(12) UK Patent Application (19) GB (11) 2467321 (13) A

(43) Date of A Publication 04.08.2010

(21) Application No: 0901419.2

(22) Date of Filing: 28.01.2009

(71) Applicant(s):
Fluid Transfer Systems Ltd
(Incorporated in the United Kingdom)
Unit 17 Sir Frank Whittle Business Center,
Great Central Way, Butlers Leap, RUGBY,
Warwickshire, CV21 3XH, United Kingdom

(72) Inventor(s):
Kenneth William Merritt

(continued on next page)

(51) INT CL:
F02M 55/00 (2006.01) ***F02M 61/16*** (2006.01)
F16B 2/06 (2006.01) ***F16K 15/04*** (2006.01)

(56) Documents Cited:
EP 1662132 A2 **EP 0918156 A1**
WO 2008/020145 A2 **FR 001477777 A**
US 5666922 A **US 20050001426 A1**
US 20020053799 A1

(58) Field of Search:
INT CL **F02M, F16B**
Other: **EPODOC, TXTE, WPI**

(54) Title of the Invention: **Fuel pipe component**
Abstract Title: **Snap-fit connector and non-return valve for a fuel injector leak-off line**

(57) A snap-fit connector 300 for the leak-off line(s) of a fuel injector has a leak-tight entry plug for attachment to a leak-off port 242 of a fuel injector and an exit port arm 206 for attachment of a fuel leak-off line. The snap-fit formation may be a pair of curved spring arms 222, 224 which are pushed onto an injector housing 240 and may be held together by a clip or staple 304. The connector may be made from fibre-reinforced nylon. The connector may have two exit port arms (204,206, figs.2a, 2b). A shut-off valve, fig.4c, for a leak-off line may comprise a two-part body enclosing a ball 306 urged by a spring 307 with low closing force against a seat 316. In use, fuel at normal drain pressure passes through the valve against the closing force of the spring but if the low pressure line is disconnected eg for maintenance, the fuel upstream of the shut-off valve is retained.

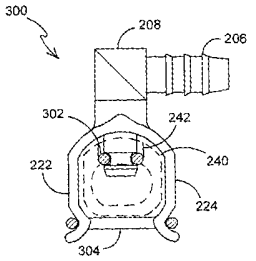

FIGURE 3A

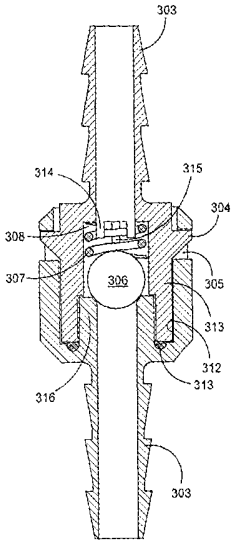

FIGURE 4C

GB 2467321 A

(74) Agent and/or Address for Service:
Withers & Rogers LLP
Goldings House, 2 Hays Lane, LONDON, SE1 2HW,
United Kingdom

