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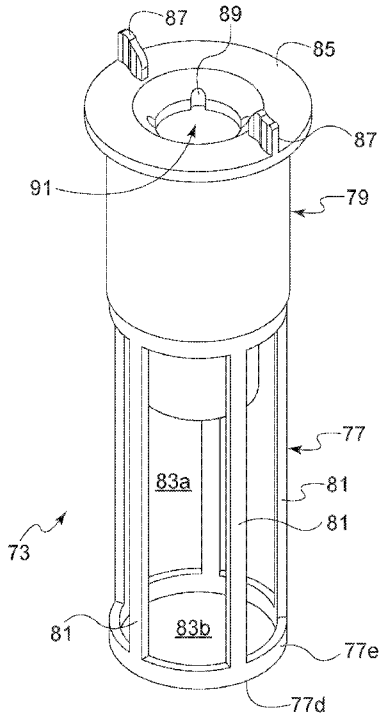

Fig. 18

(57) Abstract: Tank (11) having a filler pipe (73), comprising a wall (13) made of a plastic material and defining therein a tank chamber (15), and an assembly (17) for heating and drawing the fluid contained in the tank, wherein said filler pipe (73) comprises a body made of a plastic material in which an outer hollow portion (77) and an inner hollow portion (79) are defined, and wherein the outer hollow portion (77) comprises a cylindrical portion (77b) having a cross-sectional size larger than the cross-sectional size of the inner portion (79) and being provided with at least one side opening housing a filtering net (83a).

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TANK HAVING A FILLER PIPE AND METHOD FOR MANUFACTURING SAME

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DESCRIPTION

Technical Field

The present invention relates to a tank having a filler pipe and to a method of manufacturing said tank. The tank according to the invention is arranged to contain a fluid in liquid state, intended for a selective catalytic reduction (SCR) system of an exhaust system of an internal combustion engine. More particularly, the tank according to the invention is arranged to be installed on a vehicle equipped with an internal combustion engine having an exhaust system incorporating a selective catalytic reduction (SCR) system.

Prior Art

SCR (Selective Catalytic Reduction) technology is based on a reduction of ammonia NH_3 to nitrogen N_2, with a consequent handover of hydrogen atoms H to nitrogen oxides NO_x, in order to produce water molecules H_2O and nitrogen molecules N_2. Such a reaction is stoichiometric, i.e., if a sufficient amount of ammonia, proportionate to the amount of NO_x produced by the internal combustion engine, is fed into a predetermined volume, or reaction chamber, all of NO_x will be transformed into water and nitrogen. SCR technology allows therefore cutting down NO_x that are released into the atmosphere with the exhaust gases of an endothermic engine.

The SCR system is generally fed with a solution containing 32.5% in weight urea and 67.5% demineralised water. Such a solution is commercially available under the name AdBlue®. AdBlue® is fed to the reduction system incorporated in the exhaust system of an endothermic engine through a suction pump connected to an injection system. A supply circuit is provided upstream of the pump and is connected to a tank in which the AdBlue® liquid is stored.

As known, the AdBlue® liquid contained in the tank solidifies when temperature falls below -11.5°C.

At present, to prevent freezing of the urea solution, the tank is equipped with a unit known as sender unit or drawing unit, arranged to heat the liquid contained in the tank by means of a heat exchanger and to allow drawing the liquid through a duct or suction pipe. The heat exchanger includes a metal duct in which the coolant liquid of the endothermic engine, the exhaust gases of which are treated with the AdBlue® solution contained in the tank, circulates. Thanks to the heat exchanger, the temperature of the AdBlue® liquid

contained in the tank is brought to and kept at a temperature higher than -11.5°C.

The sender unit further includes delivery and return pipes for the liquid contained in the tank, for delivering the liquid from the tank to the suction pump and for the return of the excess amount to the tank, respectively.

The most recent sender units are equipped with some additional components besides the components mentioned above. More particularly, sender units are known that are equipped with sensors for measuring parameters of the liquid contained in the tank, such as level, temperature and quality, the latter parameter being generally determined through a measurement of the urea concentration in the solution.

The prior art sender units are further equipped with net filters for a coarse filtering of the solution contained in the tank before the solution is sucked from the tank for being sent to the metering pump.

Lastly, the sender units are also equipped with a printed circuit board for acquiring the signals coming from the sensors and with electrical connectors for connecting the unit to an electrical circuit, associated with an electronic control unit for controlling the operation of the SCR reduction system.

As evidenced above, the current sender units integrate the functions of heating and drawing the liquid contained in the tank into a single apparatus. According to the prior art, the sender unit includes a portion internal to the tank, an external portion and a flange, located between the internal and external portions, for securing the unit to the tank wall in correspondence of a suitable hole. The unit is thus inserted into the tank through an opening provided in the tank wall and is secured to the tank by means of screws engaging the flange. This operating manner gives rise to a number of drawbacks and limitations. For instance, the shape and the development of the portion of the sender unit housed in the tank cannot be chosen at will, for instance in order to increase the unfreezing capability and rapidity, but they must be compatible with the entrance hole in order to allow installing the unit. Moreover, the sender units presently known are designed for being generally installed in the upper tank portion, typically at the top face of the tank. Such a limitation entails the need to make sender units equipped with a suction pipe with a suitable length, in order to suck the liquid as the tank is being emptied. Said suction pipe undergoes vibrations while the vehicle is traveling and can therefore undergo breakages.

Always due to the situation mentioned above, supplementing a sender unit with further functions and components, e.g. sensors, is at present difficult.

US 2011/0271754 and EP 3177814 A1 disclose examples of prior art sender units.

The current tanks designed for containing a urea solution are moreover equipped with a filler pipe having a closing cap. The filler pipe allows filling a tank by means of the spout of a container of the urea solution or by means of the spout of a supply gun. The urea solution is highly corrosive and it is necessary that the filler pipe has a passageway suitable for such a spout, preventing the loss of substance during filling up.

To prevent impurities from entering the tank during filling operations, the filler pipe is moreover equipped with a filter. The filter includes a cylindrical tube open at its bottom and laterally and equipped with a net. The tube has a section suitable to receive the standard spout of a supply gun or of a container of the urea solution, and it is introduced through an annular flange secured to the tank at a hole provided for that aim. The tube is secured to the flange by means of a coupling system allowing removing the filter for cleaning it. In the prior art filler pipes currently used, the filtering surface is therefore determined by the diameter of the cylindrical tube. At present, the filtering surface of the filler pipe of a tank for urea is of about 4070 mm^2.

Such a circumstance determines a reduced flow of the urea solution through the filler pipe, with consequently long filling times. Moreover, the prior art configuration described determines a reduced filtering capability, with a consequent risk of introducing impurities into the tank during the operations of filling-up with the urea solution.

It is a first object of the invention to obviate the drawbacks and the limitations of the prior art by providing a tank having a filler pipe allowing a greater filling rapidity.

It is another object of the invention to provide a tank having a filler pipe with an improved filtering capability.

It is a further, but not the last object of the invention to provide a tank for a urea solution, arranged to be installed on a vehicle equipped with an endothermic engine and an SCR system for reducing NO_x in the exhaust gases, which tank can be industrially manufactured at limited costs and on a large scale.

The above and other objects are achieved by means of the tank according to the invention as claimed in the appended claims.

Description of the invention

The tank according to the invention is equipped with a filler pipe and comprises a wall made of a plastic material internally defining a tank chamber. Preferably, the tank is further equipped with an assembly for heating and drawing the fluid contained in the tank.

Advantageously, according to the invention, said filler pipe comprises a body made of a plastic material in which an outer hollow portion and an inner hollow portion are

defined. Moreover, the outer hollow portion has a cylindrical portion having a cross-sectional size larger than the cross-sectional size of the inner portion and provided with at least one side opening housing a filtering net.

Always according to the invention, the outer portion of the filler pipe comprises opposite bases both of which are preferably open, and has a substantially cylindrically shape with circular cross-section. Said outer portion of the filler pipe further comprises in succession a laterally closed portion and a laterally open portion that are axially aligned, and said laterally open portion and the open base of said laterally open portion are moreover provided with a filtering net.

Preferably, the laterally open portion is defined by a set of axial extensions extending along corresponding generatrices, said extensions starting from the laterally closed portion and ending at an annular portion surrounding said open base of the outer portion of the filler pipe.

The filler pipe further includes an inner hollow portion including a cylindrical body with circular cross-section preferably housed in removable manner in the outer hollow portion. Said inner portion, when housed in the outer portion of the filler pipe, extends over the whole length of the closed portion starting from the open base and over a section of the open portion preferably corresponding to at least about 1/4 of the length of said open portion.

Moreover, the inner portion preferably includes an annular ring nut or ferrule having tabs axially extending outside said annular ferrule, and the inner portion can be engaged into or disengaged from the outer portion by manually rotating the inner portion by means of said tabs, thanks to a threaded or bayonet coupling between said inner and outer portions of the filler pipe according to the invention.

According to the invention, the tank is thus equipped with a filler pipe for introducing the liquid into the tank, the pipe being preferably provided with a net filter suitably dimensioned so as to enable increasing the surface through which the liquid passes while the tank is being filled. In this manner, it is advantageously possible to make the filter of the filler pipe with porosity lower than the current 100 microns. According to this particular embodiment of the invention, the filter of the filler pipe can be made with porosity in the range 20 to 100 microns.

Advantageously, according to this particular embodiment of the invention, the filtering surface of the filler pipe will be at least about 9550 mm^2, to allow an adequate filling rate notwithstanding the reduction in the porosity of the filtering surface.

Advantageously, according to the invention, the filler pipe has therefore a filtering surface preferably of at least 9550 mm^2, that is a surface considerably wider than that of the filler pipes made in accordance with the present state of the art.

Still according to the invention, the tank is provided with a seat adapted to house a filler pipe for filling up the tank. The seat is preferably formed in a cylindrical extension extending outside the tank in a direction substantially perpendicular to the upper face of the tank body. Said seat further has a preferably circular opening, housing the filler pipe.

