



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
27.05.2009 Bulletin 2009/22

(51) Int Cl.:
F02M 37/00 (2006.01) F02D 33/00 (2006.01)

(21) Application number: **07121357.3**

(22) Date of filing: **22.11.2007**

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IS IT LI LT LU LV MC MT NL PL PT RO SE SI SK TR
Designated Extension States:
AL BA HR MK RS

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(54) **Fuel module**

(57) A fuel pumping and level detection assembly (10) for fitting in a fuel tank (12) of a motor vehicle having a small access opening (14) is provided. A method of installation is also provided. The assembly (10) comprises a fuel pump (16), a fuel filter (18), an fuel level sensor (20) having an elongate sensor body (21) and a support structure (22) including an attachment portion (24) to attach to the fuel tank (12) in the vicinity of the access

opening (14) and a support portion (24) for mounting the pump (16) and filter (18) thereon. The sensor (20) is complementarily shaped with the support structure (22) to allow the sensor (20) to be slidably inserted therein providing for simple installation. The sensor (20) also provides additional strength to the support structure (22), without the need for additional components, to prevent the fuel pump (16) and filter (18) oscillating excessively in the fuel tank (12) when in use.

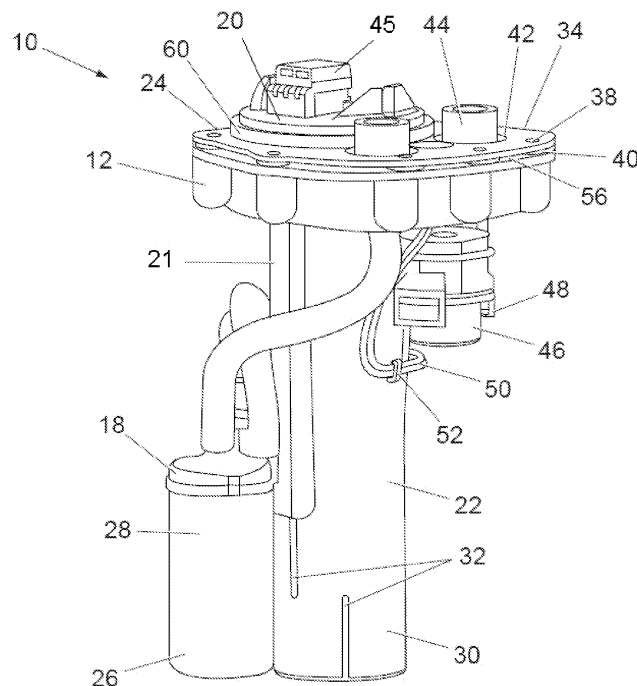


Figure 6

Description

[0001] The present invention relates to a fuel pumping and level-detection assembly for fitting in a fuel tank of a motor vehicle. More specifically, the present invention relates to a fuel module for use in the fuel tank of a two-wheeled motor vehicle wherein the tank has an access opening of small cross section.

[0002] Fuel tanks used on motor vehicles, in particular two-wheeled motor vehicles, for example so-called scooters and mopeds, are often quite irregular in shape and small in size due to packaging constraints. As a result, access openings in such fuel tanks are small in cross section making the fitting inside the fuel tank of devices or assemblies, for example a fuel pump and fuel filter, a pressure regulator and fuel level sensor, including the respective tubing, extremely difficult.

[0003] Fuel modules are typically used inside fuel tanks of four-wheeled vehicles which house a fuel pump and filter, a pressure regulator and fuel level sensor and means to mount the module from the access opening in the fuel tank. However, the opening in the fuel tank of a four-wheeled motor vehicle is generally larger than that of a fuel tank in a two-wheel vehicle, for example a scooter. The small access opening therefore makes it extremely difficult, if not impossible, to fit the module in the fuel tank. In the event of failure of one or more of the devices in the module, removal of the module from the fuel tank is also extremely difficult.

[0004] A fuel pumping and level-detection assembly for fitting in a fuel tank of a motor vehicle having a small access opening is required. Such an assembly will include one or more of the following features:

- quick and easy to install and remove;
- compact;
- have adequate stiffness, strength and rigidity for use; and
- inexpensive.

[0005] According to a first aspect of the present invention, a fuel pumping and level detection assembly for installation within a fuel tank having a small access opening is provided, the assembly comprising:

- a fuel pump;
- a fuel filter;
- an fuel level sensor having an elongate sensor body; and
- a support structure including an attachment portion at or near an upper end, by which the support structure is attached to the fuel tank in the vicinity of the access opening, and a support portion disposed at or near a lower end for mounting the pump and filter thereon;

wherein the support structure defines a housing open at the upper end to define a housing opening, the housing

being complementarily shaped with the sensor body to allow the sensor to engage with and be guided by the housing when slidably inserted into the housing via the housing opening.

[0006] The elongate sensor may conveniently be inserted into the top of the assembly and guided into the support structure. The housing is complementarily shaped with the sensor body to aid engagement and guidance therewith. A compact assembly is provided which is quick and simple to assemble and disassemble ensuring installation and manufacturing costs are reduced.

[0007] Preferably, the sensor provides the complete assembly with additional stiffness, strength and rigidity to prevent excessive oscillation, particularly at its lower end, during operation. The bending stiffness of the assembly is increased, at least in a horizontal direction, by the presence of the elongate sensor. Conveniently, this is achieved by using an existing component of the assembly and not additional means, such as a spring or the like.

[0008] The sensor body may suitably be cylindrical. A circular cross section advantageously maximises the bending stiffness of the sensor, determined along a longitudinal axis of the sensor body, and subsequently the support structure, in at least a horizontal direction. The bending stiffness of a sensor having a circular cross section will conveniently be the same in all directions on a horizontal plane and will not be greater in one particular direction, which would be the case if the cross section were rectangular, for example.

[0009] Preferably, the support structure defines a housing having a substantially circular cross section having a longitudinal axis being complementarily shaped with the sensor body. Preferably, the housing extends between the upper and lower ends, i.e. from the attachment portion to the support portion. Conveniently, the housing is complimentary shaped with the sensor to allow the support structure to engage with and receive and guide the sensor when slidably inserted therein. Suitably, the elongate sensor may share the same axis as the support structure.

