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(54) **System for fixing an injector to the engine head of a vehicle, method for fixing the injector, and manufacturing method of the system**

(57) The present invention refers to a method for fixing an injector to the engine head of a vehicle. The injector (4) comprises two recesses (53) on the opposite sides, and the head comprises a first hole (43) for inserting the injector, and two threaded holes (24) that are lateral with respect to said first hole. The fixing system comprises two plates (21, 22) equipped with central hole (23), configured so that one of their borders (51) directly projects on a lower edge (52) of said recesses placed opposite to them, and so that their central hole (23) corresponds to a respective hole of said two lateral threaded holes (24) in order to be screwed on said head.

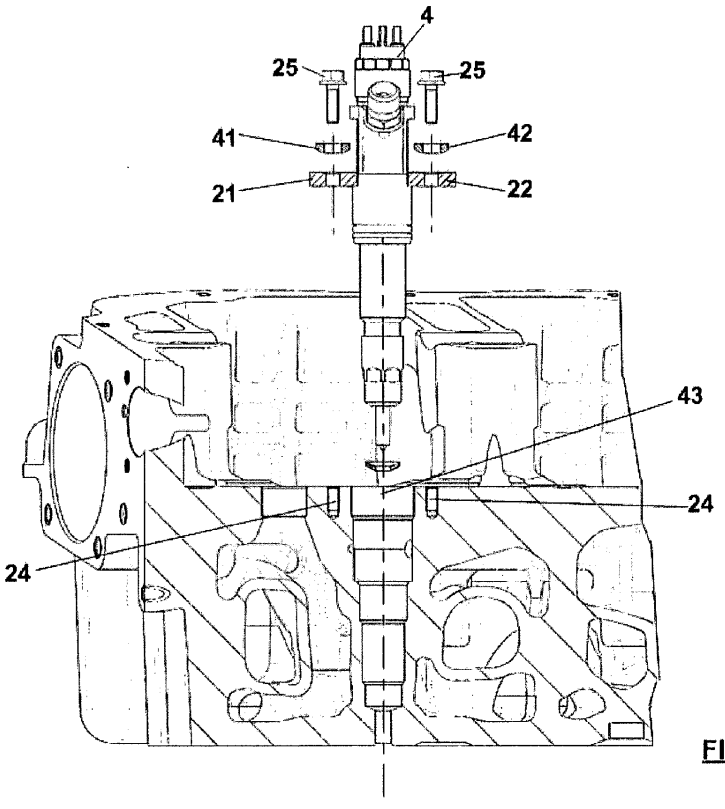

FIG. 4

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Description

Application field of the invention

[0001] The present invention refers to a system for fixing an injector to the engine head of a vehicle, to a method for fixing the injector, and to a manufacturing method of the system.

Description of the prior art

[0002] The use of injectors in engines with different configurations of the propulsion systems is known in the art. Injectors are critical devices for the correct functioning of the system, and their correct usage and installation demands great attention: they are normally positioned on the engine head, near the intake and the exhaust valves and openings of the combustion chamber.

[0003] The injector must be correctly centered and tightened on the engine head, being firmly fixed and tight, since the internal pressure of the combustion chamber is very high (e.g. with peaks of 220 bars).

[0004] It is very important that the tightening is linear and axial, above all because the seal washer, usually made of copper and being truncated cone shaped, that is present at the nozzle at the end of the injector directly on the head, should be uniformly pressed to avoid leaking. The washer is made of soft material, for example of copper, whose surface should get deformed in a uniform way in order to ensure the seal, adapting to possible irregularities of the head surface.

[0005] Some solutions for fixing the injector to the head to counterbalance the draft differences on the two sides are known in the art.

[0006] For example the injector may be fixed by means of a flange surrounding the injector, which, in this case, is of the type with cylindrical body and with the fuel supply connector inside the head. The flange is inserted on the injector body from the top, and is fixed to the head by means of two screws at the opposite ends of the flange itself. The tightening pressure on the injector is exerted by the two lateral extensions of the flange that connect the ends of the flange itself that house the screws. The two lateral extensions are engaged on appropriate recesses on the two sides of the injector.

[0007] This solution has criticalities due to the generation of lateral thrusts on the body of the injector, due to the lateral connection of the fuel supply, which imposes an increase of the dimensions of the injector body, and therefore also of the flange, which may not be used with different injectors, for example having an external fuel supply connector, since the insertion from the top would not be possible.

[0008] According to another known solution, with reference to the figures 1.1, ...1.4, a bracket 1 is fixed in correspondence of its center to the engine head 2 by means of a screw 3. The bracket rests on a ball joint placed at the farthest end with respect to the injector 4, and rests on the injector on a circle arc with a U-shaped bracket with two cradle-shaped lateral extensions 5, in order to ensure a uniform pressure on both sides of the injector. The latter has two recesses 6 on its lateral opposite sides, whose lower edge is the contact surface for the two lateral extensions of the bracket. The contact lines of the bracket with the head and the injector are rounded (7) in order to guarantee a more certain positioning of the contact points realized in a single point, in correspondence of the center of the rounded lines

[0009] The force F generated by the tightening torque of the screw 3 is distributed on the constraining reactions R1 on the head and R2 on the injector.

