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(54) **Fuel injection arrangement**

Kraftstoffeinspritzungsanordnung

Agencement d'injection de carburant

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Description

[0001] The present invention relates to a fuel injection arrangement for a piston engine in accordance with the preamble of claim 1.

Background of the invention

[0002] The fuel injection systems of compression ignition piston engines can be divided into common rail systems and systems that comprise a separate fuel injection pump for each cylinder of the engine. In common rail systems, fuel pressurized by a high-pressure pump is supplied into a storage, from which it can be fed to several cylinders of the engine. The amount of the injected fuel and the fuel injection timing is controlled by the fuel injectors, which are usually electrically controlled. In fuel injection systems with individual fuel injection pumps, each cylinder of the engine is provided with an own fuel injection pump, which also controls the amount of the fuel to be injected and the fuel injection timing. The fuel injectors are opened by the pressure of the fuel. A feed pump supplies fuel to the fuel injection pumps. In the systems with individual fuel injection pumps, which are commonly called as jerk pumps, pressure peaks occur in the low pressure part of the fuel injection system, i.e. in the fuel supply line and in the return line that collects clean excess fuel from the fuel injection pumps.

[0003] Pressure peaks can be lowered by using large diameter pipes, but this is not always sufficient and often leads to a need to provide the pipes with pulsation dampers. Often several different pulsation dampers need to be used. This increases the costs and the need for service.

[0004] Patent application WO 2012/175800 A2 discloses a fuel injection system for a reciprocating engine. The fuel injection system comprises injection pumps for feeding fuel to fuel injectors and a pump for feeding fuel to the injection pumps. A fuel line connects each injector to an injection pump. A return line and a pressure control valve are connected to the fuel line for controlling fuel pressure in the fuel line.

Summary of the invention

[0005] The object of the present invention is to provide an improved fuel injection arrangement for a piston engine. The fuel injection arrangement comprises a number of fuel injection pumps, each fuel injection pump being configured to inject liquid fuel into a cylinder of the engine, at least one feed pump for supplying fuel to the fuel injection pumps, a fuel supply line connecting the fuel injection pumps to the feed pump, a return line for receiving excess fuel from the fuel injection pumps and pressure regulating means arranged in the return line. The characterizing features of the fuel injection arrangement according to the invention are given in the characterizing part of claim 1.

[0006] According to the invention, the fuel injection arrangement is provided with a by-pass line allowing outflow from the fuel supply line and/or the return line for reducing pressure pulsations.

[0007] The arrangement according to the invention effectively reduces pulsations in the fuel injection system. The reliability of the engine and the lifetime of the components can thus be increased. The need for expensive pulsation dampers can be avoided and manufacturing costs can thus be reduced.

[0008] According to an embodiment of the invention, the arrangement comprises means for restricting flow into the by-pass line. The means for restricting flow into the by-pass line can comprise an orifice having a smaller diameter than the by-pass line. According to an embodiment of the invention, the diameter of the orifice is 5 to 30 percent of the inner diameter of the by-pass line.

[0009] According to an embodiment of the invention, a first end of the by-pass line is connected to the fuel supply line. According to another embodiment of the invention, a first end of the by-pass line is connected to the return line on the upstream side of the pressure regulating means. A second end of the by-pass line can be connected to the return line on the downstream side of the pressure regulating means or to a pressureless tank.

[0010] According to an embodiment of the invention, the inner diameter of the by-pass line is 20 to 60 percent of the inner diameter of the return line.

[0011] The pressure regulating means can be a pressure regulating valve.

Brief description of the drawings

[0012] Embodiments of the invention are described below in more detail with reference to the accompanying drawing, which shows a fuel injection arrangement according to an embodiment of the invention.

