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(54) **A nozzle for a fuel injector for internal combustion engines, and method of manufacturing a nozzle**

Düse für ein Kraftstoffeinspritzventil für Verbrennungsmotoren und Verfahren zur Herstellung einer Düse

Buse pour injecteur de carburant pour moteurs à combustion interne et procédé de fabrication de buse

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Description

Background of the invention

[0001] The present invention relates to fuel injectors for internal combustion engines. The invention relates in particular to a fuel injector for large four- or two-stroke internal combustion engines with or without crosshead, such as diesel engines for marine propulsion or stationary engines to supply power.

[0002] More specifically, the present invention relates to a nozzle for a fuel injector and to a method for manufacturing such nozzle.

Description of the prior art

[0003] In order to reduce the HC content in exhaust gas, to reduce the smoke, to reduce the unburned fuel deposits at the exhaust valve and at the piston, and to keep clean the combustion chamber it is important to reduce the sac volume in the nozzle tip. One of the ways is to close the injection holes directly in the nozzle tip.

[0004] One of the possible and promising designs is a solution with slide valve to open and close the injection holes, as disclosed for instance in EP-A-052937 and WO2008/071187. These documents disclose a fuel injector comprising an axially displaceable spindle having a valve portion which cooperates with a corresponding valve seat of the valve guide and a cut-off element extending below the valve portion of the valve spindle into a central bore of the atomizer. The outer wall of the cut-off element is effective to open and close inlet openings of the nozzle bores.

[0005] With a design of this type it would be desirable to have a nozzle tip with a hardened sliding surface in the inner part and a hot corrosion resistant part in the outer part.

[0006] EP-A-1549449 discloses a method of manufacturing a nozzle tip wherein in a mould a corrosion-resistant first alloy is arranged in an outer area which is to constitute the outer surface of a nozzle around the nozzle bores. A second alloy is used in another area of the nozzle. The materials in the mould are treated by isostatic pressing into a consolidated material. The boundary area between the two alloys should be free of cracks.

[0007] A problem of the solution disclosed in EP-A-1549449 is that it is expensive. Additionally, the inner or outer part needs a minimum thickness of one ore more millimetres and there is a risk of lack of fusion between materials.

[0008] WO93/07386 discloses a nozzle for a fuel injector for internal combustion engines, having a body of corrosion-resistant material with a longitudinal bore closed at its bottom end and having a cylindrical guide surface, wherein a plurality of nozzle bores is formed in a lateral wall of the body.

[0009] WO03/006821 and DE10318135 disclose injectors wherein a wear resistant layer if formed on an inner surface of the injector body.

Summary of the invention

[0010] The object of the present invention is to provide an improved nozzle and a method of manufacturing such nozzle which will overcome the above problems.

[0011] In accordance with the present invention, this object is achieved by a nozzle having the features of claim 1 and by a method of manufacturing a nozzle having the features of claim 5.

Brief description of the drawings

[0012] Further characteristics and advantages of the present invention will become clear in the course of the detailed description which follows, given purely by way of non-limiting example, with reference to the annexed drawings, wherein:

- figure 1 is an axial cross-section of a nozzle according to the present invention,
- figure 2 is a schematic axial cross-section showing a variant of the embodiment of figure 1.

Description of the preferred embodiments

[0013] Referring to figure 1, a nozzle for a fuel injector for internal combustion engines is indicated 10. The nozzle 10 has a body 12 of corrosion-resistant material. The body 12 has no coating on its outer surface.

[0014] A material can be defined as corrosion resistant, in the application in combustion chambers of large diesel engines, especially diesel engines which burn heavy fuel oils (without coatings on the outer surface), if the chromium content is grater than 20% (mass per cent).

[0015] Examples of corrosion resistant materials for this application include: Stellite 6, Haynes 188, Stellite 4, Inconel MA 758, Haynes 230, Nicofer 6125GT, Alloy 6052, Nimonic 81, Inconel 671, Haynes 160.

[0016] The body 12 has a longitudinal bore 14 closed at its bottom end and having a cylindrical guide surface 16. The longitudinal bore is designed for receiving an axially slidable valve element 26 having a cut-off portion in contact with the cylindrical guide surface 16.

