(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 3 851 663 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
21.07.2021 Bulletin 2021/29

(51) Int Cl.:
F02M 61/18 *(2006.01)*

(21) Application number: **20152340.4**

(22) Date of filing: **17.01.2020**

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME
KH MA MD TN

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(54) **VALVE SEAT BODY ASSEMBLY FOR A FLUID INJECTOR OF AN INTERNAL COMBUSTION ENGINE WITH A VALVE SEAT BODY AND AN ORIFICE PART**

(57) The invention relates to a valve seat body assembly (10) for a fluid injector of an internal combustion engine, wherein the valve seat body assembly (10) comprises a valve seat body (100) which extends in axial and radial direction with respect to a central longitudinal axis (30) and an orifice part (200) which is arranged at the valve seat body (100), wherein the orifice part (200) extends in axial and radial direction with respect to the central longitudinal axis (30) and is arranged coaxially with respect to the central longitudinal axis.

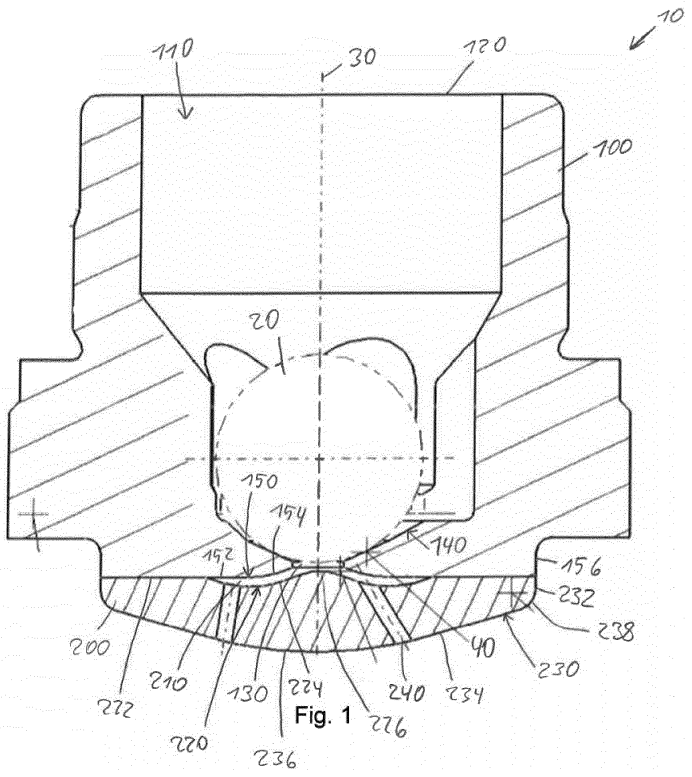

Fig. 1

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Description

[0001] The invention relates to a valve seat body assembly for a fluid injector of an internal combustion engine, wherein the valve seat body assembly comprises a valve seat body which extends in axial and radial direction with respect to a central longitudinal axis and an orifice part which is arranged at the valve seat body.

[0002] Fluid injectors are in widespread use, in particular for internal combustion engines, where they may be arranged in order to doze a fluid or fuel amount into an intake manifold of the internal combustion engine or directly into a combustion chamber of a cylinder of the internal combustion engine.

[0003] Due to increasingly strict legal regulations concerning the admissibility of pollutant emissions by the internal combustion engine, which are arranged for example in vehicles, it is necessary to take action in various ways in order to reduce these pollutant emissions.

[0004] One possible starting point to reduce the pollutant emission and in particular to reduce particle emission is to increase the fluid pressure inside the fluid injector. Conventional fluid injectors are designed to operate at a fluid pressure of below 10 MPa. If the fluid pressure is increased inside the fluid injector it is possible to reduce pollutant emission caused by the internal combustion engine. The increased fluid pressure inside the fluid injector requires a change of design of the fluid injector. An important part of the fluid injector which has to be changed is the valve seat body assembly. The valve seat body assembly is arranged at an outlet portion of the fluid injector. The valve seat body assembly comprises two or more flow holes which are arranged to inject the fluid which is pressurized in the fluid injector in the combustion chamber of the internal combustion engine. The valve seat body assembly forms together with a valve needle of the fluid injector a fluid tight sealing edge between the valve needle and the valve seat body assembly so that the fluid inside the fluid injector cannot flow out of the fluid injector when the valve needle contacts the valve seat body assembly. The valve needle is arranged displaceable inside the fluid injector and is therefore designed to allow the fluid to flow out of the fluid injector to the flow holes of the valve seat body assembly when the valve needle is displaced away from a closing position or to create the fluid tight sealing edge when the valve needle is in the closing position.