Description of embodiments of the invention

[0013] In figure 1 is shown schematically a fuel injection system of a piston engine. 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. In the embodiment of figure 1, the fuel injection system is configured for a four-cylinder engine, but the invention is applicable to engines with any number of cylinders. In the embodiment of the figure, the cylinders are arranged in line, but the invention is also suitable for V-engines and other cylinder configurations. The fuel injection system of figure 1 is configured to inject liquid fuel directly into the cylinders of the engine. The fuel can be, for instance, light fuel oil (LFO), heavy fuel oil (HFO), marine gas oil (MGO), crude oil or marine diesel oil (MDO). The engine can be provided with additional fuel injection systems, such as a gas injection system for introducing gaseous fuel into the engine and a pilot fuel injection system for introducing liquid pilot fuel

into the cylinders when the engine is operated using a gaseous main fuel.

[0014] The fuel injection system of figure 1 comprises a number of fuel injection pumps 1. One fuel injection pump 1 is provided for each cylinder of the engine. The fuel injection pumps 1 are conventional fuel injection pumps, which are preferably cam-operated. The fuel injection pumps 1 can also be called as jerk pumps. Each fuel injection pump 1 is connected to a fuel injector 6, which is arranged to inject fuel directly into a cylinder of the engine. Each fuel injector 6 is provided with an injector needle, which is opened by the pressure produced by the fuel injection pump 1. As opposed to a common rail system, the fuel injectors 6 are thus not electrically controlled, but the fuel injection timing and the amount of the injected fuel is determined by the fuel injection pumps 1. The injection pressure is typically 1000 to 1800 bar.

[0015] The fuel injection system is provided with a feed pump 2 for supplying fuel from a tank 10 to the fuel injection pumps 1. The feed pump 2 is a low-pressure pump that raises the pressure of the fuel to the range of 5 to 15 bar. A fuel supply line 3 connects the feed pump 2 to the inlets of the fuel injection pumps 1. During each cycle of a fuel injection pump 1, the fuel injection pump 1 takes in substantially the same amount of fuel. However, the amount of the fuel that is supplied to the fuel injector 6 depends on the load of the engine. The fuel injection system is provided with a return line 4 for receiving the excess fuel that is not supplied to the fuel injector 6. In the embodiment of figure 1, all the cylinders are connected to the same return line 4. However, more than one return lines 4 could be provided, for instance in a V-engine a separate return line 4 could be arranged for each bank of the engine. Via the return line 4, the excess fuel can be returned to the tank 10. The return line 4 comprises pressure regulating means 8. In the embodiment of the figure, the pressure regulating means is a pressure regulating valve 8. The pressure regulating valve 8 is a normally closed valve, which is arranged to open when a certain threshold pressure is exceeded. The opening pressure of the pressure regulating valve 8 can be adjusted. Typically, the nominal pressure in the return line 4 is kept in the range of 6 to 12 bar. With that nominal pressure, the actual pressure in the return line 4 typically varies in the range of 2 to 20 bar. Instead of the pressure regulating valve 8, a throttling device could be arranged in the return line 4 to regulate the pressure.

[0016] The fuel injection system is further provided with a leakage line 7. The leakage line 7 collects clean fuel leakage from the fuel injectors 6 and the fuel injection pumps 1. The clean leakage is caused by the clearances of the fuel injection pumps 1 and the fuel injectors 6 during normal operation of the engine. The clean fuel leakage can be returned to the tank 10. The engine is also provided with a separate leakage line for dirty fuel (not shown). Via the leakage line for dirty fuel, the fuel that is mixed with other substances can be collected to a separate tank.

[0017] For reducing pulsations in the low-pressure part of the fuel injection system, i.e. in the return line 4 and the fuel supply line 3, the fuel injection system is provided with a by-pass line 5. The by-pass line 5 is arranged to allow outflow from the fuel supply line 3 and/or from the return line 4. In the embodiment of the figure, the by-pass line 5 is configured to allow outflow from both the fuel supply line 3 and the return line 4. However, instead of connecting the by-pass line 5 to both lines 3, 4, the by-pass line 5 could be connected only to the fuel supply line 3 or to the return line 4. It is also possible to provide each of the fuel supply line 3 and the return line 4 with an own by-pass line 5. The fuel injection system would thus comprise two by-pass lines 5. By connecting both the fuel supply line 3 and the return line 4 to a by-pass line 5, pulsations in the low-pressure lines 3, 4 of the fuel injection system can be more effectively reduced. On the other hand, if only the return line 4 is connected to a by-pass line 5, sufficient cooling and filling of the fuel injection pumps 1 is better guaranteed.

