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(71) Applicant: **Borgwarner Luxembourg Automotive Systems SA**
4940 Bascharage (LU)

(72) Inventors:
• **MARX, Patrice**
Saulnes (FR)
• **BERNARD, Jean-Pierre**
Lamadeleine (LU)

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(74) Representative: **Office Freylinger**
P.O. Box 48
8001 Strassen (LU)

(54) **TANK COVER AND FUEL DELIVERY MODULE**

(57) The invention concerns a tank cover for a fuel delivery module, which comprises: a cover body (12) configured to close an aperture in a fuel tank, the body (12) having a first side (14), which in use is facing the tank interior, and an opposite, second side (16); the cover body (12) comprising at least one fuel outlet port (18), at least one electrical connector (24) on the second side (16), and electrical connection means (26) on the first side (14).

Control electronics (30) are connected to the at least one electrical connector (24) and to said electrical connection means (26).

The cover body (12) includes a recess (28) arranged on the first side (14) that accommodates the control electronics (30), the recess (28) being closed in a fluid tight manner by a panel (32).

The invention also concerns a fuel delivery module comprising such tank cover.

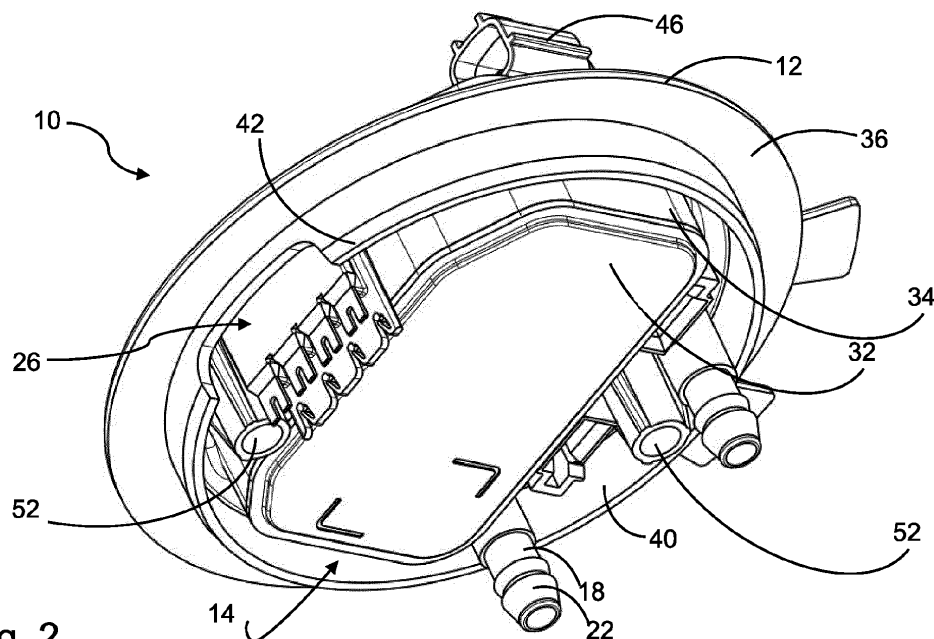


Fig. 2

Description

[0001] The present invention generally relates to fuel delivery systems, particularly fuel delivery from liquid fuel tanks of automotive vehicles. More specifically, the invention relates to tank covers and particularly to fuel delivery modules comprising such tank covers.

Background of the Invention

[0002] Transportation vehicles such as cars, planes and boats operating engines include an on-board fuel tank to hold fuel to be used by the engine. The fuel tank generally includes a fuel delivery module, which is disposed within the fuel tank and inserted therein through a top aperture. The top aperture is closed by a tank cover having a fuel outlet port, whereby pressurized fuel is carried through the cover to the engine fuel delivery circuit. The cover typically also includes an electrical connector to operatively connected the ECU with a fuel pump arranged inside the fuel tank. The fuel delivery module further includes a fuel reservoir, an electrical fuel pump disposed in the reservoir and a jet pump typically used to fill the reservoir. The tank cover is conventionally rigidly connected to the fuel reservoir by rods.

[0003] Modern fuel pumps use an electronically commutated motor (brushless) and are piloted by control electronics (typically a printed circuit board with electronic components, referred to as PCB assembly). The control electronics are often arranged in a sealed housing integrated in the upper surface of the tank cover. The cover is plastic molded with a recess arranged in the upper side, in which the PCB assembly is placed and subsequently closed by means of a panel that is laser welded.

[0004] Although widely used, such design may be unsuitable when the number of interfaces to be integrated in the tank cover increases. For example, a further connector may be required to provide connections to a sensor device arranged within the fuel tank. Further, an additional hydraulic port may be required to provide a fluid route for fuel return. A further parameter is the dimension of the tank cover itself. A conventional diameter of the tank aperture is 130.5 mm, but some car manufacturers also use tank apertures of smaller diameters, e.g. 115.5 mm. Obviously, a reduction in size makes it even more difficult to integrate the various interfaces in the tank cover.