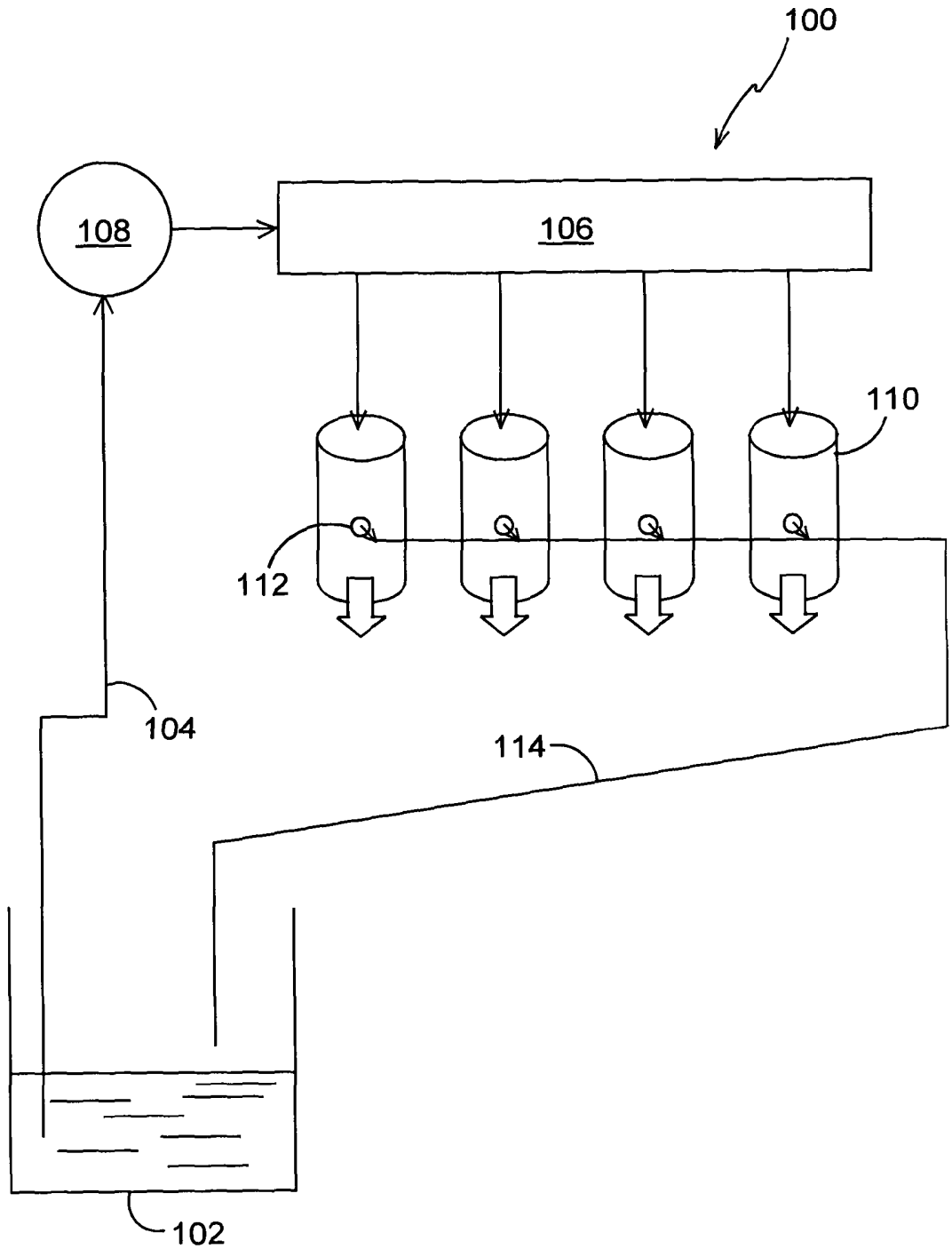

FIGURE 1

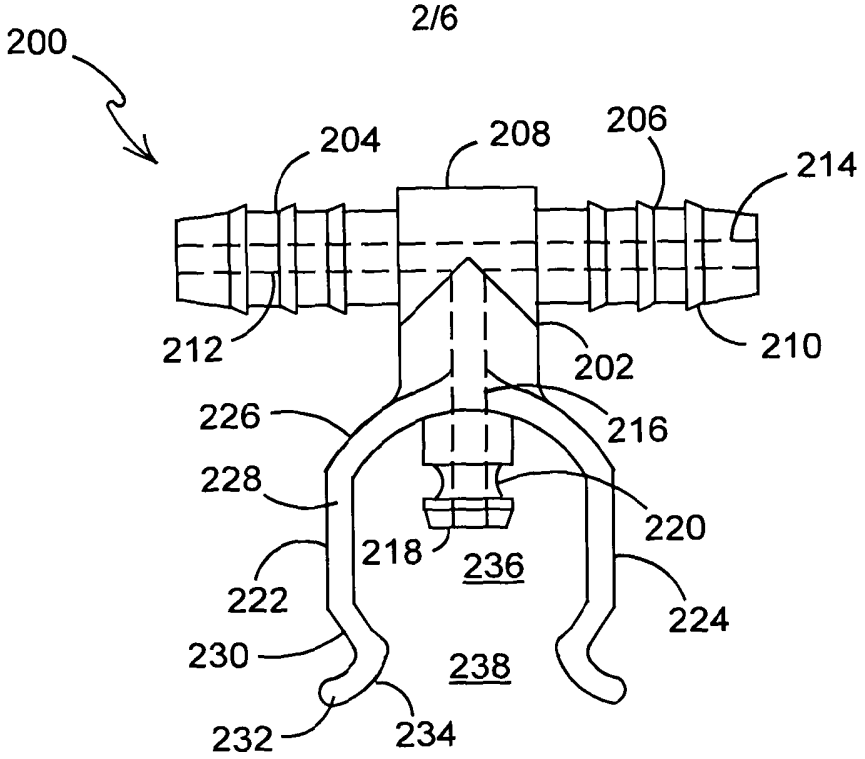

FIGURE 2A

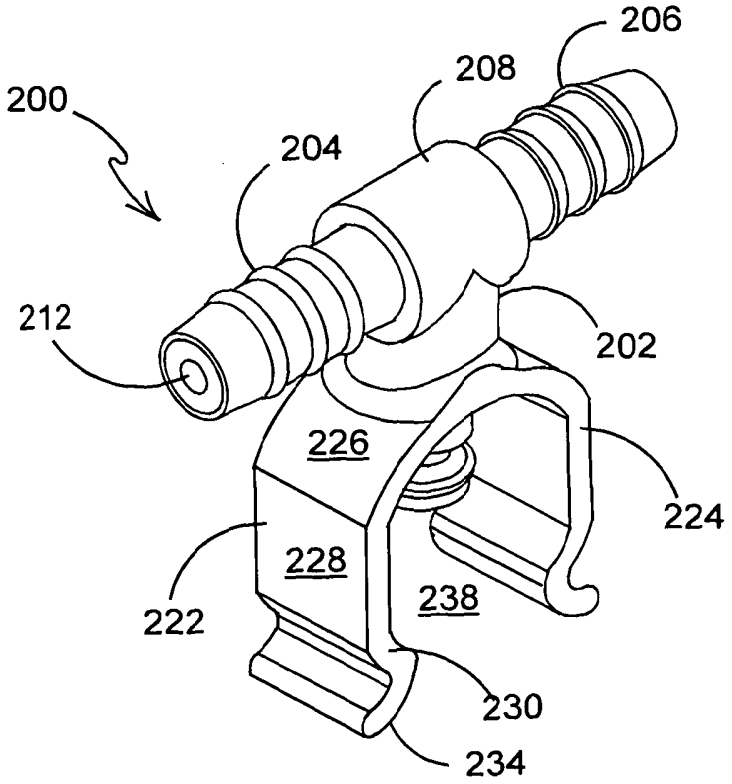

FIGURE 2B

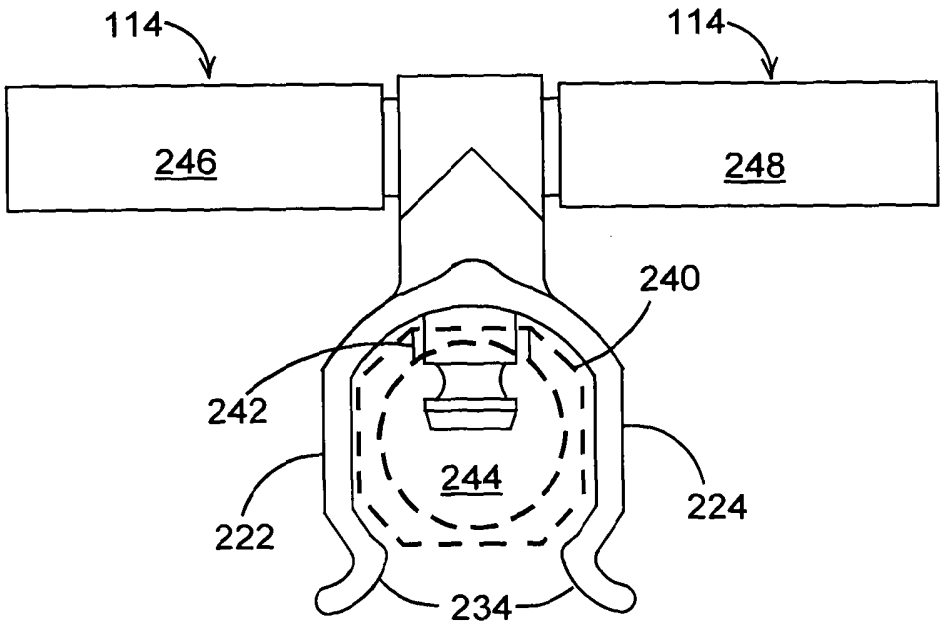

FIGURE 2C

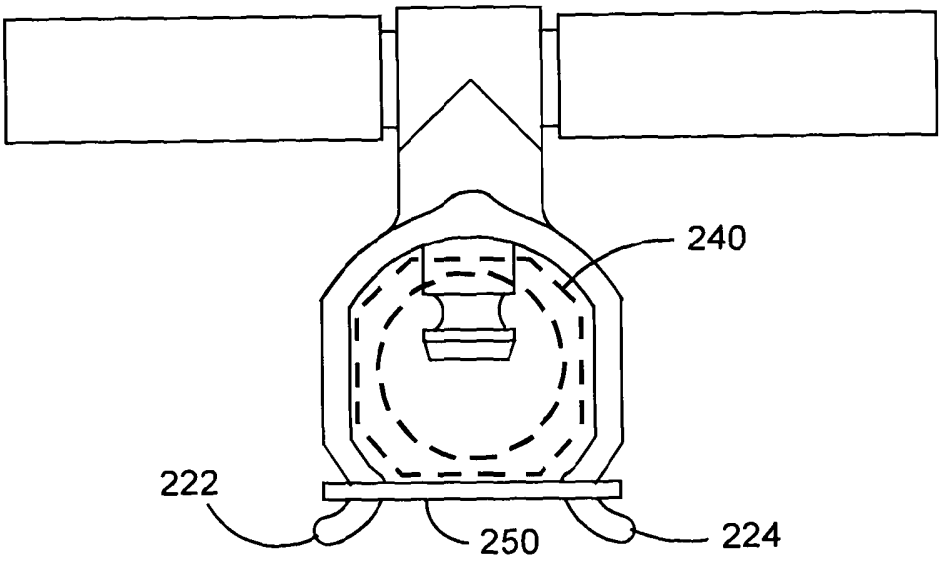

FIGURE 2D

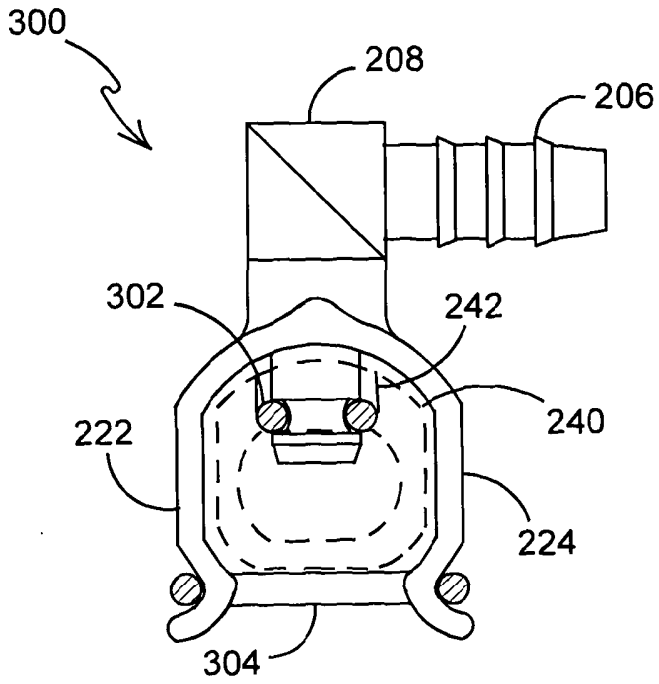

FIGURE 3A

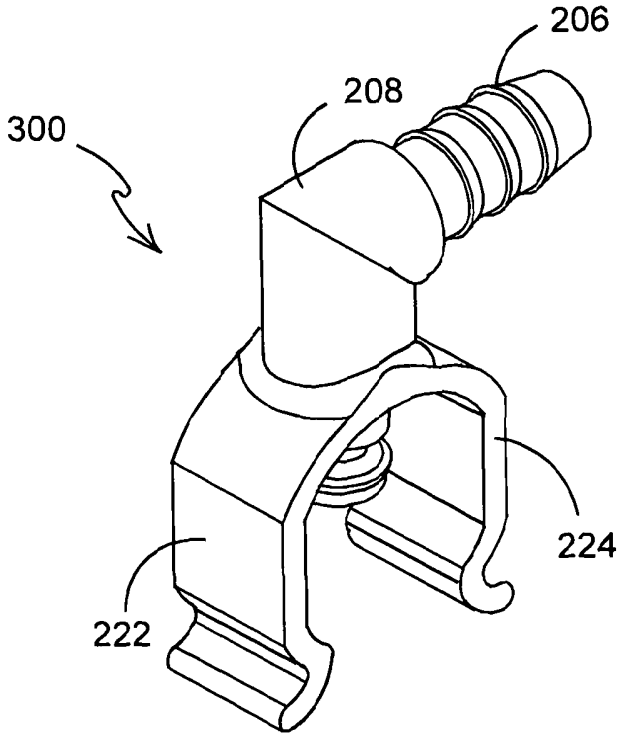

FIGURE 3B

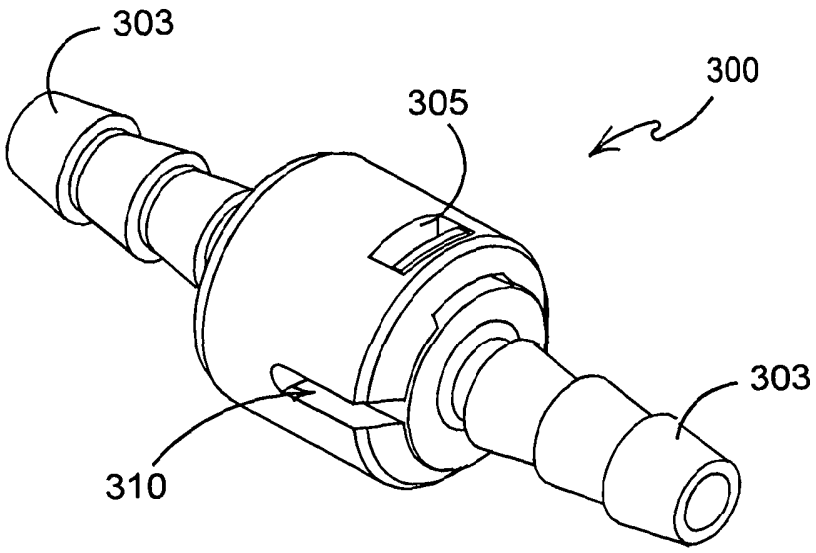

FIGURE 4A

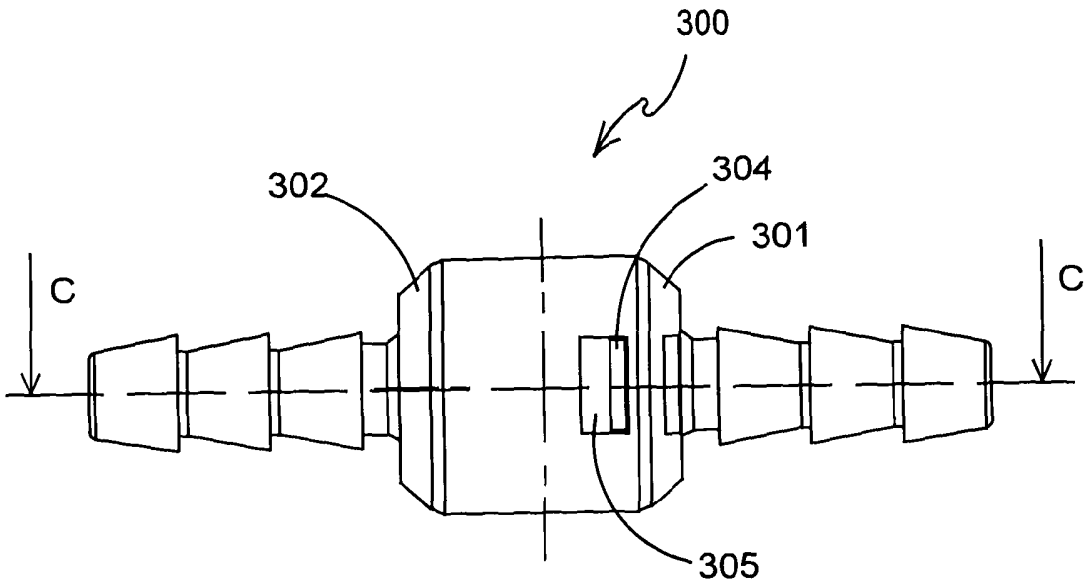

FIGURE 4B

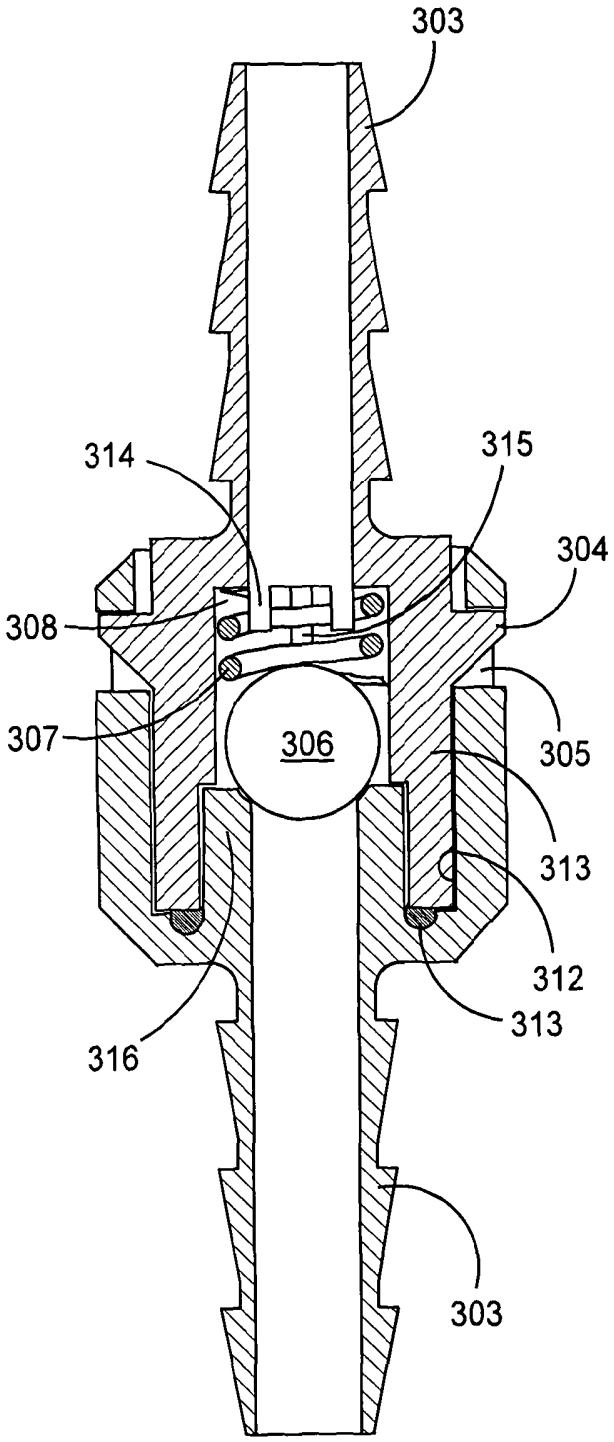

FIGURE 4C

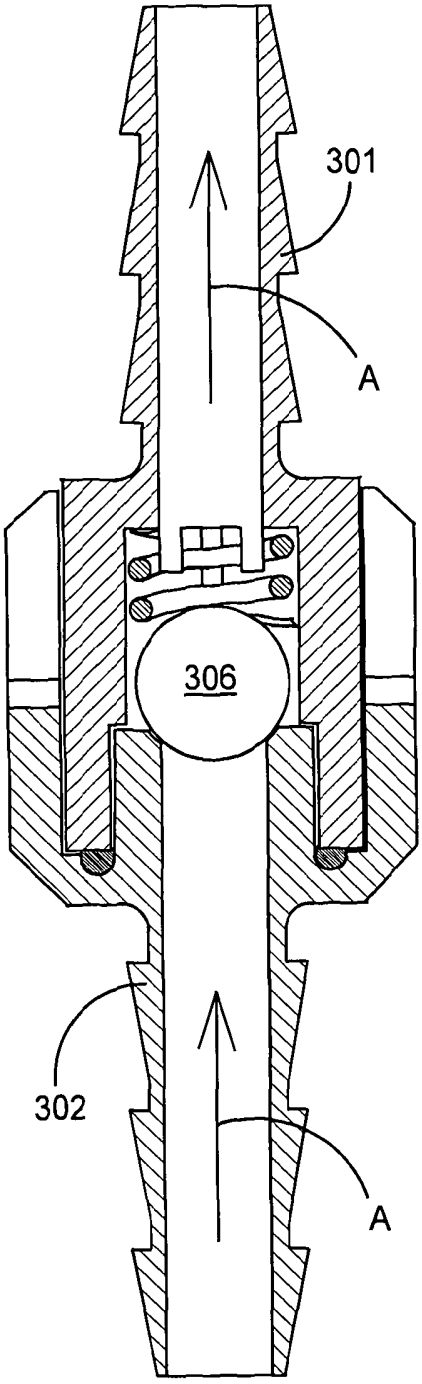

FIGURE 4D

Fuel pipe component

The present invention relates to fuel pipe components. More specifically, the present invention relates to fuel pipe components used in directing leak-off flow from internal combustion engines.

In internal combustion engines, fuel can be introduced into the cylinder in a number of ways. In diesel combustion engines, fuel is often directly introduced into each of a plurality of cylinders by a fuel injector. In common rail diesel engines, the fuel is initially held under