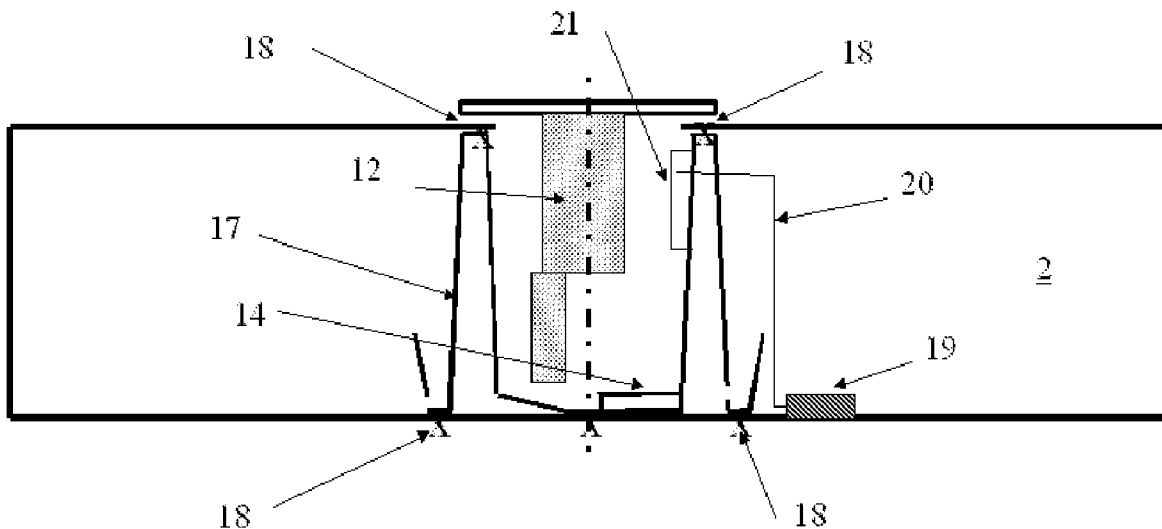


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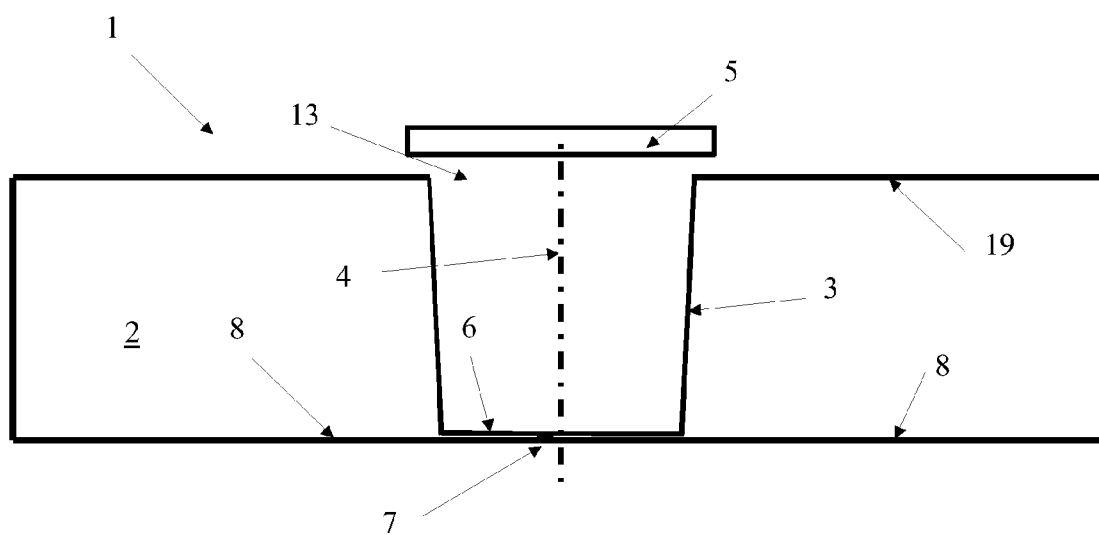