[0005] The object of the present invention is thus to provide an improved tank cover design that does not comprise the above-mentioned drawbacks.

Summary of the Invention

[0006] The present invention relates to a tank cover for a fuel delivery module. The tank cover (or tank cover assembly) comprises a cover body configured to close an aperture in a fuel tank, the body having a first side,

which in use is facing the tank interior, and an opposite, second side. The cover body comprises a plurality of connector features for systems outside the fuel tank, in particular at least one fuel outlet port, at least one electrical connector on the second side, and an electrical connection means on the first side. The tank cover further comprises control electronics connected to the at least one electrical connector and to the electrical connection means on the first side. The cover body includes a recess arranged on the first side (i.e. facing the tank) that accommodates the control electronics, the recess being closed in a fluid tight manner by a panel.

[0007] The proposed tank cover entails several benefits. Contrary to prior art solutions, the control electronics are integrated in the tank cover and received in a recess located on the first side. The second side, which is a side that faces an external environment of the tank cover is free of such recess/housing for electronics and thus provides more space which can be used otherwise, namely for arranging the electrical connector(s). As a result, a particular large amount of space is provided on the second side. Additionally, this design allows a high density of interface feature in the cover, even for tank covers of smaller dimensions. Arranging the recess and control electronics in a recess in the tank facing side of the fuel tank may be considered to go against conventional wisdom. The present inventors however have found that arranging the recess on the first side of the cover does not entail any risks due to the presence of fuel or vapors, when the recess is properly sealed, e.g. by laser welding. Last but not least, moving the recess to the first side frees up space on the second side, where electrical connectors and pipe connectors are needed, and where space is required to allow for mold movements during the injection process. This is even more important where cantilevered/horizontal electrical connectors are required.

[0008] In embodiments, the recess is integrated with the cover body and has a closed bottom surrounded by a lateral wall projecting from the cover body, the lateral wall defining, opposite from the bottom, an opening that is closed by the panel. In this connection, the lateral wall may protrude in a direction substantially to the first surface of the cover body. The lateral wall together with the recess bottom as well as the panel form a housing that defines an internal space for the control electronics. The panel is configured to seal the recess in a liquid-tight manner, such that fuel or fuel gases may not enter the recess.

[0009] In embodiments, the panel has a peripheral rib for centering the panel relative to the opening, wherein the wall protrudes from a side thereof facing the recess. Due to this peripheral rib, this panel may be easily centered and mounted on the recess, which reduces circle time in an assembly line. The mounting process may be carried out manually, semi-automatically or automatically.

[0010] In embodiments, the cover body includes, on the first side, a peripheral protruding annular ring having

an outer diameter substantially matching the fuel tank aperture, i.e. of similar diameter. The annular ring may fittingly or press-fittingly engage to a section of the fuel tank aperture, which is also liquid-tight. The outer diameter of the annular ring may be designed to receive an annular sealing element.

[0011] In embodiments, the tank cover further comprises a peripheral flange extending away from the cover body, in particular beyond the annular ring. The cover body may generally have a plate-like or disk shape and the flange extends in a plane parallel to a plane passing through the cover body, between the first and second surfaces.

[0012] In embodiments, the cover body is molded with plastic, together with its various components, in particular the lateral wall, a bottom of the recess, the at least one fuel outlet port, the at least one electrical connector, and with the peripheral flange. In other words, the tank cover presents a molten cover body being integral with the recess, the bottom of the recess as well as the lateral wall, the fuel outlet port, the electrical connector as well as the peripheral flange. A tank cover fabricated with appropriate plastic material provides a sufficient structural integrity whilst being less expensive to produce. For example, the cover body may be produced by an injection molding process.

[0013] In embodiments a set of first conductor elements is integrated in the cover body, the first conductor elements have a first end arranged at the at least one electrical connector (forming terminals/pins within the connector) and the first conductor elements have a second end protruding in the recess, the second ends being electrically connected with the control electronics.

[0014] In embodiments, the electrical connection means include pins, conductors, terminals and/or electrical connectors that are connected to the control electronics and/or to electrical connection means on the second side of the tank cover. Electrical connection means on the first side may take any appropriate form, as required for connection purposes with the components inside the fuel tank.

[0015] In particular, a set of second conductor elements are integrated in the cover body and have a first end connected to the control electronics and a second end arranged at a first side of the tank cover, in particular forming an array of pins or integrated in an electrical connector.

[0016] The cover body and the panel are made from plastic material, preferably by injection molding. Any suitable synthetic material may be used, polymers or resins, in particular a thermoplastic or mixture of thermoplastics, preferably a polyoxomethylene, a polyethylene terephthalate or mixtures thereof. The use of said materials provides a cover body and a panel having a relatively high stiffness, a good dimensional stability as well as low friction properties.

[0017] According to another aspect, the invention relates to a fuel delivery module comprising the present

tank and a fuel reservoir adapted to be disposed in a liquid fuel tank, wherein the reservoir has a top opening and a fuel pump mounted within said reservoir.

