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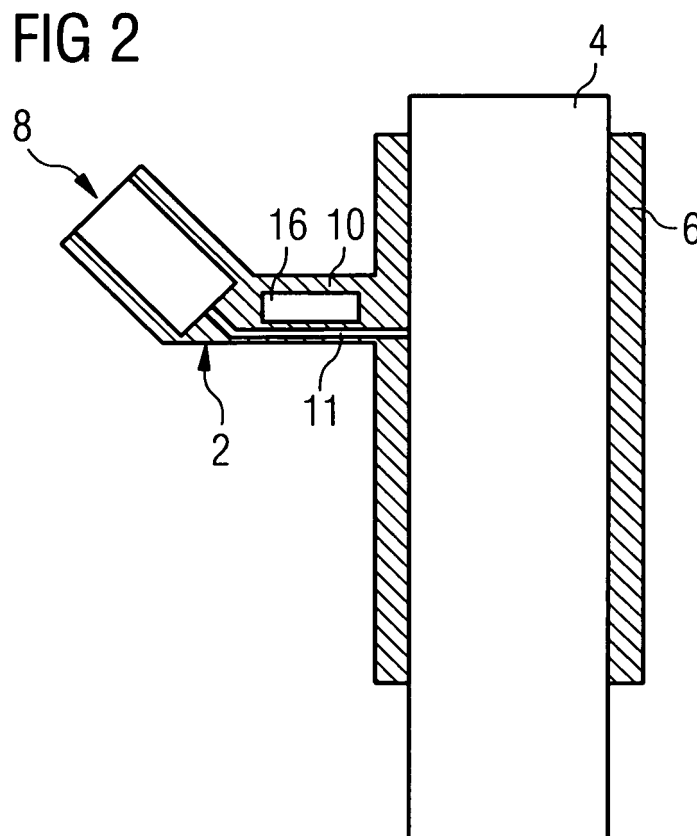
(72) Inventors:
• **Bertini, Paolo**
57100 Livorno (IT)
• **Morelli, Alessandro**
57128 Livorno (IT)

(71) Applicant: **SIEMENS AKTIENGESELLSCHAFT**
80333 München (DE)

(54) **Electrical connector for fuel injector**

(57) A Connector (2) for an injector (4) comprises a socket (8), a flange (6) and a junction area (10). The junction area (10) couples the flange (6) with the socket (8). The socket (8) comprises one or more electric con-

ductors (11) and an absorber, which mass exceeds the mass of the one or respectively more electric conductors (11). The absorber further comprises a density, which exceeds the density of the main material of the connector (2).



Description

[0001] The invention relates to a connector for an injector comprising a socket, a flange and a junction area, the junction area coupling the flange with the socket.

[0002] In order to meet the requirements of strict emission legislation and in order to save fuel consumption, fluid injectors, in particular fluid injectors for internal combustion engines, are arranged in a cylinder head of an internal combustion engine in a way that they inject the fuel directly into a combustion chamber of the engine. In order to get a very fine atomization of the fluid in such applications, it is necessary to provide the fluid under high pressure. In gasoline internal combustion engines, the fluid pressure may reach up to 200 bars; in Diesel engines, the fluid pressure may reach up to 2000 bars. The duration while there is an injection can be very short. The duration may go down to a few milliseconds or lower. So the pressure conditions in the injector during the operation of the injector are changing very fast. The fast change from high to low pressure in the fluid in the injector can cause shock waves in the fluid which leads to shock waves in the whole injector material.

[0003] The object of the invention is to create a connector for an injector, which enables simply low-noise operation of the connector-injector-unit.

[0004] The object of the invention is achieved by the features of claim 1. Advantageous embodiments of the invention are given in the sub-claims.

[0005] The invention is distinguished by a connector for an injector comprising a socket, a flange and a junction area. The junction area couples the flange with the socket. The socket comprises one or more electric conductors and an absorber. The mass of the absorber exceeds the mass of the one or respectively more electric conductors. The density of the absorber exceeds the density of the main material of the connector. The main material of the connector is considered as the material of the connector making up the biggest percentage of the mass of the connector.

