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(54) **FUEL INJECTOR**

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Description

Technical field

[0001] The present invention relates to a fuel injector. In particular, but not exclusively, the invention relates to a fuel injector of the type used in a compression ignition internal combustion engine to regulate the delivery of fuel into a combustion chamber.

Background

[0002] DE102009028979 discloses a fuel injector as per the preamble of claim 1. Fuel injectors for internal combustion engines generally comprise a nozzle needle that is controlled by a valve needle actuation system. The nozzle needle of the injector is movable within a nozzle body, towards and away from a nozzle needle seating, to control the delivery of fuel from the injector into the combustion chamber. The valve needle actuation system includes an actuator arranged to control a valve to vary fuel pressure in a control chamber located above the nozzle needle. The top of the nozzle needle is exposed to fuel pressure within the control chamber, so by varying fuel pressure within the control chamber, movement of the nozzle needle towards and away from the nozzle needle seating is controlled so as to control injection.

[0003] In one known injector type, the control chamber is defined at the top of the nozzle body, with the upper ceiling of the chamber being closed by a valve body located immediately above the nozzle body (sometimes referred to as the piston guide). It is important to maintain a good seal between the nozzle body and the valve body, to ensure no leakage of fuel from the control chamber. However, it has been found that in some injectors of the aforementioned type, fuel leakage between the upper surface of the nozzle body and the lower surface of the valve body is excessive and results in degradation of parts due to high pressure fuel leakage in undesirable areas.

[0004] It is one object of the present invention to provide a fuel injector in which this problem is overcome or alleviated.

Summary of the invention

[0005] According to a first aspect of the present invention, there is provided a fuel injector for an internal combustion engine, the fuel injector comprising a nozzle needle which is movable within a nozzle body to control fuel delivery through an outlet; a control chamber for fuel defined, at least in part, within the nozzle body so that an upper surface of the nozzle needle is exposed to fuel within the control chamber; and a housing located above the control chamber, wherein the housing includes a lower surface including a first region located, in part, above or defining a contact region for the nozzle body surrounding the control chamber; and wherein the lower surface

of the housing further includes a relieved region which is further spaced from the nozzle body, relative to the first region, so that there is an increased contact pressure at the first region when the housing and the nozzle body are clamped together, relative to a lower surface in which there is no relieved region.

[0006] For the purpose of this specification, the "separation" between the relieved region and the nozzle body is measured in a direction parallel with the longitudinal axis of the fuel injector.

[0007] According to the invention, the housing takes the form of a valve body which houses a control valve of the injector.

[0008] The effect of providing the relieved region is that the contact pressure at the interface between the nozzle body and the valve body located above the nozzle body is increased for those areas of the lower surface of the housing part which are not relieved. This improves the seal between the parts and, hence, fuel leakage between the surfaces is reduced or substantially removed altogether. In this way damage to the surfaces, which may be contacting, is reduced.

[0009] In one embodiment, the housing and the nozzle body are in contact with one another via the first region. In this case, contact pressure between the nozzle body and the housing is increased in the area of contact between these parts (the first region) so that the seal provided between the parts is improved.

[0010] In another embodiment, the housing and the nozzle body are spaced apart by an intermediate washer so that the first region is spaced from the upper surface of the nozzle body by the intermediate washer, and in which case the intermediate washer defines the ceiling of the control chamber. Typically, an intermediate washer is required between the nozzle body and the housing when the injector is provided with a measurement system for determining needle position. In this case the intermediate washer is an electrically insulating washer. In this embodiment contact pressure is reduced at both the washer/nozzle body and washer/housing part interfaces, in the first region (the contact region). In the example where an intermediate component is present between the nozzle body and the housing, it will be appreciated that the "contact pressure" referred to above is not a direct contact pressure between the housing and the nozzle body, but is at the intermediate component/housing interface and the intermediate component/nozzle body interface.

[0011] By way of example, in one embodiment the relieved area may surround, in part, the second region.

[0012] In one embodiment, the second region may extend to a periphery of the lower surface via a bridging region. For example, the bridging region may include a peripheral region which extends to the periphery of the lower surface.

[0013] In one embodiment the relieved region may include an arc region which extends into the bridging region. As this arc region is not needed to ensure contact

between the housing part and the nozzle body (or between an intermediate washer and the nozzle body), the arc region may be a relieved region to further enhance the contact pressure at the lower surface.

[0014] In one embodiment the arc region may separate the supply path from the first region.

[0015] An inlet from a supply path for delivering high pressure fuel to the nozzle body may, for example, be arranged to open at the lower surface in the bridging region.

[0016] Typically, the housing part may include an opening in the first region to provide a spill path for leakage fuel, wherein the opening is closed by the upper face in the nozzle body.

[0017] According to the invention, a spill path is provided in the housing part so as to open into the second region so as to provide a flow path for fuel out of the control chamber to a low pressure drain.

[0018] The fuel injector may further comprise an inlet opening which opens into the second region and provides a flow path for fuel into the control chamber from a high pressure fuel supply.

[0019] In one embodiment, the lower surface may be provided with a plurality of peripheral regions which are separated from the nozzle body by the same amount as the first region.

[0020] For example, each of the peripheral regions may define an arc at the periphery of the lower surface.

[0021] Each of the peripheral regions may be of elongate form and extends radially inwards from the periphery of the housing part towards the first and second regions.

[0022] In another example, at least one of the peripheral arc regions may be joined to an adjacent one of the other peripheral arc regions via a joining region which is separated from the nozzle body by the same amount as the first region and which is separated, laterally across the lower surface, from the periphery of the housing part by a further relieved region.

[0023] It will be appreciated that even with an intermediate washer between the housing and the nozzle body, the relieved region is still spaced further from the nozzle body (even if not immediately adjacent to the nozzle body) than would otherwise be the case if the intermediate washer wasn't there, by virtue of the lower surface having different depths across the surface (i.e. with depth being measured in the direction of the longitudinal axis of the nozzle needle).

[0024] Within the scope of this application it is expressly intended that the various aspects, embodiments, examples and alternatives set out in the preceding paragraphs, in the claims and/or in the following description and drawings, and in particular the individual features thereof, may be taken independently or in any combination. That is, all embodiments and/or features of any aspect or embodiment can be combined in any way and/or combination with those in other aspects and/or embodiments, unless such features are incompatible.

Brief description of the drawings

[0025] In order that the present invention may be more readily understood, an example of the invention will now be described in detail with reference to the accompanying figures, in which:

Figure 1 is a cross sectional view of a fuel injector in accordance with the present invention;

Figure 2 is a plan view of the underside of a valve housing forming part of the injector in Figure 1;

Figure 3 is a perspective view, from the underside, of the interface between the valve housing in Figure 2 and an adjacent nozzle body of the injector;

Figure 4 is a perspective view from the underside of an alternative valve housing for use in the injector of Figure 1;

Figure 5 is a plan view of the underside of a further alternative valve housing for use in the injector of Figure 1;

Figure 6 is a plan view of the underside of a still further alternative valve housing for use in the injector of Figure 1; and

Figure 7 is a perspective view from the underside of the valve housing in Figure 6.