[0018] In embodiments, the tank cover is connected to the fuel delivery module further by guide rods that are provided in tubular cavities in the first side of the tank cover.

[0019] In embodiments, the second electrical connector is electrically connected to a temperature sensing device for measuring a temperature within the fuel tank.

Brief Description of the Drawings

[0020] The present invention will now be described, by way of example, with reference to the accompanying drawings, in which:

FIG.1 is a perspective view of a tank cover according to an embodiment of the invention;

Fig.2 is a bottom, perspective view of the tank cover illustrated in FIG.1;

FIG.3 is an exploded view of the tank cover of FIG. 1;

FIG.4 is a perspective view of a fuel delivery module comprising the tank cover illustrated in Figs. 1-3;

FIG.5 is a view of the tank cover of FIG. 1 from below.

Detailed Description of a Preferred Embodiment

[0021] An embodiment of the present tank cover 10 is shown in the drawings. The tank cover 10 is designed to close an aperture in a fuel tank (not shown), typically a liquid fuel tank (e.g. gasoline, diesel, biofuel, etc...). The tank cover 10 presents a cover body 12 that is configured to close the fuel tank aperture, which is generally arranged in a top region of the fuel tank and through which a fuel delivery module (shown in Fig.4) is inserted, as is known in the art.

[0022] The cover body 12 has a first side 14 facing -in use- the tank interior and a second side 16 arranged opposite to the first side 14, which faces an exterior environment. According to their orientation during use, the first and second sides of the tank cover may also be referred to as bottom side 14 and upper side 16. As shown in this embodiment, the tank cover 10 has a globally planar or plate-like shape, with a generally circular periphery, which may thus also be described as disk-like shape.

[0023] Conveniently, the cover body 12 comprises on the bottom side 14 a peripheral protruding annular ring 40 having an outer diameter matching the fuel tank aperture. The annular ring 40 thus allows engagement with a tank portion defining the fuel tank aperture (not shown), in particular for a press-fit engagement. A chamfer 42 is provided at the free end of ring 40, which facilitates a positioning of the ring 40 within the tank aperture. The

annular ring 40 may be continuous over the circumference or may be locally interrupted. In practice, an annular sealing element/gasket is fitted around ring 40, before the cover is placed in tank aperture. A peripheral flange 36 extends from the cover body 12 beyond the annular ring 40, parallel to the upper/bottom sides. Upon assembly of the tank cover 10 in the fuel tank aperture, the flange 36 will rest against the top surface of the fuel tank and extend over the cover / aperture interface area, which is thus protected.

[0024] For connection to hydraulic and electric systems outside the fuel tank, the tank cover includes a number of interface features. Reference sign 18 designates a fuel outlet port 18 formed as a tube passing through the cover body and having a first connecting portion 20 protruding from the upper side 16, and a second connecting portion 22 protruding from the bottom side 14. The first connecting portion 20 and the second connecting portion 22 are each configured to be connected to a hose or pipe, e.g. as quick connectors. This tubular fuel outlet port 18 provides a conduit configured for passing fuel from inside the tank to the outside, through the tank cover 10. The second connecting portion 22 extends perpendicularly to the cover body 12, whereas the first connecting portion 20 is here configured as a bent tube (90°), in a cantilevered manner.

[0025] The tank cover 10 here further includes a second hydraulic port 19, for the return of fuel into the fuel tank, e.g. fuel returned from a cooling circuit or external fuel filter. Here again the port 19 is formed as a tube crossing the cover body 12 and having tube ends 19.1 and 19.2 extending on the upper and bottom side. Tubes 18 and 19 can be integrally molded with cover 10 (as is the case here) or produced separated and fitted in orifices.

[0026] The tank cover 10 also includes a first electrical connector 24 arranged on the upper side 16 as well as electrical connection means arranged on the bottom side 14 (here at several locations).

[0027] Furthermore, reference sign 46 designates a second electrical connector on the upper side 16.

[0028] It will be appreciated that the cover body 12 further comprises a recess 28 (see Fig.5) arranged on the bottom side 14. The recess 28 is configured for accommodating control electronics 30 which are connected to the first electrical connector 24 and to electrical connection means on the bottom side. The control electronics 30 may generally comprise a printed circuit board 30 with electronic components thereon, hence forming a PCB assembly. The recess 28 is closed by a panel 32.

[0029] It should be noted that the recess 28 is integrated, respectively embedded, in the cover body 12 and has a closed bottom 29 surrounded by a lateral wall 34 projecting downwardly from the cover body 12. The lateral wall 34 defines an opening 31, distal from the bottom, which is closed by the panel 32. The panel 32 is arranged such as to close, in liquid-tight manner, the opening 31 of the recess 28. Conveniently, the panel 32 is laser weld-

ed onto the recess opening. As a result, the recess 28 is sealed against any fuel liquids or fuel gases.