[0006] Normally, the injector comprises arrangements for contacting the injector, for example for electric connections. Shock waves in the injector, caused by fast and heavily changing pressure conditions in the injector, cause shock waves in the connector. Simulations show that the amplitude of the shock waves can be very high in that area where the connector is connected to the injector. The shock waves in the injector and the connector cause to acoustic waves in the surrounding air which leads to noise during the operation of the injector.

[0007] An absorber with a properly given mass and density contributes simply to an absorption of the shock waves in the connector-injector-unit. This avoids acoustic waves in the air and contributes to a noise reduction while operating the injector.

[0008] In an advantageous embodiment of the connector, the absorber comprises a first absorber body which is surrounded by the connector material in the junction

area. So the first absorber body simply is well-protected from corrosion by the material of the connector.

[0009] In a further advantageous embodiment of the connector, the absorber comprises a second absorber body, which is arranged in a recess of the connector in the junction area. This enables noise reduction of the injector with insignificant modification of the connector.

[0010] In a further advantageous embodiment of the connector, the absorber comprises a third absorber body, which is arranged in a groove of the connector in the junction area. This enables noise reduction of the injector with insignificant weakening of the connector in the junction area.

[0011] In a further advantageous embodiment of the connector, the absorber comprises a fourth absorber body having a form enabling a positive connection of the fourth absorber body to the connector in the junction area. This enables noise reduction of the connector-injector-unit without any modification of the connector.

[0012] In a further advantageous embodiment of the connector, the absorber comprises carbide. This enables a good noise absorption and a cheap production of the absorber.

[0013] In a further advantageous embodiment of the connector, the absorber comprises lead. This enables a very good noise absorption.

[0014] In a further advantageous embodiment of the connector, the absorber comprises steel. This enables a very good noise absorption.

[0015] In a further advantageous embodiment of the connector, the total absorber mass has about 5% to 15% of the total injector mass. This enables a very good noise reduction while having a low mass.

[0016] Exemplary embodiments of the invention are explained in the following with the aid of schematic drawings.

These are as follows:

[0017]

Figure 1 a first embodiment of a connector,

Figure 2 a cut through a second embodiment of the connector,

Figure 3 a third embodiment of the connector,

Figure 4 a fourth embodiment of the connector,

Figure 5 a cut through the fourth embodiment according to figure 4.

[0018] Elements of the same design and function that appear in the different illustrations are identified by the same reference character.

[0019] A connector 2 for an injector 4 comprises a flange 6, a socket 8, and a junction area 10 (figure 1).

The flange 6 has an injector-recess, in which the injector 4 is arranged. The socket 8 comprises a socket-recess for a jack. The junction area 10 connects the socket 8 to the flange 6. The junction area 10 comprises at least one electric conductor 11 (figure 2). The electric conductor 11 may be a wire, for example a copper wire. The electric conductor 11 also could be a pin made of an electric conducting material.

[0020] An internal combustion engine comprises a cylinder head, in which the connector 2 and the injector 4 may be arranged, and a control unit. The control unit operates the injector 4 by sending signals through the electric conductor 11 to the injector 4. Via the injector 4, the control unit is able to control the amount of fuel which is injected to a combustion chamber of the internal combustion engine. The injector 4 that is suitable for injecting fuel into a gasoline engine or that also may be suitable for injecting fuel into a diesel engine, may comprise a housing, a valve body, at least one nozzle and a connection area for a fuel supply.

[0021] The connector 2, especially the flange 6, the socket 8 and the junction area 10, may be formed in a different way. For example, the flange 6 may cover in axial direction of the injector 4 only a small part of the injector 2. The flange 6 may be not circulating the injector 4. This means that the flange 6 contacts the injector 4 only in a part of the scope of the injector 4. The junction area 10 could be arranged in any part of the flange 6, while its functionality is still given. The design of the socket 8 is dependent on the jack which is meant to be put in the socket 8.

