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(71) Applicants:
- **Robert Bosch GmbH**
  70469 Stuttgart (DE)
- **Bosch Limited**
  Adugodi, Bangalore 560 030 (IN)

(72) Inventors:
- **Plaparambil Kurian, Jeemon**
  560035 Carmelaram P.O, Bengaluru (IN)
- **Muraleedharakurup, Girish**
  691017 Kerala (IN)
- **Sunilkumar Laxmanrao, Kulkarni**
  560078 Bangalore (IN)
- **Geakaravally Rangegowda, Santhosh Kumar**
  573201 Udayagiri, Hassan (DE)
- **Mohan Chintalapati, Vamsi**
  500044 Old Nallakunta, Hyderabad (IN)

(74) Representative: **Bee, Joachim**
Robert Bosch GmbH
C/IPE
Wernerstrasse 1
70469 Stuttgart (DE)

(54) A FUEL INJECTOR AND A FUEL INJECTION SYSTEM

(57) A fuel injector and a fuel injection system are disclosed. The fuel injector comprises a pressure sensor located in a recess in a manner such that a chamber is formed in recess between an end wall of the recess and said pressure sensor. The fuel injection system comprises at least two fuel injector and a pressure sensor located in the second fuel injector such that one pressure sensor is adapted to measure fuel pressure throughout the fuel injection system.

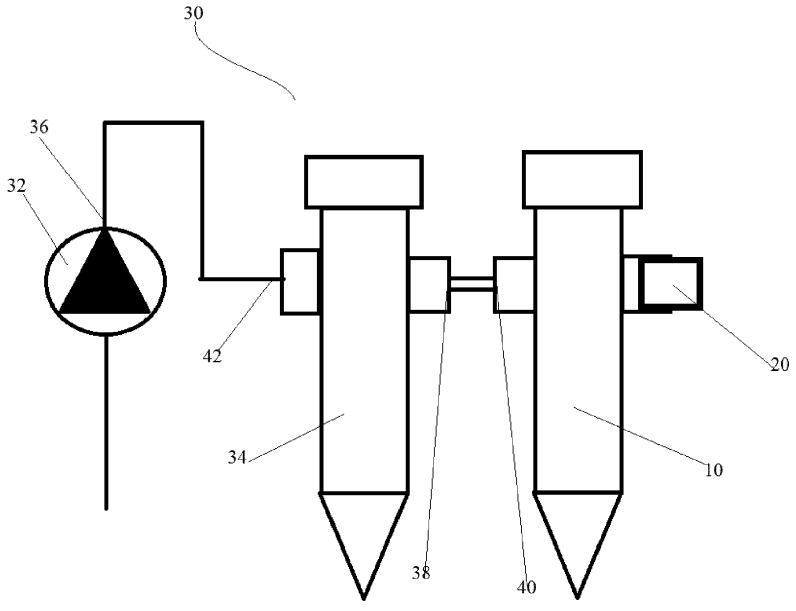

Figure 2

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Description

Field of the invention

[0001] This disclosure relates to a fuel injector and a fuel injection system

Background of the invention:

[0002] A published US patent application US20120031376 discloses a fuel injection system. The fuel injection system comprises a high pressure pump and at least two injectors. The fuel injector has a high-pressure area, which in operation for at least some of the time contains fuel under high injection pressure. The fuel injector according also has a low-pressure area, which in operation contains no fuel and/or is connected to an outlet, so that a high fuel pressure does not build up in the low-pressure area and a lower pressure prevails than in the high-pressure area. A pressure sensor is located in the low-pressure area and a transmission means is arranged so that for at least some of the time it exerts a force, which corresponds to the pressure of the fuel in the high-pressure area, on the sensor. The force exerted on the sensor by the transmission means is proportional to the pressure in the high-pressure area. Since the pressure sensor is located in the low-pressure area of the fuel injector, the sensor does not need to have a special high pressure seal.

Brief description of the accompanying drawings:

[0003] An embodiment of the disclosure is described with reference to the following accompanying drawings;

Figure 1 illustrates a sectional view of a fuel injector in accordance with this disclosure; and
Figure 2 illustrates a fuel injection system in accordance with this disclosure.