[0017] A plurality of nozzle bores 18 is formed in a lateral wall of the body. The nozzle bores 18 have respective inner openings facing into the longitudinal bore 14 and outlet openings open on an outer surface of the body 12.

[0018] The cylindrical guide surface 16 is formed by an inner surface of a tubular sleeve 24 of wear resistant material.

[0019] The sleeve 24 is inserted into the longitudinal bore 14 of the body 12 of corrosion resistant material.

[0020] The sleeve 24 can be pressed in or shrink fitted into the longitudinal bore 14. Alternatively, the sleeve can be floating with respect to the longitudinal bore 14. The nozzle bores 18 extend through the lateral wall of the

sleeve 24.

[0021] Figure 2 shows a variant of the embodiment of figure 3, wherein a tubular sleeve 28 of heat conducting material is fitted between the open end of the longitudinal bore 14 and a top front surface of the tubular sleeve 24. The sleeve 28 is made of a material which has a better coefficient of thermal conductivity than the sleeve 24 of wear resistant material and is effective for transporting heat away from the lower part of the nozzle 10.

Claims

1. A nozzle (10) for a fuel injector for internal combustion engines, having a body (12) of corrosion-resistant material with a longitudinal bore (14) closed at its bottom end and having a cylindrical guide surface (16), wherein a plurality of nozzle bores (18) is formed in a lateral wall of the body (12), the nozzle bores (18) having respective inner openings facing into the longitudinal bore (14) and outlet openings open on an outer surface of the body (12), **characterised in that** said cylindrical guide surface (16) is formed on a tubular sleeve (24) of wear resistant material inserted into said longitudinal bore (14).

2. A nozzle according to claim 1, **characterised in that** said corrosion-resistant material has a chromium content greater than 20% in mass.

3. A nozzle according to claim 1, **characterised in that** the tubular sleeve (24) of wear resistant material is pressed in, shrink fitted or floating with respect to the longitudinal bore (14).

4. A nozzle according to claim 1, **characterised in that** a second sleeve (28) of heat conductive material is fitted into said longitudinal bore (14) between an open end of the longitudinal bore (14) and an upper front surface of the tubular sleeve (24) of wear resistant material.

5. A method of manufacturing a nozzle (10) for a fuel injector for internal combustion engines, comprising: forming a body (12) of corrosion-resistant material with a longitudinal bore (14) closed at its bottom end and having a cylindrical guide surface (16), forming a plurality of nozzle bores (18) in a lateral wall of the body, the nozzle bores (18) having respective inner openings facing into the longitudinal bore (14) and outlet openings open on an outer surface of the body (12), **characterised in that** said cylindrical guide surface (16) is formed on a tubular sleeve (24) of wear resistant material inserted into said longitudinal bore (14).

6. A method according to claim 5, **characterized in that** said tubular sleeve (24) of wear resistant material is pressed in, shrink fitted or floating with respect to the longitudinal bore (14).

Patentansprüche

1. Eine Düse (10) für einen Kraftstoffinjektor für Verbrennungsmotoren, aufweisend einen Körper (12) aus korrosionsbeständigem Material mit einer Längsbohrung (14), welche an ihrem unteren Ende verschlossen ist, und einer zylindrischen Führungsoberfläche (16), wobei eine Mehrzahl von Düsenbohrungen (18) in einer Seitenwand des Körpers (12) ausgebildet sind, wobei die Düsenbohrungen (18) entsprechende innere Öffnungen aufweisen, welche in die Längsbohrung (14) hinein zeigen, und Auslassöffnungen aufweisen, welche an einer äußeren Oberfläche des Körpers (12) offen sind,
dadurch gekennzeichnet, dass
die zylindrische Führungsoberfläche (16) auf einer röhrenförmigen Hülse (24) aus verschleißfestem Material ausgebildet ist, welche in die Längsbohrung (14) eingebracht wurde.

2. Düse gemäß Anspruch 1, **dadurch gekennzeichnet, dass** korrosionsbeständige Material einen Chrom-Anteil von mehr als 20 Gew.-% aufweist.