[0022] The junction area 10 comprises an absorber-recess 12 (Figure 1). The absorber-recess 12 could be formed while forming the whole connector 2 or may be formed after forming the connector 2 by drilling the absorber-recess 12 in the connector 2 in the junction area 10. There is a first absorber body 14 which is arranged in the recess 12 of the junction area 10. The absorber may be made of carbide and can have a mass of about 8% of the whole connector-injector-unit 2, 4 mass.

[0023] A simulation shows, that the junction area 10 is that part of the connector-injector-unit 4, 2 which comprises the biggest vibration amplitude while operating the injector. The vibrations are caused by shock waves which are caused by fast and heavily changing pressure conditions in the injector 4. This leads to acoustic waves in the surrounding air of the connector-injector-unit 2, 4 and so creates noise. The first absorber body 14 contributes to the absorption of the shock waves in the junction area 10, which enables low noise operation of the connector-injector-unit 2, 4.

[0024] The absorber may be built in an alternative way. There may be a second absorber body 16 which is built in the junction area 10 in a way that the material of the junction area totally surrounds the second absorber body 16 (figure 2). This embodiment comprises a cheap possibility to produce the connector 2 absorber unit. Further, the second absorber body 16 is protected by the material

of the connector 2 in the junction area 10. This protects the second absorber body 16 from corrosion. Further, it enables to put the second absorber body 16 in any part of the connector 2 in the junction area 10. The second absorber body 16 may be an alternative to the first absorber body 14 or may be additional to the first absorber body 14.

[0025] In an embodiment in which the arrangement of the absorber only needs insignificant modifications of the connector 2, the junction area 10 comprises a groove 20 in which a third absorber body 18 is arranged (figure 3).

[0026] The absorber may comprise a fourth absorber body 24 which is formed in a way which enables a positive connection between the fourth absorber body 24 and the connector 2 in the junction area 10 (figure 4). The fourth absorber body 24 may be formed like two brackets which are connected on one side. So the connector 2 does not need to be modified (figure 5).

[0027] The absorber, especially the absorber bodies one to four 14, 16, 18, 24 alternatively may be made of lead or stainless steel or any further material which enables the absorption of acoustic waves in the material of the connector 2. Stainless steel is especially advantageous, if it needs to be robust against corrosion.

[0028] Best absorption of the shock waves in the connector-injector-unit 2, 4 is given if the absorber has a mass of 5% to 15% of the total connector-injector-unit 2, 4 mass. For example, the injector 4 having a mass of 24 g requires an absorber with about 2 g. The absorber may have another mass which enables the absorption of the shock waves.

[0029] The different embodiments of the invention may be combined. For example, the third absorber body 18 and the fourth absorber body 24 may be arranged together. Further, any combination of the single absorber bodies one to four 14, 16, 18, 24 is possible.

Claims

1. Connector (2) for an Injector (4) comprising a socket (8), a flange (6) and a junction area (10), the junction area (10) coupling the flange (6) with the socket (8), the socket (8) comprising one or more electric conductors (11) and an absorber, which mass exceeds the mass of the one or respectively more electric conductors (11) and which comprises a density, which exceeds the density of the main material of the connector (2).
2. Connector (2) in accordance with claim 1 with the absorber comprising a first absorber body (14) which is surrounded by the connector (2) material in the junction area (10).
3. Connector (2) in accordance with one of the preceding claims with the absorber comprising a second absorber body (16), which is arranged in an absorb-

er-recess (12) of the connector (2) in the junction area (10).