Detailed description of the embodiments:

[0004] Figure 1 illustrates a fuel injector 10 in accordance with this disclosure. The fuel injector 10 comprises an injector body 12. The injector body 12 comprises an inlet port 14 adapted to allow fuel to enter the injector body 12. A fuel flow path 16 is defined within the injector body 12, which is adapted to allow fuel to flow from the inlet port 14 to an injector needle of the fuel injector 10. The fuel injector 10 comprises a recess 18 provided in the injector body 12. The fuel injector 10 is characterized so as to comprise a pressure sensor 20 located in the recess 18 in a manner such that a chamber 22 is formed in the recess 18 between an end wall 24 of the recess 18 and the pressure sensor 20 and a flow path 26 extends from the fuel flow path 16 to the recess 18 such that fuel from the fuel flow path 16 flows into the chamber 22.

[0005] Figure 2 illustrates a fuel injection system 30 in accordance with this disclosure. A fuel injection system 30 comprises a high pressure fuel pump 32 and at least 'n' fuel injectors, 'n' being the number of injector in said fuel injection system. A first fuel injector 34 of the at least 'n' fuel injectors in fluid communication with an outlet 36 of the high pressure fuel pump 32 and the second to n^{th} fuel injector adapted to receive fuel the $(n-1)^{th}$ fuel injector. The fuel injection system 30 is characterized such that a pressure sensor 20 is located in the n^{th} fuel injector 10 in a manner such that the pressure sensor 20 is adapted to measure pressure of fuel throughout the fuel injection system 30.

[0006] The n^{th} fuel injector 10 comprises a recess 18 and the pressure sensor 20 located in the recess 18 in a manner such that a chamber 22 is formed in the recess 18 between an end wall 24 of the recess 18 and the pressure sensor 20. The n^{th} fuel injector 10 comprises a flow path 26 extending from fuel flow path 16 of the n^{th} fuel injector 10 to the recess 18 such that fuel from the fuel flow path 16 flows into the chamber 22. The first injector 34 comprises an inlet 42 and an outlet 38, wherein the inlet 42 is in fluid communication with outlet 36 of the high pressure fuel pump 12 and the outlet 38 is in fluid communication with inlet 40 of the n^{th} fuel injector 10. The said pressure sensor 20 is located in the recess 18 of the n^{th} fuel injector 10 in a manner such that time taken to measure pressure by the pressure sensor 20 is lesser than the time between injection events in 'n' injectors.

[0007] For better understanding of this disclosure we consider an embodiment of the fuel injection system where n=2. Thus the fuel injection system 30 has two fuel injectors. However, it must be understood that concept of this disclosure can be extended to a fuel injection system with n>2. Thus for the fuel injection system 30 where n=2, the first fuel injector is marked as 34 and the second fuel injector is marked as 10 in figure 2. The fuel injection system 30 comprises a high pressure fuel pump 32 and at least two fuel injectors. A first fuel injector 34 of the at least two fuel injectors are in fluid communication with outlet 36 the high pressure fuel pump 32. The outlet 38 of the first fuel injector 34 is connected to the inlet 40 of a second fuel injector 10 of the at least two fuel injectors. The fuel injection system 30 is characterized such that a pressure sensor 20 located in the second fuel injector 10 in a manner such that the pressure sensor 20 is adapted to measure pressure of fuel throughout the fuel injection system 30.

[0008] The detailed layout of the fuel injection system 30 and the components of the fuel injection system 30 can be explained as follows. The high pressure fuel pump 32 receives fuel from a fuel tank through a low pressure circuit comprising a feed pump and a filter. A person skilled in the art will already be aware of the components involved in low pressure circuit of a fuel injection system. For the purposes of this disclosure we will focus on the fuel injector and the fuel injection system downstream of the high pressure pump12. The high pressure pump 32 has an outlet 36 which is connected to one of the at least

two fuel injectors. The outlet 36 of the high pressure pump 30 is in fluid communication with the inlet 42 of the first fuel injector 34. The fuel from the inlet 42 flows into the fuel flow path inside the first injector 34 and at least a part of the fuel flows out of the outlet 38 of the first fuel injector to the second fuel injector 10. The outlet 38 of the first injector 34 is in fluid communication with the inlet 40 of the second fuel injector 10.

