



(11) EP 1 918 572 A1

(12)

## EUROPEAN PATENT APPLICATION

(43) Date of publication:  
07.05.2008 Bulletin 2008/19

(51) Int Cl.:  
*F02M 55/02* (2006.01)      *F02M 69/46* (2006.01)

(21) Application number: 06022239.5

(22) Date of filing: 24.10.2006

(84) Designated Contracting States:

AT BE BG CH CY CZ DE DK EE ES FI FR GB GR  
HU IE IS IT LI LT LU LV MC NL PL PT RO SE SI  
SK TR

Designated Extension States:

AL BA HR MK RS

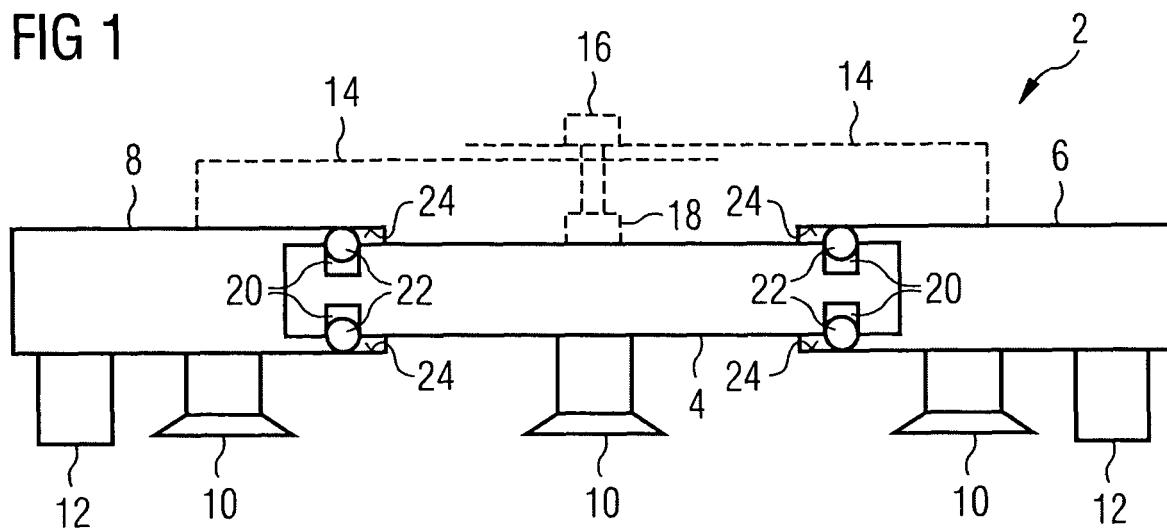
(71) Applicant: SIEMENS AKTIENGESELLSCHAFT  
80333 München (DE)

(72) Inventor: Liuzzo, Antonio  
57014 Collesalvetti (IT)

### (54) Fuel rail

(57) A Fuel rail (2) for an internal combustion engine comprises a first and a second side-piece (6, 8) and a middle-piece (4). The middle-piece (4) is arranged between the first and the second side-piece (6, 8) and is movable relative to the first and the second side-piece (6, 8). The middle-piece (4) is hydraulically and sealingly coupled to

the first and the second side-piece (6, 8). At least one connection (10) is arranged at each of the pieces of the fuel rail (2) for connecting each piece of the fuel rail (2) to at least one injection valve of the internal combustion engine. An inlet is arranged at the fuel rail (2) for supplying the fuel rail (2) with fuel.



## Description

**[0001]** The invention relates to a fuel rail for an internal combustion engine.

**[0002]** US 4,457,280 discloses a fuel rail assembly for holding a plurality of electromechanical fuel injector elements in aligned positions on an internal combustion engine. The beam portion of the fuel rail is comprised of two elongated manifold members with overlapping sides brazed together. One of the manifold members has a series of planar sides with apertures for retaining and precisely aligning a plurality of injector cups. To prevent vapor locks the injector cups are mounted with their cavities in close proximity to the inside of the fuel rail. The fuel rail is structurally designed for ease of assembly and to provide adequate rigidity without excessive weight.

**[0003]** It is an object of the invention to create a fuel rail for an internal combustion engine which enables a simple use of the fuel rail for different internal combustion engines.