[0010] This type of bracket is very expensive, being made of a special material (sintered steel), and occupies a remarkable space on the head.

Summary of the invention

[0011] Therefore the aim of the present invention is to provide a system for fixing an injector to the engine head of a vehicle, a method for fixing the injector, and a manufacturing method of the system suitable to overcome the drawbacks set forth above.

[0012] It is object of the present invention, in accordance to claim 1, a system of fixing an injector to the engine head of a vehicle, said injector comprising two recesses on its opposite sides, said head comprising a first hole for inserting the injector and two lateral threaded holes with respect to said first hole, characterized in that it comprises two plates equipped with a central hole, configured so that one of their edges directly projects on a lower edge of said recesses positioned in front of them, and so that their central hole corresponds to a respective hole of said lateral threaded holes (24) for being screwed on said head.

[0013] It is also an object of the present invention a method for fixing an injector to the engine head of a vehicle, in accordance to claim 5, suitable to use the fixing system set forth above.

[0014] Further objects of the present invention are methods for realizing plates, injector, and engine head, in accordance to claims 7, 8 and 12 respectively, suitable to be used in the fixing system set forth above.

[0015] The dependent claims describe preferred embodiments of the present invention, and are an integral part of the present description.

Brief description of the Figures

[0016] Further purposes and advantages of the present invention will become clear from the following detailed description of a preferred embodiment (and its alternative embodiments) and the drawings that are attached hereto, which are merely illustrative and non-limitative, in which:

figures 1.1, ...1.4 show a fixing system of the type

known in the art;
figures 2.1, ..2.2 show a first alternative embodiment of the fixing system that is object of the present invention;
figures 3.1, 3.2 show a second alternative embodiment of the fixing system that is object of the present invention;
figures 4 and 5 show cross-sectional views of the engine head wherein the parts forming the fixing system that is object of the invention are shown, respectively in an exploded view and in a view where they are inserted in the head, with the injector;
figures 5.1 and 5.2 show magnified details of figure 5;
figures 6.1 and 6.2 show two alternative embodiments of an injector suitable to be used with the system that is object of the invention.

[0017] In the figures the same reference numbers and letters identify the same elements or components.

Detailed description of preferred embodiments of the invention

[0018] In a first alternative embodiment of the fixing system object of the invention, with reference to figures 2.1, 2.2, two plates or brackets 21, 22, with a central hole 23, correspond to their respective threaded holes 24 on the engine head, in a position that is near the hole 43 for inserting the injector and is symmetric with respect to the latter, in order to be screwed by means of screws 25.

[0019] The plates are preferably parallelepiped, rectangular or square, having a substantially constant thickness, for example between 5 and 7 mm, preferably made of blank sheet metal.

[0020] They may be symmetric, in order to be indifferently used on both sides of the injector, without needing a particular orientation during assembling.

[0021] The central hole 23 has a spherical countersunk edge 23' with a concave upper part, in order to house a washer 41, 42 whose edge is reciprocally spherical, in order to facilitate the centering of the screw 25, and to remove possible verticality errors of the holes, in order to ensure the correct support of the screw, both during the application of the tightening torque, both during the functioning (fig. 5.1).

[0022] An edge of the plate, for example the edge 51 of the plate 21 (fig. 5.1), is preferably shaped as to engage with the lower edge 52 of a recess 53 of the injector 4. Thus the distance between the edge 51 and the hole 23 must be appropriately dimensioned. In the figure, the deformation of the border of the plate 51 is merely illustrative, in order to show the type of stress applied to it during tightening.

[0023] The lower edge 52 of the recess 53 of the injector where the plate acts, once the injector is inserted in the hole 43 of the head, has a position such that its level is substantially equal to the level 54 of the head where the plate is screwed. Preferably the edge 52 of the injector has a positive difference of level Δ from 0 to 0.7 mm with respect to the level 54 of the head, in order to ensure that the deformations of the system having such dimensions remain in the elastic field.

[0024] Thus the injector comprises two recesses 53 in symmetric position on its body, whose dimensioning must be such that the lower edge 52 is at a level equal or slightly higher than the level 54 of the head.

[0025] On the engine head, two threaded holes 24 must be provided at the two sides of the hole 43 where the injector is inserted, being appropriately distanced from the latter, in order to house the tightening screws 25 of the plates.

[0026] As regards the method for fixing the injector to the head, it is necessary to ensure that the load acting on the body of the injector when it is tightened on the head, and during the functioning of the engine, is perfectly vertical, in order to ensure the integrity of the injector itself, which is crucial to stand the pressures in the combustion chamber.

