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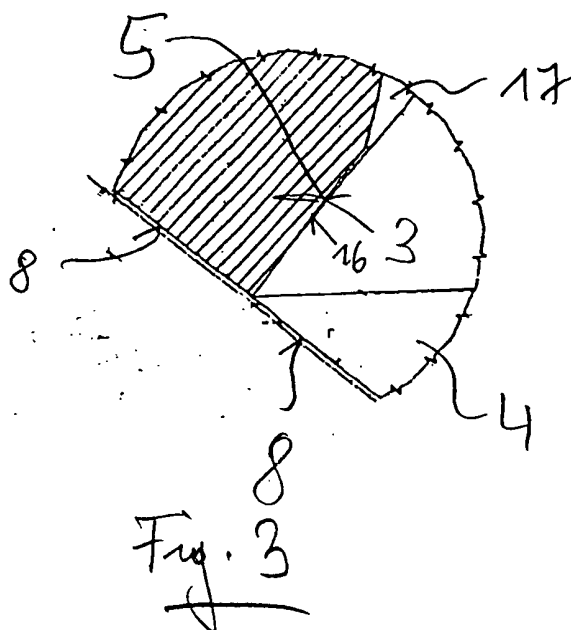
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(54) **Method for producing an injector with a common plane end face**

(57) The invention describes a method for producing a plane common face (8) for an end face (7) of a needle (1) and an end face (8) of a corresponding nozzle (2) of an outwardly opening injector. The nozzle (2) and the needle (1) are produced with shapes, which fit at least roughly together, the needle (1) comprising a closing member (4) with an upper end face (19) with a second sealing face (5) and a lower end face (7) and the nozzle (2) comprising an opening end with an inner end

face (18) with a first sealing face (3) and an outer end face (6). Moreover, the needle (1) is inserted into the nozzle (2) from the opening end and pressed with the second sealing face (5) against the first sealing face (3) of the nozzle. Afterwards the lower end face (7) of the needle (1) and the outer end face (6) of the nozzle are grinded to a common plane end face (8), which is at least at the border of the lower end face (7) and the outer end face (6).



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Description

[0001] The invention relates to a method for producing an injector with a plane common face for an end face of a needle and an end face of one corresponding nozzle of an outwardly opening injector according to claim 1. Furthermore the invention relates to an injector which comprises a nozzle with a plane common face for an end face of a needle and an end face of a corresponding nozzle according to claim 11.

[0002] In the field of direct injection cylinders in a combustion engine, the injectors are arranged in a cylinder head whereby the tip of the injector is within a combustion chamber of the combustion engine. Using a directly injecting injector shows the advantage that the fuel air mixture can be formed in the cylinder and the mass of fuel which has to be injected for a good combustion process can be precisely injected into the combustion chamber.

[0003] The disadvantage of the directly injecting injector is that the injector is subjected to high pressure, high temperature and a chemically aggressive atmosphere. The high temperature could lead to building up combustion residues at an opening of an injector nozzle.

[0004] DE 10 012 969 A1 describes an injection nozzle and a method for forming a fuel-air mixture. The described injection nozzle comprises a housing end face and a closure member which together form a common, planar surface in the closed state of the injection nozzle. The result of this is that the combustion residues which accumulate in the region of the nozzle outlet, are broken-up by the outwardly opening closing member during a next injection process and are detached by the emergent fuel jet. A growth in combustion residues in the region of the outlet opening or nozzle opening is prevented in this manner.

[0005] Usually, the closure member and the housing of the injection nozzle are produced independently. This procedure shows the disadvantage that for forming a planar surface the closure member end face and the housing end face have to be produced with a precise shape in order to correspond to each other.

[0006] The object of the present invention is to provide a method for producing an injector with a plane common face for an end face of a needle and an end face of a corresponding nozzle of an outwardly opening injector which allows a very precise fitting of the nozzle and the needle for the plane common face.

