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(54) **Assembly and thermostatic calibration system for fuel gas flow regulating modules and associated fuel gas flow regulating module**

(57) An assembly and calibration system (100) for thermostatic fuel gas flow regulating modules (200), the system comprising a calibration pin (108) inserted inside a cavity (211) of the body of the flow regulator (200) and comprising a portion (105) suitable for accommodating

locking means coupled with the calibration pin (108) inside the cavity (211); the locking means have a mechanical fit against a wall of said calibration pin (108).

The invention further regards the associated flow regulator.

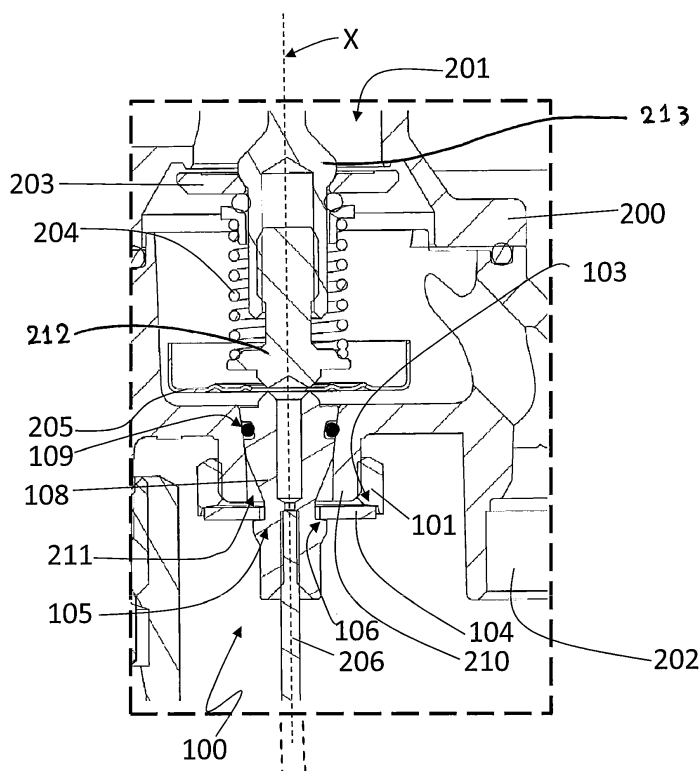


Fig.2

Description

Technical field.

[0001] The present invention relates to an assembly and thermostatic calibration system, and in detail it concerns an assembly and thermostatic calibration system for fuel gas flow regulators.

[0002] The present invention further concerns a fuel gas flow regulator comprising the above-mentioned assembly and thermostatic calibration system.

Prior art.

[0003] It is known that various fuel gas flow regulators, for example those intended to supply fuel gas to ovens, and also called thermostats, are provided with thermostatic shutters.

[0004] These thermostatic shutters work through the expansion of an expandable fluid as a function of temperature: the fluid is contained in a bulb, or temperature-sensitive element, the end of which is placed inside the oven. The fluid is allowed to expand or contract inside a chamber or expansion membrane placed inside the regulator and connected to the end placed inside the oven by means of a conduit, for example a metallic one. This variation in the volume of the chamber axially moves a shutter pin, along with the thermostatic shutter connected to it, in such a way as to vary the flow of gas to the regulator outlet and maintain the temperature set inside the oven.

[0005] In the prior art, moreover, in order to enable the thermostat to be regulated, the thread on the end of the shutter pin is left-handed so that when the user turns the thermostat control shaft anticlockwise in order to request a higher temperature inside the oven, the thermostatic shutter is moved away from its respective closure seat on the body of the regulator; in this manner the shutter will intervene to close off the passage of gas at a higher temperature.

[0006] When the thermostatic shutter comes to abut against the closure seat on the body of the regulator, the main gas flow is shut off; however, a minimal flow of gas remains, assured by secondary conduits and a suitable means for regulating this minimum flow, which in turn prevents the flame from extinguishing.

[0007] Essentially, as illustrated in figure 1, when the fluid contained in the bulb expands or contracts inside the expansion chamber 2, it axially moves a pin 9 and consequently moves the thermostatic shutter 6 of the valve means 4, thereby varying the flow of gas supplied to the oven according to the temperature thereof. The temperature-sensitive element acting on the valve means 4 is fixed onto the body of the regulator 5 by means of an assembly portion 7 and locked in that position by a locknut 8.

[0008] It is likewise known that thermostatic systems must be calibrated in order to function correctly; that is,

it is necessary to create a relative position between the various parts of the system such that at a pre-established temperature at the end of the temperature-sensitive element and in the corresponding position of the valve control axis, the shutter must be in contact with the closure seat on the body of the regulator.

[0009] Document US6634351 illustrates a thermostatically controlled gas flow regulator with a pilot flame, comprising assembly and calibration means like the ones described in figure 1.

[0010] Again with regard to the background art for this invention, document IT1319143 envisages the use of a suitably shaped body mounted externally to the body of a thermostatic regulator, which is provided with terminal portions that slide until becoming lodged on one of the inclined serrated surfaces of the body of the thermostatic regulator itself: this shaped body, once set in the predefined assembly position, constrains a respective pin, said assembly portion, which is part of the temperature-sensitive element, in the correct assembly position, and at the same time axially pre-loads the system so as to suitably load an appropriate sealing ring of the "O-ring" type. This known technique proves to be disadvantageous in terms of the geometric complexity of the various components thereof and in any case implies a longer, more complicated assembly process.

[0011] In this known technique, moreover, the mechanism just described creates a friction torque resistant to the rotation of the temperature-sensitive element relative to the body of the regulator. During calibration, this torque is overcome in order to rotate the temperature-sensitive element and thereby regulate the distance of the valve means relative to the valve body; at the same time, this resistant torque precludes the free rotation of the temperature-sensitive element relative to the body of the regulator. However, the calibration system described in document IT01319143 has some disadvantages: in particular, this system is relatively complex and costly to implement, just as casting the body of the thermostatic regulator having inclined serrated surface is complicated to achieve. Moreover, the terminal portions of the shaped body can bend, break or undergo wear as a result of the force impressed by the calibration, thus causing malfunctions of the thermostatic regulator. In addition, being completely positioned outside the body of the thermostatic regulator, the above-described shaped body is exposed to impacts; any impacts imparted even accidentally to the shaped body can cause a variation in the calibration of the regulator. Finally, the shaped body described in the above-mentioned document needs to be assembled using particular tools. Still furthermore, the shaped body thus made needs to be inserted for the entire length of the temperature-sensitive element once the latter has already been inserted into the body of the regulator, which takes a considerable amount of time during the assembly phase.

[0012] This latter disadvantage can also be found in the prior art systems described in fig. 1, where the locknut

8, too, must be inserted along the temperature-sensitive element until reaching the assembly portion 7 and then be screwed in until contacting the body 5.

