



- (51) International Patent Classification:
F16K 3/26 (2006.01) *F01P 7/16* (2006.01)
- (21) International Application Number:
PCT/TR2016/050060
- (22) International Filing Date:
7 March 2016 (07.03.2016)
- (25) Filing Language: Turkish
- (26) Publication Language: English
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- (81) Designated States (unless otherwise indicated, for every
kind of national protection available): AE, AG, AL, AM,
AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY,

BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM,
DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT,
HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KN, KP, KR,
KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG,
MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM,
PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC,
SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN,
TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

- (84) Designated States (unless otherwise indicated, for every
kind of regional protection available): ARIPO (BW, GH,
GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ,
TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU,
TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE,
DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU,
LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK,
SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ,
GW, KM, ML, MR, NE, SN, TD, TG).

Published:

— with international search report (Art. 21(3))

- (54) Title: A THERMAL MANAGEMENT MODULE WITH LOOSE SLIDER VALVE

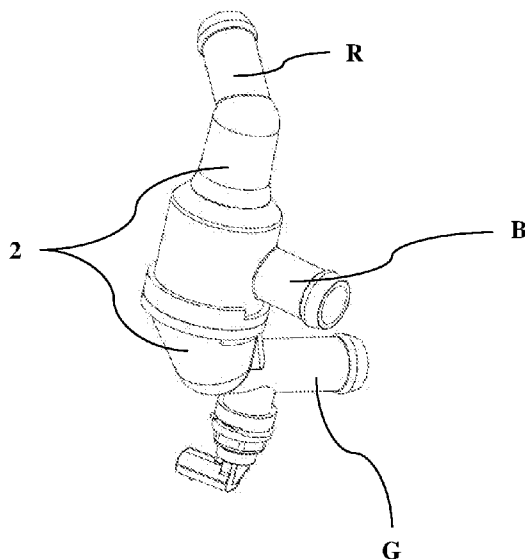


Figure 1

- (57) Abstract: This invention relates to thermal management module with loose slider valve for cooling circulation systems of internal combustion engines which comprises a sliding loose valve (3) to control the flow of the coolant fluid by opening or closing the output connection whether with the movement generated by an actuator with thermal element (4) which is not connected solid or with the movement which is generated by an electromechanical actuator (9) and transformed to linear movement



A THERMAL MANAGEMENT MODULE WITH LOOSE SLIDER VALVE

5 **Technological Area**

This invention relates to a thermal management module with loose slider valve which controls the circulation direction of the coolant fluid and which is a component of coolant circulation system of internal combustion engines.

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Known Situation of the Art

Thermostats are used to regulate the motor temperature at the intended value in internal combustion engines. These thermostat mechanisms are located inside of a
15 body and control the direction of coolant fluid whether radiator output or by-pass output regarding the temperature changes of the coolant fluid.

In current known situation, to circulate or not to circulate the fluid is provided by a poppet type valve which is solidly connected to the body of the thermal element
20 besides the circulation of the fluid through the by-pass connection is provided a by-pass valve which is located on the other direction of the thermal element which is also connected solidly. Thermal element is moving up and down bidirectionally and valves control the circulation of the fluid by opening and closing the by-pass and radiator outputs.

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In most case, an L shaped curtain type valve which is connected solidly to the main valve is used for controlling the by-pass output if by-pass output and thermal element movement axis is not placed in the same axis. Due to this solid connection between radiator port valve and bypass port valve; perfect leakage
30 tightness could not be achieved through the bypass port.

In one of the known situation, a thermostat mechanism to regulate the flow of the coolant liquid is mentioned which is cited in the U.S. patent document US8827172. Thermal expandable element which is a component of this thermostat mechanism has a piston. When the piston moves, the valve is driven
5 and the flow of the coolant is controlled. On this invention, radiator port and bypass port is placed on the same axis which is called coaxial and also thermal actuator has a motion on the same axis.

Brief Description of the Invention

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With this invention , it is aimed to control the circulation of the fluid between radiator output and by-pass output which is not placed on the same axis with thermal actuator mechanism motion axis and to embody loose valve thermal management system which open or close the by-pass output by means of up/down
15 movement of the thermal actuator and which will not cause of coolant leakage to by-pass output while sliding loose valve is fully closing bypass output since it is bonded to thermal element motion mechanism with a loose structure

It is aimed to embody a thermal management module with loose slider valve where a sliding loose valve is installed to a parallel axis which is not coaxial with
20 movement axis of the actuator and which controls the circulation of coolant fluid through by-pass output and which has an actuator rather paraffin based or electrically heated paraffin based or electromechanically activated.

Detailed Description of the Invention

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This invention is explained by following figures detailed. On these figures:

Figure 1 3D view of paraffin based thermal management module with loose slider valve

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Figure 2 Cross-section view of paraffin based thermal management module with loose slider valve while sliding loose valve is fully opened

- Figure 3** Cross-section view of paraffin based thermal management module with loose slider valve showing the position of valve when by-pass is open
- 5 **Figure 4** Cross-section view of paraffin based thermal management module with loose slider valve showing the position of valve while by-pass is closing
- Figure 5** Cross-section view of paraffin based thermal management module with loose slider valve showing the position of valve when by-pass is closed by sliding loose valve
- 10 **Figure 6** View of guide teeth of loose valve and primary connection element
- Figure 7** Pop up view of loose valve and primary connection element
- Figure 8** Cross-section view of the electromechanically activated thermal management module with loose slider valve when radiator output is fully opened and by-pass output is fully closed.
- 15 **Figure 9** Cross-section view of the electromechanically activated thermal management module with loose slider valve showing coupling, sealing element and its mechanism for converting rotary motion to linear motion.
- Figure 10** Cross-section view of electrically heated paraffin based thermal management module with loose slider valve structure when radiator output is fully closed and by-pass output is fully opened.
- 20 **Figure 11** View of the loose valve of electrically heated paraffin based thermal management module with sliding loose L shaped valve structure while radiator output is fully opened and by-pass output is fully closed.
- Figure 12** View of the loose valve of electrically heated paraffin based thermal management module with loose slider valve when by-pass output is closed when radiator output is fully closed and by-pass output is fully opened.
- 25 **Figure 13** View of valve seat
- Figure 14** View of clearance between valve seat and loose valve
- 30 **Figure 15** Detailed view of clearance between valve seat and loose valve
- Figure 16** View of clearance between valve seat and loose valve

Figure 17 View of the valve position of known situation of the art

Figure 18 View of curtain valve of known situation of the art

There are references below and here are descriptions of references:

- 5
1. Thermal management module with loose slider valve
 2. Body
 21. Space
 3. Loose valve
 - 10 4. Actuator with thermal element
 5. Spring
 6. Radiator valve
 7. Primary connection element
 8. Guide teeth
 - 15 9. Electromechanical actuator
 91. Primary shaft
 92. Coupling
 10. Spindle drive mechanism
 101. Guiding hole
 - 20 102. Secondary connection element
 103. Leaning point
 104. Sealing element
 105. Spindle drive
 11. Seating element
 - 25 12. Heating element
 - B. By-pass output
 - R. Radiator output
 - G. Input
 - 30

Thermal management module with loose slider valve which is a component of the coolant circulation system of the internal combustion engines essentially comprises:

- 5 - At least one input (G) which transmits the coolant liquid from engine block
- At least a body (2) which provides housing for the elements of the thermal management module with loose slider valve and has two parts impending upper and lower and transmits the coolant from input (G)
- 10 - At least a space (21) which is inside the body and in which components of the module is installed
- Inside of the space (21), at least a sliding loose valve (3) which moves bidirectionally up and down along the axis of the space (21) and controls the flow of the coolant liquid
- 15 - Inside of the space (21), at least an actuator with thermal element (4) which moves up and down on the axis of the space (21) according to temperature change and through this change a force to be generated for driving the radiator valve (6) and sliding loose valve (3) and controls the temperature of coolant fluid.
- 20 - Inside of the space (21), at least a spring (5) which applies force on the actuator with thermal element (4) in the opposite direction of the force generated by the actuator with thermal element (4)
- At least a radiator valve (6) which controls the flow of the coolant fluid through the radiator output (R) by opening and closing and which is connected to the actuator with thermal element (4)
- 25 - At least two primary connection elements (7) which are in fact an extensity of radiator valve (6) and transfer the movement of the actuator with thermal element (4) to the sliding loose valve (3) by the holes which guide primary connection elements (7) on the sliding loose valve (3)
- 30 - At least two guide teeth (8) which are in fact an extensity of the body (2) in and along the space (21) which keeps the sliding loose valve (3) on the axis of the space (21) by guiding from both edges.

