain assembly of Figure 1;
- 10 - Figure 3 is a section view along plane III-III, and with parts removed for clarity, of Figure 1; and
- Figure 4 is a perspective view, with exploded parts, of a rocker arm of the control device of the engine-valvetrain assembly of Figure 1;
- 15 - Figure 5 is a perspective view of a detail of the rocker arm of the control device; and
- Figure 6 is an enlarged section view of the detail of Figure 5.
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BEST MODE FOR CARRYING OUT THE INVENTION

[0029] In Figure 1, reference number 1 indicates an engine-valvetrain assembly of an internal-combustion engine. In particular, the internal-combustion engine is a high-powered and heavy-duty engine.

[0030] The engine-valvetrain assembly 1 comprises a plurality of valve assemblies 2, wherein each assembly comprises two valves 2; a control device 3 for each valve assembly 2 for controlling the opening and closing of the respective valve assembly 2; a shaped shaft 5 (Figure 1), in particular a camshaft, rotatable about an axis A2, and coupled to the plurality of control devices 3 for driving control devices 3; and a fixed shaft 19 whereon control devices 3 are arranged and which extends along an axis A1.

[0031] In a preferred embodiment, the valves 2 are exhaust valves.

[0032] In another preferred embodiment, the valves 2 are intake valves.

[0033] With reference to figures 1 and 2, each control device 3 comprises a rocker arm 6 rotatable about shaft 19 and axis A1; a rocker arm 7 rotatable about shaft 19 and axis A1; a bridge 4 which connects the respective valve assembly 2 to the respective rocker arm 6; a connection element 4a (figure 3) housed in the bridge 4 and interposed between the rocker arm 7 and one of the two valves 2; and a metal plate 13.

[0034] In particular, the metal plate 13 is fixed on one side on the shaft 19 and on the other side it is in contact with the rocker arm 7 for pushing the rocker arm 7 into contact with the shaped shaft 5.

[0035] In greater detail, rockers 6 and 7 oscillate around the axis A1.

[0036] In another embodiment, which is not shown in the attached figures, the engine-valvetrain assembly comprises a single exhaust or intake valve for each rock-

er arm and the rocker arm is directly connected to the exhaust or intake valve without interposition of the bridge.

[0037] The shaped shaft 5 comprises a shaft 8 and a plurality of cams which in turn comprise lobes or protrusions 10. In particular, the cam coupled and in contact with the rocker arm 6 comprises a lobe; the 9 in contact with the rocker arm 7 comprises two protrusions 10. In particular, the lobes and protrusions 10 extend radially to the axis A2 and each lobe has a radial dimension with respect to the axis A2 greater than the radial dimension with respect to the axis A2 of protrusions 10.

[0038] The shaft 8 can be hollow or solid. In addition, the shaft 8 and the cams can be made in one piece or in multiple elements assembled together.

[0039] In an alternative embodiment, the shaped shaft 5 consists of a solid machined piece on which cams and protrusions are obtained. In other words, the shaped shaft 5 is defined by a single piece whereon cams and protrusions are obtained and which can be solid or hollow.

[0040] With reference to figure 3, the rocker arm 7 comprises a body 11 which has a central element 11a and two arms 11b and 11c arranged on opposite sides of the central element 11a. The arm 11b is adjacent to the shaped shaft 5 and the 11c is adjacent to the exhaust valve 2.

[0041] In addition, the rocker arm 7 includes a roller 12 in contact with the shaped shaft 5 and rotatable about an axis A3; a lubrication duct 14 formed in the body 11; a driving foot 15 for the valve 2; a driving piston 16 comprising the foot 15; a driving duct 17 formed in the body 11; and a driving valve 18 coupled to the driving duct 17.

[0042] With reference to Figure 1, the engine-valve-train assembly comprises an oil control valve 27 coupled to the driving duct 17 (Figure 3) which controls the supply of oil to the driving duct 17 (Figure 3). In greater detail, the oil control valve 27 is configured for adjusting the flow and pressure of oil in the driving duct 17 equal to a desired flow in one sense or the other. In particular, in a preferred embodiment, the driving duct 17 is coupled to a plurality of driving valves 18, as a result, the oil control valve 27 is coupled to a plurality of driving valves 18 and adjusts the pressure in the driving duct 17 and, as a result, the opening and closing of a plurality of driving valves 18.

[0043] The driving duct 17 is a hydraulic duct which transports liquid and is in communication with the driving valve 18 to actuate the driving valve 18 hydraulically, in particular by supplying liquid under pressure.

[0044] Furthermore, the rocker arm 7 has an abutment plane 24 (figure 4) arranged in the arm 11b which is in contact with one end of the plate 13. In particular, the plate 13 pushes the rocker arm 7 on the shaped shaft 5 by exerting pressure on the abutment plane 24, so that the rocker arm 7, in particular the roller 12 of rocker arm 7, is kept in contact with the shaped shaft 5, in particular with cam 9 of shaped shaft 5.

[0045] In greater detail, the plate 13 is made so that its thickness is much less than its length. In greater detail,

the thickness is less than 1/10 of its length. Preferably, the thickness is less than 1/15 of its length. In particular, the thickness is less than 1/20 of its length.

[0046] In one embodiment, due to its shape, the plate 13 imposes a force on the end of the rocker arm 7 in contact with the shaped shaft 5. In other words, the plate 13 is configured and mounted so that it holds in position the end of rocker arm 7. With this aim, plate 13 is made so as to have a length greater than its thickness according to one of the ratios mentioned above.

[0047] In greater detail, the rocker arm 7 has a cavity 21 formed in the arm 11c and facing the exhaust valve 2 in which the driving piston 16 is housed. The cavity 21 which defines a chamber 22 between the walls of cavity 21 and the driving piston 16. The chamber 22 can be filled with liquid through the actuation duct 17 and the actuation valve 18 depending on whether the driving piston 16 has to be positioned in a first position, also called the ON position, or in a second position, also called the OFF position.

[0048] In addition, the rocker arm 7 comprises an adjustment element 28 coupled to the driving piston 16. In particular, the driving piston 16 comprises a coupling seat 29 which houses a portion of the adjustment element 28.

[0049] The adjustment element 28 is fixed with a screw element 26, in particular a bolt, to the rocker arm 7, in particular to the arm 11c of the rocker arm 7. The adjustment element 28 is fixed to the rocker arm 7 on a side opposite to that in contact with the driving piston 16.

[0050] The adjustment element 28 can be fixed in an adjustable manner thanks to the screw element 26 in the arm 11c. In particular, the adjustment element 28 can be fixed to the rocker arm 7 so that it protrudes more or less towards the piston 16, in this way it adjusts the movement of the piston 16 between a minimum and a maximum position.

[0051] In particular, the driving piston 16 comprises a machined area which defines the housing seat 29 and which is located on the opposite side of the portion which abuts on the connecting element 4a. In particular, the machined area comprises a recess 50 obtained inside a central body 51 of the driving piston 16, a blocking element 52 which is defined by a partial annular frame 53 which extends from the central body 51 of driving piston 16 and defines the recess 50, which has a partially annular shape, between the partial annular frame 53 and the central body 51. The partial annular frame 53 comprises a partial annular side wall 54 and also a partial annular base wall 55. The term partial annular refers to a portion of an annular region, in a preferred form of this invention the portion of the annular region is greater than half of the annular region. The adjustment element 28 is housed between the recess 50 and the block element 52 which together define a minimum and a maximum position of driving piston 16.