[0010] Preferably, the longitudinal axis of the support structure is vertical and is orientated perpendicularly relative to the access opening. Preferably, the sensor is slidably inserted into the housing along the longitudinal axis. Suitably, the housing of the support structure provides an axis of rotation to the support structure. This conveniently allows the support structure to be inserted substantially perpendicularly into the fuel tank, rotated about its longitudinal axis into a suitable desired position before the elongate sensor is slidably inserted into the support structure to complete the assembly.

[0011] Preferably, the elongate sensor engages with the support structure. Conveniently and preferably, the engagement may be provided by an outer surface of the sensor simply interfacing with an inner surface of the support structure. Alternatively, the engagement may be pro-

vided by one or more protrusions on the sensor which engage with one or more corresponding slots in the housing. Further alternatively, the one or more protrusions may engage with one or more notches to provide a snap-fit engagement. Further alternatively, the sensor may comprise a screw thread which corresponds with the housing to allow the sensor to be screwed into the support structure.

[0012] Suitably, the attachment portion comprises a flange which interfaces with a part of the fuel tank around the access opening. Preferably, the flange surrounds the housing opening *via* which the sensor is slidably inserted into the housing of the support structure. Preferably, the flange is perpendicularly orientated relative to the longitudinal axis of the support structure. Suitably, the flange may comprise one or more holes for tubing to pass from or to one or more of the fuel pump and fuel filter.

[0013] Preferably, the flange comprises a plurality of holes corresponding to a plurality of holes arranged around the access opening in the fuel tank. Suitable fixings, e.g. bolts, may clamp the flange to the fuel tank. Alternatively, the plurality of holes in the fuel tank may comprise a screw thread adapted to receive a bolt.

[0014] The sensor may simply be inserted into the housing of the support structure and engage with the support structure, as described above, to be secured *in situ*. In addition or alternatively, a suitably adapted cover may fit on the sensor and have a plurality of holes which correspond with the holes in the flange and fuel tank to allow the cover to clamp the sensor *in situ*. Alternatively, the fuel tank may comprise a threaded lip on to which a suitably adapted cover screws to clamp the assembly in the fuel tank.

[0015] Suitable sealing means, e.g. an 'O'-ring or washer, may be disposed between the fuel tank and the attachment portion to prevent fuel escaping from the fuel tank.

[0016] Preferably, the support portion comprises first and second receptacles, each adapted to receive one of the fuel pump and fuel filter.

[0017] Suitably, the receptacles may be complementarily shaped with the fuel pump and filter and may provide complete or partial containment thereof. Advantageously, the pump and filter may be simply placed into the receptacles and be supported by a base of each receptacle or alternatively the pump and filter may simply snap into suitably adapted receptacles having no base.

[0018] Preferably, the receptacles are substantially cylindrical having longitudinal axes and are adapted to receive a substantially cylindrical fuel pump or filter. The fuel pump and filter may be readily available, standard devices and the receptacles may be sized accordingly. Preferably, the longitudinal axes of the cylindrical receptacles are vertical and parallel to the longitudinal axis of the support structure.

[0019] Suitably, the receptacles may be integral with the support portion.

[0020] Suitably, the first and second receptacles may

interface with the bottom of the fuel tank. This will provide further support and rigidity to the assembly and ensure the fuel pump and filter are located at or near a lower portion of the fuel tank for reasons known in the art.

[0021] Suitably, the support structure may comprise mounting means to support a pressure regulator. The mounting means may be integral with the support structure. Suitably, the mounting means may be a third receptacle or alternatively may be other suitable means, e.g. a clip. Preferably, the mounting means is disposed on the outside of the support structure, near the upper end of the support structure. Preferably, the mounting means is disposed on an outer surface of the housing and further preferably on an opposing side to the support portion. Suitably, a longitudinal axis of the pressure regulator may be orientated substantially parallel with the longitudinal axis of the support structure.

[0022] Preferably, the support structure defines outer limits within those of the access opening to allow a substantial portion of the support structure to pass perpendicularly through the access opening. This allows the support structure, including at least the fuel pump and filter, to be easily installed in the fuel tank without being angled or requiring additional means to angle a portion of the support structure when being installed.

[0023] Suitably, the support structure may be a plastics material and preferably resistant to fuel.

[0024] A fuel tank comprising a fuel pumping and level detection assembly as described above is also provided.

[0025] According to a second aspect of the present invention, a method of installing a fuel pumping and level-detection assembly in a fuel tank having an access opening is also provided. The method comprises the steps of:

- providing a fuel pump;
- providing a fuel filter;
- providing a fuel level sensor having an elongate sensor body;
- providing a support structure including an attachment portion at or near an upper end to attach to the fuel tank in the vicinity of the access opening, a support portion at or near a lower end for mounting the fuel pump and fuel filter thereon, and which defines a housing open at the upper end defining a housing opening, the housing being complementarily shaped with the sensor body;
- mounting the fuel pump and fuel filter to the support portion;
- inserting the support structure through the access opening and into the fuel tank in a direction parallel to a longitudinal axis of the support structure;
- clamping the attachment portion to the corresponding part of the fuel tank; and
- slidably inserting the fuel level sensor into the housing *via* the housing opening.

[0026] It will be understood that a method of removing the assembly from the fuel tank will comprise the reverse

of one or more of the steps as described above.

[0027] An embodiment of the present invention will now be described, by way of example only, with reference to the accompanying drawings, in which:

- Figure 1 is a view of the support structure sub-assembly prior to installation in the fuel tank;
- Figure 2A is a schematic showing the sub-assembly being inserted into the access opening of the fuel tank;
- Figure 2B is a schematic showing the sub-assembly being rotated into position in the fuel tank;
- Figure 2C is a schematic showing the sensor being inserted into the support structure;
- Figure 2D is a schematic showing the completed assembly;
- Figure 3 is a bottom view of the support structure sub-assembly of Figure 2A being inserted into the fuel tank;
- Figure 4 is a view of the assembly fitted in a fuel tank;
- Figure 5 is a side view of an installed assembly; and
- Figure 6 is an opposite side view of the assembly of Figure 5.