Detailed description

[0026] For the purpose of the following description it will be appreciated that references to above, below, upper, lower, upward, downward, above and below, for example, are not intended to be limiting and relate only to the orientation of the injector as shown in the illustration.

[0027] Figure 1 shows an injector 10 of one embodiment of the invention in which a nozzle needle 12 is movable within a bore 14 provided in a nozzle body 16. The nozzle body 16 is provided with a plurality of outlets (not visible in the section shown) through which fuel is injected into a combustion chamber when the nozzle needle 12 is moved away from a nozzle needle seating 18 defined at the blind end of the bore 14. The bore 14 is divided into three regions; a lower region 14a from where fuel is delivered through the outlets, an upper region 14b of enlarged diameter which defines a volume 20 for receiving high pressure fuel, and an intermediate region 14c between the upper and lower regions 14b, 14a. The intermediate region 14c of the bore 14 is slightly enlarged at its upper end 14d.

[0028] The volume 20 opens into a recess 22 defined at the end of the nozzle body 16 remote from the blind end of the bore 14. The recess 22 receives a nozzle body insert 16a of generally annular form with a downwardly

extending projection 26 on its underside (in the orientation shown). For the purpose of this specification, reference to the nozzle body 16, 16a shall be taken to include any part such as the nozzle body insert 16a which resides primarily within the envelope of the nozzle body 16, even if it is a separate part and not integral with the main nozzle body itself.

[0029] The nozzle body insert 16a is provided with a through bore 28 for receiving the upper end of the nozzle needle 12 in a sliding manner. The nozzle needle 12 is provided with an enlarged region 12a approximately half way along its length. The enlarged region 12a of the valve needle 12 is provided with a restricted passage 28 which restricts the flow of fuel between the high pressure fuel volume 20 and the intermediate region 14c of the bore. The enlarged region 12a of the nozzle needle 12 also acts as a guide for the nozzle needle 12 as it moves within the slightly enlarged region 14d of the intermediate region 14c of the bore 14.

[0030] A spring seat 30 defined by a collar attached to or otherwise forming part of the nozzle needle 12 is provided to define an abutment for a lower end of a spring 32 which serves to bias the nozzle needle 12 towards a seated position in which the outlets are closed. The upper end of the spring 32 abuts the underside of the projection 26 on the nozzle body insert 16a. The nozzle body insert 16a is further provided with a drilling 34 which defines a part of a high pressure flow path for fuel which is delivered from a high pressure fuel source to the volume 20.

[0031] The nozzle body insert 16a has an upper surface 36 which faces a lower surface 38 of a valve housing 42 (or valve body) which is located immediately above the nozzle body insert 16a. The valve housing 42 accommodates a control valve 44 of the injector, which includes a valve stem 44a. The control valve 44 is of well known type and so a detailed description of its structure and operation will not be included here. The control valve 44 is actuated by means of an electromagnetic actuator (not visible) including a solenoid winding to which a current is applied to cause movement of the valve stem 44a. A further housing part 46 is located above the control valve 44, so that the control valve 44 separates the nozzle body 16 from the further housing part 46. A lower region of the further housing part 46, the control valve 44 and an upper region of the nozzle body 16 (including the nozzle body insert 16) are clamped together within a cap nut 48.

[0032] The control valve 44 is operable to control the fuel pressure within a control chamber 50 defined within an upper region of the through bore 28 in the nozzle body insert 16a, and bounded at its ceiling 52 by the lower surface 40 of the valve housing 42. The upper surface of the nozzle needle 12 defines the floor of the control chamber 50 and is therefore exposed to fuel pressure within the control chamber 50. By controlling fuel pressure in the control chamber 50, the downward force acting on the nozzle needle 12 is controlled so as to control whether the nozzle needle 12 is seated against the nozzle needle seating 18 (when fuel pressure within the control

chamber 50 is relatively high) or whether it is lifted from the nozzle needle seating 18 (when fuel pressure within the control chamber 50 is relatively low). If the valve stem 44a is actuated so that the control chamber communicates with a low pressure drain (not shown), fuel flows out of the control chamber 50 and fuel pressure is reduced. If the valve stem 44a is moved so that communication between the control chamber 50 and the low pressure drain is broken, high pressure is re-established in the control chamber 50 due to communication with a high pressure fuel supply.

[0033] Referring to Figures 2, the construction of the valve housing 42 will now be described in more detail. The valve housing 42 is provided with various flow drillings to allow the flow of fuel into and out of the control chamber 50 under the control of the control valve 44, and thereby to control fuel pressure in the control chamber 50. The valve housing 42 is also provided with first and second positioning drillings 54, 56, which open at the lower surface 40, arranged in symmetry about a cross axis X-X of the valve housing 42, to accommodate dowel pins (not shown) which serve to locate the valve housing 42 in position on top of the nozzle body 16. The cross axis X-X is orientated perpendicularly to the longitudinal axis of the nozzle needle 12.

[0034] A first one of the flow drillings that can be identified in Figure 2 is a drilling 134 which communicates with the drilling 34 in Figure 1. Together the drillings 34, 134 define a part of the high pressure flow path into the nozzle body volume 20. The first drilling 34 defines a first opening at the lower surface of the valve housing 42 at a position located off-centre in valve housing 42 and towards the left-hand side of the housing 42 (in the orientation shown in Figure 2).

[0035] Second 60, third 62 and fourth 64 flow drillings are also provided in the valve housing 42, and open at the lower surface 40 of the valve housing at first, second and third openings, respectively. The second drilling 60 defines a first spill path from the control chamber 50, through which fuel flows to the low pressure drain when the valve stem 44 is actuated to connect the control chamber 50 with the low pressure drain. The flow path defined by the second drilling 60 may be referred to as the spill path orifice, or "SPO". The third flow drilling 62 defines a further path into the control chamber for high pressure fuel (the flow path defined by the third drilling 62 may be referred to as the inlet orifice channel or the "INO" channel), and the fourth drilling 64 defines a further spill channel through which any leakage fuel flows to the low pressure drain (the flow path defined by the fourth drilling 64 may be referred to as a further SPO channel). The references to "orifice" derive from the presence of restrictions or orifices provided in all three of the flow paths 60, 62, 64 to restrict the rate of flow of fuel through the flow path.

[0036] Referring to Figure 3, which shows a view of the nozzle body 10 from the underside, the insert 16a of the nozzle body 16 is provided with corresponding first

and second positioning drillings 154, 156 which cooperate with the first and second positioning drillings 54, 56, respectively, in the valve housing 42 to define channels for receiving the dowel pins for location purposes. The further drilling 134 in the valve housing 42 (as shown in Figure 1) communicates with the high pressure drilling 34 in the nozzle body 16 to define the flow path for fuel into the downstream parts of the injector.

