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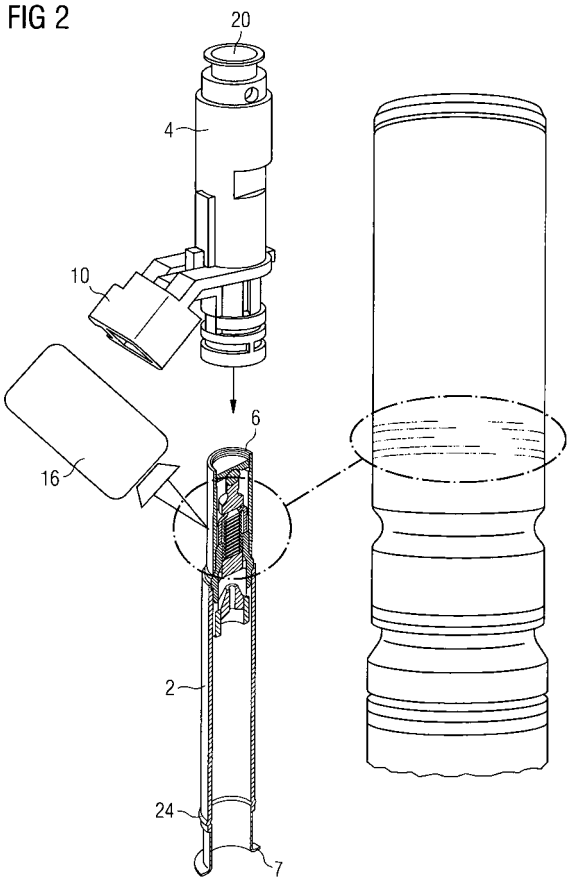
(54) **Injection valve and method for its manufacturing**

(57) Injection valve (16), comprising an actuator module (4) with a cavity (20) and an actuator unit (14). The injection valve (16) further comprises a fluid module (2), being disposed at least partially within the cavity (20) of the actuator module (4) and comprising a housing and a valve needle (8). The valve needle (8) is disposed in the housing and is actuatable by the actuator unit (14). The valve needle (8) is operable to prevent a fluid injection in a closing position and permit the fluid injection in further. The actuator module (4) is adhered to the fluid module (2) via a metal adhesive (16), which is arranged between a surface of the housing of the fluid module (2) and a surface of a wall of the cavity (20) of the actuator module (4).

FIG 2



EP 2 177 747 A1

Description

[0001] The invention relates to an injection valve and its manufacturing.

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

[0003] Injection valves are manufactured in various forms in order to satisfy the various needs for the various combustion engines. Therefore, for example, their length, their diameter and also various elements of the injection valves being responsible for the way the fluid is dosed may vary in a wide range. In addition to that, injection valves may accommodate an actuator for actuating a needle of the injection valve, which may, for example, be an electromagnetic actuator.

[0004] The object of the invention is to provide an injection valve and a method for manufacturing the injection valve which facilitates a reliable and precise function.

[0005] This object is achieved by the features of the independent claims. Advantageous embodiments of the invention are given in the sub-claims.

[0006] The invention is distinguished concerning a first aspect by an injection valve which comprises an actuator module with a cavity and an actuator unit. The injection valve further comprises a fluid module, being disposed at least partially within the cavity of the actuator module and comprising a housing and a valve needle. The valve needle is disposed in the housing and is actuatable by the actuator unit. The valve needle is operable to prevent a fluid injection in a closing position and permit the fluid injection in further positions at a fluid module end. The actuator module is adhered to the fluid module via a metal adhesive, which is arranged between a surface of the housing of the fluid module and a surface of a wall of the cavity of the actuator module. This contributes to prevent a permeation path of moisture, for example air moisture with fuel, between the housing of the fluid module and the wall of the cavity of the actuator module. A further advantage is that the metal adhesive is robust against movements, for example due to vibrations or thermal expansions, between the fluid module and the actuator module. This contributes to ensure a reliable operation of the injection valve. The fluid module end may for example associate to an intake manifold of the internal combustion engine. The injection valve may for example be a low pressure injection valve for dosing gasoline into the intake manifold.

[0007] The invention is distinguished concerning a second aspect by a method for manufacturing an injection valve, wherein a fluid module with a valve needle and a housing is provided. The valve needle is disposed within the housing and is operable to prevent a fluid injection in a closing position and permit the fluid injection in further positions at a fluid module end. An actuator module with a cavity and an actuator unit to actuate the valve needle is provided. A metal adhesive is at least sectionally applied on a surface of the housing of the fluid module and/or on a surface of a wall of the cavity of the actuator module. The actuator module is put over the fluid module in such a way, that the fluid module is disposed at least partially within the cavity of the actuator module. The metal adhesive is in contact with the surface of the housing of the fluid module and the surface of the wall of the cavity of the actuator module. Afterwards the metal adhesive is hardened.