significant pressure in a common rail, or pressure chamber upstream of the injectors. Each injector comprises a valve to release the fuel into the cylinder at the appropriate moment, as required.

As a by product of this process, excess fuel accumulates in the injectors which cannot return directly to the common rail, nor can it enter the cylinder. This excess fuel is removed from the injectors via a leak-off system, in which each injector is in fluid communication with a low-pressure leak-off line which returns excess fuel to the fuel tank.

It is an object of the present invention to provide an improved leak-off system.

According to a first aspect of the invention there is provided a fuel injector leak-off line connector comprising an entry port for connection to a leak-off port of a fuel injector and an exit port for attachment of a fuel leak-off line, the entry and exit ports in fluid communication, which connector comprises a snap fit formation for attachment to an injector housing to retain the entry port in fluid communication with the leak-off port of the injector.

Such a connector provides a convenient and direct attachment to a fuel injector, without the need for other fixing or locking components.

In the preferred embodiment the snap-fit formation and the entry port are independent so as to ensure that the function of one does not affect the other.

Preferably the entry port is defined by a tubular circular projection having an external annular groove for an o-ring. Such a projection allows a push fit into the leak-off port of the injector body, with sealing to the injector body being provided by the o-ring. The o-ring is typically a separate resilient ring sprung over the nose of the projection in use.

The snap-fit formation preferably comprises opposed resilient arms for engagement around the body of a fuel injector on either side. The ends of the arms preferably turn outwardly to each define a channel. The outward turn both facilitates push fitting of the connector on to the injector body, and provides opposed channels for receiving a lock staple or the like.