[0037] With the injector assembled as shown in Figure 1, it can be seen that the lower surface 40 of the valve housing 42 faces and abuts, over a part of its surface, the upper surface 36 of the nozzle body insert 16a. The extent to which the lower surface 40 of the valve housing 42 actually makes contact with the nozzle body insert 16a will now be described in more detail.

[0038] The lower surface 40 of the valve housing 42 is made up of several different zones or regions so that the lower surface 40 is not flat but has different depths (along the longitudinal axis of the injector) at different regions across the surface. A central region, referred to generally as 66, comprises a first region 66a (defined by the dashed line) which defines in part that region of the lower surface 40 into which the INO channel 62 and the SPO channel 60 open into the control chamber 50. The first region 66a is located so as to define the ceiling 52 of the control chamber 50 and therefore does not make contact with the upper surface 36 of the nozzle body 16. The central region 66 also includes a contact region 66b which makes contact with the upper surface 36 of the nozzle body 16, 16a by virtue of its positioning above an annular area of the surface 36 of the nozzle body insert 16a which surrounds the control chamber 50.

[0039] The central region 66 further includes a curved outer edge 66d at one end. At the opposite end, the contact region 66b extends to the periphery of the valve housing 42 via a bridging region 66e which forms part of the contact region 66b. The bridging region 66e further includes a peripheral region 66c which reaches the periphery of the surface 40. The bridging region 66e defines that part of the lower surface 40 into which the further SPO channel 64 opens. The peripheral region 66c defines that part of the lower surface 40 through which the high pressure fuel path 34 opens.

[0040] As lower surface 40 of the valve housing 42 is not flat across its entirety, and the central region 66, the peripheral region 66c and the bridging region 66e stand proud of a relieved region 72 which surrounds, and fills the space around, these other regions. The relieved region 72 is generally annular in shape, with an irregular outer profile, and with the annular path broken only by the presence of the peripheral region 66c and the bridging region 66e which stand proud. The effect of relieving the relieved region 72 in this way, so that the relieved region of the lower surface is spaced further from the nozzle body than the remainder of the unrelieved surface, is that contact between the lower surface 40 of the valve housing 42 and the upper surface 36 of the nozzle body /nozzle body insert 16/16a is only made over a reduced area (i.

e. via the contact region), compared to the case where the lower surface 40 of the valve housing 42 is flat. For a given clamping force, this has the effect of increasing the contact pressure in the region of contact between the valve housing 40 and the nozzle body 16, so that a reducing clamping force can be applied to ensure the same contact pressure. By applying an increased clamping force, contact pressure is therefore increased and, hence, an improved seal that is required between the lower surface 40 of the valve housing 42 and the upper surface 36 of the nozzle body/nozzle body insert 16/16a can be achieved.

[0041] In use, with the injector assembled, contact between the lower surface 40 of the valve housing 42 and the upper surface 36 of the nozzle body 16 is essential to ensure a seal is maintained between the high and low pressure regions across the surface. For example, it is essential that the SPO channel 64 if the injector is to operate properly. In addition, the INO channel 62, the SPO channel 60, and the further SPO channel 64 must be isolated from the opening to the high pressure supply 34. It is also essential that high pressure fuel leakage from the control chamber to the outside of the nozzle body 16 is kept to a minimum. The provision of the relieved area 72 on the lower surface 40 of the valve housing 42 improves the contact pressure, as described previously, such that fuel leakage across the surfaces 40, 16 is reduced and does not cause damage to the surfaces, which has otherwise been observed where the lower surface of the valve housing 40 is entirely flat with no reliefs.

[0042] Between the peripheral region 66c and the contact region 66b, adjacent to the bridging region 66e, the relieved area 72 includes a projection or arc 74 which projects towards the SPO channel 64. The provision of the arc 74 provides an additional relieved area where a seal is not necessary between the lower surface 40 of the valve housing 42 and the upper surface 36 of the nozzle body insert 16/16a, but this is carefully shaped so as to ensure that fluid communication between the high pressure supply 34 and the INO channel 62, the SPO channel 60 and the further SPO channel 64 does not occur.

[0043] In addition to the central region 66, the peripheral region 66c and the bridging region 66e, the contact region includes first, second and third peripheral contact regions 80, 82, 84, in the form of arcs, provided at the periphery of the valve housing 40, and spaced apart around the periphery at three of four equi-angularly spaced locations. In this configuration, the first and third peripheral arcs 80, 84 are diametrically opposed to one another whilst the other (second) arc 82 is located diametrically opposite the peripheral region 66c. The peripheral arc regions 80, 82, 84 make contact with the upper surface of the nozzle body 16, 16a and define a seal therewith. One end of each of the first and third peripheral arcs 80, 84 lies immediately adjacent to a respective one of the positioning drillings 54, 56 for the

locating pins, so that the region of contact with the upper surface 36 of the nozzle body provided by these peripheral arcs 80, 84 lies right on the edge of the openings to the positioning drillings 54, 56. The benefit of providing the peripheral arc regions 80, 82, 84 ensures contact pressure is equally distributed around the periphery, and hence avoids undesirable component distortion under assembly of the injector or during valve manufacturing.

[0044] In another embodiment, the peripheral arc regions 80, 82, 84 need not be separate elements and may be joined so as to extend over one or more longer regions around the periphery of the housing 42.

[0045] Referring to Figure 4, in an alternative embodiment the peripheral arc regions 80, 82, 84 are joined together at their extremities; the first arc 80 is joined at one end to one end of the second arc 82 via a first joining region 90, and the other end of the second arc 82 is joined with the third arc 84 via a second joining region 92. The effect of the joining regions 90, 92 as part of the contact region is to define first and second isolated relief regions 98, 100 at the periphery of the lower surface 40. A relieved region is, however, retained between the non-joined end of the third arc 84 and the peripheral region 66c, and between the non-joined end of the first arc 80 and the peripheral region 66c.

[0046] The embodiment of the valve housing 42 in Figure 4 provides a particular advantage when employed in an injector in which an insulating washer (not shown) is placed between the lower surface 40 of the valve housing 42 and the upper surface 36 of the nozzle body 16. In such embodiments it is the lower surface of the washer which defines the ceiling of the control chamber, rather than the lower surface 40 of the valve housing 42. If the injector is provided with a measurement system for electrical monitoring of the position of the valve needle 12, as is known in the art, it is necessary to include an electrically insulating washer between the valve housing 42 and the nozzle body 16 so as to ensure that there is electrical isolation between the valve needle 12 and the valve housing 42 when the nozzle needle 12 reaches its lift stop at the end of its range of travel (i.e. maximum lift). Such measurement systems are known in the art and are sometimes referred to as Injector Closed Loop (ICL) systems. The inventors have observed that when implemented within the embodiment of Figures 1 to 3, the relieved surface of the valve housing 42, without the joining regions 90, 92, may result in the washer suffering from wear at its periphery due to the increased contact pressure at the valve housing/washer and washer/nozzle body interfaces. The presence of the joining regions 90, 92 serves to reduce damage to the washer in this way.

