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(54) **CONNECTING ELEMENT FOR FUEL INJECTION SYSTEM**

VERBINDUNGSELEMENT FÜR EINSPRITZSYSTEM

ÉLÉMENT DE RACCORDEMENT POUR SYSTÈM D'INJECTION.

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Description

Technical field of the invention

[0001] The present invention relates to a connecting element for connecting a fuel injector of a piston engine to a fuel rail in accordance with the preamble of claim 1.

Background of the invention

[0002] In a common rail system of a piston engine several fuel injectors are connected to a fuel rail, in which fuel is stored in a high pressure. The pressure in the fuel rail may be up to 3000 bar. The fuel injectors are typically operated electrically and comprise a valve needle for opening and closing fluid communication between the fuel rail and the cylinder. Because of the very high pressure in the fuel system, even a small damage can cause leaking of a fuel injector. Since all the fuel injectors are continuously connected to the fuel rail, a malfunctioning fuel injector can cause constant leakage into a cylinder of the engine. The leaking fuel can cause damage in the cylinder and also leak further to the surroundings of the engine. DE4344190 shows a connection arrangement.

Summary of the invention

[0003] An object of the present invention is to provide a connecting element which can be used for connecting a fuel injector of a piston engine to a fuel rail and to prevent leakages caused by a fuel injector failure. The characterizing features of the fuel injection system according to the invention are given in the characterizing part of claim 1.

[0004] The fuel injection system according to the invention comprises a connecting block for receiving fuel from a fuel rail, and a fuel pipe that is attached to the connecting block for supplying fuel to a fuel injector. The connecting block is provided with a fuel inlet for receiving fuel from the fuel rail and with a fuel outlet that is connected to the fuel pipe. The fuel pipe is provided with a flow fuse for preventing fuel supply to a leaking fuel injector.

[0005] The flow fuse prevents flow to a fuel injector, where the valve needle is stuck in an open position. Damages to the cylinder and fuel leakages to the surroundings of an engine can thus be prevented. Since the flow fuse is integrated in the fuel pipe, the number of parts in the fuel injection system can be reduced. Also, less space for the fuel injection system around the cylinder heads of the engine is needed. Because the number of connections between different parts of the fuel injection system is reduced, also the risk of leakages is reduced.

Brief description of the drawings

[0006] Embodiments of the invention are described below in more detail with reference to the accompanying drawings, in which

Fig. 1 shows schematically a fuel injection system of a piston engine, and

Fig. 2 shows a connecting element for a fuel injection system according to an embodiment of the invention.

Description of embodiments of the invention

[0007] In figure 1 is shown schematically a fuel injection system of a piston engine 1. The engine is a large internal combustion engine, such as a main or an auxiliary engine of a ship or an engine that is used at a power plant for producing electricity. The fuel injection system is a common rail system, where pressurized fuel is stored in a fuel rail 4 before being introduced into fuel injectors 3. In addition to the common rail fuel injection system of figure 1, the engine 1 can comprise one or more additional fuel injection systems. For instance, the fuel injection system of figure 1 could be used for injecting liquid pilot fuel that is used for igniting gaseous fuel that is introduced into the intake system of the engine 1. The engine 1 could thus be provided with an additional fuel injection system for gaseous fuel and also with an additional fuel injection system for liquid main fuel.

