



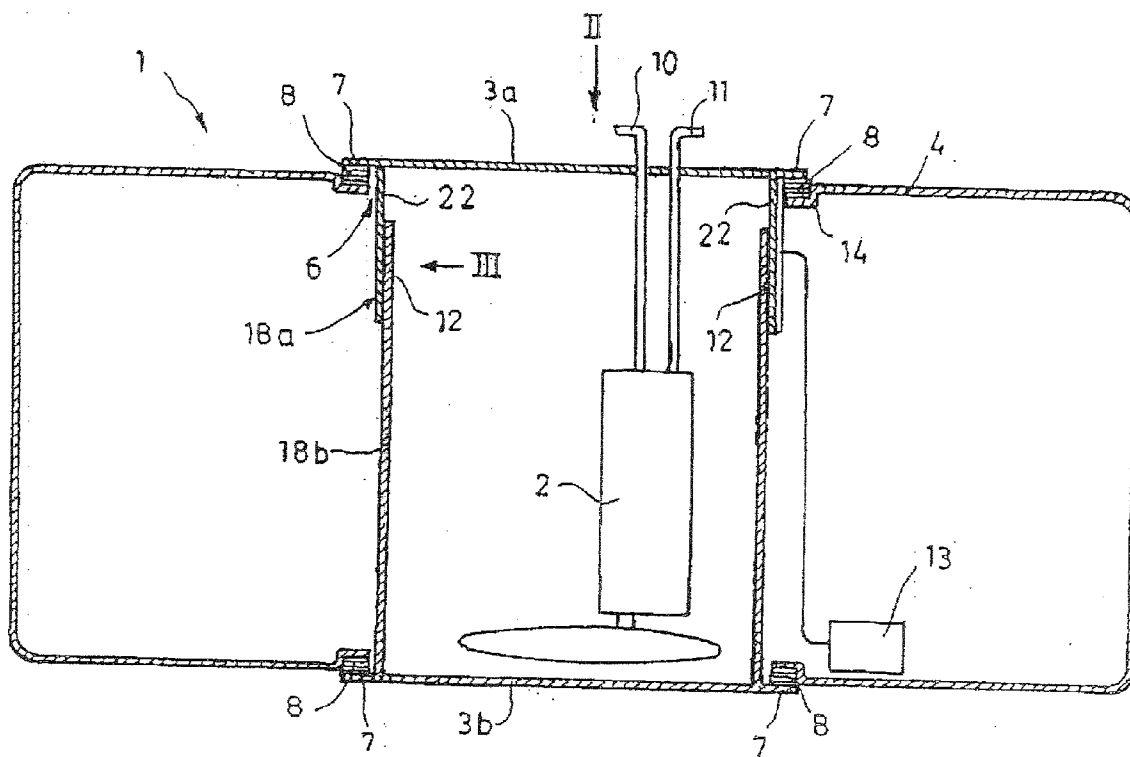
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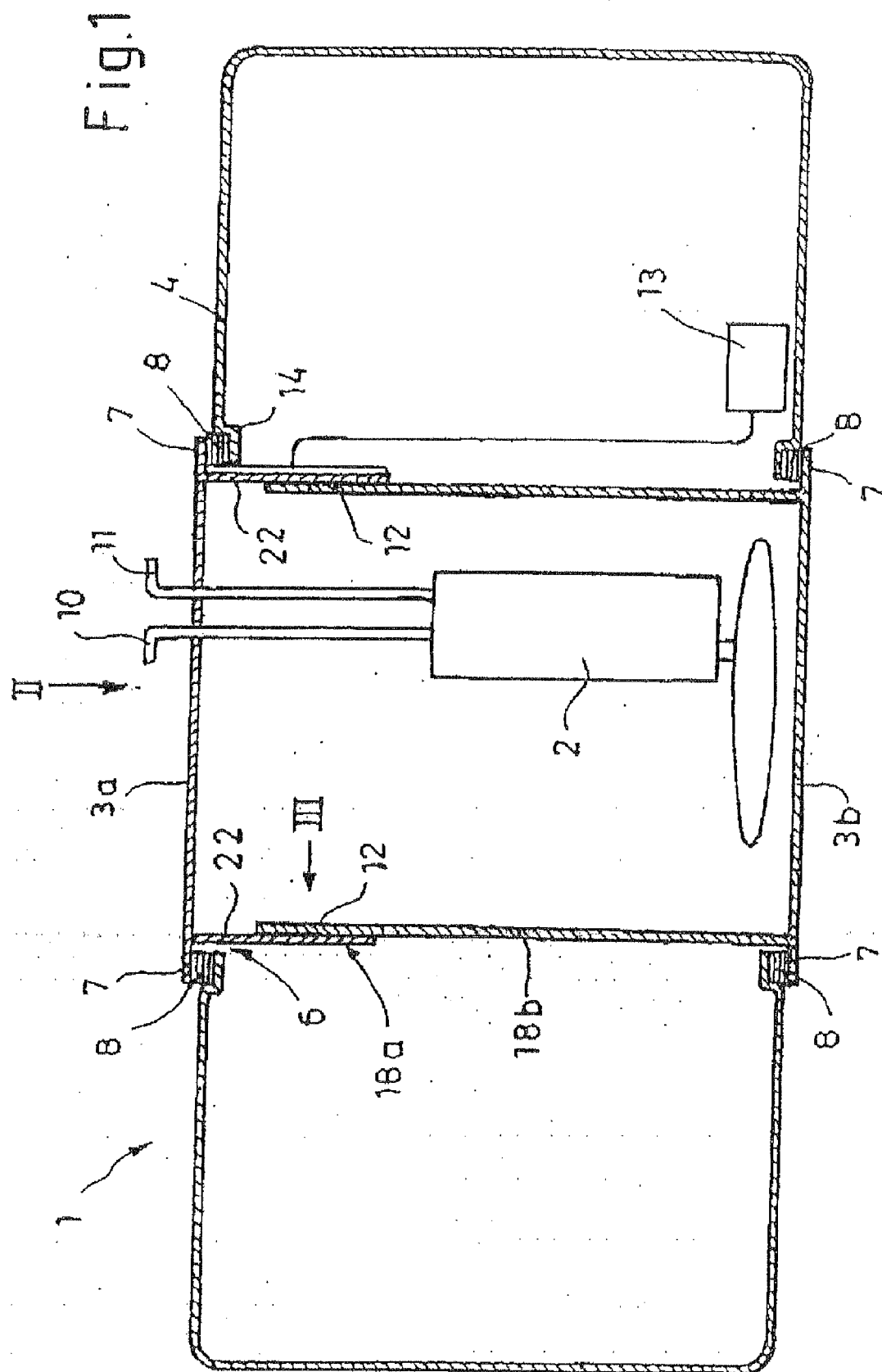
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Gebert et al.(10) **Pub. No.: US 2009/0206097 A1**(43) **Pub. Date: Aug. 20, 2009**(54) **FUEL TANK FOR A MOTOR VEHICLE OF THERMOPLASTIC MATERIAL**(30) **Foreign Application Priority Data**