[0027] This is necessary above all because, as said above, the seal washer 56 (fig. 5.2), placed around the nozzle 57 of the injector, between the point 58 of the latter and the hole 59 of the head from which the nozzle projects toward the combustion chamber, should be uniformly pressed on all its surface.

[0028] Thus the elasticity of the washer, usually made of copper, if fully exploited in order to perfectly adapt to the body of the injector from one side, and to the edge of the hole of the head from the other side.

[0029] For this purpose, the tightening devices preferably comprise a double tightening torque motor of the type known, which ensures that the two tightening actions of the two plates are equal and simultaneous, with automatic and continuous control, and instant and simultaneous measuring of the applied tightening torque.

[0030] The tightening torque to be applied is similar to the one applied in the known solutions (13 - 15 Nm) distributed between the two screws, thus each screw may be under-dimensioned with respect to the known solution with a single screw.

[0031] According to the fixing method, first the washer 56 and then the injector 4 are inserted in the hole 43 on the engine head, being oriented such that the two recesses 53 face the holes 24 of the head for fixing the plates.

[0032] Then the plates 21, 22 are positioned in correspondence of the holes 24 on the head, so that their edge 51 projects on the recess 53 of the injector, and the screws 25 with their respective washer 42 are placed in the holes 23 of the plates.

[0033] Thus the screws 25 are screwed and tightened with an appropriate torque, as described above.

[0034] In a first alternative embodiment (fig. 6.1) the lower edge 52' of the recess 53 of the injector has a flat shape, in order to provide a continuous contact surface with the plate 21.

[0035] In a second alternative embodiment (fig. 6.2) the lower edge 52" has a curved or convex shape, in

order to provide a single contact point with the plate, instead of a continuous surface.

[0036] The first alternative embodiment allows a easier execution of the manufacturing process of the injector sides with respect to the second alternative embodiment; the first alternative embodiment, however, requires stricter verticality tolerances on the head, while said tolerances are at least partially compensated by using the second alternative embodiment.

[0037] In an alternative embodiment (figures 3.1, 3.2) the two plates are put together into a single component 31 with a lateral connector or bridge 32, in order to facilitate the positioning of the two plates during the assembling.

[0038] The connector connects opposite corners of the plates and is shaped in such a way that, when the component 31 is inserted on the head, it is laterally placed with respect to the injector.

[0039] In case of an automatic assembling, for example by means of the torque motor described above, this second solution with the bridge is totally equivalent with respect to the one with two separate plates: the connector does not work and it does not have a primary function, but the one of facilitating the positioning.

[0040] In case of a mounting at least partially by hand, the solution with the bridge may also have the function of releasing the possible differences of pressure on the two plates during the tightening.

[0041] Preferably the position of the two holes 24 on the head is not changed, so that each one of the two alternative embodiments, with or without the bridge, may be indifferently used during the assembling.

[0042] The positioning of the injector on the head with respect to the combustion chamber depends on the type of the engine itself.

[0043] A correct use of the fixing system that is object of the invention only requires an appropriate shape of the head around the hole that houses the injector, in order to correctly house the anchorage plates.

[0044] In particular, the surface of the head around the point where the injector is inserted must be perpendicular with respect to the latter, and flat.

[0045] It is also object of the invention a method for manufacturing the plates so that they are shaped according to any of the two variants described above.

[0046] According to the invention, a method is adopted for manufacturing the injector in order to realize the recesses 53 as described above, so that their lower edge (52', 52") is at an appropriate level once the injector is inserted in the head. The edge 52 of the injector has preferably a positive difference of level Δ from 0 a 0,7 mm with respect to the level 54 of the head.

[0047] According to the invention, a method is adopted for manufacturing the engine head, suitable to provide the two threaded holes 24 at the two opposite sides of the hole 43 where the injector is inserted, being appropriately distanced from the latter, in order to house the tightening screws 25 of the plates.

[0048] It will be apparent to the person skilled in the art that further alternative and equivalent embodiments of the invention can be conceived and reduced to practice without departing from the scope of the invention.

[0049] The advantages deriving from the application of this invention are evident.

[0050] In particular the manufacturing cost of the plates remarkably lower, in addition to a reduction of the occupied space on the engine head with respect to the solutions known in the art.

[0051] The fixing system may be indifferently used with any type of injectors, in particular both with the ones equipped with internal fuel supply connector and with the ones with external connector.

[0052] From the description set forth above it will be possible for the person skilled in the art to embody the invention with no need of describing further construction details.

