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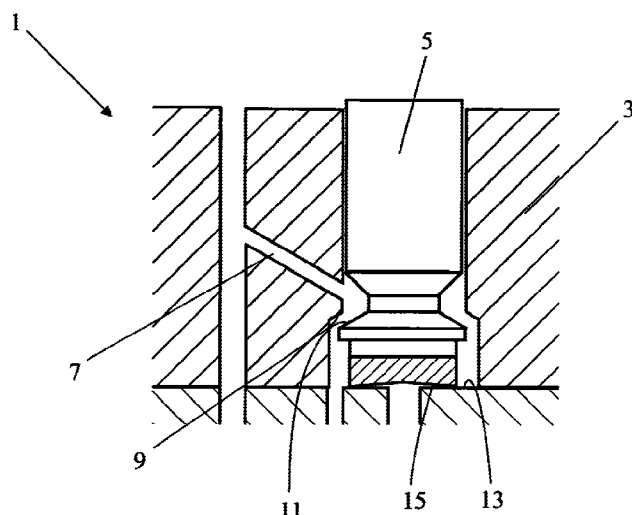
AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PE, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

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(54) Title: SYSTEM COMPRISING TWO INTERACTING SEALING FACES

**FIG. 1**

(57) **Abstract:** A fuel injection system (1) comprises two parts (3, 5) which are each provided with sealing faces which are in contact with each other and form a sealing. One of the parts (3) is provided with a fuel supply passage (7) and a valve seating (9). The other part (5) is formed by a valve provided with a valve face (11). For realising a better sealing of the sealing faces, the valve face (11) is covered with a coating that has a hardness exceeding the hardness of the surface of the valve seating (9). The fuel injection system (1) further comprises a further valve seating (13) and a further valve face (15). For having here too a better sealing of the two sealing faces, the sealing face (13) is covered with a coating that has a high embedding power. Since the valve face (15) is pointed, the coating is to have at least the hardness of the valve face (13).

System comprising two interacting sealing faces

DESCRIPTION

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Field of the invention.

The invention relates to a system comprising two parts which are each provided with a rigid sealing face, which sealing faces are engageable with each other and form a sealing.

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State of the art.

A system of this type is known from EP 1 541 860 A1. This known system is formed by a fuel injection system in which one of the parts is provided with a fuel supply passage and a valve seating that forms one of the sealing faces and the other part is formed by a valve provided with a valve face that forms the other sealing face.

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In the fuel supply passage new-generation fuel injection systems the fuel pressure may rise up to 2000 bars and over. During the opening and closing of the valve the following phenomena occur as a result of these high pressures: corrosion, plastic deformation, high flow rates and high temperatures which consequently deteriorate the sealing faces. In the known fuel injection system such influences lead to unacceptable deterioration of the sealing faces. As a result of this deterioration it would no longer be possible for the required fuel pressure to be built up, leading to the fact that the fuel injection system would not operate in optimum fashion.

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Summary of the invention.

It is an object of the invention to provide a system of the type defined in the opening paragraph in which the sealing faces have a sufficiently large resistance to wear to satisfy future requirements. To this end the system according to the invention is characterised in that at least one of the sealing faces is covered with a coating which comprises a basic layer directly on the sealing face, as well as a top layer covering the basic layer, the top layer having a hardness that is lower than that of the basic layer. If either of the two sealing faces is

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covered with a coating with a soft top layer, a perfect sealing is obtained where no problems of wear are developed at pressures of 2000 bars and over. Preferably, the outermost layer of the coating, that is to say, the layer that is in contact with the other sealing face, is relatively soft, that is to say has a hardness of less than 1500 HV, preferably less than 1250 HV, or the outermost layer is softer than the other sealing face. As a result, the coating has an embedding power so that when the coating is used the two sealing faces can interact.

The coating is preferably a CrN + a-C:H:W coating, where the a-C:H:W coating forms the outermost layer. This outermost layer has a hardness of about 1000 HV and thus forms a relatively soft layer with a large embedding power.

An embodiment of the system according to the invention is characterised in that also the other sealing face is covered with a coating. The outermost layers of the two coatings preferably have different hardnesses and/or a hardness that is less than 1500 HV.

In a further embodiment of the system according to the invention the other sealing face is also covered with a CrN + a-C:H:W coating, where the a-C:H:W coating again forms the outermost layer. This is pre-eminently suitable for systems in which one of the sealing faces has a relatively small contact area.

In another embodiment of the system according to the invention the other coating is a Cr_xN coating. Preferably a CrN or Cr₂N coating. This is a relatively hard coating having a hardness of about 1700 HV. This coating is preferably used for a relatively small sealing face. The other sealing face is then to have a good embedding power to obtain a proper sealing.