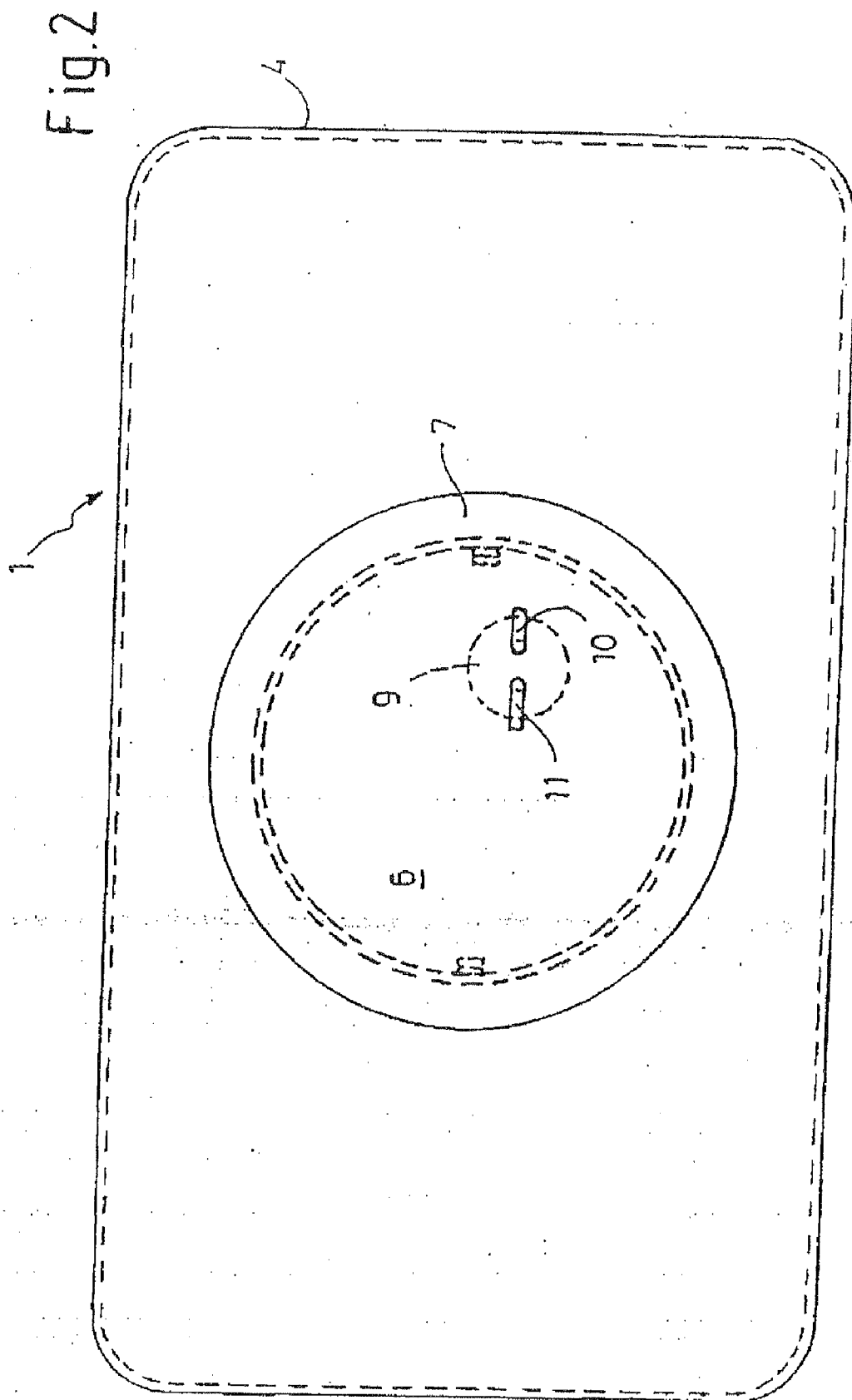
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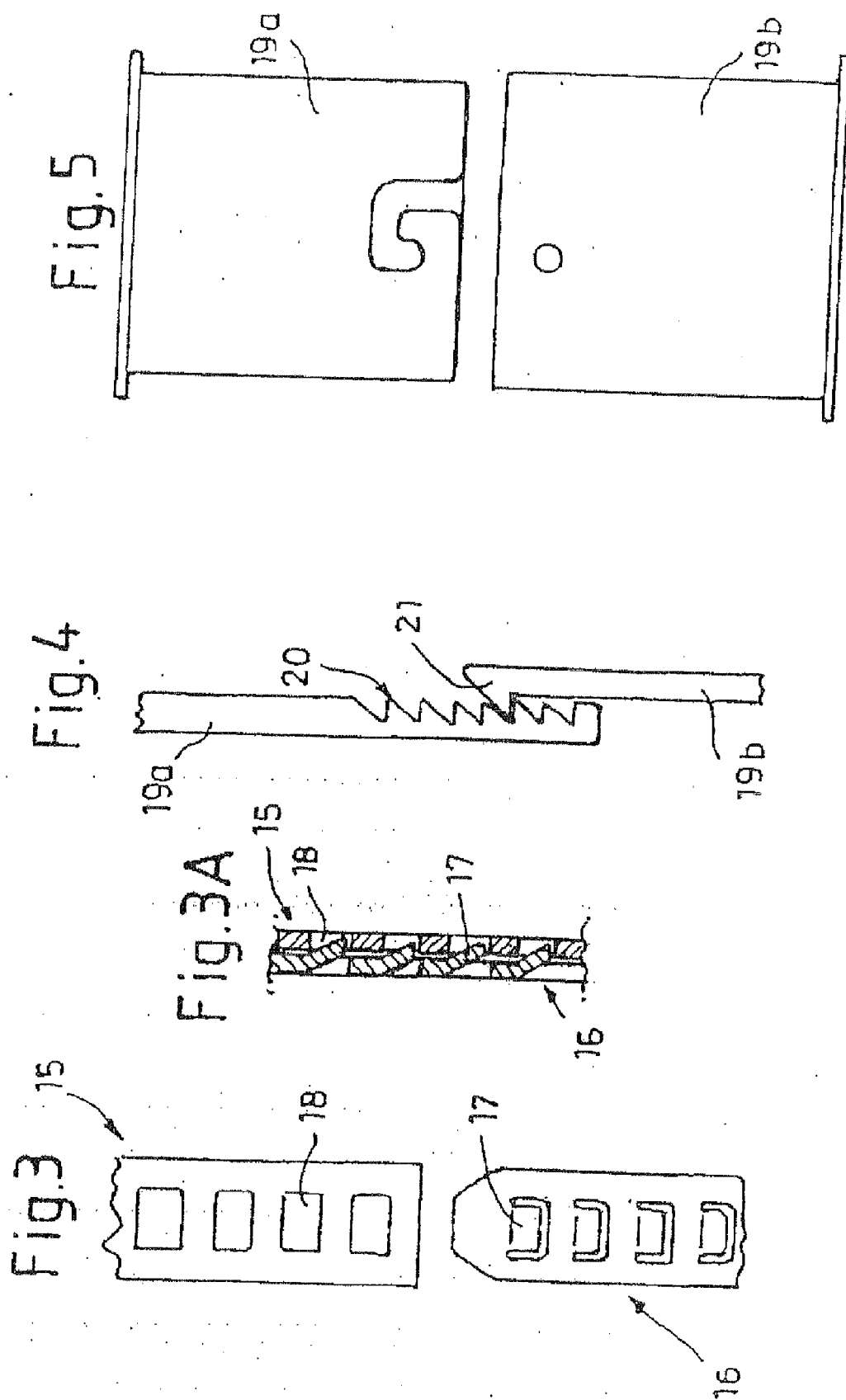
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Ulrich Karsch, Niederkassel (DE)**Publication Classification**(51) **Int. Cl.**
B65D 1/42 (2006.01)(52) **U.S. Cl.** 220/653(57) **ABSTRACT**