Claims

1. System for fixing an injector to the engine head of a vehicle, said injector (4) comprising two recesses (53) on its opposite sides, said head comprising a first hole (43) for inserting the injector, and two threaded holes (24) that are lateral with respect to said first hole,
   characterized in that it comprises two plates (21, 22) equipped with central hole (23), configured so that one of their edges (51) directly projects on a lower edge (52) of said recesses placed in front of them, and so that their central hole (23) corresponds to a respective hole of said two lateral threaded holes (24) in order to be screwed on said head.

2. Fixing system as in claim 1, wherein said plates are connected by a lateral connector or bridge (32), which connects the opposite corners of said plates.

3. System for fixing as in claim 1 or 2, wherein said plates (21, 22) are parallelepiped, rectangular, or square with a substantially constant thickness, preferably made of blank sheet metal.

4. Fixing system as in claim 1, wherein said central hole (23) has an upper countersunk edge (23'), configured in order to house a washer (41, 42) having a reciprocally countersunk edge, and to facilitate the centering of a screw (25) for said screwing.

5. Method for fixing an injector to the engine head of a vehicle, suitable to use the fixing system according to any of the previous claims, comprising the following steps:

   - inserting the injector (4) in said first hole (43), being oriented so that said two recesses (53)

face said two lateral threaded holes (24);
- positioning said plates (21, 22) so that the central hole (23) corresponds with said two holes (24), and so that their edge (51) projects on the respective recess (53) of the injector;
- placing the screws (25) with their respective washers (41, 42) in the holes of the plates (23) and of the head (24);
- simultaneously screwing and tightening said screw (25).

6. Fixing method as in claim 5, wherein said screwing and tightening of the screws (25) is performed by a double tightening torque motor, with automatic and continuous control, and instant and simultaneous measure of the applied tightening torque.

7. Method for manufacturing plates for a system for fixing an injector to the engine head of a vehicle, comprising steps suitable to shape said plates according to any of the claims from 1 to 4.

8. Method for manufacturing an injector suitable to be used in a fixing system to the engine head of a vehicle according to any of the claims from 1 to 4, comprising a step for realizing said two recesses (53) on its opposite sides, so that a lower edge (52', 52") of said recesses is at a level substantially equal to a level (54) of the head in the application area of said plates, when said injector is inserted in the head.

9. Method for manufacturing an injector as in claim 8, wherein said level of the lower edge (52', 52") has a positive difference of level (Δ) comprised between 0 and 0.7 mm with respect to said level (54) of the head, when it is inserted in the latter.

10. Method for manufacturing an injector as in claim 9, wherein said lower edge (52') has a flat shape.

11. Method for manufacturing an injector as in claim 9, wherein said lower edge (52') has a curve or convex shape.

12. Method for manufacturing an engine head of a vehicle, said head being suitable for being used in a fixing system of an injector according to any of the claims from 1 to 4, the method comprising a step for realizing said threaded holes (24) at the two opposite sides of the central hole (23) wherein the injector is inserted, at a distance from the latter such that it can correctly house the tightening screws (25) of the plates, and further comprising a realization step of the surface around said central hole (23) perpendicular with respect to the latter, and flat.