The connector may have plural exit ports to permit insertion into a leak-off line whereby flow of leak-off fuel through the connector is via the exit ports enabled. In one embodiment two opposed exit ports are provided in substantially the same plane as the opposed resilient arms. The exit ports are typically in-line.

According to a second aspect of the invention there is provided a fuel leak-off line non-return valve.

Preferably the non-return valve inhibits flow in a first direction, and inhibits flow under a predetermined pressure in a second direction.

The preferred valve comprises a two-part housing having a tubular circular male port fitting within a tubular circular female port. The tubular male port includes a concentric outer wall to tightly receive the tubular female port and to define a latch aperture for a latching tongue of the female port.

The male tubular port defines a seat for a resiliently biased sealing member, typically a ball. Internal ribs of the female port guide the sealing member longitudinally of a chamber defined between the male and female ports.

Other features of the invention will be apparent from the following description of embodiments, by way of example only and shown in the accompanying drawings in which:-

Figure 1 is a schematic view of a common rail diesel fuel leak-off system,
Figure 2a is a side view of a first embodiment of a connector in accordance with a first aspect of the present invention,
Figure 2b is a perspective view of the connection of figure 2a,
Figure 2c is a side view of the connector of figure 2a installed,
Figure 2d is a side view of the connector of figure 2a installed,
Figure 3a is a side view of a second embodiment of a connector in accordance with a first aspect of the present invention,
Figure 3b is a perspective view of the connector of figure 3a,
Figure 4a is a perspective view of a valve in accordance with a second aspect of the present invention,
Figure 4b is a side view of the valve of figure 4a,
Figure 4c is a side section view of the valve of figure 4a along line CC in figure 4b, and,
Figure 4d is a side section view of the valve of figure 4a at 90 degrees to the view of figure 4c.