Fig. 1

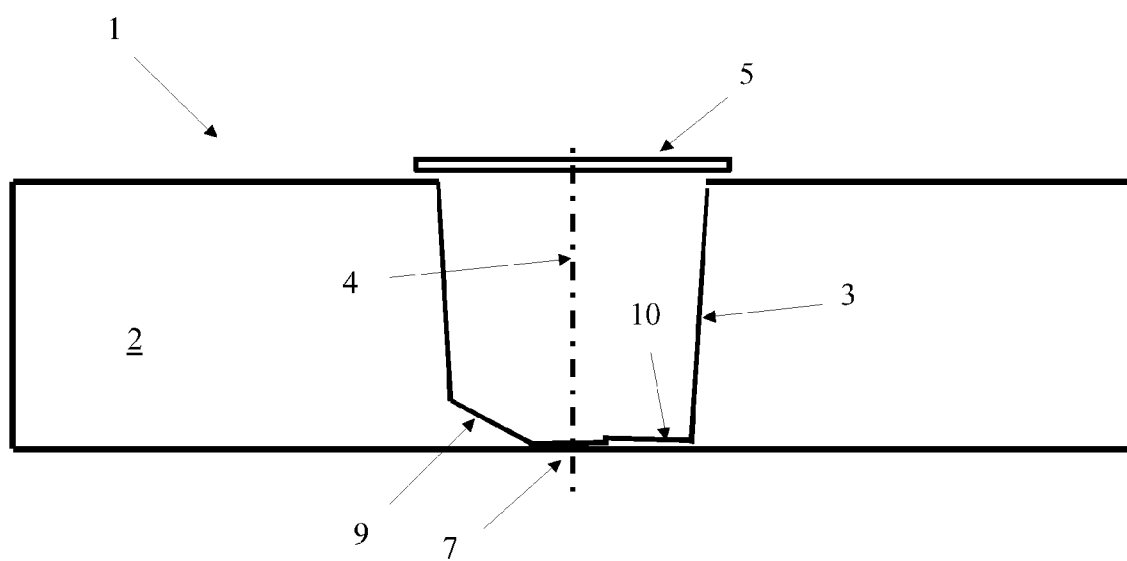


Fig. 2

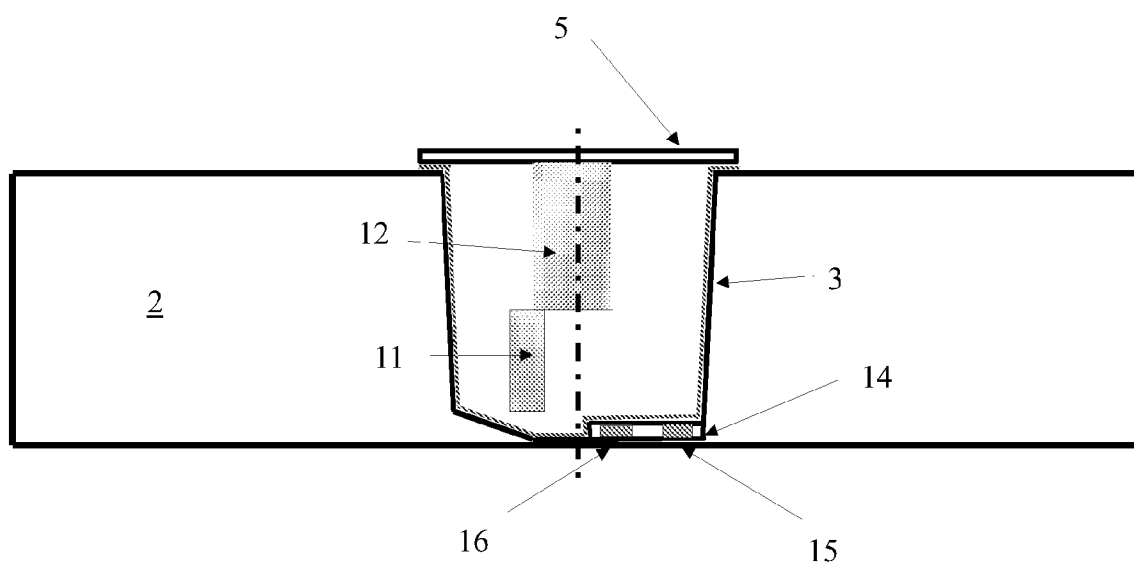


Fig. 3

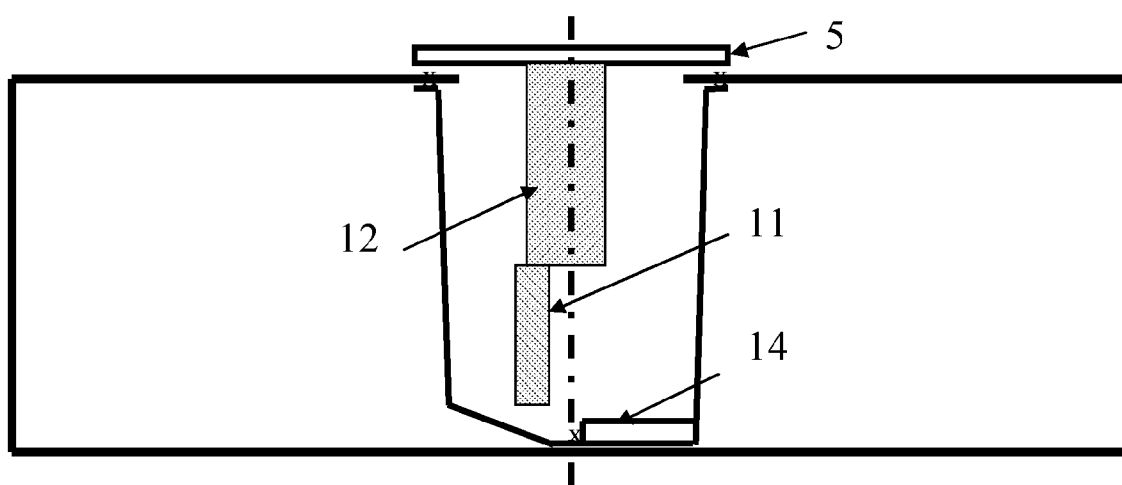


Fig. 4

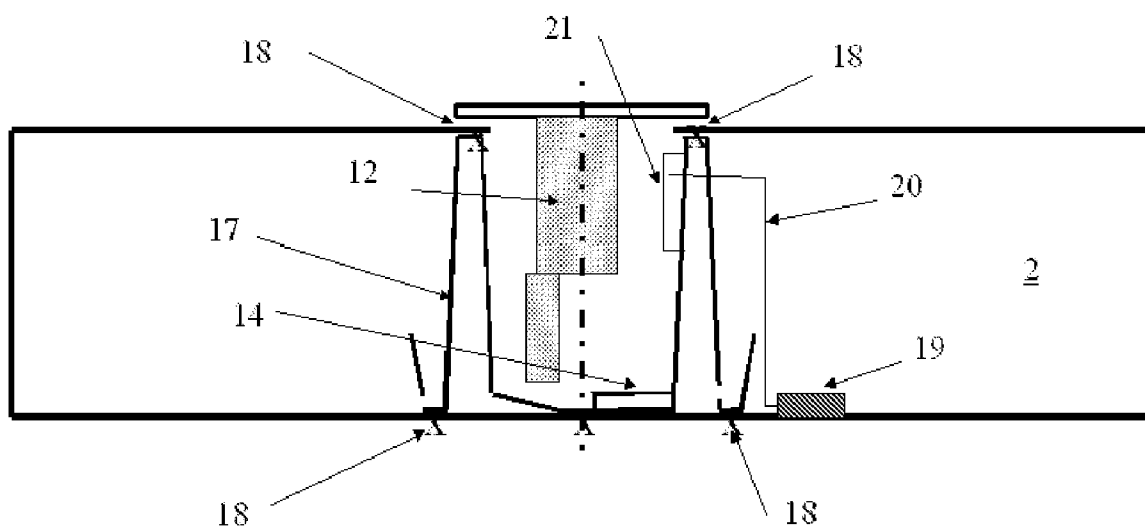


Fig. 5

FUEL TANK

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application is a U.S. National-Stage entry under 35 U.S.C. § 371 based on International Application No. PCT/EP2006/011391, filed Nov. 28, 2006, which was published under PCT Article 21(2) and which claims priority to German Application No. 102005056860.2, filed Nov. 29, 2005, which are all hereby incorporated in their entirety by reference.