[0007] The object is achieved according to the present invention in that the needle and the housing of the injector are mounted together and the end face of the needle and the end face of the nozzle are grinded in one process for forming a common plane end face which is built up partly by the end face of the needle and the end face of the nozzle. In this way a precise plane common face is generated. This shows the advantage that there is no step between the end face of the needle and the end face of the nozzle. Therefore the possibility

for generating combustion residues between the end face of the needle and the end face of the nozzle is limited. Further advantages and particulars of the present invention are clarified in the depending patent claims.

[0008] In a preferred embodiment of the inventive method, the sealing face of the needle and the sealing face of the nozzle are polished using a polishing paste whereby the needle is rotated and the nozzle is pressed against the sealing surface of the nozzle. Using this step, a precise fitting of the sealing faces is guaranteed. A precise fitting prevents any leakage between the sealing faces and limits the danger of producing combustion residues at the nozzle opening.

[0009] For the grinding process it is advantageous that the end face of the nozzle incorporates a step prior the grinding process so that during the grinding process only the end face of the nozzle is grinded first and after grinding a predetermined depth of the end face of the nozzle, the end face of the closing member of the needle is grinded as well. Using this method shows the advantage that the material which has to be grinded off the closing member of the needle can be reduced. Therefore the forces working on the needle are limited ensuring that the needle or the sealing face of the needle is not damaged by the grinding process.

[0010] Experiments have shown that it is of advantage to use a grinded depth of the end face of the needle as a stop of the grinding process.

[0011] In a preferred embodiment the common plane end face is grinded as a conical face. In a preferred embodiment of the invention there is a sealing face between the needle and the nozzle which shows the shape of a ring which is arranged at a given distance from the common end face. The given distance is of advantage for forming an injecting jet.

[0012] In a further preferred embodiment of the inventive method the rotational position of the needle and the nozzle is fixed during the grinding process and the needle and the nozzle are arranged in that rotational grinding position in the injector for use in a combustion engine. Fixing the needle and the nozzle at a rotational position during the grinding process shows the advantage that there is a precise fitting of the needle and the nozzle providing a plane common face. Using the needle and the nozzle at the rotational grinding position during use in the injector guarantees a precise plane common face.

[0013] Particulars of the present invention are depicted in the figures.

[0014] Fig. 1 shows a sectional view of the injection nozzle of the injector and the needle.

[0015] Fig. 2 shows a sectional view of an end face of the needle and an end face of the nozzle before grinding.

[0016] Fig. 3 shows a sectional view of an end face of the needle and an end face of the nozzle after grinding.

[0017] Fig. 4 shows an assembly tool 12 in which the nozzle 2 and the needle 1 is retained.

[0018] Fig. 1 shows a sectional view of a nozzle 2 of an injector which opens outwardly. The nozzle 2 is part of a direct injector which is arranged in a cylinder head protruding into a combustion chamber of a combustion engine. The combustion chamber is limited by a respective piston. The nozzle 2 shows the shape of a sleeve, whereby the sleeve comprises at an end portion an outer end face 6 and an inner end face 18 at which a first sealing face 3 is arranged. The needle 1 comprises a closing member 4 which is arranged at an end portion of the nozzle 2. The shown injector opens outwardly, which means that the closing member 4 comprises an upper and a lower end face 19, 7. The upper end face 19 comprises a second sealing face 5 which corresponds to the first sealing face 3. The first sealing face 3 defines a valve seat for the closing member 4.

[0019] Fig. 2 shows a detail of the end portion of the nozzle 2 and the closing member 4 of the needle 1 before the grinding process. The needle 1 and the nozzle 2 were produced in preshaped forms which fit together with regard to the first and the second sealing faces 3, 5. A main feature of the preshaped form is that the outer end face 6 of the nozzle 2 and the lower end face 7 of the closing member 4 are not arranged at a common plane. The lower end face 7 is set a step back in comparison to the outer end face 6.

[0020] Fig. 3 shows the nozzle 2 and the closing member 4 after the grinding process. During the grinding a layer of the outer end face 6 and a layer of the lower end face 7 are grinded off. As it can be seen from Fig. 2, the outer end face 6 is grinded first and after grinding the outer end face 6 to a common plane with the lower end face 7, the lower end face 7 is grinded commonly with the outer end face 6. After grinding there is a common plane face 8 which is partly formed by the nozzle 2 and the closing member 4.