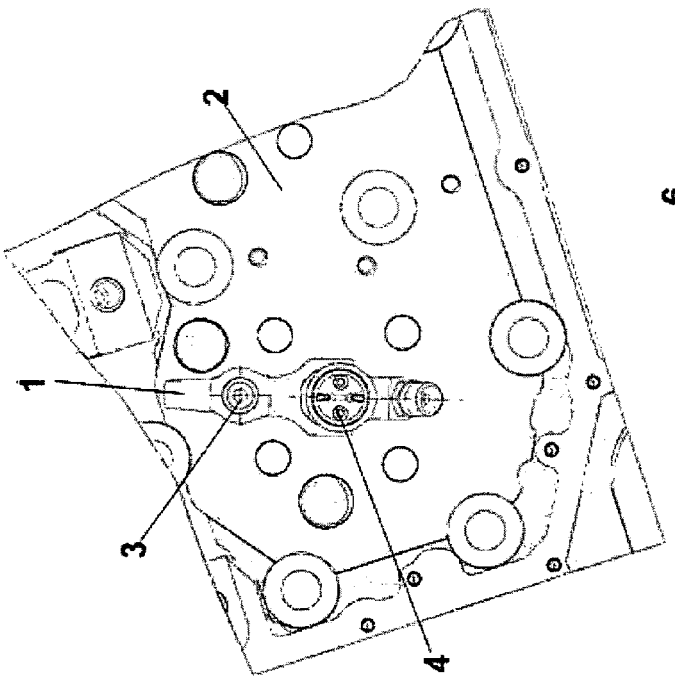


FIG. 1.1

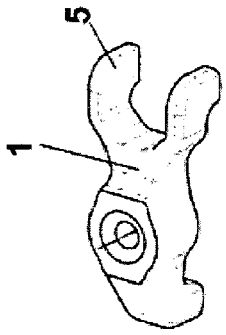


FIG. 1.2

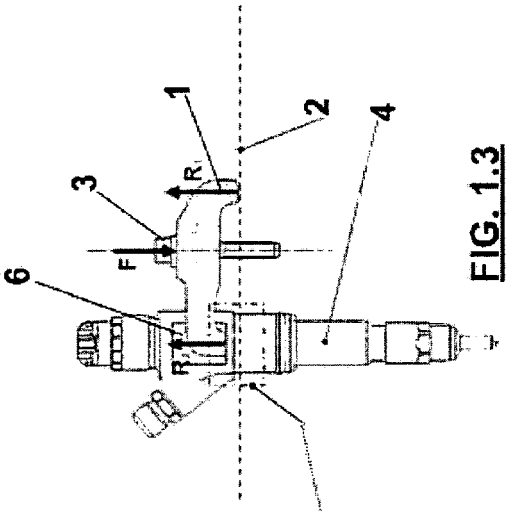


FIG. 1.3

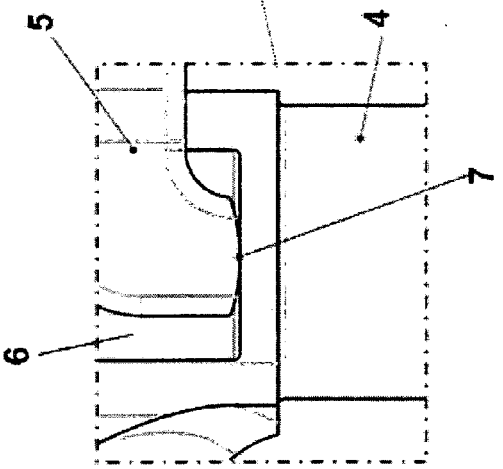


FIG. 1.4

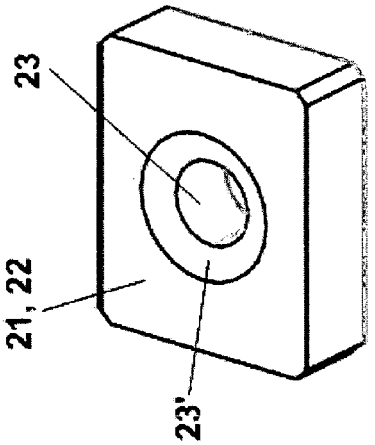


FIG. 2.2

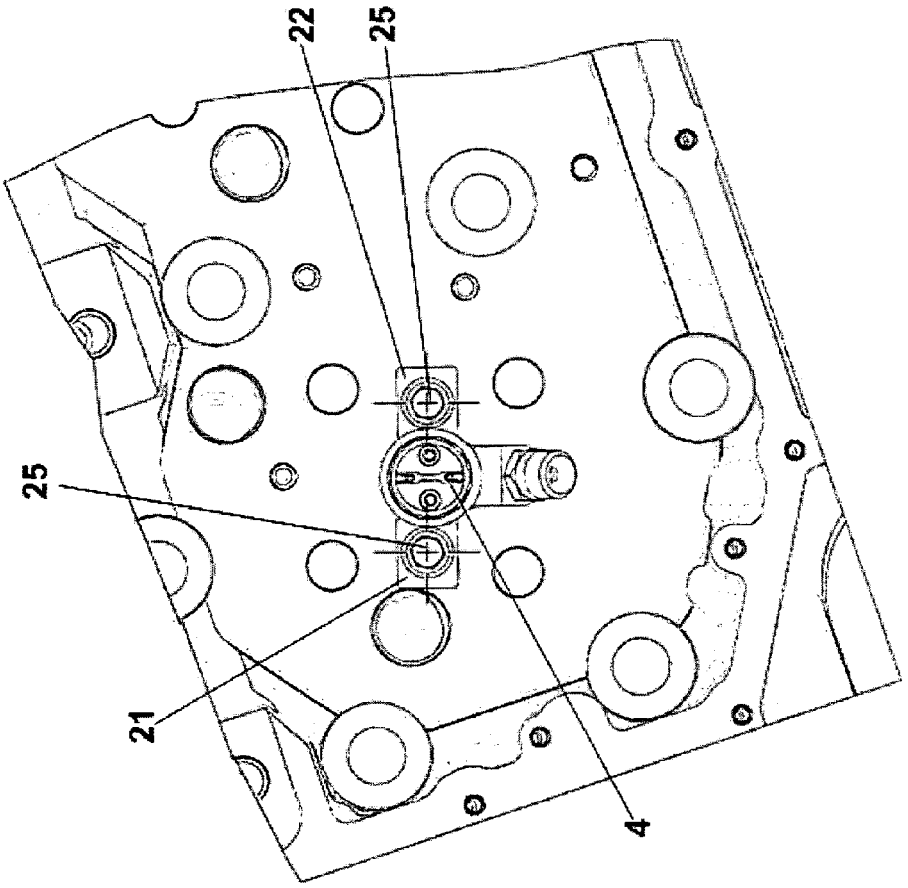


FIG. 2.1

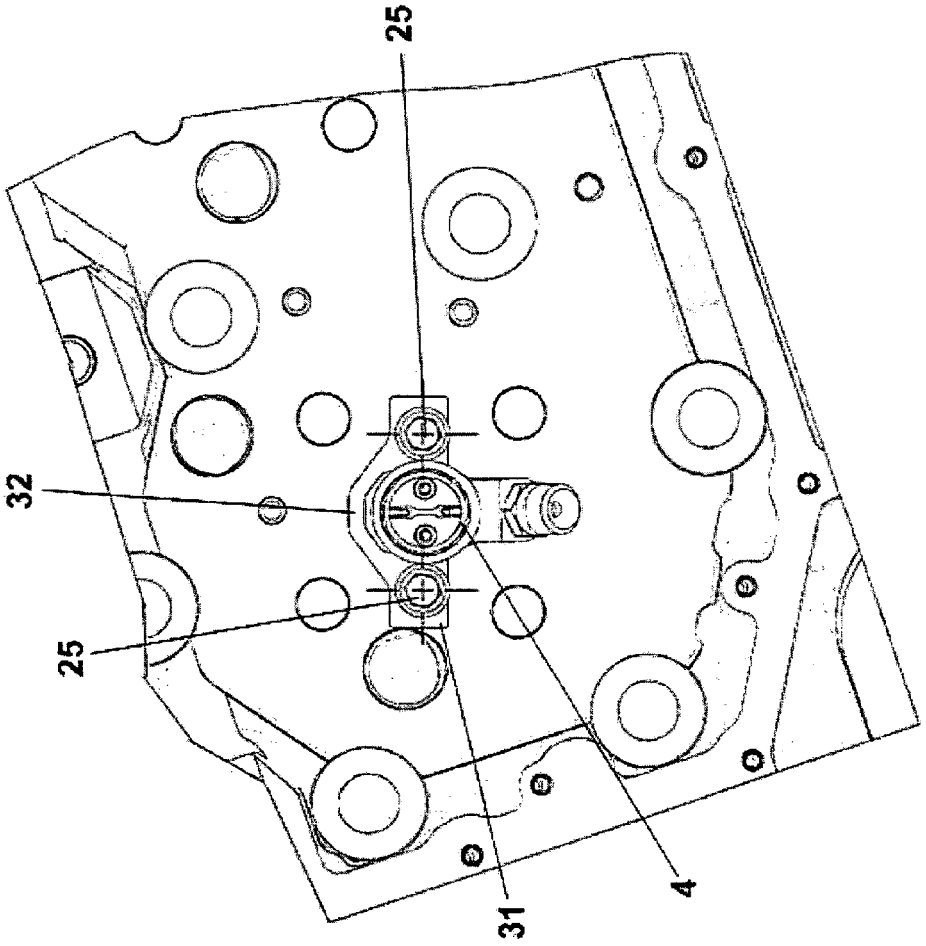


FIG. 3.1

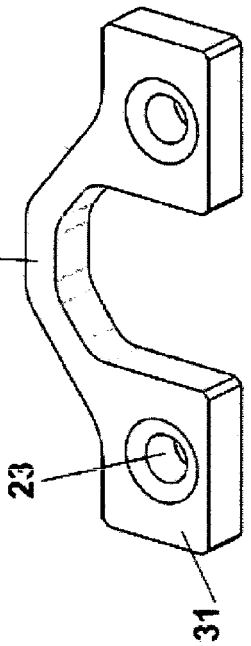


FIG. 3.2

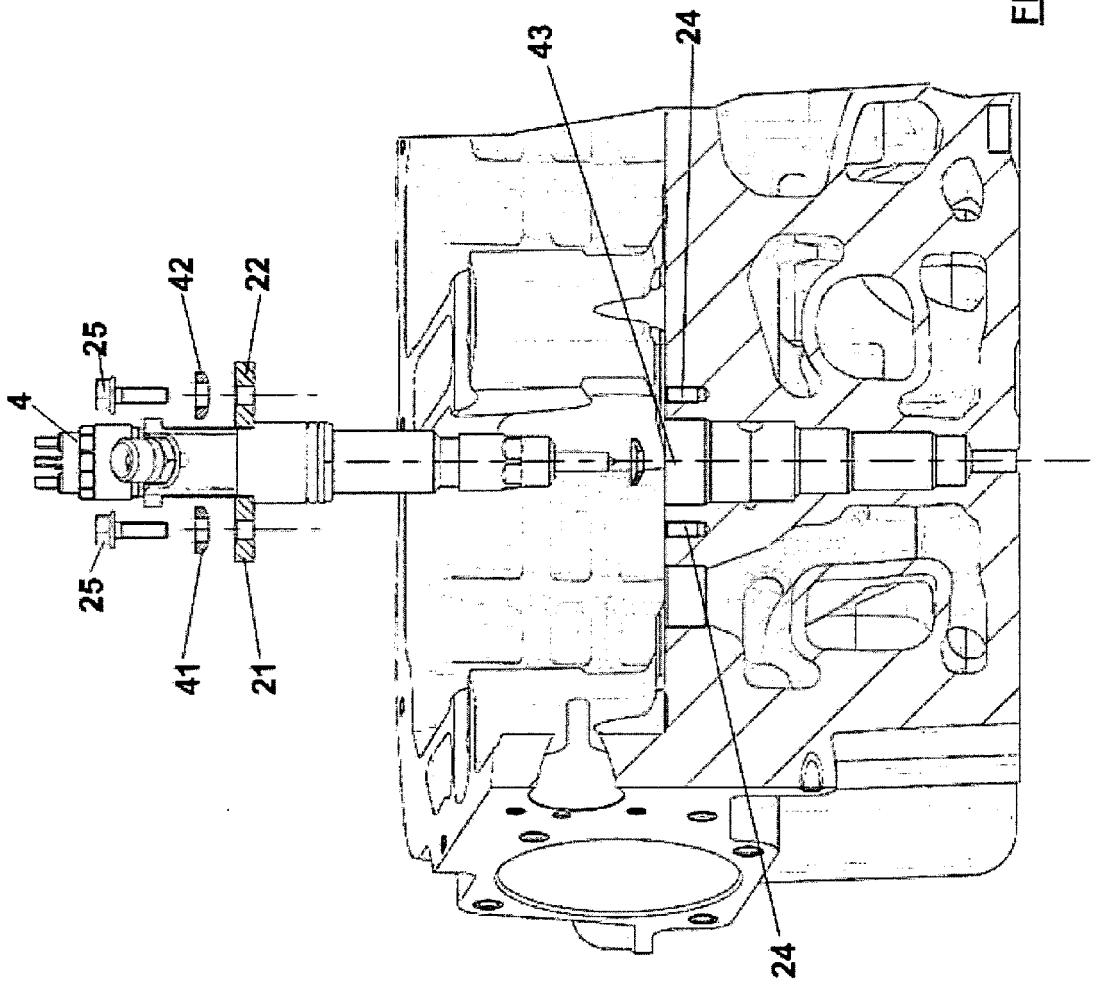


FIG. 4

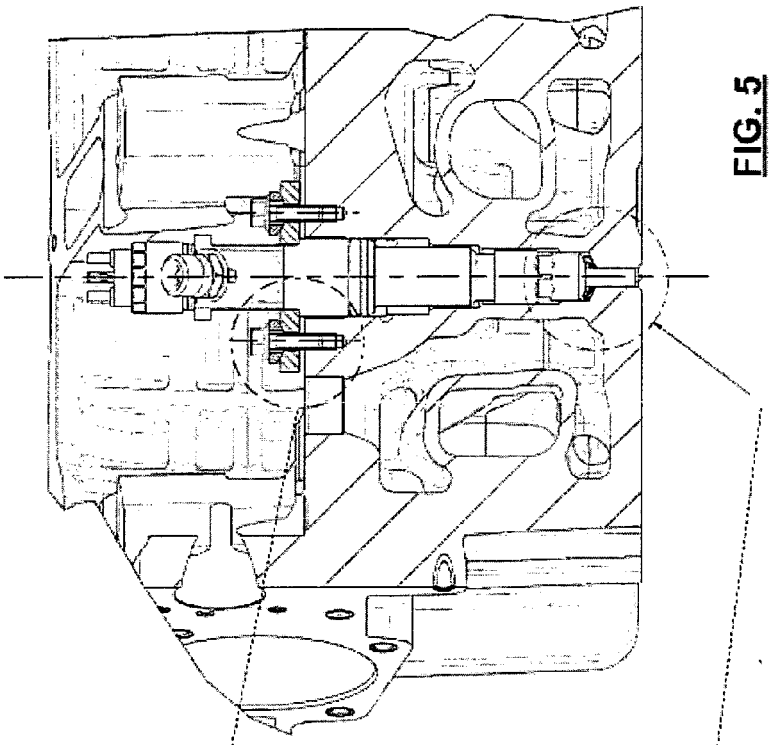