[0009] The second injector 10 comprises a recess 18 and the pressure sensor 20 is located in the recess 18 in a manner such that a chamber 22 is formed in the recess 18 between an end wall 24 of the recess 18 and the pressure sensor 20. The second injector 10 comprises a flow path 26 extending from the fuel flow path 16 of the second injector 10 to the recess 18 such that fuel from the fuel flow path 16 flows into the chamber 22. The first injector 34 comprises an inlet 42 and an outlet 38. The inlet 42 is in fluid communication with outlet 36 of the high pressure fuel pump 32 and the outlet 38 is in fluid communication with inlet 40 of the second injector 10. The pressure sensor 20 is located in the recess 18 of the second injector 10 in a manner such that time take to measure pressure by the pressure sensor 20 is lesser than the time between injection events of the at least two injectors. The pressure sensor 20 is located in the recess 18 using internal threads in the recess 18 and mating threads provided on the pressure sensor 20. Upon tightening, the threaded joint between threads on the recess 18 and the pressure sensor 20 produces axial force needed for sealing the high pressure interface between second injector 10 and pressure sensor 20. The pressure sensor 20 is fitted on the second injector 10 along an axis, which is perpendicular or inclined to the injector main axis to suit engine/vehicle packaging. An electrical interface of the pressure sensor 20 is used for transmitting the pressure signal to an electronic control unit. The drive current for the injector actuation is received through the electrical interface.

[0010] The working of the fuel injection system 30 and the fuel injector 10 is described in detail in the description below. The fuel, which is, pressurized in the high pressure pump 32 flows from the outlet 36 towards the inlet 42 of the first injector 34. As mentioned, earlier the fuel from the inlet 42 flows into the fuel flow path inside the first injector 34 and at least a part of the fuel flows out of the outlet 38 of the first fuel injector to the second fuel injector 10. When the fuel enters the second injector 10, the fuel flows through the fuel flow path 16. A part of the fuel flows from the fuel flow path 16 to the flow path 26 and enters the chamber 22. The chamber 22 is formed between the end wall 24 of the recess 18 and the pressure sensor 20 located in the recess 18. When the fuel from the fuel flow path 16 enters the flow path 26 it enters the chamber 22. When the fuel is collected in the chamber 22, it exerts pressure on the pressure sensor 20. The pressure exerted on the components of the pressure sensor is used to the pressure sensor provides a signal to an electronic control unit of the fuel injection system 30. The electronic control unit thus receives fuel pressure information. This fuel pressure information is further used to operate the fuel injection system as desired.

[0011] The fuel injection system 30 is such that only one of the two injectors viz., the second injector 10 has the pressure sensor 20, which is fitted onto the injector. During the working of the fuel injection system 30 one single pressure sensor 20 provided in the second fuel injector 10 which is able to provide fuel pressure information of the entire fuel injection system 30. When the fuel enters the first injector 34 and the second injector 10, the pressure build up in the fuel injection system is sensed by the pressure sensor 20 provided in the second injector. When an injection event occurs, say in a first injector 34 there may be a reduction in the fuel pressure in the overall fuel injection system. However, the components of the fuel injection system 10 are designed in such a way that the time taken to measure the fuel pressure between two successive injection events is lower that time between two successive injection events. The pressure sensor 20 is adapted to measure pressure of fuel throughout the fuel injection system and further control the fuel supplied to the high pressure pump 32 of the fuel injection system 30. The measurement of the fuel pressure using the single pressure sensor 20 further allows overall fuel injection system 30 pressure control as fuel pressure information can be used to meter the fuel in the fuel injection system 30.

[0012] By using a fuel injector according to the invention having an integral pressure sensor, it is possible to dispense with a central pressure accumulator, in which the pressure sensor is fitted. The fuel injection system 30 as disclosed can be designed with few components and is therefore inexpensive. Since the pressure sensor is located in the fuel injector itself, the pressure can easily be measured, even in systems that do not have a central pressure accumulator. It is therefore possible to use simple and inexpensive sensors. Further, since only one pressure sensor is used for the entire fuel injection system the system further.

[0013] It should be understood that embodiments explained in the description above are only illustrative and do not limit the scope of this invention. Many such embodiments and other modifications and changes in the embodiment explained in the description are envisaged. The scope of the invention is only limited by the scope of the claims.