[0052] Furthermore, the rocker arm 7 comprises a cavity 20 which is obtained in the central element 11a in a position close to arm 11c. The cavity 20 houses the valve

18 and is in communication with the cavity 21. Furthermore, the cavity 20 is in communication with the actuation duct 17. In greater detail, the cavity 20 is arranged between the cavity 21 and the actuation duct 17.

[0053] With reference to Figures 3 and 4, the valve 18 is powered by the driving duct 17 and defines a chamber 23 inside the cavity 20. The chamber 23 is powered by the driving duct 17.

[0054] The valve 18 comprises a shutter 25, in particular a ball, arranged between the chamber 22 and the chamber 23 and which adjusts the passage of fluid between the chamber 22 and the chamber 23.

[0055] Furthermore, the valve 18 comprises a shutter guide 30; an elastic element 31 arranged between the shutter 25 and the shutter guide 30; an annular element 32 facing the shutter 25 from the side opposite the elastic element 31; a piston 33 having a main body 33a and an elongated element 33b; a protection element 34 of piston 33, in particular having a funnel shape; an elastic element 35 and a sleeve-shaped container element 36.

[0056] In particular, the shutter guide 30 comprises a base 37 from which a plurality of spokes 38 extend and which together define a cup shape.

[0057] The plurality of spokes 38 is in contact with the annular element 32.

[0058] In addition, the shutter guide 30 defines a seat which houses the elastic element 31 and at least in part the shutter 25.

[0059] The annular element 32 is, on one side, in contact with the shutter 25 when the valve 18 is closed and prevents the passage of fluid. Furthermore, the annular element 32 is in contact with the shutter guide 30, in particular with the plurality of spokes 38.

[0060] Furthermore, the annular element 32 is, on the other side, in contact with chamber 23. Furthermore, in use, the annular element 32 is crossed at least partially and internally by the elongated element 33b of piston 33. Furthermore, the annular element 32 faces the protection element 34.

[0061] The piston 33 is partially housed in the container element 36, in particular the main body 33a is completely housed in the container element 36. Furthermore, the main body 33a comprises an internal cavity 39 which faces the side opposite the elongated element 33b.

[0062] The elastic element 35 is arranged in the container element 36 and partially in the internal cavity 39 of the main body 33a. In particular, the elastic element 35 is housed between a bottom wall 41 of the container element 36 and an internal wall 39a of cavity 39 of the main body 33a so as to push piston 33 from the opposite side to the bottom wall 41 of container element 36, in particular towards shutter 25. In particular, the elastic element 35 pushes the piston 33 along the direction D and with the sense V1.

[0063] The protection element 34 faces piston 33 from the side opposite the cavity 39 and engages with an inner annular wall 40 of the container element 36. The inner annular wall 40 of the container element 36 which ex-

tends from the bottom wall 41 and houses the main body 33a of piston 33.

[0064] Furthermore, the protection element 34 has an opening 34a inside which the elongated element 33b of the piston 33 passes. In greater detail, the protection element 34 has a funnel shape, having a portion with a minimum diameter and a portion with a maximum diameter; the portion with a minimum diameter is turned towards the shutter 25. The protection element 34 is, on one side, bordering on chamber 23. The other side of the protection element 34 is turned towards the main body 33a of piston 33 and the bottom wall 41 of the container element 36.

[0065] In addition, the protection element 34 defines a chamber 42 partly inside the container element 36.

[0066] The chamber 42 has an annular shape. In particular, the chamber 42 is delimited by the protection element 34, by the piston 33 and by the internal annular wall 40.

[0067] The protection element 34 and the main body 33a are arranged on opposite sides with respect to chamber 42.

[0068] The chamber 42 is in connection with the chamber 23 and, consequently, it is in connection with the actuation duct 17.

[0069] In particular, the minimum diameter of opening 34a of the protection element 34 is greater than the maximum diameter of the elongated element 33b that passes through it, as a result, it defines a communication channel between chamber 23 and chamber 42. In other words, chamber 23 and chamber 42 are in communication through the opening 34a of the protection element 34. Then, the liquid passes between chamber 23 and chamber 42 and comes into contact with piston 33, in particular with the main body 33a pushing it along a sense opposite to the sense of thrust of the elastic element 35. In other words, the liquid passing from chamber 23 to chamber 42 pushes the main body of piston 33a along the direction D and the sense V2.

[0070] The protection element 34 has the function of protecting the main body 33a of piston 33 from turbulences that can be created by the flow of liquid when it moves from chamber 22 to chamber 23 and towards the actuation duct 17, in other words, when the actuation duct 17 lowers the pressure of the liquid to make the liquid flow from chamber 22 towards chamber 23 and finally towards the actuation duct 17, this liquid which moves with a considerable flow should not impact on to the main body 33a of piston 33 because otherwise it would tend to move it and, as a result, move the shutter 25.

[0071] In other words, the protection element 34 has the task of diverting the flow of the liquid arriving from chamber 22 towards chamber 23 towards the actuation duct 17, and of protecting the body 33a of piston 33 from this flow.

[0072] Furthermore, the elastic force of the elastic element 35 is greater than the elastic force of the elastic element 31 so that, when the pressure in the actuation

duct 17 is below a first threshold, the piston 33 is pushed by the elastic element 35 towards the shutter 25 to open the valve 18, that is to set chamber 23 in communication with chamber 22.

[0073] When, on the other hand, the pressure in the actuation duct 17 is above a second threshold, the pressurized fluid pushes the piston 33 with a sense opposite to that of the elastic element 35, in particular with the sense V2, and the piston 33 is not in contact with the shutter 25. In this case, the elastic element 31 pushes the shutter 25 towards the annular element 32, in particular along the sense V2, and closes the valve 18, that is, it prevents any passage of fluid between chamber 22 and chamber 23. In particular, the pressurized fluid passes from chamber 23 to chamber 42 through the opening 34a of the protection element 34 and pushes the piston 33 with a sense opposite to that of the elastic element 35, in particular along the sense V2.

[0074] When, on the other hand, the pressure inside the actuation duct 17 is below the first threshold, the piston 33 pushes the shutter 25 and moves it away from the annular element 32, in this way the valve 18 is open and allows the passage of liquid between chamber 22 and chamber 23 and the actuation duct 17. In greater detail, the elongated element 33b of piston 33 is pushed into contact with shutter 25 and passes through the protection element 34 and the annular element 32. Shutter 25 under the thrust of piston 33 is opened and some liquid can flow between chamber 23 and chamber 22 in both senses. In fact, the elastic force of the elastic element 31 is less than the elastic force of the elastic element 35. In this condition, the driving piston can move within cavity 21 and any liquid of cavity 21 can move from chamber 22 towards chamber 23 under the thrust of driving piston 16. Consequently, when the rocker arm 7 passes over the protrusions 10, the driving piston 17 moves within cavity 21 compressing the chamber 22 and has no effect on the exhaust valve 2. In this condition, therefore, the driving piston 16 does not act on valves 2 for braking and the passage over the protrusions 10 is compensated by a movement of piston 2 within the chamber 22. In other words, when the roller 12 of the rocker arm 7 passes over the protrusions 10, the piston 16 compresses the chamber 22 without actuating the exhaust valve 2. In particular, the piston can move within cavity 21 towards the bottom of cavity 21. This configuration is called the OFF configuration of the rocker arm 7 and occurs when the actuation duct 17 has a pressure below the first threshold. In other words, when the pressure in the actuation duct 17 is below the first threshold, the rocker arm 7 does not read the protrusions 10 and the internal-combustion engine braking is not activated.