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

**[0005]** The invention is distinguished by a fuel rail for an internal combustion engine. The fuel rail comprises a first and a second side-piece, a middle-piece, at least one connection at each of the pieces, and an inlet for supplying the fuel rail with fuel. The middle-piece is arranged between the first and the second side-piece moveable relative to the first and the second side-piece. The middle-piece is hydraulically and sealingly coupled to the first and the second side-piece. The connections are arranged for connecting each piece of the fuel rail to at least one injection valve of the internal combustion engine.

**[0006]** The movability of the middle-piece relative to the side-pieces enables to use the fuel rail for different internal combustion engines. In particular, the movability of the middle-piece relative to the side-pieces enables to use the fuel rail for different internal combustion engines which have different distances from one injection valve of the internal combustion engine to another injection valve of the internal combustion engine.

**[0007]** In an advantageous embodiment of the fuel rail the middle-piece is partially arranged in the first and/or the second side-piece. This contributes to hydraulically and sealingly coupling the middle-piece to the side-pieces in an easy way.

**[0008]** In a further advantageous embodiment of the fuel rail the first and/or second side-piece is partially arranged in the middle-piece. This contributes to hydraulically and sealingly coupling the middle-piece to the side-pieces in an easy way.

**[0009]** In a further advantageous embodiment of the fuel rail the middle-piece and/or the first and/or the second side-piece comprises a bracket for fixing the fuel rail to the internal combustion engine. This enables to fix the fuel rail to the internal combustion engine in an easy way.

Further, this may contribute to stabilize the fuel rail.

**[0010]** In a further advantageous embodiment of the fuel rail the fuel rail comprises at least one supporting bracket for fixing the middle-piece to the first and/or the second side-piece. This contributes to stabilize the fuel rail.

**[0011]** In a further advantageous embodiment of the fuel rail the middle-piece and the first and/or the second side-piece comprise an overlapping area. A surface of the overlapping area comprises a given roughness for sealingly coupling the middle-piece to the first and, respectively, the second side-piece. This very effectively contributes to sealingly coupling the middle-piece to the first and, respectively, the second side-piece. Preferably, a sealing is arranged between the middle-piece and the side-pieces at the surface of the overlapping area. The sealing and the given roughness of the surface in the overlapping area may contribute very effectively to the proper sealed coupling.

**[0012]** The invention is explained in the following with the help of schematic drawings.

**[0013]** These are as follows:

figure 1 a first embodiment of a fuel rail,

25

figure 2 a second embodiment of the fuel rail,

figure 3 a third embodiment of the fuel rail.

**[0014]** Elements with the same design or function that appear in the different illustrations are identified by the same reference characters.

**[0015]** A fuel rail 2 (figure 1) comprises a middle-piece 4, a first side-piece 6 and a second side-piece 8. Preferably, the fuel rail 2 is arranged at an internal combustion engine. The fuel rail 2 is arranged for storing fuel with a given pressure and to supply at least one, preferably more injection valves of the internal combustion engine with fluid at the given pressure.

**[0016]** Each of the pieces of the fuel rail 2 comprises at least one connection 10 for connecting the fuel rail 2 to the injection valves. The first and/or the second side-piece 6, 8 comprise a bracket 12. The brackets 12 are arranged for fixing the fuel rail 2 to the internal combustion engine. Alternatively, the fuel rail 2 may comprise different devices for fixing the fuel rail 2 to the internal combustion engine.

**[0017]** For fixing the middle-piece 4 to the first and/or the second side-piece 6, 8, the middle-piece 4 and/or the first and/or the second side-piece 6, 8 may comprise a supporting bracket 14 which may be fixed to the middle-piece by a screw 16 and a corresponding thread 18 at the middle-piece 4 and, respectively, at the first and/or the second side-piece 6, 8. Preferably, the supporting bracket 14 comprises a slot for taking in the screw 16. To fix the middle-piece 4 to the first and/or the second side-piece 6, 8 may contribute to stabilize the fuel rail.