Claims

1. A fuel injector (10) comprising:

- an injector body (12), said injector body (12) comprising an inlet port (14) adapted to allow fuel to enter said injector body, a fuel flow path (16) defined within said injector body (12) adapted to allow fuel to flow from said inlet port (14)

to a injector needle of said fuel injector (10); and
a recess (18) provided in said injector body (12) **characterized in that**

a pressure sensor (20) located in said recess (18) in a manner such that a chamber (22) is formed in said recess (18) between an end wall (24) of said recess (18) and said pressure sensor (20); and
a flow path (26) extending from said fuel flow path (16) to said recess (18) such that fuel from said fuel flow path (16) flows into said chamber (22).

2. A fuel injection system (30) comprising

- a high pressure fuel pump (32);
- at least 'n' fuel injectors, 'n' being the number of injector in said fuel injection system, a first fuel injector (34) of said at least 'n' fuel injectors in fluid communication with an outlet (36) of said high pressure fuel pump (32) and the second to n^{th} fuel injector adapted to receive fuel the $(n-1)^{th}$ fuel injector;

characterized in that
a pressure sensor (20) located in said n^{th} fuel injector (10) in a manner such that said pressure sensor (20) is adapted to measure pressure of fuel throughout the fuel injection system (30).

3. The fuel injection system (10) as claimed in claim 2, wherein said n^{th} fuel injector (10) comprises a recess (18) and said pressure sensor (20) located in said recess (18) in a manner such that a chamber (22) is formed in said recess (18) between an end wall (24) of said recess (18) and said pressure sensor (20).

4. The fuel injection system (10) as claimed in claim 2 and 3, wherein said n^{th} fuel injector (10) comprises a flow path (26) extending from fuel flow path (16) of said n^{th} fuel injector (10) to said recess (18) such that fuel from said fuel flow path (16) flows into said chamber (22).

5. The fuel injection system (10) as claimed in claim 2, wherein said first injector (34) comprising an inlet (42) and an outlet (38), wherein said inlet (42) is in fluid communication with outlet (36) of said high pressure fuel pump (12) and said outlet (38) is in fluid communication with inlet (40) of said n^{th} fuel injector (10).

6. The fuel injection system (10) as claimed in claim 2, wherein said pressure sensor (20) is located in said recess (18) of said n^{th} fuel injector (10) in a manner such that time taken to measure pressure by said pressure sensor (20) is lesser than the time between injection events of said at 'n' injectors.

7. The fuel injection system (10) as claimed in claim 2, wherein said pressure sensor 20 is adapted to measure pressure of fuel throughout the fuel injection system and further control the fuel supplied to said high pressure pump (32) of said fuel injection system.