[0075] When the motor brake is to be activated, the pressure in the actuation duct 17 is increased to a value above a second threshold. When the pressure of the actuation duct 17 increases above the first threshold, the liquid passes from chamber 23 to chamber 22 and chamber 22 fills with liquid thus pushing the piston 16 towards

the exhaust valve 2. Furthermore, the increase of the pressure in the actuation duct 17 above the first threshold also causes a passage of liquid from chamber 23 to chamber 42 which begins to exert a force on piston 33 with a sense opposite to the elastic force of the elastic element 35, i.e. along the sense V2.

[0076] As the pressure in the actuation duct 17 increases, the amount and pressure of liquid passing from chamber 23 to chamber 22 increase.

[0077] As the pressure in the actuation duct 17 increases, the amount and pressure of liquid passing from chamber 23 to chamber 42 increase.

[0078] When the pressure in the actuation duct 17 reaches a pressure greater than the second threshold, the liquid in the chamber 42 exerts a force on piston 33 which is greater and with a sense opposite to the elastic force of the elastic element 35, consequently the piston 33 moves towards the side opposite the shutter 25, in particular along the sense V2. In other words, the piston 33 moves away from shutter 25 and detaches from it.

[0079] When the pressure in the actuation duct 17 is greater than the second threshold, the shutter 25 is no longer in contact with the piston 33 and is pushed by the elastic element 31 towards the annular element 32 thus closing the passage between chamber 23 and chamber 22. Then, when the pressure in the actuation duct 17 is greater than the second threshold, the valve 18 is closed and the chamber 22 is filled with liquid at a pressure equal to that in the actuation duct 17 which is greater than the second threshold. This liquid in the chamber 22 pushes the driving piston 16 towards the exhaust valve 2. Consequently, when the rocker arm 7, in particular the roller 12 of the rocker arm 7, passes over the protrusions 10, the driving piston 16 acts on the respective exhaust valve 2 thus actuating it. In other words, when the pressure in the actuation duct 17 is greater than the second threshold, the rocker arm 7 reads the protrusions 10 and activates the internal-combustion engine braking. Consequently, when the pressure in the actuation duct 17 is greater than the second threshold, the passage of the rocker arm 7 over the protrusions 10 causes an actuation of the exhaust valve 2.

[0080] This configuration is called the ON configuration of the rocker arm 7 and occurs when the actuation duct 17 has a pressure greater than the second threshold and results in the activation of the motor brake on the internal-combustion engine.

[0081] The transition between the OFF configuration and the ON configuration of the rocker arm 7 takes place in a very rapid time, preferably less than one second, in particular in the order of milliseconds. The pressure in the actuation duct 17 passes from a pressure below the first threshold to a pressure above the second threshold in a very rapid time, preferably less than one second, in particular in the order of milliseconds.

[0082] This allows a very advantageous and performing application of this control device to vehicles with automatic transmission.

[0083] When the pressure in the actuation duct 17 decreases from the second threshold to the first threshold, some liquid passes from chamber 42 to chamber 23 and the pressure in chamber 42 decreases. Consequently, the piston 33 starts to move towards the shutter 25, in particular along the sense V1, until it comes into contact with the shutter 25. This movement of piston 33 is caused by the fact that the elastic force of the elastic element 35 is greater than the force exerted by the pressure of the liquid in the chamber 42. The shutter 25, as a result, moves away from the annular element 32 and the valve 18 opens thus setting the chamber 22 in communication with the chamber 23. In this circumstance, the liquid from the chamber 22 moves towards the chamber 23 and in the driving duct 17.

[0084] As mentioned above, the protective element is arranged between chamber 23 and chamber 42.

[0085] The pressure wave determined by the liquid passing from chamber 22 to chamber 23 and flowing into the driving duct 17, is reduced by the protection element 34 and, as a result, arrives strongly attenuated into chamber 42. As a result, the correct functioning of piston 33 is not affected by the pressure wave. In fact, the protection element 34 has the function of diverting the pressure wave coming from chamber 22 into chamber 23 towards the actuation duct 17 and, therefore, drastically reduces the portion of liquid flowing towards the chamber 42. In this way, the flow of liquid from chamber 22 into chamber 23 does not impact the main body 33a of piston 33 and does not move piston 33. This avoids involuntary movements of piston 33 and involuntary closings of driving valve 18. The chamber 22, the chamber 23, the piston 16 and the valve 18 define a rocker arm 7 actuation device which is driven by the actuation duct 17 as a function of the pressure in the actuation duct 17.

[0086] The chamber 22 defines a compensation chamber for driving piston 16 which can move within it so as to compensate for the passage over protrusions 10 and to not actuate the exhaust valve 2 when the actuation duct 17 has a pressure below the first threshold.

Claims

1. A control device for controlling the valve of an internal-combustion engine; the control device (3) comprising:
 - a rocker arm (7), which is mounted so as to be rotatable about a first axis (A1) and can be coupled to a shaped shaft (5), in particular a cam-shaft;
 - a driving foot (15) configured to act on the valve (2);
 - an actuation device (22, 23, 18, 16) housed within the rocker arm (7) for selectively transmitting a movement between the shaped shaft (5) and the valve (2);

- a driving duct (17) in communication with the actuation device (22, 23, 18, 16); the driving duct (17) being configured to hydraulically enable or disable the actuation device (22, 23, 18, 16); preferably the valve (2) is an exhaust or intake valve;

the control device being **characterized in that:**

the rocker arm (7) comprises a driving piston (16) and a first chamber (22), preferably a compensation chamber, that houses part of the driving piston (16), which in turn defines the position of the driving foot (15); a driving valve (18); and a second chamber (23), preferably the second chamber (23) is housed in the driving valve (18); the driving duct (17) is in connection with the first chamber (22) via the driving valve (18); the driving valve is arranged between the first chamber (22) and the driving duct (17); wherein the driving valve (18) comprises a third chamber (42) in communication with the second chamber (23) via a protection element (34) interposed between the second and the third chambers (23, 42).

