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(54) **FUEL INJECTORS**

(57) The invention comprises a fuel injector (20) for supplying fuel to a fuel combustion engine, the fuel injector (20) comprising an injector body (21) adapted to receive an injector assembly and supply fuel thereto and a backleak nipple (23a) communicating with an internal chamber of the injector body (21), the backleak nipple (23a) being connected to a backleak pipe (24) via a backleak connector (23) for returning excess fuel to a low pressure fuel tank. The fuel injector (20) comprises a support mechanism (25) adapted to bias the backleak pipe (24) towards the injector body (21).

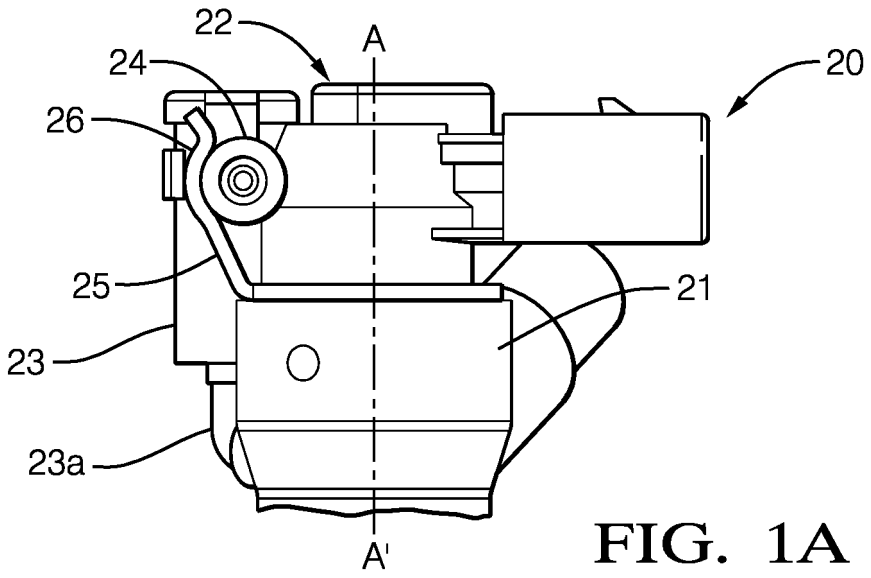

FIG. 1A

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Description

BACKGROUND

Technical Field

[0001] The present invention relates generally to the field of fuel injectors. More particularly, but not exclusively, the present invention concerns an improved injector support member for a backleak pipe in a fuel combustion engine.

Description of the Related Art

[0002] Fuel combustion engines require a fuel injector to supply a calculated amount of the fuel to the combustion chamber of an engine for ignition.

[0003] A typical fuel injector comprises an injector body and an electrical connector that fits onto the injector body. The injector body is essentially a plain cylinder comprising a chamber into which an injector assembly is fitted. The injector body is then mounted within a cylinder head and, a backleak circuit is required to evacuate excess fuel from a nozzle needle and returning said fuel to a low pressure fuel tank. The injector is further provided with a backleak nipple connected to the chamber, said backleak nipple protruding from the injector body. The backleak circuit comprises a plurality of backleak connectors each being connected to the backleak nipple of a fuel injector and, a plurality of section of backleak pipes each section being connected at both ends to two backleak connectors.

[0004] Although the backleak connectors are directly connected to the injector, the backleak pipe is required to be mounted with a clearance of few millimetres to each fuel injector. The rationale behind this is to avoid vibration transmissions from the injector to any components, including backleak pipes, that are not directly fixed to the injector. For instance, the backleak connector are connected to the backleak nipple while the pipes being only connected to backleak connector are not directly linked to the injector.

[0005] Reduced space available around an engine obliges to specific difficult and costly arrangements of the backleak.

[0006] It is an object of the present invention to address one or more of the problems of known arrangements, particularly, but not exclusively for fuel combustion engines.

[0007] Therefore, it is now desired to provide an improved fuel injector providing an optimised support member for a backleak pipe.

SUMMARY OF THE INVENTION

[0008] In a first aspect of the present invention there is provided a fuel injector for supplying fuel to a fuel combustion engine, the fuel injector comprising an injector body adapted to receive an injector assembly and supply fuel thereto and a backleak nipple communicating with an internal chamber of the injector body, the backleak nipple being connected to a backleak pipe for returning excess fuel to a low pressure fuel tank. The fuel injector further comprises a support mechanism adapted to fix the backleak pipe in a predetermined position on to the injector body.

With this fuel injector, the support mechanism can provide a snug fit between the backleak pipe and the injector body thereby reducing damage and wear.

[0009] Preferably, the support mechanism comprises a clip to receive the backleak pipe.