[0030] The panel 32 is provided with a peripheral rib 44, which assists in centering the panel 32 relative to the opening of the recess 28. The peripheral rib 44 follows the outer profile of the panel 32 in a margin region thereof. The peripheral rib 44 therefore protrudes substantially perpendicularly from a recess-facing side of the panel 32.

[0031] The entire cover body 12 may generally be manufactured by a plastic molding process. In other words, the cover body 12 is a plastic molded part, respectively molded with plastic in a mold via plastic injection. As a result, the cover body 12 can be made integral with the bottom of the recess 28, the hydraulic ports 18, 19, with the first electrical connectors 24 and/or the second electrical connector 46, the peripheral flange 36 as well as with the lateral wall 40. The cover body 12 formed by a single mold casting provides the advantage of a very stable and liquid-tight structure. Likewise, the panel 32 may be formed by plastic injection. Preferably the cover body 12 and/or the panel 32 are manufactured from a thermoplastic or a mixture of thermoplastic polymers, in particular a polyoxomethylene, a polyethylene terephthalate or mixtures thereof.

[0032] For the purpose of laser welding, the panel 32 may be made in a comparatively light transparent polymer (i.e. white or clear coloured) whereas the cover body is in a light absorbing polymer (i.e. black or dark coloured). In order to seal the recess 28, the panel 32 is positioned on the recess opening 31 and the welding laser beam is moved along the periphery of the panel 32. The laser beam will pass through the panel 32 and locally melt the edge region of the lateral wall 40. The melted wall portion will, upon solidifying, adhere to the panel 32 and its rib 44. As a result, a peripheral laser weld is formed, providing liquid/fluid tight sealing. The recess is thus hermetically sealed from the exterior environment.

[0033] As will be understood, a number of conductor elements, e.g. copper wires or strips, are integrated within the tank cover 10, mainly embedded in the plastic body material. A set of first conductor elements is integrated in the cover body 12 and extend from the first electrical connector 24 to the PCB 30. Reference sign 48 designates first end of these first conductor elements at the first electrical connector 24, where they form terminals that will cooperate with terminals of a matching connector. These first conductor elements run through the cover body and protrude inside the recess 28, where their ends 49 are engaged into the PCB. For this purpose the ends 49 of the first connectors may be formed as compliance pins.

[0034] A set of second conductors 50 are also connected, at one end 51, to the PCB 30 and run through the cover 10, embedded in plastic, to a peripheral region, where their ends are shaped as terminals 26, forming electric connection means.

[0035] In practice, the first connector 24 is a 6-way connector, where typically two pins are used for power sup-

ply, one pin for diagnosis, one pin for PWM command and two pins for a fuel level sensor signal.

[0036] Referring to Fig.5, one will distinguish the four pins 26, as well as a pair of electrical connectors 43 and 45. Electrical connector 43 is directly connected via embedded conducting strips to electrical connector 46 on the upper side. These two-way connectors 43, 46 are provided for connection of a sensor inside the fuel tank, in particular a temperature sensor. The other electrical connector 45 is linked by conducting strips to the PCB 30. Electrical connector 45 is used for connecting the fuel level sensor to the PCB 30, which is then electrically connected to the 6-way connector 24. At least part of pins 26 are used for connecting the fuel pump.

[0037] Still to be noticed in Fig.5 are two tubular cavities 52 (receptacles) formed as furtrees on the bottom side 14, which are designed to receive guide rods.

[0038] To avoid water retention, the electrical connectors 24 and 46 on the upper side 16 are bent or cantilevered, i.e. they extend parallel to the upper side 16.

[0039] FIG. 4 illustrates an embodiment of a fuel delivery module 110 (also known as fuel pump module) comprising the tank cover 10 as illustrated by FIGS. 1-3. The fuel delivery module 110 is adapted for use in a liquid fuel tank of an automotive vehicle with internal combustion engine.

[0040] The fuel delivery module 110 is installed inside the fuel tank (not shown), which may be designed to contain liquid fuel such as, e.g., diesel, gasoline, etc.

[0041] The fuel delivery module 110 conventionally comprises a generally bucket-shaped reservoir 114 that is typically made from plastic material. The reservoir 114 has a base portion 116 and an annular side portion 118 extending generally perpendicularly from the base portion 116, thus forming an open chamber 120 for fuel having an upward top opening 122. The reservoir 114, which forms a "subtank" or "reserve cup," is disposed in proximity of the bottom plate within the fuel tank (not shown). A fuel pump 128 is arranged in the reservoir 14 and pumps fuel to a fuel hose 129 connected to connecting portion 22 of outlet port 18.

[0042] The fuel delivery module 110 comprises further a plurality of guide rods 126 (also referred to as spacing studs) that connect the tank cover 10 to the fuel reservoir 114. The guide rods 126 are connected to the receptacles 52 in the bottom side of the tank cover 10. The guide rods 126 may be surrounded by compression springs (not shown).

[0043] Reference sign 130 designates a fuel level sensor assembly, with a pair of wires 131 connected to the electrical connector 45.