3. Düse gemäß Anspruch 1, **dadurch gekennzeichnet, dass** die röhrenförmige Hülse (24) aus verschleißfestem Material in Bezug auf die Längsbohrung (14) hineingepresst, aufgeschrumpft oder beweglich ("*floating*") ist.

4. Düse gemäß Anspruch 1, **dadurch gekennzeichnet, dass** das eine zweite Hülse (28) aus wärmeleitendem Material in die Längsbohrung (14) zwischen einem offenen Ende der Längsbohrung (14) und einer Stirnoberfläche der röhrenförmigen Hülse (24) aus verschleißfestem Material eingepasst ist.

5. Ein Verfahren zur Herstellung einer Düse (10) für einen Kraftstoffinjektor für Verbrennungsmotoren, aufweisend:

   Ausbilden eines Körpers (12) aus korrosionsbeständigem Material mit einer Längsbohrung (14), welche an ihrem unteren Ende verschlossen ist, und eine zylindrische Führungsoberfläche (16) aufweist,
   Ausbilden einer Mehrzahl von Düsenbohrungen (18) in einer Seitenwand des Körpers (12), wobei die Düsenbohrungen (18) entsprechende innere Öffnungen aufweisen, welche in die Längsbohrung (14) hinein zeigen, und Auslassöffnungen aufweisen, welche an einer äußeren Oberfläche des Körpers (12) offen sind,
   dadurch gekennzeichnet, dass

die zylindrische Führungsoberfläche (16) auf einer röhrenförmigen Hülse (24) aus verschleißfestem Material ausgebildet ist, welche in die Längsbohrung (14) eingebracht wurde.

6. Verfahren gemäß Anspruch 5, **dadurch gekennzeichnet, dass** die röhrenförmige Hülse (24) aus verschleißfestem Material in Bezug auf die Längsbohrung (14) hineingepresst, aufgeschrumpft oder beweglich ("*floating*") ist.

Revendications

1. Buse (10) pour un injecteur de carburant pour moteurs à combustion interne, ayant un corps (12) réalisé à partir d'un matériau résistant à la corrosion avec un alésage longitudinal (14) fermé au niveau de son extrémité inférieure et ayant une surface de guidage cylindrique (16), dans laquelle une pluralité d'alésages de buse (18) sont formés dans une paroi latérale du corps (12), les alésages de buse (18) ayant des ouvertures internes respectives orientées en face de l'alésage longitudinal (14) et des ouvertures de sortie s'ouvrent sur une surface externe du corps (12), **caractérisée en ce que** ladite surface de guidage cylindrique (16) est formée sur un manchon tubulaire (24) réalisé avec un matériau résistant à l'usure inséré dans ledit alésage longitudinal (14).

2. Buse selon la revendication 1, **caractérisée en ce que** ledit matériau résistant à la corrosion a une teneur en chrome supérieure à 20 % en poids.

3. Buse selon la revendication 1, **caractérisée en ce que** le manchon tubulaire (24) réalisé à partir d'un matériau résistant à l'usure est comprimé dans, ajusté par contraction ou flottant par rapport à l'alésage longitudinal (14).

4. Buse selon la revendication 1, **caractérisée en ce qu'**un second manchon (28) réalisé à partir d'un matériau thermo-conducteur est monté dans ledit alésage longitudinal (14) entre une extrémité ouverte de l'alésage longitudinal (14) et une surface avant supérieure du manchon tubulaire (24) réalisé avec un matériau résistant à l'usure.

5. Procédé pour fabriquer une buse (10) pour un injecteur de carburant pour moteurs à combustion interne, comprenant les étapes consistant à : former un corps (12) réalisé avec un matériau résistant à la corrosion avec un alésage longitudinal (14) fermé au niveau de son extrémité inférieure et ayant une surface de guidage cylindrique (16), former une pluralité d'alésages de buse (18) dans une paroi latérale du corps, les alésages de buse (18) ayant des ouvertures internes respectives orientées en face de l'alésage longitudinal (14) et des ouvertures de sortie s'ouvrent sur une surface externe du corps (12), **caractérisé en ce que** ladite surface de guidage cylindrique (16) est formée sur un manchon tubulaire (24) réalisé avec un matériau résistant à l'usure inséré dans ledit alésage longitudinal (14).