Referring to figure 1, a diesel engine comprises a fuel system 100. The fuel system 100 comprises a fuel tank 102 from which a fuel feed line 104 feeds a common rail pressure chamber 106 via a pump 108. The common rail pressure chamber 106 is in fluid communication with a plurality of fuel injectors 110, each of which comprises a valve (not shown) to release fuel into a cylinder of the engine (not shown).

Each injector 110 has a leak-off port 112 for the removal of excess fuel. Each leak-off port 112 is connected to a common leak-off line 114. The leak-off line 114 is in fluid

communication with the fuel tank 102 to return excess fuel thereto. The leak-off line may return fuel to a location downstream of the pump but upstream of the fuel tank.

Turning to figures 2a, and 2b a connector 200 is shown. The connector 200 comprises a body 202 substantially in the shape of a "T". The body 202 comprises two oppositely directed arms 204, 206 and a central part 208. Each arm 204, 206 is cylindrical and comprises a number of ribs 210 configured to grip a fuel pipe placed over the arm 204, 206. Each arm 204, 206 comprises a central channel 212, 214 respectively. Both channels 212, 214 are in fluid communication with a first end of a feed channel 216 running through the central part 208.

A plug 218 is defined at an end of the central part 208 distant from the arms 204, 206, extending away therefrom, and is generally cylindrical comprising a circumferential seal groove 220. The seal groove 220 is configured to receive an o-ring (not shown) to provide a fuel-tight seal. The feed channel 216 opens at the end of the plug 218.

A pair of grip arms 222, 224 each extend in the same direction as the plug 218 at the point where the plug 218 and the central part 208 meet. The grip arms are opposite and identical and as such only grip arm 222 will be described here.

The grip arm 222 comprises a curved portion 226 depending from the central part 208, a straight portion 228 depending from the curved portion 226 in the same direction as the plug 218 and a return curved portion 230 depending from the straight portion 228.

The return curved portion 230 has substantially the same curvature and origin of curvature as the curved portion 226. The return curved portion 230 terminates in a tab 232 which curves outwardly with respect to the plug 218 to present a curved face 234.

Therefore both grip arms define an inner region 236 and a neck 238 between the return curved portions 230.

The connector 200 is constructed from a plastics material, in particular 30 percent fibre reinforced nylon 12. Therefore the grip arms 222, 224 exhibit a flexibility and resilience when deformed.

In use, the curved faces 234 of the grip arms 222, 224 are pushed onto an injector housing 240 as shown in figure 2c. The grip arms 222, 224 flex and open to receive the housing 240 through the neck 238 and into the region 236.

The plug 218 engages with a leak-off port 242 of the injector housing 240 for fluid communication with a leak-off chamber 244 inside the injector housing 240.

Once the housing is within the region 236, the grip arms 222, 224 resile to their undeformed state and the connector 200 is held in position engaged with the housing 240.

Once connected, the leak-off line 114 can be connected in the form of a pair of flexible hoses 246, 248.

Referring to figure 2d, an alternative arrangement is shown in which a clip or staple 250 engages the free ends of the grip arms 222, 224 from the outside to ensure that the connector 200 cannot be pulled off the housing 240 without first removing the clip 250.

Referring to figure 3a, an alternative connector 300 is shown with reference numerals per connector 200. The connector 300 has a single arm 206 and is designed to be placed around the first injector housing of a line of housings. Figure 3a shows an o-ring 302 in the seal ridge 220 which is arranged to provide a fluid tight seal with the leak-off port 242.

A clip or staple 304 holds the grip arms 222, 224 together to prevent accidental separation of connector and fuel injector body.

Figs. 4a-4d illustrate a shut-off valve for a low pressure fuel line, such as the leak-off line from the fuel injectors of a diesel engine.

A two-part body 300 comprises male and female members 301,302 each having a tubular pipe connection tail 303 of conventional form. The tails accommodate push-fit fuel-resistant resilient tubing of around 6-8 mm diameter.

The male and female members 301,302 have respective opposed snap fitting lugs 304 and apertures 305 to enclose a ball 306 and return spring 307 within an internal chamber 308 thereof, as illustrated. The apertures extend through the wall of the female member 302 so as to allow visual confirmation of correct assembly.

Opposed pegs 309 (not shown) and slots 310 are also provided in the respective male and female members to assure correct orientation of the lugs 304 and apertures 305. The pegs 309 are substantially at right angles to the lugs 304.

The male member comprises a tubular projection 311 which is for close-fitting engagement in an annular recess 312 of the female member. A seal 313, typically in the form of an o-ring is provided at the base of the recess 312 for engagement with the axial end of the projection 311.