The invention is particularly suitable for use in a fuel injection system. Therefore, the system according to the invention is preferably a fuel injection system in which one of the parts is provided with a fuel supply passage and a valve seating which forms one of the sealing faces and the other part is formed by a valve that has a valve seating which forms the other sealing face.

Brief description of the drawings.

The invention will be described below in more detail based on an example of embodiment of the system according to the invention represented in the drawing figures, in which:

Fig. 1 shows a part of a fuel injection system provided with a first embodiment of the sealing according to the invention; and

Fig. 2 shows a fuel injection system provided with a second embodiment of the sealing according to the invention.

Detailed description of the drawings.

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Fig. 1 shows a part of a first embodiment of the system according to the invention arranged as a fuel injection system. The fuel injection system 1 comprises two parts 3, 5 which are each provided with sealing faces which are in contact with each other and form a sealing. One of the parts 3 is equipped with a fuel supply passage 7 and a valve seating 9. The other part 5 is formed by a valve equipped with a valve face 11. The valve seating 9 and the valve face 11 together form interacting sealing faces.

Both sealing faces are in contact with each other over a relatively large area. As a result it may suffice to provide only one of the sealing faces with a coating. For reasons of manufacturing technology this coating preferably covers the valve face 11. This coating has a hardness that exceeds the hardness of the surface of the valve seating 9 and in this embodiment is a CrN + a-C:H:W coating, for example Tribond 43 made by Ionbond, with the a-C:H:W coating forming the outermost layer.

The fuel injection system 1 further comprises a further valve seating 13 and a further valve face 15. The valve seating 13 here has a planar surface whereas the valve face 15 is pointed. For practical reasons, if at all possible the complete part 5 is covered with the same coating. For this reason the valve face 15 preferably also has a CrN + a-C:H:W coating and the valve seating 13 has a similar well-inbedding CrN + a-C:H:W coating. The layer thicknesses of the coatings are of the order of several micrometers.

Fig. 2 shows a second embodiment of the system according to the invention, again arranged as a fuel injection system. Similar parts to those of the first embodiment have been referred to with like reference numerals. In this fuel injection system 17 the part 5 is covered with a relatively hard coating CrN or Cr₂N. The two valve seatings 9 and 13 are provided with a CrN + a-C:H:W coating. If the valve face 11 is provided with the CrN or Cr₂N coating and the valve seating 9 with the CrN + a-C:H:W coating, this provides a very good sealing as well.

Albeit the invention has been described in the foregoing based on the drawing figures, it should be observed that the invention is not by any manner or means restricted to the embodiment shown in the drawing figures. The invention also extends to all embodiments

deviating from the embodiment shown in the drawing figures within the spirit and scope defined by the claims.

CLAIMS:

1. A system comprising two parts which are each provided with a rigid sealing face, which sealing faces are engageable with each other and form a sealing, characterised in that at least one of the sealing faces is covered with a coating which comprises a basic layer
5 directly on the sealing face, as well as a top layer covering the basic layer, the top layer having a hardness that is lower than that of the basic layer.
2. A system as claimed in claim 1, characterised in that the coating is a $\text{CrN} + \text{a-C:H:W}$ coating, where a-C:H:W forms the outermost layer.
3. A system as claimed in claim 1 or 2, characterised in that also the other sealing
10 face is covered with a coating.
4. A system as claimed in claim 3, characterised in that the other sealing face is also covered with a $\text{CrN} + \text{a-C:H:W}$ coating, where the a-C:H:W forms the outermost layer.
5. A system as claimed in claim 3, characterised in that the other sealing face has a Cr_xN coating.
- 15 6. A system as claimed in any one of the preceding claims, characterised in that the system is a fuel injection system in which one of the parts is provided with a fuel supply passage and a valve seating which forms one of the sealing faces and the other part is formed by a valve that has a valve face which forms the other sealing face.