[0010] Preferably, the support mechanism is formed partly by a support member and partly by the injector body. Preferably, therefore, the support member comprises a clip adapted to bias the backleak pipe into a substantially opposingly-disposed receiving hollow formed in the injector body. Most preferably, the receiving hollow is formed in an electrical connector housing of the injector body.

[0011] Alternatively, the clip may be formed solely by a support member. Preferably, therefore, the support member comprises at least two substantially opposingly-disposed clips adapted to receive and hold with snug fit between them the backleak pipe. Preferably, a first of said clips is adapted to bias the backleak pipe towards the injector body, and preferably, a second of said clips is adapted to provide a supporting component. The support member may comprise three clips, which may comprise a first clip to bias the backleak pipe towards the injector body and a second and third clip adapted to provide supporting components for disposal adjacent the injector body, or *vice versa.*

[0012] In both clip arrangement, preferably, the clip(s) and/or the hollow are shaped to at least partially comprise a concave curvature in which is received the backleak pipe. Accordingly, the clip(s) and/or the hollow may adopt a configuration to match the outer profile of the backleak pipe.

[0013] Preferably, the support member is resiliently flexible. The support member may comprise resiliently flexible plastics, or metal, or metal alloy, for example stainless steel. Where the support member comprises plastics, the support member may be formed by plastics molding. Where the support member comprises metal or metal alloy, the support member may be formed by stamping and folding the metal.

[0014] The support member may be integrally formed with the injector body.

[0015] Preferably, the support member comprises an independently-formed member mounted on said injector body.

[0016] The independently-formed support member may be connected to the injector body with a ring connector. The ring connector may be adapted to be secured between the injector body and an electrical connector mounted on top of the injector body. The independently-

formed support member may be press-fitted onto the injector body.

[0017] In both clip arrangements, the support member preferably comprises one or more legs for the clip(s).

[0018] Preferably, where the support member comprises opposingly-disposed clips, each clip is mounted atop an individual leg and the legs of the clips lean away from one another. Alternatively, each opposingly-disposed clip may be mounted atop a shared leg.

[0019] Preferably, with the independently-formed support member, each leg is connected to the ring connector by a foot. The feet preferably extend generally laterally outwardly from a segment of the ring connector. Preferably, the feet are configured to extend different lengths from the ring connector in order to provide a base of said legs in a substantially linear configuration.

[0020] In a second aspect of the present invention there is provided a support mechanism for mounting a backleak pipe relative to an injector body of a fuel injector, characterised in that the support mechanism is adapted to bias the backleak pipe towards the injector body.

[0021] It will be appreciated that the preferred features described in relation to the first aspect of the invention also apply to the second aspect of the invention.

[0022] In a third aspect of the present invention there is provided a fuel injector for supplying fuel to a fuel combustion engine, the fuel injector comprising an injector body adapted to receive an injector assembly and supply fuel thereto and a backleak nipple communicating with an internal chamber of the injector body for returning excess fuel to a low pressure fuel tank, the backleak nipple being connected to a backleak pipe leading to a low pressure fuel reservoir, characterised in that the injector body comprises a support mechanism comprising a receiving hollow formed therein to receive said backleak pipe.

[0023] It will be appreciated that the preferred features described in relation to the first and second aspects of the invention also apply to the third aspect of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0024] For a better understanding of the invention, and to show how exemplary embodiments may be carried into effect, reference will now be made to the accompanying drawings in which:

Figure 1A is a schematic partial side view of a fuel injector with a first support member according to a first embodiment of the invention;

Figure 1B is a schematic perspective side view of the first support member of Figure 2A;

Figure 1C is a schematic partial perspective view of the fuel injector of Figure 2A;

Figure 2A is a schematic partial side view of a fuel injector with a second support member according to a second embodiment of the invention;

Figure 2B is a schematic perspective side view of the second support member of Figure 3A;

Figure 2C is a schematic partial perspective view of the fuel injector of Figure 3A; and

Figure 3 is a schematic perspective side view of a third support member according to a third embodiment of the invention.

DETAILED DESCRIPTION OF THE EXEMPLARY EMBODIMENTS

[0025] As shown in the Figures, the invention comprises a fuel injector 20, 30 for supplying fuel to a fuel combustion engine, the fuel injector 20, 30 comprising an injector body 21, 31 adapted to receive an injector assembly (not shown) and supply fuel thereto and, a backleak nipple 23a, 33a communicating with an internal chamber of the injector body 21, 31, the backleak nipple 23a, 33a being connected to a backleak pipe 24, 34 via a backleak connector 23, 33 for returning excess fuel to a low pressure fuel tank (not shown). The fuel injector 20, 30 further comprises a support mechanism 25, 35, 46 fixed to the body 21, 31 and adapted to receive and hold in place the backleak pipe 24, 34 relative to the injector body 21, 31.