[0047] A further difference between the valve housing 40 in Figures 2 and 3 and that shown in Figure 4 is that in Figure 4 there is only one dowel or locating pin (identified as 96) provided in only one of the positioning drillings 54. Due to the need for the electrical wire forming part of the measurement system, the other positioning hole 56 is in this case needed as a feed path for the wire

and so only one dowel can be provided.

[0048] In a further alternative embodiment to that shown in the previous figures, the first and third peripheral arc regions 80, 84 of the contact region may be shaped differently, as shown in Figure 5, so that one end 180, 184 of each of these arcs projects further inwards towards the central contact region 66 of the lower surface 40 so as to surround the holes where the positioning drillings 54, 56 open at the lower surface 40. In practice this means that the relieved area 72 of the lower surface 40 is slightly smaller in area than the previous embodiments, with the difference being the amount of material that surrounds the periphery of the positioning drillings 54, 56. One benefit of providing the extension regions at the ends 180, 184 of the arcs 80, 84 is that the regions can be shaped to define a particulate trap for trapping particulates generated during dowel pin insertion and injector assembly, thereby preventing fuel contamination with dowel pin material. The particulate trap is defined by forming a closed shape around each of the openings for receiving a dowel pin.

[0049] In a further embodiment of the invention, as shown in Figures 6 and 7, the peripheral regions need not take the form of arc regions and instead take the form of elongate fingers 280, 282, 284, 286, 288, 290, 292 which project radially, from the periphery of the valve housing 42, inwardly towards the central axis (marked as A). In the embodiment shown in Figures 6 and 7, there are seven peripheral fingers in total, each finger having a round tip at its innermost end. The provision of the round tip at the end of each finger has the benefit that edge stresses are reduced, and provides a cleaner finish to the edge. The first to sixth fingers 280-290 are equi-angularly spaced around the periphery of the valve housing 42, with the rounded ends directed towards and spaced apart from the contact region 66a, 66b. The seventh one of the fingers 292 is of shorter length, due to the presence of the bridging region 66e, and projects inwardly towards the bridging region 66e. The sixth and seventh fingers, 290, 292 respectively, are located one on each side of the second positioning drilling 56. The first and second fingers, 280, 282 respectively, are located one on each side of the first positioning drilling 54. In the same way as for the peripheral arc regions in previous embodiments, the presence of the contact regions 280-292 ensures that contact pressure around the periphery of the valve housing is more equally distributed, so that component distortion upon assembly is avoided.

[0050] It will be appreciated that various modifications may be made to the embodiments which have been described without departing from the scope of the invention as set out in the claims. For example, the shape and number of the peripheral regions may take one of many forms, in addition to those shown in the previous figures, whilst still providing a benefit of distributing contact pressure more evenly around the periphery of the valve housing at the washer/nozzle body or valve housing/nozzle body interface. In another embodiment (not shown) the

peripheral regions are concentric with the valve housing periphery, and may, but need not, be defined at the very periphery.

Claims

1. A fuel injector (10) for an internal combustion engine, the fuel injector comprising:

a nozzle needle (12) which is movable within a nozzle body (16, 16a) to control fuel delivery through an outlet;

a control chamber (50) for fuel defined, at least in part, within the nozzle body (16, 16a) so that an upper surface of the nozzle needle (12) is exposed to fuel within the control chamber (50); and

A valve housing (42) comprising a control valve (44) and being located above the nozzle body (16, 16a) having a lower surface (40) including a first region (66b) located, in part, above or defining a contact region for the nozzle body (16, 16a) surrounding the control chamber (50),

characterized in that the lower surface (40) further comprises a relieved region (72) further separated from the nozzle body (16, 16a), relative to at least the first region (66b), so as create an increased contact pressure at the first region (66b) when the housing part (42) and the nozzle body (16, 16a) are clamped together, relative to a lower surface in which there is no relieved region and wherein the lower surface (40) includes a second region (66a) located above or defining a ceiling of the control chamber (50) and,

the fuel injector further comprising a spill path (60) provided in the housing part (42) which opens into the second region (66a) and provides a flow path for fuel out of the control chamber (50) to a low pressure drain.

2. The fuel injector as claimed in claim 1, wherein the lower surface (40) of the housing part (42) and the nozzle body (16, 16a) are in contact with one another via the first region (66b), and the second region (66a) defines the ceiling (52) for the control chamber (50).
3. The fuel injector as claimed in claim 1, wherein the lower surface (40) of the housing part (42) and the nozzle body (16, 16a) are spaced apart by an intermediate washer, and the intermediate washer defines the ceiling of the control chamber (50).

4. The fuel injector as claimed in any of claims 1 to 3, wherein the relieved area (72) surrounds, in part, the second region (66b).

5. The fuel injector as claimed in claim 4, wherein the second region (66b) extends to a periphery of the lower surface (40) via a bridging region (66e, 66c).

6. The fuel injector as claimed in claim 5, wherein the bridging region (66e) includes a peripheral region (66c) which extends to the periphery of the lower surface (40).

7. The fuel injector (10) as claimed in claim 5 or claim 6, wherein the relieved region (72) includes an arc region (74) which extends into the bridging region (66e, 66c).

8. The fuel injector as claimed in any of claims 5 to 7, wherein an inlet from a supply path (34) for delivering high pressure fuel to the nozzle body (16, 16a) opens at the lower surface (40) in the bridging region (66e, 66c).

9. The fuel injector as claimed in claim 1 further comprising an inlet opening (62) which opens into the second region (66a) and provides a flow path for fuel into the control chamber (50) from a high pressure fuel supply.

10. The fuel injector as claimed in any of claims 1 to 9, wherein the lower surface (40) is provided with a plurality of peripheral regions (80, 82, 84; 280-292) which are separated from the nozzle body (16, 16a) by the same amount as the first region (66b).

11. The fuel injector as claimed in claim 10, wherein each of the peripheral regions defines an arc (80, 82, 84) at the periphery of the lower surface (40).

12. The fuel injector as claimed in claim 10, wherein each of the peripheral regions (280-292) is of elongate form and extends radially inwards from the periphery of the housing part (42) towards the first and second regions (66a, 66b).

13. The fuel injector as claimed in claim 11, wherein at least one of the peripheral arc regions (80, 82, 84) is joined to an adjacent one of the other peripheral arc regions via a joining region (90, 92) which is separated from the nozzle body (16, 16a) by the same amount as the first region (66b) and which is separated, laterally across the lower surface (40), from the periphery of the housing part (42) by a further relieved region (98, 100).