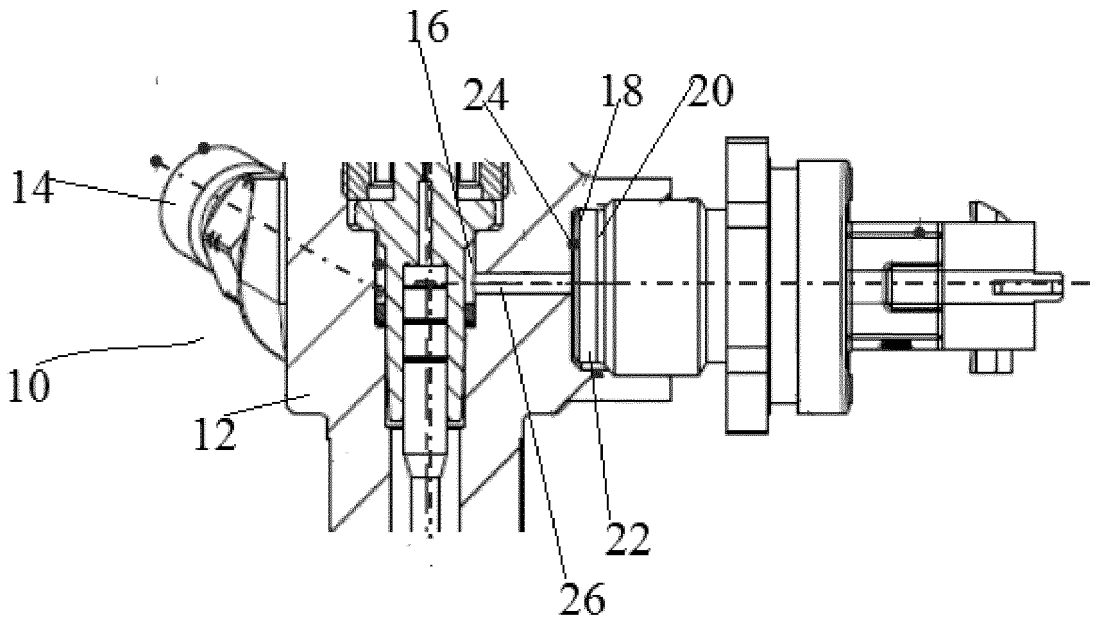

Figure 1

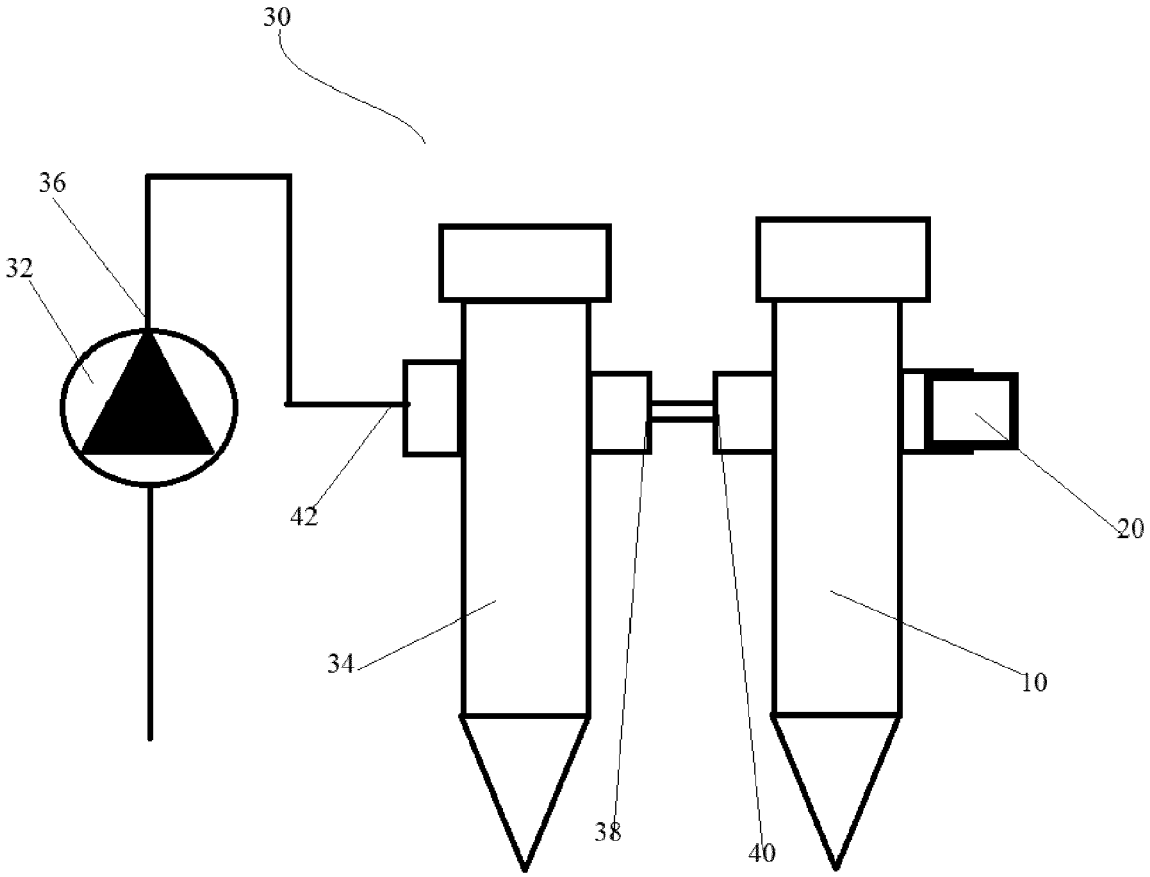

Figure 2

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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