[0008] In an advantageous embodiment of the first and second aspect, the metal adhesive is arranged or applied on an area of the surface of the housing of the fluid module and/or on an area of the surface of the wall of the cavity of the actuator module which is associated to the smallest gap between the housing of the fluid module and the wall of the actuator module. This contributes to efficiently prevent the permeation path of moisture.

[0009] In a further advantageous embodiment of the first and second aspect, the metal adhesive is arranged or applied on an area of the surface of the housing of the fluid module and/or on an area of the surface of the wall of the cavity of the actuator module which is located between the actuator unit of the actuator module and the fluid module end. This contributes to prevent the permeation of moisture to the actuator unit. By this a corrosion of the actuator unit can be avoided. Furthermore the permeation path going from the fluid module end to an opposite end of the fluid module can be stopped.

[0010] In a further advantageous embodiment of the first and second aspect, the actuator module comprises an electrical connector. The electrical connector is electrically coupled to the actuator unit. The metal adhesive is arranged or applied on an area of the surface of the housing of the fluid module and/or on an area of the surface of the wall of the cavity of the actuator module which is located between the electrical connector and the fluid module end. This contributes to prevent the permeation of the moisture to the electrical connector. Furthermore this contributes to stop the permeation path going from the fluid module end to the opposite end of the fluid module.

[0011] Exemplary embodiments of the invention are explained in the following with the aid of schematic drawings. These are as follows:

Fig. 1 an injection valve,

Fig. 2 fluid module and actuator unit of the injection valve.

[0012] Elements of the same design or function that appear in different illustrations are identified by the same reference sign.

[0013] An injection valve 18 (figure 1), that is in particular suitable for dosing fuel into an intake manifold, comprises a fluid module 2 and an actuator module 4. The

fluid module 2 comprises a housing 24 and a valve needle 8. The valve needle 8 is disposed within the housing 24 and is operable to prevent a fluid injection into the intake manifold in a closing position and permit the fluid injection into the intake manifold in further positions. A first fluid module end 6 is associated to the intake manifold, where the fluid is dosed into. A second opposite fluid module end 7 may be hydraulically coupled to a fluid rail, in which fluid is reserved under a predetermined pressure.

[0014] The actuator module 4 comprises a cavity 20 (figure 2) in which the fluid module 2 is at least partially disposed. The actuator module 4 further comprises an actuator unit 14 which is for example a magnetic coil which is operable to magnetically actuate the valve needle 8 to move along a longitudinal axis L of the injection valve 18. Also other accomplishments of the actuator unit 14 are possible. Furthermore the actuator module 4 comprises an electrical connector 10 which is electrically coupled to the actuator unit 14 to electrically actuate the actuator unit 14. Preferably the electrical connector 10 is electrically coupled to the actuator unit 14 via one or more wires, which are routed through an actuator housing of the actuator module 4 to the actuator unit 14.

[0015] At least the housing 24 of the fluid module 2 and at least the wall of the cavity 20 of the actuator module 4 are preferably made of stainless steel.

[0016] If the injection valve 18 is attached to the intake manifold of for example an internal combustion engine, there can run a permeation path 12 between the wall of the cavity 20 of the actuator module 4 and the housing 24 of the fluid module 2. Additionally the permeation path 12 can run along the routing of the one or more wires which electrically couple the electrical connector 10 to the actuator unit 14. In particular if the internal combustion engine comprises boost applications like turbochargers the intake manifold is typically pressurized. By this a permeation of moisture, for example air moisture with gasoline, can arise along the permeation path 12 from the intake manifold to the outside combustion engine environment.

[0017] Figure 2 depicts the fluid module 2 and the actuator module 4 of the injection valve 18. Figure 2 further depicts a metal adhesive 16 which is applied on a surface of the housing 24 of the fluid module 2. As illustrated in the enlarged illustration of the fluid module 2 the metal adhesive 16 is applied sectionally on a predetermined area of the surface of the housing 24 of the fluid module 2 which is associated to the first fluid module end 6 of the fluid module 2. Preferably the metal adhesive 16 is applied completely around the housing 24 of the fluid module 2. Alternatively or additionally the metal adhesive 16 is at least sectionally applied on an area of a surface of the wall of the cavity 20 of the actuator module 4. The metal adhesive 16 is preferably liquid if it is not hardened and is preferably applied on the particular surface in liquid form. After applying the metal adhesive 16 the actuator module 4 is put over the fluid module 2, whereas the metal adhesive 16 is in contact with the surface of the housing of the fluid module 2 and the surface of the wall of the cavity 20 of the actuator module 4. During this step the metal adhesive 16 is still liquid. After putting the actuator module 4 over the fluid module 2, the metal adhesive is hardened for a predetermined period of time, for example 5 min.