[0008] The engine 1 comprises a plurality of cylinders 2. Each cylinder 2 of the engine 1 is provided with at least one fuel injector 3. Each fuel injector 3 is arranged to inject fuel into a cylinder 2 of the engine 1. The fuel injection system comprises a low-pressure pump 6, which supplies fuel to a high-pressure pump 5. The high-pressure pump 5 supplies the fuel at a high-pressure into a fuel rail 4. The pressure in the fuel rail 4 is typically 700 to 3000 bar. In the embodiment of figure 1, all the fuel injectors 3 of the engine 1 are connected to the same fuel rail 4. However, the fuel injection system could be provided with two or more fuel rails 4, in which case only some of the fuel injectors 3 would be connected to each fuel rail 4. The fuel injection system could also be provided with two or more low-pressure pumps 6 and/or high-pressure pumps 5. For instance, one low-pressure pump 6 and one high-pressure pump 5 could be provided for each fuel rail 4 of the engine 1, or several pumps 5, 6 could supply fuel to each fuel rail 4. Each fuel injector 3 is connected to the fuel rail 4 via a connecting element 10. The connecting element 10 is connected to the fuel rail 4 via a connecting duct 7. The connecting element comprises a fuel pipe 12 and a connecting block 11 to which the fuel pipe 12 and the connecting duct 7 are connected.

[0009] Figure 2 shows a connecting element 10 according to an embodiment of the invention. The main parts of the connecting element 10 are a connecting block 11 and a fuel pipe 12. The connecting block 11 is provided with a fuel inlet 13, which can be connected to the connecting duct 7 for introducing the pressurized fuel from the fuel rail 4 into the connecting element 10. The con-

necting block 11 is further provided with a fuel outlet 14, to which the fuel pipe 12 is attached. The fuel pipe 12 and the connecting block 11 are separate parts. The connecting block 11 is provided with an internal thread 19, which is engaged with an external thread 20 that is arranged at a first end of the fuel pipe 12. The other end of the fuel pipe 12 can be inserted into a cylinder head, where it is connected to a fuel injector 3.

[0010] The connecting element 10 further comprises a flow fuse 15. A flow fuse is generally used as a safety device in fuel injection apparatuses and usually disposed between the pressure accumulator and the injection valve. The flow fuse prevents an uncontrolled fuel leakage to the combustion space of the cylinder, which may take place, by limiting the fuel flow rate. The flow fuse, also called as a flow limiting valve, is a device that is designed to be triggered in certain predetermined conditions to prevent flow through it. The flow fuse 15 is used for preventing flow from the fuel rail 4 to the fuel injector 3 in the case the valve needle of the fuel injector 3 is stuck in an open position. The flow fuse 15 thus functions as a safety device that prevents fuel leakage through a malfunctioning fuel injector 3. The flow fuse 15 is arranged inside the fuel pipe 12. The fuel pipe 12 forms the body of the flow fuse 15. The flow fuse 15 comprises a piston 17 and a spring 16. The piston 17 is arranged completely inside the fuel pipe 12 and can move in the longitudinal direction of the fuel pipe 12. The spring 16 is arranged to push the piston 17 against a valve seat 18. The valve seat 18 surrounds the fuel outlet 14 of the connecting block 11. When the fuel injector 3 opens, a pressure difference over the piston 17 is created and the fuel pressure in the fuel rail 4 pushes the piston 17 against the spring force and moves the piston 17 towards the fuel injector end of the fuel pipe 12. Fuel flow from the fuel outlet 14 of the connecting block 11 into the fuel pipe 12 is thus allowed. When the valve needle of the fuel injector 3 returns to the closed position, the pressure difference over the piston 17 disappears and the spring 16 pushes the piston 17 against the valve seat 18. During each injection cycle, the piston 17 thus moves towards the fuel injector 3 and returns back to the initial position.

[0011] If the fuel injector 3 is not closed properly, a pressure difference over the piston 17 remains. The piston 17 thus keeps moving towards the fuel injector end of the fuel pipe 12 until it reaches a stopper surface 21 and closes the fluid communication between the connecting block 11 and the fuel injector 3. The pressure of the fuel rail 4 keeps the piston 17 in this position and prevents flow to the malfunctioning fuel injector 3. Damage to the engine 1 and leaking of the fuel to the surroundings is thus prevented. During normal fuel injection, the piston 17 does not move the full distance against the stopper surface 21, but the flow fuse 15 is configured so that the fuel injection is terminated before the piston 17 has moved the full stroke from the initial position to the flow blocking position. The piston 17 has a channel (not shown) or a clearance (not shown), through which the flow is permitted for example when the piston is at halfway of the stroke but not permitted when the piston 17 is at its injector side end. Because the flow fuse 15 is integrated into the fuel pipe 12, the arrangement is space saving and reduces joints between the parts of the fuel injection system.