[0013] The systems analogous to the one represented in figure 1 have the further disadvantage of a slow and laborious calibration, as described in IT1319143, since it is necessary to loosen the locknut 8, perform the calibration by rotating the assembly portion 7 and, finally, tightening the locknut 8 again in order to definitively secure the element 7 to the body of the regulator 5.

[0014] In light of the foregoing, the object of the present invention is to describe an assembly and thermostatic calibration system for fuel gas flow regulators which contributes to mitigating the above-described drawbacks. A further object of the present invention is to describe a thermostatic fuel gas regulator which contributes to mitigating the above-described drawbacks.

Summary of the invention.

[0015] According to the present invention an assembly and calibration system for thermostatic fuel gas flow regulating modules is provided, the calibration system comprising a calibration pin, configured to be at least partly inserted into a cavity of the body of said flow regulator, and a portion suitable for accommodating locking means coupled with said calibration pin inside said cavity. The locking means have a mechanical fit against a wall of said calibration pin and, advantageously, comprise a nut capable of being screwed onto a portion of the body of said flow regulator.

[0016] Advantageously, said locking means comprise a retaining ring.

[0017] Advantageously, said locking means are mutually interconnected and engaged and can comprise a recess suitable for rendering the locking means mutually interconnected and engaged; said recess is preferably formed in the nut or in the retaining ring and the nut and the retaining ring are mutually interconnected and engaged at said recess.

[0018] According to the present invention there is further described a fuel gas flow regulator comprising a thermostatic shutter configured to vary an aperture between an inlet and an outlet of the flow regulator; said flow regulator comprises an assembly and thermostatic calibration system comprising a calibration pin at least partly introduced into a lower cavity of said flow regulator and connected with said thermostatic shutter. Advantageously, the calibration pin has a cavity inside it which defines a communication conduit between the thermostatic module and an end sensitive to the operating temperature, introduced inside an oven; in the communication conduit there is a fluid capable of expanding in volume as the temperature thereof increases and of consequently causing a shift in the thermostatic shutter such as to reduce the passage of the gas toward the outlet of said regulator as the temperature of the temperature-sensitive end 3 increases.

[0019] Advantageously, said thermostatic module comprises an opposing spring acting upon the thermostatic valve of said thermostatic module and wherein said opposing spring is configured to be compressed in a variable manner according to the position of said shutter which is slidable on the axis of axial movement X.

[0020] Advantageously, said regulator is of the offset cone type, i.e. provided with a gas flow distributing element rotating on an axis that is offset relative to the axis of a control shaft.

[0021] Advantageously, moreover, said control shaft is capable of rotating and sliding on the same axis X of movement as the shutter and is configured to act upon said thermostatic module by moving said shutter relative to the valve body according to the angular position taken on thereby.

Description of the figures.

[0022] The invention will be described hereinbelow with reference to the appended figures, according to the which:

- Figure 1 illustrates a sectional view of an assembly and thermostatic calibration system for fuel gas flow regulators of the known type;
- Figure 2 illustrates a sectional view of an assembly and thermostatic calibration system for fuel gas flow regulators according to the present invention; and
- The figures in sequence from 3 to 7 illustrate different successive assembly and calibration steps made possible by the present invention.

Detailed description of the invention.

[0023] With reference to the appended figures, and in detail figure 2, the reference number 100 denotes in its entirety a preferred embodiment of a assembly and thermostatic calibration system for fuel gas flow regulators. In detail, the thermostatic fuel gas regulator 200 has a fuel gas inlet 201 to the thermostatic module and at least one outlet 202 for supplying a gas delivery nozzle placed, by way of non-limiting example, in an oven. Between the inlet and the outlet 202 there is a disk-shaped shutter 203 and a rod 213 is movable relative to the centre thereof; positioned below the shutter 203 there is an opposing spring 204 of the helical compression type, which has a first end acting upon the shutter 203 itself and a second end resting against a wall of a pin 212 welded onto a fluid expansion chamber 205. The fluid comes from a conduit 206 connected with a temperature-sensitive end 3, which is designed to be introduced into the oven.

[0024] In particular, the fluid contained in the temperature-sensitive end is strongly expandable as a function of temperature, with a positive coefficient; therefore, the higher the temperature is, the more the fluid will expand and the more the chamber 205 will increase in size. Consequently, the pin 212, the rod 213 and the spring 204

translate upward, moving the shutter 203 toward the corresponding closure seat on the body of the regulator.

[0025] The shutter 203 can translate upward until blocking off the passage of gas completely.

[0026] The thermostatic regulator is moreover provided with auxiliary gas bypass conduits, serving to assure a minimal passage of gas toward the outlet 202 even when the shutter 203 abuts against the closure seat and is in contact on the body of the regulator 200.

[0027] The temperature-sensitive element, made up of the pin 212, the membrane 205, the calibration pin 108, the conduit 206 and the end 3 placed in the oven, is fixed to the body of the regulator 200 by means of the system 100 of the present invention, which comprises a nut 101 having a threaded cylindrical internal passage acting on a lower end 210 and a retaining ring 104.

[0028] For this purpose the body of the thermostatic regulator 200 has:

- a cavity 211, in which the calibration pin 108 is inserted; and
- an exterior surface that is threaded in such a way as to mate with the thread of the nut 101.

[0029] The calibration pin 108 thus possesses a first portion which, during use, is positioned inside the cavity 211 and a second contiguous portion, which projects outside the cavity and has an intermediate zone 105 with a tapered diameter that is sufficient to permit the introduction of a retaining ring 104. The intermediate zone 105 ends in the direction of the portion projecting from the cavity 211 with a wall 106 that is substantially oriented transversely, with a slight inclination relative to an axis X of the body housing the calibration pin 108.

[0030] Moreover, the portion of the calibration pin introduced into the cavity 211 has a diameter which decreases progressively as it extends into the cavity itself, which has, in a portion thereof, inclined walls with the same inclination as the portion of the calibration pin. On the inclined walls of the calibration pin, there is an annular recess 109 which is suitable for housing within it a sealing ring; once assembly of the system has been completed, this ring assures that the gas contained in the regulator does not leak out of the regulator 200 itself.

[0031] The retaining ring 104 is configured so as to be capable of being introduced inside an annular recess 103 at one end of the nut 101; therefore, the maximum diameter of the retaining ring 104 is substantially equivalent to the maximum diameter offered by the annular recess 103 of the nut 101.

[0032] Also constrained on the calibration pin is a conduit 206, which is intended to make the expandable fluid flow from the expansion chamber 205 to the end placed in the oven.

[0033] The system 100 is installable on gas flow regulators both of the type with a regulating cone on an axis with the control shaft and on gas flow regulators of the offset cone type, where a control shaft for regulating the

flow of gas acts on the cone valve by means of a pair of gears; in these regulators, the cone axis is parallel to the axis of the control shaft, but it is positioned laterally thereto.