TECHNICAL FIELD

[0002] The invention generally relates to a fuel tank for motor vehicles, and more particularly to a fuel tank for passenger vehicles.

BACKGROUND

[0003] Fuel tanks used to be produced from two sheet metal shells with an upper shell and a lower shell. Further components, such as, for example, a swirl pot, also called a surge pot, as well as labyrinth walls for reducing the flow speed of the fuel in the intake region of the fuel pump could be fitted into the lower shell. The upper and lower shell are then welded to one another.

[0004] In the meantime, fuel tanks are predominantly formed of plastics material, in particular, to reduce the weight of the vehicle. The fuel tank is generally produced here by means of blow molding or extrusion blow molding. Further components, such as, for example, a swirl pot, can then be introduced through an opening introduced retrospectively into the upper fuel tank region.

[0005] DE 197 23 923 A1 discloses a tank system with a swirl pot arranged in the main tank. The content of the swirl pot defines a reserve volume, which is made available on reaching a minimum fill level in the main tank as a fuel reserve.

[0006] DE 198 27 944 A1 describes a fuel tank with a main chamber and a residual quantity reservoir. The fuel tank may be produced from plastics material, the residual quantity reservoir being fastened in a suitable manner to the base of the fuel tank. DE 198 27 944 A1 designates it as its object to provide a fuel system which makes it possible for the driver to have more precise residual quantity information in the last phase of emptying.

[0007] JP 03213430 describes a fuel tank with a swirl pot, which is arranged in the center between two main chambers and is configured in one piece with the main chambers. The swirl pot is covered at the top by a flange. A pump arranged at the base of the fuel tank has a conveying hose guided by the flange.

[0008] At least one object of an embodiment of the present invention is to provide an improved fuel tank. In addition, other objects, desirable features, and characteristics will become apparent from the subsequent summary and detailed description and the appended claims, taken in conjunction with the accompanying drawings and this background.

SUMMARY

[0009] This object, and other objects, desirable features and characteristics are achieved with a fuel tank formed at least partially of a plastics material, the fuel tank comprising an opening and a swirl pot arranged in its interior. The edge of

the opening is connected to the edge of the swirl pot in a material-uniting manner, in which a flange is associated with the opening and electric and/or hydraulic means for conveying liquid fuel to the internal combustion engine are fastened on the flange.

[0010] A first embodiment of the invention relates to a fuel tank made of plastics material with a swirl pot arranged in its interior. The fuel tank has an opening, the edge of this opening and the edge of the swirl pot being connected to one another in a material uniting manner.

[0011] A material-uniting connection of the fuel tank and swirl pot is intended to mean in the framework of this description, in particular, that the two parts are held together by atomic or molecular forces. Above all, however, "material-uniting connection" according to an embodiment of the invention means that the connection can only be released by destruction. The cohesion may emanate from the fact, as is also the case in the embodiments of this description, that the two parts are materially mixed in a transition zone, as is also the case, for example, with soldered or welded connections. Other examples of material-uniting connections in the prior art are adhesions, in which the adhesive reacts with functional groups of the surfaces of the two connection partners, and to separate them, the chemical connections have to be destroyed.

[0012] The material-uniting configuration means that the fuel tank can be prefabricated to a greater degree as the assembly of the swirl pot in the outer tank is dispensed with. As a result, the fuel tank can be produced more quickly and economically overall. The size and shape of the swirl pot can be more freely selected because restrictions due to assembly are dispensed with. For example, the size and the shape of the swirl pot are no longer limited by an assembly opening introduced into the upper fuel tank region. The possibility thus exists of also selecting large swirl pots, for example those with a large vertical extent and/or those with a volume of several liters.