[0012] It will be appreciated by a person skilled in the art that the invention is not limited to the embodiments described above, but may vary within the scope of the appended claims.

Claims

1. A fuel injection system for a piston engine (1), the fuel injection system comprising a fuel rail (4), a fuel injector (3) and a connecting element (10) for connecting the fuel injector (3) to the fuel rail (4), the connecting element (10) comprising a connecting block (11) for receiving fuel from a fuel rail (4), and a fuel pipe (12) that is attached to the connecting block (11) for supplying fuel to the fuel injector (3), the connecting block (11) being provided with a fuel inlet (13) for receiving fuel from the fuel rail (4) and with a fuel outlet (14) that is connected to the fuel pipe (12), the fuel pipe (12) being provided with a flow fuse (15) for preventing fuel supply to a leaking fuel injector (3), and the fuel pipe (12) forming the body of the flow fuse (15), **characterized in that** one end of the fuel pipe (12) is inserted into a cylinder head and connected to the fuel injector (3).

2. A fuel injection system according to claim 1, **characterized in that** the flow fuse (15) comprises a piston (17) that is arranged inside the fuel pipe (12) and that is movable in the longitudinal direction of the fuel pipe (1), and a spring (16) for pushing the piston (17) against a valve seat (18).

3. A fuel injection system according to claim 2, **characterized in that** the valve seat (18) surrounds the fuel outlet (14) of the connecting block (11).

4. A fuel injection system according to claim 2 or 3, **characterized in that** the piston (17) is configured to move against the spring force until it faces a stopper surface (21) and closes fluid communication between the fuel outlet (14) and the fuel injector (3), when the amount of fluid flowing through the fuel outlet (14) in a predetermined amount of time exceeds a predetermined amount.

Patentansprüche

1. Kraftstoffeinspritzsystem für einen Kolbenmotor (1), wobei das Kraftstoffeinspritzsystem einen Kraftstoffverteiler (4), ein Kraftstoffeinspritzventil (3) und ein

Verbindungselement (10) zum Verbinden des Kraftstoffeinspritzventils (3) am Kraftstoffverteiler (4) umfasst, wobei das Verbindungselement (10) einen Verbindungsblock (11) zur Aufnahme von Kraftstoff aus einem Kraftstoffverteiler (4), und eine Kraftstoffleitung (12), die am Verbindungsblock (11) zum Zuführen von Kraftstoff zum Kraftstoffeinspritzventil (3) befestigt ist, wobei der Verbindungsblock (11) zur Aufnahme von Kraftstoff vom Kraftstoffverteiler (4) mit einem Kraftstoffeinlass (13) und mit einem Kraftstoffauslass (14) versehen ist, der an die Kraftstoffleitung (12) angeschlossen ist, wobei die Kraftstoffleitung (12) mit einer Strömungssicherung (15) versehen ist, um die Kraftstoffzufuhr zu einem undichten Kraftstoffeinspritzventil (3) zu verhindern, und die Kraftstoffleitung (12) den Körper der Strömungssicherung (15) bildet, **dadurch gekennzeichnet, dass** ein Ende der Kraftstoffleitung (12) in einen Zylinderkopf eingesetzt und mit dem Kraftstoffeinspritzventil (3) verbunden ist.

2. Kraftstoffeinspritzsystem nach Anspruch 1, **dadurch gekennzeichnet, dass** die Strömungssicherung (15) einen Kolben (17), der innerhalb der Kraftstoffleitung (12) angeordnet ist, und der in der Längsrichtung der Kraftstoffleitung (1) beweglich ist, und eine Feder (16) zum Schieben des Kolbens (17) gegen einen Ventilsitz (18), umfasst.