In accordance with a preferred embodiment of the invention, the tank equipped with a filler pipe has a wall made of a plastic material and defining therein a tank chamber, and an assembly for heating and drawing the fluid contained in the tank. In accordance with the invention, the method of manufacturing a tank comprises a step of obtaining a cylindrical extension in the tank wall during a tank moulding step, in order to house the filler pipe.

Preferably, according to the invention, the tank further has an inlet for the return of the excess substance coming from the SCR system. Such an inlet preferably consists of a thin tube co-moulded in the tank wall and provided with a connecting joint outside the tank for connection of a return pipe coming from the SCR system. Such a thin tube is preferably made of plastics, e.g. the same plastic material as that of the tank, or of metal or another material. Preferably, said thin tube is located near the wall portion to which the first heating unit is secured and preferably on the top face of the tank.

Brief Description of the Figures

Some preferred embodiments of the invention will be described hereinafter with reference to the accompanying drawings, in which:

- Fig. 1 is a perspective view of a tank in accordance with a first embodiment of the invention;
- Fig. 2 is a cross-sectional view, taken along a first vertical plane, of the tank shown in Fig. 1;
- Fig. 3 is an enlarged view of a detail of Fig. 2;
- Fig. 4 is a cross-sectional view, taken along a second vertical plane rotated by 90°, of the tank shown in Fig. 1;
- Fig. 5 is an enlarged view of a detail of Fig. 4;
- Fig. 6 is a cross-sectional view of the drawing unit of the tank shown in Fig. 1;
- Fig. 7 is a plan view from below of the drawing unit shown in Fig. 6;
- Fig. 8 is a side view of the drawing unit shown in Fig. 6;

- Fig. 9 is a cross-sectional view, taken along a vertical plane, of a tank in accordance with a second embodiment of the invention;
- Fig. 10 is an enlarged view of a detail of Fig. 9;
- Fig. 11 is a perspective view of the drawing unit of the tank shown in Fig. 9;
- Fig. 12 is a perspective view from above of the drawing unit shown in Fig. 11;
- Fig. 13 is an exploded perspective view of the drawing unit in accordance with the first embodiment of the invention;
- Fig. 14 is a plan view from below of the drawing unit shown in Fig. 13;
- Fig. 15 is a side view of the heating unit equipped with a solenoid valve;
- Fig. 16 is a cross-sectional view, taken along a first vertical plane, of the tank equipped with a filler pipe according to a preferred embodiment of the invention;
- Fig. 17 is a cross-sectional view, taken along a second vertical plane rotated by 90°, of the tank shown in Fig. 16;
- Fig. 18 is a perspective view of the filler pipe shown in Fig. 16;
- Fig. 19 is a cross-sectional view, taken along a vertical plane, of the filler pipe shown in Fig. 16;
- Fig. 20 is an exploded view of the filler pipe shown in Fig. 16.

In all accompanying Figures, the same reference numerals have been used to denote equal or functionally equivalent components.

Description of a Preferred Embodiment

Referring to the accompanying drawings, a preferred embodiment of a tank 11 according to the invention is illustrated. Tank 11 has a wall 13, made of a plastic material, internally defining a tank chamber 15. The material wall 13 is made of is such as to allow tank 11 to contain a substance in liquid state comprising, for instance, a urea solution intended for a system for the selective catalytic reduction (SCR) of the exhaust gases of an endothermic engine.

Referring in particular to Fig. 1, tank 11 has a seat 71 for housing a filler pipe for filling up tank 11. Seat 71 can be obtained by forming a cylindrical extension 71a in tank wall 13 during the tank moulding step. Cylindrical extension 71a extends outside tank 11 in a direction substantially perpendicular to top face 35 of the tank body. Said extension 71a surrounds a preferably circular opening, housing the filler pipe.

Referring to Figs. 16 to 20, there is shown in detail a filler pipe 73 made according to a preferred embodiment of the invention. In the illustrated embodiment, an opening 75 is formed in a transverse wall or partition 75a of extension 71a. Said transverse wall or

partition 75a is formed inside extension 71a and lies in a plane substantially parallel to, but not coinciding with face 35 of the body of tank 11. In other embodiments, transverse partition 75a coincides with tank wall 13 and lies therefore in a plane coinciding with that of said wall 13. In the illustrated embodiment, extension 71a has a cylindrical shape with circular cross-section, and also internal seat 71 has a cylindrical shape with circular cross-section. Opening 75 for the passage of filler pipe 73 is formed substantially centrally of transverse partition 75a.

Filler pipe 73 comprises a body of plastic material in which an outer hollow portion 77 and an inner hollow portion 79 are defined. Outer portion 77 has a substantially cylindrical shape with circular cross-section and includes a laterally closed portion 77a and a laterally open portion 77b. Both bases 77c, 77d of outer portion 77 are open. Open outer portion 77b defines a set of axial extensions 81, five in the illustrated example, which extend along as many generatrices starting from laterally closed portion 77a and end at an annular portion 77e of open base 77d. Open portion 77b and the corresponding open base 77d house a filtering net 83a, 83b arranged to separate possibly present impurities from the substance flow introduced into filler pipe 73 for filling tank 11. Closed portion 77a of outer hollow portion 77 can be secured, at open base 77c, into opening 75 provided in transverse wall 75a of seat 71 in tank 11. Said closed portion 77a can be secured into opening 75 by known means, for instance a toothed joint, allowing removing outer portion 77 of filler pipe 73 from seat 71 for instance in order to clean filter 83a, 83b. In the alternative, it is possible to permanently secure said outer hollow portion 77 to opening 75.

Filler pipe 73 according to this preferred embodiment of the invention further includes an inner hollow portion 79 comprising a cylindrical body with circular cross-section removably housed in outer hollow portion 77. Said inner portion 79, when housed in outer portion 77, extends over the whole length of closed portion 77a starting from open base 77c, and over a section of open portion 77b corresponding to about 1/4 of the length of said open portion 77b.

According to this embodiment of the invention, inner portion 79 includes an annular ferrule 85 having tabs 87 axially extending outside said annular ferrule 85. Inner portion 79 can be made to engage outer portion 77 by manually rotating inner portion 79 by means of said tabs 87.

Advantageously, filler pipe 73 has a considerably wider filtering surface than the current filler pipes. The filtering surface of filler pipe 73 is substantially given by the

extension of filtering net 83a, 83b surrounding open cylindrical portion 77b and covering open base 77d of the body of outer portion 77.

Advantageously, inner portion 79 is equipped with an insert including a permanent magnet arranged to cooperate with the valve provided in the gun delivering the urea solution. Aeration slots 89 are provided in opening 91 of inner portion 79 surrounded by ferrule 85, through which the spout of said delivery gun is introduced.

Closed portion 77a of outer portion 77 of filler pipe 73 can moreover be locked by means of a fast coupling into opening 75 provided in partition 75a.

Referring again to Figs. 1 to 5, a first embodiment of a tank 11 according to the invention is illustrated. Tank 11 has a wall 13, made of a plastic material, internally defining a tank chamber 15. The material wall 13 is made of is such as to allow tank 11 to contain a substance in liquid state comprising, for instance, a urea solution intended for a system for the selective catalytic reduction (SCR) of the exhaust gases of an endothermic engine. Tank 11 is equipped with at least one heating and suction or drawing assembly 17, arranged to heat the fluid contained in tank 11, in particular in order to avoid freezing thereof, and to draw the fluid from tank 11, in particular in order to send it to a suction or metering pump of a system for the selective catalytic reduction (SCR) of the exhaust gases..

Heating and drawing assembly 17 includes a first unit 19, or heating unit, intended for heating the fluid in tank 11, and a second unit 21, or drawing unit, for drawing said fluid and sending it to the circuit of the SCR system.

Heating unit 19 includes a heating duct 23, provided with an inlet opening 25 and an outlet opening 27, for conveying a heating fluid. Duct 23 extends, within tank 11, from inlet opening 25 towards outlet opening 27 preferably as an integral piece, i.e. preferably without connections or interruptions. In the illustrated embodiment, moreover, duct 23 of the first unit 19 comprises a rectilinear portion and a spiral section. A delivery section 23a and a return section 23b are defined within said rectilinear portion, and said spiral section 23c establishes communication between sections 23a, 23b. Moreover, always with reference to the illustrated embodiment, spiral section 23c and drawing unit 21 are configured so that said spiral section 23c substantially surrounds inlet opening 31 of said drawing unit 21, defined at the outer surface of filter 57.

Inlet and outlet openings 25, 27 of duct 23 are located outside tank 11 and can be connected, by known means, to a section of a cooling circuit of an endothermic engine. Said endothermic engine preferably is the same engine whose exhaust gases are treated by

the SCR system receiving the fluid contained in the tank.

According to the invention, said heating and drawing units 19 and 21 are advantageously independent units, that is, they are mutually separated by a portion of the tank wall, so that, should said portion of the tank wall be removed, said units 19, 21 would be disjoined from each other. Thus, advantageously, according to the invention, heating unit 19 and drawing unit 21 can be associated with tank 11 at adjacent portions, or even at spaced apart portions, of wall 13 of tank 11.

Referring again to Figs. 1 to 5, in accordance with a first embodiment of the invention, said units 19, 21 are located at a distance from each other, that is, they are associated with wall 13 of tank 11 at respective portions 13a, 13b of said wall distant from each other, preferably on opposite parallel faces 35, 37 of tank 11. According to this embodiment of the invention, units 19, 21 can be diametrically opposite, with the respective longitudinal axes substantially parallel and preferably coaxial, for instance when they are associated with respective parallel faces 35, 37 of a parallelepiped tank 11. In the alternative, said units 19, 21 can be arranged with the respective longitudinal axes substantially perpendicular, for instance when they are associated with respective perpendicular faces 35, 39 of a parallelepiped tank 11.

In the illustrated embodiment, unit 19 and unit 21 extend in a substantially rectilinear direction and are arranged substantially coaxial to each other. Tank 11 shown in the Figures is oriented in its normal use configuration, i.e. with face 35 housing heating unit 19 located at the top and with face 37 housing drawing unit 21 located at the bottom. In accordance with such an arrangement, heating unit 19 extends over substantially the whole depth of tank 11, i.e. substantially across the tank in vertical direction, and drawing unit 21 extends over a portion sufficient to draw the liquid from the bottom of tank 11.