[0034] In particular, by rotating the control shaft in a direction corresponding to the opening of the shutter 203, as can occur, for example, when the oven is switched on to bring it to a preset temperature, the anticlockwise rotation of the control shaft serves to create a screwing between the rod 213 and a threaded pin 212, which leads the rod 213 and consequently the shutter 203 to be drawn downwards, thus increasing the passage left open by the shutter 203 for the flow of gas. Afterwards, when the oven warms up, the expansion of the fluid inside the conduit 206 and the chamber 205 causes the chamber itself to expand upward and the pin 212 also moves upward. Consequently, the rod 213 and the shutter 203 also move upward with a consequent decrease in the opening for the passage of gas.

[0035] The calibration operation is the operation which, by rotating the threaded pin 212 by means of the calibration pin 108, makes it possible to have an opening between the shutter 203 and the corresponding closure seat on the body of the regulator that becomes approximately nil with the expansion of the expansion chamber generated by the temperature set on the control shaft. In order for the calibration to be correctly defined, the temperature set on the control shaft must be the same as the one at the end of the temperature-sensitive element, created by means of special calibration ovens. Otherwise, in fact, the calibration would not be optimal and the temperature set by means of the control shaft would differ from the actual temperature present in the oven.

[0036] The assembly and calibration process made possible by the structural features of the present invention will now be illustrated in detail, making reference to the operating sequence illustrated by figures 3 to 7.

[0037] First of all, one begins (as shown in figure 3) by screwing the nut 101 all the way down on the body of the regulator; this operation is followed (as illustrated in figure 4) by insertion of the temperature-sensitive element and can be conveniently performed manually by the operator/assembler. Following these two first assembly steps, one proceeds (as illustrated in figures 5, 5a and 5b) by inserting the retaining ring 104 between the surface 105 of the calibration pin 108 and the body of the regulator. Subsequently, one proceeds (as illustrated in figures 6 and 6a) to unscrew the nut 101 by applying a predetermined torque that simultaneously creates these conditions:

- A pressure is imposed on the O-ring 109 mounted on the calibration pin 108 (which can be seen in figure 6a) such as to prevent the leakage of gas from the regulator;
- The heat-sensitive element is prevented from undergoing any axial translation; in other words it is "vertically" locked in its final assembly position, where

the conical parts of the calibration pin 108 and of the body of the regulator are in contact with each other; and

- A friction torque is created in the area of mutual contact between the retaining ring 104 and the calibration pin 108, i.e. said temperature-sensitive element is held by friction relative to the body of the regulator and thus not free in its rotation.

[0038] Subsequently, once the regulator is completely assembled, one proceeds (as illustrated in figure 7) with the actual calibration: using suitable tools, the upper shaped end of the calibration pin 108 is made to rotate until reaching the calibration of the regulator. Conveniently, in fact, the friction torque developed between the retaining ring 104 and calibration pin 108 is proportioned so as to enable rotation (in either direction: screwing or loosening) of the calibration pin 108 to be actuated during calibration; the pin is not free in any case to rotate about its axis except with the use of suitable tools.

[0039] In other words, thanks to the appropriate dimensioning of the structural parts cooperating in the assembly and calibration sequence, it is possible to finely adjust the overall system, which is "enabled" to change its general condition only if one intervenes with a tool capable of imposing a suitable torque.

[0040] Going back to the structural details of the present system, it is also worth noting the presence of an anti-rotation tooth 111, which is kinematically interposed between the pin 108 and the retaining ring 104 to prevent the pin 108 from drawing in rotation the retaining ring 104 and the nut 101 during the calibration operation, which would cause a relative shift of the temperature-sensitive element relative to the "initial" position, which is imposed on it during assembly, and a change in the load conditions of the internal O-ring 109.

[0041] On the one hand, the system 100 of the present invention enables the operation of calibrating the thermostatic regulator to be simplified, since it is no longer necessary to loosen and re-tighten a locknut.

[0042] Moreover, unlike in the prior art, the regulating assembly projects to a minimal extent outside the body 200 of the regulator, and is consequently less exposed to impacts and intrinsically more robust, since the retaining ring 104 is substantially positioned for the most part inside the recess of the nut 101.

[0043] The system 100 of the present invention has various advantages compared to the prior art, with reference in particular to the speed of assembly processes, there being no need to insert the locking elements along the entire conduit of the temperature-sensitive element before reaching the assembly position.

[0044] Being provided with inclined walls, as occurs on part of the calibration body 108, the cavity of the lower portion of the body of the regulator further enables optimal centring of the thermostatic probe.

[0045] It should be noted that the regulator 200 of the present invention can be both of the type with a distributor

cone axially disposed on the thermostatic module, and of the offset cone type. In the latter case, the distributor cone- which is the part of the regulator designed to regulate the flow of gas independently of the action of the thermostatic module and based instead on the command imposed by the user - is disposed on an axis positioned laterally relative to the axis of the pin 108 and spring 204, the axis which the control shaft rotates on and translates along. This shaft also acts directly on said thermostatic module, and on the regulator cone by means of a pair of gears, the first one of which is keyed onto the axis of the control shaft and the second of which is instead keyed onto the axis of the regulator cone.

[0046] It is clear, finally, that the system of the present invention can have additions or modifications applied to it which are obvious to the person skilled in the art, without going beyond the scope of protection of the appended claims.

Claims

1. An assembly and calibration system (100) for thermostatic fuel gas flow regulating modules (200), the system comprising a calibration pin (108) configured to be at least partly inserted inside a cavity (211) of the body of said flow regulator (200) and comprising a portion (105) suitable for accommodating locking means coupled with said calibration pin (108) inside said cavity; said locking means having a mechanical fit against a wall of said calibration pin (108); **characterized in that** said locking means comprise a nut (101) capable of being screwed onto a portion of the body of said flow regulator (200).
2. The calibration system according to claim 1, wherein said locking means comprise a retaining ring (104) cooperating with said nut (101).
3. The calibration system according to any one of the preceding claims, wherein said locking means are mutually interconnected and engaged.
4. The calibration system according to claim 3, wherein said locking means comprise a recess suitable for rendering the locking means themselves mutually interconnected and engaged, said recess being preferably formed in the nut (101) or in the retaining ring (104), the nut (101) and the retaining ring (104) being mutually interconnected and engaged in said recess.
5. A fuel gas flow regulator (200) having an inlet and an outlet and comprising a thermostatic module, configured to vary an aperture between said inlet and outlet, and a calibration system comprising a calibration pin (108) at least partly introduced into a lower cavity (211) of said flow regulator (200) so as to be connected with said thermostatic module and

wherein said calibration pin (108) comprises an intermediate portion (105) configured to house a retaining ring (104) having a matching part in said intermediate portion (105), **characterized in that** said retaining ring (104) is fitted over a nut (101) screwed onto the body of said flow regulator and abuts against a wall of said calibration pin (108) oriented transversely relative to the axis of movement of said calibration pin (108) itself.