[0005] The valve seat body assembly has therefore at least the following tasks: allowing or inhibiting the fluid flow out of the fluid injector, guiding of the valve needle and creating a desired fluid spray out of the flow holes into the internal combustion engine.

[0006] The combination of the valve needle and the valve seat body assembly during the operation of the fluid injector is therefore responsible for accurate fluid release out of the fluid injector. If the fluid pressure inside the fluid injector is increased the requirements on the valve needle and especially on the valve seat body assembly change due to the reason that these parts have to handle the higher fluid pressure.

[0007] An object of the present disclosure is to create an improved valve seat body assembly for a fluid injector of an internal combustion engine which facilitates a reliable and precise function in particular with a high fluid pressure.

[0008] The object is achieved by a valve seat body assembly comprising the features of the independent claim. Advantageous embodiment of the valve seat body and a fluid injector comprising the valve seat body are specified in the dependent claims.

[0009] A valve seat body assembly for a fluid injector of an internal combustion engine is specified. Further, a fluid injector for an internal combustion engine comprising the valve seat body assembly is specified. The fluid injector is in particular a fuel injector. The fuel injector is in particular configured to inject gasoline or diesel fuel. It may be provided for injecting fuel directly into a combustion chamber of the internal combustion engine.

[0010] According to the present disclosure, the valve seat body assembly comprises a valve seat body which extends in axial and radial direction along a central longitudinal axis and an orifice part which is arranged at the valve seat body. The valve seat body comprises an inlet opening and one, and only one, outlet opening. The inlet opening is configured to allow a fluid to flow into a valve seat body cavity of the valve seat body. The inlet opening is therefore for example a bore into the valve seat body. The one, and only one, outlet opening is configured to allow the fluid to flow out of the valve seat body cavity. The valve seat body cavity extends therefore through the valve seat body starting from the inlet opening to the one outlet opening. Fluid can therefore flow through the valve seat body from the inlet opening to the one outlet opening along the valve seat body cavity. The valve seat body comprises according to the present disclosure an inner surface which defines the valve seat body cavity. The inner surface extends therefore along the central longitudinal axis starting from the edge of the inlet opening to the one outlet opening of the valve seat body. The inner surface can for example comprise cylindrical surfaces, truncated cone surfaces or different shapes. The inner surface can for example be made by drilling or other manufacturing steps.

[0011] According to the present disclosure, a portion of the inner surface of the valve seat body cavity is configured to form a sealing edge between the inner surface and a valve needle of the fluid injector when the fluid injector is in operation. The valve needle can therefore engage with the portion of the inner surface to be in contact with the inner surface to form the sealing edge so that no fluid inside the valve seat body cavity can flow out of the valve seat body through the one outlet opening. When the valve needle is displaced away from the portion of the inner surface then the fluid flow out of the outlet opening is allowed so that fluid can flow through the valve seat body from the inlet opening to the one outlet opening

out of the valve seat body. According to the present disclosure, the valve seat body further comprises an outer surface which extends from the outlet opening in radial direction along the central longitudinal axis. According to one embodiment, the outer surface is arranged coaxially with respect to the central longitudinal axis and extends from one edge of the outlet opening in radial direction with respect to the central longitudinal axis. The outer surface is therefore a portion of the surface of the valve seat body, wherein the outer surface is arranged next to the one outlet opening.

[0012] According to the present disclosure, the valve seat body assembly comprises further the orifice part which extends with respect to the central longitudinal axis. According to one embodiment, the orifice part is arranged coaxially with respect to the central longitudinal axis. The orifice part comprises a first surface and a second surface. The first surface faces the valve seat body. The first surface comprises a flat ring surface which contacts the outer surface of the valve seat body. The first surface further comprises a curved ring surface which extends from the radial inner edge of the flat ring surface in radial inward direction with respect to the central longitudinal axis. The curved ring surface is a for example portion of a surface of a torus or a three-dimensional ring. The curved ring surface is, according to one embodiment, a concavely curved surface. The curved ring surface forms together with a portion of the outer surface of the valve seat body a flow space for the fluid. The flow space is a space between the valve seat body and the orifice part defined by at least the curved ring surface and the portion of the outer surface. According to one embodiment, the orifice part is a machined a turned part. The thickness of the orifice part can influence the penetration of the spray and is according to one embodiment customized. According to another embodiment is the thickness of the orifice part between 0,2 mm and 7 mm more preferably between 0,3 mm and 5 mm.