As it can be better seen in Figs. 6 and 7, drawing unit 21 includes a drawing duct 29 having an inlet opening 31 and an outlet opening 33. Inlet and outlet openings 31, 33 of drawing duct 29 are located inside and outside tank 11, respectively. Drawing unit 21 further includes a ferrule 41 provided with through-holes 43 for securing, for instance by means of screws, drawing unit 21 to wall 13 of tank 11 at a suitable hole provided therein. In the alternative, ferrule 41 can be welded or glued to said wall 13 of tank 11. Ferrule 41 is moreover associated with temperature sensors 45a, level sensors 45b and quality sensors 45c for the liquid contained in tank 11. Said sensors 45a, 45b and 45c are associated with ferrule 41 on face 47 of said ferrule facing the inside of tank 11, so as to be exposed in chamber 15 enclosed by tank wall 13. A seat 51 internally housing a printed circuit board

electrically connected to said sensors 45a, 45b, 45c is provided on the opposite face 49 of ferrule 41. The printed circuit board is also equipped with connectors for connecting the printed circuit board, through a cable 53, to an electrical circuit associated with an electronic control unit for controlling the functions of the SCR system through the signals coming from sensors 45a, 45b, 45c.

Turning now to Figs. 9 and 10, in accordance with a second preferred embodiment of the invention, said units 19, 21 are located adjacent, that is, they are associated with tank wall 13 at a respective and substantially coincident wall portion 13a. In the illustrated embodiment, heating unit 19 and drawing unit 21 are located adjacent on the same face 35 of a substantially parallelepiped tank 11. In the illustrated example, unit 19 and unit 21 extend in a substantially rectilinear direction and are arranged substantially coaxial to each other. Tank 11 illustrated is oriented in its normal use configuration, i.e. with face 35 housing heating unit 19 and drawing unit 21 at portion 13a located at the top. In accordance with such an arrangement, heating unit 19 preferably extends over substantially the whole depth of tank 11, i.e. substantially across the tank in vertical direction. Moreover, always with reference to this embodiment, drawing unit 21 also preferably extends over the whole depth of tank 11, i.e. substantially across the tank in vertical direction, so as to allow sucking the liquid from tank 11, preferably until the liquid is almost completely exhausted.

As it can be better seen in Figs. 11 and 12, according to this second embodiment of the invention, drawing unit 21 includes a drawing duct 29 having an inlet opening 31, substantially consisting of the outer surface of filter 57, and an outlet opening 33. Inlet and outlet openings 31, 33 of drawing duct 29 are located inside and outside tank 11, respectively. Moreover, according to this second embodiment of the invention, drawing duct 29 extends across chamber 15 in vertical direction, so as to allow sucking the liquid from tank 11, preferably until the liquid is almost completely exhausted.

Referring in particular to Fig. 11, in this second embodiment of the invention, temperature sensors 45a, level sensors 45b and quality sensors 45c for the liquid contained in tank 11 are associated with a rod 55 extending over substantially the whole depth of tank 11 starting from ferrule 41.

Referring in particular to Fig. 12, in this second embodiment, ferrule 41 is made with circular shape and has a pair of diametrically opposite recesses 41, 41b for the passage of delivery section 23a and return section 23b of duct 23. In the illustrated embodiment, moreover, duct 23 of the first unit 19 comprises a rectilinear portion 23a,

23b and a spiral section 23c. A delivery section 23a and a return section 23b are defined in said rectilinear portion, and said spiral section 23c establishes communication between sections 23a, 23b. Moreover, always with reference to the illustrated embodiment, spiral section 23c and drawing unit 21 are configured so that said spiral section 23c substantially surrounds inlet opening 31 of said drawing unit 21, substantially defined by the outer surface of filter 57.

In this embodiment, as it can be appreciated in particular from Fig. 12, unit 19 and unit 21 are associated with wall 13 in substantially coincident positions, while still being two separate independent units. Said units 19, 21 are therefore structurally connected only by wall 13 of tank 11.

According to a preferred embodiment of the invention, duct 23 for heating the liquid contained in tank 11 is associated with wall 13 of tank 11 directly in the moulding step of the plastic material by means of the co-moulding technique. In this way, it is advantageously possible to obtain a heat exchanger, having the desired development and shape, by means of unit 19 inside tank 11, so as to occupy a volume sufficient to ensure the desired unfreezing. For instance, duct 23 could have such a development that it extends within chamber 15 either vertically, as shown for instance in Fig. 9, or also horizontally.

Advantageously, the wall of duct 23 of unit 21 can be smooth or embossed, and can be made of steel or of a suitable plastic material, even identical to the material of walls 13. Moreover, duct 23, extending within chamber 15 with its delivery and return sections 23a, 23b and its spiral connecting section 23c, can be free or can be secured by means of clips or hangers or brackets located in chamber 15 of the tank and arranged to prevent possible displacements and/or breakages due to vibrations and oscillations during use, e.g. while a vehicle on which the tank is installed is traveling.

During the moulding process, preferably a rotational moulding, of the plastic material of tank 11, a pipe made of stainless steel or another material is introduced into and secured inside the same tank and is then connected to the cooling system of the internal combustion engine in order to act as a heat exchanger.

Advantageously, according to the invention, preferably a single flange 41 carries both temperature, level and quality sensors 45a, 45b, 45c for monitoring the parameters of the liquid contained in the tank, and the electronic apparatus consisting of the printed circuit board housed in seat 51 and transmitting the signals coming from said sensors 45a, 45b, 45c to the electrical circuit of the vehicle through an integrated electrical connection.

Moreover, always according to the invention, said flange 41 preferably also carries an integrated filter for purifying the operative liquid contained in tank 11 from impurities, and a threaded connection at opening 33 for the outlet of the filtered liquid.

Preferably, according to the invention, tank 11 further has an inlet 28 for the return of the excess substance coming from the SCR system. Such an inlet 28 preferably consists of a thin tube 28a co-moulded in tank wall 13 and provided with a connecting joint 28b located outside tank 11 for connection of a return pipe coming from the SCR system. Such a thin tube 28a is preferably made of plastics, e.g. the same plastic material as that of the tank, or of metal or another material. Preferably, said thin tube 28a is located near wall portion 13a to which the first heating unit 19 is secured, and preferably on top face 35 of tank 11.

Always according to the invention, tank 11 is moreover provided with a vent opening 30, preferably formed on said top face 35 of tank 11 and intended to allow gas discharge towards the atmosphere, in order to avoid pressure increase within the tank. Said opening 30 can be advantageously equipped with a filter for preventing entry of impurities.

Referring in particular to Figs. 13 and 14, drawing unit 21 includes a filter 57, preferably with substantially cylindrical shape, having a filtering material 57a that is preferably pleated in order to increase the filtering surface. Filtering material 57a has a substantially toroidal shape, has a closed bottom 57b and defines a corresponding and preferably interchangeable cartridge, as it can be better appreciated from Fig. 13. In this embodiment, flange 41 is thus provided with a hole 59 for housing a cylindrical cartridge of filtering material 57a. The cylindrical cartridge of filtering material 57a can advantageously be screwed or secured in another way into said hole 59.

In other embodiments, filter 57 will be a "for-life" filter, i.e. it does not need to be replaced during the whole life of the vehicle. Filtering material 57a can consist for instance of a pleated net or of another suitable material. The filtering degree of filtering material 57a will preferably range from 1 to 100 microns, in order to meet the different use requirements.

Referring to Fig. 15, there is shown an embodiment of the invention in which inlet and outlet openings 25, 27 of duct 23 of the first heating unit 19 are connected to at least one solenoid valve 61. According to the invention, solenoid valve 61 is located outside tank 11, in contact with wall 13 of tank 11. In the specific case of the illustrated embodiment, solenoid valve 61 is secured against portion 13a of said wall 13. Said

solenoid valve 61 is arranged to intercept the flow of the heating fluid circulating in duct 23 in order to adjust the flow rate thereof. Typically, said fluid is the fluid of the cooling circuit of the endothermic engine the exhaust system of which is equipped with an SCR system to which the fluid contained in tank 11 is sent. Solenoid valve 61 is provided with a connector 63 for connecting solenoid valve 61 to an electrical circuit associated with an electronic control unit.

Industrial applicability

The tank according to the invention has advantageous industrial application, since it is arranged to be installed aboard vehicles actuated by endothermic engines, in order to contain a fluid in liquid state, intended for a system for the selective catalytic reduction (SCR) of the exhaust system of the endothermic engine.

The invention as described and illustrated can undergo several changes and modifications, falling within the same inventive principle.

Patent claims

1. Tank (11) having a filler pipe (73), comprising a wall (13) made of a plastic material and defining therein a tank chamber (15), and an assembly (17) for heating and drawing the fluid contained in the tank, wherein said filler pipe (73) comprises a body made of a plastic material in which an outer hollow portion (77) and an inner hollow portion (79) are defined, and wherein the outer hollow portion (77) comprises a cylindrical portion (77b) having a cross-section larger than the cross-section of the inner portion (79) and being provided with at least one side opening housing a filtering net (83a).

2. Tank according to claim 1, wherein the outer portion (77) comprises opposite open bases (77c, 77d), extends substantially cylindrically with circular cross-section and comprises a laterally closed portion (77a) and a laterally open portion (77b), said laterally open portion (77b) and the open base (77d) of said laterally open portion (77b) being provided with a filtering net (83a, 83b).

3. Tank according to claim 2, wherein the laterally open portion (77b) is defined by a set of axial extensions (81) extending along corresponding generatrices starting from the laterally closed portion (77a) and ending at an annular portion (77e) surrounding said open base (77d) of the outer portion (77).

4. Tank according to claim 2 or 3, wherein the inner hollow portion (79) of the filler pipe (73) comprises a cylindrical body having a circular cross-section and being removably housed within the outer hollow portion (77), and wherein said inner portion (79), when housed within the outer portion (77) of the filler pipe (73), extends over the entire length of the closed portion (77a) starting from the open base (77c) and over a section of the open portion (77b) corresponding to about ¼ of the length of said open portion (77b).