6. Procédé selon la revendication 5, **caractérisé en ce que** ledit manchon tubulaire (24) réalisé avec un matériau résistant à l'usure est comprimé dans, ajusté par contraction ou flottant par rapport à l'alésage longitudinal (14).

FIG. 1

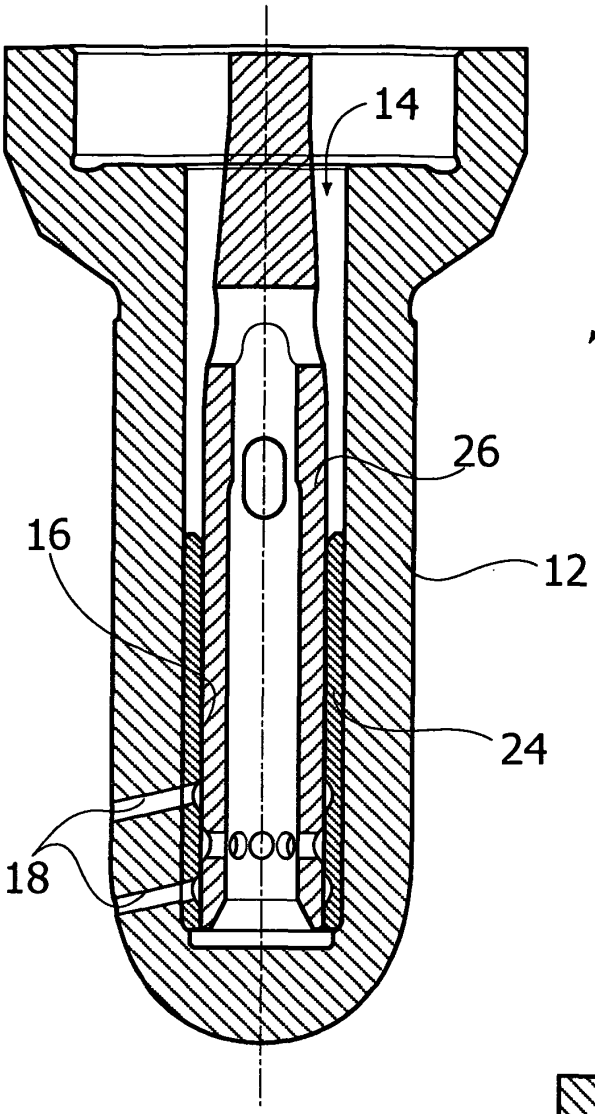
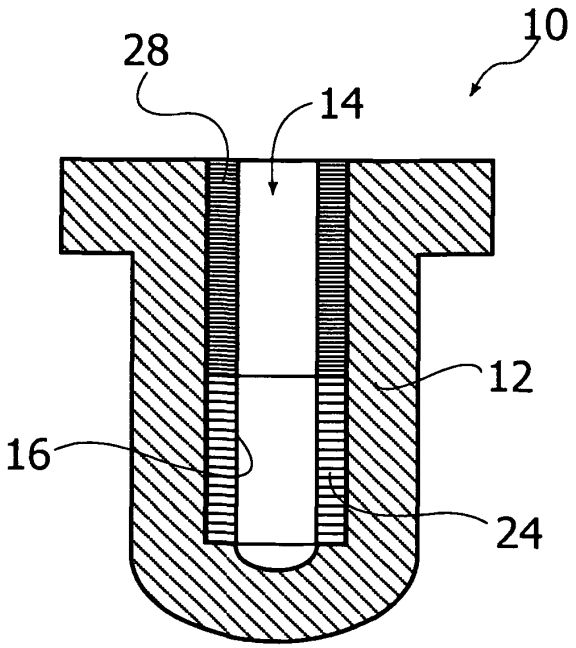


FIG. 2



REFERENCES CITED IN THE DESCRIPTION

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