[0013] The second surface defines together with the first surface the orifice part. The second surface defines a portion of an external surface of the valve seat body assembly. According to one embodiment, the second surface is arranged coaxially with respect to the central longitudinal axis. According to one embodiment, the first surface and the second surface face in opposite directions. The surface of the orifice part comprises the first surface and the second surface and the first surface is arranged towards the valve seat body. The orifice part comprises further flow holes which extend from the curved ring surface through the orifice part until the second surface. The flow holes are configured to allow the fluid to flow out of the fluid injector. When the fluid injector is in operation, fluid flows from the inlet opening of the valve seat body through the valve seat body cavity out of the valve seat body through the one outlet opening into the flow space and further through the flow holes of the orifice part and out of the flow holes.

[0014] According to the present disclosure, the valve seat body is configured, in combination with the valve needle, to provide the fluid tight sealing between the inner surface of the valve seat body and the valve needle so that no fluid can flow out of the valve seat body assembly when the valve needle is in contact with the valve seat body. The spray out of the flow holes is according to the present disclosure achieved by the orifice part which comprises the flow holes. Therefore, the two functions are assigned to the specific parts. The sealing function is assigned to the valve seat body and the spray development function is assigned to the orifice part. Therefore, it is possible that the valve seat body comprises only one outlet opening which creates the advantage that it is possible to have a very small sealing edge diameter. Due to the small sealing edge diameter it is possible to reduce the size of the valve needle. With the reduced size of the sealing edge and the reduced size of the valve needle it is possible to achieve good sealing function even if the fluid pressure inside the valve seat body cavity increases to for example 50MPa or even 100MPa. Operating the valve seat body assembly at such pressures requires a lot of energy to displace the valve needle away from the closing positions, because the force needed to actuate the valve needle depends from the interaction between the diameter of the sealing edge and the fluid pressure inside the valve cavity. When the diameter of the sealing edge is decreased, then the force needed to displace the valve needle away from the closing position is also decreased. When the diameter of the sealing edge is decreased and the fluid pressure is increased, then the force needed to displace the valve needle away from the closing position may be the same. According to the present disclosure it is possible to displace the valve needle away from the closing position with the same force / energy despite the higher fluid pressure inside the valve cavity. This is only possible due to the reduced sealing edge diameter which could only be reduced due to the design of the valve seat body according to the present disclosure.

[0015] The fluid spray out of the flow holes can be designed as desired depending on different parameters which may change with different operation conditions for the fluid injector. It is also possible to place the inlet openings of the flow holes further away from the central longitudinal axis than the sealing edge, so that the design of the flow holes and especially the angle of the flow holes can be in particular freely chosen. In addition, it is possible to manufacture the flow holes in the orifice part before the orifice part is arranged at the valve seat body. This makes the manufacturing process of the flow holes in particular fast, simple and improves the design freedom of the flow holes. Overall, it is according to the present disclosure possible to increase the fluid pressure inside the valve seat body cavity, to create the needed fluid tight sealing and to create the desired fluid spray out of the flow holes with the valve seat body assembly. Pollutant emissions can be reduced and the whole valve seat body assembly is in particular improved.

[0016] According to one embodiment, the portion of the inner surface which is configured to form the sealing edge is a truncated cone surface. The truncated cone surface is arranged coaxially with respect to the central longitudinal axis. In addition, the valve seat body comprises a cylindrical surface which is arranged coaxially with respect to the central longitudinal axis. The truncated cone surface extends to one longitudinal end of the cylindrical surface. The cylindrical surface forms or defines the one outlet opening through which fluid flows out of the valve seat body when the fluid injector is in operation. During operation of the valve seat body assembly the fluid flows along the truncated cone surface and the cylindrical surface out of the one outlet opening. Therefore, the radial inner end of the truncated cone surface is adjacent to the longitudinal end of the cylindrical surface which is directed towards the valve seat body cavity. It is in particular possible to create a good fluid tight sealing between the truncated cone surface and the valve needle due to the specific design of the truncated cone surface wherein the truncated cone surface tapers in diameter towards the one outlet opening. According to one embodiment, the valve needle comprises a valve needle ball wherein the valve needle ball is configured to form the sealing edge between the surface of the valve needle ball and the truncated cone surface of the valve seat body. A particular good sealing edge is at higher fluid pressures inside the valve seat body cavity achievable according to this embodiment. The cylindrical surface is for example manufactured by drilling. The valve seat body and in particular the one outlet opening is therefore in particular fast manufacturable.

[0017] According to one embodiment, the outer surface of the valve seat body comprises a flat ring surface and a curved ring surface. The flat ring surface and the curved ring surface are arranged coaxially with respect to the central longitudinal axis. The curved ring extends from the one outlet opening to the flat ring surface. The flat ring surface extends from the radial outer end of the curved ring surface in rectangular manner with respect to the central longitudinal axis further in radial direction. According to this embodiment, the flat ring surface of the outer surface is in contact with the orifice part, in particular in full area contact. It is therefore particularly simple to arrange the orifice part at the valve seat body. In other words, the curved ring surface may be portion of a torus surface. The profile of the curved ring surface may comprise a portion of a circle. The portion of the circle rotated by 360° around a longitudinal axis, wherein the circle segment does not contact the longitudinal axis creates the curved ring surface. The curved ring surface, is according to one embodiment, a convexly curved surface. The outer surface comprising the flat ring surface and the curved ring surface creates an improved fluid flow out of the one outlet opening to the flow holes along the flow space to the flow holes.