[0021] For grinding the needle and the nozzle a grinding machine with a plane grinding tool is used, as it is well known. Good results have been achieved by grinding the nozzle 2 and the closing member 4 to a predetermined maximum depth of the lower end face of the closing member 4. The maximum depth is advantageously in the region of 0,05 mm, especially 0,03 mm. In a preferred embodiment of the inventive method, the common end face 8 is polished after grinding using an abrasive paper and finally lapped using a diamond paste. This process steps improve the quality of the common end face 8.

[0022] Advantageously the sealing face between the closing member 4 and the nozzle 2 shows the shape of a ring which is located at a given distance to the common end face 8. The effective sealing face is located at a given distance from an inner wall of the nozzle 2. Therefore advantageously there is a split between the inner end face 18 of the nozzle 2 and the upper end face 19 of the closing member 4 in direction to the common end face 8 and in direction of a fuel chamber 17 which is arranged within the nozzle 2 and limited by the needle 1.

[0023] Fig. 4 shows an assembly tool 12 in which the nozzle 2 and the needle 1 is retained. Therefore the nozzle 2 shows a shoulder 15 which shows a greater diameter as a hole of the assembly tool. The nozzle 2 is inserted into the hole lying with the shoulder 15 upon the assembly tool 12. On the top of the nozzle 2 there is a holding sleeve 13 which is protruded by the needle 1. The upper ending of the needle 1 is fixed using a washer 10, an elastic retainer 11 and a spring 9. The spring 9 is arranged between the holding sleeve 13 and the washer 10. The closing member 4 of the needle 1 is pressed by the force of the spring 9 against the first sealing face 3 of the nozzle 2. In this way the nozzle and the needle are fixed within the assembling tool 12. A grinding tool 14 is situated within the hole of the assembly tool 12 grinding the common plane face 8 as shown in Fig. 3. In the shown embodiment the grinding tool 14 comprises a conical grinding face which produces a conical common plane end face 8.

[0024] In a preferred embodiment of the inventive method the sealing faces between the closing member of the needle and the nozzle are polished using a polishing paste, which is applied between the sealing surfaces, whereby the needle is rotated and pressed against the first sealing surface of the nozzle. This procedure guarantees a precise plane sealing surface between the needle and the nozzle. This step is carried out prior to the grinding process.

[0025] The needle and the nozzle are fixed in a rotational position during the grinding process and the relative position is marked on the needle and the nozzle. Advantageously the needle and the nozzle are mounted in the marked position in an injector and held in the marked rotational grinding position. This procedure shows the advantage that the outer end face 6 and the lower end face 7 are in the grinding position. Therefore the common end face 8 is as plane as it has been produced by the grinding process.

Claims

1. Method for producing a plane common face (8) for an end face (7) of a needle (1) and an end face (6) of a corresponding nozzle (2) of an outwardly opening injector with the steps:

the nozzle (2) and the needle (1) are produced with shapes, which fit at least roughly together; the needle (1) comprises a closing member (4) with an upper end face (19) with a second sealing face (5) and a lower end face (7); the nozzle (2) comprises an opening end with an inner end face (18) with a first sealing face (3) and an outer end face (6); the needle (1) is inserted into the nozzle (2) from the opening end and pressed with the second sealing face (5) against the first sealing

face (3) of the nozzle (2);
 afterwards the lower end face (7) of the needle
 (1) and the outer end face (6) of the nozzle (2)
 are grinded to a common plane end face (8),
 which is at least at the border of the lower end
 face (7) and the outer end face (6).