**[0018]** Preferably, the middle-piece 4 is at least par-

tially arranged in the first and/or second side-piece 6, 8. The middle-piece 4 is arranged in the first and/or second side-piece 6, 8 in such a way that it is movable relative to the first and/or the second side-piece 6, 8. In particular, the middle-piece 4 is movable relative to the first and/or the second side-piece 6, 8 in a direction which is parallel to the long side of the middle-piece 4. If the pieces of the fuel rail 2 are for example tube-shaped, the middle-piece 4 is movable relative to the first and/or the second side-piece 6, 8 in a direction parallel to an axis of the middle-piece 4. Alternatively, the pieces of the fuel rail 2 may be shaped rectangular.

**[0019]** For sealingly and hydraulically coupling the middle-piece 4 to the first and/or the second side-piece 6, 8 the middle-piece 4 may comprise a recess 20 for partially taking in a sealing 22. Preferably, the recess 20 comprises a groove at an outer shell of the middle-piece 4 next to an axial end of the middle-piece 4. If the middle-piece 4 and the first and the second side-piece 6, 8 are tube-shaped, the sealing 22 preferably is an O-ring. If the middle-piece 4 and the first and the second side-piece 6, 8 are not tube shaped, for example rectangular, the sealing 22 has a corresponding form which guarantees a hydraulically sealed coupling of the middle-piece 4 to the first and/or the second side-piece 6, 8.

**[0020]** The middle-piece 4 and the side-pieces comprise an overlapping area. The sealing 22 is arranged in the overlapping area. Preferably, a surface of the overlapping area, at which the sealing 22 is arranged, comprises a given roughness. The given roughness and the sealing 22 may contribute to improve the sealing of the coupling between the middle-piece 4 and the side-pieces.

**[0021]** If the fuel rail 2 is arranged at an internal combustion engine with three injection valves, the middle-piece 4 is adjusted relative to the first and the second side-piece 6, 8 in such a way that the connections 10 fit to the positions of the injection valves of the internal combustion engine. The fuel rail 2 preferably is adjusted by moving the middle-piece 4 relative to the first and/or the second side-piece 6, 8. If the internal combustion engine comprises six or twelve injection valves two or, respectively, four fuel rails 2 may be combined. In an alternative embodiment the fuel rail 2 may comprise further side-pieces for adjusting the fuel rail 2 to an internal combustion engine with more than three injection valves.

**[0022]** In a second embodiment of the fuel rail 2 the first and/or the second side-piece 6, 8 are partially arranged in the middle-piece 4 (figure 2). Alternatively, only the first side-piece 6 may be partially arranged in the middle-piece 4 and the middle-piece 4 may be partially arranged in the second side-piece 8.

**[0023]** In a third embodiment of the fuel rail 2 the middle-piece 4 may comprise more than one, in particular two connections 10 (figure 3). This enables to use the fuel rail 2 for internal combustion engines which comprise four, eight, or twelve injection valves in an easy way. The third embodiment of the fuel rail 2 enables to adjust the

outer connections 10 of the fuel rail 2 to the position of the injection valves of the internal combustion engine.

**[0024]** The invention is not restricted by the explained embodiments. For example, the embodiments may be combined. For example, the second and/or the third and/or further embodiments of the fuel rail 2 may comprise the supporting brackets 14. Further, the middle-piece 4, the first and/or the second side-piece 6, 8 may comprise further brackets 12 and/or further connections 10. Further, in all embodiments further side-pieces may be arranged for adjusting the fuel rail 2 to internal combustion engines which comprise more than three injection valves.

## Claims

1. Fuel rail (2) for an internal combustion engine comprising
  - a first and a second side-piece (6, 8),
  - a middle-piece (4) which is arranged between the first and the second side-piece (6, 8) movable relative to the first and the second side-piece (6, 8) and which is hydraulically and sealingly coupled to the first and the second side-piece (6, 8),
  - at least one connection (10) at each of the pieces for connecting each piece to at least one injection valve of the internal combustion engine,
  - an inlet for supplying the fuel rail (2) with fuel.
2. Fuel rail (2) in accordance with claim 1 wherein the middle-piece (4) is partially arranged in the first and/or the second side-piece (6, 8).
3. Fuel rail (2) in accordance with claim 1 wherein the first and/or the second side-piece (6, 8) is partially arranged in the middle-piece (4).
4. Fuel rail (2) in accordance with one of the preceding claims with the middle-piece (4) and/or the first and/or the second side-piece (6, 8) comprising a bracket (12) for fixing the fuel rail (2) to the internal combustion engine.
5. Fuel rail (2) in accordance with one of the preceding claims comprising at least one supporting bracket (14) for fixing the middle-piece (4) to the first and/or the second side-piece (6, 8).
6. Fuel rail (2) in accordance with one of the preceding claims with the middle-piece (4) and the first and/or the second side-piece (6, 8) comprising an overlapping area and with a surface (24) of the overlapping area comprising a given roughness for sealingly coupling the middle-piece (4) to the first and, respectively, the second side-piece (6, 8).