[0018] According to one embodiment, the flat ring surface is arranged tangentially to the curved ring surface so that the curved ring surface is extended in radial outward direction by the flat ring surface. This means that the flat ring surface only touches the curved ring surface at one edge and that the curved ring surface extends smoothly along the flat ring surface. A particular good fluid flow along the outer surface is according to this embodiment achievable.

[0019] According to one embodiment, the radial inner end of the curved ring surface of the outer surface is closer to the inlet opening in axial direction with respect to the central longitudinal axis arranged than the flat ring surface of the outer surface. According to this embodiment, a ring-shaped depression is formed by the curved ring surface in the valve seat body next to the one outlet opening. According to this embodiment, the flat ring surface of the outer surface is arranged further away from the inlet opening of the valve seat body as the radial inner end of the curved ring surface. The fluid flow out of the one outlet opening along the flow space to the flow holes is according to this embodiment in particular improved. Advantageous flow conditions for the fluid flow out of the one outlet opening are achieved in this way.

[0020] According to one embodiment, the first surface of the orifice part comprises a circular surface. According to one embodiment, the circular surface is arranged coaxially with respect to the central longitudinal axis. The circular surface extends from the radial inner end of the curved ring surface of the first surface to the central longitudinal axis. In other words, the first surface extends from the central longitudinal axis along the circular surface, the curved ring surface and the flat ring surface of the orifice part. The circular surface is arranged adjacent to the one outlet opening of the valve seat body and defines therefore partially the flow space according to this embodiment. The fluid flowing out of the one outlet opening into the flow space flows along the circular surface and the curved ring surface to the flow holes. With the first surface according to this embodiment, it is in particular simple to guide the fluid out of the one outlet opening to the flow holes as desired.

[0021] According to one embodiment, the circular surface is arranged closer to the one outlet opening in axial direction with respect to the central longitudinal axis than the flat ring surface of the first surface. The circular surface and a portion of the curved ring surface of the first surface form a protrusion of the orifice part with respect to the flat ring surface of the first surface according to this embodiment. In other words, the circular surface and the portion of the curved ring surface extend in axial direction towards the inlet opening beyond a virtual extension of the flat ring surface of the first surface to the central longitudinal axis. According to this embodiment, it is in particular possible to divide the fluid flow out of the one outlet opening so that the fluid flows along the first surface to the designated flow holes as desired.

[0022] According to one embodiment, the curved ring surface of the first surface forms a ring-shaped depression in the orifice part with respect to the flat ring surface

of the first surface. In other words, a portion of the curved ring surface of the first surface is arranged further away from the inlet opening of the valve seat body than the flat ring surface of the first surface in axial direction with respect to the central longitudinal axis. The ring-shaped depression formed by the curved ring surface extends from the radial inner end of the flat ring surface of the first surface towards the central longitudinal axis. The ring-shaped depression is therefore a portion of the flow space through which fluid flows when the fluid injector is in operation. In addition, the inlet openings of the flow holes are, according to this embodiment, arranged at the ring-shaped depression. Fluid flowing out of the one outlet opening flows according to this embodiment along the flow space which is defined by the ring-shaped depression to the inlet openings of the flow holes. The fluid flow along the flow space is in particular improved.

[0023] According to one embodiment, the second surface of the orifice part comprises a spherical surface, a truncated cone surface and a cylindrical surface. The cylindrical surface, the truncated cone surface and the spherical surface are, according to one embodiment, arranged coaxially with respect to the central longitudinal axis. The second surface extends from the central longitudinal axis along the spherical surface, the truncated cone surface and the cylindrical surface. The spherical surface, the truncated cone surface and the cylindrical surface face towards a combustion chamber when the valve seat body assembly is arranged in the internal combustion engine. With the second surface according to this embodiment it is possible to improve the fluid spray out of the flow holes into the combustion chamber which helps to reduce pollutant emission of the internal combustion engine.

[0024] According to one embodiment, the spherical surface is arranged tangentially to the truncated cone surface of the second surface. It is in particular possible to improve the fluid spray out of the flow holes when the spherical surface of the second surface is arranged tangentially to the truncated cone surface of the second surface.