5. Tank according to claim 2 or 3 or 4, wherein the inner portion (79) comprises an annular ferrule (85) having tabs (87) extending axially outside said annular ferrule (85), and wherein the inner portion (79) can be engaged into or disengaged from the outer portion (77) by manually rotating the inner portion (79) by means of said tabs (87).

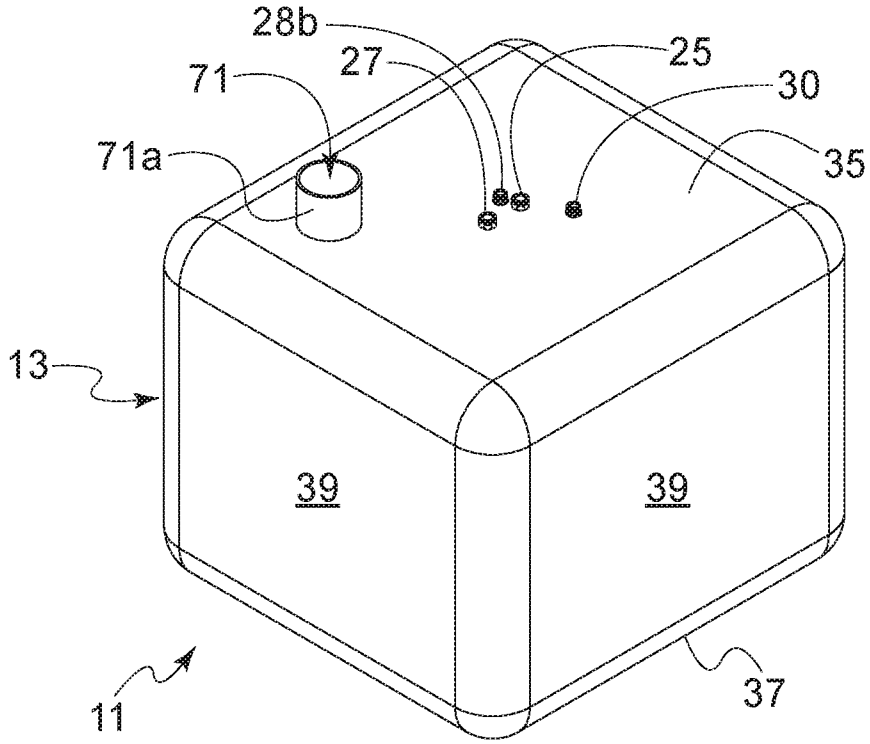
6. Tank according to any of the preceding claims, wherein the filler pipe (73) comprises a filtering surface of at least 9550 mm^2.

7. Tank according to any of the preceding claims, wherein the tank (11) is provided with a seat (71) adapted to house a filler pipe (73) for filling the tank (11) and formed in a cylindrical extension (71a) extending outside the tank (11) in a direction substantially perpendicular to the upper face (35) of the tank body.

8. Tank according to claim 7, wherein said seat has a circular opening (75) housing said filler pipe (73).

9. Method for manufacturing a tank (11) having a filler pipe (73), the tank comprising a wall (13) made of a plastic material and defining therein a tank chamber (15), and an assembly (17) for heating and drawing the fluid contained in the tank, wherein said filler pipe (73) comprises a body made of a plastic material in which an outer hollow portion (77) and an inner hollow portion (79) are defined, and wherein the outer hollow portion (77) comprises a cylindrical portion (77b) having a cross-section larger than the cross-section of the inner portion (79) and being provided with at least one side opening housing a filtering net (83a), wherein said method comprises a step of obtaining a cylindrical extension (71a) in the wall (13) of the tank (11) during a tank moulding step.

10. Method according to claim 9, wherein a step of associating said filler pipe (73) into said cylindrical extension (71a) is provided.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71
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71a
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11
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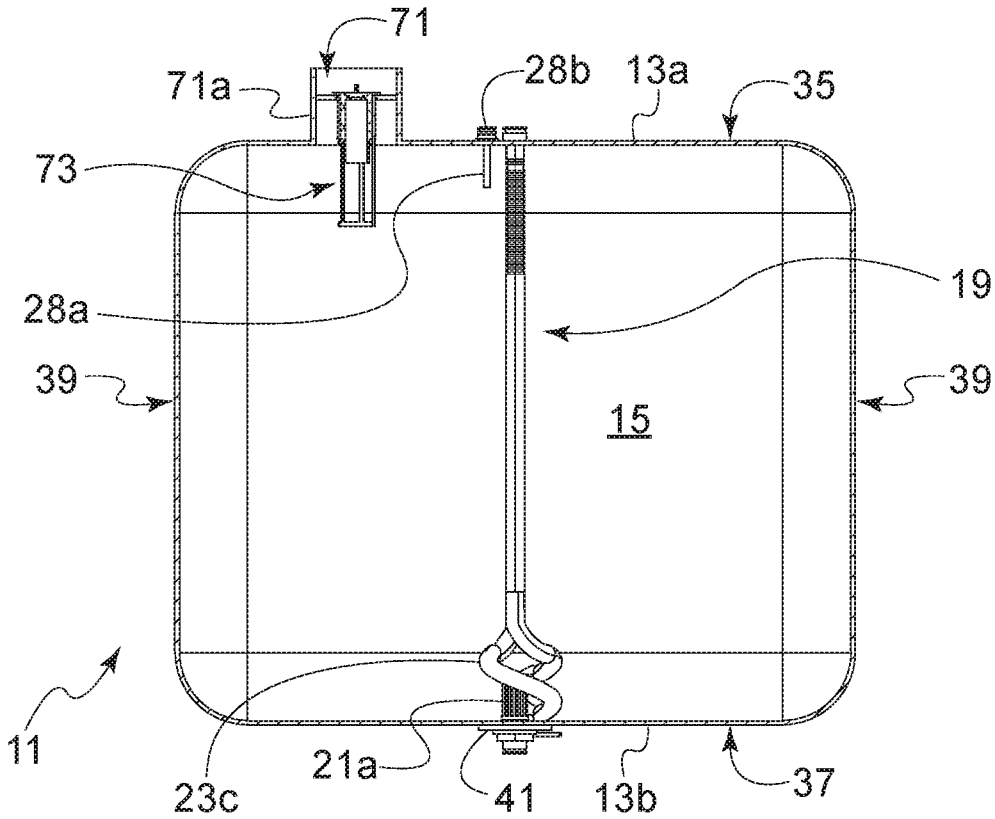
Fig. 1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71a
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73
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28a
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15
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21a
23c
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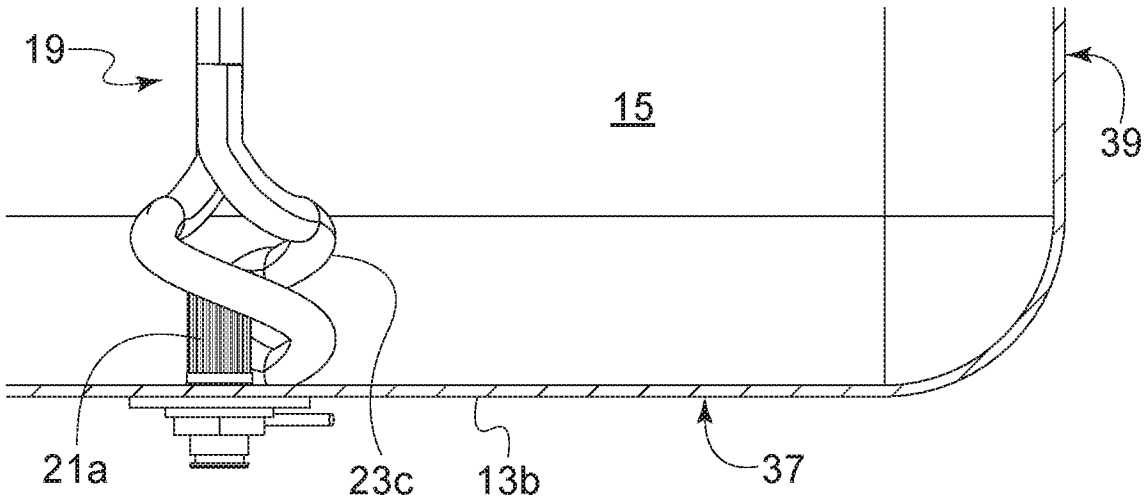
13b
37

Fig. 2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39
21a
23c
13b
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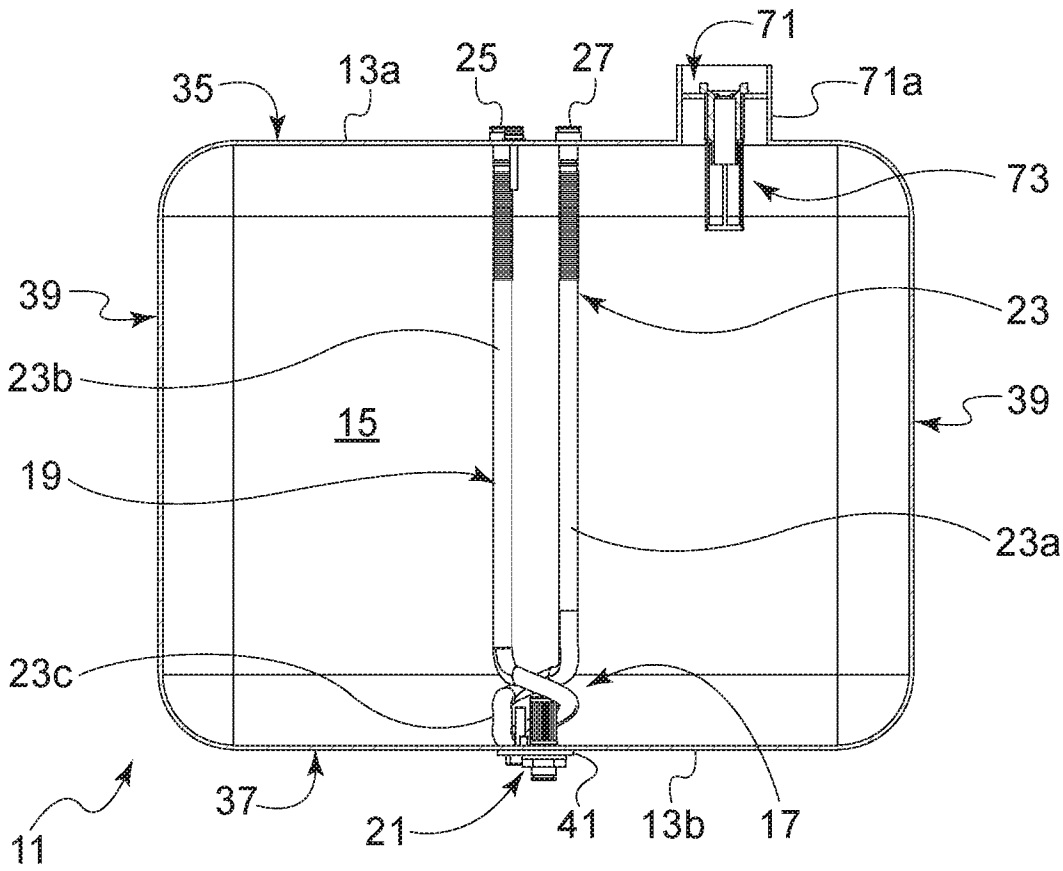
Fig. 3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13b
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Fig. 4