[0018] The by-pass line 5 is a pipe having a smaller diameter than the fuel supply line 3 and the return line 4. Suitable inner diameter for the by-pass line 5 is 20 to 60 percent of the inner diameter of the return line 4.

[0019] The by-pass line 5 has a first end and a second end. The first end of the by-pass line 5 is divided into a first branch 5a and a second branch 5b. The first branch 5a of the by-pass line 5 is connected to the fuel supply line 3 and the second branch 5b is connected to the return line 4. The point where the second branch 5b of the by-pass line 5 is connected to the return line 4 is located upstream from the pressure regulating valve 8. The second end of the by-pass line 5 is connected to the return line 4 on the downstream side of the pressure regulating valve 8. Instead of connecting the second end of the by-pass line 5 to the return line 4, the second end of the by-pass line 5 could be connected to a mixing tank.

[0020] The fuel injection system comprises means for restricting flow into the by-pass line 5. In the embodiment of the figure, the flow restricting means comprise orifices 11, 12 that are arranged between the fuel supply line 3 and the by-pass line 5 and between the return line 4 and the by-pass line 5. The orifices 11, 12 are openings between the fuel supply line 3 and the by-pass line 5 and between the return line 4 and the by-pass line 5 having a substantially smaller diameter than the by-pass line 5. A suitable diameter for the orifices is 5 to 30 percent of the inner diameter of the by-pass line 5. The orifices 11, 12 restrict the outflow from the fuel supply line 3 and/or the return line 4 to the by-pass line 5.

[0021] 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 arrangement for a piston engine, the arrangement comprising

   - a number of fuel injection pumps (1), each fuel injection pump (1) being configured to inject liquid fuel into a cylinder of the engine,
   - at least one feed pump (2) for supplying fuel to the fuel injection pumps (1),
   - a fuel supply line (3) connecting the fuel injection pumps (1) to the feed pump (2),
   - a return line (4) for receiving excess fuel from the fuel injection pumps (1), and
   - pressure regulating means (8) arranged in the return line (4),

   characterized in that the fuel injection arrangement is provided with a by-pass line (5) for reducing pressure pulsations, a second end of the by-pass line (5) is connected to a pressureless tank or to the return line (4) on the downstream side of the pressure regulating means (8), and a first end of the by-pass line (5) is connected to the return line (4) on the upstream side of the pressure regulating means (8) for allowing outflow from the return line (4).

2. An arrangement according to claim 1, wherein the arrangement comprises means (11, 12) for restricting flow into the by-pass line (5).

3. An arrangement according to claim 2, wherein the means (11, 12) for restricting flow into the by-pass line (5) comprise an orifice having a smaller diameter than the by-pass line (5).

4. An arrangement according to claim 3, wherein the diameter of the orifice is 5 to 30 percent of the inner diameter of the by-pass line (5).

5. An arrangement according to any of the preceding claims, wherein the inner diameter of the by-pass line (5) is 20 to 60 percent of the inner diameter of the return line (4).

6. An arrangement according to any of the preceding claims, wherein the pressure regulating means (8) is a pressure regulating valve.

Patentansprüche

1. Kraftstoffeinspritzungsanordnung für einen Kolbenmotor, wobei die Anordnung umfasst:

   - eine Anzahl von Kraftstoffeinspritzpumpen (1), wobei jede Kraftstoffeinspritzpumpe (1) dafür ausgelegt ist, flüssigen Kraftstoff in einen Zylinder des Motors einzuspritzen,
   - wenigstens eine Förderpumpe (2) zum Zuführen von Kraftstoff zu den Kraftstoffeinspritzpumpen (1),
   - eine Kraftstoffzuführleitung (3), welche die Kraftstoffeinspritzpumpen (1) mit der Förderpumpe (2) verbindet,
   - eine Rücklaufleitung (4) zum Aufnehmen von überschüssigem Kraftstoff von den Kraftstoffeinspritzpumpen (1), und
   - Druckregelmittel (8), die in der Rücklaufleitung (4) angeordnet sind,