[0028] As shown in Figure 1, a fuel pumping and level detection assembly comprises a fuel pump 16 and a fuel filter 18. The fuel pump 16 may include a fuel strainer 64. A support structure 22 is provided including an attachment portion 24 to attach the support structure 22 to the fuel tank 12 in the vicinity of the access opening 14 and a support portion 26 for mounting the pump 16 and filter 18 thereon. The support structure 22 defines a housing 30 which is substantially circular in cross section.

[0029] The support portion 26 is disposed at or near a lower end of the support structure 22 and the attachment portion 24 is disposed at or near the upper end. Conveniently, the support portion 26, including the fuel pump 16 and fuel filter 18, is located near or at a lower surface of the fuel tank 12 to ensure the fuel pump 16 or strainer 64 remains submerged in low levels of fuel, for reasons known in the art.

[0030] The support structure 22 comprises a housing 30 of circular cross section having a longitudinal axis (54, as shown in Figure 3), which extends from the attachment portion 24 to the support portion 26. The housing 30 is open at the upper end defining a housing opening 36.

[0031] The support portion 26 includes two receptacles 28, one for each of the fuel pump 16 and the fuel filter 18. The receptacles 28 are substantially cylindrical and receive a substantially cylindrical pump 16 and filter 18. Each receptacle 26 has a longitudinal axis which is substantially parallel with the longitudinal axis 54 of the support structure 22. The pump 16 and filter 18 therefore engage with the receptacles 28 to secure them in position to the support structure 22. A clip 27 or other suitable means may also secure the pump 16 and/or filter 18 within each receptacle 28. The receptacles 28 are integral with the support structure 22 ensuring simple and inex-

pensive manufacture. The support structure 22 including the support portion 26 may be injection moulded, for example.

[0032] The attachment portion 24 at the upper end of the support structure 22 includes a flange 34. The flange 34 surrounds the housing opening 36 and is perpendicularly orientated relative to the axis 54 of the support structure 22. The flange 34 comprises a plurality of holes 38 which correspond to holes 40 around the access opening 14 in the fuel tank 12 to provide means to clamp the support structure 22 to the fuel tank 12. The holes 40 in the fuel tank 12 may be threaded. The flange 34 also comprises one or more holes 42 to allow tubing 44 and/or electrical wire 50 to pass, e.g. from/to the fuel pump 16, fuel filter 18, and fuel level sensor 20. Suitable fixings 52 may secure the wire 50 or tubing 44 to the support structure 22.

[0033] A method of assembling a fuel tank having a small access opening including a fuel pumping and level detection assembly 10 according to the present invention will now be described. With reference to Figure 1, the fuel pump 16 and fuel filter 18 are first mounted in the corresponding receptacles 28 on the support portion 26. The tubing 44 and/or electrical wire 50 are secured to the support structure 22 by the fixings 52.

[0034] As shown in Figure 2A, the support structure 22 is then inserted substantially perpendicularly into the fuel tank 12 relative to the access opening 14 in a direction (indicated by arrow 55) substantially parallel to the longitudinal axis 54 of the support structure 22. As shown in Figure 3, the support structure 22 including the fuel pump 16 and fuel filter 18 conveniently form a sub-assembly having outer limits, below the attachment portion 24, which are within those of the access opening 14 of the fuel tank 12. These features allow for quick and simple installation and eliminate the need for complex manipulation or angling of the support structure 22, or a portion thereof, during installation into the fuel tank 12.

[0035] As shown in Figure 2B, the support structure 22 is then rotated about its longitudinal axis 54 to position the fuel pump 16 and fuel filter 18 in a desired position in the bottom of the fuel tank 12. The support structure 22 may then be secured to the fuel tank 12 by clamping the flange 34, which is conveniently perpendicularly orientated to the support structure axis 54, to a flat portion 56 surrounding the access opening 14 of the fuel tank 12 using bolts (not shown) corresponding to the plurality of threaded holes 40 in the fuel tank 12.

[0036] As shown in Figures 2C and 2D, a fuel sensor 20 having an elongate sensor body 21 is then slidably inserted into the support structure 22 to engage with, and be guided by, the housing 30. The sensor 20 is slidably inserted into the housing 30 along the longitudinal axis 54 of the housing 30. The sensor 20 is mounted in the support structure 22 and shares the same longitudinal axis 54 as the housing 30 of the support structure 22.

[0037] The sensor 20 extends from the attachment portion 24 to the support portion 26. The sensor 20 may

then be secured in the support structure 22 by suitable means. For example, the sensor 20 may be secured into the support structure 22 by a cover (not shown) which fits over the upper end of the sensor 20 and corresponds to a threaded lip 60 on the flange 34 to clamp the sensor 20 in the support structure 22. Alternatively, a clamping plate (not shown) may be used to clamp the sensor 20 and attachment portion 24 to the fuel tank 12.

[0038] The outer surface of the sensor body 21 may simply engage with an inner surface of the support structure 22 to locate and secure the sensor 20 in position. Alternatively, the housing 30 may have slots 32 which corresponding protrusions (not shown) on the sensor body 21 engage with. Further alternatively, the sensor 20 may screw into a portion of the support structure 22. When inserted within the support structure 22, the sensor 20 provides additional strength, stiffness and rigidity to the support structure 22 and, in particular, prevents the support portion 26, including the fuel pump 16 and fuel filter 18, from excessive oscillation during use. The support portion 26 may also extend to interface with the bottom of the fuel tank 12 to provide further stability and rigidity to the support structure 22.

[0039] Figure 4 shows the fuel pumping and level detection assembly 10 installed in the fuel tank 12. The sensor 20 is electrically connected to its source *via* a suitable connector 45 disposed on the sensor 20 and the tubing 44 and electrical wire 50 are also connected accordingly.

[0040] Figures 5 and 6 show the elongate sensor 20 in situ within the support structure 22 forming the assembly 10 when installed within the fuel tank 12. In addition to the fuel pump 16 and fuel filter 18, other components, e.g. a pressure regulator 46, may be mounted to the support structure 22 by a third receptacle or other suitable means, e.g. clips 48. The clips 48 may be integral with the support structure 22.