FIG 1

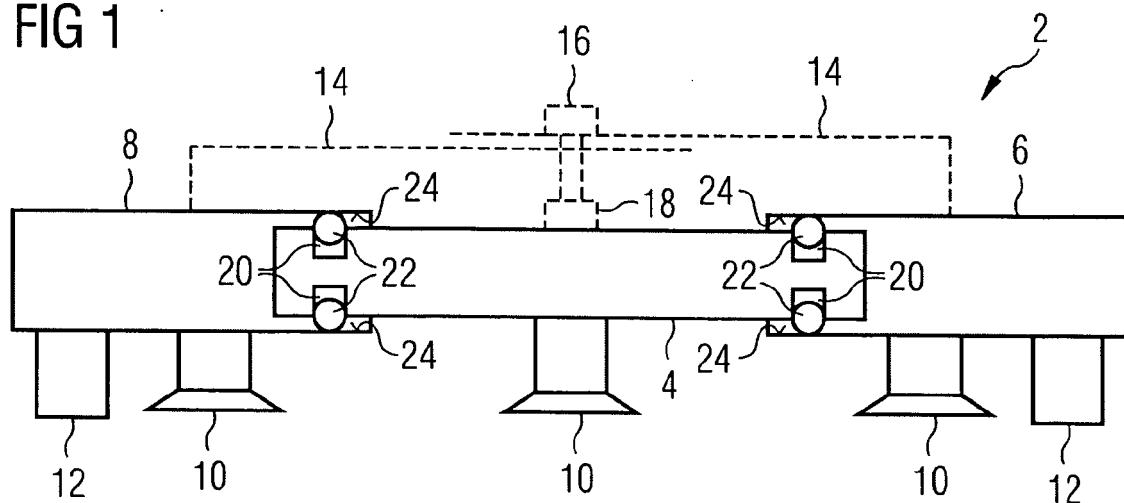


FIG 2

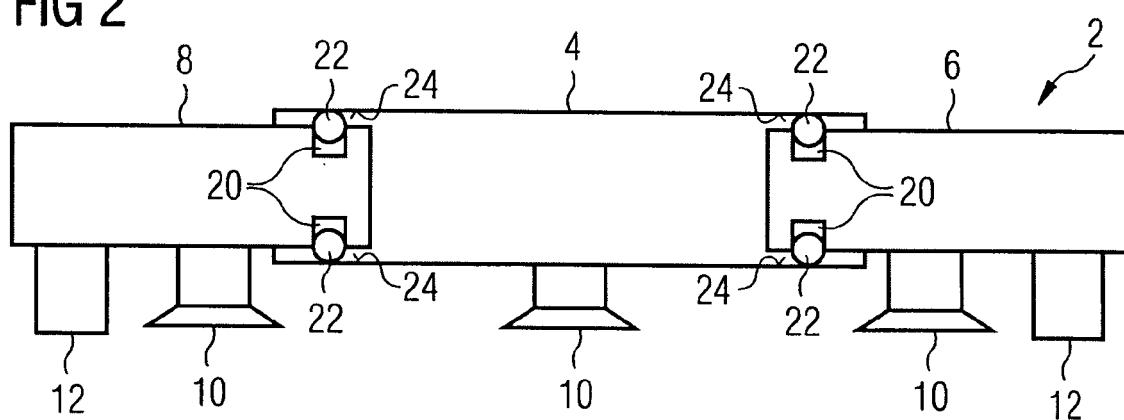
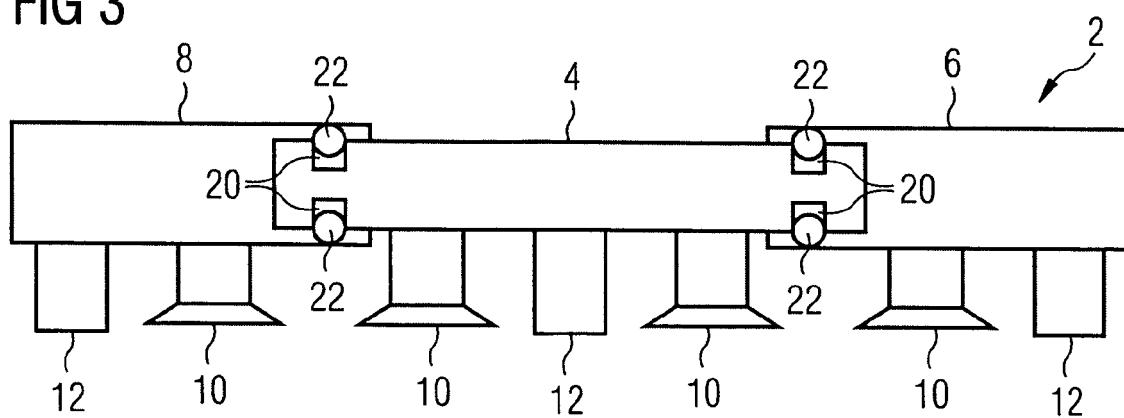