In an embodiment of the invention, sliding loose valve (3) which is not connected solidly to actuator with thermal element (4) starts to allow or obstruct the coolant fluid to flow through the by-pass output (B) and simultaneously the radiator valve (6) starts to obstruct or allow the coolant fluid to flow through the radiator output (R) with the movement created by the actuator with thermal element (4). Due to pressure difference applied on both sides of sliding loose valve (3), the sliding loose valve (3) leans against valve seat and prevent leakiness through the valve system while it is fully closed. Since slider valve is leaned against valve seat, the clearance between the sliding loose valve (3) and the seating surface of the valve on the body (2) is zeroed in

Sliding loose valve (3) thermal management module with loose slider valve comprise a body (2) which has two parts just about upper and lower case, a preferably paraffin based temperature sensitive actuator with thermal element (4), a spring (5) which forces the actuator with thermal element (4) to opposite direction, a radiator valve (6) which controls the flow through the radiator output (R) and a sliding loose valve (3)

In a preferred embodiment of the invention, a sliding loosed valve (3), an actuator with thermal element (4) and a spring (5) is fitted inside a body (2).

Upper part of the body (2) has a geometry which allows radiator output (R) and by-pass output connections (B) and lower part has a geometry which allows input (G) and actuator with thermal element (4) connections. There are guide teethes in the body (2) along the space (21) and contacting the sliding loose valve (3) from two sides. This guide teethes (8) provide a linear movement on the axis of the space by guiding the sliding loose valve (3) from both sides.

There are primary connection elements (7) to provide a connection between the sliding loose valve (3) and the actuator with thermal element (4) which are in fact

extensions of the radiator valve (6). These primary connection elements (7) transfer the movement of the actuator with thermal element (4) to the sliding loose valve (3) by contacting the sliding loose valve (3).

5 The shaft of the actuator with thermal element (4) is surrounded by the wall thickness of the body (2) around that shaft which guides the shaft so that a movement only on the axis of the space (21) is provided for the actuator with thermal element (4).

10 In an embodiment of the invention, an actuator with thermal element (4) moves up and down bidirectionally on the axis of the space (21) inside of the body (2) so that the flow to different outputs are allowed or obstructed. This movement is also transferred to the sliding loose valve (3) by the primary connection element (7) in this way the flow of the radiator output (R) and by-pass output (B) is controlled.

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Actuator with thermal element (4) is filled with a compound which is temperature sensible and this compound expands or shrinks directly proportional to temperature. Thereby in case temperature increases, actuator with thermal element
20 (4) starts to apply a downward force and push the sliding loose valve (3) and radiator valve (6) to move downward too. This movement also causes a downward movement on the spring (5) and by this movement spring (5) starts tensing and the radiator output (R) starts opening. Meantime by the downward movement of the sliding loose valve (3) by-pass output (B) starts closing. During
25 this movement radiator output (R) is opened and by-pass output is closed simultaneously and a flow through radiator output (R) is provided and the flow through the by-pass output (B) is obstructed gradually. This movement continues till the actuator with thermal element (4) reaches its full open position. When it reaches its full open position, by-pass output (B) is fully closed and radiator
30 output (R) is fully opened and the absolute amount of the coolant fluid is provided to flow through the radiator output (R).

- In case temperature decreases, compound inside of the actuator with thermal element (4) starts to shrink and the force applied to the spring (5) decreases. If this force gets lower than the force of the spring, actuator with thermal element (4) and sliding loose valve (3) correspondingly starts to move upward. During this movement, radiator output (R) is closed and by-pass output (B) is opened simultaneously by the upward moving radiator valve (6), sliding loose valve (3) and the actuator with thermal element (4). Upward moving radiator valve (6) starts to block radiator output (R) and upward moving sliding loose valve (3) starts to open by-pass output (B). This movement continues till the radiator output (R) is fully blocked by the radiator valve (6). When it is blocked fully, radiator output (R) is closed and by-pass output (B) is opened and the absolute amount of the coolant fluid is provided to flow through the by-pass output (B).
- Sliding loose valve (3) is guided by the body (2). There is no accurate overlap between the surface of the sliding loose valve (3) and the surface of guiding body (2). There is some clearance. This clearance is removed by the pressure drop between two sides of the sliding loose valve (3) which is generated by the flow pressure of the coolant liquid and which forces the sliding loose valve (3) to lean against the seating surface of the body (3) by this pressure drop sealing is provided.

In one embodiment of the invention, the force which is needed to drive the sliding loose valve (3) on the axis of the space (21) is supplied by an electromechanical actuator (9). Thermal management module with loose slider valve which is a component of the coolant circulation system of the internal combustion engines essentially comprises:

- At least one input (G) which transmits the coolant liquid from engine block

- At least a body (2) which provides housing for the elements of the thermal management module with loose slider valve and has two parts impending upper and lower and transmits the coolant from input (G)
- At least a space (21) which is inside the body and in which components of the module is installed
- At least an electromechanical actuator (9)
- Inside of the space (21), at least a sliding loose valve (3) which moves bidirectionally along the axis of the space (21) and controls the flow of the coolant liquid through by-pass output (B) or radiator output (R)
- At least a primary shaft (91) which is in fact a part of the electromechanical actuator (9)
- At least a coupling (92) which has a hole that primary shaft (91) is able to traverse and which is able to provide a movement without an axial run-out
- At least a spindle drive mechanism (10) which transfers the rotational motion from primary shaft (91) to sliding loose valve (3)
- At least a spindle drive (105) which runs along the space (21) inside the body (2) and has a guiding hole (101) on the primary shaft (91) side and rotates simultaneously with primary shaft (91)
- At least a primary connection element (7) which is in fact an extension of the sliding loose valve (3)
- At least a secondary connection element (102) which is connected to the spindle drive (105) from the side which is inside the body (2) and is inserted to a guiding hole on the primary connection element (7) with a protrusion and drives the primary connection element (7) to opening or closing direction according to rotational direction of the spindle drive (105)
- At least a seating element (11) which is connected to the body (2) and is parallel to the sliding loose valve (3) and on which sliding loose valve (3) make its movement
- At least two leaning points (103) which are connected to the spindle drive (105) from its touchpoint to primary connection element (7), secondary

connection element (102) and the body (2) and are placed to limit the movement of the spindle drive mechanism (10) between the desired area

- At least a sealing element (104) which is connected to surface on the spindle drive mechanism (10) to reduce the friction effects on the joint faces

5 In one embodiment of the invention, movement is supplied by an electromechanical drive mechanism (9). The primary shaft (91) which is in fact a part of the electromechanical actuator (9) is guided by the guiding hole (101).
10 Spindle drive mechanism (10) is driven by primary shaft (91). Primary shaft rotates to a direction by the guiding hole (101), this movement is transferred to the spindle drive mechanism (10). This rotational movement on the spindle drive mechanism is transformed to a linear movement by the secondary connection element (102) which is in form of a nut and driven by spindle drive (105). Primary
15 connection element (7) is connected directly to the secondary connection element (102) by this means sliding loose valve (3) is driven. For one direction, sliding loose valve (3) starts to open the radiator output (R) and close the by-pass output (B). This movement continues till the primary connection element (7) leans against the leaning point (103) on this direction. For other direction, sliding loose
20 valve (3) starts to close the radiator output (R) and open the by-pass output (B). This movement continues till the primary connection element (7) leans the leaning point (103) on this direction.

Sliding loose valve (3) is guided by the seating element (11). There is no accurate
25 overlap between the surface of the sliding loose valve (3) and the surface of seating element (11). There is some clearance. This clearance is removed by the pressure drop between two sides of the sliding loose valve (3) which is generated by the flow pressure of the coolant liquid and by this pressure drop sealing is provided.