[0025] According to one embodiment, a longitudinal end of the cylindrical surface of the second surface is adjacent to the radial outer end of the flat ring surface of the first surface. The radial outer edge of the orifice part is according to this embodiment formed by the cylindrical surface of the second surface, the radial outer end of the flat ring surface of the first surface and the radial outer end of the truncated cone surface of the second surface. According to this embodiment, a rounding is arranged between the other longitudinal end of the cylindrical surface which faces away from the inlet opening of the valve seat body and the truncated cone surface of the second surface. The transition edge between the truncated cone surface and the cylindrical surface of the second surface is according to this embodiment a rounding. This improves the fluid spray out of the flow holes and in addition, the combustion is improved due to the reason that less or no eddy currents are induced during the combustion by a sharp edge at this area.

[0026] According to one embodiment, the outer surface of the valve seat body comprises a cylindrical portion. The cylindrical portion is arranged coaxially with respect to the central longitudinal axis and extends from the radial outer end of the flat ring surface of the outer surface away from the orifice part towards the inlet opening of the valve seat body. According to this embodiment, the cylindrical portion has the same diameter as the cylindrical surface of the orifice part so that the cylindrical portion is arranged flush with the cylindrical surface. This helps to arrange the orifice part at the valve seat body. In addition, no sharp edges are between the valve seat body and the orifice part which might induce undesired eddy currents during the combustion.

[0027] According to one embodiment, the orifice part is fixed to the valve seat body by a weld connection. The weld connection can for example be arranged between the cylindrical portion of the outer surface of the valve seat body and the cylindrical surface of the second surface of the orifice part. With the weld connection it is in particular easy to achieve the desired structural and sealing requirements.

[0028] According to one embodiment, the valve seat body assembly is configured to operate with fluid pressure above 30 MPa and below 100 MPa, preferably above 35 MPa or preferably above 45 MPa and below 80 MPa. Due to the specific design of the valve seat body assembly according to the present disclosure and the preferred embodiments it is possible to operate the valve seat body assembly at such high fluid pressure. The separation of the fluid spray development and the sealing allows to operate at such high fluid pressure and to reduce the pollutant emissions.

[0029] According to the present disclosure, a fluid injector for an internal combustion engine comprises a valve seat body assembly with the features according to the present disclosure.

[0030] Further advantageous embodiments of the present disclosure will become apparent from the detailed description of an exemplarily embodiment in connection with figure 1.

Fig. 1 shows: a schematic longitudinal section view of a valve seat body assembly according to a first exemplary embodiment.

[0031] Fig. 1 shows a valve seat body assembly 10 of a fluid injector. The valve seat body assembly 10 extends along a central longitudinal axis 30. Fig. 1 shows a valve needle ball 20 of the fluid injector in dashed lines. The valve needle ball 20 forms together with the valve seat body assembly 10 a sealing edge 40 so that no fluid can flow out of the valve seat body assembly 10 of the fluid injector. The valve seat body assembly 10 comprises a valve seat body 100 and an orifice part 200. The valve seat body 100 comprises a valve seat body cavity 110.

The valve seat body cavity 110 extends through the valve seat body 100 in axial direction starting from an inlet opening 120 and ends at one, and only one, outlet opening 130. The valve seat body cavity 110 allows fluid to flow through the valve seat body 100. The valve seat body cavity 110 is defined by an inner surface 140 of the valve seat body 100. A portion of the inner surface 140 forms together with the valve needle ball 20 the sealing edge 40. According to this embodiment, the portion of the inner surface 140 which forms the sealing edge 40 is a truncated cone surface which tapers in diameter towards the one outlet opening 130. The outlet opening 130 is according to this embodiment formed by a cylindrical surface. The cylindrical surface is arranged coaxially with respect to the central longitudinal axis 30 and is for example manufactured by drilling. The valve seat body 100 further comprises an outer surface 150. The outer surface 150 comprises, according to this embodiment, a flat ring surface 152, a curved ring surface 154 and a cylindrical surface 156. The outer surface 150 extends from the outlet opening 130 along the curved ring surface 145, the flat ring surface 152 and the cylindrical portion 156. The outer surface 150 defines therefore partially the shape of the valve seat body 100. The flat ring surface 152 of the outer surface 150 is arranged further away from the inlet opening 120 in axial direction than the radial inner end of the curved ring surface 154 of the outer surface 150. This means that the curved ring surface 154 forms a depression in the valve seat body 100 next to the outlet opening 130 with respect to the flat ring surface 152. The curved ring surface 154 is a portion of a torus surface. In other words, the profile of the curved ring surface 154 is a section of a circle. The section of the circle forms when rotated by 360° around the central longitudinal axis 30 and when arranged in radial direction away from the central longitudinal axis 30 the curved ring surface 154. The cylindrical portion 156 extends parallel to the central longitudinal axis 30 starting from the radial outer end of the flat ring surface 152 towards the inlet opening 120.