2. The control device according to claim 1, wherein the actuation device comprises a driving piston (16), which defines the position of the driving foot (15); in particular, the driving piston (16) comprises the driving foot (15); the driving piston (16) is mobile within the first chamber (22) so that the distance between the driving piston (16) and the valve (2) can vary; in particular, the driving piston (16) is slidable with respect to the body (11) of the rocker arm (7) and along an axis that is parallel to an axis orthogonal to the first axis (A1).
3. The control device of Claim 1, wherein the driving piston (16) is mobile within the first cavity (21) between a first position and a second position as a function of the pressure of the driving duct (17), and, when the driving piston (16) is in the first position, the foot (15) is pushed towards the valve (2).
4. The control device according to any one of the preceding claims, the driving valve (18) comprising a shutter (25) arranged between the second chamber (23) and the first chamber (22) and a piston (33) coupled to the shutter (25) for pushing the shutter (25) into an open position.
5. The control device of Claim 1, wherein the protection element (34) comprises an opening (34a), which sets the second chamber (23) in communication with the third chamber (42).
6. The control device of Claim 5, wherein the piston

(33) comprises an elongated element (33b), which extends from the third chamber (42) to the second chamber (23) passing through the opening (34a) of the protection element (34), preferably the opening (34a) has a minimum diameter that is greater than the diameter, preferably maximum, of the elongated element (33b) so that a flow of liquid can pass between the opening (34a) and the elongated element (33b) from the second chamber (23) to the third chamber (42) and vice versa, preferably along the outer walls of the elongated element and the inner walls of the opening (34a).

7. The control device of Claim 5 or Claim 6, wherein the protection element (34) has a funnel-shape with a portion having a minimum diameter and a portion having a maximum diameter, and wherein the portion having the minimum diameter faces the second chamber (23) preferably towards the shutter (25).
8. The control device of Claim 4, wherein the actuation valve (18) comprises a first elastic element (35) coupled to the piston (33) for pushing the piston (32) along a direction (D) with a first sense (V1); and a second elastic element (31) coupled to the shutter (25) for pushing the shutter (25) along the direction (D) with a second sense (V2) opposite to the first sense (V1); wherein the elastic force of the first elastic element (35) is greater than the elastic force of the second elastic element (31).
9. The control device according to any one of the preceding claims, comprising another rocker arm (6) configured to be coupled to a valve assembly (2) comprising the valve (2).
10. An engine-valvetrain assembly comprising at least one valve (2) of an internal-combustion engine and a control device (3) of a valve (2) according to any one of the preceding claims; the engine-valvetrain (1) comprising a shaped shaft (5), coupled to the rocker arm (7) for acting on the valve (2) through the rocker arm (7).
11. The engine-valvetrain assembly according to Claim 10 comprising at least one valve assembly (2), comprising the valve (2) and another valve (2); and wherein the rocker arm (7) is coupled to the valve (2), preferably so as to act exclusively on the valve (2); and the other rocker arm (6) is coupled to the valve assembly (2) via a bridge (4) so as to act simultaneously on both of the valves (2).
12. The engine-valvetrain assembly according to Claim 11, wherein the shaped shaft (5) has a first cam (9) having a plurality of protrusions (10) and a second cam having a main lobe, which has a radial dimension greater than each radial dimension of the pro-

trusions (10); and wherein the first cam (9) is coupled to the rocker arm (7) and the second cam is coupled to the other rocker arm (6).

Patentansprüche

1. Steuervorrichtung zum Steuern des Ventils eines Verbrennungsmotors; wobei die Steuervorrichtung (3) aufweist:

- einen Kipphebel (7), der um eine erste Achse (A1) drehbar gelagert ist und mit einer geformten Welle (5), insbesondere einer Nockenwelle, gekoppelt werden kann;
- einen Antriebsfuß (15), der zum Einwirken auf das Ventil (2) konfiguriert ist;
- eine in dem Kipphebel (7) untergebrachte Betätigungsvorrichtung (22, 23, 18, 16) zum selektiven Übertragen einer Bewegung zwischen der geformten Welle (5) und dem Ventil (2);
- einen Antriebskanal (17), der mit der Betätigungsvorrichtung (22, 23, 18, 16) in Verbindung steht; wobei der Antriebskanal (17) zum hydraulischen Aktivieren oder Deaktivieren der Betätigungsvorrichtung (22, 23, 18, 16) konfiguriert ist, vorzugsweise ist das Ventil (2) ein Auslass- oder Einlassventil;

wobei die Steuervorrichtung **dadurch gekennzeichnet ist, dass:**

der Kipphebel (7) einen Antriebskolben (16) und eine erste Kammer (22), vorzugsweise eine Ausgleichskammer, die einen Teil des Antriebskolbens (16) aufnimmt, der wiederum die Position des Antriebsfußes (15) definiert; ein Antriebsventil (18); und eine zweite Kammer (23), wobei die zweite Kammer (23) vorzugsweise in dem Antriebsventil (18) untergebracht ist, aufweist, der Antriebskanal (17) über das Antriebsventil (18) mit der ersten Kammer (22) in Verbindung steht; das Antriebsventil zwischen der ersten Kammer (22) und dem Antriebskanal (17) angeordnet ist;

wobei das Antriebsventil (18) eine dritte Kammer (42) aufweist, die mit der zweiten Kammer (23) über ein Schutzelement (34) in Verbindung steht, das zwischen der zweiten und der dritten Kammer (23, 42) angeordnet ist.

2. Steuervorrichtung nach Anspruch 1, wobei die Betätigungsvorrichtung einen Antriebskolben (16) aufweist, der die Position des Antriebsfußes (15) definiert; insbesondere weist der Antriebskolben (16) den Antriebsfuß (15) auf; ist der Antriebskolben (16) in der ersten Kammer (22) beweglich, sodass der

Abstand zwischen dem Antriebskolben (16) und dem Ventil (2) variieren kann; insbesondere ist der Antriebskolben (16) in Bezug auf den Körper (11) des Kipphebels (7) und entlang einer Achse verschiebbar, die parallel zu einer orthogonal zur ersten Achse (A1) verlaufenden Achse verläuft.

3. Steuervorrichtung nach Anspruch 1, wobei der Antriebskolben (16) in Abhängigkeit vom Druck des Antriebskanals (17) im ersten Hohlraum (21) zwischen einer ersten Position und einer zweiten Position beweglich ist und der Fuß (15) in der ersten Position des Antriebskolbens (16) in Richtung des Ventils (2) gedrückt wird.
4. Steuervorrichtung nach einem der vorstehenden Ansprüche, wobei das Antriebsventil (18) einen zwischen der zweiten Kammer (23) und der ersten Kammer (22) angeordneten Verschluss (25) und einen mit dem Verschluss (25) gekoppelten Kolben (33) zum Schieben des Verschlusses (25) in eine offene Position aufweist.
5. Steuervorrichtung nach Anspruch 1, wobei das Schutzelement (34) eine Öffnung (34a) aufweist, die die zweite Kammer (23) mit der dritten Kammer (42) in Verbindung setzt.
6. Steuervorrichtung nach Anspruch 5, wobei der Kolben (33) ein längliches Element (33b) aufweist, das sich von der dritten Kammer (42) durch die Öffnung (34a) des Schutzelements (34) hindurch zur zweiten Kammer (23) erstreckt, wobei die Öffnung (34a) vorzugsweise einen minimalen Durchmesser aufweist, der größer als der Durchmesser, vorzugsweise der maximale Durchmesser, des länglichen Elements (33b) ist, sodass ein Flüssigkeitsstrom zwischen der Öffnung (34a) und dem länglichen Element (33b) von der zweiten Kammer (23) zur dritten Kammer (42) und umgekehrt, vorzugsweise entlang der Außenwände des länglichen Elements und der Innenwände der Öffnung (34a) fließen kann.
7. Steuervorrichtung nach Anspruch 5 oder Anspruch 6, wobei das Schutzelement (34) eine Trichterform mit einem Abschnitt mit einem minimalen Durchmesser und einem Abschnitt mit einem maximalen Durchmesser aufweist, und wobei der Abschnitt mit dem minimalen Durchmesser der zweiten Kammer (23) vorzugsweise dem Verschluss (25) zugewandt ist.
8. Steuervorrichtung nach Anspruch 4, wobei das Betätigungsventil (18) ein erstes elastisches Element (35), das mit dem Kolben (33) gekoppelt ist, um den Kolben (32) entlang einer Ausrichtung (D) in einer ersten Richtung (V1) zu schieben, und ein zweites elastisches Element (31), das mit dem Verschluss

(25) gekoppelt ist, um den Verschluss (25) entlang der Ausrichtung (D) in einer zweiten Richtung (V2) entgegengesetzt zur ersten Richtung (V1) zu schieben, aufweist, wobei die elastische Kraft des ersten elastischen Elements (35) größer als die elastische Kraft des zweiten elastischen Elements (31) ist.