[0041] Conveniently, the elongate sensor 20 and housing 30 of the support structure 22 are suitably sized and shaped to allow the elongate sensor 20 to engage with and be guided by the support structure 22 when slidably inserted along the longitudinal axis 54 of the support structure 22 during assembly of the fuel pumping and level detection assembly 10. This also provides a compact sub-assembly which can be easily inserted substantially perpendicularly into the access opening 14 of a fuel tank 12 requiring no inconvenient angular manipulation, particularly where the access opening 14 of the fuel tank 12 is small. The elongate sensor 20 also provides the support structure 22 with a form of backbone, thereby offering the support structure 22 with additional strength, adequate stiffness in at least the horizontal direction, and rigidity to prevent the support structure 22, particularly the support portion 26 including the fuel pump 16 and fuel filter 18, oscillating excessively, particularly during use within the fuel tank 12.

Claims

1. A fuel pumping and level detection assembly (10) for installation within a fuel tank having a small access opening, comprising:

- a fuel pump (16);
- a fuel filter (18);
- a fuel level sensor (20) having an elongate sensor body (21); and
- a support structure (22) including an attachment portion (24) at or near an upper end, by which the support structure (22) is attached to the fuel tank (12) in the vicinity of the access opening (14), and a support portion (26) disposed at or near a lower end for mounting the pump (16) and filter (18) thereon;

wherein the support structure (22) defines a housing (30) open at the upper end to define a housing opening (36), the housing (30) being complementarily shaped with the sensor body (21) to allow the sensor body (21) to engage with and to be guided by the housing (30) when slidably inserted into the housing (30) *via* the housing opening (36).

2. An assembly (10) according to claim 1, wherein the support structure (22) has a longitudinal axis (54) which is substantially vertical and orientated substantially perpendicularly to the access opening (14), and wherein the sensor body (21) is slidably inserted into the housing (30) along the longitudinal axis (54).
3. An assembly (10) according to claim 2, wherein the sensor body (21) and housing (30) are substantially circular in cross section.
4. An assembly (10) according to any preceding claim, wherein the attachment portion (24) comprises a flange (34) which interfaces with the fuel tank (12) in the vicinity of the access opening (14) and which surrounds the housing opening (36).
5. An assembly (10) according to claim 4, wherein the flange (34) is perpendicularly orientated relative to the longitudinal axis (54) of the support structure (22).
6. An assembly (10) according to claims 4 or 5, wherein the flange (34) comprises one or more holes (42) for tubing (44) to pass from or to one or more of the fuel pump (16) and fuel filter (18).
7. An assembly (10) according to any preceding claim, wherein the support portion (26) comprises first and second receptacles (28), each adapted to receive one of the fuel pump (16) and fuel filter (18).

8. An assembly (10) according to claim 7, wherein the receptacles (28) and fuel pump (16) and fuel filter (18) are cylindrical having longitudinal axes substantially parallel with the longitudinal axis (54) of the support structure (22). 5
9. An assembly (10) according to claims 7 or 8, wherein the receptacles (28) are integral with the support portion (26). 10
10. An assembly (10) according to any preceding claim, wherein the support structure (22) comprises mounting means (48) to support a pressure regulator (46).
11. An assembly (10) according to any preceding claim, wherein the support structure (22) defines outer limits within those of the access opening (14) to allow a substantial portion (26) of it to pass perpendicularly through the access opening (14). 15
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12. A fuel tank (12) comprising an assembly (10) according to any one of claims 1 to 11.
13. A method of installing a fuel pumping and level-detection assembly (10) in a fuel tank (12) having an access opening (14), the method comprising the steps of: 25
- providing a fuel pump (16);
 - providing a fuel filter (18); 30
 - providing a fuel level sensor (20) having an elongate sensor body (21);
 - providing a support structure (22) including an attachment portion (24) at or near an upper end to attach to the fuel tank (12) in the vicinity of the access opening (14), a support portion (26) at or near a lower end for mounting the fuel pump (14) and fuel filter (16) thereon, and a housing (30) open at the upper end to define a housing opening (36), the housing (30) being complementarily shaped with the sensor body (21); 35
40
 - mounting the fuel pump (14) and fuel filter (16) to the support portion (26);
 - inserting the support structure (22) substantially perpendicularly through the access opening (14) and into the fuel tank (12); 45
 - rotating the support structure (22) about its axis (54) to position the pump (14) and filter (16) in desired positions in the fuel tank (12) and to align a part of the support structure (22) with a corresponding part of the fuel tank (12); 50
 - clamping the attachment portion (24) to the fuel tank (12); and
 - slidably inserting the fuel level sensor (20) into the housing (30) via the housing opening (36). 55