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In yet another embodiment of the invention the force which is required to drive the sliding loose valve (3) on the axis of the space (21) is provided by an actuator with thermal element (4) which has a heating element (12). Thermal management module with loose slider valve which is a component of the coolant circulation system of the internal combustion engines essentially comprises:

- At least one input (G) which transmits the coolant liquid from engine block
- At least a body (2) which provides housing for the elements of the thermal management module with loose slider valve and has two parts impeding upper and lower and transmits the coolant from input (G)
- At least a space (21) which is inside the body and in which components of the module is installed
- At least a sliding loose valve (3) which moves bidirectionally along the axis of the space (21) and controls the flow of the coolant liquid through by-pass output (B)
- At least an actuator with thermal element (4) which is contacting with a heating element (12) and moves up and down on the axis of the space (21) according to temperature change and through this change a force to be generated for driving the sliding loose valve (3) and controls the temperature of coolant fluid.
- At least a spring (5) which applies force on the actuator with thermal element (4) in the opposite direction of the force generated by the actuator with thermal element (4)
- At least a radiator valve (6) which controls the flow of the coolant fluid through the radiator output (R) by opening and closing and which is connected to the actuator with thermal element (4)
- At least a primary connection element (7) which is in fact an extensity of radiator valve (6) and transfers the movement of the actuator with thermal element (4) to the sliding loose valve (3)

- At least a seating element (11) which is connected to the body (2) and is parallel to the sliding loose valve (3) and on which sliding loose valve (3) make sliding movement
- 5 The force which is needed to drive the valves is provided by an actuator with thermal element (4) preferably including a heating element (12). It comprises an actuator with thermal element (4), preferably an electrical heating element (12) to heat the actuator with thermal element (4), a spring (5) which apply a force to the actuator with thermal element (4) to the closing direction when temperature decreases, a radiator valve (6) to control the flow through the radiator output (R) and a sliding loose valve (3) to control the flow through the by-pass output (B).

Upper case of the body (2) has a suitable geometry for by-pass output (B) and radiator output (R) as well as lower case of the body (2) has for input (G) and actuator with thermal element (4). There is primary connection element (7) existing to provide a connection between sliding loose valve (3) and actuator with thermal element (4). Primary connection element (7) transfers the movement of the actuator with thermal element (4) to the sliding loose valve (3).

20 The actuator with thermal element (4) is forced to move to the opening direction by heating by the aid of the heating element (12) to allow the fluid to flow through desired outputs with desired flow rates. This movement causes a tension on the spring (5). By the primary connection element (7), this movement is transferred to the sliding loose valve (3). In this way radiator output (R) starts to open and by-pass output (B) starts to close. This movement continues till the actuator with thermal element (4) reaches its full open position. So radiator output (R) is fully opened and by-pass output (B) is fully closed thereby absolute amount of the coolant fluid is provided to flow through the radiator output (R).

30 In case there is no heating and temperature decreases, compound inside of the actuator with thermal element (4) starts to shrink and the force applied to the

spring (5) decreases. When this force gets lower than the force of the spring, actuator with thermal element (4) and sliding loose valve (3) correspondingly starts to move. During this movement, radiator output (R) is closed and by-pass output (B) is opened simultaneously by the moving radiator valve (6) sliding loose valve (3) and the actuator with thermal element (4). Moving radiator valve (6) starts to block radiator output (R) and moving sliding loose valve (3) starts to open by-pass output (B). This movement continues till the radiator output (R) is fully blocked by the radiator valve (6). When it is blocked fully, radiator output (R) is closed and by-pass output (B) is opened and the absolute amount of the coolant fluid is provided to flow through the by-pass output (B).

Sliding loose valve (3) is guided by the seating element (11). There is no accurate overlap between the surface of the sliding loose valve (3) and the surface of seating element (11). There are some clearances in millimeters. This clearance is removed by the pressure drop between two sides of the sliding loose valve (3) which is generated by the flow pressure of the coolant liquid and by this pressure drop sealing is provided.

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CLAIMS

1. Thermal management module with loose slider valve for cooling circulation systems of the internal combustion engines essentially
 5 **comprises** at least an input (G) which transfers the coolant from engine block and **characterized by**,
 - At least a body (2) which provides housing for the elements of the thermal management module with loose slider valve and has two parts impending upper and lower and transmits the coolant from input (G)
 - 10 - At least a space (21) which is inside the body and in which components of the module is installed
 - At least a sliding loose valve (3) inside of the space (21), which moves bidirectionally up and down along the axis of the space (21) and controls the flow of the coolant liquid
 - 15 - At least an actuator with thermal element (4) inside of the space (21) which moves up and down on the axis of the space (21) according to temperature change and through this change a force to be generated for driving the radiator valve (6) and sliding loose valve (3) and controls the temperature of coolant fluid.
 - 20 - At least a spring (5) inside of the space (21) which applies force on the actuator with thermal element (4) in the opposite direction of the force generated by the actuator with thermal element (4)
 - At least a radiator valve (6) which controls the flow of the coolant fluid through the radiator output (R) by opening and closing and which is
 25 connected to the actuator with thermal element (4)
 - At least two primary connection elements (7) which are in fact an extensity of radiator valve (6) and transfer the movement of the actuator with thermal element (4) to the loose valve (3) by the holes which guide primary connection elements (7) on the sliding loose valve (3)

- At least two guide teeth (8) which are in fact an extensity of the body (2) in and along the space (21) which keeps the sliding loose valve (3) on the axis of the space (21) by guiding from both edges.
- 5 2. A thermal management module with loose slider valve (1) according to claim 1, **characterized by** a body (2) which's upper part is connected to the radiator output (R) and by-pass output (B) and lower part is connected to the input (G) and actuator with thermal element.
- 10 3. A thermal management module with loose slider valve (1) according to claim 1, **characterized by** an actuator with thermal element (4) which has a thermal-sensible compound inside or which is produced by thermal-sensible element.
- 15 4. A thermal management module with loose slider valve (1) according to claim 1, **characterized by** an actuator with thermal element (4) which has paraffin based compound inside.
- 20 5. A thermal management module with loose slider valve (1) according to claim 1, **characterized by** an actuator with thermal element (4) which expands according to temperature and generates a force downward and drives the actuator with thermal element (4) and the sliding loose valve (3) downward by this force and which is pushed back upward by a spring (5) in case of shrinkage caused by temperature decreases.
- 25 6. A thermal management module with loose slider valve (1) according to claim 1, **characterized by** a sliding loose valve (3) which doesn't have a solid connection with actuator with thermal element (4)
- 30 7. A thermal management module with loose slider valve (1) according to claim 1, **characterized by** a sliding loose valve (3) which provides sealing

by the pressure drop generated by the flows of the coolant fluids on both sides.

8. A thermal management module with loose slider valve (1) according to claim 1, **characterized by** a body (2) which has a wall thickness around the shaft of the actuator with thermal element (4) to surround that shaft to guide the shaft to provide a movement only on the axis of the space (21) for the actuator with thermal element (4).
9. Thermal management module with loose slider valve for cooling circulation systems of the internal combustion engines essentially **comprises** at least an input (G) which transfers the coolant from engine block and **characterized by**,
 - At least a body (2) which provides housing for the elements of the thermal management module with loose slider valve and has two parts impeding upper and lower and transmits the coolant from input (G)
 - At least a space (21) which is inside the body and in which components of the module is installed
 - At least an electromechanical actuator (9).
 - At least a sliding loose valve (3) inside of the space (21), which moves bidirectionally up and down along the axis of the space (21) and controls the flow of the coolant liquid
 - At least a primary shaft (91) which is in fact a part of the electromechanical actuator (9) and makes rotational movement
 - At least a coupling (92) which has a hole that primary shaft (91) is able to traverse and which is able to provide a movement without an axial run-out
 - At least a spindle drive mechanism (10) which transfers the rotational motion from primary shaft (91) to sliding loose valve (3)
 - At least a spindle drive (105) which runs along the space (21) inside the body (2) and has a guiding hole (101) on the primary shaft (91) side and rotates simultaneously with primary shaft (91)

- At least a primary connection element (7) which is in fact an extensity of radiator valve
 - At least a secondary connection element (102) which is connected to the spindle drive (105) from the side which is inside the body (2) and is inserted to a guiding hole on the primary connection element (7) with a protrusion and drives the primary connection element (7) to opening or closing direction according to rotational direction of the spindle drive (105)
 - At least a seating element (11) which is connected to the body (2) and is parallel to the sliding loose valve (3) and on which sliding loose valve (3) make sliding movement
 - At least two leaning points (103) which are connected to the spindle drive (105) from its touchpoint to primary connection element (7), secondary connection element (102) and the body (2) and are placed to limit the movement of the spindle drive mechanism (10) between the desired area and
 - At least a sealing element (104) which is connected to surface on the spindle drive mechanism (10) to reduce the friction effects on the joint faces
10. A thermal management module with loose slider valve (1) according to claim 9, **characterized by** an electromechanical actuator (9)
11. A thermal management module with loose slider valve (1) according to claim 9, **characterized by** a primary shaft (91) which is in fact a part of the electromechanical actuator (9) and makes rotational movement
12. A thermal management module with loose slider valve (1) according to claim 9, **characterized by** a secondary connection (102) element which is in fact a nut.