9. Steuervorrichtung nach einem der vorstehenden Ansprüche, aufweisend einen weiteren Kipphebel (6), der so konfiguriert ist, dass er mit einer das Ventil (2) aufweisenden Ventilanordnung (2) gekoppelt werden kann.
10. Motor-Ventiltrieb-Anordnung mit mindestens einem Ventil (2) eines Verbrennungsmotors und einer Steuervorrichtung (3) eines Ventils (2) nach einem der vorstehenden Ansprüche, wobei der Motor-Ventiltrieb (1) eine geformte Welle (5) aufweist, die mit dem Kipphebel (7) gekoppelt ist, um über den Kipphebel (7) auf das Ventil (2) einzuwirken.
11. Motor-Ventiltrieb-Anordnung nach Anspruch 10, aufweisend mindestens eine Ventilanordnung (2), die das Ventil (2) und ein weiteres Ventil (2) aufweist, und wobei der Kipphebel (7) mit dem Ventil (2) vorzugsweise so gekoppelt ist, dass er ausschließlich auf das Ventil (2) einwirkt; und der andere Kipphebel (6) über eine Brücke (4) mit der Ventilanordnung (2) gekoppelt ist, so dass er gleichzeitig auf beide Ventile (2) einwirkt.
12. Motor-Ventiltrieb-Anordnung nach Anspruch 11, wobei die geformte Welle (5) einen ersten Nocken (9) mit mehreren Vorsprüngen (10) und einen zweiten Nocken mit einem Hauptnocken aufweist, der eine radiale Abmessung hat, die größer als jede radiale Abmessung der Vorsprünge (10) ist; und wobei der erste Nocken (9) mit dem Kipphebel (7) gekoppelt ist und der zweite Nocken mit dem anderen Kipphebel (6) gekoppelt ist.

Revendications

1. Dispositif de commande de la soupape d'un moteur à combustion interne ; le dispositif de commande (3) comprenant :
 - un culbuteur (7), qui est monté de manière à pouvoir tourner autour d'un premier axe (A1) et qui peut être couplé à un arbre de forme (5), en particulier un arbre à cames ;
 - un pied d'entraînement (15) configuré pour agir sur la soupape (2) ;
 - un dispositif d'actionnement (22, 23, 18, 16) logé dans le culbuteur (7) pour transmettre sélectivement un mouvement entre l'arbre de forme (5) et la soupape (2) ;

- un conduit d'entraînement (17) en communication avec le dispositif d'actionnement (22, 23, 18, 16) ; le conduit d'entraînement (17) étant configuré pour activer ou désactiver hydrauliquement le dispositif d'actionnement (22, 23, 18, 16) ; de préférence, la soupape (2) est une soupape d'échappement ou d'admission ;

le dispositif de commande étant **caractérisé en ce que** :

- le culbuteur (7) comprend un piston d'entraînement (16) et une première chambre (22), de préférence une chambre de compensation, qui loge une partie du piston d'entraînement (16), qui à son tour définit la position du pied d'entraînement (15) ; une soupape de commande (18) ; et une deuxième chambre (23), de préférence la deuxième chambre (23) est logée dans la soupape d'entraînement (18) ; le conduit d'entraînement (17) est relié à la première chambre (22) par la soupape d'entraînement (18) ; la soupape d'entraînement est disposée entre la première chambre (22) et le conduit d'entraînement (17) ; dans lequel la soupape d'entraînement (18) comprend une troisième chambre (42) en communication avec la deuxième chambre (23) par l'intermédiaire d'un élément de protection (34) interposé entre la deuxième et la troisième chambre (23, 42).
2. Dispositif de commande selon la revendication 1, dans lequel le dispositif d'actionnement comprend un piston d'entraînement (16), qui définit la position du pied d'entraînement (15) ; en particulier, le piston d'entraînement (16) comprend le pied d'entraînement (15) ; le piston d'entraînement (16) est mobile à l'intérieur de la première chambre (22) de sorte que la distance entre le piston d'entraînement (16) et la soupape (2) peut varier ; en particulier, le piston d'entraînement (16) est coulissant par rapport au corps (11) du culbuteur (7) et le long d'un axe parallèle à un axe orthogonal au premier axe (A1).
 3. Dispositif de commande selon la revendication 1, dans lequel le piston d'entraînement (16) est mobile à l'intérieur de la première cavité (21) entre une première position et une deuxième position en fonction de la pression du conduit d'entraînement (17), et, lorsque le piston d'entraînement (16) est dans la première position, le pied (15) est poussé vers la soupape (2).
 4. Dispositif de commande selon l'une quelconque des revendications précédentes, la soupape d'entraînement (18) comprenant un obturateur (25) disposé entre la deuxième chambre (23) et la première chambre (22) et un piston (33) couplé à l'obturateur (25) pour pousser l'obturateur (25) dans une position ouverte.
 5. Dispositif de commande selon la revendication 1, dans lequel l'élément de protection (34) comprend une ouverture (34a) qui met la deuxième chambre (23) en communication avec la troisième chambre (42).
 6. Dispositif de commande selon la revendication 5, dans lequel le piston (33) comprend un élément allongé (33b), qui s'étend de la troisième chambre (42) à la deuxième chambre (23) en passant par l'ouverture (34a) de l'élément de protection (34), de préférence l'ouverture (34a) a un diamètre minimum qui est plus grand que le diamètre, de préférence maximal, de l'élément allongé (33b) afin qu'un flux de liquide puisse passer entre l'ouverture (34a) et l'élément allongé (33b) de la deuxième chambre (23) à la troisième chambre (42) et vice versa, de préférence le long des parois extérieures de l'élément allongé et des parois intérieures de l'ouverture (34a).
 7. Dispositif de commande selon la revendication 5 ou la revendication 6, dans lequel l'élément de protection (34) a une forme d'entonnoir avec une partie ayant un diamètre minimum et une partie ayant un diamètre maximum, et dans lequel la partie ayant le diamètre minimum fait face à la deuxième chambre (23) de préférence vers l'obturateur (25) .
 8. Dispositif de commande selon la revendication 4, dans lequel la soupape d'actionnement (18) comprend un premier élément élastique (35) couplé au piston (33) pour pousser le piston (32) le long d'une direction (D) avec un premier sens (V1) ; et un second élément élastique (31) couplé à l'obturateur (25) pour pousser l'obturateur (25) le long de la direction (D) avec un second sens (V2) opposé au premier sens (V1) ; dans lequel la force élastique du premier élément élastique (35) est plus grande que la force élastique du second élément élastique (31).
 9. Dispositif de commande selon l'une quelconque des revendications précédentes, comprenant un autre culbuteur (6) configuré pour être couplé à un ensemble de soupapes (2) comprenant la soupape (2) .
 10. Ensemble moteur-organes de distribution comprenant au moins une soupape (2) d'un moteur à combustion interne et un dispositif de commande (3) d'une soupape (2) selon l'une quelconque des revendications précédentes ; le moteur-organes de distribution (1) comprenant un arbre de forme (5), couplé au culbuteur (7) pour agir sur la soupape (2) par l'intermédiaire du culbuteur (7).
 11. Ensemble moteur-organes de distribution selon la