FIG. 5

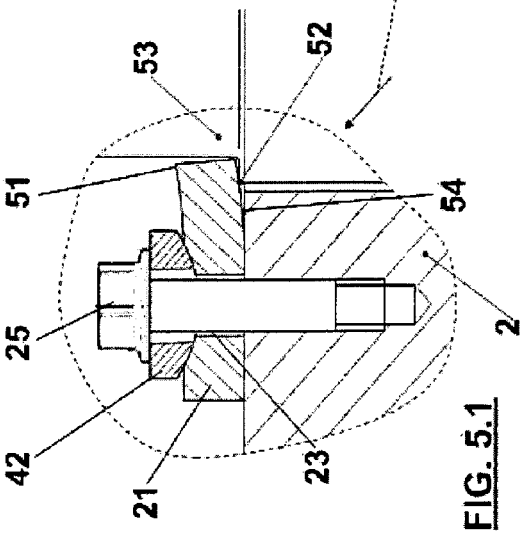


FIG. 5.1

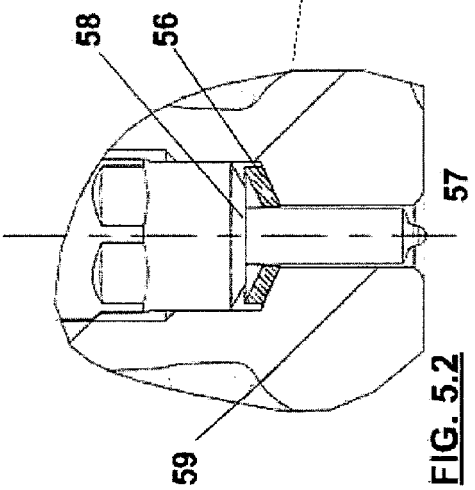
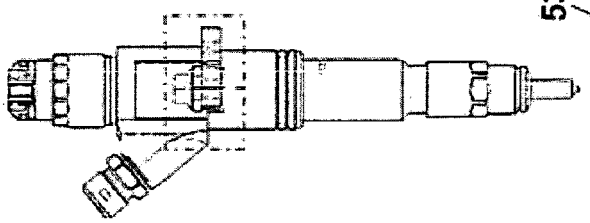


FIG. 5.2



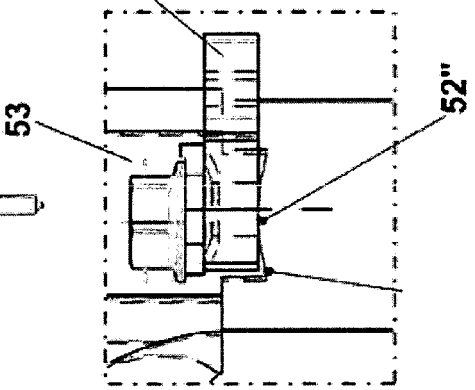
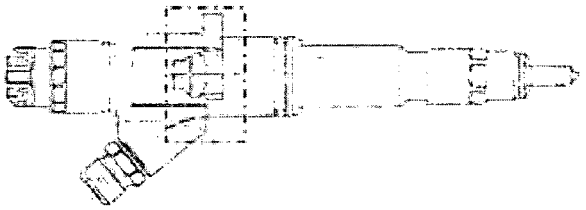


FIG. 6.2



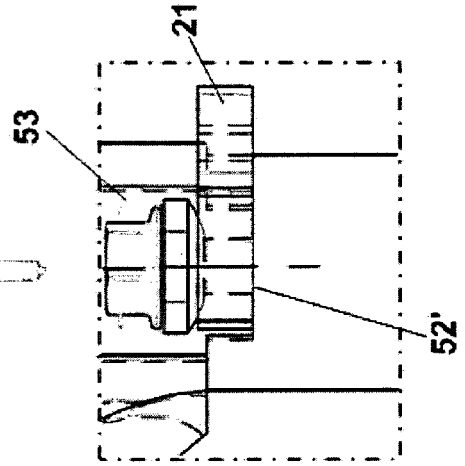


FIG. 6.1

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EUROPEAN SEARCH REPORT

Application Number
EP 10 42 5384

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	EP 0 735 267 A2 (BAYERISCHE MOTOREN WERKE AG [DE] BAYERISCHE MOTOREN WERKE AG) 2 October 1996 (1996-10-02) * column 2, lines 35-54; figures 1-3 *	1-6,8-12	INV. F02M61/14
X	DE 21 09 727 A1 (ROBERT BOSCH) 14 September 1972 (1972-09-14) * page 3, paragraph 4 - page 4, paragraph 2; figures 1-3 *	1-6,8-12	
X	FR 2 211 600 A1 (BOSCH GMBH ROBERT [DE]) 19 July 1974 (1974-07-19) * page 2, lines 11-27; figures 1-3 *	1,2,8-10	
X	WO 84/02161 A1 (PERKINS ENGINES GROUP [GB]) 7 June 1984 (1984-06-07) * page 3, paragraph 2 - page 4, paragraph 4; figures 1-3 *	1,2	
X	DE 88 14 249 U1 (VOEST ALPINE) 19 January 1989 (1989-01-19) * page 3, paragraphs 2,3; figures 1,2 *	1	

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	15 April 2011	Etschmann, Georg

CATEGORY OF CITED DOCUMENTS

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1

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 10 42 5384

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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