Claims

1. A tank cover for a fuel delivery module, said tank cover (10) comprising:

a cover body (12) configured to close an aperture in a fuel tank, said body (12) having a first side (14), which in use is facing the tank interior, and an opposite, second side (16);

said cover body (12) comprising at least one fuel outlet port (18), at least one electrical connector (24) on said second side (16), and electrical connection means (26) on said first side (14);

control electronics (30) connected to said at least one electrical connector (24) and to said electrical connection means (26);

characterized in that said cover body (12) includes a recess (28) arranged on said first side (14) that accommodates said control electronics (30), said recess (28) being closed in a fluid tight manner by a panel (32).

2. The tank cover according to claim 1, wherein said recess (28) is integrated with said cover body (12) and has a closed bottom (29) surrounded by a peripheral wall (34) projecting from the cover body (12), said lateral wall (34) defining, opposite from said bottom, an opening (31) that is closed by said panel (32); and preferably said panel is laser welded to said wall (34) about said opening.
3. The tank cover according to any one of the preceding claims, wherein said cover body (12) includes, on said first side (14), a peripheral protruding annular ring (40) having an outer diameter matching the fuel tank aperture.
4. The tank cover according to any one of the preceding claims, further comprising a peripheral flange (36) extending from the cover body (12), in particular beyond said annular ring (40).
5. The tank cover according to any one of the preceding claims, wherein said panel (32) has a peripheral rib (44) for centering said panel relative to said opening, wherein said wall protrudes from a panel side facing said recess.
6. The tank cover according to any one of the preceding claims, wherein said cover body is molded with plastic, together with said lateral wall (34), a bottom of said recess (28), said at least one fuel outlet port (18); said at least one electrical connector (24; 46), and with said peripheral flange (36) and said annular ring (40).
7. The tank cover according to any one of the preceding claims, wherein a set of first conductor elements (48) is integrated in said cover body (12), wherein said first conductor elements (48) have a first end arranged at said at least one electrical connector (24) and the first conductor elements (48) have a second end protruding in said recess (28), whereby the first

conductor elements (48) are electrically connected with said control electronics (30).

8. The tank cover according to any one of the preceding claims, wherein said electrical connection means include pins, conductors, terminals and/or electrical connectors that are connected to said control electronics or to electrical connection means on said second side of said tank cover. 5
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9. The tank cover according to claim 8, comprising a set of second conductor elements (50) having a first end connected to said control electronics (30) and a second end arranged at a first side of said tank cover, in particular forming an array of pins or integrated in a connector. 15
10. The tank cover according to any one of the preceding claims, further comprising a second electric connector (46) on said second side, which is connected by conductor elements in the cover body to electric connection means (43) on the first side. 20
11. The tank cover according to any one of the preceding claims, further comprising a return fuel port (19) through said cover body. 25
12. The tank cover according to any one of the preceding claims, further comprising at least one tubular cavity (52) arranged on said first side for receiving therein an end of a guide rod (126). 30
13. Tank cover according to any one of the preceding claims, wherein the cover body (12) and/or the panel (32) are molded with plastic material, preferably a thermoplastic polymer or a mixture of thermoplastic polymers, in particular a polyoxomethylene, a polyethylene terephthalate or mixtures thereof. 35
14. A fuel delivery module (110) comprising: 40
 - a tank cover (10) according to any one of the preceding claims; and
 - a fuel reservoir (114) adapted to be disposed in a liquid fuel tank, wherein said reservoir has a top opening (122) and a fuel pump (128) mounted within said reservoir (114). 45
15. The fuel delivery module (110) according to claim 14, wherein the fuel delivery module further comprises a plurality of rods (126) connecting the tank cover (10) to the fuel reservoir (114), said rods being engaged into respective tubular cavities (52) in said first side. 50
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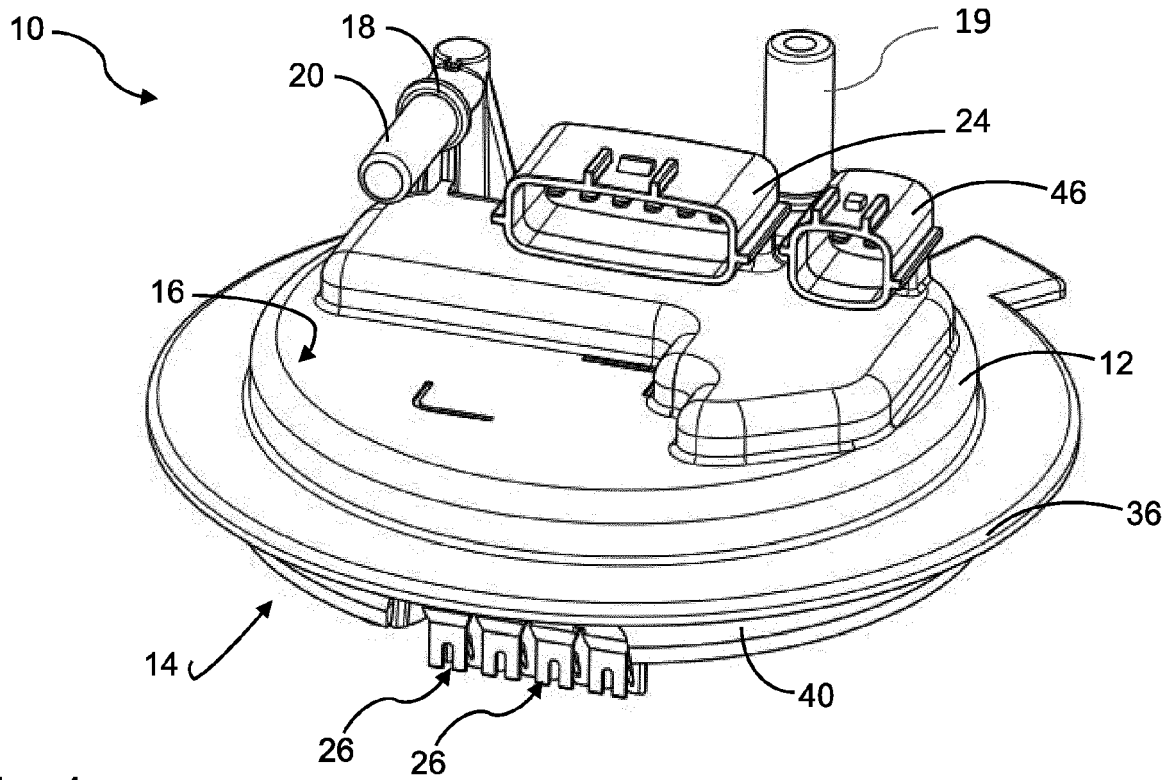