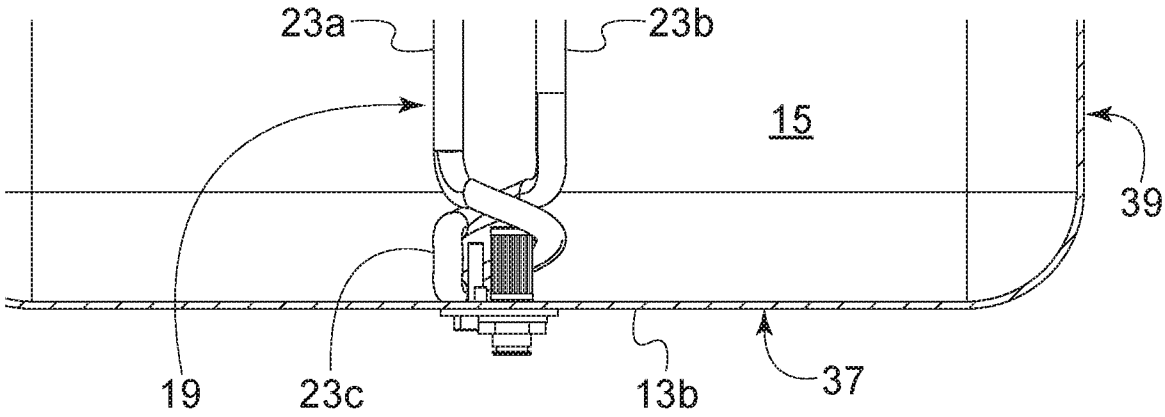


Fig. 5

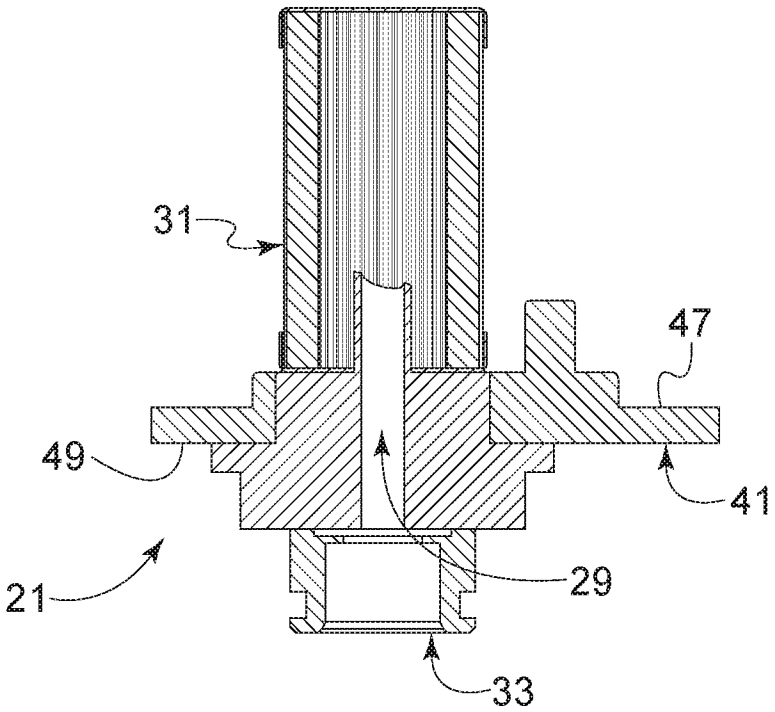


Fig. 6

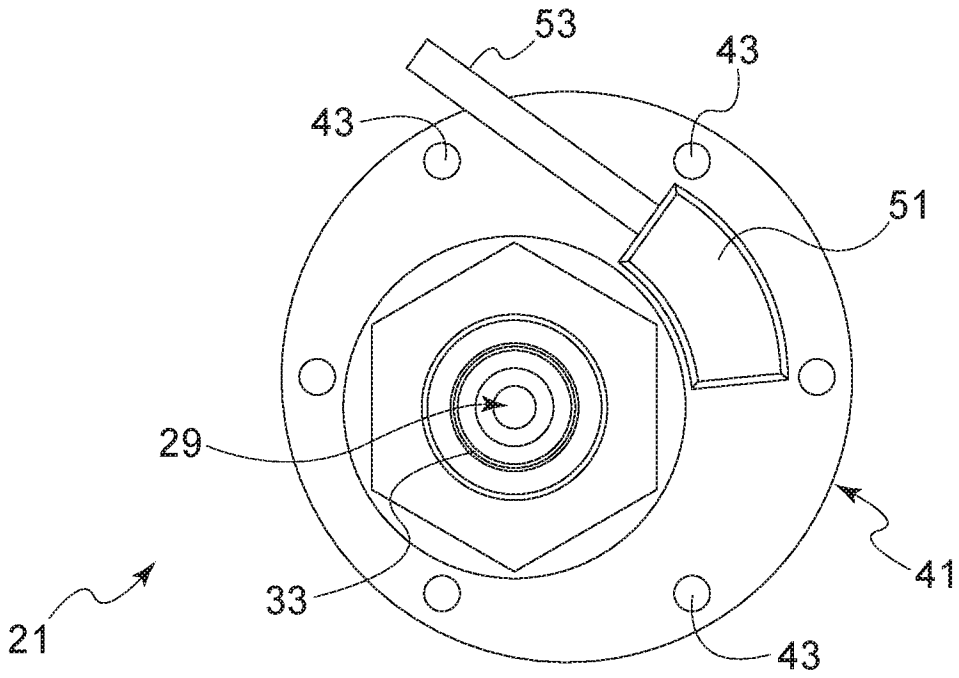


Fig. 7

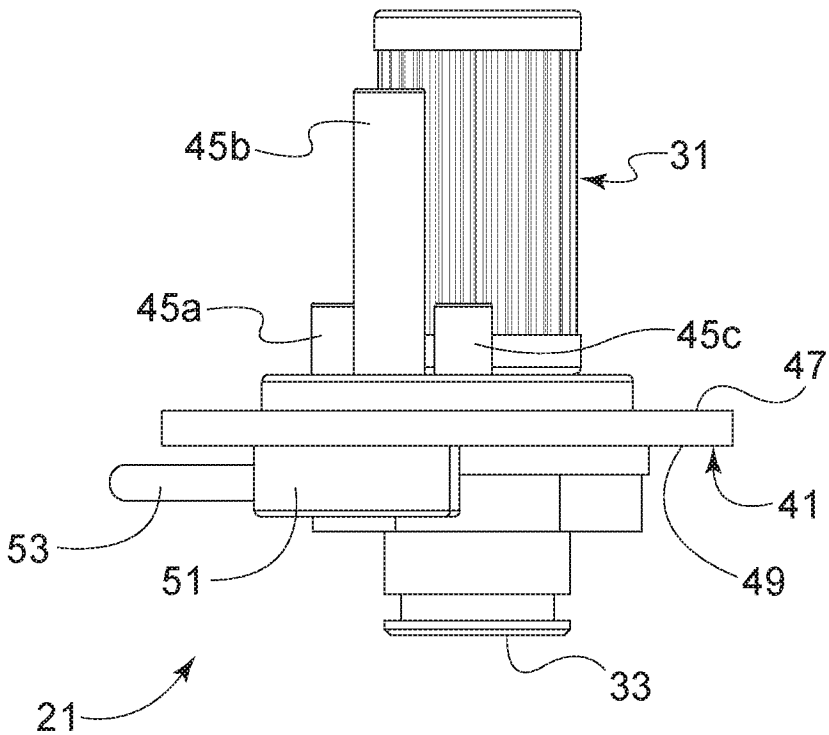