- 13.** Thermal management module with loose slider valve for cooling circulation systems of the internal combustion engines essentially **comprises** at least an input (G) which transfers the coolant from engine block and **characterized by**,
- 5 - At least a body (2) which provides housing for the elements of the thermal management module with loose slider valve and has two parts impeding upper and lower and transmits the coolant from input (G)
 - At least a space (21) which is inside the body and in which components of the module is installed
 - 10 - At least a sliding loose valve (3) inside of the space (21), which moves bidirectionally and controls the flow of the coolant liquid
 - At least an actuator with thermal element (4) which is contacting with a heating element (12) and moves up and down on the axis of the space (21) according to temperature change and through this change a force to be
 - 15 generated for driving the loose valve (3) and controls the temperature of coolant fluid.
 - At least a spring (5) which applies force on the actuator with thermal element (4) in the opposite direction of the force generated by the actuator with thermal element (4) when temperature decreases
 - 20 - At least a radiator valve (6) which controls the flow of the coolant fluid through the radiator output (R) and which is connected to the actuator with thermal element (4)
 - At least a primary connection element (7) which is in fact an extensity of radiator valve (6) and transfers the movement of the actuator with thermal
 - 25 element (4) to the sliding loose valve (3)
 - At least a seating element (11) which is connected to the body (2) and is parallel to the sliding loose valve (3) and on which sliding loose valve (3) make sliding movement
 - 30 **14.** A thermal management module with loose slider valve (1) according to claim 13, **characterized by** heating element (12)