The backleak connector 23, 33, has a T-shape with vertical leg connected to the injector backleak nipple 23a, 33a and, each of the two horizontal arms connected to a section of the backleak pipe, the overall assembly of the sections and connectors forming the backleak pipe 24,34.

[0026] A first embodiment of the invention is shown in Figures 1A, 1B and 1C.

[0027] As can be seen in Figure 1A, the injector body 21 comprises the backleak nipple 23a with the backleak connector 23 mounted thereover in an orientation generally parallel with an axis A-A' of the injector body 21. The backleak connector 23 is disposed at an upper end of the body 21 and to one side, so as to be proximal to the body 21 and an electrical connector casing 22 that sits atop of the injector body 21. The backleak nipple 23a is connected to an interior chamber of the injector body 21 from which excess fuel is collected by a tube or orifice within a forged balcony of the body 21.

[0028] The backleak pipe 24 passes through the backleak connector 23 in series with adjacent backleak connectors in order to collect excess fuel from the fuel injector 20 and return it to the a low pressure fuel tank.

[0029] As seen more clearly in Figures 1A and 1C, in this first embodiment of the invention, the support mechanism 25 is formed partly by a support member 26 and partly by the electrical connector casing 22 of the injector body 21.

As shown in Figure 1B, the support member 26 comprises an annular connector 27, a wide leg 28 extending generally upwardly and outwardly from a segment of the annular connector 27 and a clip 29 atop the leg 28.

[0030] The annular connector 27 is configured as a thin washer-type element adapted to enter and sit around atop of the injector body 21, so as to be held tightly between the electrical connector casing 22 and the injector body 21. Thanks to this tight fixation the support member 26 is directly connected to the injector.

In a resting position, the leg 28 is arranged to extend outwardly at an angle B of between approximately 100° and approximately 110° from an edge of the annular connector 27.

[0031] The clip 29 comprises a wide convexly curved portion 29a having same width as the leg 28, adopting an inner radius approximately matching that of an outer radius of the backleak pipe 24. The clip 29 further terminates in a wide outwardly-turned flange 29b having same width as the leg 28 and the curved portion 29a.

[0032] The annular connector, leg 28 and clip 29 are formed as one integral component, typically stamped from a stainless steel sheet and then bent to provide the respective angle B for the leg 28 and curvatures of the clip 29. However, it is to be appreciated that the annular connector, leg 28 and clip 29 could also be formed from plastics.

[0033] The leg 28 and clip 29 are resiliently flexible outwardly so as to allow the angle B to increase from the resting position.

[0034] To compliment the support member 26, the electrical connector casing 22 comprises a hollow 22a provided in a side of the injector body 21 that corresponds with the passage of the backleak pipe 24. The hollow 22a comprises a concave curvature disposed generally vertically and extends across a segment of the electrical connector casing 22.

[0035] In use, the annular connector 27 of the support member 26 is adapted to enter and sit around atop of the injector body 21, and is held tightly between the electrical connector casing 22 and the injector body 21. The leg 28 and the clip 29 are arranged to project at a side of the body 21 corresponding with the passage of the backleak pipe 24. The clip 29 is therefore, disposed substantially opposite the hollow 22a of the electrical connector casing 22.

[0036] As the backleak pipe 24 is fitted, it is brought downwardly towards the flange 29b and atop of the electrical connector casing 22. Upon reaching the flange 29b and the electrical connector casing 22, the backleak pipe 24 requires a small amount of force to push the flange 29b, and therefore the convexly curved portion 29a and the leg 28, outwardly away from the hollow 22a of the electrical connector casing 22 to increase the angle B. As the flange 29b moves outwardly, the backleak pipe 24 slides past the flange 29b and into the hollow 22a and the oppositely-disposed convexly curved portion 29a of the clip 29. Once the backleak pipe 24 passes into the confines of the hollow 22a and the convexly curved portion 29a, the leg 28 and clip 29 spring back towards the hollow 22a to bias the backleak pipe 24 towards and within the hollow 22a.

[0037] With the above first embodiment, the support member 26 is easy to manufacture and fit, whilst directly coupling the backleak pipe 24 to the injector body 21 and removing any gaps therebetween.

[0038] A second embodiment of the invention is shown in Figures 2A, 2B and 2C.

[0039] As can be seen in Figure 2A, the injector body 31 comprises the backleak nipple 33a within the backleak connector 33 in an orientation generally parallel with an axis A-A' of the injector body 31. The backleak connector 33 is disposed at an upper end of the body 31 and to one side, so as to be proximal to the body 31 and an electrical connector casing 33 that sits atop of the body 31. The backleak nipple 33a is connected to an interior chamber of the body 31 from which excess fuel is collected by a tube or orifice within a forged balcony of the body 31.