2. Method according to claim 1, **characterised in that**
 the sealing face (5) of the needle (1) and the sealing
 face (3) of the nozzle (2) are polished using a pol-
 ishing paste,
 that the polishing paste is applied between the seal-
 ing surfaces (5, 3),
 that the needle (1) is rotated and pressed against
 the sealing surface (3) of the nozzle (2). 5

3. Method according to one of the claims 1 or 2, **char-
 acterised in that** the opening end of the nozzle (2)
 shows a greater diameter than the diameter of the
 closing member of the needle, 10
 that at the beginning of the grinding process there
 is a step between the outer end face (6) of the noz-
 zle (2) and the lower end face (7) of the needle, the
 outer end face (6) is arranged more outwardly than
 the lower end face (7). 20 25

4. Method according to one of the claims 1 to 3, **char-
 acterised in that** the grinding of the lower end face
 (7) of the needle (1) and the outer end face of the
 nozzle (2) is stopped at a maximum grinded depth 30
 of the lower end face (7) of the needle (1).

5. Method according to claim 4, **characterised in that**
 the maximum depth is 0,05 mm, especially 0,03
 mm. 35

6. Method according to one of the claims 1 to 5, **char-
 acterised in that** the common plane end face (8)
 is grinded as a conical face. 40

7. Method according to one of the claims 1 to 6, **char-
 acterised in that** the sealing faces (5, 3) of the nee-
 dle (1) and the nozzle (2) are produced **in that**
 shape that the sealing faces are ring faces which
 are arranged at a given distance from the common 45
 end face (8), and that there is a split between the
 inner end face (18) of the nozzle (2) and the upper
 end face (19) of the needle starting at the common
 end face up to the sealing faces (5, 3). 50

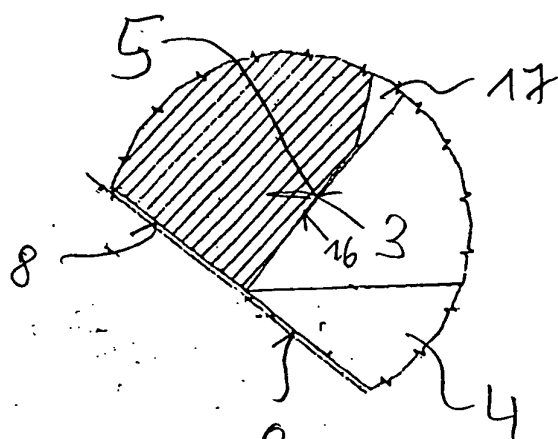
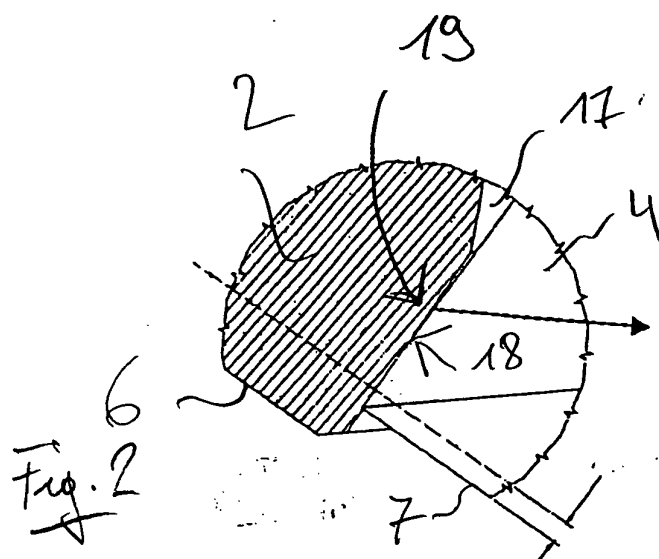
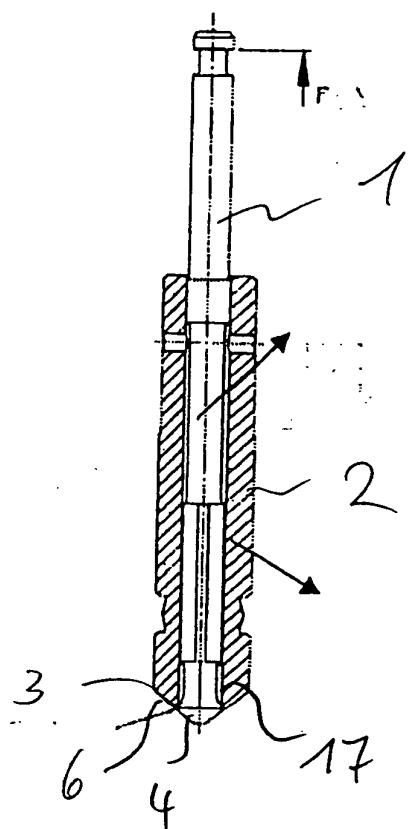
8. Method according to one of the claims 1 to 7, **char-
 acterised in that** the sealing faces (5, 3) of the nee-
 dle (1) and the nozzle (2) are produced **in that**
 shape that the sealing faces (5, 3) of the needle and
 the nozzle show the form of ring faces and that there 55
 is a split between the needle and the nozzle starting
 at a fuel chamber, which is determined by the nee-
 dle (1) and the nozzle (2) ending at the sealing faces