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6. The flow regulator according to claim 5, wherein said calibration pin (108) has a cavity inside it which is capable of creating a communication conduit between said thermostatic module and an element introduced inside an oven which is sensitive to the operating temperature; there being present in said communication conduit a fluid capable of expanding in volume as the temperature thereof increases and capable of consequently causing a variable force on said thermostatic module such as to reduce the passage of said gas toward said outlets of said regulator (200) as the temperature of the fluid itself and/or of said temperature-sensitive element increases.
7. The flow regulator according to either of claims 5 and 6, wherein said thermostatic module comprises an opposing spring (204) acting on a shutter (203) of said thermostatic module and wherein said opposing spring (204) is configured to be compressed in a variable manner according to the position of said calibration pin (108), which is slidable on said axis of axial movement.
8. The flow regulator according to any one of the preceding claims 5-6, **characterized in that** it is of the offset cone type, provided with a gas flow reducing element rotating on an axis that is offset relative to the axis of a control shaft.
9. The flow regulator according to claim 7, wherein said control shaft is capable of rotating and sliding on the same axis as the calibration pin (108) and is configured to act upon said thermostatic module so as to cause the temporary opening of said aperture during a step of igniting the gas.
10. The flow regulator according to any one of the preceding claims, wherein there is further present at least an anti-rotation tooth (111) kinematically interposed between the nut (101), the calibration pin (108) and the retaining ring (104) to prevent at least a relative rotation thereof.