[0040] The backleak pipe 34 passes through the backleak connector 33 in series with adjacent backleak connectors in order to collect excess fuel from the fuel injector 30 and return it to the a low pressure fuel tank.

[0041] As seen more clearly in Figures 2A and 2C, in this second embodiment of the invention, the support mechanism 35 is formed by a support member 36, which sits in close to the electrical connector casing 32.

[0042] As shown in Figure 2B, the support member 36 comprises an annular connector 37, three wide legs 38, 38', 38" extending generally upwardly and outwardly from a segment of the annular connector 37 and three clips 39, 39', 39" atop the three wide legs 38, 38', 38".

[0043] The annular connector 37 is configured as a thin washer-type element adapted to enter and sit around atop of the injector body 31, so as to be held tightly between the electrical connector casing 32 and the injector body 31.

[0044] In order that the three clips 39, 39', 39" can be provided in substantially linear configuration, each leg is attached to the annular connector 37 in the same segment thereof, via a protruding tab 38a, 38a', 38a". The two outer (second and third) legs 38', 38" comprise tabs 38a', 38a" approximately equal to one another in length in order to extend to the position of the middle (first) leg 38.

[0045] In a resting position, each leg 38, 38', 38" is arranged to extend outwardly at an angle B from the annular connector 37. A first leg 38 extends at an angle B of between approximately 100° and approximately 110°. A second and third leg 38', 38" extend at a similar angle B' (to one another) of between approximately 80° and approximately 70°. Therefore, the angle between the legs 38, 38', 38" is approximately between 20° and 40°.

[0046] Each clip 39, 39', 39" comprises a wide convexly curved portion 39a, 39a', 39a" (width same as the leg 38, 38', 38") adopting an inner radius approximately matching that of an outer radius of the backleak pipe 36.

The clips 39, 39', 39" further terminate in a wide outwardly-turned flange 39b, 39b', 39b" (width same as the leg 38, 38', 38" and the curved portion 39a, 39a', 39a").

[0047] The annular connector 37, legs 38, 38', 38" and clip 39, 39', 39" are formed as one integral component, typically stamped from a stainless steel sheet and then bent to provide the respective angle B for the legs 38, 38', 38" and curvatures of the clips 39, 39', 39". However, it is to be appreciated that the annular connector 37, legs 38, 38', 38" and clip 39, 39', 39" could also be formed from plastics.

[0048] The legs 38, 38', 38", and clips 39, 39', 39" are resiliently flexible outwardly to a greater inclination, so as to be adapted to allow the angle B to increase from the resting position and the angle B' to decrease from the resting position.

[0049] In use, the annular connector 37 of the support member 36 is adapted to enter and sit around atop of the injector body 31, and is held tightly between the electrical connector casing 32 and the injector body 31. The legs 38, 38', 38", and clips 39, 39', 39" are arranged to project at a side of the body 31 corresponding with the passage of the backleak pipe 34.

[0050] As the backleak pipe 34 is fitted, it is brought downwardly towards the flanges 39b, 39b', 39b". Upon reaching the flanges 39b, 39b', 39b", the backleak pipe 34 requires a small amount of force to push the flanges 39b, 39b', 39b", and therefore the convexly curved portions 39a, 39a', 39a" and the legs 38, 38', 38" outwardly. Since the second and third legs 38', 38", and respective clips 39', 39" are in close proximity with the electrical connector casing 32 from the outset, the first flange 39b, clip 39 and leg 38 may be required to move to a greater extent once the movement of the second and third legs 38', 38", and respective clips 39', 39" are restricted by the electrical connector casing 32. As the flanges 39b, 39b', 39b" move outwardly, the backleak pipe 34 slides past the flanges 39b, 39b', 39b" and into oppositely-disposed convexly curved portions 39a, 39a', 39a" of the clips 39, 39', 39". Once the backleak pipe 34 passes into the confines of the convexly curved portions 39a, 39a', 39a", the legs 38, 38', 38" and clips 39, 39', 39" spring back towards one another to hold the backleak pipe 34.

[0051] With the above second embodiment, the support member 36 is easy to manufacture and fit, whilst coupling the backleak pipe 34 to the injector body 31.

[0052] Finally, a third embodiment of the support member 46 is shown in Figure 3.

[0053] In this third embodiment of the invention, the support mechanism is formed by a support member 46, which sits close to the electrical connector casing 42.

[0054] The support member 46 comprises an annular connector 47, two legs 48, 48' extending generally upwardly from a surface of the annular connector 47 and two oppositely-disposed clips 49, 49' sat atop the two legs 48, 48'. Each clip 49, 49' extends across both legs 48, 48" to be supported by both legs 48, 48'.