Patentansprüche

1. Kraftstoffinjektor (10) für einen Verbrennungsmotor, wobei der Kraftstoffinjektor aufweist:

eine Düsennadel (12), die in einem Düsenkörper (16, 16a) bewegbar ist, um eine Kraftstofflieferung durch einen Auslass zu steuern;
eine Steuerkammer (50) für Kraftstoff, die zumindest teilweise in dem Düsenkörper (16, 16a) definiert ist, so dass eine obere Oberfläche der Düsennadel (12) Kraftstoff in der Steuerkammer (50) ausgesetzt ist; und
ein Ventilgehäuse (42), das ein Steuerventil (44) aufweist und über dem Düsenkörper (16, 16a) angeordnet ist, mit einer unteren Oberfläche (40) mit einem ersten Bereich (66b), der teilweise über einem Kontaktbereich für den Düsenkörper (16, 16a) angeordnet ist oder diesen definiert, der die Steuerkammer (50) umgibt,
dadurch gekennzeichnet, dass die untere Oberfläche (40) weiter einen ausgesparten Bereich (72) aufweist, der relativ zu zumindest dem ersten Bereich (66b) weiter von dem Düsenkörper (16, 16a) getrennt ist, um so einen höheren Kontaktdruck an dem ersten Bereich (66b) zu erzeugen, wenn der Gehäuseteil (42) und der Düsenkörper (16, 16a) zusammengeklemt sind, relativ zu einer unteren Oberfläche, in der sich kein ausgesparter Bereich befindet, und wobei die untere Oberfläche (40) einen zweiten Bereich (66a) umfasst, der über einer Decke der Steuerkammer (50) angeordnet ist oder diese definiert, und
wobei der Kraftstoffinjektor weiter einen Überlaufpfad (60) aufweist, der in dem Gehäuseteil (42) vorgesehen ist, der in den zweiten Bereich (66a) mündet und einen Strömungspfad für Kraftstoff aus der Steuerkammer (50) zu einem Niederdruckablass vorsieht.

2. Der Kraftstoffinjektor gemäß Anspruch 1, wobei die untere Oberfläche (40) des Gehäuseteils (42) und der Düsenkörper (16, 16a) über den ersten Bereich (66b) miteinander in Kontakt sind und der zweite Bereich (66a) die Decke (52) für die Steuerkammer (50) definiert.
3. Der Kraftstoffinjektor gemäß Anspruch 1, wobei die untere Oberfläche (40) des Gehäuseteils (42) und der Düsenkörper (16, 16a) durch eine Zwischenscheibe voneinander beabstandet sind und die Zwischenscheibe die Decke der Steuerkammer (50) definiert.
4. Der Kraftstoffinjektor gemäß einem der Ansprüche 1 bis 3, wobei der ausgesparte Bereich (72) zum Teil den zweiten Bereich (66b) umgibt.

5. Der Kraftstoffinjektor gemäß Anspruch 4, wobei sich der zweite Bereich (66b) über einen Überbrückungsbereich (66e, 66c) zu einem Umfang der unteren Oberfläche (40) erstreckt.

6. Der Kraftstoffinjektor gemäß Anspruch 5, wobei der Überbrückungsbereich (66e) einen Umfangsbereich (66c) umfasst, der sich zu dem Umfang der unteren Oberfläche (40) erstreckt.

7. Der Kraftstoffinjektor (10) gemäß Anspruch 5 oder Anspruch 6, wobei der ausgesparte Bereich (72) einen Bogenbereich (74) umfasst, der sich in den Überbrückungsbereich (66e, 66c) erstreckt.

8. Der Kraftstoffinjektor gemäß einem der Ansprüche 5 bis 7, wobei ein Einlass von einem Versorgungspfad (34) zum Liefern von Hochdruckkraftstoff zu dem Düsenkörper (16, 16a) an der unteren Oberfläche (40) in dem Überbrückungsbereich (66e, 66c) mündet.

9. Der Kraftstoffinjektor gemäß Anspruch 1, der weiter eine Einlassöffnung (62) aufweist, die in den zweiten Bereich (66a) mündet und einen Strömungspfad für Kraftstoff in die Steuerkammer (50) von einer Hochdruckkraftstoffversorgung vorsieht.

10. Der Kraftstoffinjektor gemäß einem der Ansprüche 1 bis 9, wobei die untere Oberfläche (40) mit einer Vielzahl von Umfangsbereichen (80, 82, 84; 280-292) vorgesehen ist, die von dem Düsenkörper (16, 16a) um den gleichen Betrag wie der erste Bereich (66b) getrennt sind.

11. Der Kraftstoffinjektor gemäß Anspruch 10, wobei jeder der Umfangsbereiche einen Bogen (80, 82, 84) an dem Umfang der unteren Oberfläche (40) definiert.

12. Der Kraftstoffinjektor gemäß Anspruch 10, wobei jeder der Umfangsbereiche (280 - 292) eine längliche Form hat und sich von dem Umfang des Gehäuseteils (42) radial nach innen in Richtung des ersten und des zweiten Bereichs (66a, 66b) erstreckt.

13. Der Kraftstoffinjektor gemäß Anspruch 11, wobei zumindest einer der peripheren Bogenbereiche (80, 82, 84) mit einem angrenzenden der anderen peripheren Bogenbereiche über einen Verbindungsbereich (90, 92) verbunden ist, der von dem Düsenkörper (16, 16a) um den gleichen Betrag wie der erste Bereich (66b) getrennt ist und der seitlich über die untere Oberfläche (40) von dem Umfang des Gehäuseteils (42) durch einen weiteren ausgesparten Bereich (98, 100) getrennt ist.

Revendications

1. Injecteur de carburant (10) pour un moteur à combustion interne, l'injecteur de carburant comprenant :

un pointeau de buse (12) qui est déplaçable à l'intérieur d'un corps de buse (16, 16a) pour commander la distribution de carburant à travers une sortie ;

une chambre de commande (50) pour le carburant, définie au moins en partie à l'intérieur du corps de buse (16, 16a) de telle sorte qu'une surface supérieure du pointeau de buse (12) est exposée au carburant à l'intérieur de la chambre de commande (50) ; et

un boîtier de valve (42) comprenant une valve de commande (44) étant située à l'intérieur du corps de buse (16, 16a) ayant une surface inférieure (40) incluant une première région (66b) située en partie en haut ou définissant une région de contact pour le corps de buse (16, 16a) entourant la chambre de commande (50),

caractérisé en ce que

la surface inférieure (40) comprend en outre une région dégagée (72) séparée plus loin du corps de buse (16, 16a), par rapport à la première région (66b), de manière à créer une pression de contact augmentée au niveau de la première région (66b) quand la partie de boîtier (42) et le corps de buse (16, 16b) sont serrés ensemble, par rapport à une surface inférieure dans laquelle il n'existe pas de région dégagée et dans lequel la surface inférieure (40) inclut une seconde région (66a) située en haut ou définissant un plafond de la chambre de commande (50) et l'injecteur de carburant comprenant en outre un trajet de fuite (60) prévu dans la partie de boîtier (42) qui s'ouvre dans la seconde région (66a) et constitue un trajet d'écoulement pour le carburant sortant de la chambre de commande (50) vers un drain à basse pression.