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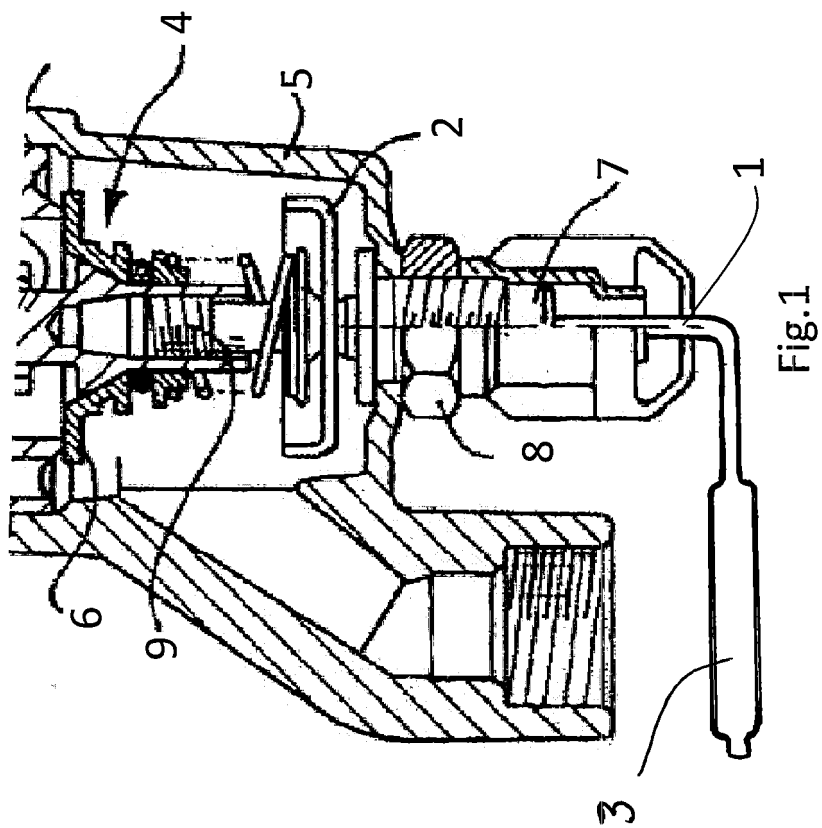
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