Figure 1

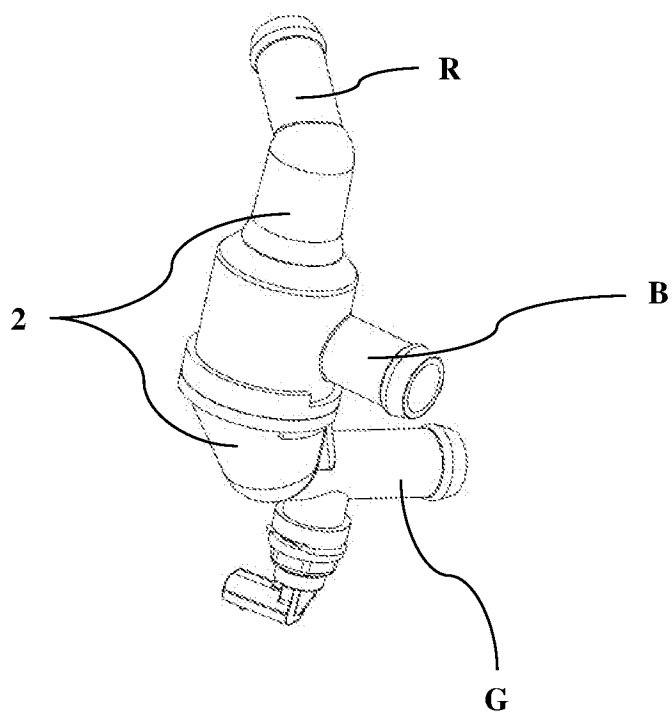


Figure 2

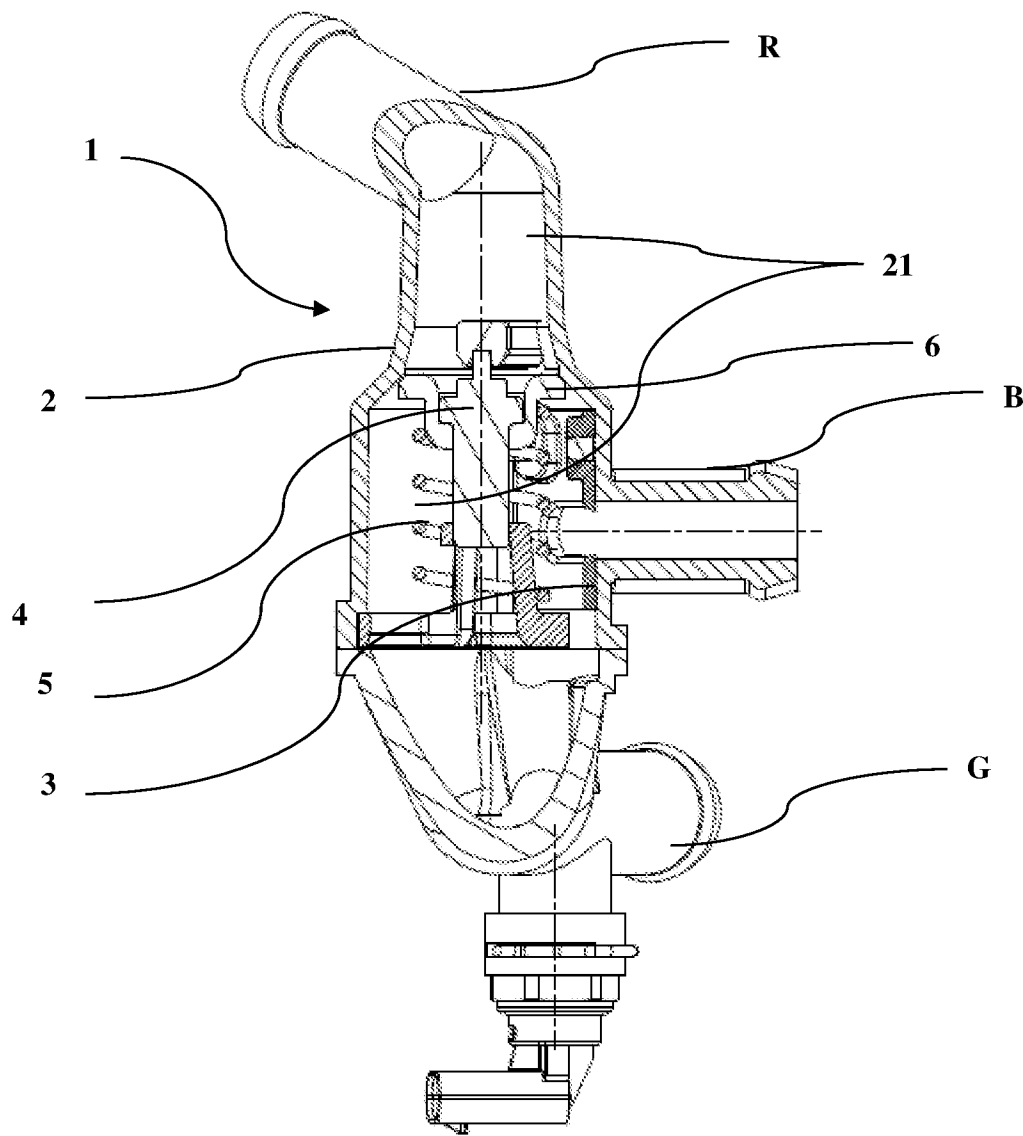


Figure 3

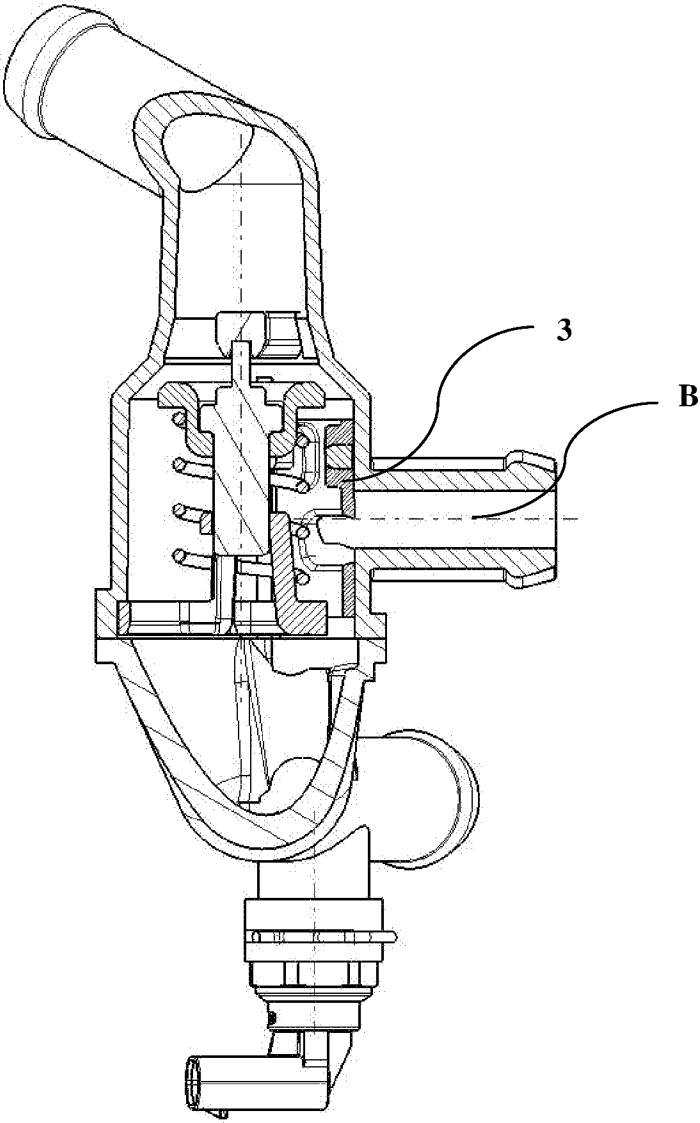


Figure 4

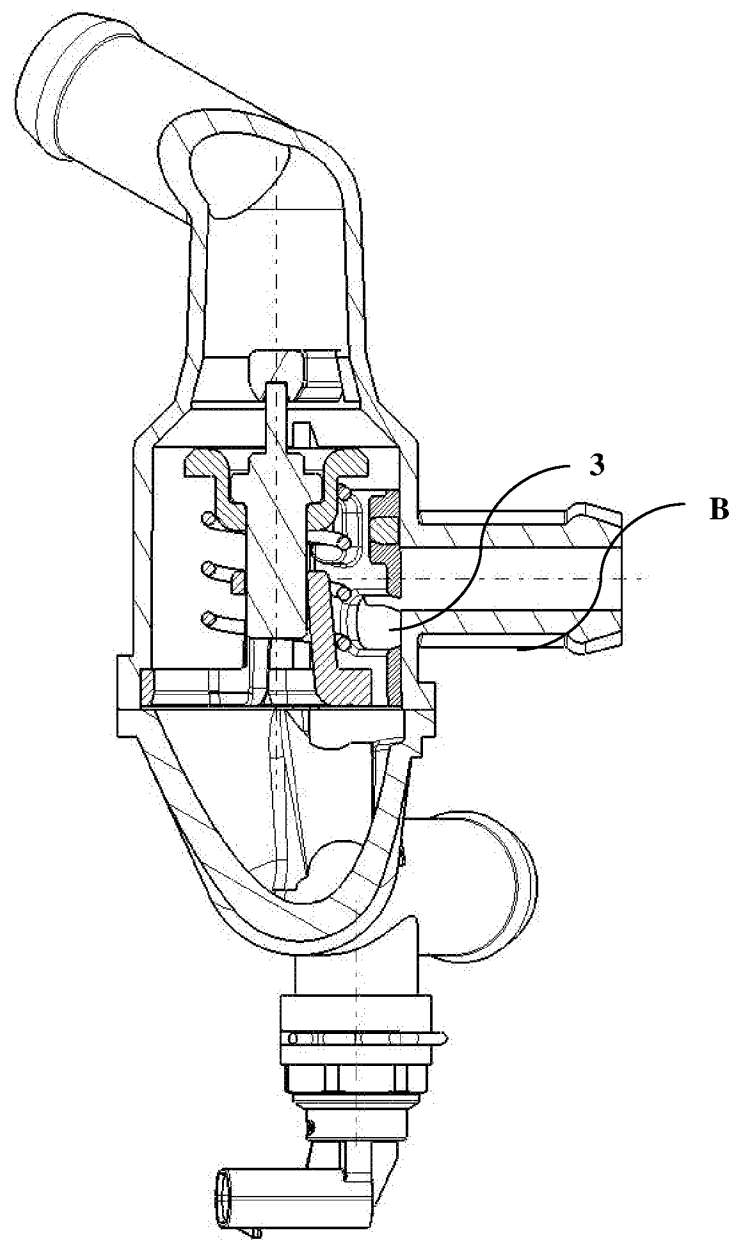


Figure 5

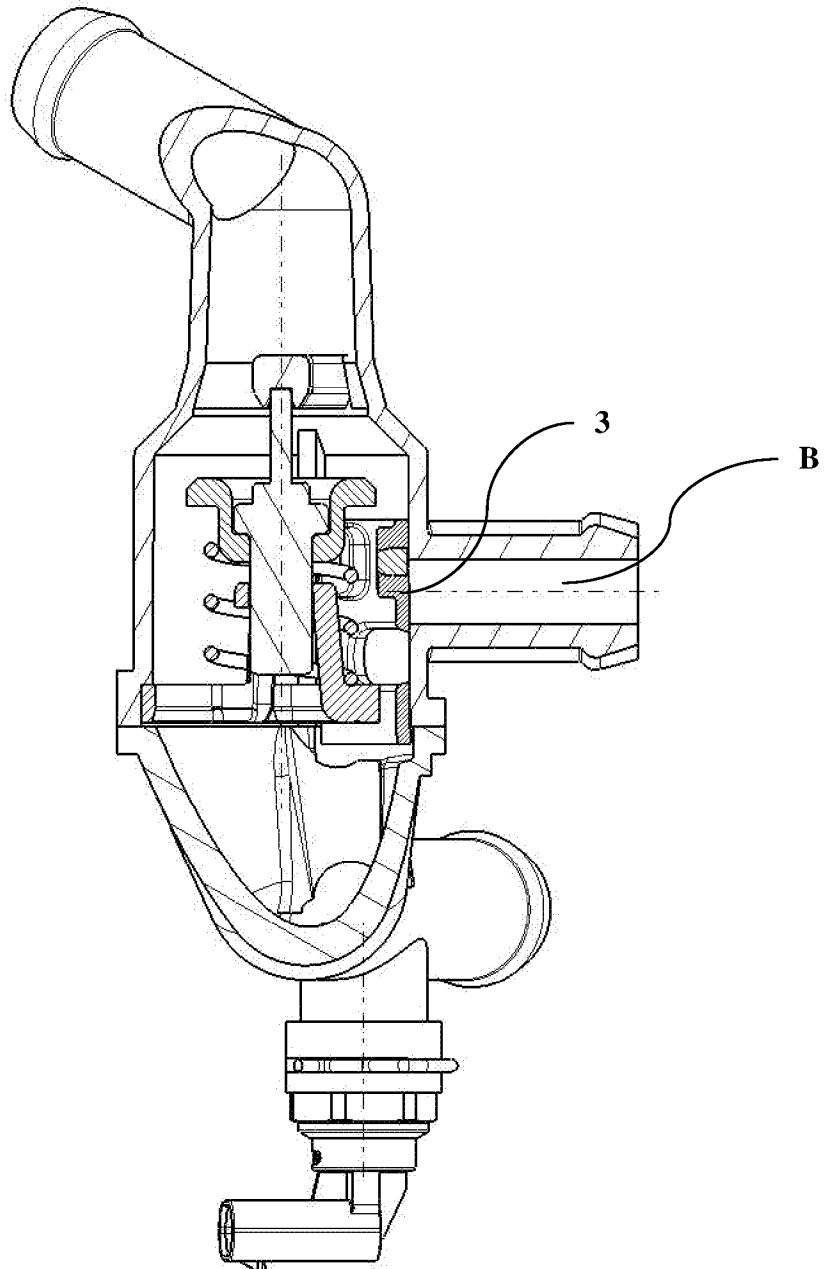
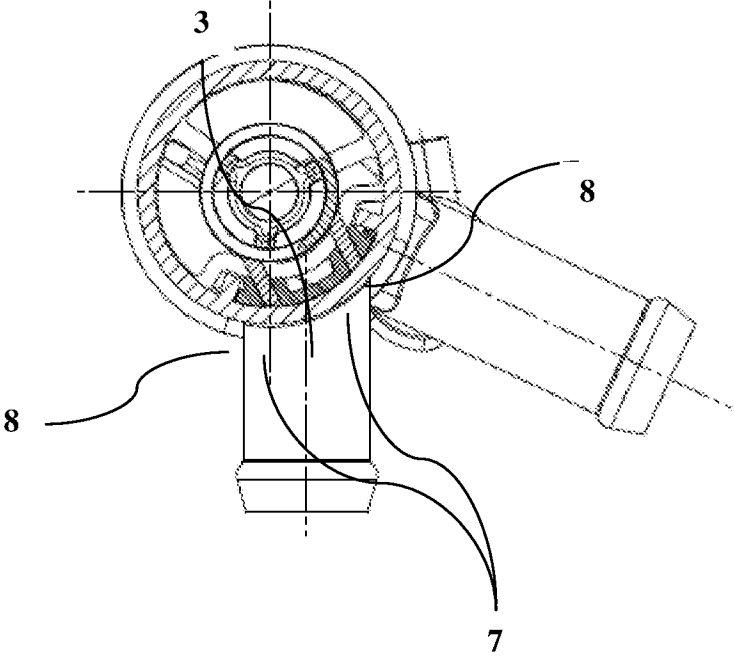