Fig. 1

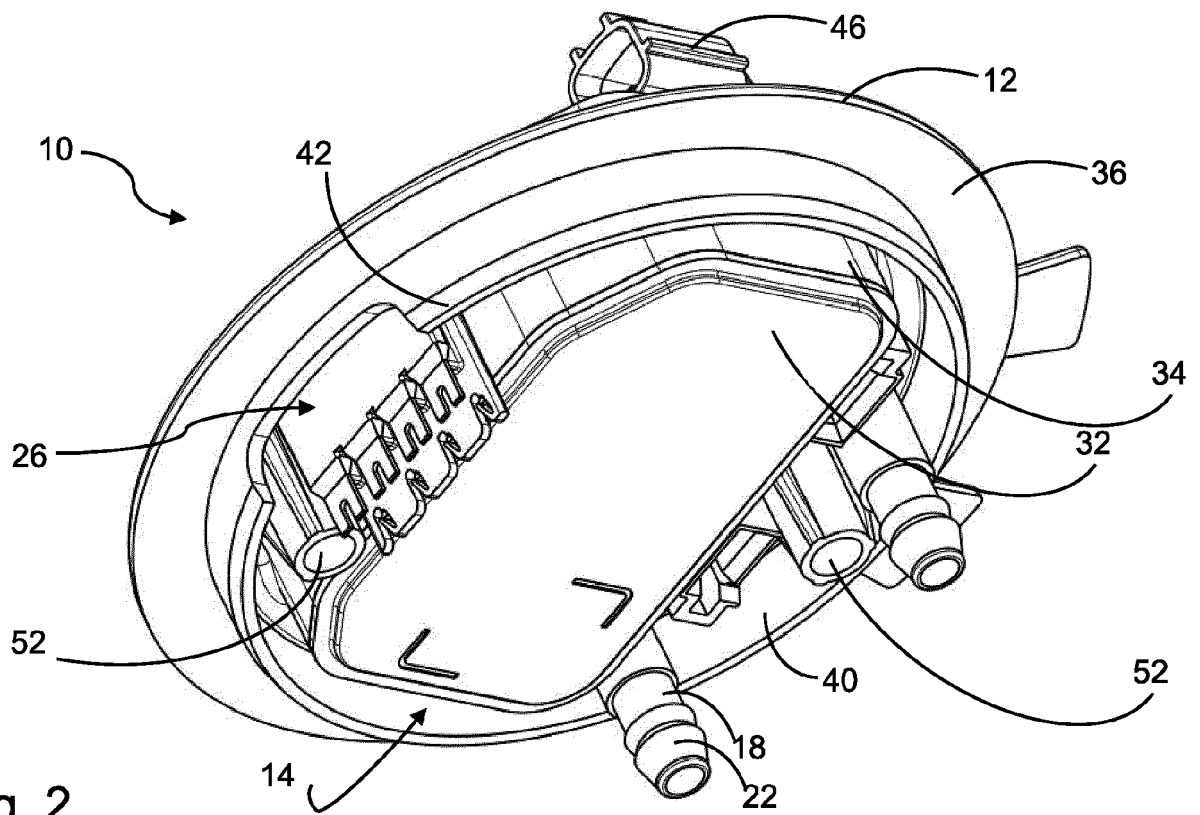


Fig. 2