   dadurch gekennzeichnet, dass die Kraftstoffeinspritzungsanordnung mit einer Umgehungsleitung (5) zur Reduzierung von Druckpulsationen versehen ist, ein zweites Ende der Umgehungsleitung (5) mit einem drucklosen Tank oder mit der Rücklaufleitung (4) auf der stromabwärtigen Seite der Druckregelmittel (8) verbunden ist und ein erstes Ende der Umgehungsleitung (5) mit der Rücklaufleitung (4) auf der stromaufwärtigen Seite der Druckregelmittel (8) verbunden ist, um den Ausfluss aus der Rücklaufleitung (4) zu ermöglichen.

2. Anordnung nach Anspruch 1, wobei die Anordnung Mittel (11, 12) zum Begrenzen des Flusses in die Umgehungsleitung (5) umfasst.

3. Anordnung nach Anspruch 2, wobei die Mittel (11, 12) zum Begrenzen des Flusses in die Umgehungsleitung (5) eine Drosselblende mit einem Durchmesser umfassen, der kleiner als derjenige der Umgehungsleitung (5) ist.

4. Anordnung nach Anspruch 3, wobei der Durchmesser der Drosselblende 5 bis 30 Prozent des Innendurchmessers der Umgehungsleitung (5) beträgt.

5. Anordnung nach einem der vorhergehenden Ansprüche, wobei der Innendurchmesser der Umgehungsleitung (5) 20 bis 60 Prozent des Innendurchmessers der Rücklaufleitung (4) beträgt.

6. Anordnung nach einem der vorhergehenden Ansprüche, wobei das Druckregelmittel (8) ein Druckregelventil ist.

Revendications

1. Ensemble d'injection de carburant pour un moteur à piston, l'ensemble comprenant

   - un nombre de pompes d'injection de carburant (1), chaque pompe d'injection de carburant (1) étant configurée pour injecter du carburant liquide dans un cylindre du moteur,

- au moins une pompe d'alimentation (2) destinée à alimenter les pompes d'injection de carburant (1) en carburant,
- une conduite d'alimentation en carburant (3) reliant les pompes d'injection de carburant (1) à la pompe d'alimentation (2),
- une conduite de retour (4) destinée à recevoir du carburant excédentaire en provenance des pompes d'injection de carburant (1), et
- un moyen de régulation de la pression (8) disposé dans la conduite de retour (4),

caractérisé en ce que l'ensemble d'injection de carburant est doté d'une conduite de dérivation (5) destinée à réduire les pulsations de pression, une deuxième extrémité de la conduite de dérivation (5) est reliée à un réservoir sans pression ou à la conduite de retour (4) sur le côté aval du moyen de régulation de la pression (8), et une première extrémité de la conduite de dérivation (5) est reliée à la conduite de retour (4) sur le côté amont du moyen de régulation de la pression (8) pour permettre l'écoulement hors de la conduite de retour (4).

2. Ensemble selon la revendication 1, dans lequel l'ensemble comprend des moyens (11, 12) destinés à restreindre l'écoulement dans la conduite de dérivation (5) .

3. Ensemble selon la revendication 2, dans lequel les moyens (11, 12) destinés à restreindre l'écoulement dans la conduite de dérivation (5) comprennent un orifice présentant un diamètre inférieur à celui de la conduite de dérivation (5).

4. Ensemble selon la revendication 3, dans lequel le diamètre de l'orifice mesure entre 5 et 30 pourcents du diamètre intérieur de la conduite de dérivation (5).

5. Ensemble selon l'une quelconque des revendications précédentes, dans lequel le diamètre intérieur de la conduite de dérivation (5) mesure entre 20 et 60 pourcents du diamètre intérieur de la conduite de retour (4) .