Figure 6



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Figure 7

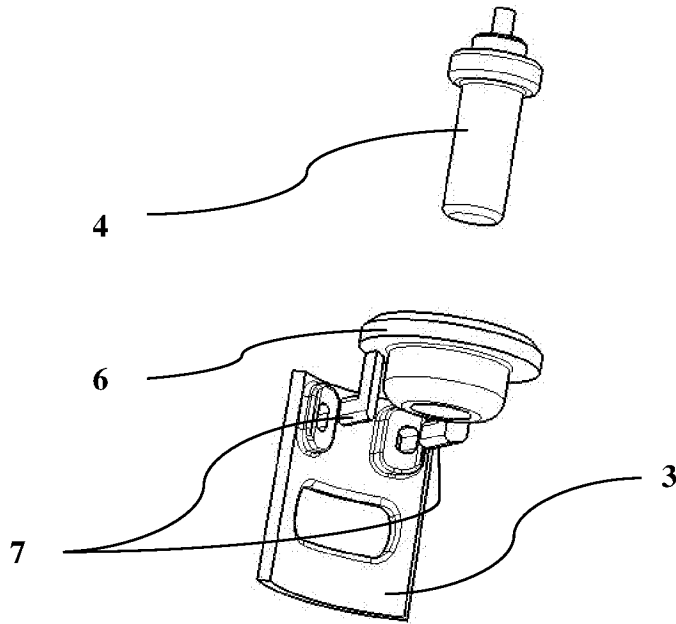
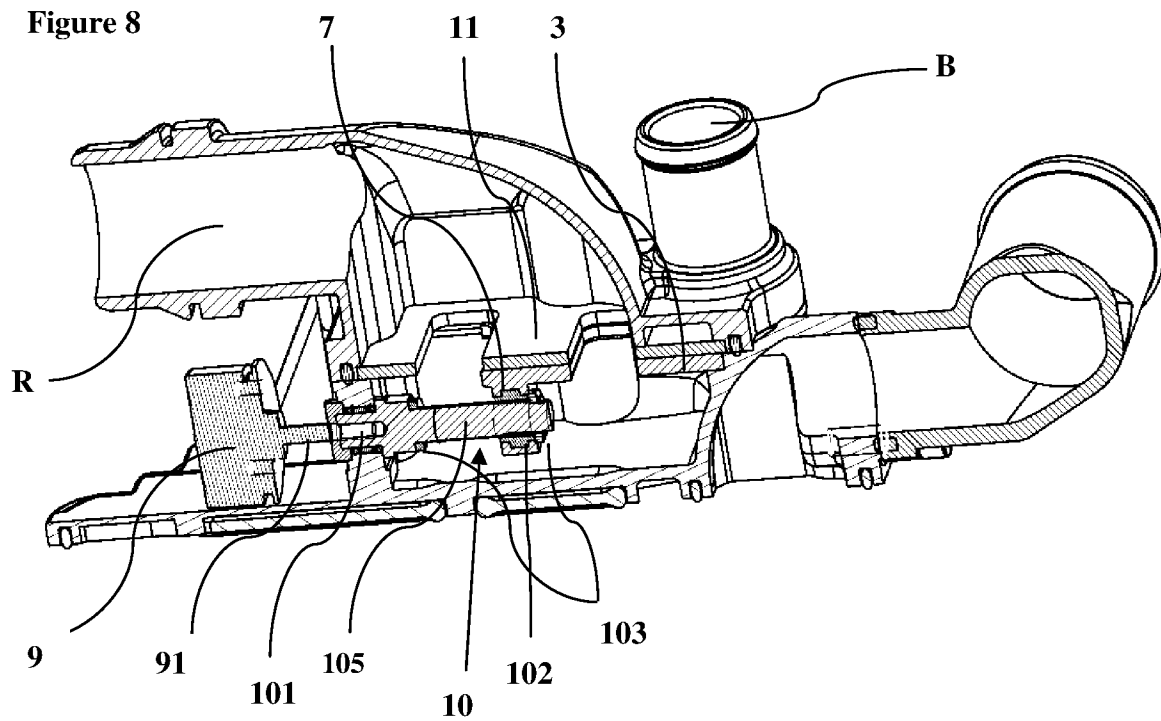