[0013] Furthermore, simplified manufacturing and assembling possibilities for functional modules provided in the fuel tank are produced by this type of configuration. The weight of the fuel tank is not impaired by the selected material, which is a plastics material.

[0014] The division of the fuel tank volume being established with the swirl pot, into an outer tank and an inner fuel tank, or swirl pot, allows the provision in the outer region of a rough resolution fuel measuring system, and, in the inner region, of a second fuel measuring system with greater resolution accuracy. The aforementioned freer selection of shape in the case of the swirl pot means that a geometry can be selected for it which facilitates detection and a precise display of the fuel contained therein. The hydraulic decoupling accompanying the aforementioned division into two of the outer fuel tank from the inner one in addition allows a virtually complete utilization and display of the fuel located in the inner container or swirl pot.

[0015] The flexibly selectable size and shape of the swirl pot in combination with the division of the fuel tank volume into two also allows a very large residual fuel volume of several liters, for example, to be displayed to the driver. The residual fuel volume is defined here by the volume of the swirl pot. A trip computer of the motor vehicle, for example, can thus display the fuel quantity still available for a relatively long driving distance down to virtually 0 km.

[0016] Since the fuel volume available can actually be reliably used, the initial filling of the fuel tank when delivering the vehicle can be reduced.

[0017] In one embodiment, the fuel tank is configured in one piece, with a further embodiment proposing that a fuel tank which can be produced or was produced in a blow molding or extrusion blow molding process should be provided or that the outer tank and swirl pot should form a blow molded unit. In a blow molded, one-piece fuel tank, the latter is produced in a simple manner in a single production process and an assembly step is dispensed with.

[0018] An embodiment proposes for this purpose that the blow molding process comprises the following steps: a) Extruding a plastics material hose. This extrusion of the plastics material takes place vertically downward; b) Moving an insert of the blow molding tool laterally from the outside against the extruded plastics material to create the swirl pot. The movement direction of the insert is substantially perpendicular with respect to the extrusion direction. The interior of the swirl pot is determined by the insert, for example an insert in the upper shell tool of the blow molding machine;

[0019] As an alternative to step b), the moving of a prefabricated swirl pot laterally from the outside against the extruded plastics material; and

[0020] Forcing compressed air into the plastics material hose and the resultant pressing of the plastics material hose against a blow molding tool defining the outer shape of the fuel tank.

[0021] As an alternative to the one-piece configuration, a further embodiment provides that the swirl pot and the outer tank should be welded in the region of the edge of the opening. A variant here involves welding the swirl pot to an outer tank which has been blow-molded around it. In other words, a swirl pot is initially prefabricated from a plastics material, fitted on the mandrel of the blow molding machine, and then the remaining part of the fuel tank is manufactured by a blow molding process. Thus blow molding occurs around the prefabricated swirl pot.

[0022] In both embodiments, freer selection possibilities are thus produced with regard to the material used for the swirl pot and outer tank. Thus, the swirl pot and outer tank may be of the same or different material, it being possible to select the material matrix in the last-mentioned case such that the thermal expansion capacity is selected so as to be optimal, with high mechanical stability. The prefabricated swirl pot may have arrangements, for example holding means, for receiving functional modules of the fuel tank. If the swirl pot is injection-molded, for example, these arrangements may already be molded in during production.

[0023] In a further embodiment, the base of the swirl pot is welded at least one point to the lower side of the outer tank. As a result, the swirl pot has a maximum size in the vertical direction and this allows a large swirl pot to be provided, the volume of which can be used for the precise determination of a remaining range of the vehicle. In addition, this produces a reinforcement of the fuel tank in the region of the swirl pot. This reinforcement in the vertical direction facilitates the adherence to tolerances during manufacture. The fuel tank therefore becomes more stable during operation. It is also more stable over the service life as, in addition, fewer signs of fatigue appear in the fuel tank.