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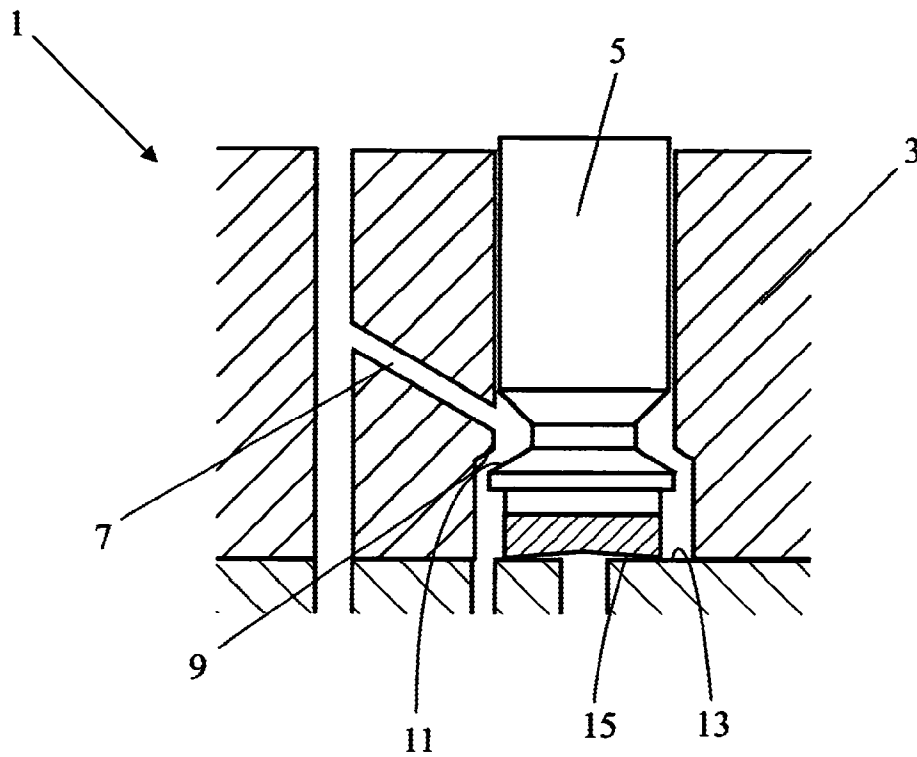


FIG. 1

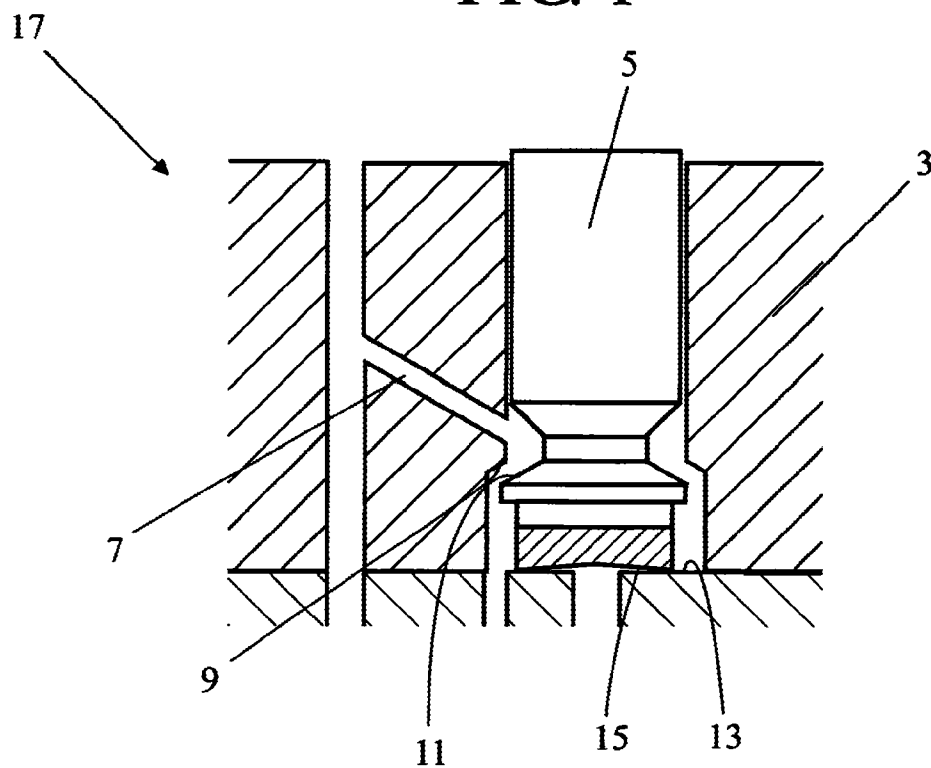


FIG. 2

INTERNATIONAL SEARCH REPORT

International application No
PCT/NL2010/050445

A. CLASSIFICATION OF SUBJECT MATTER
INV. F16K25/00
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
F16K

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EP0-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	DE 10 2008 020607 A1 (GENERAL ELECTRIC CO.) 27 November 2008 (2008-11-27) paragraph [0011]; figure 1 paragraph [0017] - paragraph [0018] -----	1
A	FR 2 669 938 A1 (ROBINETTERIE MECANIQUE STE GLE [FR]; SOUDURE IND SA [FR]) 5 June 1992 (1992-06-05) page 5, line 33 - page 9, line 18; figures 1,2 -----	1
A	US 6 302 136 B1 (WEAVER BILLY LEE [US] ET AL) 16 October 2001 (2001-10-16) column 6, line 1 - line 13; figures 3-5 -----	1,3
A	EP 1 541 860 A1 (DELPHI TECH INC [US]) 15 June 2005 (2005-06-15) cited in the application * abstract -----	1,6

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier document but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
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"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
"&" document member of the same patent family

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INTERNATIONAL SEARCH REPORT

Information on patent family members

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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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