3. Kraftstoffeinspritzsystem nach Anspruch 2, **dadurch gekennzeichnet, dass** der Ventilsitz (18) den Kraftstoffauslass (14) des Verbindungsblocks (11) umgibt.

4. Kraftstoffeinspritzsystem nach Anspruch 2 oder 3, **dadurch gekennzeichnet, dass** der Kolben (17) konfiguriert ist, um sich gegen die Federkraft zu bewegen, bis er einer Anschlagfläche (21) zugewandt ist und die Strömungsverbindung zwischen dem Kraftstoffauslass (14) und dem Kraftstoffeinspritzventil (3) schließt, wenn die Menge an Flüssigkeit, die durch den Kraftstoffauslass (14) in einer vorbestimmten Zeitdauer fließt, eine vorbestimmte Menge überschreitet.

Revendications

1. Système d'injection de carburant pour moteur à piston (1), ce système d'injection de carburant comprenant un rail à carburant (4), un injecteur de carburant (3) et un élément de connexion (10) pour connecter l'injecteur de carburant (3) au rail à carburant (4), l'élément de connexion (10) comprenant un bloc de connexion (11) pour recevoir du carburant en provenance d'un rail à carburant (4), et un tuyau à carburant (12) qui est fixé au bloc de connexion (11) pour fournir du carburant à l'injecteur de carburant (3), le bloc de connexion (11) étant pourvu d'une admission de carburant (13) pour recevoir du carburant en provenance du rail à carburant (4) et d'une sortie de carburant (14) qui est connectée au tuyau à carburant (12), le tuyau à carburant (12) étant pourvu d'un fusible d'écoulement (15) pour empêcher la fourniture de carburant à un injecteur de carburant qui fuit (3), et le tuyau à carburant (12) formant le corps du fusible d'écoulement (15), **caractérisé en ce qu'**une extrémité du tuyau à carburant (12) est insérée dans une tête de cylindre et connectée à l'injecteur de carburant (3).

2. Système d'injection de carburant selon la revendication 1, **caractérisé en ce que** le fusible d'écoulement (15) comprend un piston (17) qui est disposé dans le tuyau à carburant (12) et qui est mobile dans le sens longitudinal du tuyau à carburant (1), et un ressort (16) pour pousser le piston (17) contre un siège de vanne (18).

3. Système d'injection de carburant selon la revendication 2, **caractérisé en ce que** le siège de vanne (18) entoure la sortie de carburant (14) du bloc de connexion (11).

4. Système d'injection de carburant selon la revendication 2 ou 3, **caractérisé en ce que** le piston (17) est conçu pour se déplacer contre la force de ressort jusqu'à ce qu'il soit face à face avec une surface d'arrêt (21) et ferme la communication fluidique entre la sortie de carburant (14) et l'injecteur de carburant (3) lorsque le volume de fluide s'écoulant par la sortie de carburant (14) dans un laps de temps prédéterminé excède un volume prédéterminé.