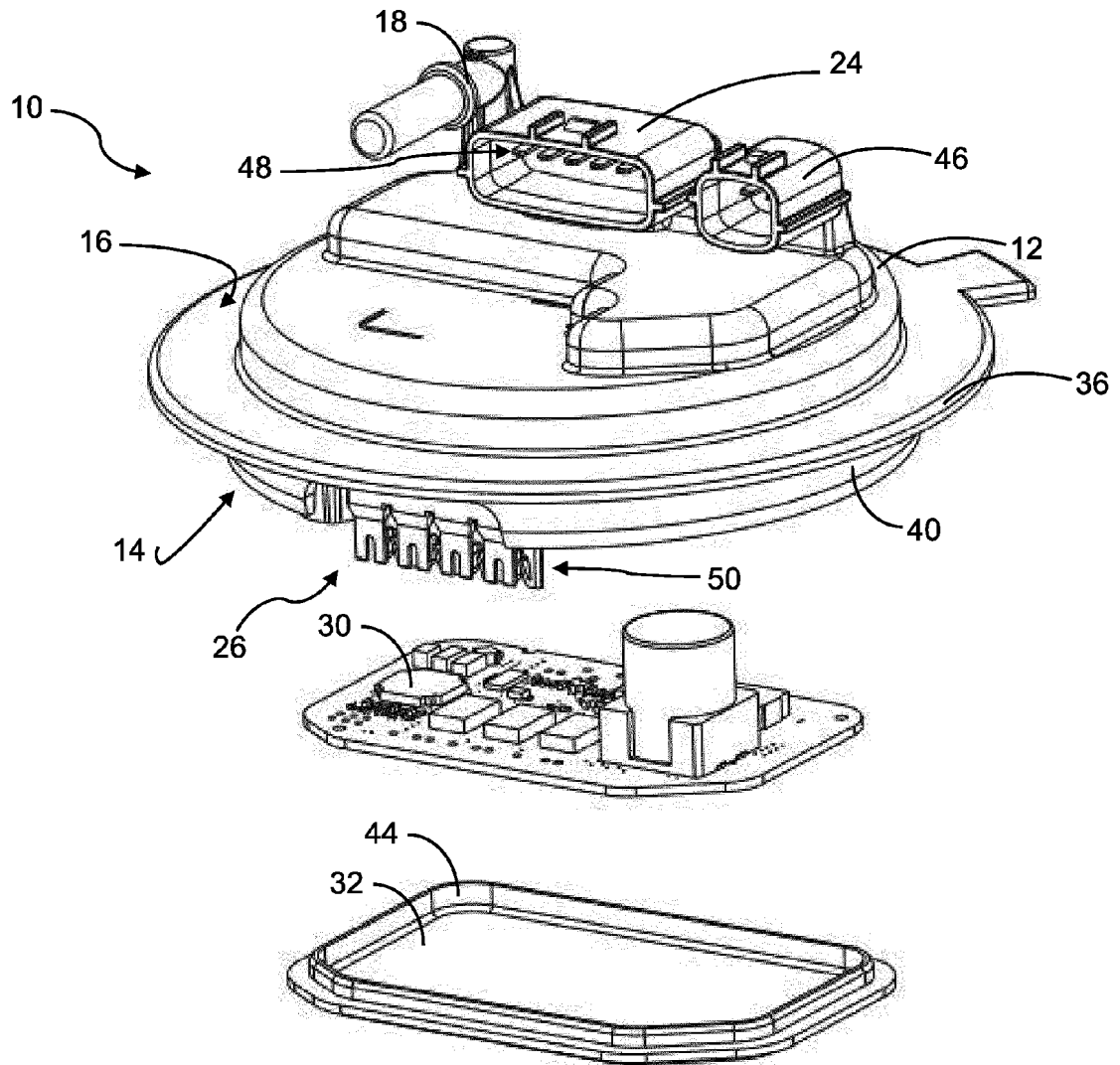
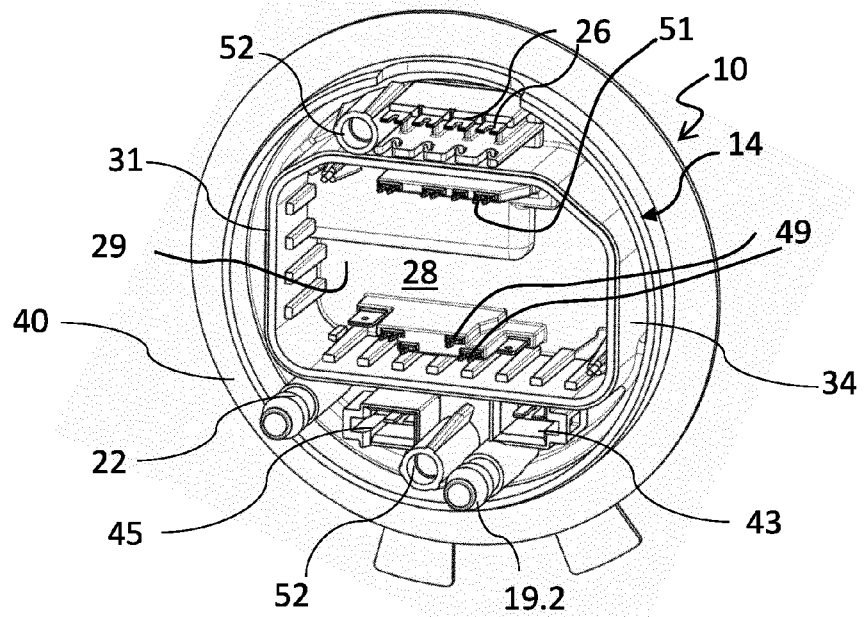