[0055] The annular connector 47 is configured as a thin washer-type element adapted is adapted to enter and sit around atop of the injector body 41, so as to be held tightly between the electrical connector casing 42 and the injector body 41.

[0056] The legs 48, 48' are arranged to extend upwardly, but not outwardly from the annular connector 47.

[0057] Each clip 49, 49' comprises a wide (extending across both legs 48, 48') convexly curved portion 49a, 49a', adopting an inner radius approximately matching that of an outer radius of the backleak pipe. The clips 49, 49' further terminate in a wide (same as the curved portion 49a, 49a') outwardly-turned flange 49b, 49b'.

[0058] The annular connector 47, legs 48, 48' and clip 49, 49' are formed as one integral component, typically moulded from plastics.

[0059] The clips 49, 49' are resiliently flexible outwardly, so as to be adapted to allow the backleak pipe to pass.

[0060] In use, the annular connector 47 of the support member 46 is adapted to enter and sit around atop of the injector body 41, and is held tightly between the electrical connector casing 42 and the injector body 41. The legs 48, 48' and clips 49, 49' are arranged to project at a side of the body 41 corresponding with the passage of the backleak pipe.

[0061] As the backleak pipe is fitted, it is brought downwardly towards the flanges 49b, 49b'. Upon reaching the flanges 49b, 49b' the backleak pipe requires a small amount of force to push the flanges 49b, 49b', and therefore the convexly curved portions 49a, 49a' outwardly away from one another. As the flanges 49b, 49b' move outwardly, the backleak pipe slides past the flanges 49b, 49b' and into oppositely-disposed convexly curved portions 49a, 49a' of the clips 49, 49'. Once the backleak pipe passes into the confines of the convexly curved portions 49a, 49a', they spring back towards one another to hold the backleak pipe therein. Ideally, one clip 49' is in close proximity with the electrical connector casing 42 at this point.

[0062] With the above third embodiment, the support member 46 is easy to manufacture and fit, whilst coupling the backleak pipe to the injector body 41.

[0063] In the case of all three embodiments, the support mechanism 25, 35, can essentially integrate the backleak pipe 24, 34 with the injector 20, 30 and provide a snug fit between the backleak pipe 24, 34 and the injector body 21, 31, thereby reducing damage and wear.

[0064] Although the above embodiments are shown and have been described in relation to a fuel combustion engine, it is to be appreciated that the invention may be applied to other fuel consuming devices.

[0065] Although a few preferred embodiments have been shown and described, it will be appreciated by those skilled in the art that various changes and modifications might be made without departing from the scope of the invention, as defined in the appended claims.

Claims

1. A fuel injector (20, 30) for supplying fuel to a fuel combustion engine, the fuel injector (20, 30) comprising an injector body (21, 31) adapted to receive an injector assembly (not shown) and supply fuel thereto and a backleak nipple (23a, 33a) communicating with an internal chamber of the injector body (21, 31), the backleak nipple (23a, 33a) being connected to a backleak pipe (24, 34) via a backleak connector (23, 33) for returning excess fuel to a low pressure fuel tank, **characterised in that** the fuel injector (20, 30) further comprises a support mechanism (25, 35, 46) adapted to directly fix the backleak pipe (24, 34) in a predetermined position on to the injector body (21, 31).

2. The fuel injector (20) according to claim 1, **characterised in that** the support mechanism (25) is formed partly by a support member (26) and partly by the injector body (21).

3. The fuel injector (20, 30) according to claim 2, **characterised in that** the support mechanism (25, 35, 46) comprises a clip (29, 39, 39', 39", 49, 49') to receive the backleak pipe (24,34).

4. The fuel injector (20) according to any one of the claims 2 or 3, **characterised in that** the support member (26) comprises the clip (29) adapted to bias the backleak pipe (24) into a substantially opposingly-disposed receiving hollow (22a) formed in the injector body (21).

5. The fuel injector (20) according to claim 4, **characterised in that** the receiving hollow (22a) is formed in an electrical connector housing (22) of the injector body (21).

6. The fuel injector (20, 30) according to claim 3, **characterised in that** the clip (39, 39', 39", 49, 49') is formed solely by a support member (36, 46) comprising at least two substantially opposingly-disposed clips (39, 39', 39", 49, 49') adapted to receive and hold with snug fit between them the backleak pipe.

7. The fuel injector (20, 30) according to any one of claims 4 to 6, **characterised in that** the clip(s) (29, 39, 39', 39", 49, 49') and/or the hollow (22a) are shaped to at least partially comprise a concave curvature in which is received the backleak pipe (24, 34).

8. The fuel injector (20, 30) according to any one of claims 2 to 7, **characterised in that** the support member (26, 36, 46) is resiliently flexible.