2. Injecteur de carburant selon la revendication 1, dans lequel la surface inférieure (40) de la partie de boîtier (42) et le corps de buse (16, 16a) sont en contact l'un avec l'autre via la première région (66b), et la seconde région (66b) définit le plafond (52) pour la chambre de commande (50).

3. Injecteur de carburant selon la revendication 1, dans lequel la surface inférieure (40) de la partie de boîtier (42) et le corps de buse (16, 16a) sont écartés par une rondelle intermédiaire, et la rondelle intermédiaire définit le plafond de la chambre de commande (50).

4. Injecteur de carburant selon l'une quelconque des

revendications 1 à 3, dans lequel la zone dégagée (72) entoure en partie la seconde région (66b).

5. Injecteur de carburant selon la revendication 4, dans lequel la seconde région (66b) s'étend jusqu'à une périphérie de la surface inférieure (40) via une région de pontage (66e, 66c).

6. Injecteur de carburant selon la revendication 5, dans lequel la région de pontage (66e) inclut une région périphérique (66c) qui s'étend jusqu'à la périphérie de la surface inférieure (40).

7. Injecteur de carburant (10) selon la revendication 5 ou 6, dans lequel la région dégagée (72) inclut une région en arc (74) qui s'étend jusque dans la région de pontage (66e, 66c).

8. Injecteur de carburant selon l'une quelconque des revendications 5 à 7, dans lequel une entrée provenant d'un trajet d'alimentation (34) pour distribuer du carburant à haute pression vers le corps de buse (16, 16a) s'ouvre au niveau de la surface inférieure (40) dans la région de pontage (66e, 66c).

9. Injecteur de carburant selon la revendication 1, comprenant en outre une ouverture d'entrée (62) qui s'ouvre dans la seconde région (66a) et qui constitue un trajet d'écoulement pour le carburant jusque dans la chambre de commande (50) depuis une alimentation de carburant sous haute pression.

10. Injecteur de carburant selon l'une quelconque des revendications 1 à 9, dans lequel la surface inférieure (40) est dotée d'une pluralité de régions périphériques (81, 82, 84 ; 280-292) qui sont séparées du corps de buse (16, 16a) de la même distance que la première région (66b).

11. Injecteur de carburant selon la revendication 10, dans lequel chacune des régions périphériques définit un arc (80, 82, 84) à la périphérie de la surface inférieure (40).

12. Injecteur de carburant selon la revendication 10, dans lequel chacune des régions périphériques (280-292) a une forme allongée et s'étend radialement vers l'intérieur depuis la périphérie de la partie de boîtier (42) en direction de la première et de la seconde région (66a, 66b).

13. Injecteur de carburant selon la revendication 11, dans lequel l'une au moins des régions en arc périphériques (81, 82, 84) est jointe à une région adjacente parmi les autres régions en arc périphériques via une région de jonction (90, 92) qui est séparée du corps de buse (16, 16a) de la même distance que la première région (66b), et qui est séparée latéra-

lement à travers la surface inférieure (40), depuis la périphérie de la partie de boîtier (42) par une autre région dégagée (98, 100).

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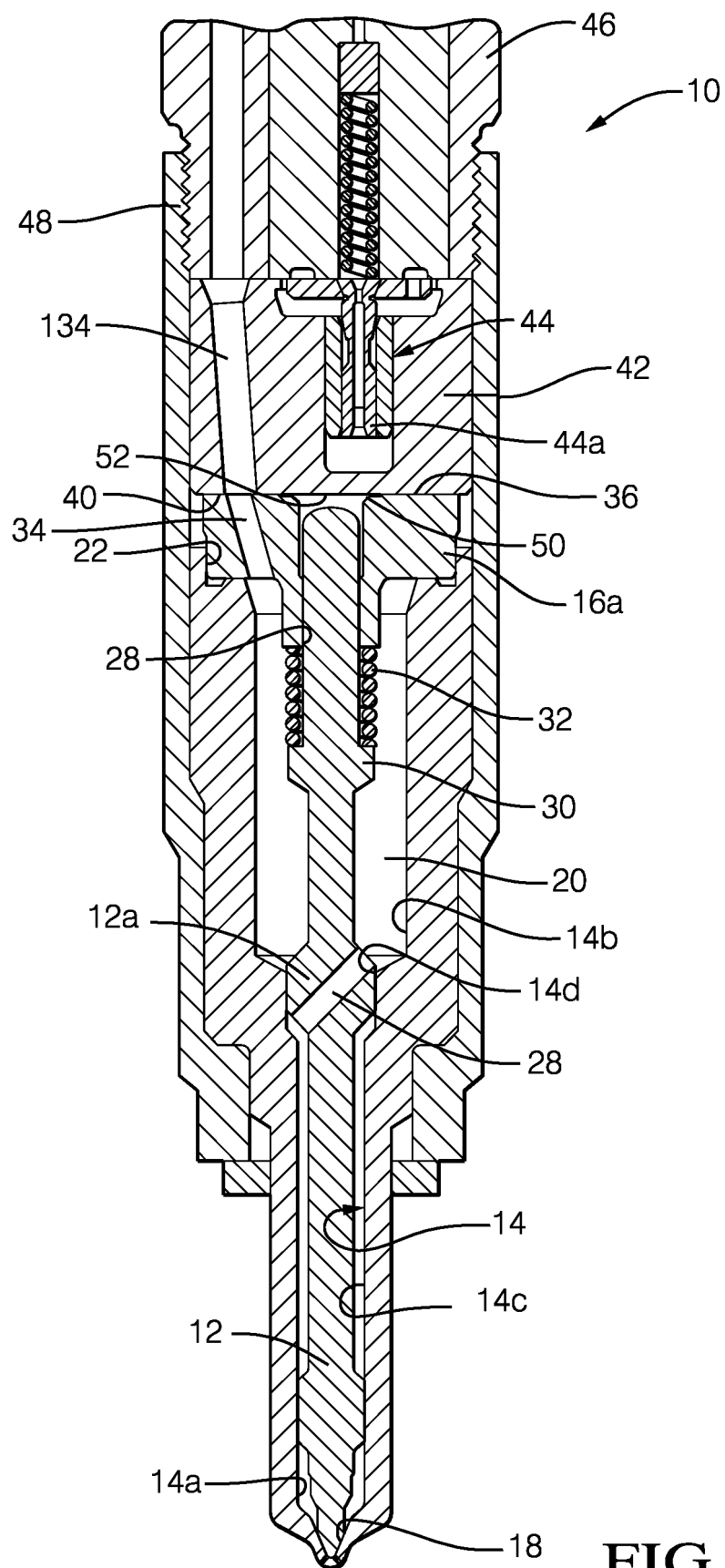