The invention relates to a thermoplastic fuel tank (1) for motor vehicles, with at least one stiffening element within the fuel tank (1), wherein the stiffening element extends between two opposite tank walls (4) in such a manner that it counteracts deformation caused by internal pressure of the fuel tank (1). According to the invention, two ends of the stiffening element arranged within the fuel tank (1) engage behind the tank wall (4) from the outside.

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FUEL TANK FOR A MOTOR VEHICLE OF THERMOPLASTIC MATERIAL

[0001] The invention relates to a thermoplastic fuel tank for motor vehicles, with at least one stiffening element within the fuel tank, wherein the stiffening element extends between two opposite tank walls in such a manner that it counteracts deformation caused by internal pressure of the fuel tank.

[0002] The fuel tanks used in motor vehicles nowadays are predominantly composed of thermoplastic and are produced by extrusion blow molding. The internal and add-on components required for operation, such as, for example, internal surge components, ventilation valves and lines, a fuel pump, sensors, splash baffles and the like, can be encapsulated by blow molding during the production of the fuel tank, or can be inserted retrospectively into the finished tank. For example, it is known from the prior art to introduce a feed unit, comprising a surge pot and a fuel pump, into the fuel tank as a "drop-in" solution via an opening in the upper side of the fuel tank. The feed unit is advantageously arranged on the fuel tank base which is at the bottom in the fitted position of the fuel tank. For this purpose, the feed unit is generally pressed resiliently against the fuel tank base. A disadvantage of this is that the spring forces can be added to the internal pressure of the tank and jointly act therewith on the tank walls.

[0003] A fuel tank is customarily operated in an unpressurized state. The pressure ratios in the fuel tank can be changed, for example by filling and emptying, temperature fluctuations, fuel movements in the fuel tank, and the like. In order to ensure the unpressurized state in the fuel tank, the pressure changes are compensated for via venting valves and lines.

[0004] The gas mixture conducted away is cleaned by an activated carbon filter and subsequently output into the surroundings. The activated carbon filter has only a limited capacity and generally has to be back flushed at regular intervals, which is realized by sucking up air for the internal combustion engine of the motor vehicle.

[0005] In the case of hybrid vehicles, there is a limited option for flushing the activated carbon filter, since the internal combustion engine is only switched on in certain driving situations. This means that, in the case of hybrid vehicles, it is possible for operating situations to prevail, in which it is advantageous if the fuel tank is "closed". In the "closed" state, a gas mixture cannot be conducted away to the activated carbon filter. A disadvantage of this is that the internal pressure of the tank can rise, which could result in an impermissibly severe deformation of the fuel tank.

[0006] The compressive strength problem of fuel tanks is known from the prior art. DE 10 2006 031 902 A1 discloses a method for producing hollow bodies from thermoplastic, in particular a method for producing fuel tanks from plastic, in which web-shaped or strip-shaped preforms made of plasticized material are reshaped in a multi-part mold, which forms a mold cavity, to the inner contour of the mold cavity. Two mutually complementary intermediate products in the form of shells are firstly formed. Inserts are subsequently fastened to the inner sides of the shells, which sides face each other in each case in the fitted position, with at least some inserts of mutually complementary shells each being of mutually complementary design, in the sense that they can be connected to form an assembled component or to form a functional unit. The shells are joined together in such a manner that the mutually complementary inserts engage in one

another and/or enter into operative connection with each other. In order to counteract deformations of the fuel tank due to an increased internal pressure of the tank, it is proposed that the internal components be designed as cross struts.