[0018] The metal adhesive 16 is preferably based on acrylate and is a single component metal adhesive. This metal adhesive 16 hardens if it is hermetically sealed and ensures a high tightness if hardened. The metal adhesive 16 is robust against movements between the fluid module 2 and the actuator module 4 for example due to vibrations or thermal expansions. The metal adhesive may be for example LOCTITE® 648™.

[0019] After hardening the metal adhesive 16 the permeation path 12 between the fluid module 2 and the actuator module 4 is at least stopped at the point where the metal adhesive 16 is arranged. Preferably the metal adhesive 16 is arranged or applied on an area of the surface of the housing 24 of the fluid module 2 and/or on an area of the surface of the wall of the cavity 20 of the actuator module 4 which is located between the actuator unit 14 of the actuator module 4 and the first fluid module end 6. This stops the permeation path 12 before the moisture reaches the actuator unit 14 of the actuator module 4. By this a corrosion of the actuator unit 14 can be avoided. Alternatively or additionally the metal adhesive 16 is arranged or applied on an area of the surface of the housing 24 fluid module 2 and/or on an area of the surface of the wall of the cavity 20 of the actuator module 4 which is located between the electrical connector 10 and the first fluid module end 6 of the fluid module 2. By this arrangement the fluid permeation path 12 is at least stopped before it runs along the routing of the one or more wires of the electrical connector 10 to the outside combustion engine environment.

[0020] The use of the metal adhesive 16 contributes to prevent the permeation of moisture between the fluid module 2 and the actuator module 4 may be combined with other facilities to contribute to prevent the permeation of moisture, for example the use of a sealing ring between the first fluid module end 6 and the actuator unit 14. Basically the use of the metal adhesive 16 is sufficient to prevent the permeation path 12 between the fluid module 2 and the actuator module 4.

Claims

1. Injection valve (16), comprising

- an actuator module (4) with a cavity (20) and an actuator unit (14),
- a fluid module (2), being disposed at least partially within the cavity (20) of the actuator module (4) and comprising a housing and a valve needle (8), being disposed in the housing and being actuatable by the actuator unit (14), the valve nee-

dle (8) is operable to prevent a fluid injection in a closing position and permit the fluid injection in further positions at a fluid module end (6), with the actuator module (4) being adhered to the fluid module (2) via a metal adhesive (16), which is arranged between a surface of the housing of the fluid module (2) and a surface of a wall of the cavity (20) of the actuator module (4).

2. Injection valve (16) according to claim 1, the metal adhesive (16) being arranged on an area of the surface of the housing of the fluid module (2) and/or on an area of the surface of the wall of the cavity (20) of the actuator module (4) which is associated to the smallest gap between the housing of the fluid module (2) and the wall of the actuator module (4).

3. Injection valve (16) according to claim 1 or 2, the metal adhesive (16) being arranged on an area of the surface of the housing of the fluid module (2) and/or on an area of the surface of the wall of the cavity (20) of the actuator module (4) which is located between the actuator unit (14) of the actuator module (4) and the fluid module end (6).

4. Injection valve (16) according to one of the preceding claims, the actuator module (4) comprising an electrical connector (10) being electrically coupled to the actuator unit (14), the metal adhesive (16) being arranged on an area of the surface of the housing of the fluid module (2) and/or on an area of the surface of the wall of the cavity (20) of the actuator module (4) which is located between the electrical connector (10) and the fluid module end (6).

5. Method for manufacturing an injection valve (18), wherein

- a fluid module (2) with a valve needle (8) and a housing is provided, the valve needle (8) being disposed within the housing and being operable to prevent a fluid injection in a closing position and permit the fluid injection in further positions at a fluid module end (6),
- an actuator module (4) with a cavity (20) and an actuator unit (14) to actuate the valve needle (8) is provided,
- a metal adhesive (16) is at least sectionally applied on a surface of the housing of the fluid module (2) and/or on a surface of a wall of the cavity (20) of the actuator module (4),
- the actuator module (4) is put over the fluid module (2) in such a way, that the fluid module (2) is disposed at least partially within the cavity (20) of the actuator module (4), whereas the metal adhesive (16) is in contact with the surface of the housing of the fluid module (2) and the surface of the wall of the cavity (20) of the actuator module (4),
- the metal adhesive (16) is hardened.