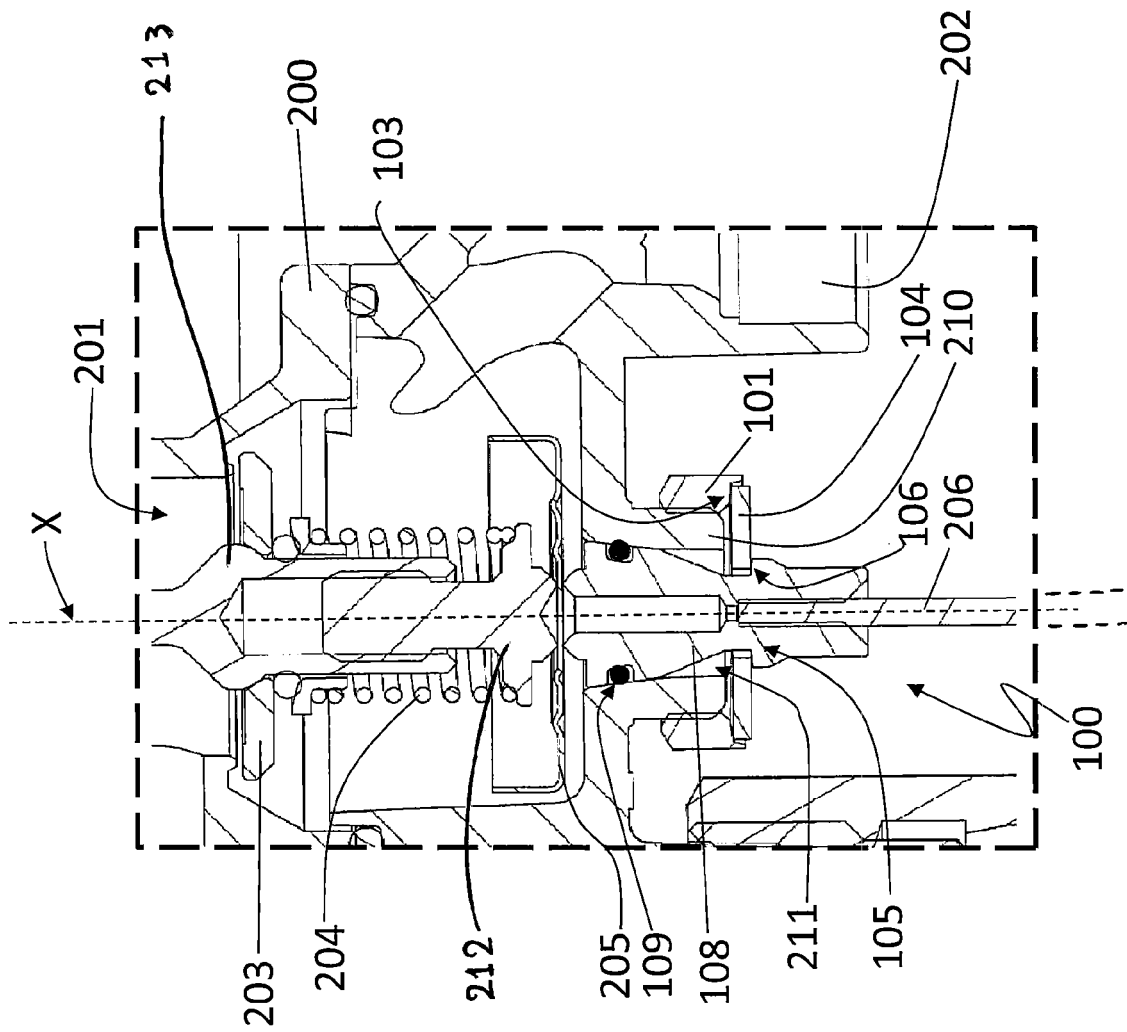
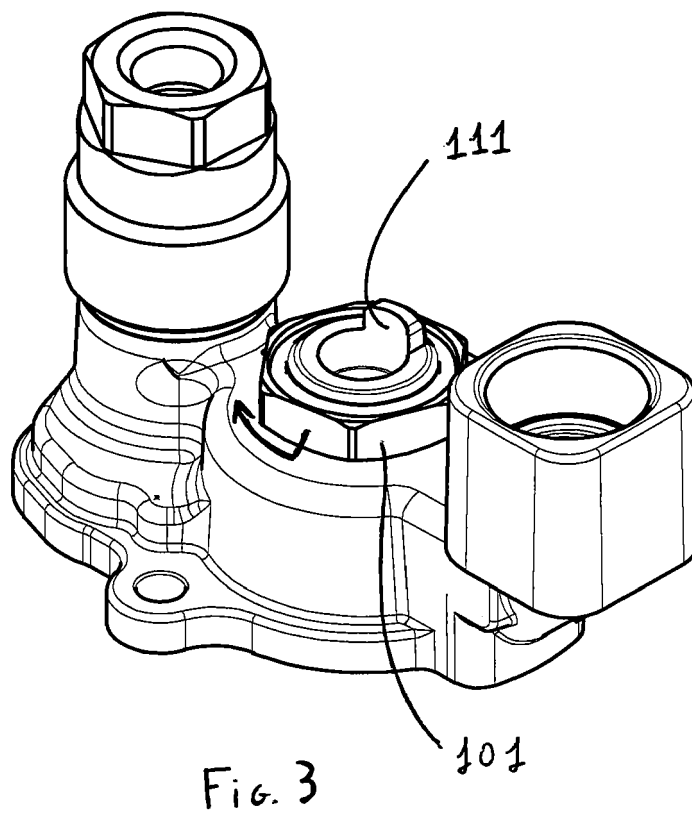
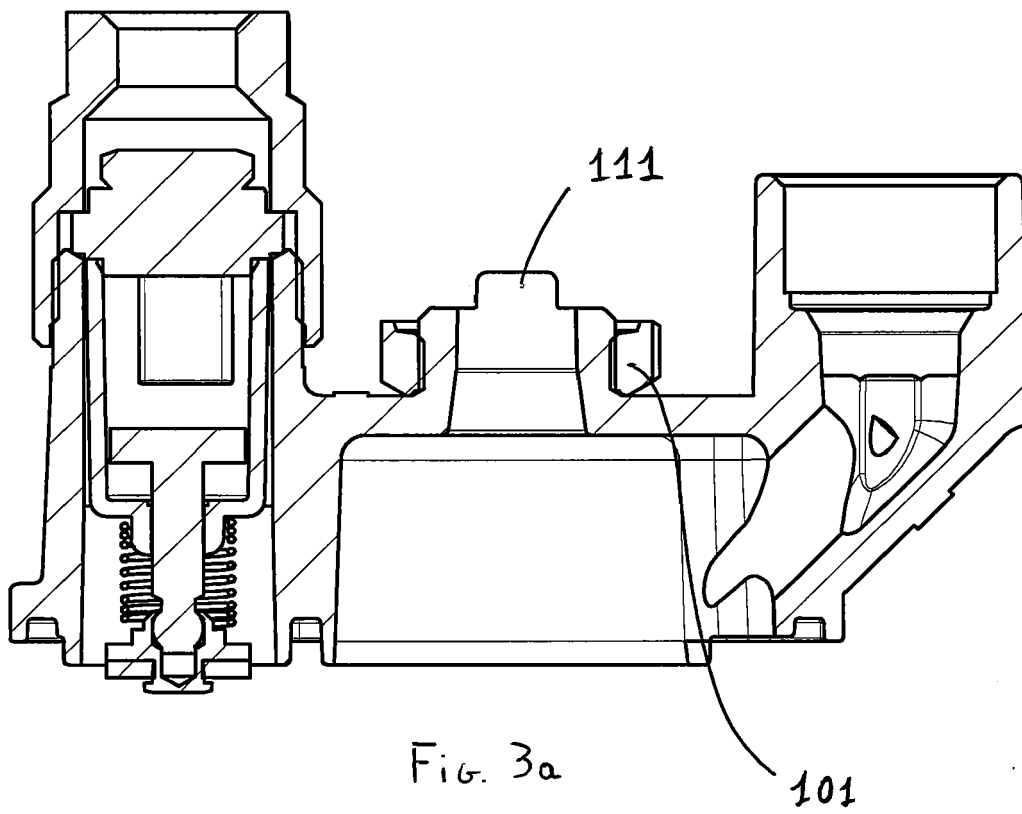
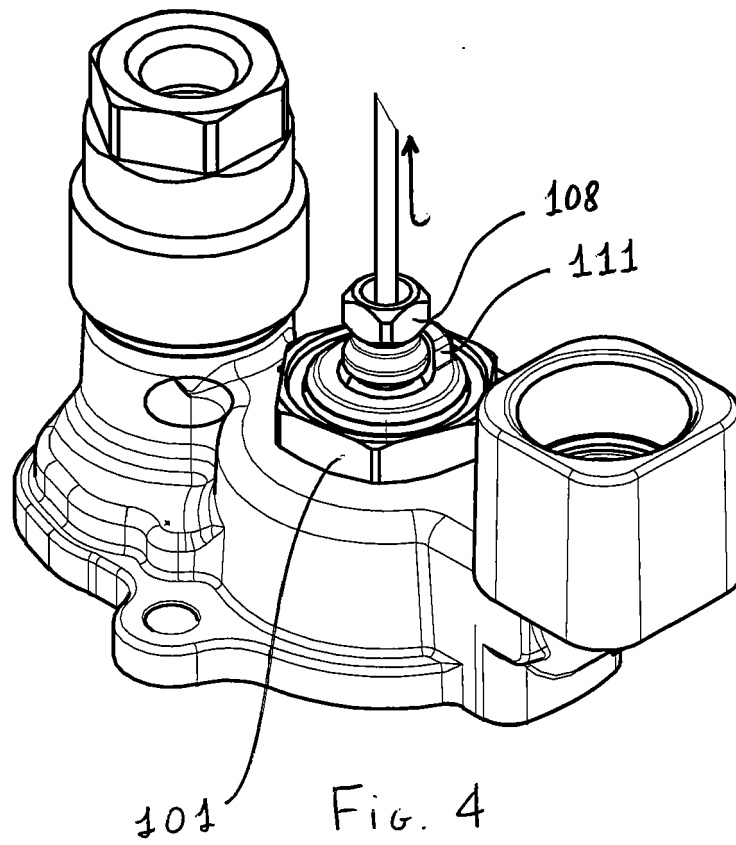