Fig. 8

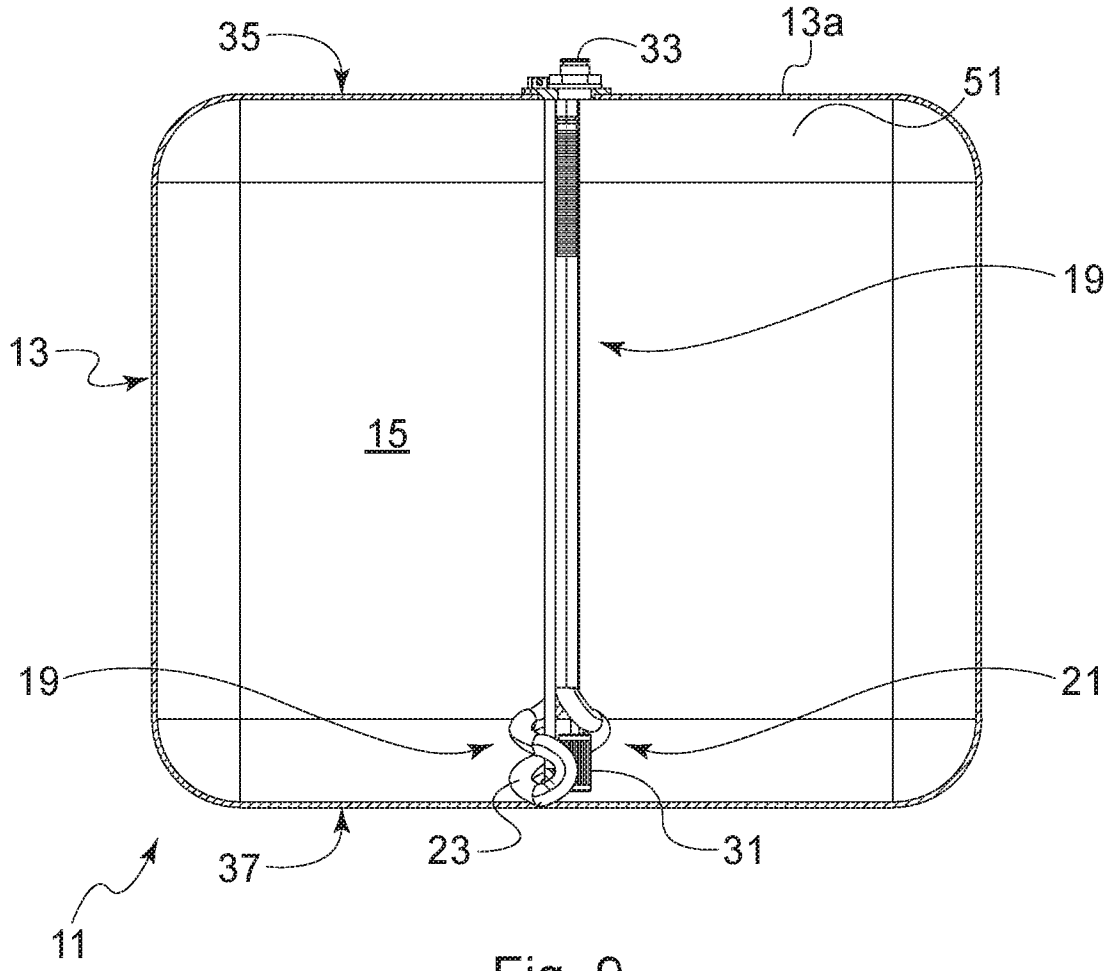


Fig. 9

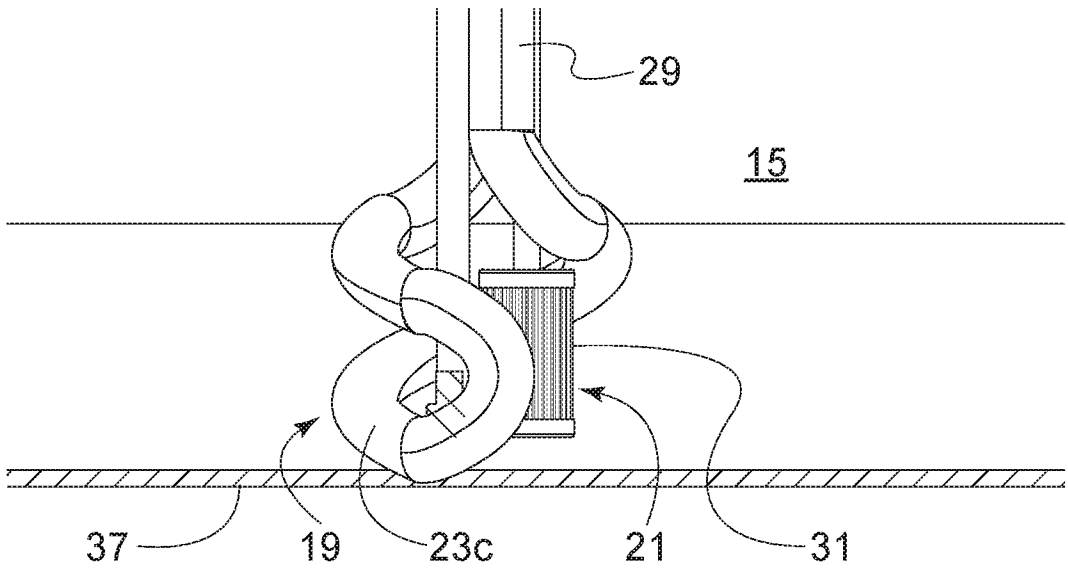


Fig. 10

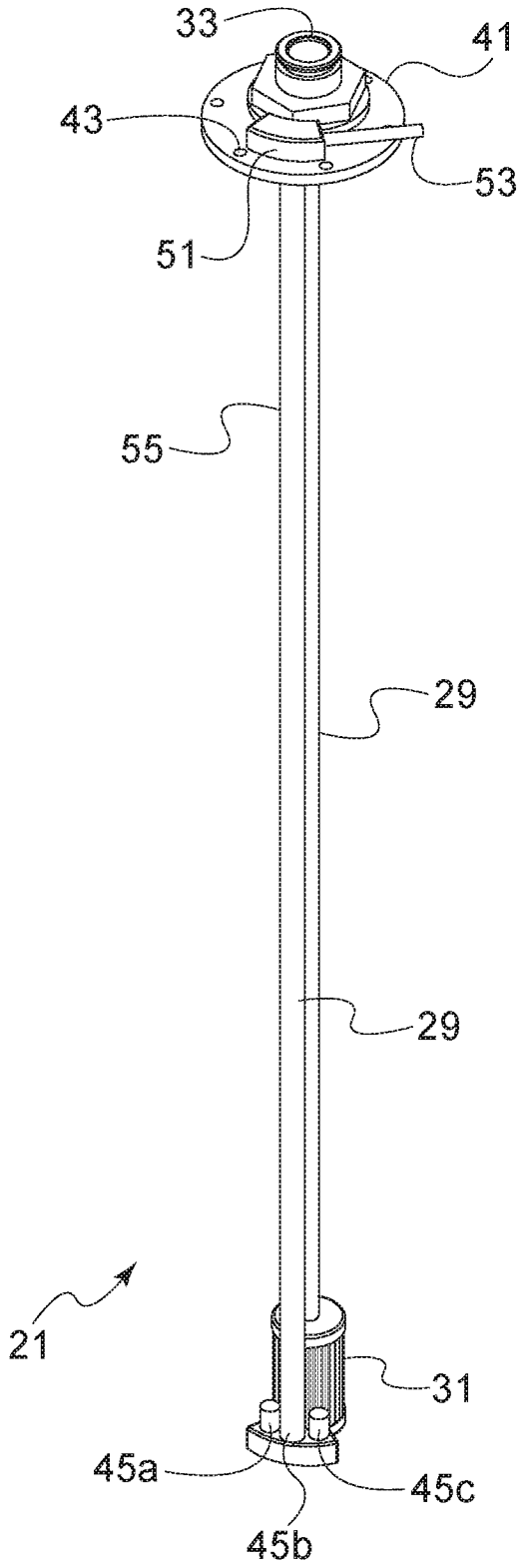
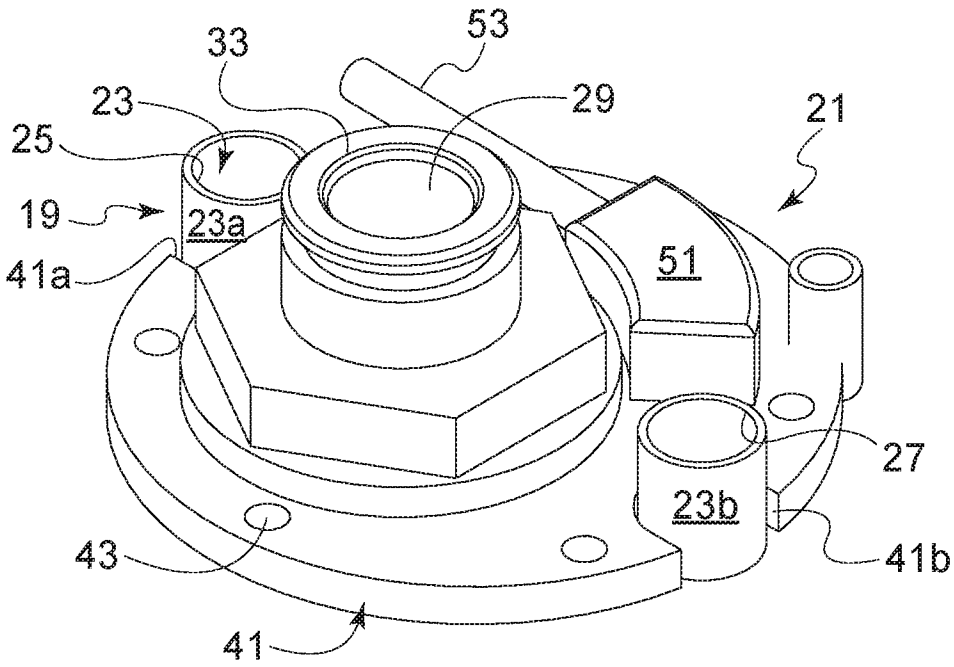