[0007] According to DE 31 31 040 A1, a pressure-resistant fuel tank for fitting into the space provided for the spare wheel in the case of normal motor vehicles comprises two curved shells which are welded to each other at their inner edges and are connected to each other by a coaxial pipe acting as a tension rod. The pipe has apertures such that its interior forms part of the usable tank volume and at the same time limits the maximum filling level in the tank. The pipe, which can be composed of two sections screwed together, is welded at its lower end to the inner wall of the lower shell while, at its upper end, it is welded onto a central bore provided in the upper shell.

[0008] DE 711 117 discloses a portable pressure tank, in particular for medium pressures, said pressure tank having a flat cuboidal shape and the substantially planar side walls of which are connected to each other by tension rods preventing bulging of the same, with the valves serving for the filling and emptying and for other purposes being accommodated in the interior of a pipe which passes through the tank and expediently likewise serves as a tension rod.

[0009] EP 1 493 961 B1 describes a compressed gas tank for motor vehicles. In the case of the metal gas tank, mutually opposite tank walls have a profiling which increases the rigidity thereof, and are additionally connected by at least one tension element. The ends of the tension element are deformed by heat and application of force in such a manner that the tank wall is held in a molded annular groove. The ends of the tension element are subsequently tightly welded to the upper shell and the lower shell. In the case of the thermoplastic fuel tank known from the prior art, the stiffening elements are welded between opposite tank walls of the fuel tank.

[0010] Upon a rise in pressure, the forces which occur are transmitted via the connection between the stiffening element and tank wall. Said force transmission may result in the plastic creeping in the region of the connection, as a result of which the compressive strength of the plastic tank may be reduced. This is the case in particular if connections are subjected to a tensile load. If, for example, stiffening elements in the form of tension bars which extend over the clear height of the tank are welded or riveted to the tank wall, the cross section available for transmitting tensile forces is determined by the number and arrangement of the welding or riveting connections, and not, by contrast, by the cross section of the stiffening element itself. Of course, with such a structure, the cross section available in total for transmitting tensile forces is relatively limited. This can be counteracted by a multiplicity of stiffening elements being provided in the interior of the tank, but this is at the expense of the volume of the tank.

[0011] The invention is therefore based on the object of providing a thermoplastic fuel tank of high compressive strength for motor vehicles.

[0012] The object on which the invention is based is achieved by a thermoplastic fuel tank for a motor vehicle, with at least one stiffening element within the fuel tank, wherein the stiffening element extends between two opposite tank walls in such a manner that it counteracts deformation caused by internal pressure of the fuel tank, with the fuel tank being distinguished in such a manner that two ends of the stiffening element engage behind the tank wall from the outside. The compressive strength of the fuel tank according to

the invention is increased by the stiffening element within the fuel tank, said stiffening element extending between two opposite tank walls.

[0013] Internal pressure within the meaning of the invention is understood as meaning a pressure of the order of magnitude of at least 400 mbar above atmospheric pressure. For example, at a temperature of approximately 40° C., a positive pressure of approximately 400 mbar over the atmospheric pressure is produced in a hermetically sealed fuel tank. By contrast, at low temperatures, a negative pressure of more than 150 mbar can be produced. The stiffening element according to the invention also serves, of course, to stabilize the fuel tank against, for example, a temperature-induced rise in pressure from the outside (negative pressure in the interior of the tank in relation to atmospheric pressure).

[0014] The plastic creeping known from the prior art in the region of the connection between the stiffening element and the tank wall, which creeping has a disadvantageous effect on the compressive strength of the fuel tank, is prevented in that, according to the invention, two ends of the stiffening element engage behind the tank wall from the outside. This has the advantage that the connection between the stiffening element and tank wall is only subjected to a compressive load, thus counteracting the tendency of the plastic to creep in the region of the connection between the stiffening element and tank wall.

[0015] It is particularly expedient if the stiffening element passes through two mutually aligned openings in regions of the tank wall lying opposite each other at a distance from each other.

[0016] In a particularly advantageous embodiment, the connecting element is supported on both sides against the tank outer wall by a flange-like fastening edge or fastening tongues. This has the advantage that the supporting surface which serves with the force transmission is larger, thus reducing the surface pressure.