Fig. 2







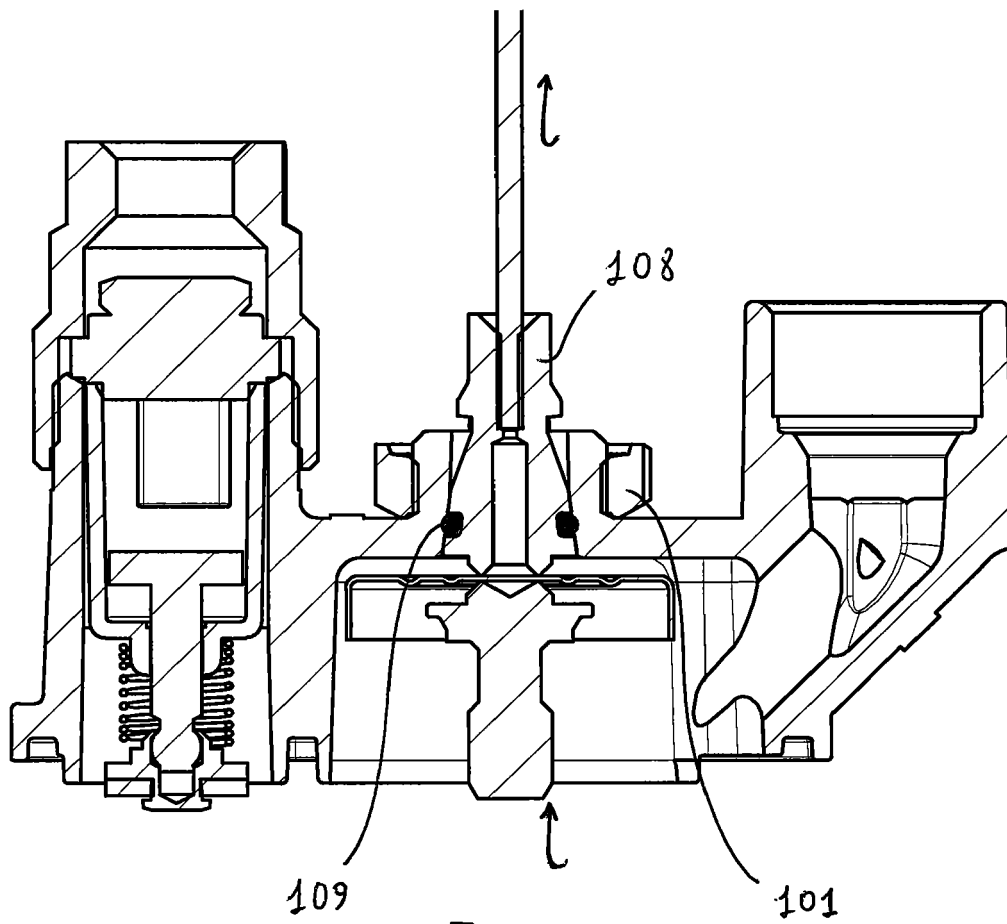
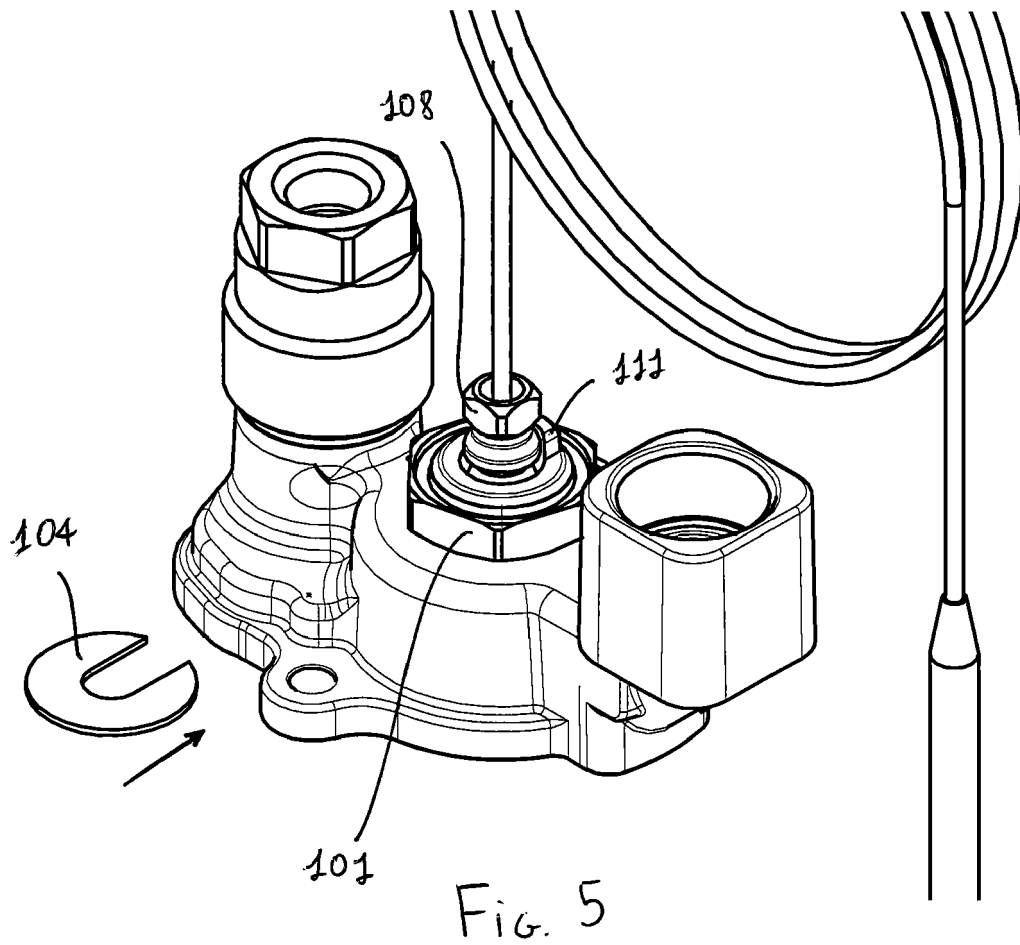
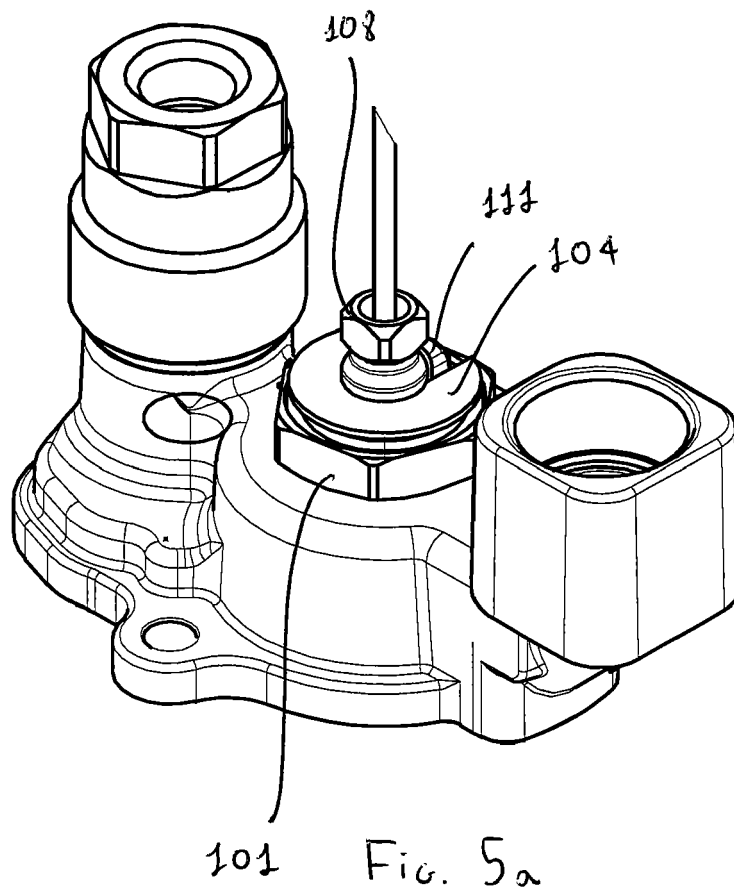
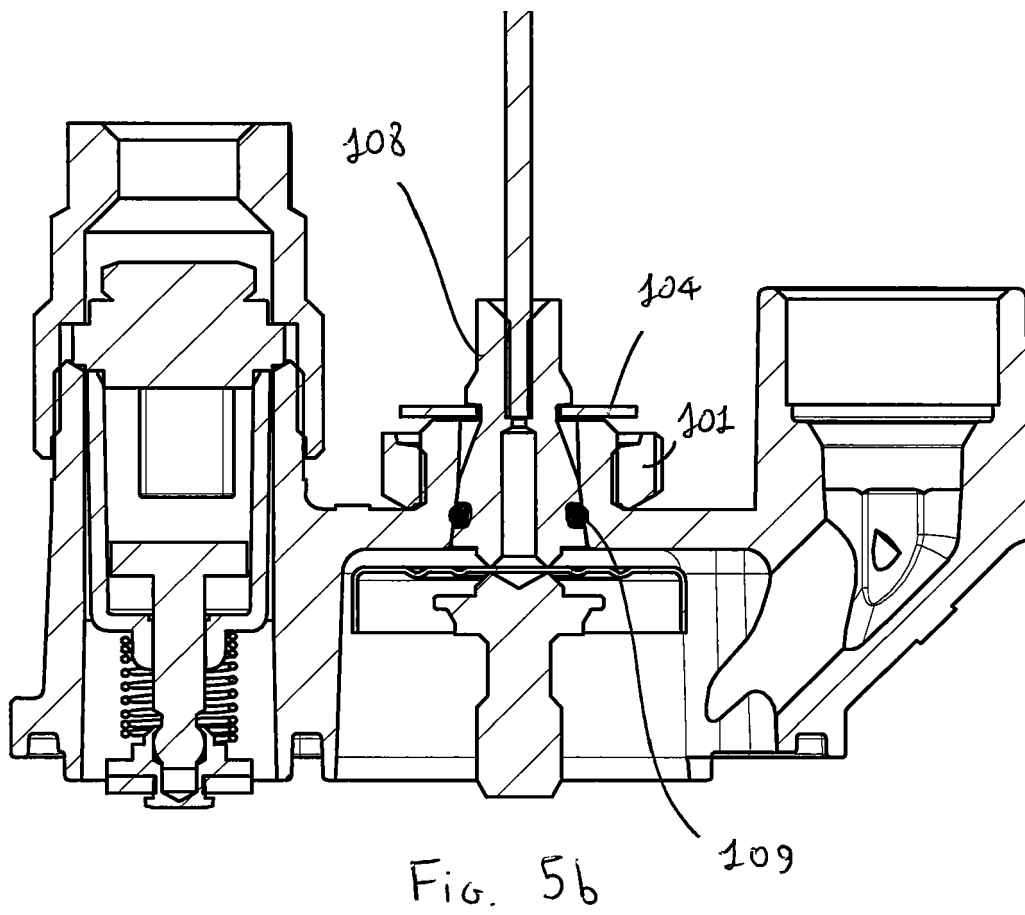