[0032] The valve seat body assembly 10 shown in fig. 1 further comprises the orifice part 200. The orifice part 200 is arranged at a valve seat body 100 next to the outlet opening 130 of the valve seat body 100. The valve seat body 100 and the orifice part 200 form together a flow space 210 between each other. The orifice part 200 comprises a first surface 220. The first surface 220 is arranged towards the inlet opening 120 of the valve seat body 100. The first surface 220 comprises a flat ring surface 222 and a curved ring surface 224 and a circular surface 226. The flat ring surface 222, the curved ring surface 224 and the circular surface 226 of the first surface are arranged coaxially with respect to the central longitudinal axis 30. The first surface 220 extends from the central longitudinal axis 30 along the circular surface 226, the curved ring surface 224 and the flat ring surface 222. The flat ring surface 222 is in contact with the flat ring surface 152 of the outer surface 150 of the valve seat body 100. The flat ring surface 222 in combination with the flat ring surface 152 of the outer surface defines therefore the axial position of the orifice part 200 at the valve seat body 100.

[0033] The orifice part 200 further comprises a second surface 230 which comprises a cylindrical surface 232, a truncated cone surface 234 and a spherical surface 236. The orifice part 200 is defined by the first surface 220 and the second surface 230 according to the embodiment shown in fig. 1. The second surface 230 extends from the central longitudinal axis 30 to the radial outer edge of the flat ring surface 222 of the first surface 220. The cylindrical surface 232, the truncated cone surface 234, and the spherical surface 236 are arranged coaxially with respect to the central longitudinal axis 30. The second surface 230 extends from the central longitudinal axis along the spherical surface 236, the truncated cone surface 234 and the cylindrical surface 232. The spherical surface 236 is arranged tangentially with respect to the truncated cone surface 234. The truncated cone surface 234 tapers in diameter towards the spherical surface 236. The radial outer end of the truncated cone surface 234 is adjacent to the longitudinal end of the cylindrical surface 232 which faces away from the inlet opening 120 of the valve seat body 100. As it can be seen in fig. 1 a rounding is arranged between the cylindrical surface 232 and the truncated cone surface 234. The other longitudinal end of the cylindrical surface 232 which faces towards the inlet opening 120 of the valve seat body 100 is arranged adjacent to the radial outer end of the flat ring surface 222 of the first surface 222. The whole outer surface of the orifice part 200 according to this embodiment is therefore defined by the first surface which comprises the flat ring surface 222, the curved ring surface 224 and the circular surface 226 and the second surface 230 which comprises the cylindrical surface 232, the truncated cone surface 234 and the spherical surface 236. The cylindrical surface 232 is according to this embodiment arranged flush with the cylindrical portion 156 of the outer surface 150 of the valve seat body 100. In other words, the diameter of the cylindrical portion 156 of the valve seat body 100 is the same than the diameter of the cylindrical surface 232 of the orifice part 200.

[0034] The orifice part 200 as shown in fig. 1 comprises flow holes 240 which extend through the orifice part 200. The inlet openings of the flow holes 240 open into the flow space 210 so that fluid can flow out of the outlet opening 130 of the valve seat body 100 along the flow space 210 and through the flow holes 240. The flow holes 240 can be created or manufactured in the orifice part 200 before the orifice part 200 is fixed to the valve seat body 100. This makes the manufacturing process of the flow holes 240 easier and faster. In addition, it is in particular simple to adjust the design of the flow holes depending on the desired fluid spray out of the flow holes 240. As it can be seen in fig. 1 the inlet openings of the flow holes 240 are placed further away from the central

longitudinal axis 30 in radial direction than the sealing edge 40 between the valve needle ball 20 and the inner surface 140 of valve seat body 100. This is only possible due to the reason that the sealing functionality is separated from the spray development functionality. It is therefore in particular simple to adjust the drilling angle of the flow holes 240 with respect to the central longitudinal axis 30 as desired.