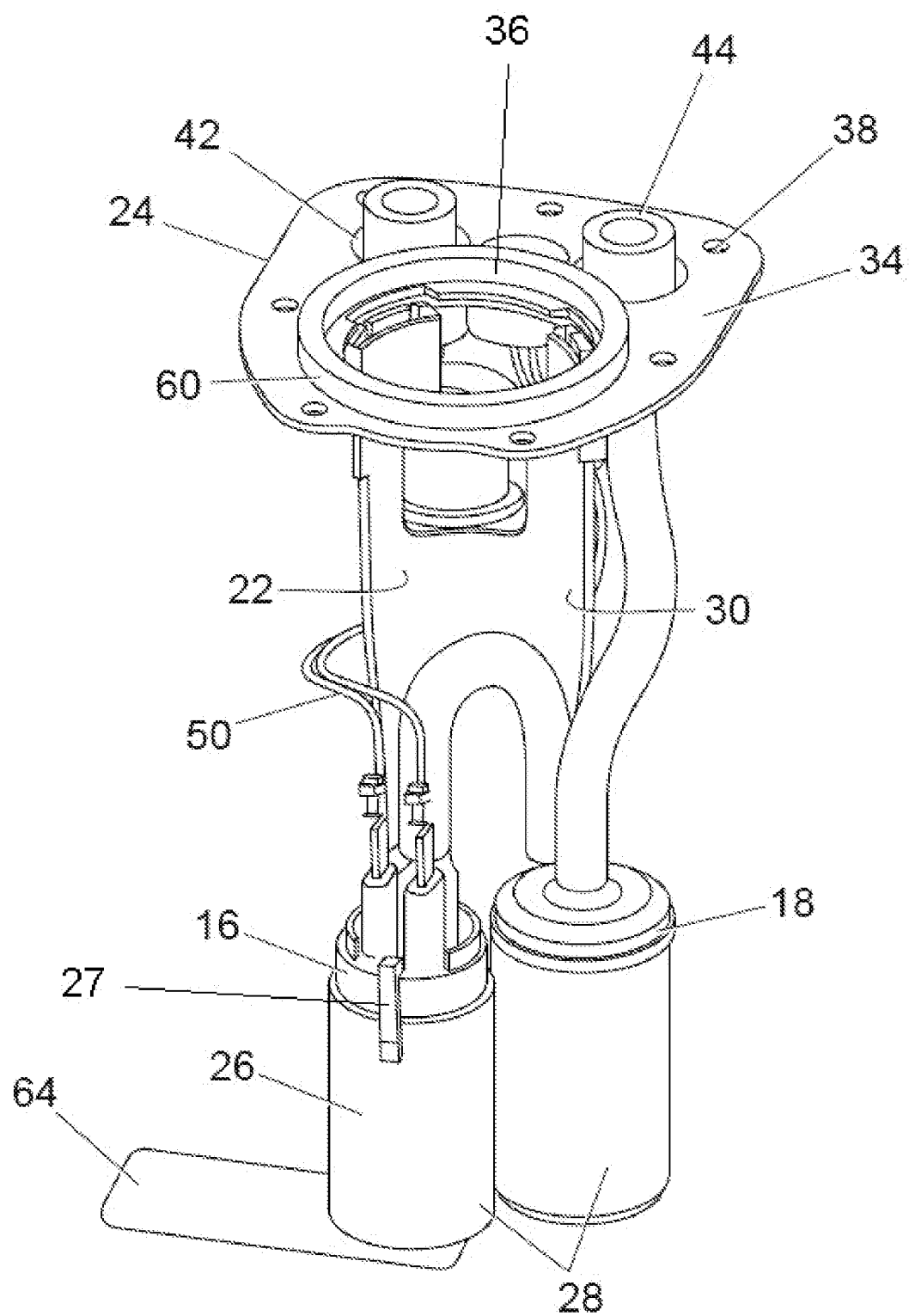


Figure 1

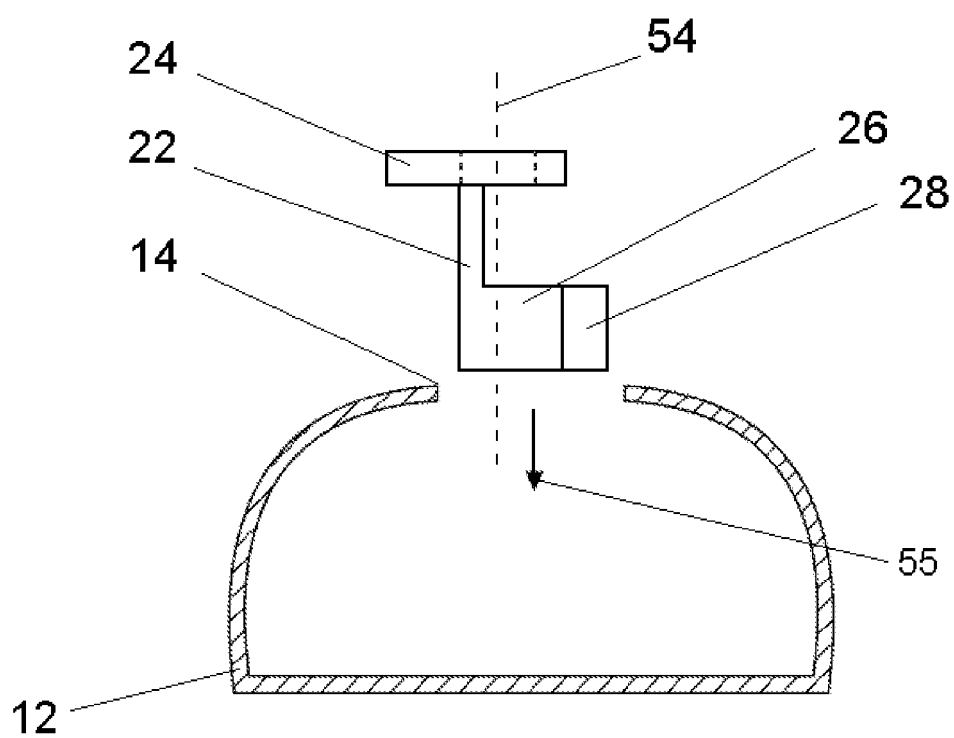


Figure 2A

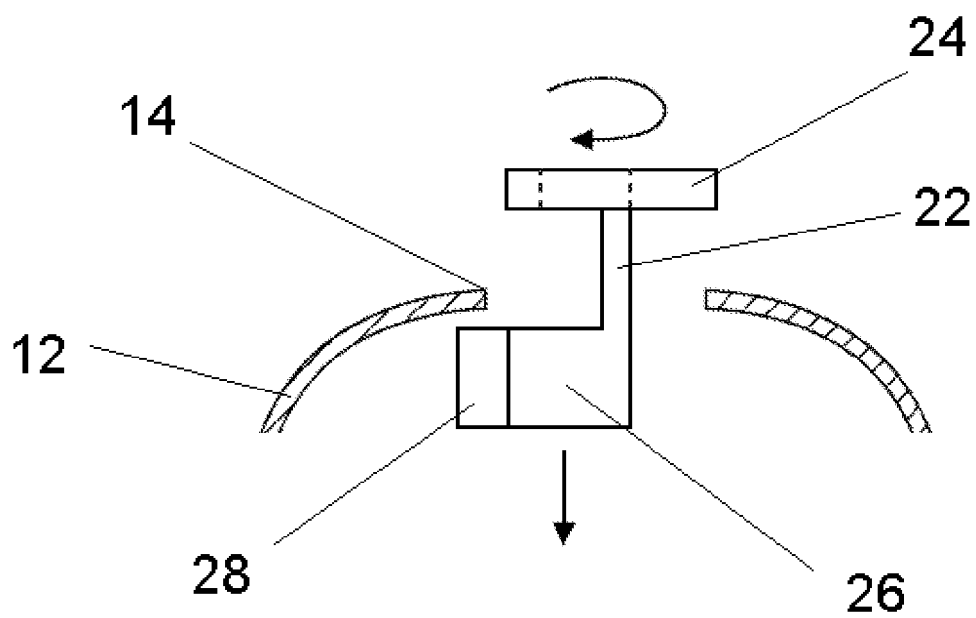


Figure 2B

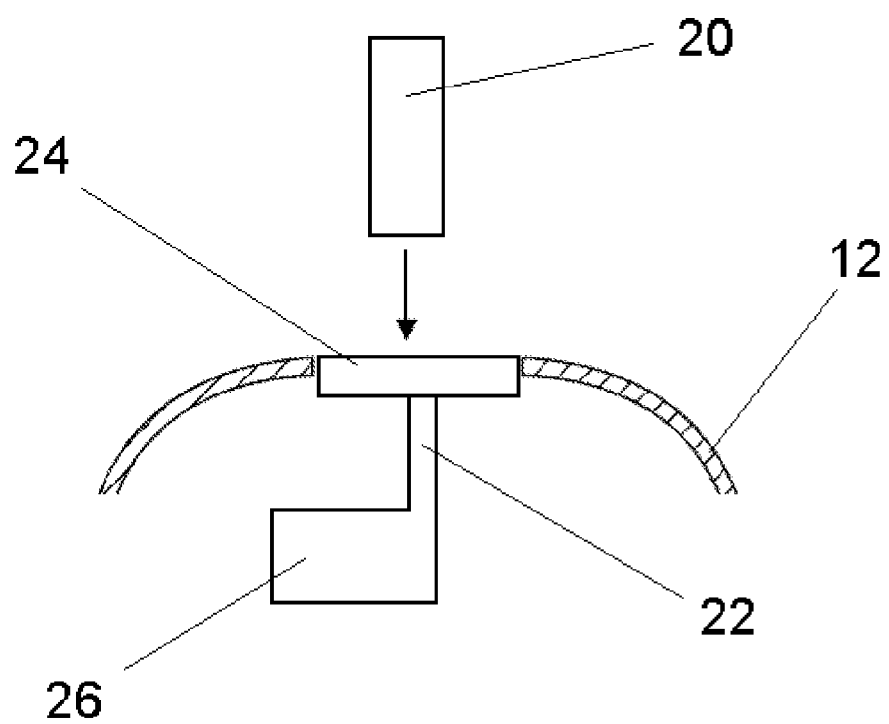


Figure 2C