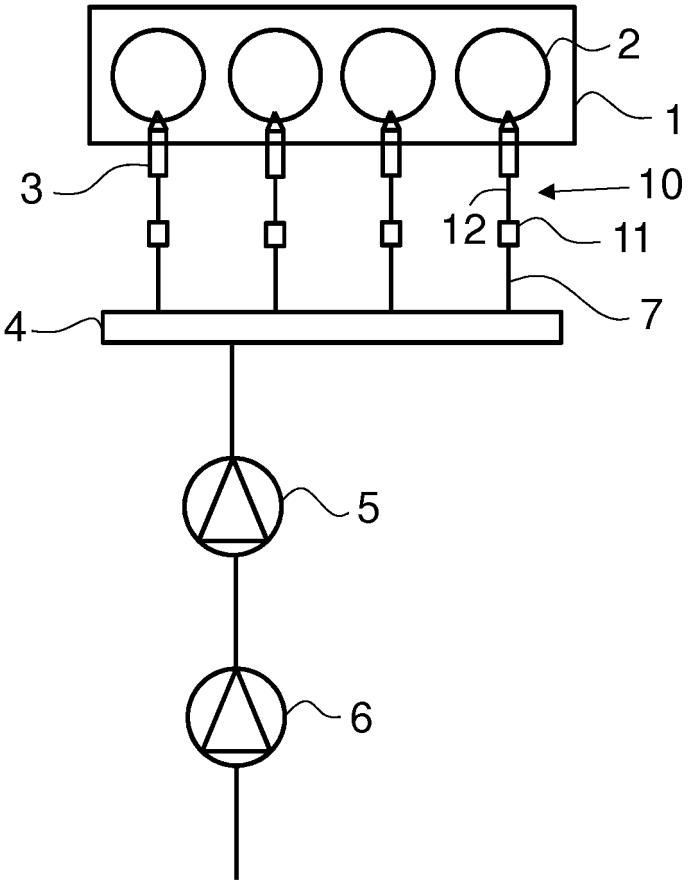

FIG. 1

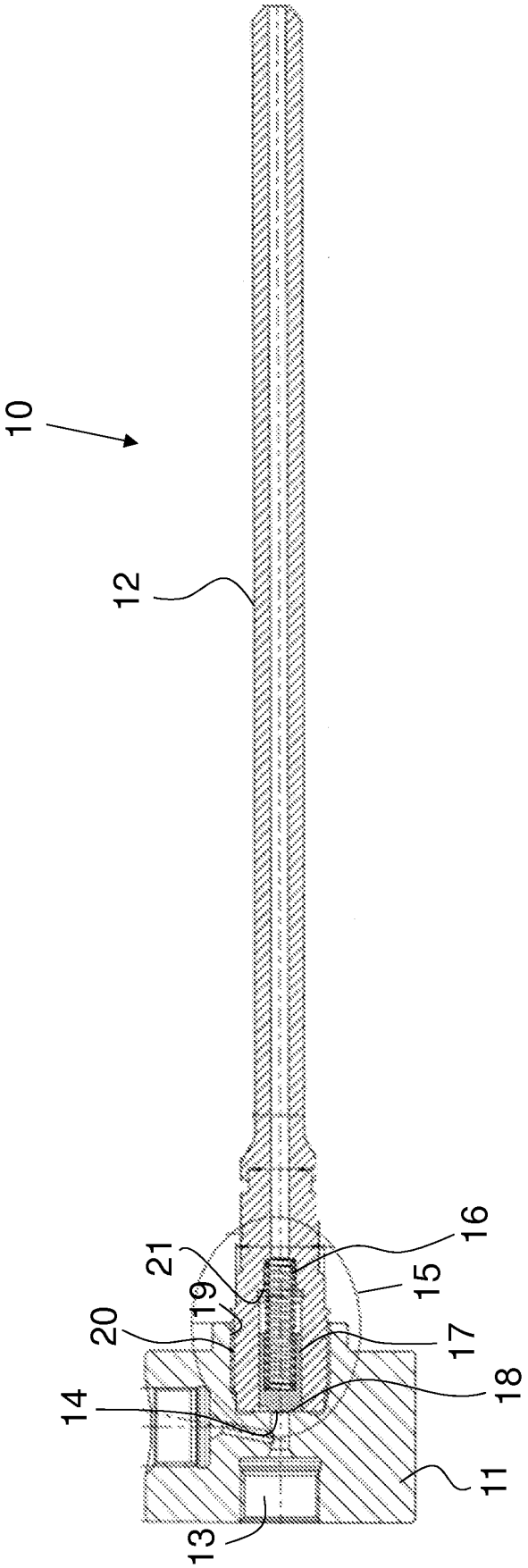

FIG. 2

REFERENCES CITED IN THE DESCRIPTION

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