FIG. 1

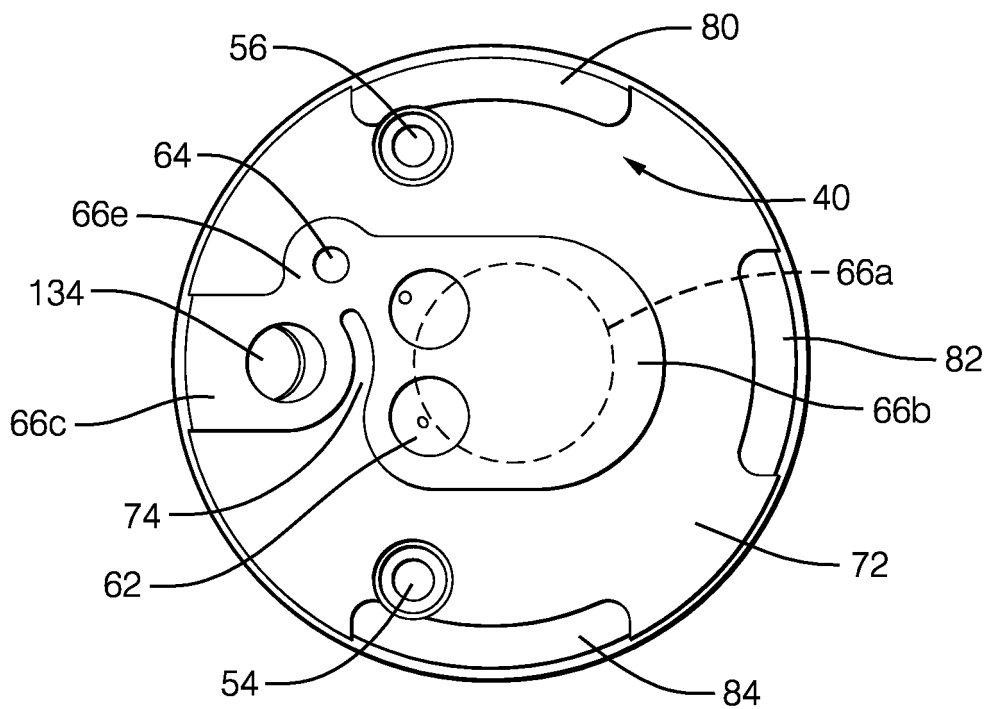


FIG. 2

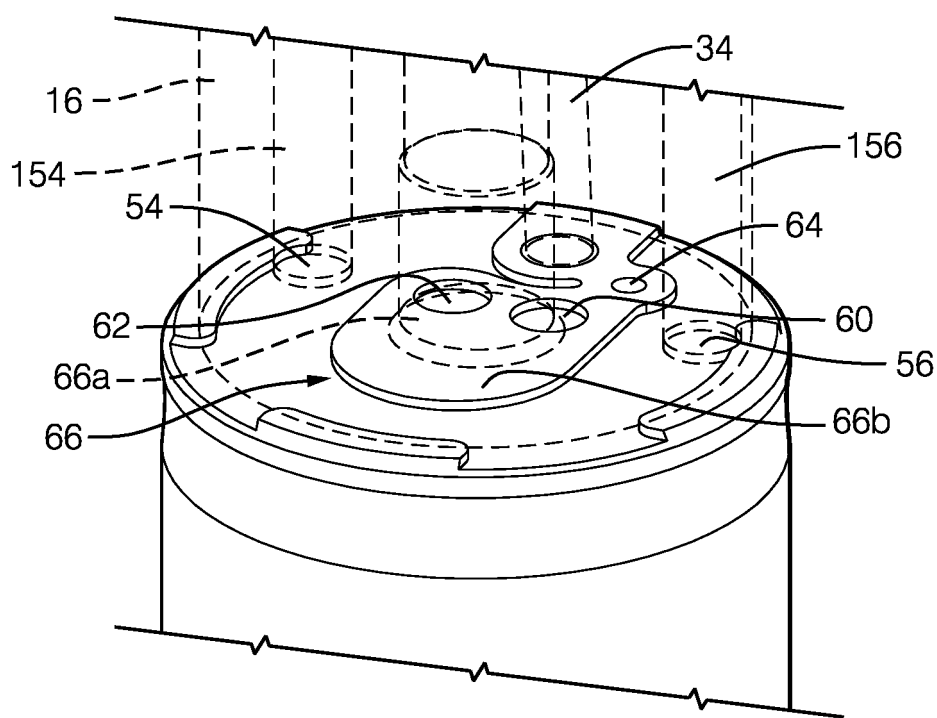


FIG. 3

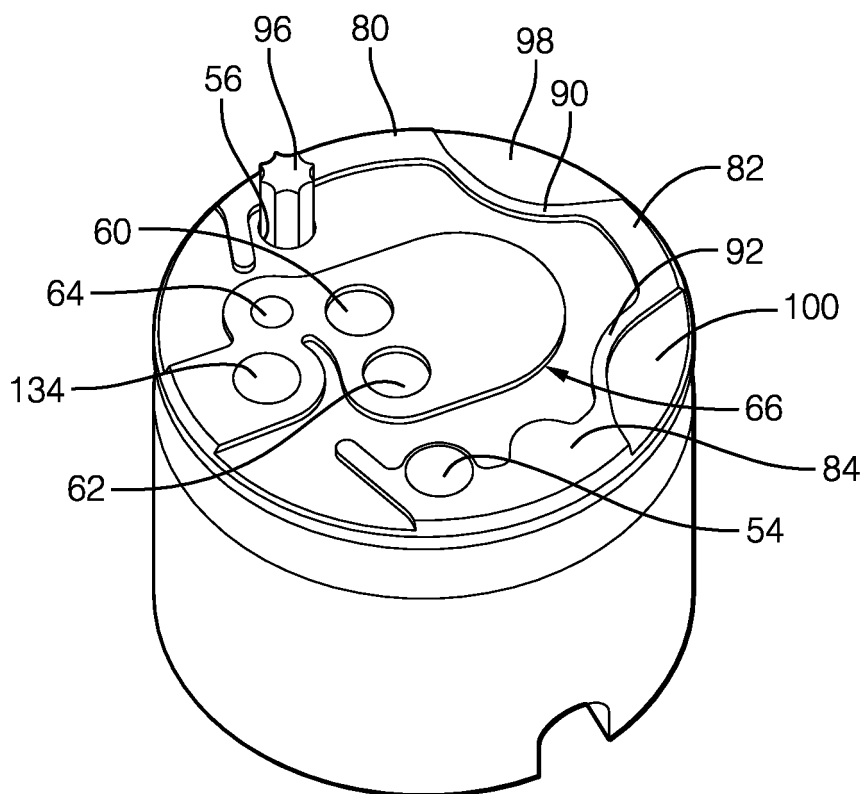


FIG. 4

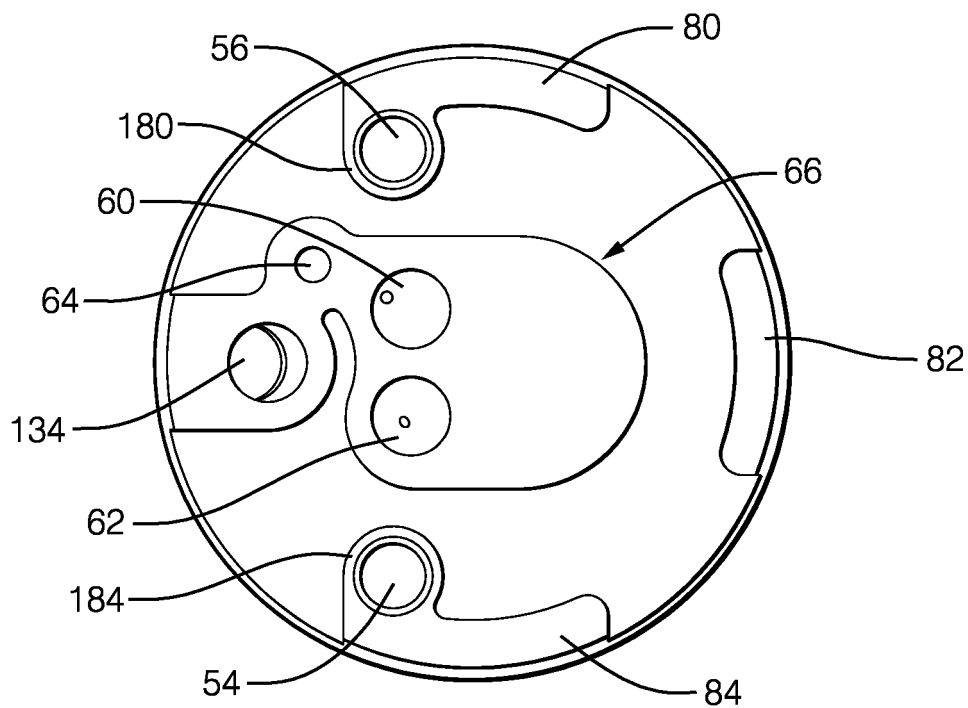