9. The fuel injector (20, 30) according to any one of claims 2 to 8, **characterised in that** the support member (26, 36, 46) is integrally formed with the injector body (21, 31).

10. The fuel injector (20, 30) according to any one of claims 2 to 8, **characterised in that** the support member (26, 36, 46) comprises an independently-formed member mounted on said injector body (21, 31).

11. The fuel injector (20, 30) according to any one of claims 2 to 10, **characterised in that** the support member (26, 36, 46) comprises one or more legs (28, 38, 38', 38", 48, 48') for the clip(s) (29, 39, 39', 39", 49, 49').

12. The fuel injector (20, 30) according to any one of claims 6 to 11, **characterised in that** each oppositely-disposed clip (39, 39', 39") is mounted atop an individual leg (28, 38, 38', 38") and the legs (28, 38, 38', 38") of the clips (29, 39, 39', 39") lean away from one another.

13. The fuel injector (20, 30) according to any one of claims 6 to 11, **characterised in that** each oppositely-disposed clip (49, 49') is mounted atop a shared leg (48, 48').

14. The fuel injector (20, 30) according to claim 10 taken in combination with any one of claims 11 to 13, **characterised in that** each leg (28, 38, 38', 38") of the independently-formed support member (26, 36) is connected to the ring connector (27, 37) by a foot (38a, 38a', 38a"), each extending generally laterally outwardly from a segment of the ring connector (37) and the feet (38a, 38a', 38a") are configured to extend different lengths from the ring connector (37) in order to provide a base of said legs (38a, 38a', 38a") in a substantially linear configuration.