Claims

1. A valve seat body assembly (10) for a fluid injector of an internal combustion engine, wherein the valve seat body assembly (10) comprises a valve seat body (100) which extends along a central longitudinal axis (30) and an orifice part (200) which is arranged at the valve seat body (100), wherein the valve seat body (100) comprises:

   - an inlet opening (120) which is configured to allow a fluid to flow into a valve seat body cavity (110) of the valve seat body (100) and one, and only one, outlet opening (130) which is configured to allow the fluid to flow out of the valve seat body cavity (110) of the valve seat body (100);
   - an inner surface (140) of the valve seat body (100) which defines the valve seat body cavity (110), wherein a portion of the inner surface (140) is configured to form a sealing edge (40) between the inner surface (140) and a valve needle of the fluid injector when the fluid injector is in operation;
   - an outer surface (150) of the valve seat body (100) which extends from the outlet opening (130) in radial direction with respect to the central longitudinal axis (30);

   wherein the orifice part (200) extends along the central longitudinal axis (30), wherein the orifice part (200) comprises:

   - a first surface (220) which faces the valve seat body (100), wherein the first surface (220) comprises a flat ring surface (222) which contacts the outer surface (150) of the valve seat body (100) and a curved ring surface (224) which extends from the radial inner end of the flat ring surface (222) in radial inward direction with respect to the central longitudinal axis (30), wherein the curved ring surface (224) forms together with a portion of the outer surface (150) of the valve seat body (100) a flow space (210) for the fluid;
   - a second surface (230) which defines a portion of an external surface of the valve seat body assembly (10);
   - two or more flow holes (240) which extend from the curved ring surface (224) through the orifice part (200) to the second surface (230) so that the fluid can flow from the one outlet opening (130) of the valve seat body (100) through the flow space (210) and the flow holes (240).

2. The valve seat body assembly (10) according to claim 1, wherein the portion of the inner surface (140) which is configured to form the sealing edge (40) is a truncated cone surface, wherein the radial inner end of the truncated cone surface extends to a longitudinal end of the one outlet opening (130).

3. The valve seat body assembly (10) according to any one of the preceding claims, wherein the outer surface (150) comprises a flat ring surface (152) and a curved ring surface (154), wherein the curved ring surface (154) extends from the one outlet opening (130) to the flat ring surface (152), and wherein the flat ring surface (152) extends in rectangular manner with respect to the central longitudinal axis (30).

4. The valve seat body assembly (10) according to claim 3, wherein the flat ring surface (152) is arranged tangentially to the curved ring surface (154), so that the curved ring surface (154) is extended in radial outward direction by the flat ring surface (152).

5. The valve seat body assembly (10) according to claim 3 or 4, wherein the radial inner end of the curved ring surface (154) of the outer surface (150) is in axial direction arranged closer to the inlet opening (120) than the flat ring surface (152) of the outer surface (150) so that a ring shaped depression is formed by the curved ring surface (154) in the valve seat body (100) next to the one outlet opening (130).

6. The valve seat body assembly (10) according to any one of the preceding claims, wherein the first surface (220) comprises a circular surface (226) and which extends from the radial inner end of the curved ring surface (224) of the first surface (220) to the central longitudinal axis (30).

7. The valve seat body assembly (10) according to claim 6, wherein the circular surface (226) is arranged closer to the one outlet opening (130) in axial direction with respect to the central longitudinal axis (30) than the flat ring surface (222) of the first surface (220), so that the circular surface (226) and a portion of the curved ring surface (224) of the first surface (220) form a protrusion of the orifice part (200) with respect to the flat ring surface (222) of the first surface (220).

8. The valve seat body assembly (10) according to any one of the preceding claims, wherein the curved ring

surface (224) of the first surface (220) forms a ring shaped depression in the orifice part (200) with respect to the flat ring surface (222) of the first surface (220), wherein the ring shaped depression extends from the radial inner end of the flat ring surface (222) of the first surface (220) towards the central longitudinal axis (30), so that the ring shaped depression is a portion of the flow space (210), and wherein the flow holes (240) open into the ring shaped depression, with their inlet openings being comprised by the curved ring surface (224).

9. The valve seat body assembly (10) according to any one of the preceding claims, wherein the second surface (230) of the orifice part (200) comprises a spherical surface (236), a truncated cone surface (234) and a cylindrical surface (232), wherein the spherical surface (236), the truncated cone surface (234) and the cylindrical surface (236) follow one another in this order in direction away from the central longitudinal axis (30).

10. The valve seat body assembly (10) according to claim 9, wherein the spherical surface (236) is arranged tangentially to the truncated cone surface (234).

11. The valve seat body assembly (10) according to claim 9 or 10, wherein a longitudinal end of the cylindrical surface (232) is adjacent to the radial outer end of the flat ring surface (222) of the first surface (220) and wherein a rounding is arranged between the other longitudinal end of the cylindrical surface (232) and the truncated cone surface (234) of the second surface (230).

12. The valve seat body assembly (10) according to claim 9, 10 or 11, wherein the outer surface (150) of the valve seat body (100) comprises a cylindrical portion (156) which extends from the radial outer end of the flat ring surface (152) of the outer surface (150) away from the orifice part (200), wherein the cylindrical portion (156) has the same diameter as the cylindrical surface (232) of the orifice part (200), so that the cylindrical portion (156) is arranged flush with the cylindrical surface (232).