[0017] At least one end of the stiffening element is expediently welded to the tank outer wall in a gastight and liquid tight manner.

[0018] At least one end of the stiffening element can also be braced against the tank outer wall, with means for providing a seal preferably being arranged between the tank wall and the stiffening element in such a manner that the connection between the stiffening element and tank outer wall is gastight and liquid tight. One advantage of a connection of this type is that the connection between the stiffening element and tank outer wall can be released if the need arises.

[0019] At least one end of the stiffening element can likewise be connected to the tank outer wall by a rotary and latching connection, with the rotary and latching connection preferably comprising means for providing a seal such that the connection between the stiffening element and tank outer wall is gastight and liquid tight. The advantage of such a rotary and latching connection between the stiffening element and tank outer wall is that the connection can easily be released and re-closed at any time. For example, such a rotary and latching connection can be designed as a bayonet fastening.

[0020] The stiffening element is preferably supported against the tank outer wall under prestress in such a manner that the prestress counteracts deformation of the fuel tank due to a rise in pressure within the fuel tank.

[0021] In a particularly preferred embodiment, the stiffening element can comprise at least two parts. The parts of the

stiffening element can be designed in a complementary manner to each other in the sense that they can be connected to form an assembled stiffening element. One advantage of the multi-part structure of the stiffening element is that the stiffening element can be arranged more simply within the fuel tank.

[0022] The parts of the stiffening element can be connected to one another, for example, by means of a screw connection, bayonet connection, plug-in connection, snap-in connection or latching connection. The screw connection or the bayonet connection affords the advantage that the parts of the stiffening elements can be separated from one another without relatively great effort and that the connection between the individual parts of the stiffening element has a sufficient load-bearing capacity. A plug-in connection has the advantages that the connection can easily be produced and released again. A snap-in or latching connection has the advantage that the connection can easily be produced and has a sufficient load-bearing capacity.

[0023] In a preferred embodiment of the invention, the stiffening element is designed as a feed unit, with the feed unit being arranged between opposite aligned maintenance openings in the tank wall. An advantage thereof is that one insert fewer has to be placed into the fuel tank, since the feed unit serves at the same time as the stiffening element.

[0024] The feed unit generally comprises a surge pot and a fuel pump arranged therein. If the stiffening element is of multi-part design, then, for example, that part of the stiffening element which is at the bottom in the fitted position can be designed as the surge pot.

[0025] The fuel tank is expediently designed as a single piece in the form of an extrusion blow-molded tank.

[0026] The invention is explained in more detail below with reference to an exemplary embodiment which is illustrated in the drawings, in which:

[0027] FIG. 1 shows a section through a fuel tank according to the invention, with the stiffening element being designed as a feed unit,

[0028] FIG. 2 shows a top view of the fuel tank from FIG. 1, and

[0029] FIGS. 3 to 5 show different variants of the connection of the parts of the stiffening element to one another.

[0030] A fuel tank 1 according to the invention is illustrated in FIG. 1. The fuel tank 1 is designed in a known manner as a thermoplastic tank. Said tank can be produced, for example, as a single piece by extrusion blow molding. FIG. 1 shows a greatly simplified sectional view of the fuel tank 1 according to the invention. A filling pipe and means for ventilating and venting the fuel tank 1 are not illustrated for simplicity reasons.

[0031] The tank wall 4 of the fuel tank 1 is provided with an opening 6 which is at the top in the fitted position and an opening 5 which is at the bottom in the fitted position. The two openings 5, 6 are arranged, aligned with each other, in mutually opposite sections of the tank wall and have a substantially identical diameter. Furthermore, the openings 5, 6 are provided in the form of circular sections of the tank wall 4. A feed unit 2 which extends over the entire height of the fuel tank and accommodates a fuel pump 9 in a known manner is inserted into the openings 5, 6. The feed unit 2 defines a fuel reservoir which is separated from the main volume of the fuel tank 1 and from which the fuel pump 9 feeds fuel via a fuel supply line 10 to the internal combustion engine.

[0032] According to the invention, it is provided that the feed unit 2 is of two-part design, said feed unit being formed from two mechanically interacting, pot-shaped inserts 3a, 3b which are each supported on the outer sides of opposite regions of the tank wall 4 and pass through the openings 5 and 6.