6. Method according to claim 1, wherein the metal adhesive (16) is applied on an area of the surface of the housing of the fluid module (2) and/or on an area of the surface of the wall of the cavity (20) of the actuator module (4) which is associated to the smallest gap between the housing of the fluid module (2) and the wall of the actuator module (4) if the fluid module (2) and the actuator module (4) are assembled.

7. Method according to claim 5 or 6, wherein the metal adhesive (16) is applied on an area of the surface of the housing of the fluid module (2) and/or on an area of the surface of the wall of the cavity (20) of the actuator module (4) which is located between the actuator unit (14) of the actuator module (4) and the fluid module end (6) if the fluid module (2) and the actuator module (4) are assembled.

8. Method according to one of the claims 5 to 7, the actuator module (4) comprising an electrical connector (10) being electrically coupled to the actuator unit (14), wherein the metal adhesive (16) is applied on an area of the surface of the housing of the fluid module (2) and/or on an area of the surface of the wall of the cavity (20) of the actuator module (4) which is located between the electrical connector (10) and the fluid module end (6) if the fluid module (2) and the actuator module (4) are assembled.

FIG 1

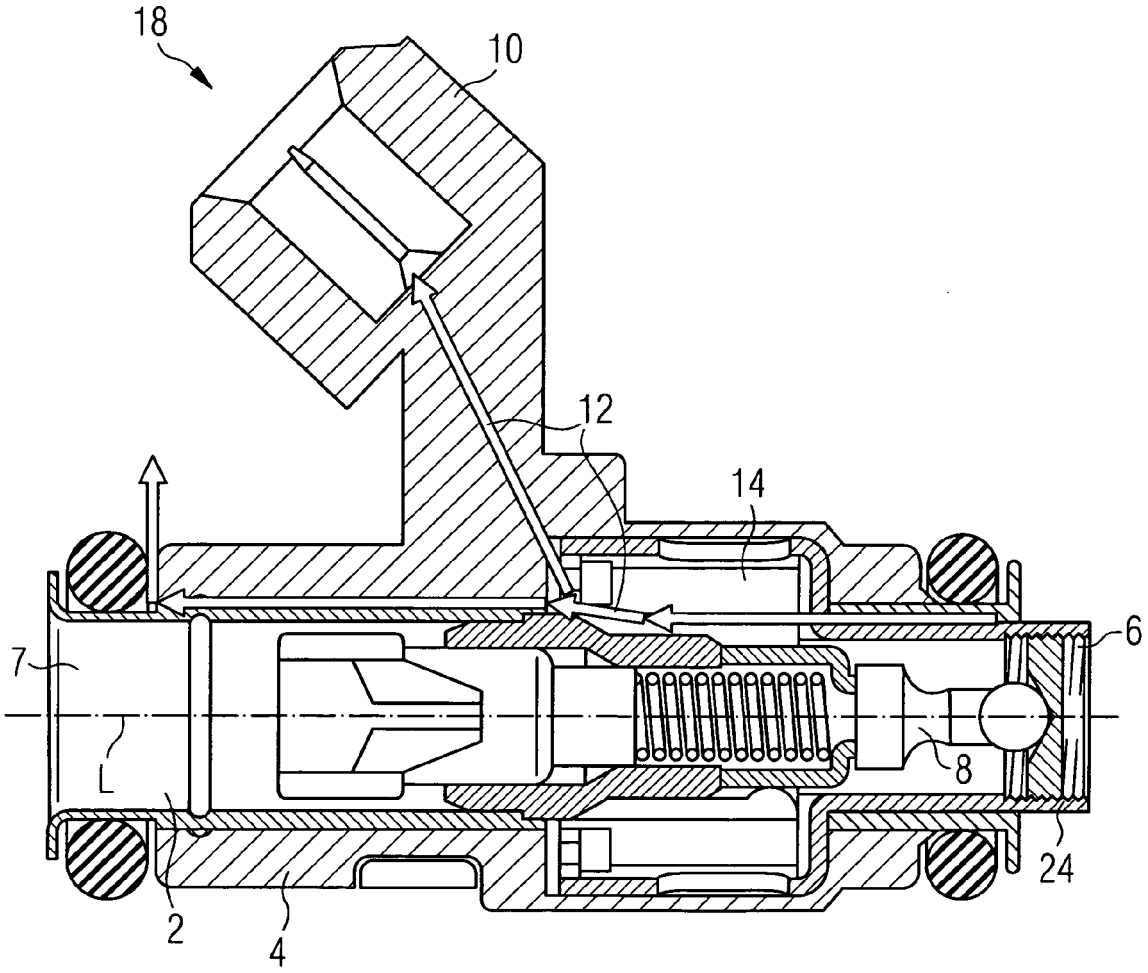
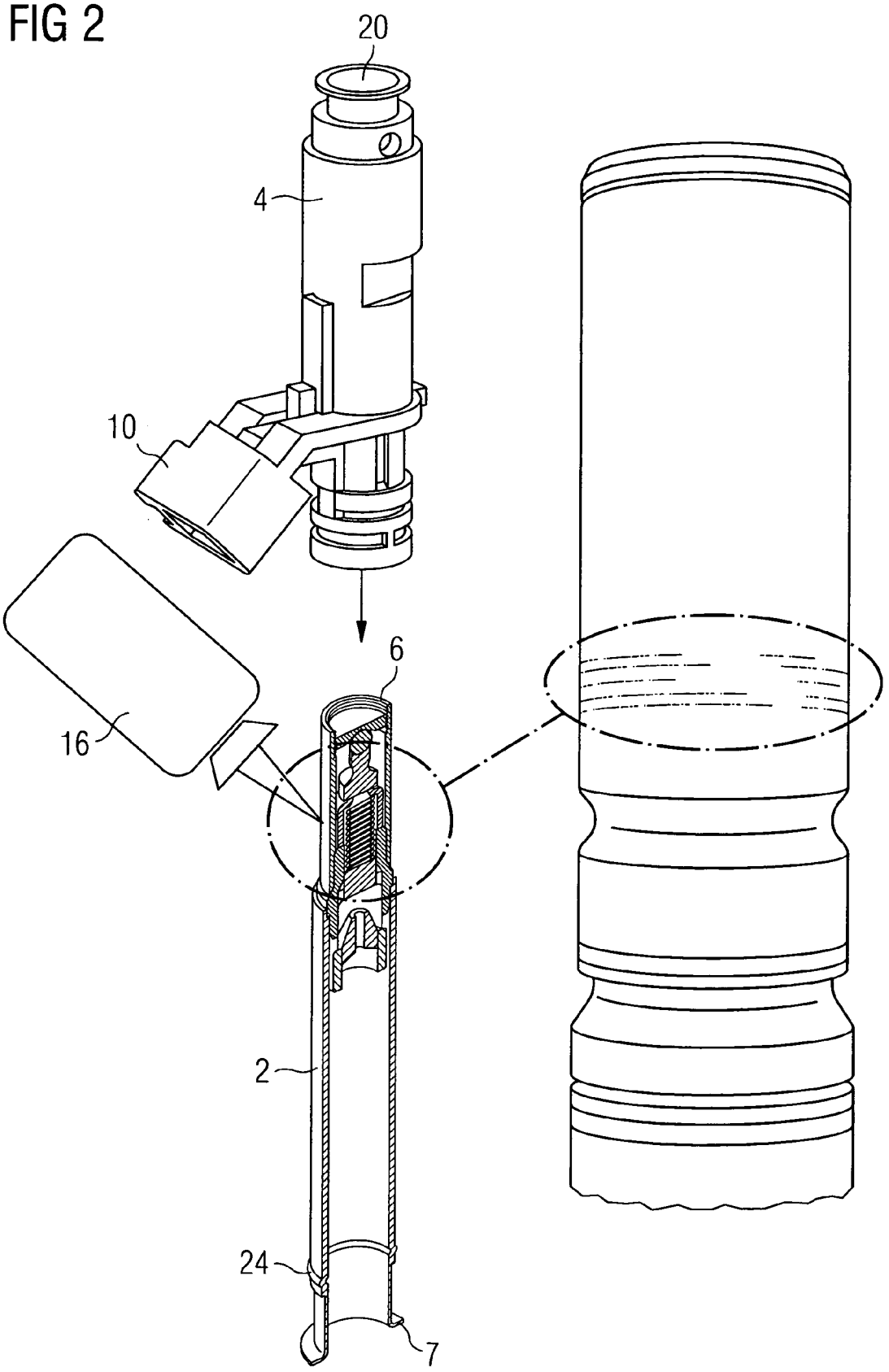


FIG 2



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EUROPEAN SEARCH REPORT

Application Number
EP 08 01 8063

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X	US 2006/076437 A1 (DALLMEYER MICHAEL [US]) 13 April 2006 (2006-04-13) * page 7, paragraph 57 *	1-8	INV. F02M61/16
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TECHNICAL FIELDS SEARCHED (IPC)
F02M

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	23 March 2009	Etschmann, Georg

CATEGORY OF CITED DOCUMENTS

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