FIG 3





DOCUMENTS CONSIDERED TO BE RELEVANT			CLASSIFICATION OF THE APPLICATION (IPC)
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	
A	DE 199 36 685 A1 (BOSCH GMBH ROBERT [DE]) 22 February 2001 (2001-02-22) * column 3, lines 31-42; figure 2 * -----	1-6	INV. F02M55/02 F02M69/46
A	DE 10 2005 012165 A1 (ORANGE GMBH [DE]) 28 September 2006 (2006-09-28) * page 4, paragraphs 35,36; figure 1 * -----	1-6	
A	WO 2004/013487 A (WAERTSILAE FINLAND OY [FI]; LEHTONEN KAI [FI]) 12 February 2004 (2004-02-12) * page 3, line 23 - page 4, line 5; figure 1 * -----	1-6	
A	DE 10 2004 055266 A1 (BOSCH GMBH ROBERT [DE]) 18 May 2006 (2006-05-18) * page 3, paragraphs 25,26; figure 1 * -----	1-6	
A	EP 1 188 919 A2 (HITACHI LTD [JP]) 20 March 2002 (2002-03-20) * column 6, paragraphs 34,35; figure 2 * -----	1-6	TECHNICAL FIELDS SEARCHED (IPC)
			F02M
The present search report has been drawn up for all claims			
1	Place of search	Date of completion of the search	Examiner
	Munich	10 January 2007	Etschmann, Georg
CATEGORY OF CITED DOCUMENTS		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	
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			

ANNEX TO THE EUROPEAN SEARCH REPORT  
ON EUROPEAN PATENT APPLICATION NO.

EP 06 02 2239

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. The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

10-01-2007

Patent document cited in search report		Publication date		Patent family member(s)		Publication date
DE 19936685	A1	22-02-2001	CZ WO EP JP	20011137 A3 0111226 A1 1117923 A1 2003506624 T		16-01-2002 15-02-2001 25-07-2001 18-02-2003
DE 102005012165	A1	28-09-2006		NONE		
WO 2004013487	A	12-02-2004	AT AU DE EP FI	325270 T 2003249130 A1 60305047 T2 1540169 A1 20021432 A		15-06-2006 23-02-2004 28-09-2006 15-06-2005 03-02-2004
DE 102004055266	A1	18-05-2006	WO	2006053812 A1		26-05-2006
EP 1188919	A2	20-03-2002	DE DE JP US	60112681 D1 60112681 T2 2002089401 A 2002033167 A1		22-09-2005 08-06-2006 27-03-2002 21-03-2002

**REFERENCES CITED IN THE DESCRIPTION**

*This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.*

**Patent documents cited in the description**

- US 4457280 A [0002]