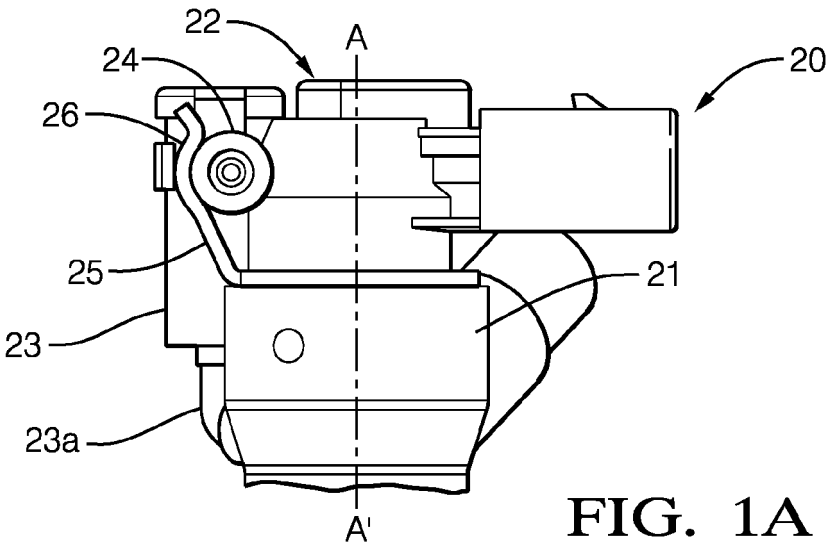

FIG. 1A

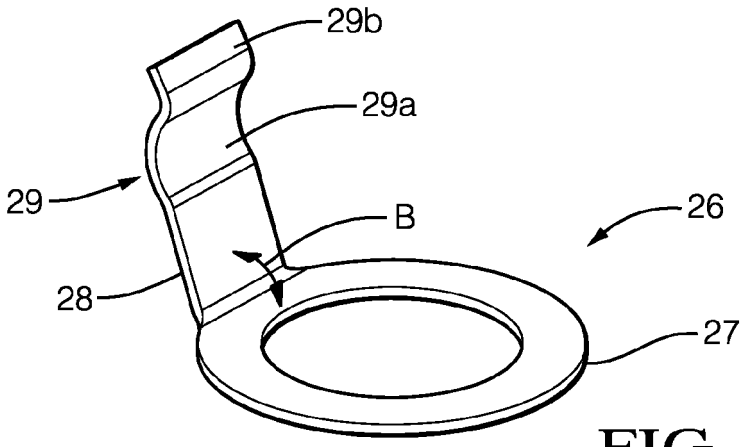

FIG. 1B

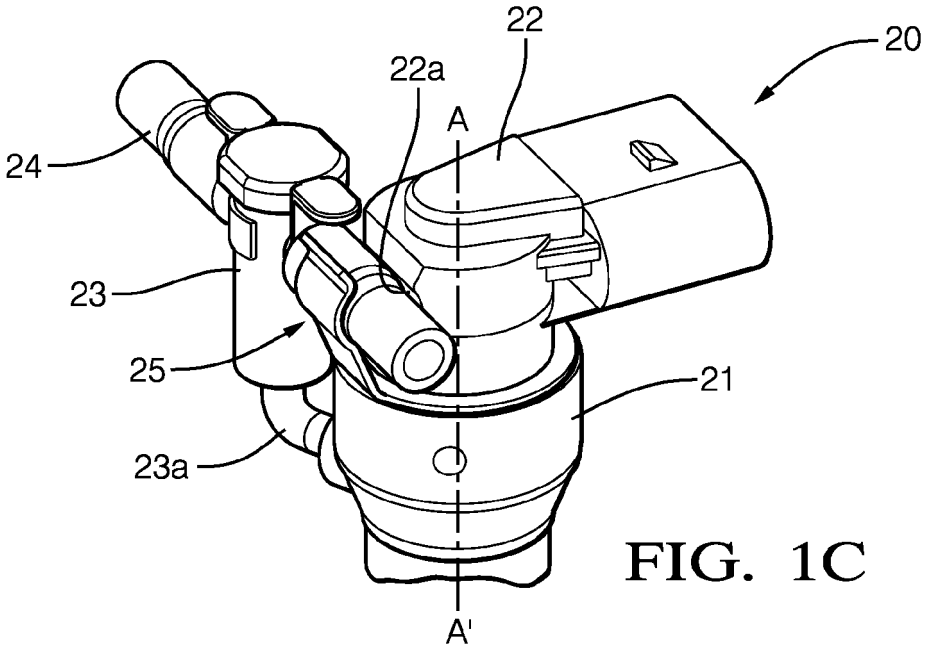

FIG. 1C

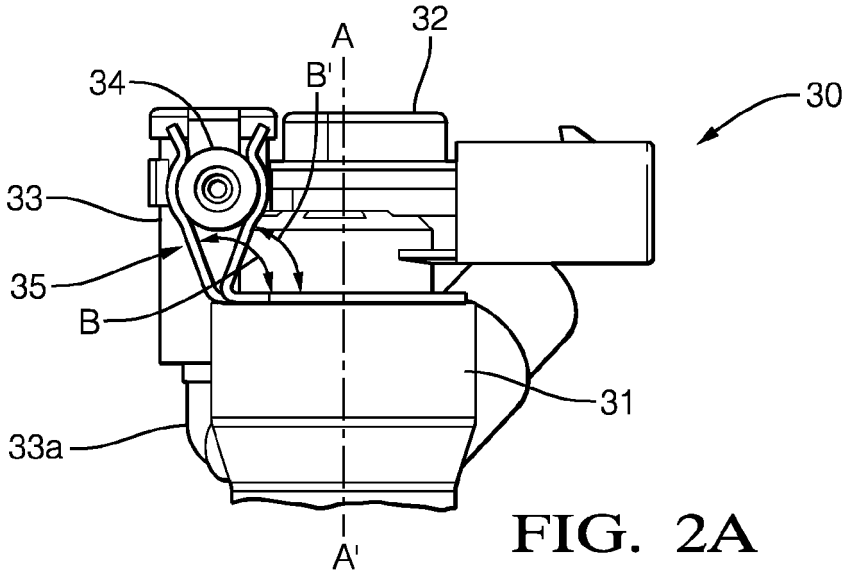

FIG. 2A

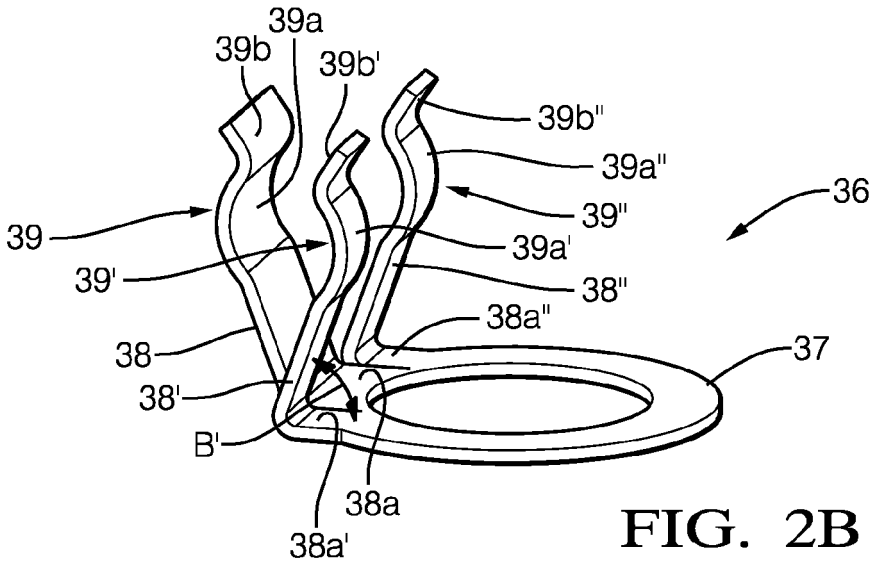

FIG. 2B

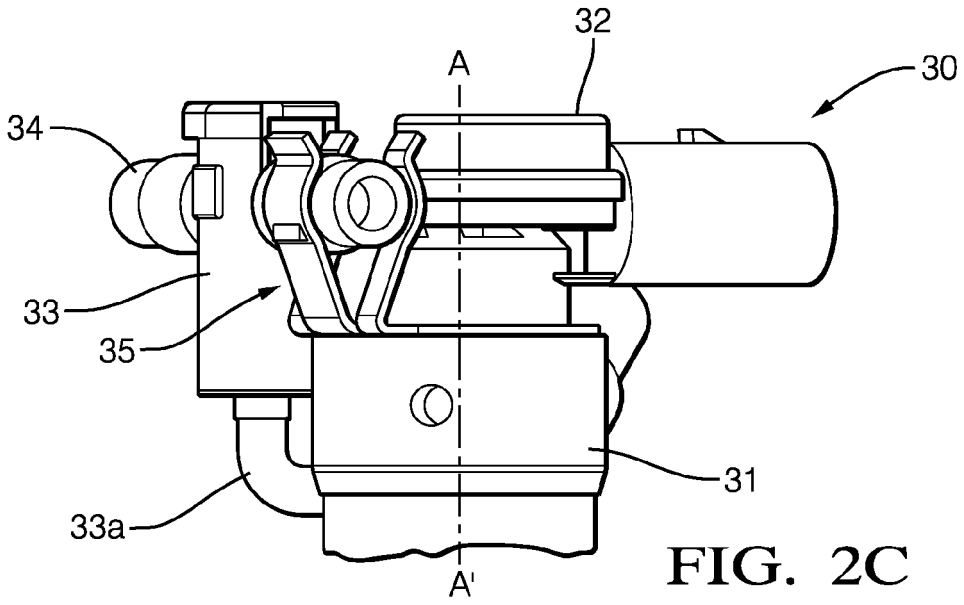