Figure 8



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Figure 9

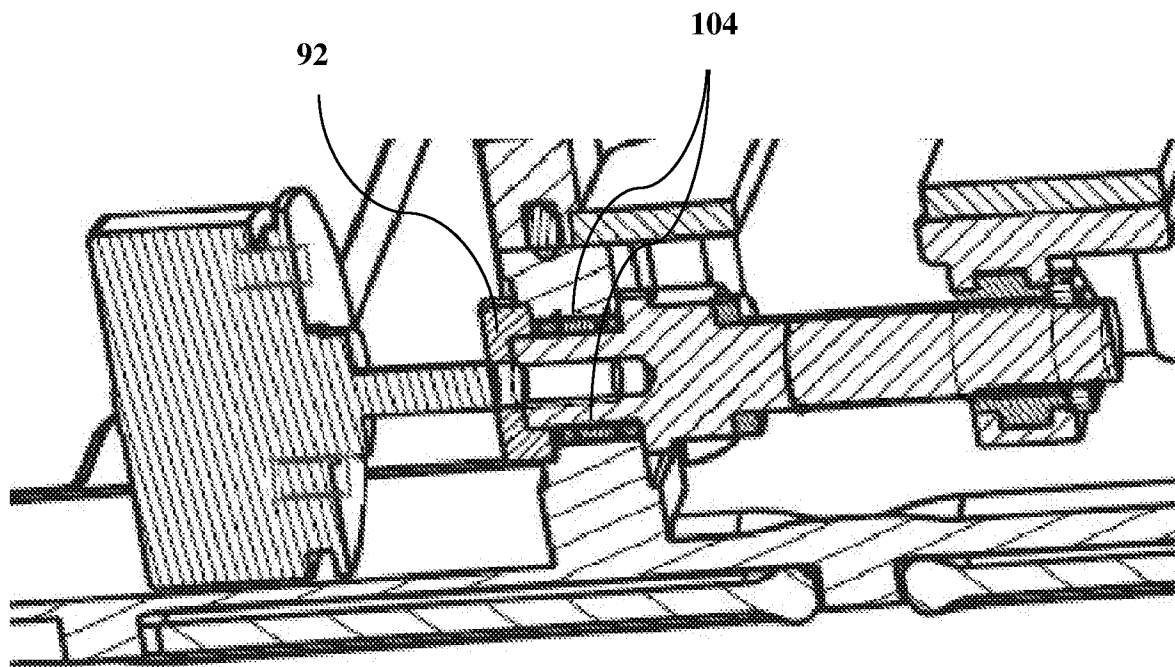
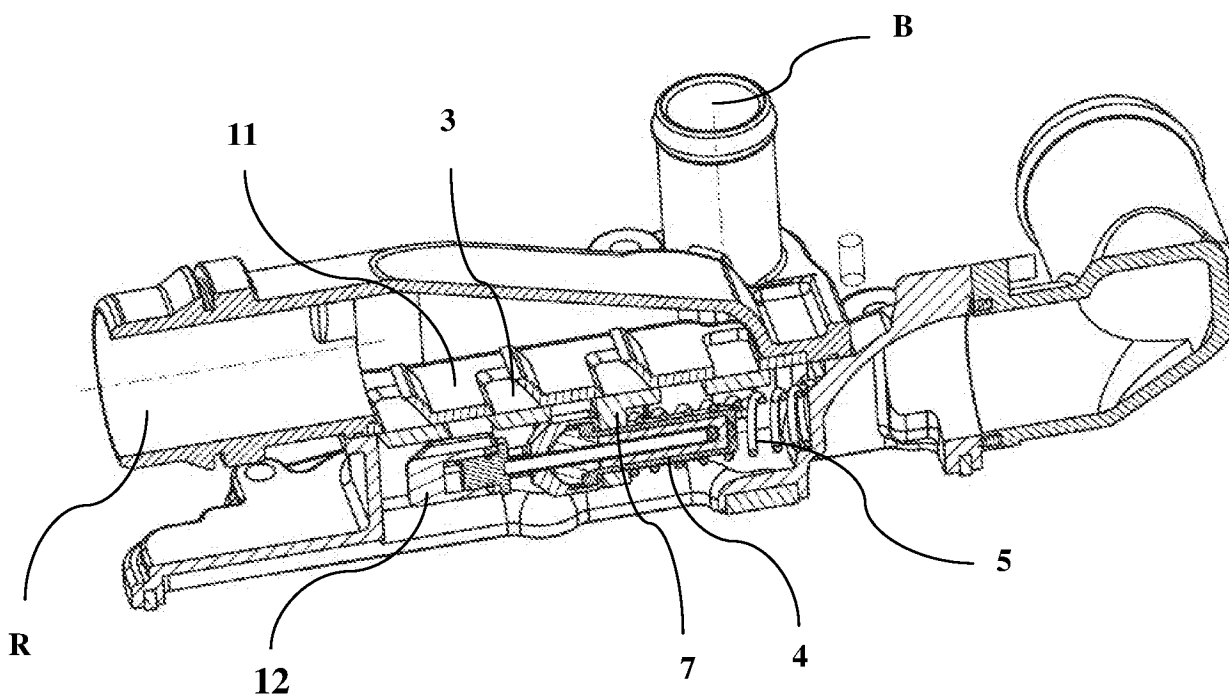