(5, 3) of the needle (1) and nozzle (2).

9. Method according to one of the claims 1 to 8, **char-
 acterised in that** a rotational position between the
 needle and the nozzle is fixed during the grinding
 process and that the nee-die and the nozzle are ar-
 ranged in the rotational grinding position in the in-
 jector.

10. Method according to one of the claims 1 to 9, **char-
 acterised in that** the common end face is polished
 using an abrasive paper and finally lapped using an
 diamond paste.

11. Injector with a needle and a needle housing, which
 were processed according to one of the claims 1 to
 10.



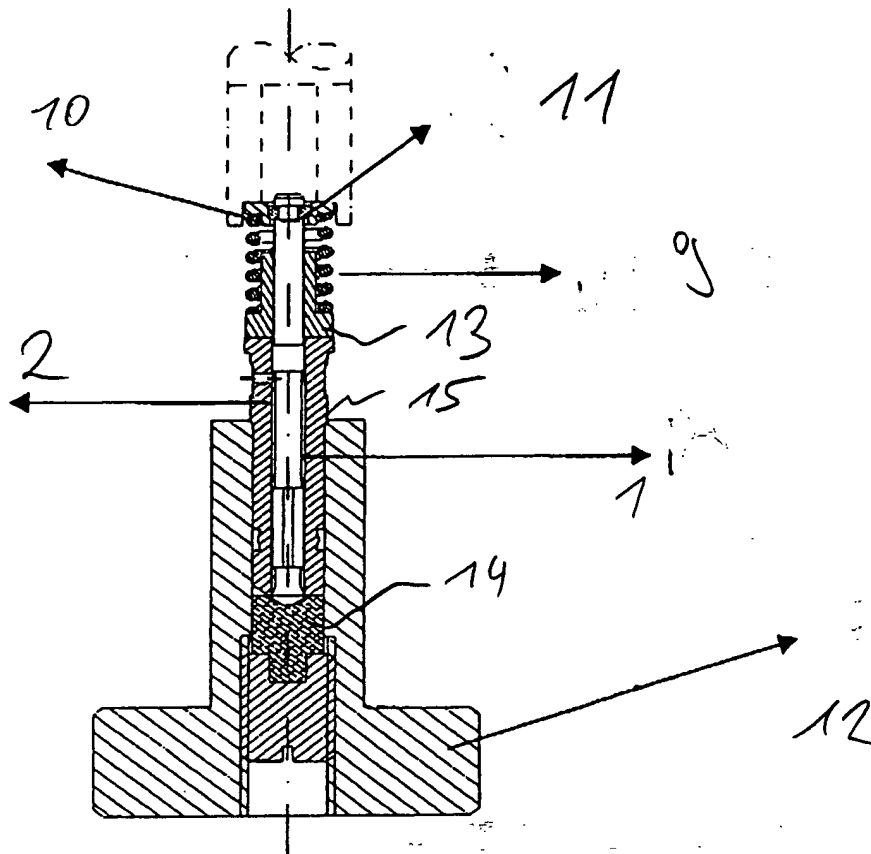


Fig. 4



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