[0033] The insert 3b which is at the bottom in the fitted position and is illustrated in FIG. 1 forms the surge tank for the fuel pump 9 whereas the insert 3a at the top in the fitted position forms a cover closure of the feed unit 2, which cover closure is provided in a known manner with leadthroughs for a fuel supply line 10 and for electric lines 11. In the exemplary embodiments illustrated, the two inserts 3a, 3b which form the feed unit 2 are designed as cylindrical or pot-shaped elements; it is self-evident to a person skilled in the art that the inserts can each have any mutually complementary cross-sectional contours.

[0034] In the exemplary embodiments illustrated, the inserts 3a, 3b are each designed with a closed outer contour and are supported on the outer side of the tank wall 4, in each case with the interposition of a seal 8, by an encircling collar 7 of flange-like design.

[0035] As will be described below, the inserts 3a, 3b are connected in a form-fitting manner to each other in the region of their mutual penetration.

[0036] Although the feed unit 1 in the exemplary embodiment described is designed with a predominantly closed outer contour, it is clear to a person skilled in the art that only part of the contour defined by the inserts 3a, 3b has to be designed as a closed outer contour.

[0037] In the exemplary embodiment described, the insert 3b which is at the bottom in the fitted position defines the "surge tank" of the feed unit 2, which surge tank forms a reservoir which is sealed in relation to the rest of the volume of the fuel tank 1, minimizes surging caused by the driving dynamics during various driving states of the motor vehicle and at the same time ensures that the fuel pump 7 is completely immersed in fuel in each driving state. Furthermore, said reservoir defines the spare topping-up volume of the motor vehicle.

[0038] The fuel reservoir formed by the inserts 3a, 3b communicates with the remaining volume of the fuel tank 1, either by means of lines (not illustrated) or by means of apertures provided at a corresponding height of the inserts. This is not illustrated in the drawings for simplification reasons.

[0039] Fuel tanks frequently comprise a plurality of partial volumes which communicate with one another and have different filling levels because of the design. To this end, at least one further pump, for example in the form of a suction jet pump, is provided in the fuel tank, said pump, which is driven, for example, via a fuel return from the internal combustion engine, feeding fuel from the main volume of the fuel tank 1 into the reservoir formed by the inserts 3a, 3b.

[0040] A filling level sensor which is arranged on the feed unit 2 and is intended for the main volume of the fuel tank 1 is denoted by 13. Said filling level sensor 13 is connected in a known manner to the electronic control system of the motor vehicle via electric lines (not illustrated).

[0041] The feed unit 2 according to the invention is advantageously designed in such a manner that it also acts as a reinforcing or stiffening element of the fuel tank 1 in the event of an internal pressure building up, for example, in the fuel tank 1. As already mentioned above, for this purpose the inserts 3a, 3b are mechanically connected to each other in

their region of penetration 12 into the fuel tank 1 in such a manner that they are each supported against the outer side of the tank wall 4 by their collar 7, which acts as a fastening flange, and thereby counteract a pressure-induced deformation. The collar 7 of the inserts is supported in each case with a sufficiently large supporting surface against the tank wall, and therefore tensile forces which are caused by the internal pressure of the fuel tank and act on the feed unit 2 are reliably introduced into the tank wall in such a manner that plastic deformation of the plastic material is avoided.

[0042] The invention can be understood in such a manner that, instead of an encircling collar 7, individual fastening tongues which are supported from the outside against the tank wall 4 can in each case be provided.

[0043] As already mentioned, the insert 3a which is at the top in the fitted position is designed, in particular in its region of penetration 12 with the lower insert 3b, with a contour which is closed in an encircling manner; as an alternative thereto, the insert 3a can be designed, for example, as a cover plate which closes the upper opening 6 in the tank wall 4 and has fastening tongues or fastening webs protruding into the interior of the tank.

[0044] In the variant, illustrated in FIG. 1, of a fuel tank 1 according to the invention, the inserts which each fully outwardly seal the openings 5, 6 in the tank wall 4 are merely clamped against the tank wall 4, with the tensile force required for this purpose being applied via the mechanical connection of the inserts 3a, 3b, as will be described below. The sealing is brought about, as already mentioned, via the seals 8, said seals each being inserted into encircling steps 14 of the tank wall 4. The clamping can alternatively be brought about by means of a separate flange ring if a correspondingly designed fastening flange is likewise provided in the wall of the fuel tank, and would then be engaged under by the flange ring.

[0045] As an alternative thereto, the collars 7 of the inserts 3a, 3b can be welded to the tank wall 4. In this case, removal of the inserts 3a, 3b from the fuel tank 1 for inspection purposes is no longer possible. A closable inspection opening, through which, for example, the fuel supply line 10 and the electric lines 11 are passed, is then expediently provided in the insert 3a.