13. The valve seat body assembly (10) according to any one of the preceding claims, wherein the orifice part (200) is fixed to the valve seat body (100) by a weld connection.

14. The valve seat body assembly (10) according to any one of the preceding claims, wherein the valve seat body assembly (10) is configured to operate with fluid pressure above 30 MPa, preferably above 35 MPa or more preferably above 45 MPa.

15. A fluid injector for an internal combustion engine comprising a valve seat body assembly (10) according to any one of the preceding claims.

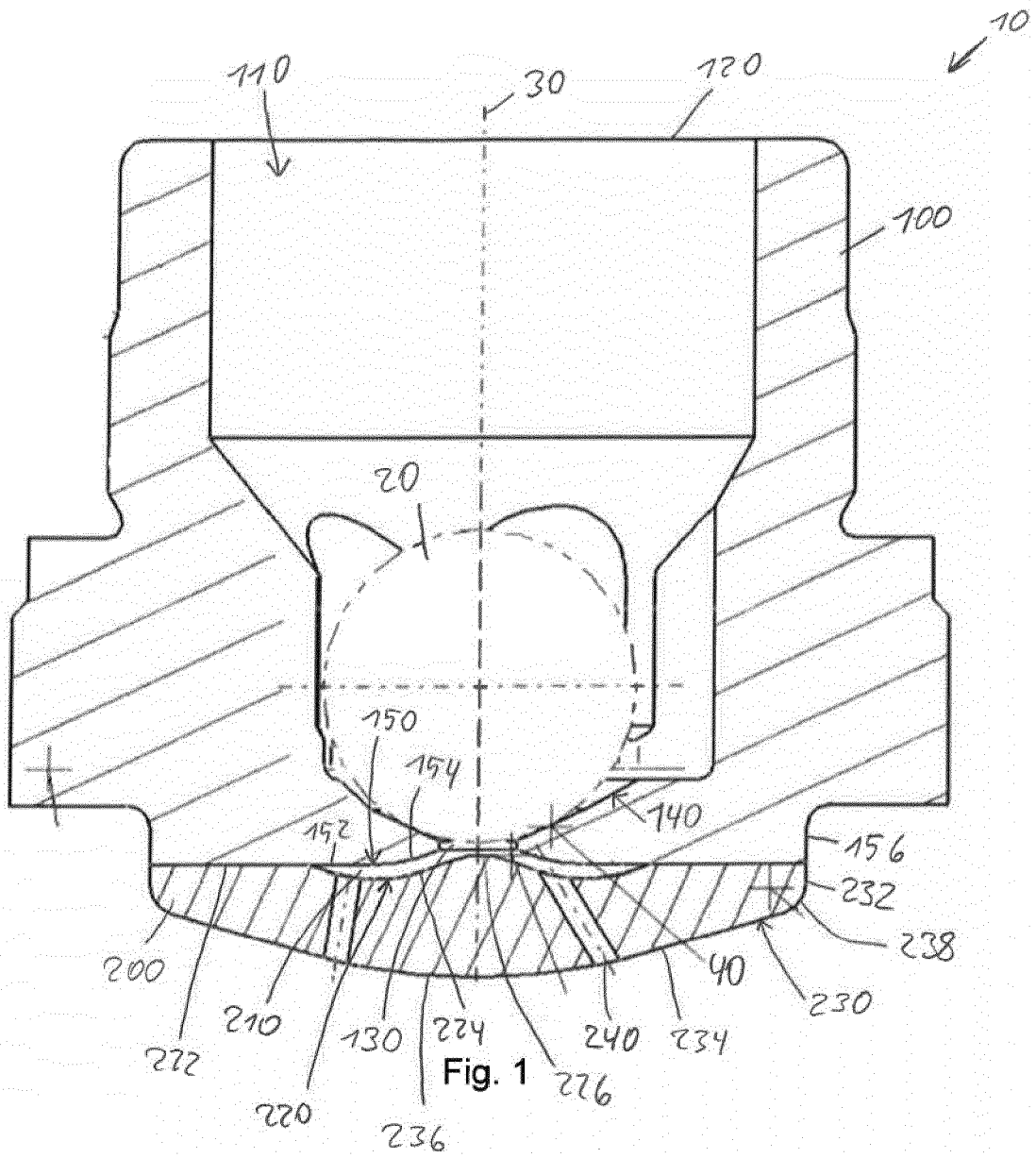
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Fig. 1

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EUROPEAN SEARCH REPORT

Application Number
EP 20 15 2340

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F02M

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	18 June 2020	Morales Gonzalez, M

CATEGORY OF CITED DOCUMENTS

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