FIG. 5

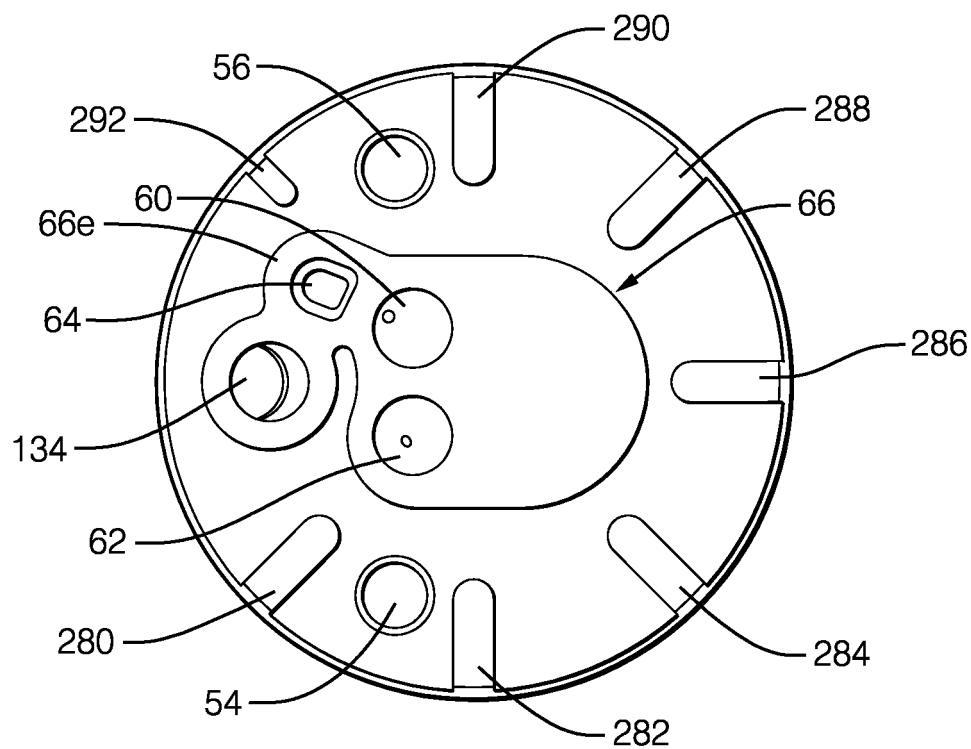


FIG. 6

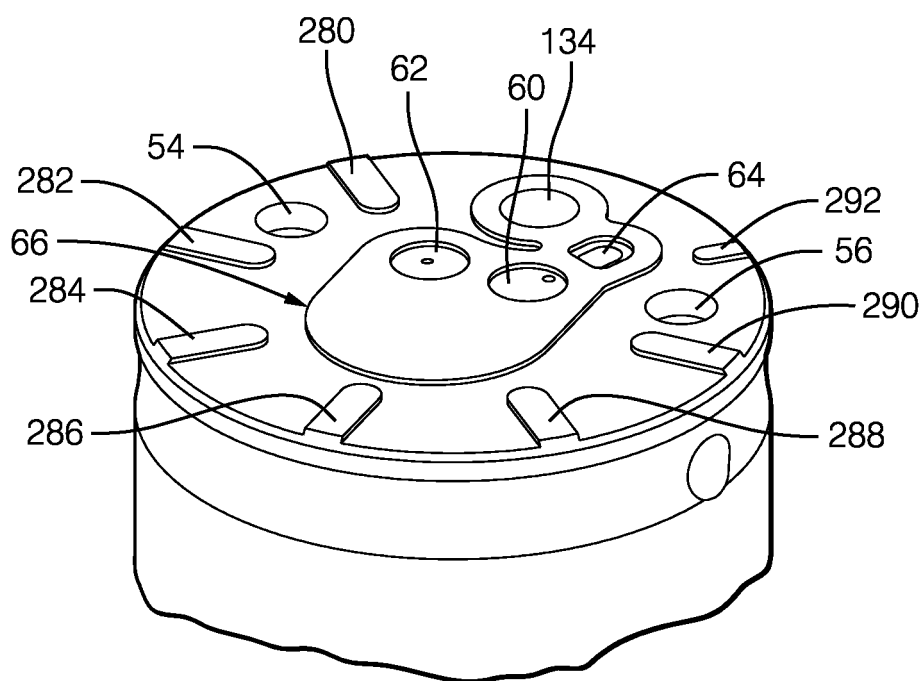


FIG. 7

REFERENCES CITED IN THE DESCRIPTION

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