[0046] As illustrated by way of indication in FIGS. 3 to 5, the inserts 3a, 3b can have been latched to each other in various ways in their region of penetration 12; as an alternative, said inserts can also have been connected to each other via a rotary and latching connection (bayonet fastening), screw connection or bayonet connection.

[0047] FIG. 3 shows a schematic view of a latching connection, comprising a latching receptacle 15 and a latching tongue 16 matched thereto. For example, a plurality of latching receptacles 15 which are arranged at a distance from one another and are in the form of latching channels, in which latching tongues 16 fastened on the circumference of the insert 3b engage, can be provided on the outer side of a cylindrical section 19a of the insert 3a. For this purpose, the latching tongues 16 can be provided with latching springs 17 which spring into correspondingly designed latching recesses 18 of the latching receptacles 15, as illustrated in FIG. 3a. FIG. 3a shows a longitudinal section through the latching.

[0048] FIG. 4 shows an alternative variant of a latching connection of the inserts 3a, 3b. It is provided here that the cylindrical section 19a of the insert 3a is latched to the cylindrical section 19b of the insert 3b in each case over the entire

circumference, with latching serrations **20** encircling the inside of the cylindrical section **19a**, of the insert **3a** being provided, and a latching hook **21** of encircling design being provided on the outer circumference of the cylindrical section **19b**. It is clear to a person skilled in the art that, instead of encircling latching serrations **20** and latching hooks **21**, latching means distributed discretely around the circumference of the cylindrical sections **19a**, **19b** can also be provided.

[0049] FIG. 5 finally illustrates, in greatly simplified form, a type of bayonet fastening via which the cylindrical sections **19a**, **19b** of the inserts **3a**, **3b** can be locked to each other in a form-fitting manner.

LIST OF REFERENCE NUMBERS

[0050]	1 Fuel tank
[0051]	2 Feed unit
[0052]	3a , 3b Inserts
[0053]	4 Tank wall
[0054]	5 Bottom opening
[0055]	6 Top opening
[0056]	7 Collar
[0057]	8 Seal
[0058]	9 Fuel pump
[0059]	10 Fuel supply line
[0060]	11 Electric lines
[0061]	12 Region of penetration
[0062]	13 Filling level sensor
[0063]	14 Steps
[0064]	15 Latching receptacle
[0065]	16 Latching tongue
[0066]	17 Latching springs
[0067]	18 Latching recess
[0068]	19a , 19b Cylindrical sections of the inserts 3a , 3b
[0069]	20 Latching serrations
[0070]	21 Latching hooks

1. Thermoplastic fuel tank for a motor vehicle, with at least one stiffening element within the fuel tank, wherein the stiffening element extends between two opposite tank walls in such a manner that it counteracts deformation caused by internal pressure of the fuel tank, characterized in that two ends of the stiffening element engage behind the tank wall from the outside.

2. Fuel tank according to claim 1, characterized in that the stiffening element passes through two mutually aligned openings in regions of the tank wall lying opposite each other at a distance from each other.

3. Fuel tank according to claim 1, characterized in that the connecting element is supported on both sides against the tank outer wall by a flange-like collar or fastening tongues.

4. Fuel tank according to claim 1, characterized in that at least one end of the stiffening element is welded to the tank outer wall in a gastight and liquid tight manner.

5. Fuel tank according to claim 1, characterized in that at least one end of the stiffening element is braced against the tank wall, with means for providing a seal preferably being arranged between the tank wall and the stiffening element in such a manner that the connection between the stiffening element and tank outer wall is gastight and liquid tight.

6. Fuel tank according to claim 1, characterized in that at least one end of the stiffening element is connected to the tank outer wall by a rotary and latching connection, with the rotary and latching connection preferably comprising means for providing a seal such that the connection between the stiffening element and tank outer wall is gastight and liquid tight.

7. Fuel tank according to claim 1, characterized in that the stiffening element is supported against the tank outer wall under prestress in such a manner that the prestress counteracts deformation of the fuel tank due to a rise in pressure within the fuel tank.

8. Fuel tank according to claim 1, characterized in that the stiffening element comprises at least two parts.

9. Fuel tank according to claim 1, characterized in that the parts of the stiffening element can be connected by means of a screw connection, bayonet connection, plug-in connection, snap-in connection or latching connection.

10. Fuel tank according to claim 1, characterized in that the stiffening element is designed as a feed unit, with the feed unit being arranged between opposite aligned openings in the tank wall.

11. Fuel tank according to claim 1, characterized in that the fuel tank is designed as an extrusion blow-molded tank.

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