6. Ensemble selon l'une quelconque des revendications précédentes, dans lequel le moyen de régulation de la pression (8) est une soupape de régulation de la pression.

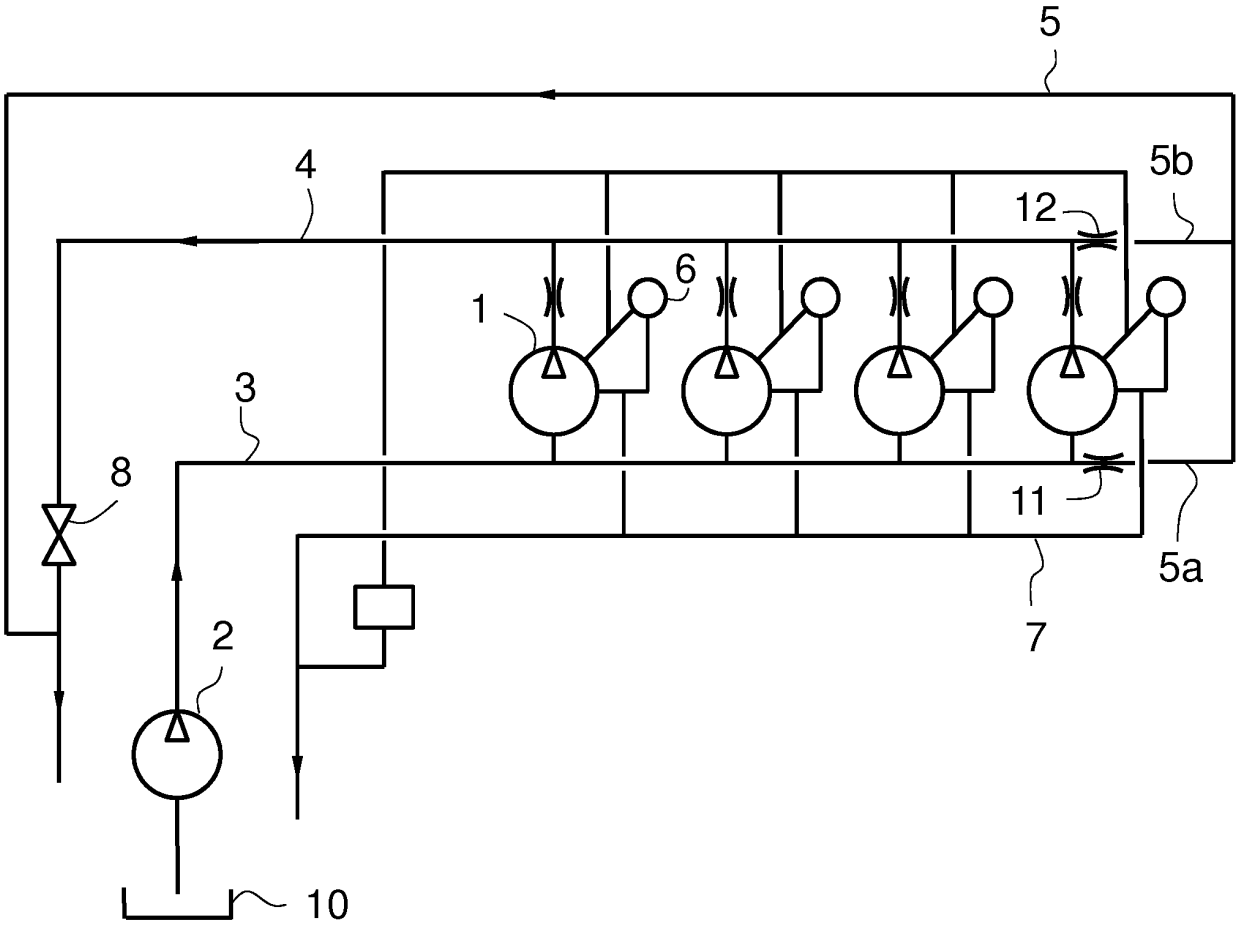

FIG. 1

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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