Fig. 4a







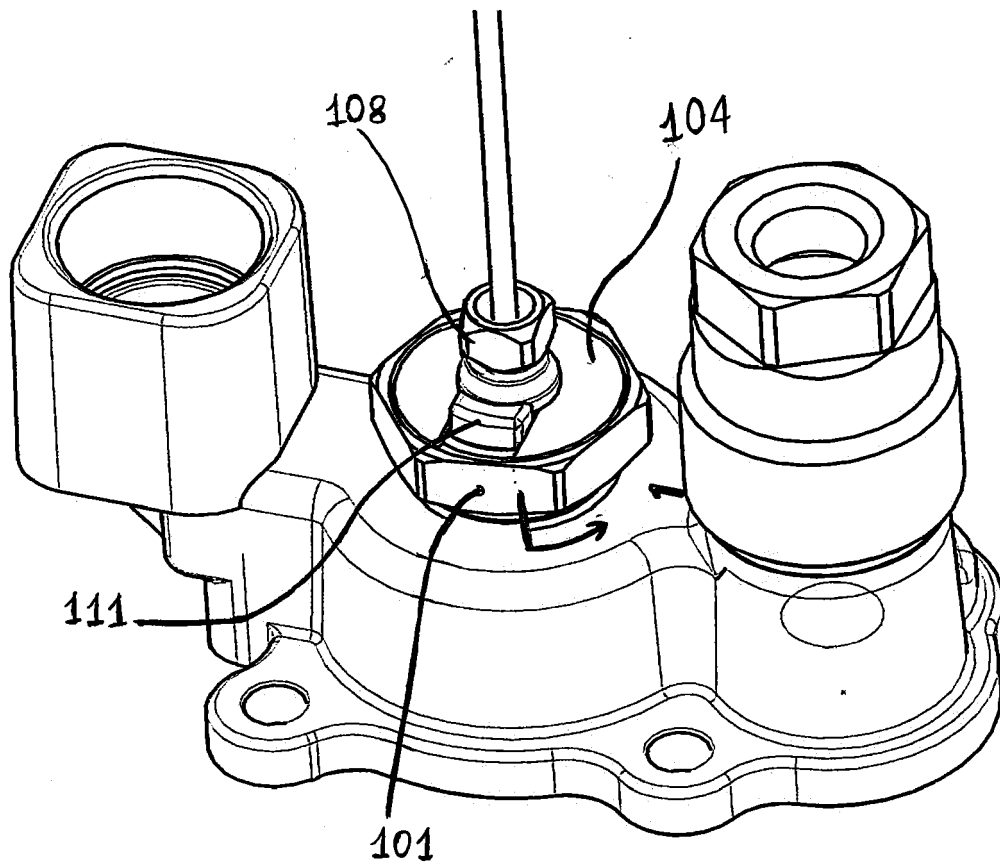
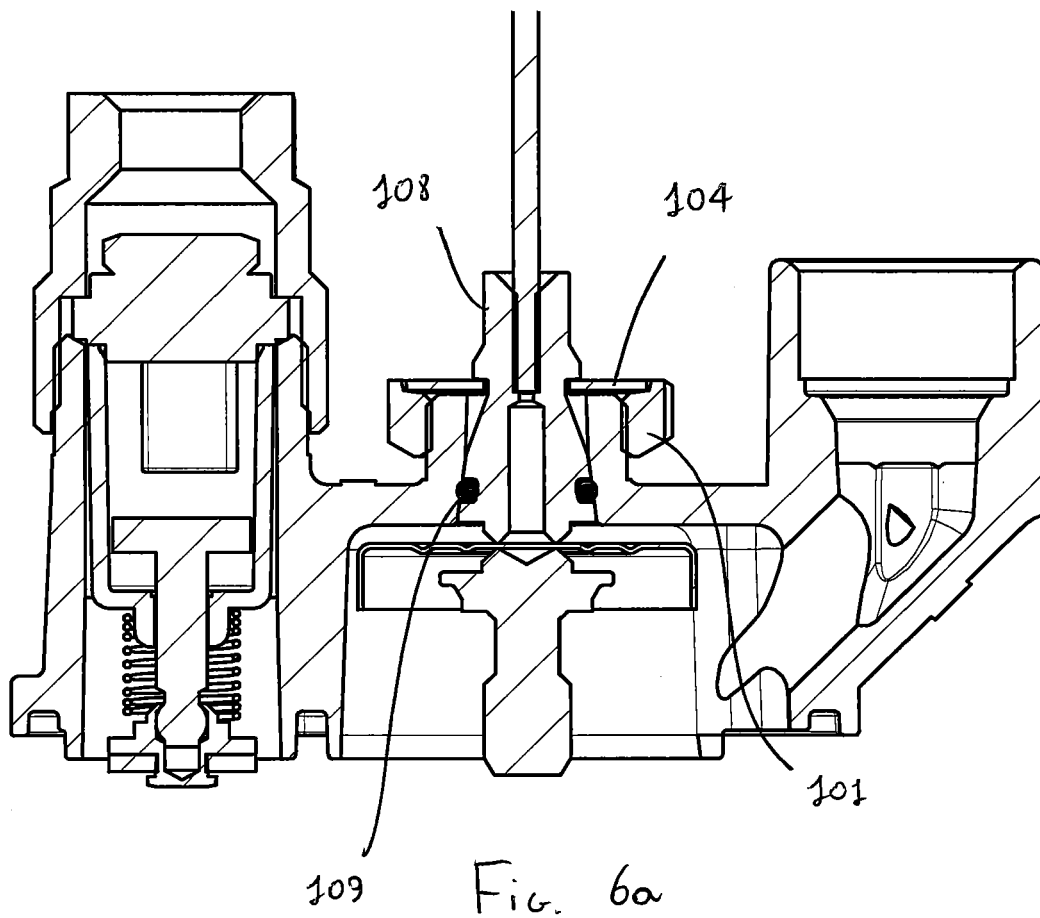


Fig. 6



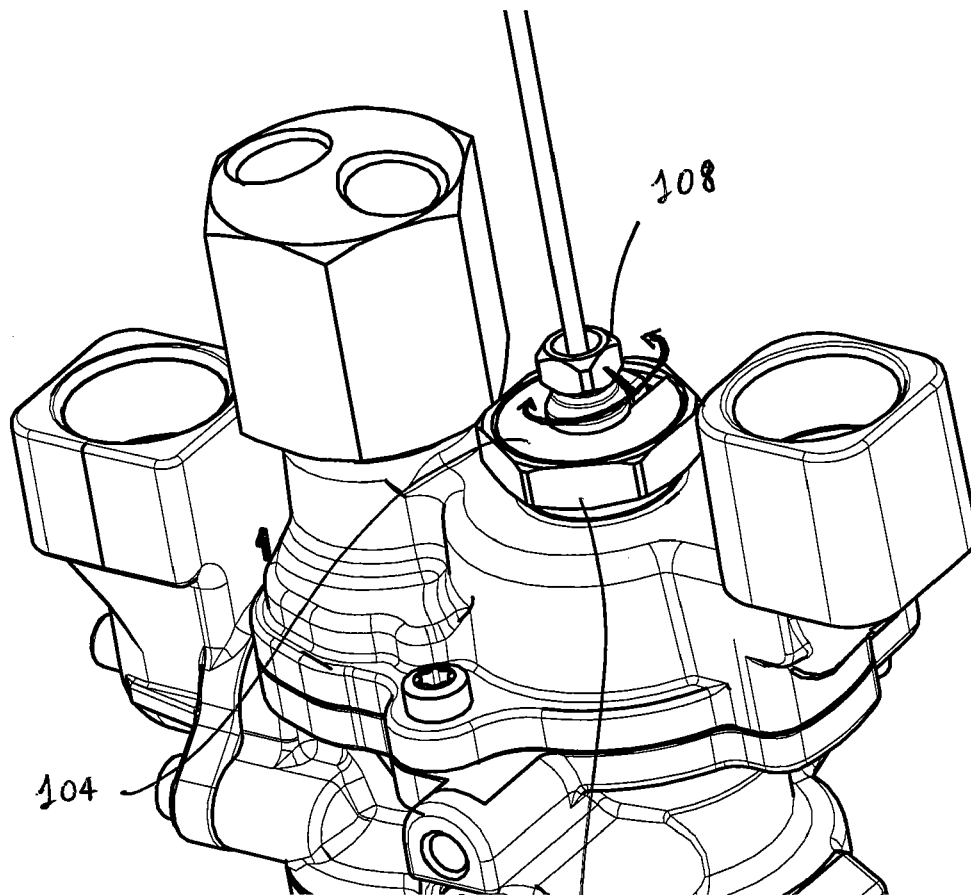


FIG. 7

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EUROPEAN SEARCH REPORT

Application Number
EP 14 18 2459

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The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 14 January 2015	Examiner Coli, Enrico
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**ANNEX TO THE EUROPEAN SEARCH REPORT
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EP 14 18 2459

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