[0024] In a further embodiment, the fuel tank has labyrinth walls arranged around the swirl pot and connected thereto in a material-uniting manner. If fuel flows through openings into

the labyrinth system, it is ready to be sucked in by a pump and transferred into the swirl pot even when the vehicle is driving along a slope with a low fuel level. The fuel tank is also additionally reinforced by the labyrinth walls and consequently mechanically more stable.

[0025] In a further embodiment, the swirl pot has a volume of between about two and about five liters. Consequently, a larger fuel quantity is available as a reliably usable and precisely displayable fuel volume.

[0026] The upper edge of the swirl pot defines an opening of the fuel tank. In a further embodiment, a flange is associated with the fuel tank or with this opening, and the flange is connected to means for conveying liquid fuel to an internal combustion engine. The mechanical fastening of these means to the flange instead of to the swirl pot represents a simplified assembly of these means, because in comparison to this, the interior of the swirl pot is more difficult to access for geometric reasons. In addition, this fastening as a suspended functional unit allows simplified removal of these means from the interior of the fuel tank for the purpose of repair.

[0027] The fuel conveying means mentioned in the last paragraph may, for example, comprise a fuel pump, a fuel filter, electrical connections for the fuel pump, and/or connections for a fuel return pipe and a venturi tube.

[0028] In a further embodiment, the flange is connected to a tank sensor. This facilitates the assembly and the exchange of the tank sensor in case of repair or service measures.

[0029] In a further embodiment, a fuel conveying module is provided on the base of the swirl pot. The fuel conveying module is used to convey fuel from the outer tank into the swirl pot. The fuel conveying module allows the fill level in the swirl pot to be higher than in the outer tank. The fuel conveying module may comprise a venturi tube, an ascending pipe, a valve (for example a mushroom valve), an overflow, tank sensors for the outer tank and swirl pot, communicating pipes and a fuel pre-filter.

BRIEF DESCRIPTION OF THE DRAWINGS

[0030] The present invention will hereinafter be described in conjunction with the following drawing figures, wherein like numerals denote like elements, and

[0031] FIG. 1 schematically shows a fuel tank according to a first embodiment of the invention—

[0032] FIG. 2 schematically shows a fuel tank according to a second embodiment of the invention—

[0033] FIG. 3 schematically shows a fuel tank according to a third embodiment of the invention—

[0034] FIG. 4 schematically shows a fuel tank according to a fourth embodiment of the invention— and

[0035] FIG. 5 schematically shows a fuel tank according to a fourth embodiment of the invention.

DETAILED DESCRIPTION

[0036] The following detailed description is merely exemplary in nature and is not intended to limit the invention or the application and uses of the invention. Furthermore, there is no intention to be bound by any theory presented in the preceding background or the following detailed description.

[0037] FIG. 1 shows a schematic side view of a blow molded fuel tank 1. The fuel tank 1 is divided into two and has an outer tank 2 and a swirl pot 3. The fuel tank 1 has an opening 13. The shape of the swirl pot 3 can be selected so as to be different with a high degree of freedom and in the

example of FIG. 1 is virtually cylindrically symmetrical about an axis 4 of symmetry. The swirl pot 3 is terminated and sealed at the top by the flange 5.

[0038] The outer tank 2 and swirl pot 3 comprises a plastics material and preferably consist of plastics material and are welded at the edge of the opening 13 of the swirl pot 3 located below the flange 5. The swirl pot 3 is connected (not shown) in a fuel-supplying manner to the outer tank 2 only in the base region so that fuel can be conveyed from the swirl pot to the internal combustion engine. An overflow valve (not shown), with which excess fuel can flow back into the outer tank 2, is also located in the upper region of the swirl pot 3.

[0039] The size of the swirl pot 3 depends, like the size of the entire fuel tank 1, on the vehicle model or its fuel consumption and may be in the single-digit liter range, for example between about 2 liters and about 5 liters. In the example of FIG. 1, the diameter of the swirl pot 3 is about 200 mm at a height of also about 200 mm, so a volume of the swirl pot of about 6 liters is produced.

[0040] As already mentioned, the shape of the swirl pot 3 can be selected with great freedom. If a simple geometry is selected, for example a cylindrical symmetry, the fill level in the swirl pot 3 indicates with a high resolution accuracy the fuel quantity contained therein. This is only possible with more difficulty with the outer tank 2 because of its multiply angled shape.