Figure 10



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Figure 11

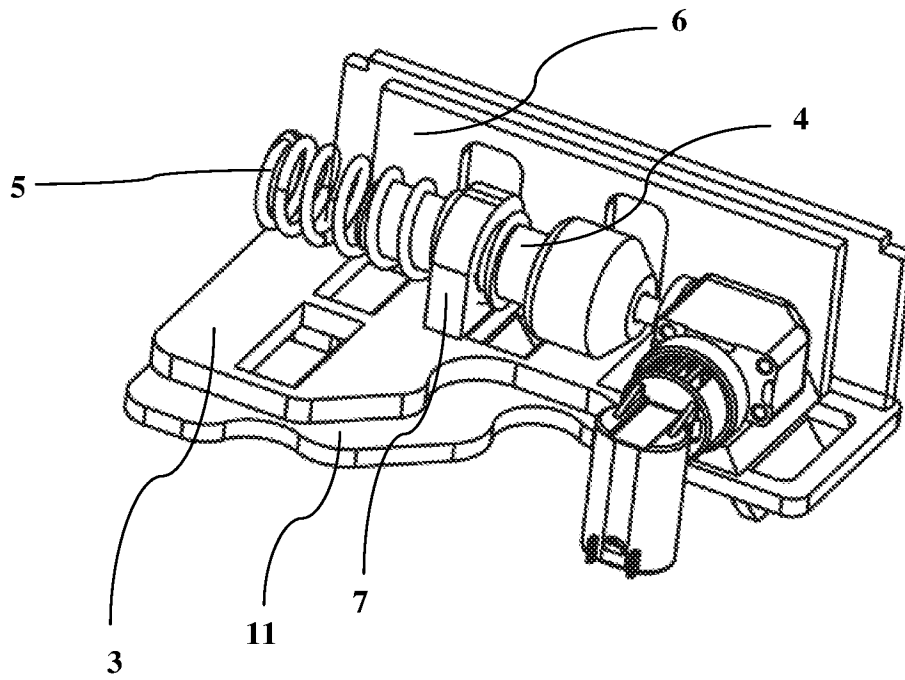


Figure 12

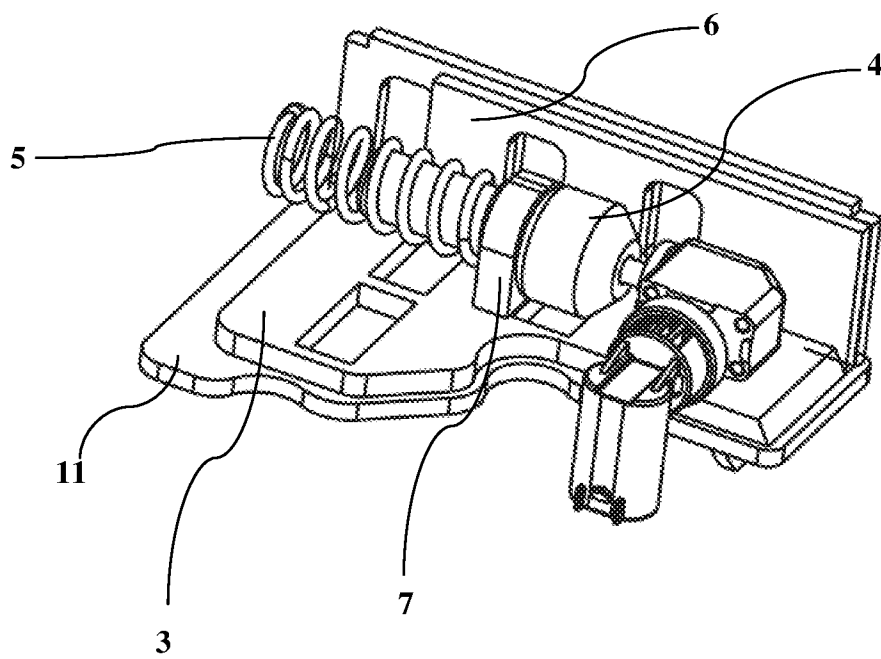


Figure 13

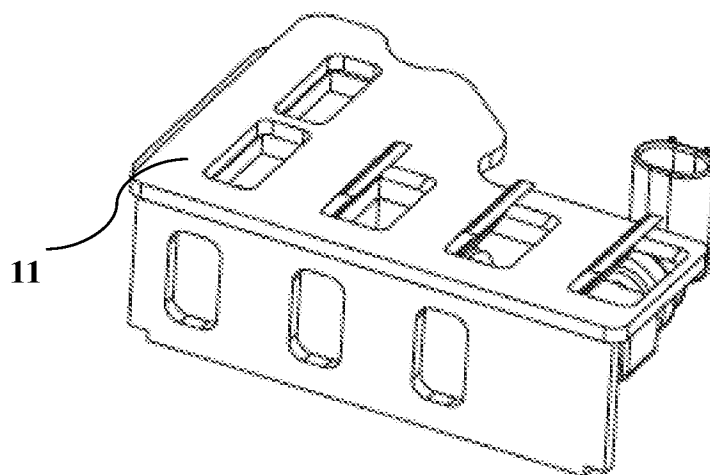


Figure 14

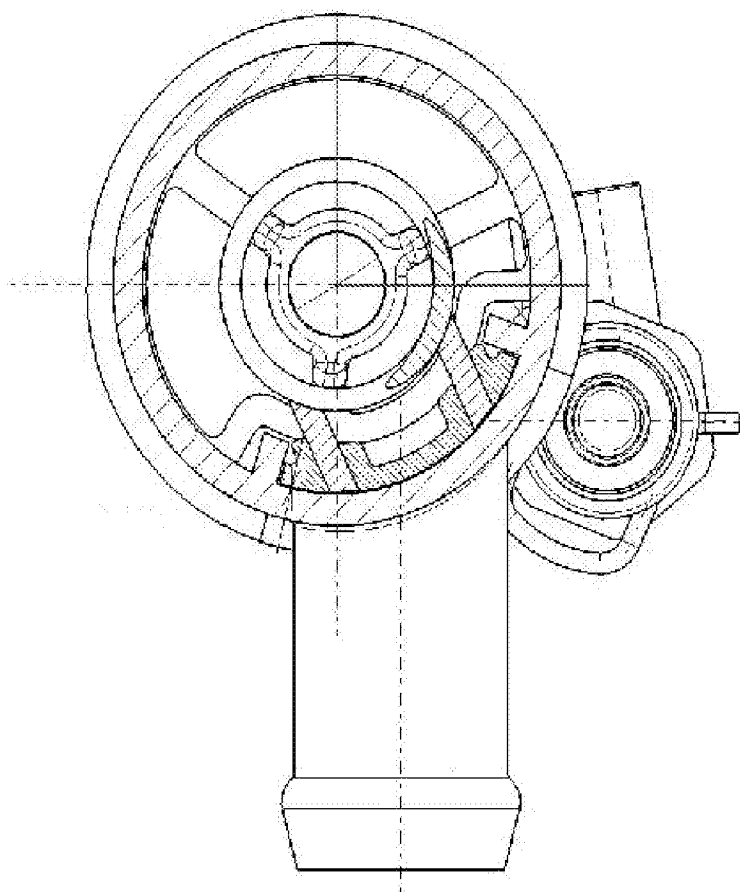


Figure 15

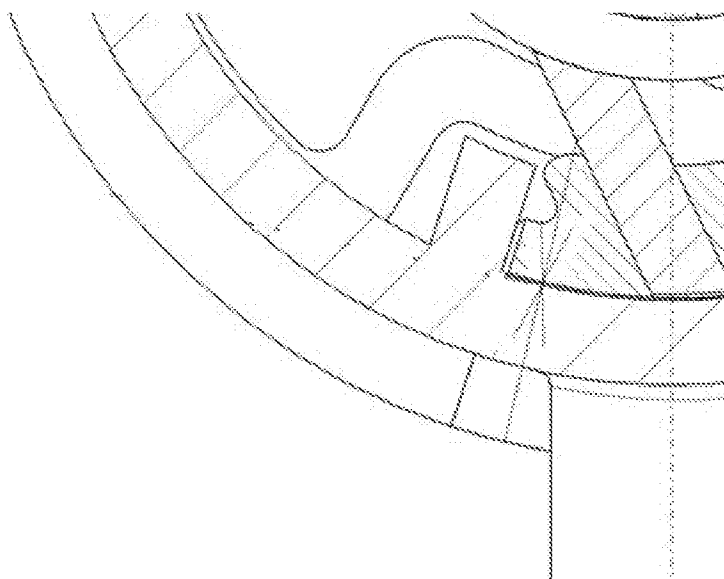
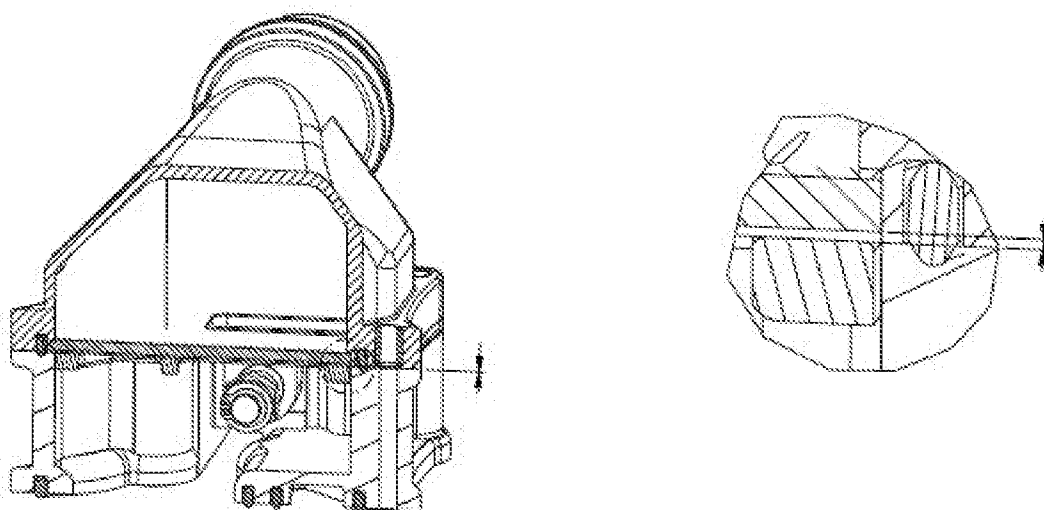


Figure 16



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Figure 17

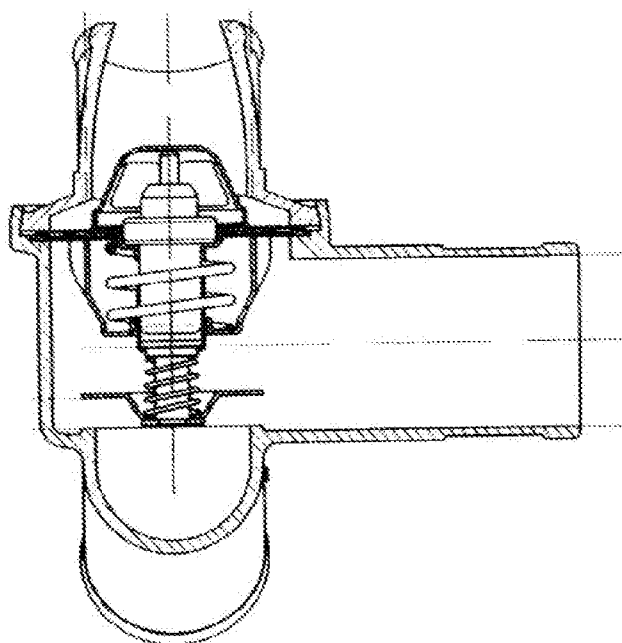
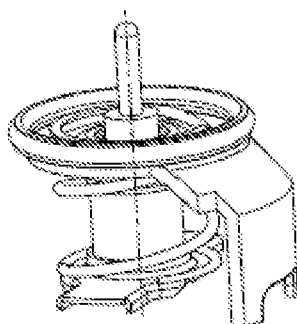


Figure 18



INTERNATIONAL SEARCH REPORT

International application No
PCT/TR2016/050060

A. CLASSIFICATION OF SUBJECT MATTER
INV. F16K3/26 F01P7/16
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
F16K F01P

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EP0-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 2008/119189 A1 (DANA CANADA CORP [CA]; PERIC YURI [CA]; VANDERWEES DOUG [CA]) 9 October 2008 (2008-10-09) paragraphs [0043] - [0049], [0053], [0061]; figures 13A,13B16,24 -----	1-14
A	FR 2 868 811 A1 (MARK IV SYSTEMES MOTEURS SA [FR]) 14 October 2005 (2005-10-14) page 3, lines 4-16; figures 1,2 page 5, line 3 - page 6, line 23 -----	1-14
A	US 4 875 437 A (COOK ANDRE [FR] ET AL) 24 October 1989 (1989-10-24) column 3, line 11 - column 4, line 33; figure 2 -----	13,14



Further documents are listed in the continuation of Box C.



See patent family annex.

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Date of the actual completion of the international search

9 August 2016

Date of mailing of the international search report

26/08/2016

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Authorized officer

Luta, Dragos

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/TR2016/050060

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US 4875437	A	24-10-1989	NONE