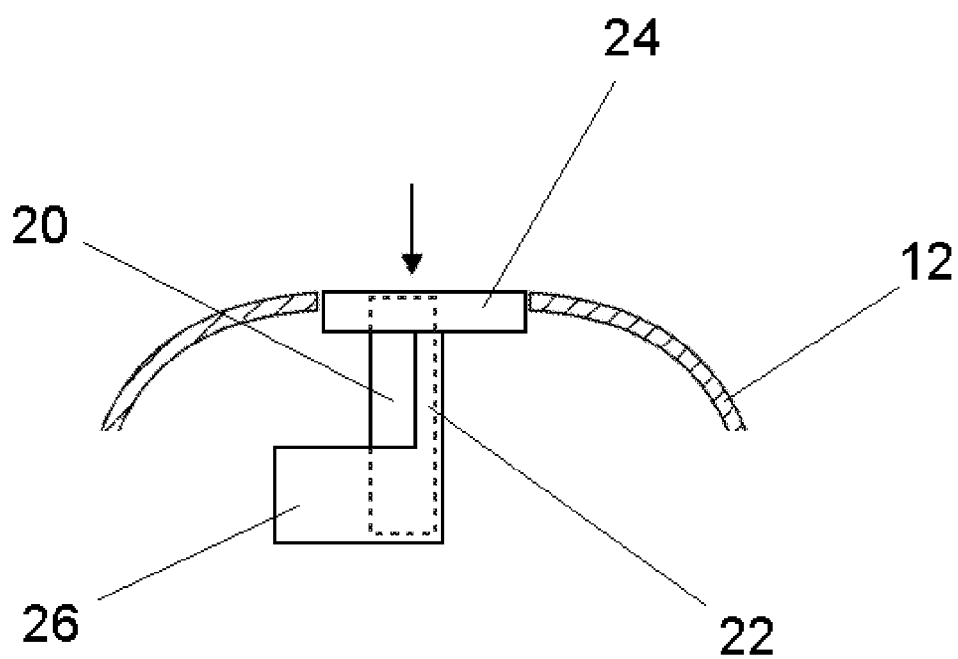


Figure 2D

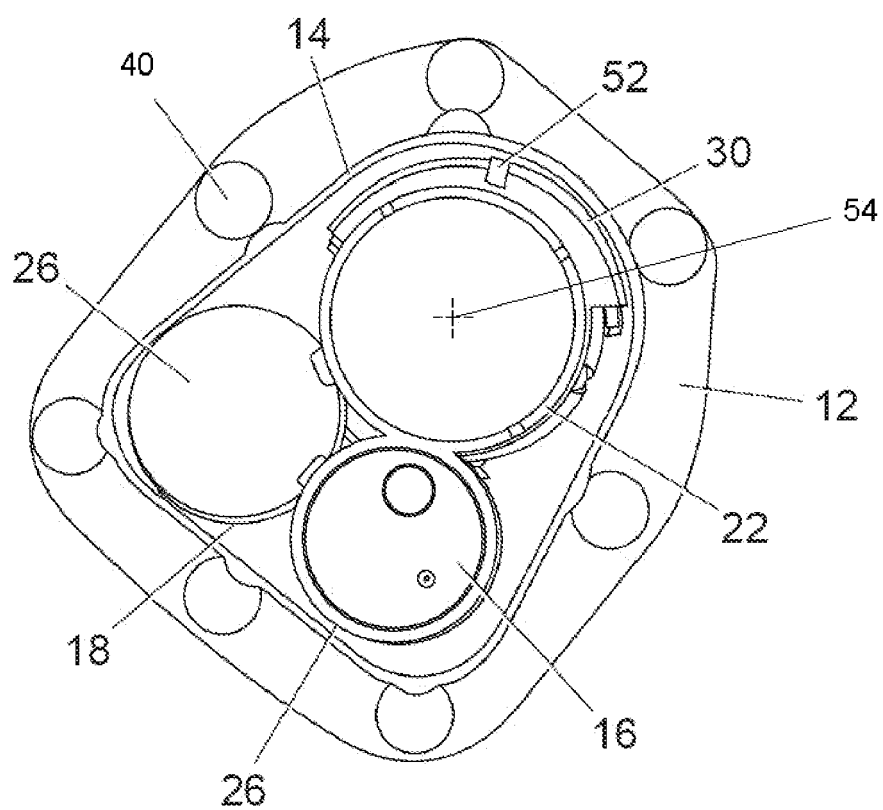


Figure 3

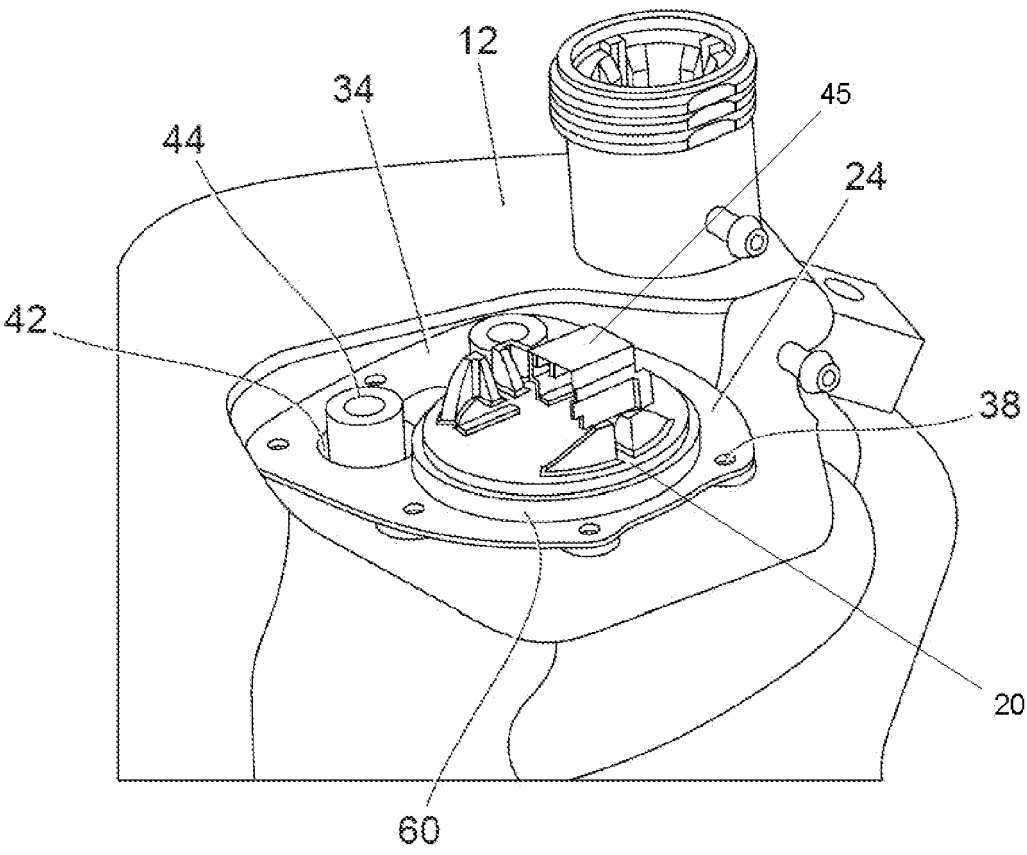


Figure 4

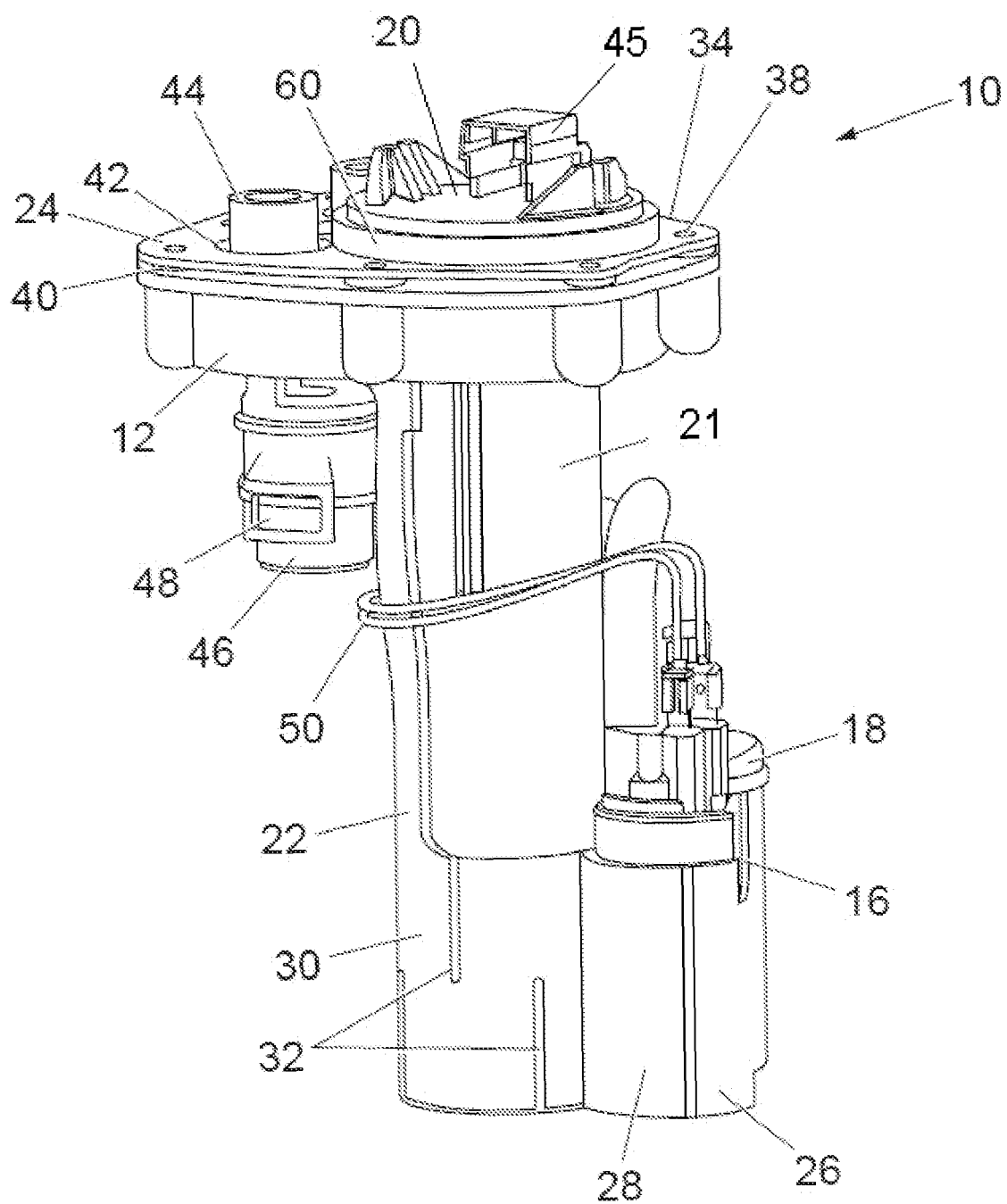


Figure 5

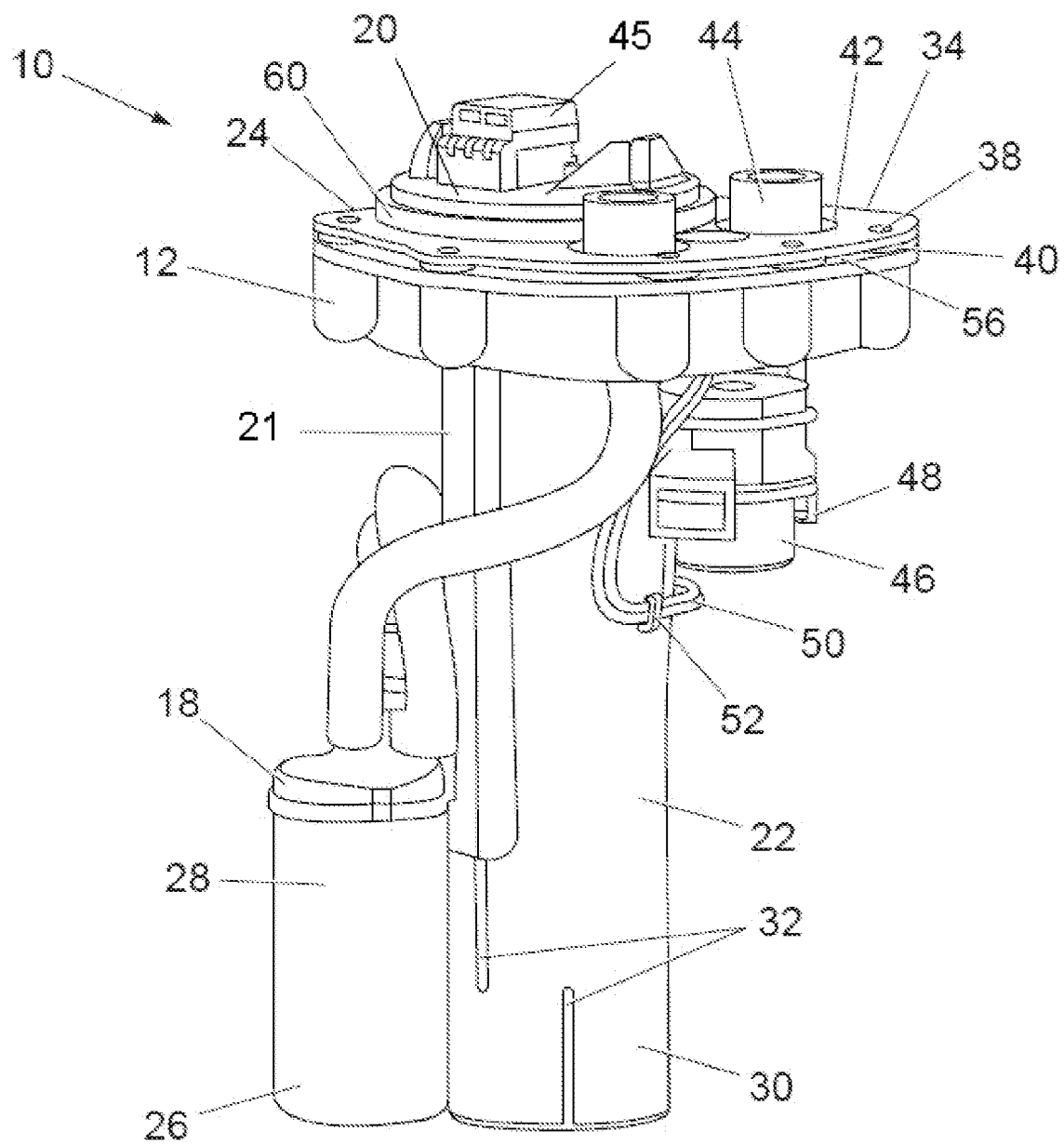


Figure 6



European Patent
Office

EUROPEAN SEARCH REPORT

Application Number
EP 07 12 1357

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The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 22 May 2008	Examiner Raposo, Jorge
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**ANNEX TO THE EUROPEAN SEARCH REPORT
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EP 07 12 1357

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