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(54) HIGH PRESSURE TANK AND METHOD FOR PRODUCING THE SAME

(57) A high pressure tank (10) including a plastic liner (12) with a metallic boss (14), a winded layer of dry fibres of a first type (16), a winded layer of dry fibres of a second type (18); the winded layer of dry fibres of the first type (16) being sandwiched between the plastic liner (12) and the winded layer of dry fibres of the second type (18); the dry fibres of the first type having a higher abrasion resistance than the dry fibres of the second type; the winded layer of dry fibres of the first type (16) not adhering to the plastic liner (12) and the metallic boss (14); the high pressure tank (10) having a nominal working pressure equal to or greater than 200 bar.

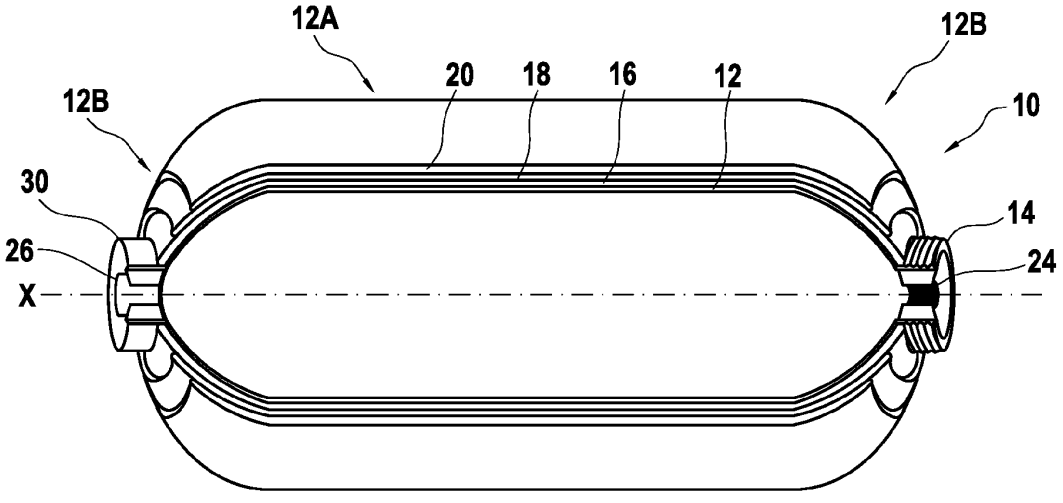

FIG. 1

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Description

TECHNICAL FIELD

[0001] The present disclosure is related to pressure tanks, and more particularly to high pressure tank for gas or liquid under pressure and a method for producing a high pressure tank.

BACKGROUND

[0002] High pressure tank for gas or liquid under pressure are known. Generally, high pressure tank are made with prepreg bundles of fibres, i.e., bundles of fibres that are in a matrix of polymeric material and/or with bundles of fibres that are impregnated with a liquid polymer before being winded on a plastic liner.

[0003] However, these processes are time consuming and may be cumbersome. For example when fibres impregnated with a liquid polymer is used, there is limit to the speed at which the winding process may be carried out and the polymerization time may take up to few hours.

SUMMARY

[0004] Currently, it remains desirable to simplify the producing method and reduce the production costs and time.

[0005] Therefore, according to embodiments of the present disclosure, a high pressure tank is provided. The high pressure tank includes:

- a plastic liner having a cylindrical central part and two dome-shaped extremities, at least one of the dome-shaped extremities having a metallic boss;
- a winded layer of dry fibres of a first type;
- a winded layer of dry fibres of a second type;

the winded layer of dry fibres of the first type being partially or fully sandwiched between the plastic liner and the winded layer of dry fibres of the second type, the winded layer of dry fibres of the first type partially covering an external surface of the metallic boss;
the dry fibres of the first type having a higher abrasion resistance than the dry fibres of the second type;
the winded layer of dry fibres of the first type and the winded layer of dry fibres of the second type not adhering to the plastic liner and the winded layer of dry fibres of the first type and the second type not adhering to the metallic boss;
the high pressure tank having a nominal working pressure equal to or greater than 200 bar.