FIG. 2C

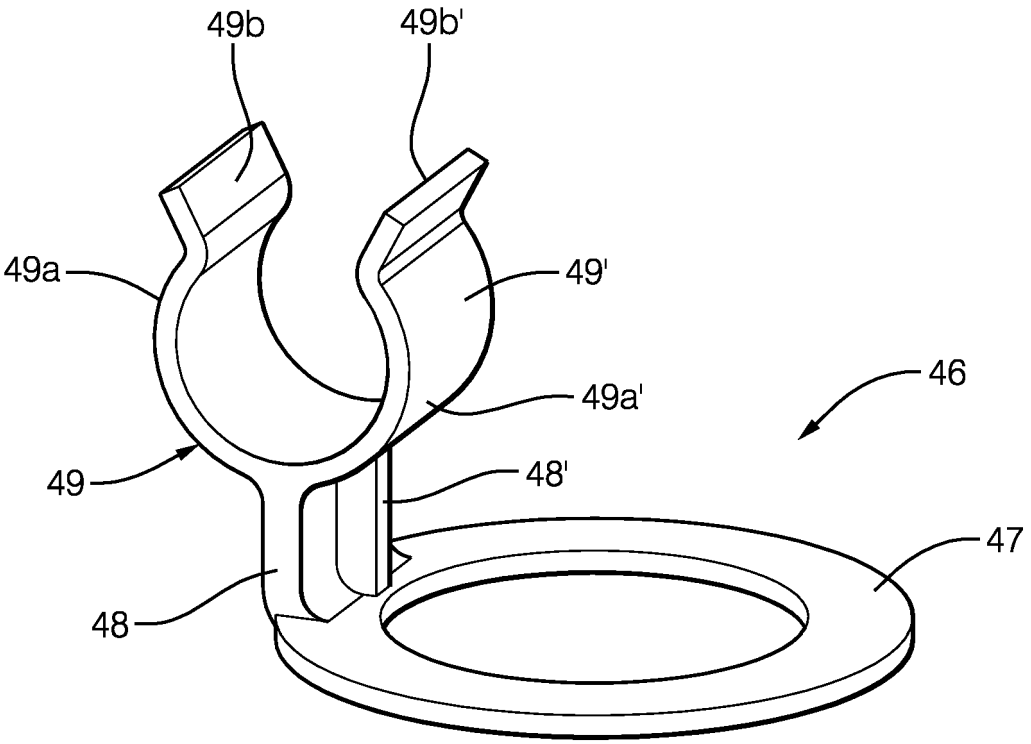

FIG. 3

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EUROPEAN SEARCH REPORT

Application Number
EP 17 16 0210

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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