Fig. 3

Fig. 5



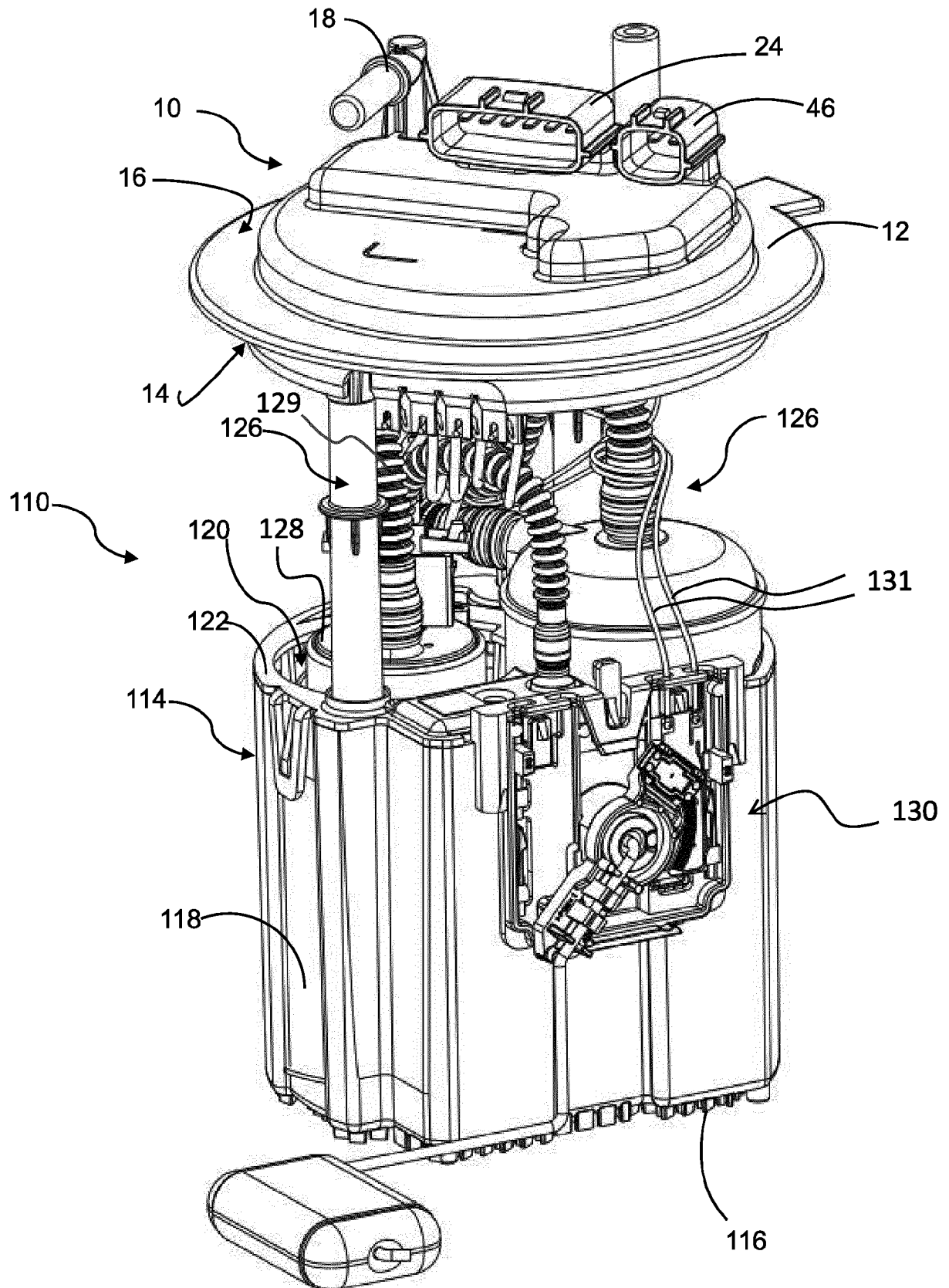


Fig. 4



EUROPEAN SEARCH REPORT

Application Number

EP 22 17 7657

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**ANNEX TO THE EUROPEAN SEARCH REPORT
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