[0041] The swirl pot 3 has a smaller base area than the outer tank 2, so the same fuel quantity in the swirl pot 3 leads to a greater filling height, and therefore to a more precisely detectable and displayable fuel quantity. This also applies if the volume of the swirl pot is several liters. Since, as will be described in more detail below, during driving operation, a fuel conveying means can convey the fuel from the outer tank 2 into the swirl pot 3 and in the process can virtually completely empty the outer tank 2, when there is a low fuel level, virtually the entire residual quantity of fuel is located in the swirl pot 3. This residual quantity can be precisely determined and indicated, or a trip computer can calculate a remaining range of the vehicle for this purpose. For example, it evaluates, for this purpose, the consumption signal supplied by the engine control unit. Because of the size of the swirl pot 3 which can be selected with a high degree of freedom, this can also be implemented for fuel quantities of several liters, so the driver can be warned in good time and also reliably before becoming stranded for lack of fuel.

[0042] The fuel tank of FIG. 1 is configured in one piece and produced by a blow molding process. In the lower region, the base 6 of the swirl pot 3 is welded at least one fastening point 7 to the base 8 of the outer tank 2. This welding is implemented as a so-called "kiss-point".

[0043] The base of the swirl pot 3 may be level, as shown. In order to be able to convey fuel easily when the vehicle is in an oblique position, a downwardly inclined direction of the base is also possible. The base thus becomes truncated cone-shaped, for example, with an angle of 20°, for example, relative to the horizontal.

[0044] FIG. 2 shows a second embodiment of the claimed invention. In this, the swirl pot 3 has a bevel 9 in comparison to the first embodiment, so fuel can also be conveyed into the swirl pot 3 when the vehicle is standing or driving on a slope. The fastening point 7 is now configured in a planar manner and is implemented as a planar kiss-point. The plateau 10 is intended to be connected to functional modules, which for example comprise a venturi unit. In addition, located in this

region is a fuel-supplying opening (not shown), through which fuel can arrive from the outer tank 2 into the swirl pot, for example by way of a mushroom valve.

[0045] FIG. 3 shows a third embodiment of the claimed invention. Firstly, and this may be provided in all embodiments, functional modules 11 and 12 are fastened to the flange 5. The functional modules may be means for conveying liquid fuel to the internal combustion engine. For example, the functional module 12 may be a fuel filter, and the functional module 11 a fuel pump or a tank module. Other functional modules can also be fastened to the flange 5, for example electric connections for the fuel pump, connections for a fuel return pipe, a venturi tube and/or a fuel pump driver module. The functional module may, however, also be a tank sensor, with which the quantity of fuel in the outer tank 2, and also optionally in the swirl pot 3, is measured.

[0046] Furthermore, the embodiment according to FIG. 3 has a fuel conveying module 14 below the plateau 10. This fuel conveying module 14, apart from the plateau 10, may also be provided in the other embodiments. The fuel conveying module 14 is used to convey fuel from the outer tank 2 into the swirl pot 3. A venturi tube 15 and a fuel filter 16 may belong to the fuel conveying module 14. A fuel sensor, a connection for a fuel return line, an overflow from the swirl pot 3 to the outer tank 2 and/or a return valve, for example a mushroom valve (not shown in each case), may also belong to the fuel conveying module 14. The fuel conveying module 14 may be detachably connected to the swirl pot 3, for example by means of an annular closure, or is alternatively welded to the swirl pot.

[0047] The outer tank 2 and swirl pot 3 are configured in two pieces in the embodiment shown in FIG. 3. Production takes place by means of a blow molding process. Firstly, a separate swirl pot 3 is produced, for example by injection molding. The fuel tank 1 is then produced by means of blow molding, the swirl pot 3 being fitted laterally on the blow mould. During the blow molding process, the swirl pot 3 has plastics material blow molded around it. As a result, the outer tank is produced upon cooling of the plastics material on the wall of the blow molding tool. This procedure allows the receiving of functional modules to be prepared during the prefabrication of the swirl pot 3, for example by the provision of corresponding retainers. Furthermore, the swirl pot 3 may be otherwise processed, for example by the introduction of openings. These openings may be used, for example, for fuel supply openings in the base region for a return line from the upper region of the swirl pot to the outer tank or for the connection of a fuel filling pipe.