revendication 10 comprenant au moins un ensemble de soupapes (2), comprenant la soupape (2) et une autre soupape (2) ; et dans lequel le culbuteur (7) est couplé à la soupape (2), de préférence de manière à agir exclusivement sur la soupape (2) ; et l'autre culbuteur (6) est couplé à l'ensemble de soupapes (2) par l'intermédiaire d'un pont (4) de manière à agir simultanément sur les deux soupapes (2). 5

12. Ensemble moteur-organe de distribution selon la revendication 11, dans lequel l'arbre de forme (5) a une première came (9) ayant une pluralité de saillies (10) et une seconde came ayant un lobe principal, qui a une dimension radiale supérieure à chaque dimension radiale des saillies (10) ; et dans lequel la première came (9) est couplée au culbuteur (7) et la seconde came est couplée à l'autre culbuteur (6). 10 15

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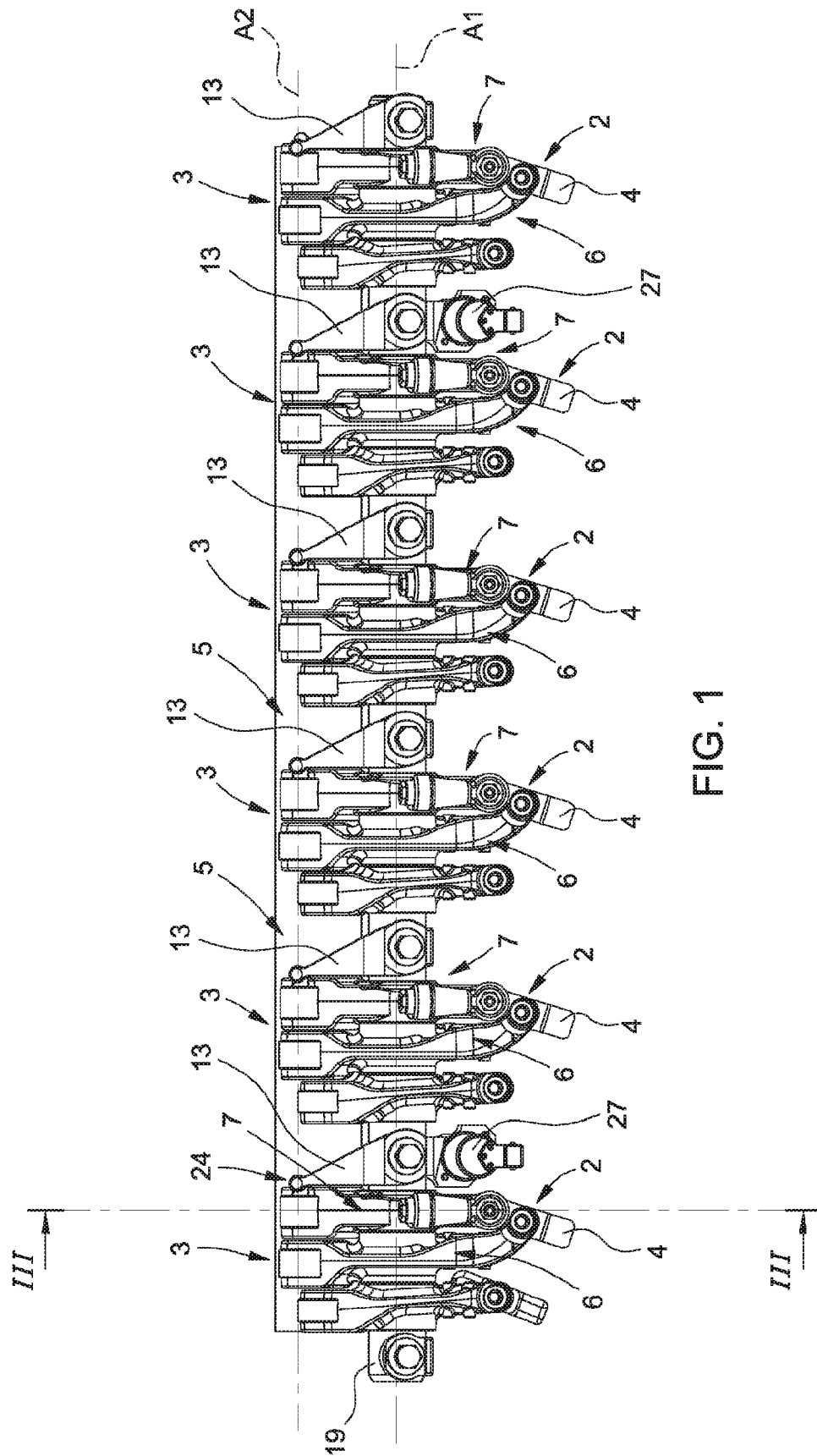
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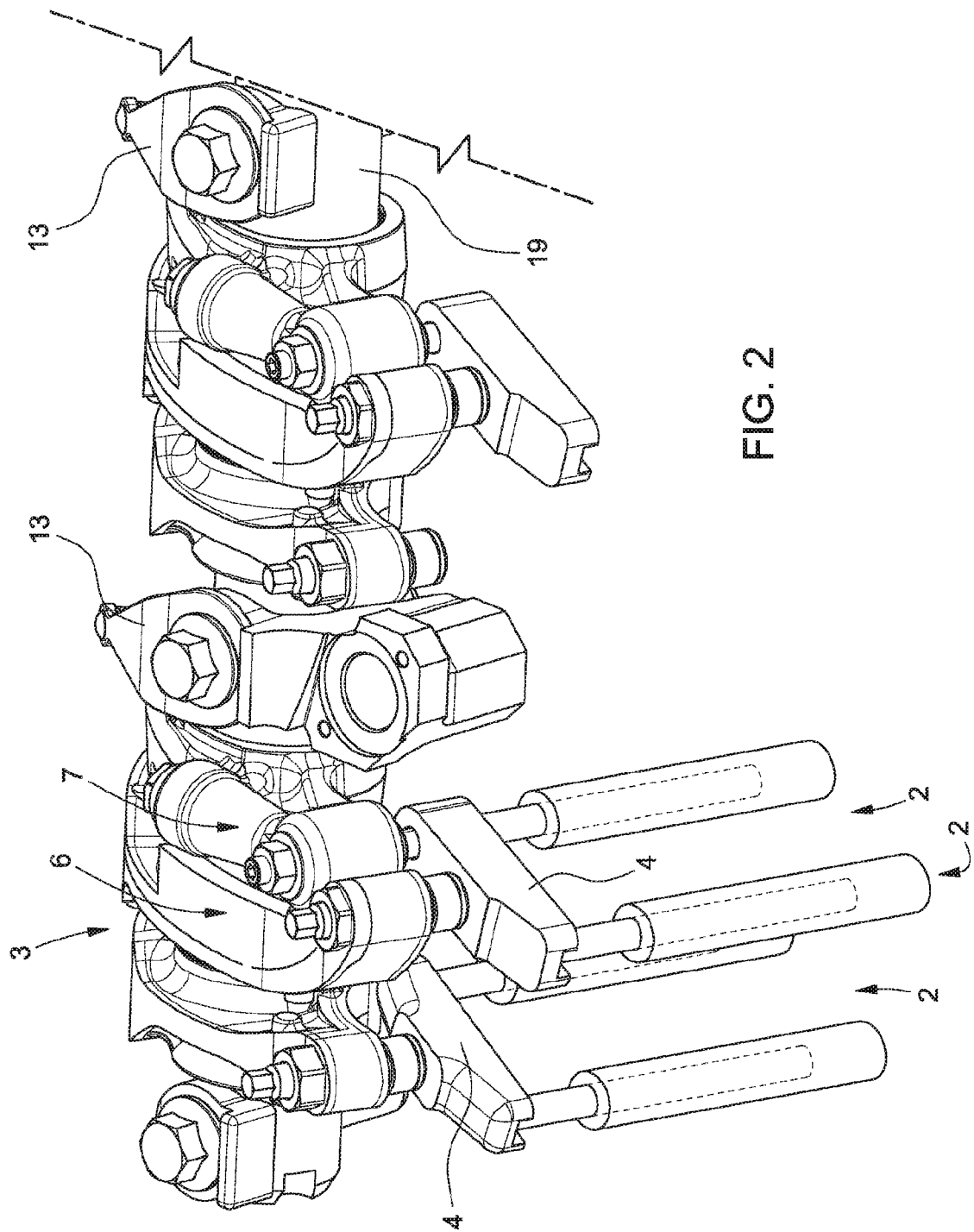
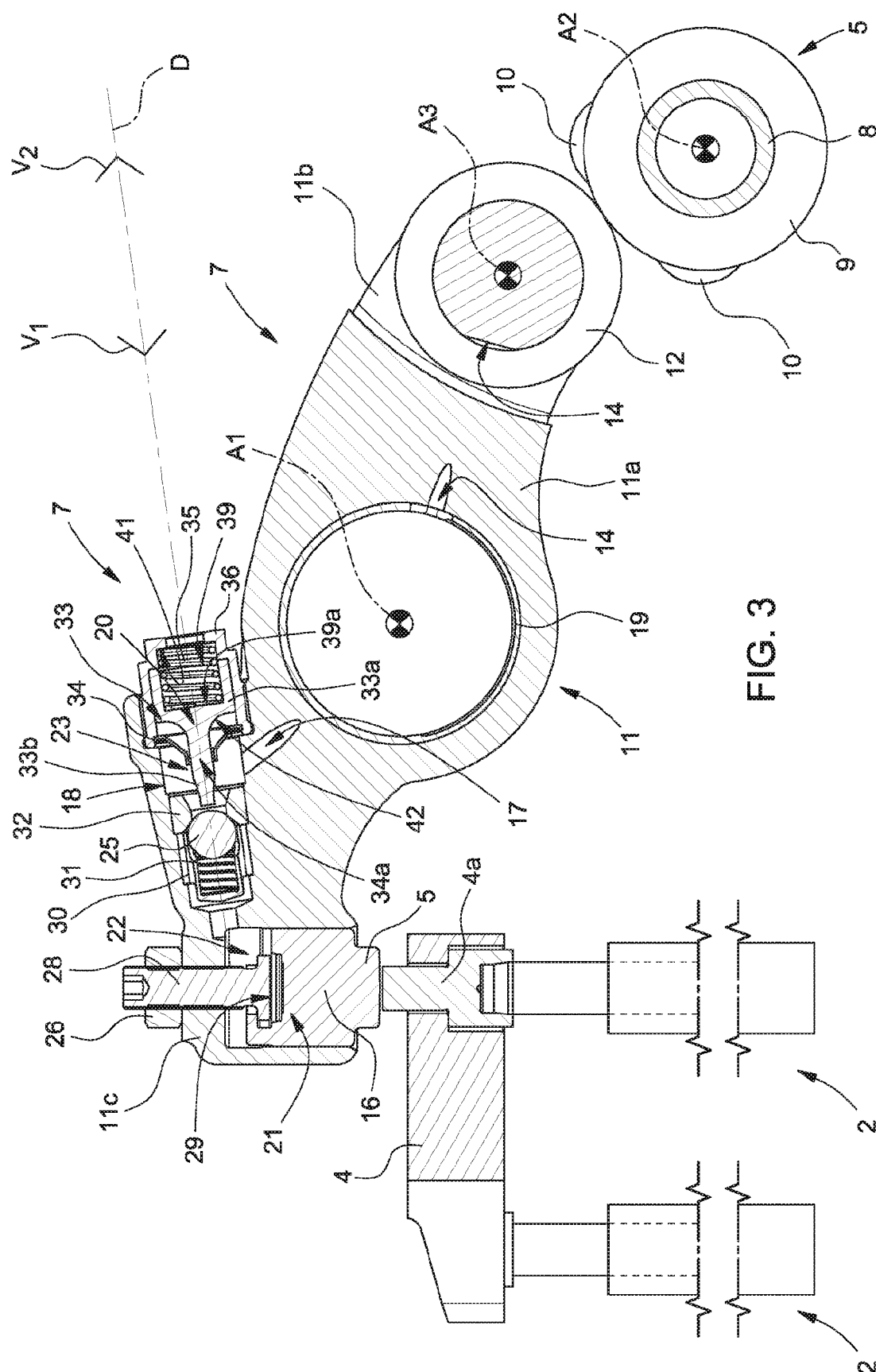