The internal wall of the recess 312 is the external wall of a tubular seat 316 from which the corresponding tail extends.

The male member 302 define the internal chamber 308 which houses the ball 306 for axial movement with respect to the seat 316. The spring 307 reacts against the male member 302 as illustrated, and is retained centrally by equispaced lugs 314 projecting therein from the tail side. Equispaced ribs 315 guide the ball 306 for axial movement.

In use fuel passes through the shut-off valve against the closing force of the spring 307, as illustrated by arrows A of Fig. 4d. The closing force is low, so that the ball lifts from the seat at normal drain pressure; accordingly no substantial flow restriction is imposed. However should the low pressure line become disconnected, for example

for maintenance or servicing, the fuel upstream of the shut-off valve is retained, rather than drawing from the disconnection open pipe end. Thus the fluid integrity of the system is preserved, and introduction of air and/or containment can be avoided.

Reverse flow is completely obviated since any pressure differential urges the ball 306 onto the seat 316. The seat typically has a conical form so as to give a line contact seal at the seat surface.

Claims

1. A fuel injector leak-off line connector comprising an entry port for connection to a leak-off port of a fuel injector and an exit port for attachment of a fuel leak-off line, the entry and exit ports in fluid communication,

wherein the connector comprises a snap fit formation for attachment to an injector housing to retain the connector relative to an injector housing.

2. A fuel injector leak-off line connector according to claim 1 in which the snap fit formation comprises a pair of resilient arms arranged to at least partially surround a fuel injector housing.

3. A fuel injector leak-off line connector according to claim 2 in which the resilient arms define an entry region comprising a pair of curved contact surfaces arranged to deform the arms upon entry of an injector housing.

4. A fuel injector leak-off line connector according to claim 2 or claim 3 in which said entry port is defined by a plug is arranged to extend between the arms.

5. A fuel injector leak-off line connector according to any of claims 2 to 4 comprising a retaining member arranged to selectively constrain relative movement of the arms to retain an injector housing.

6. A fuel leak-off line non-return valve.

7. A fuel leak off line non-return valve arranged to inhibit flow in a first direction, and inhibits flow under a predetermined pressure in a second direction.

8. A fuel leak off line non-return valve according to claim 6 or claim 7 comprising a first housing part having a first leak-off line connector and a second housing part having a second leak-off line connector in which the first and second housing parts are

engageable to put the first and second leak off line connectors in fluid communication via a snap fit.

9. A fuel leak off line non-return valve according to claim 8 in which the snap fit comprises a resilient tab on an external surface of the first housing part engageable with a recess on an internal surface of a second housing part.

10. A fuel leak off line non-return valve according to claim 9 comprising mating means on the first and second housing to only permit insertion of the first housing part into the second housing part in a predetermined position in which the tab and recess are aligned.

11. A fuel leak off line non-return valve according to any of claims 6 to 10 in which the valve comprises a ball movable within a channel to open and close the valve.

12. A fuel leak off line non-return valve according to claim 11 in which the ball is movable against a resilient member.

13. A fuel leak off line non-return valve according to claim 11 or 12 in which the channel comprises a flow passage defined in an internal wall and arranged to allow passage of fluid through the valve when the ball is in a first position, and to inhibit flow of fluid through the valve when the ball is in a second position.

14. A fuel leak-off line for connection to an injector leak-off port, the leak-off line comprising a non-return valve according to any of claims 6 to 13.

15. A fuel injector leak-off line connector substantially as described herein with reference to or in accordance with the accompanying drawings.

16. A fuel leak off line non-return valve substantially as described herein with reference to or in accordance with the accompanying drawings.

Application No:	GB0901419.2	**Examiner:**	John Twin
Claims searched:	1 to 5	**Date of search:**	27 April 2010

Patents Act 1977: Search Report under Section 17

Documents considered to be relevant:

Category	Relevant to claims	Identity of document and passage or figure of particular relevance
X,Y	X:1-4; Y:5	WO 2008/020145 A2 (Delphi Technologies)
X,Y	X:1-4; Y:5	EP 1662132 A2 (ITT Manufacturing)
X,Y	X:1-4; Y:5	EP 0918156 A1 (Renault)
X,Y	X:1-4; Y:5	US 5666922 A (Robert Bosch)
X	1	US 2002/0053799 A1 (Brandt et al.) - note eg snap fit formations 46a
X	1	US 2005/0001426 A1 (Dick et al.) - note eg snap fit formation 25
Y	5	FR 1477777 A (Metal Usine) - note eg retaining element 8

Categories:

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.

Field of Search:

Search of GB, EP, WO & US patent documents classified in the following areas of the UKC^{X} :

Worldwide search of patent documents classified in the following areas of the IPC

F02M; F16B

The following online and other databases have been used in the preparation of this search report

EPODOC, TXTE, WPI

International Classification:

Subclass	Subgroup	Valid From
F02M	0055/00	01/01/2006
F02M	0061/16	01/01/2006
F16B	0002/06	01/01/2006
F16K	0015/04	01/01/2006