Fig. 11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41b
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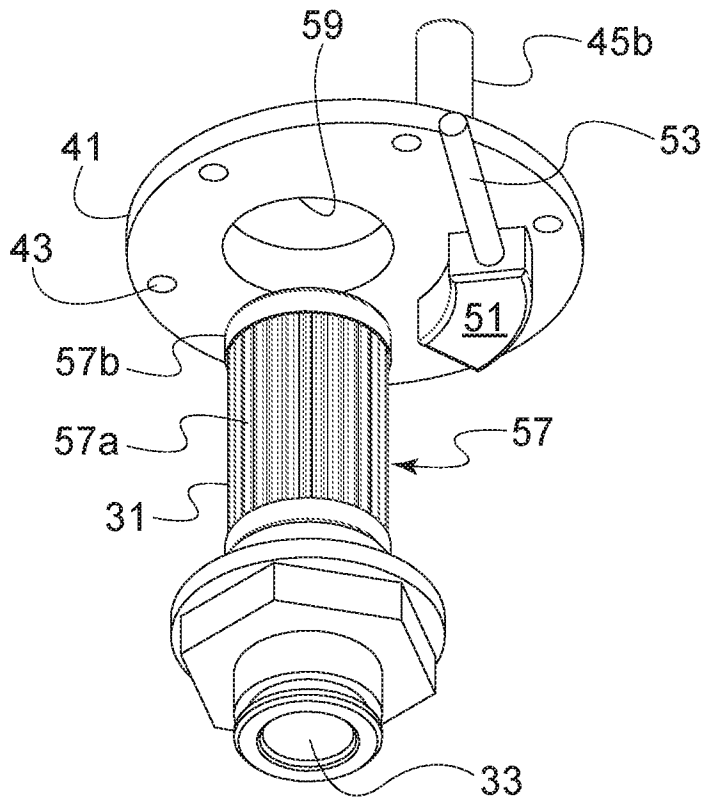
Fig. 12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33

Fig. 13

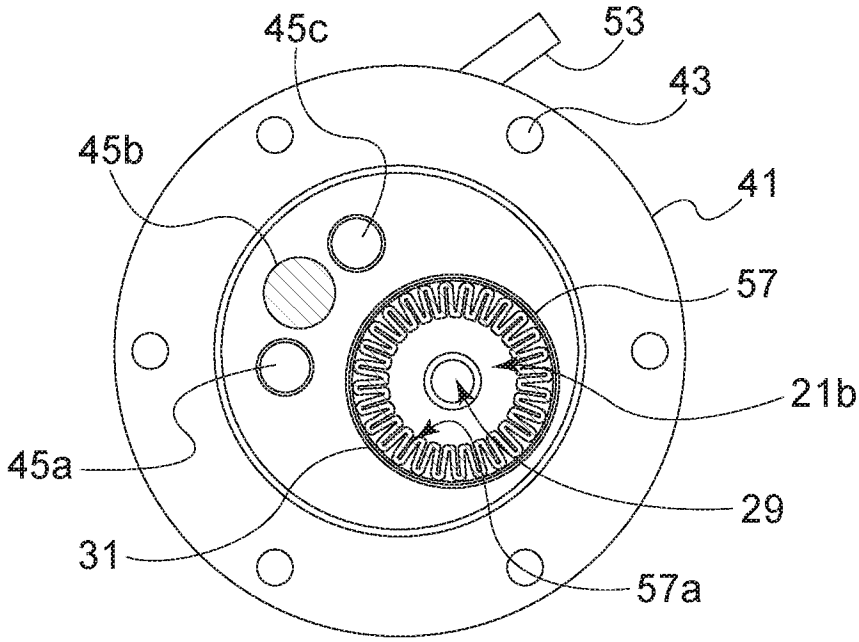


Fig. 14

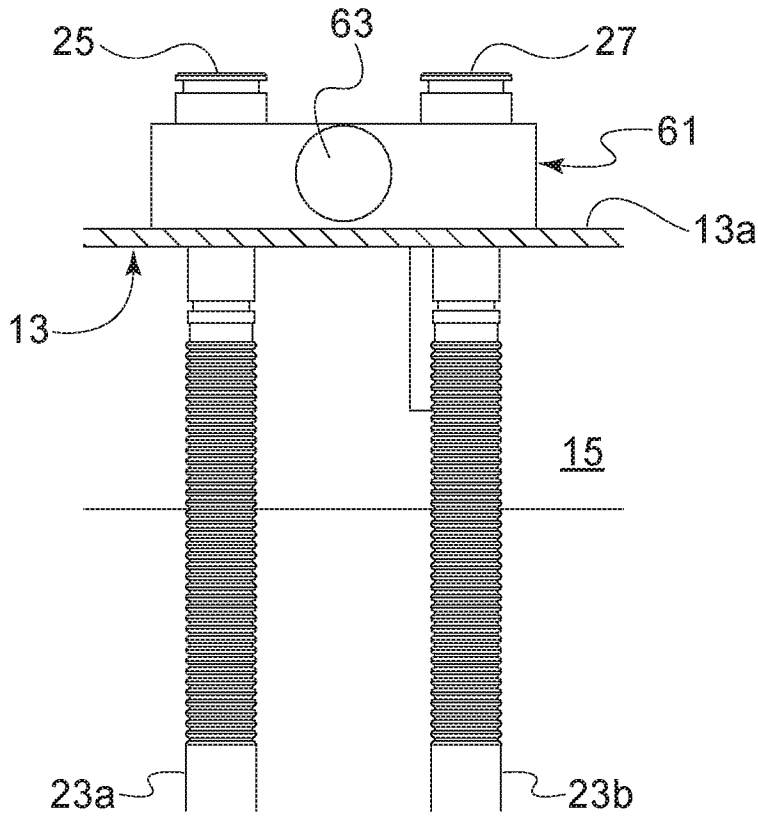
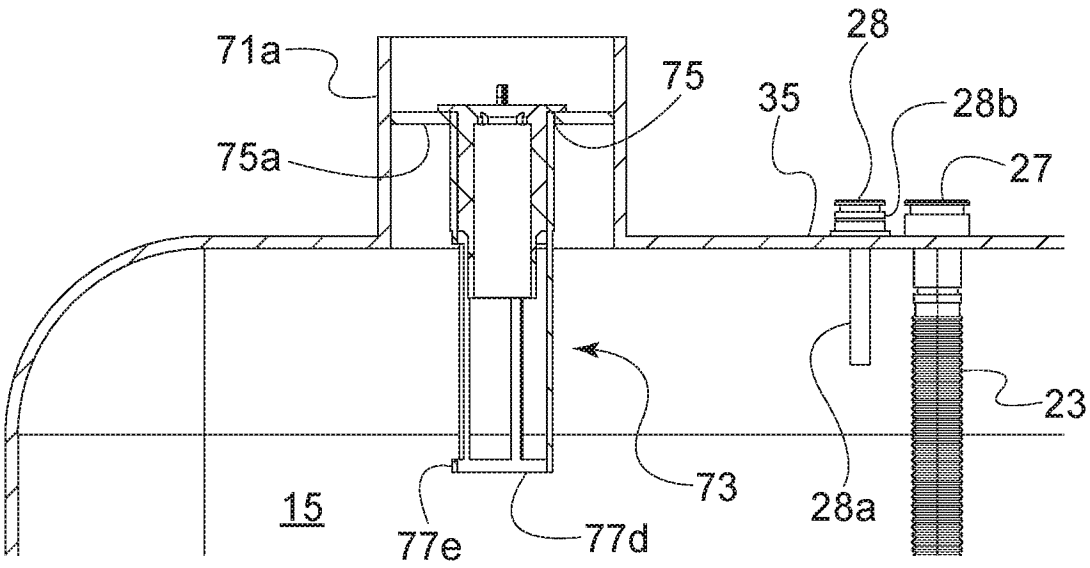


Fig. 15


71a
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28b
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23
73
28a
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77e
77d

Fig. 16

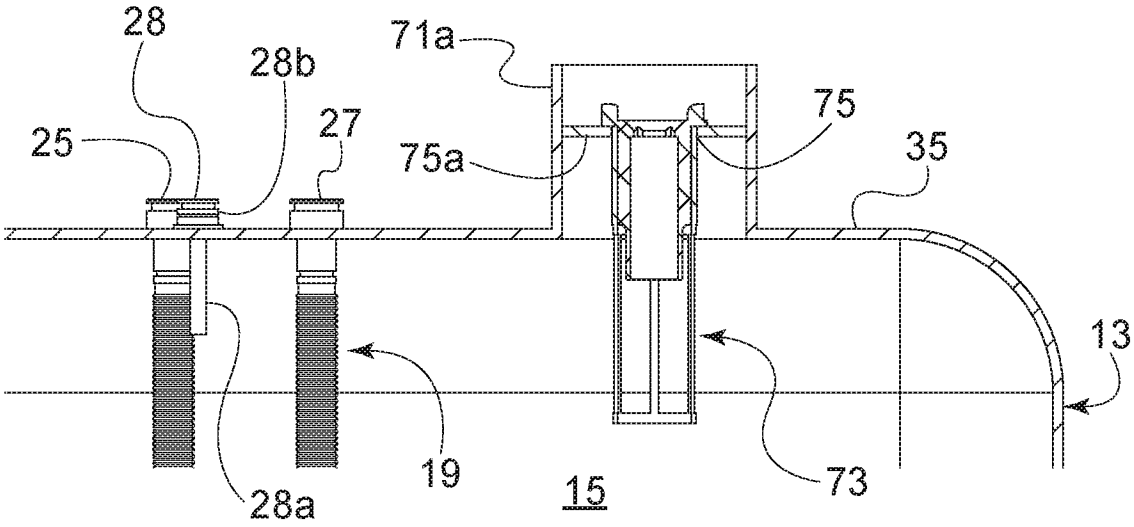
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Fig. 17