FIG. 2



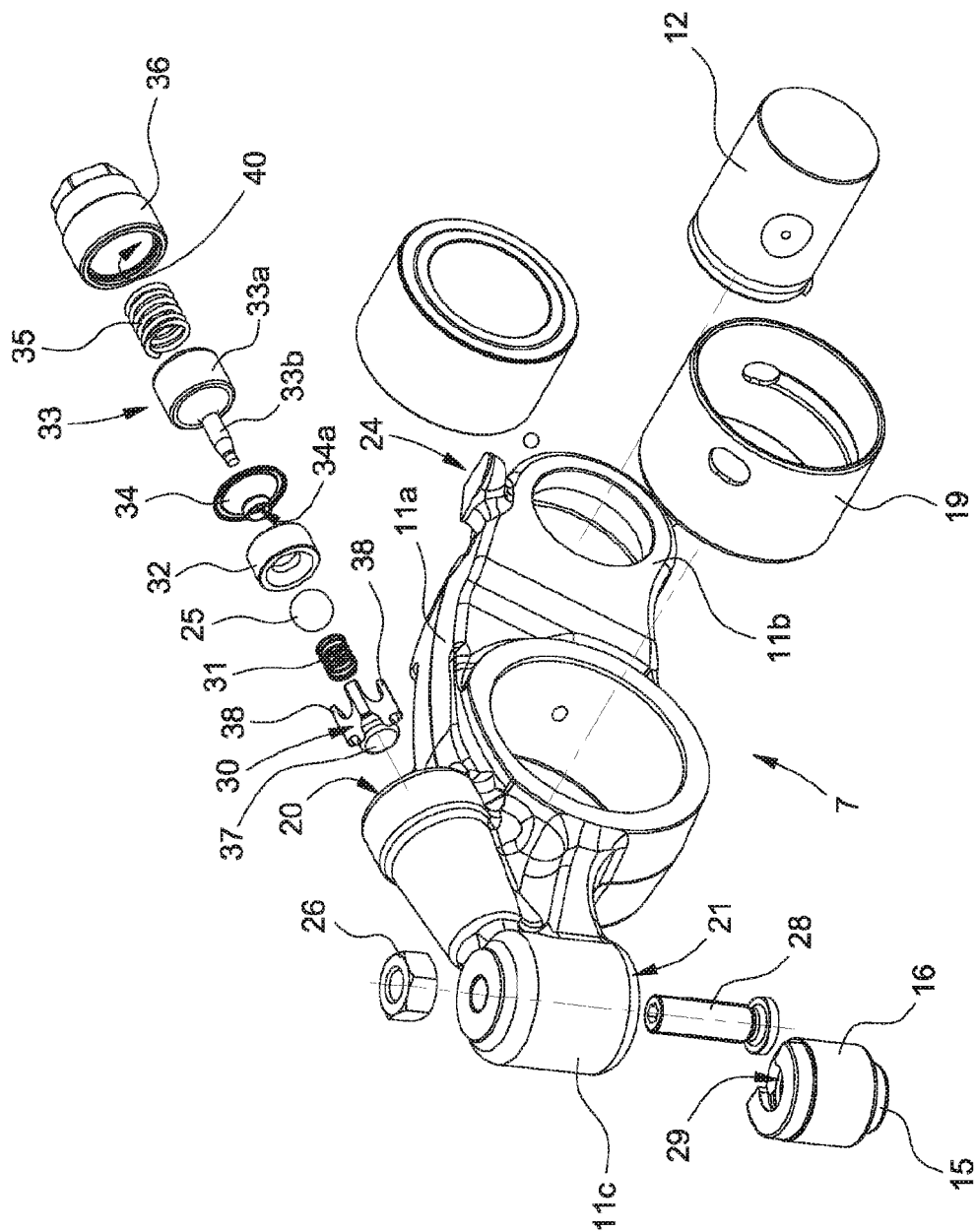
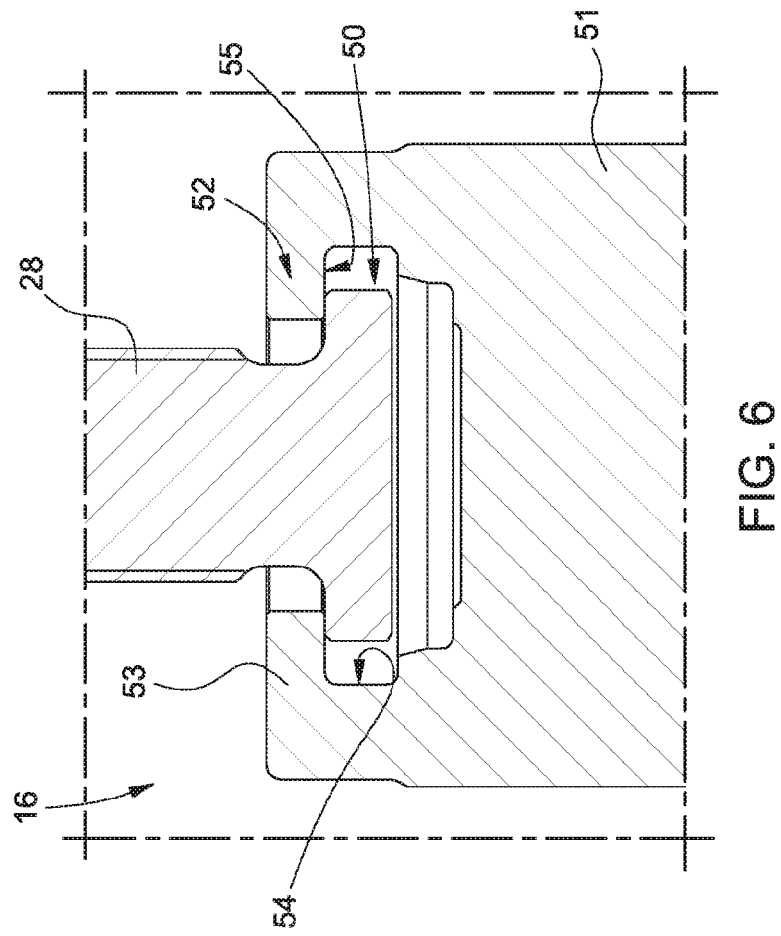
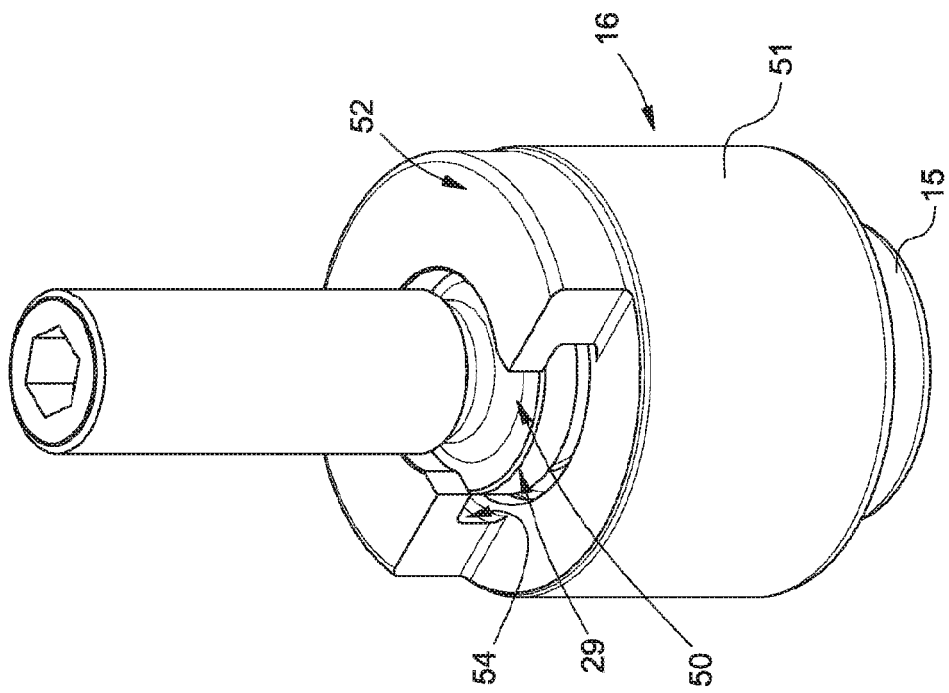


FIG. 4



REFERENCES CITED IN THE DESCRIPTION

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