4. Connector (2) in accordance with one of the preceding claims with the absorber comprising a third absorber body (18), which is arranged in a groove (20) of the connector (2) in the junction area (10). 5
5. Connector (2) in accordance with one of the preceding claims with the absorber comprising a fourth absorber body (24) having a form, enabling a positive connection of the fourth absorber body (24) to the connector (2) in the junction area (10). 10
6. Connector (2) in accordance with one of the preceding claims with the absorber comprising carbide. 15
7. Connector (2) in accordance with one of the preceding claims with the absorber comprising lead. 20
8. Connector (2) in accordance with one of the preceding claims with the absorber comprising steel.
9. Connector (2) in accordance with one of the preceding claims with the total absorber mass having about 5% to 15% of the total mass of the connector (2) and the injector (4). 25

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FIG 1

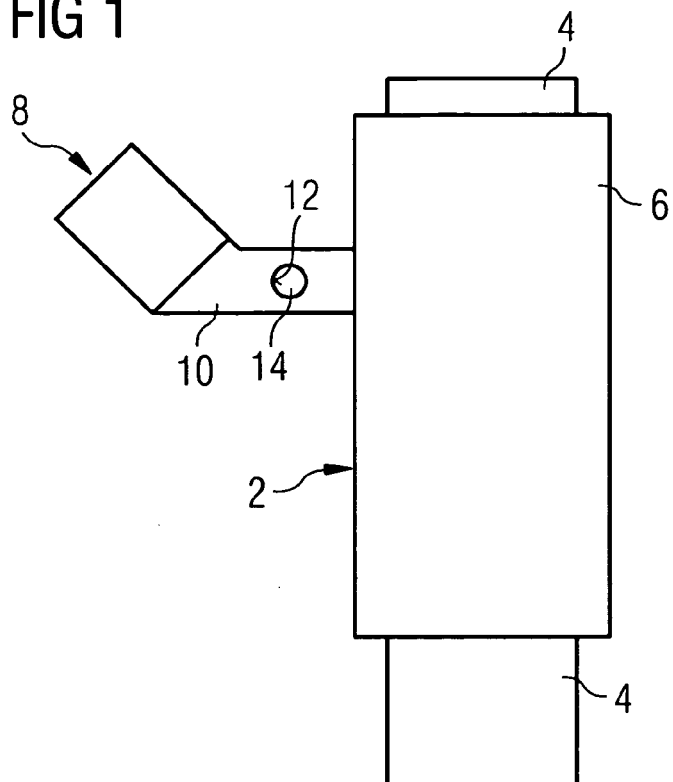


FIG 2

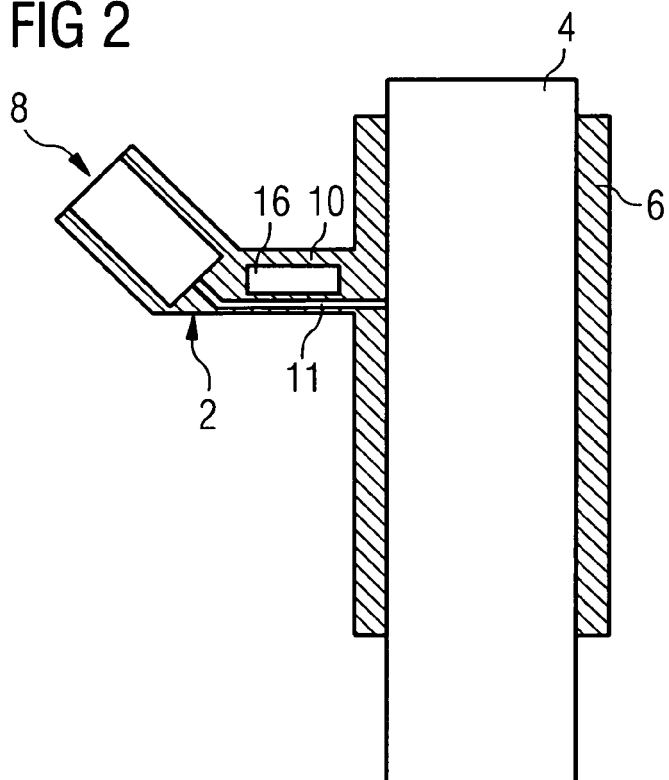


FIG 3

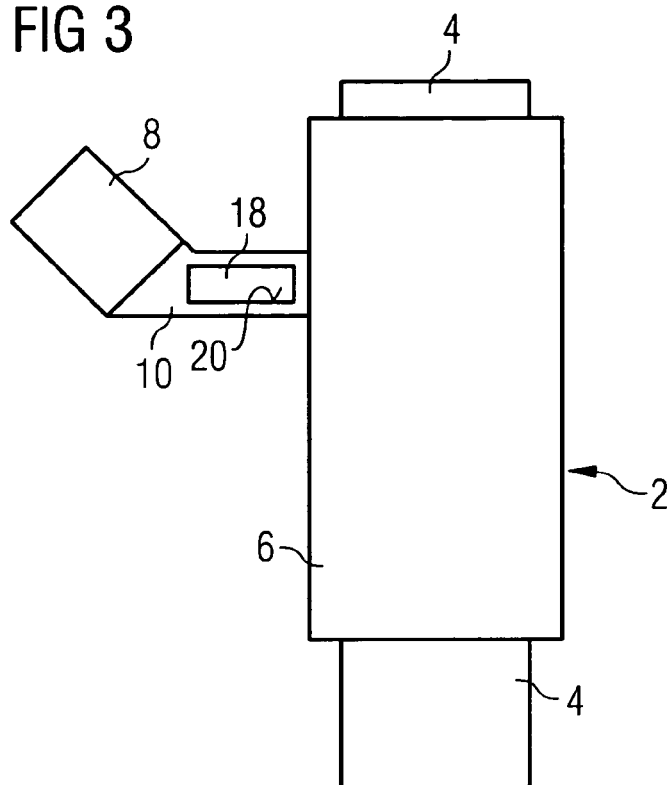


FIG 4

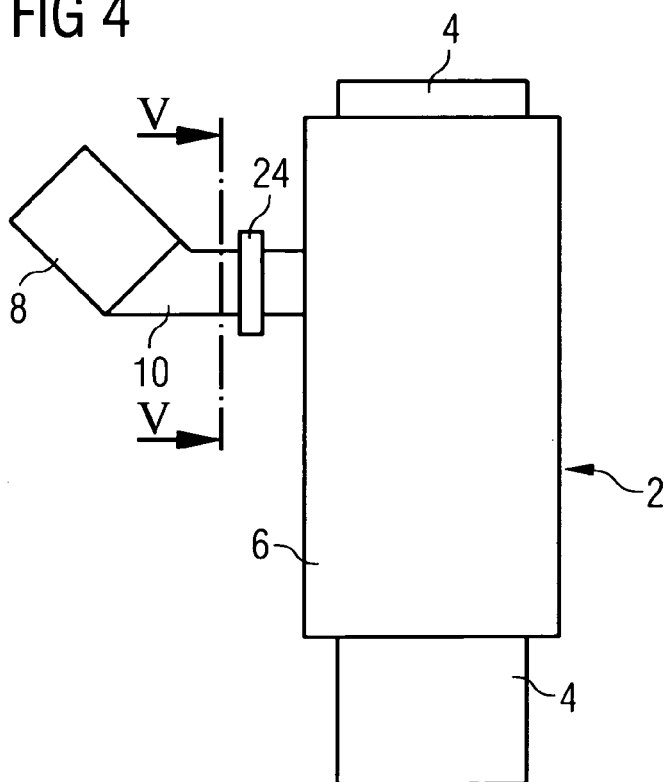
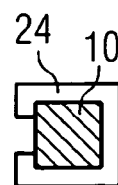


FIG 5





European Patent
Office

EUROPEAN SEARCH REPORT

Application Number
EP 05 00 9254

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The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 26 July 2005	Examiner Wagner, A
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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EPO FORM 1503 03/82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
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