[0048] FIG. 4 shows a fuel tank 1, in which a prefabricated swirl pot 3, for example an injection-molded swirl pot, was integrated into the fuel tank 1 by means of a blow molding process. The swirl pot 3 is received by an insert of the blow molding machine and moved laterally against the vertically downwardly extruded plastics material. The base 6 of the swirl pot 3 comes into contact here with the extruded plastics material hose, thus producing a kiss-point 7 there.

[0049] The fuel tank of FIG. 4 may, according to a fifth embodiment of the claimed invention also have a system of labyrinth walls 17, cf. FIG. 5. The labyrinth walls 17 are connected by means of weld points 18 to the base 8 of the outer tank 2 and the outer tank upper side 19. These welds are produced as kiss-points.

[0050] Furthermore, the fifth embodiment, and this may also be the case in other embodiments, has a fuel measuring

unit 19, for example a floater. This is connected to an evaluation unit 21, for example an electronic module, fitted to the inner edge of the swirl pot 3, by means of a feed line 20. The fuel measuring unit 19 measures the fuel in the outer tank 2. [0051] While at least one exemplary embodiment has been presented in the foregoing detailed description it should be appreciated that a vast number of variations exist. It should also be appreciated that the exemplary embodiment or exemplary embodiments are only examples, and are not intended to limit the scope, applicability, or configuration of the invention in any way. Rather, the foregoing detailed description will provide those skilled in the art with a convenient road map for implementing an exemplary embodiment of the invention, it being understood that various changes may be made in the function and arrangement of elements described in an exemplary embodiment without departing from the scope as set forth in the appended claims and their legal equivalents.

1. A fuel tank made of plastics material, comprising:
an opening;
a swirl pot arranged in an interior of the opening, wherein
an edge of the opening is connected to an edge of the
swirl pot in a material-uniting manner;
a flange associated with the opening; and
means for conveying liquid fuel fastened on the flange.
2. The fuel tank according to claim 1, wherein the swirl pot and an outer tank defined by a remaining part of the fuel tank, are configured in one piece.
3. The fuel tank according to claim 2, wherein the outer tank and the swirl pot form a blow-molded unit.
4. The fuel tank according to claim 1, wherein the swirl pot and the outer tank are welded to one another in the region of the edge of the opening.

5. The fuel tank according to claim 4, wherein the swirl pot is welded to an outer tank which is blow-molded around it.

6. The fuel tank according to claim 1, wherein a base of the swirl pot is welded as a kiss-point.

7. The fuel tank according to claim 1, further comprising a plurality of labyrinth walls arranged around the swirl pot and connected to the swirl pot in a material-uniting manner.

8. The fuel tank according to claim 1, wherein the swirl pot has a volume of between about two and about five liters.

9. The fuel tank according to claim 1, wherein a flange is associated with an opening and the means for conveying liquid fuel are fastened on the flange.

10. The fuel tank according to claim 8, wherein the means for conveying liquid fuel comprise at least one of a fuel pump, a fuel filter, electrical connections for the fuel pump, connections for a fuel return pipe and a venturi tube.

11. The fuel tank according to claim 8, wherein the flange is connected to a tank sensor.

12. The fuel tank according to claim 1, further comprising a fuel conveying module on the base of the swirl pot.

13. The fuel tank according to claim 8, wherein the fuel conveying module comprises at least one of a venturi tube, an ascending pipe, a valve, an overflow, tank sensors for the outer tank and swirl pot, communicating pipes, and a fuel filter.

14. (canceled)

15. A method of performing a fuel tank, comprising the steps of:

- extruding a plastic material hose;
- moving a prefabricated swirl pot laterally from an outside against the plastics material hose; and
- forcing compressed air into the plastic material hose.

* * * * *