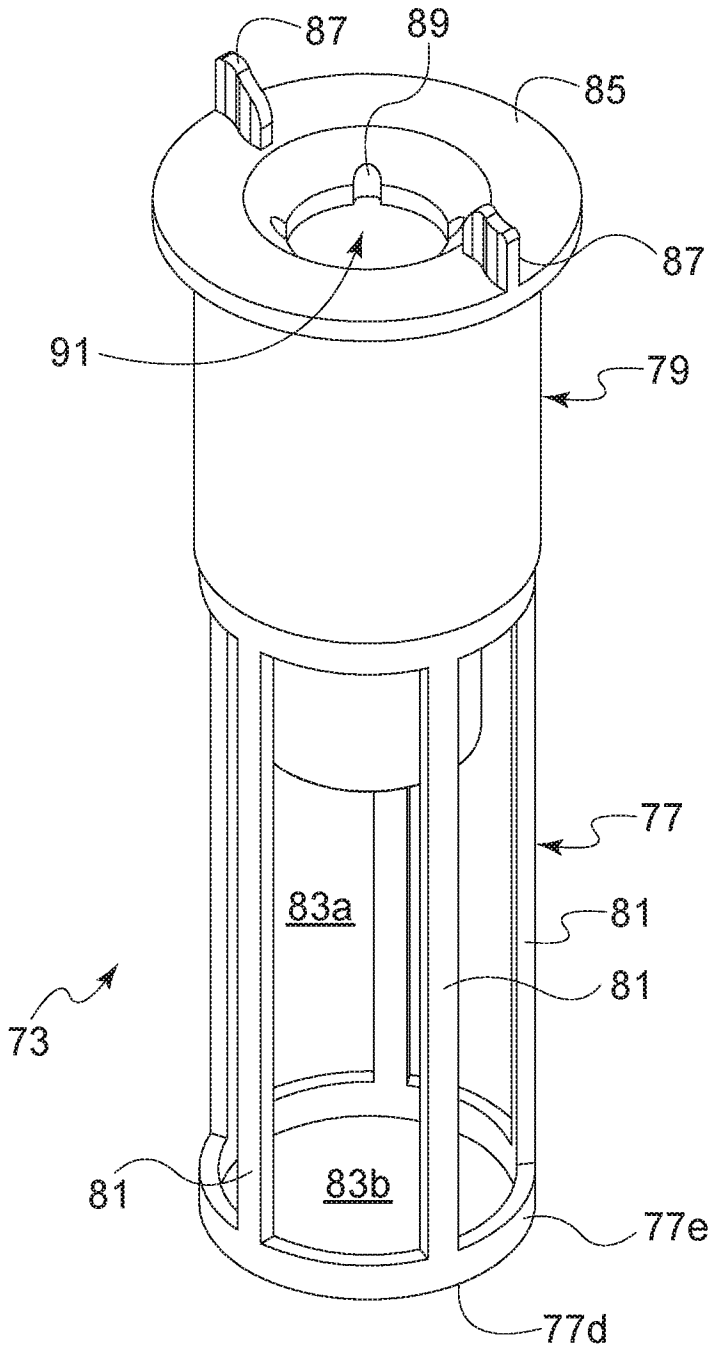

Fig. 18

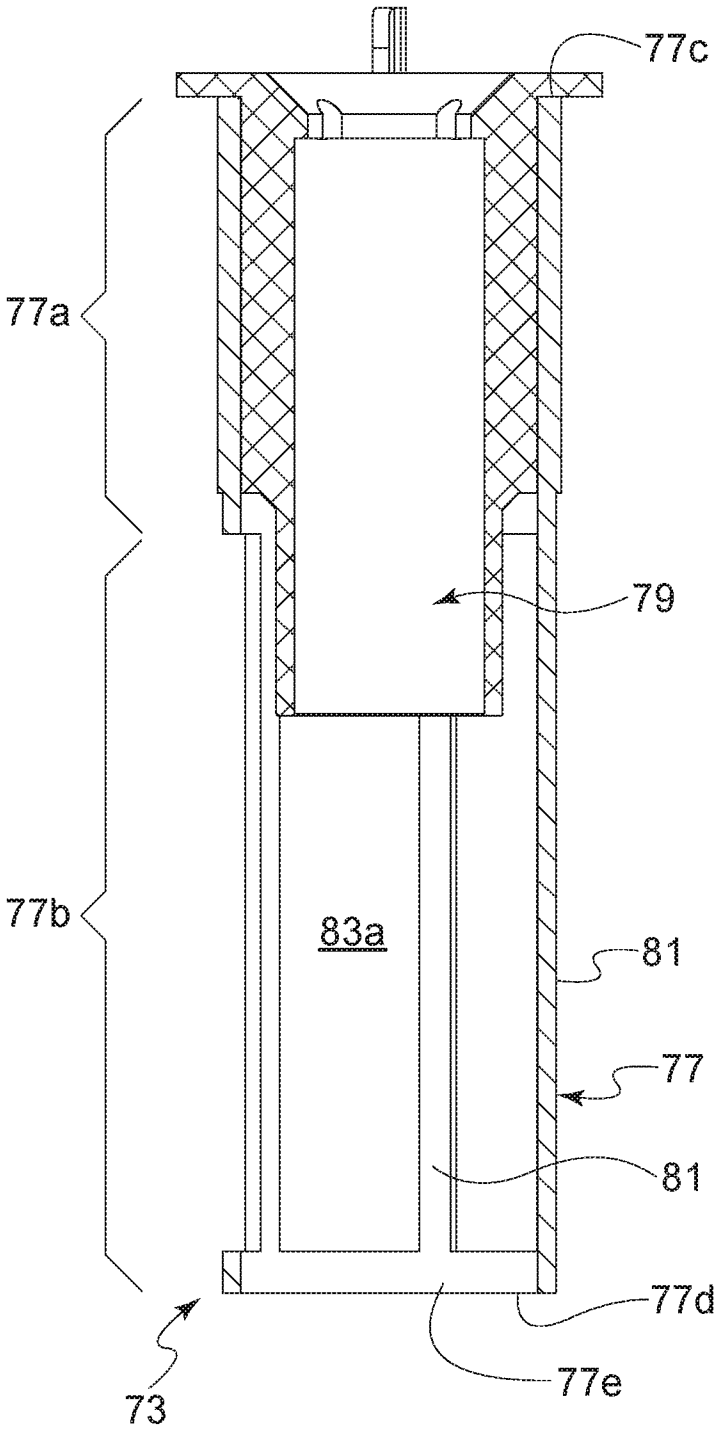

Fig. 19

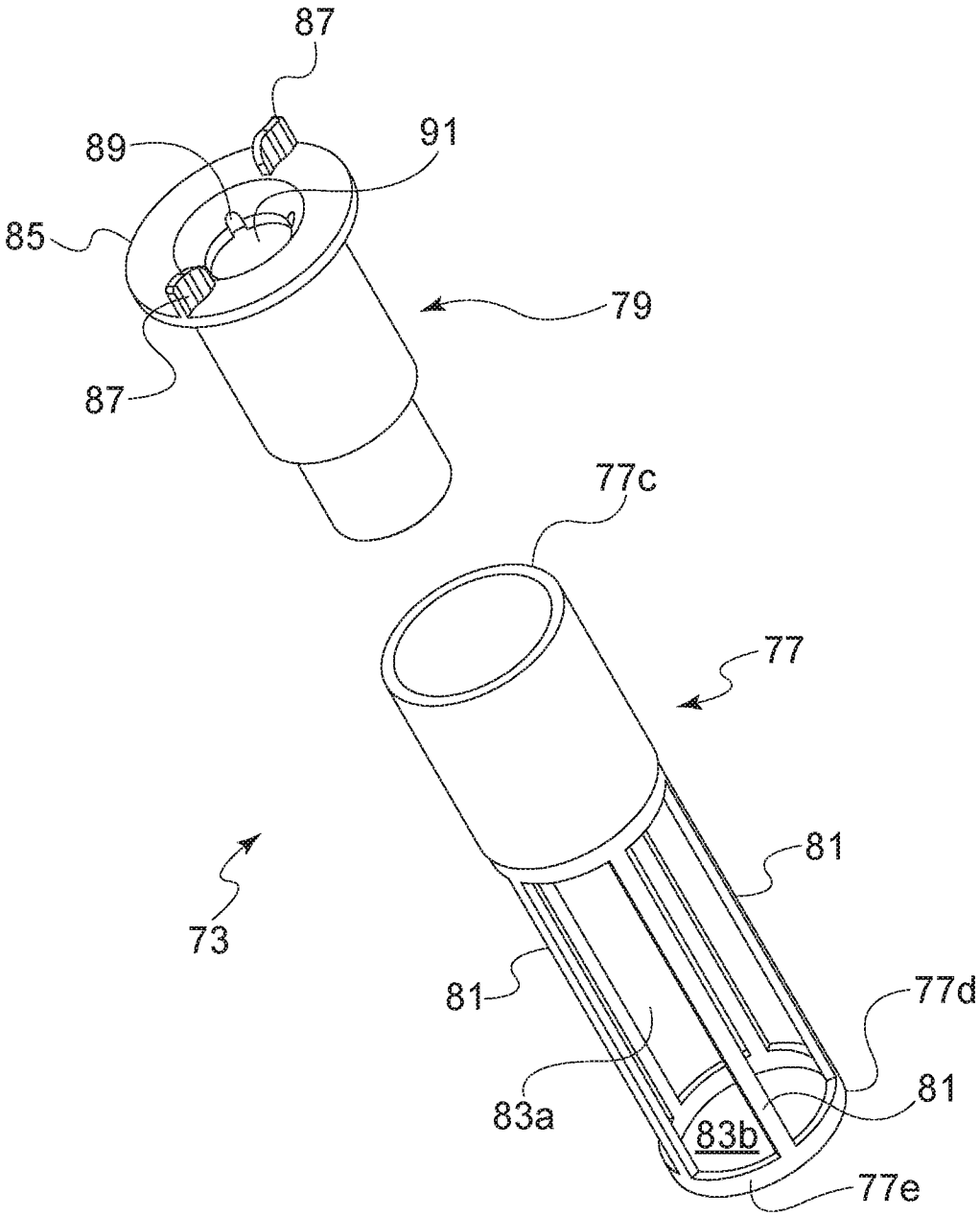

Fig. 20

INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2019/060757

A. CLASSIFICATION OF SUBJECT MATTER
INV. F01N3/20 F01N13/18 F01N13/16
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
F01N B60K

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	DE 20 2010 001147 U1 (REUTTER GMBH [DE]) 12 May 2011 (2011-05-12)	1-3,5-10
A	abstract; claims 1,2,4,9,12,13,14,15,17; figure 3 paragraphs [0012], [0013], [0020], [0030] - [0036], [0043] - [0047]	4

A	US 2010/200115 A1 (SANTINON ALVISE [IT]) 12 August 2010 (2010-08-12) abstract; claims 1-4; figures 1,2,3 the whole document	2-8,10

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
4 March 2020	13/03/2020

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Steinberger, Yvonne

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/IB2019/060757

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
DE 202010001147 U1	12-05-2011	DE 202010001147 U1	12-05-2011
		EP 2340956 A2	06-07-2011
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