[0006] By providing such a configuration, when the winded layer of dry fibres of the first type is partially sandwiched between the plastic liner and the winded layer of dry fibres of the second type, the winded layer of dry fibres of the second type is protected from abrasion with the dome-shaped extremities of the plastic liner and the metallic boss. Such abrasion may occur during pressurization of the high pressure tank.

[0007] By providing such a configuration, when the winded layer of dry fibres of the first type is fully sandwiched between the plastic liner and the winded layer of dry fibres of the second type, the winded layer of dry fibres of the second type is protected from abrasion with the plastic liner and the metallic boss. Such abrasion may occur during pressurization of the high pressure tank.

[0008] As the winded layer of dry fibres of the first type has higher abrasion resistance than the dry fibres of the second type, the winded layer of dry fibres of the first type resists better to abrasion than the winded layer of dry fibres of the second type.

[0009] When the winded layer of dry fibres of the first type is fully sandwiched between the plastic liner and the winded layer of dry fibres of the second type, the winded layer of dry fibres of the first type is fully covering an external surface of the plastic liner and partially an external surface of the metallic boss, in particular a part of the external surface of the metallic boss that is flush with or close to the plastic liner.

[0010] When the winded layer of dry fibres of the first type is partially sandwiched between the plastic liner and the winded layer of dry fibres of the second type, the winded layer of dry fibres of the first type is partially covering an external surface of the metallic boss, in particular a part of the external surface of the metallic boss that is flush with or close to the plastic liner. The winded layer of dry fibres of the first type may also cover a part of the plastic liner, for example the dome-shaped extremities of the plastic liner.

[0011] In particular, the metallic boss may damage the fibres of the second type due to stress concentration at the edge of the metallic boss between the metallic boss and the winded layer of dry fibres during pressurization/-depressurization of the high pressure tank. The dry fibres of the first type having a higher abrasion resistance than the dry fibres of the second type, the dry fibres of the first type resist better than the dry fibres of the second type to such type of damage, allowing the winded layer of dry fibres of the second type to be protected from such damage. The winded layer of dry fibres of the second type resisting longer to the pressure inside the high pressure tank as the dry fibres of the second type are not damaged.

[0012] When the winded layer of dry fibres of the first type is fully sandwiched between the plastic liner and the winded layer of dry fibres of the second type, the winded layer of dry fibres of the first type does not adhere to the plastic liner and the metallic boss as the fibres are dry, i.e. not impregnated with liquid resin or pre-impregnate with solidifying resin.

[0013] Thanks to the dry fibres of the winded layer of dry fibres of the first type not adhering to the plastic liner and the metallic boss, there is no transmission of shearing between the plastic liner and the winded layer of dry

fibres of the first type and between the metallic boss and the winded layer of dry fibres of the first type.

[0014] When the winded layer of dry fibres of the first type is partially sandwiched between the plastic liner and the winded layer of dry fibres of the second type, the winded layer of dry fibres of the first type does not adhere to the plastic liner and the metallic boss as the fibres are dry, i.e. not impregnated with liquid resin or pre-impregnate with solidifying resin. The winded layer of dry fibres of the second type is in direct contact with the plastic liner where winded layer of dry fibres of the first type is not sandwiched between the plastic liner and the winded layer of dry fibres of the second type. The winded layer of dry fibres of the second type does not adhere to the plastic liner as the fibres are dry, i.e., not impregnated with liquid resin or pre-impregnate with solidified resin.

[0015] Thanks to the dry fibres of the winded layer of dry fibres of the first type not adhering to the plastic liner and the metallic boss, there is no transmission of shearing between the plastic liner and the winded layer of dry fibres of the first type and between the metallic boss and the winded layer of dry fibres of the first type.

[0016] Thanks to the dry fibres of the winded layer of dry fibres of the second type not adhering to the plastic liner, there is no transmission of shearing between the plastic liner and the winded layer of dry fibres of the second type.

[0017] Thanks to the metallic boss not being in contact with the dry fibres of the second type, higher burst pressure is achieved. Furthermore, change in mode failure from failure at the interface between the plastic liner and the metallic boss when no dry fibres of the first type are present to failure away from the metallic boss when dry fibres of the first type are partially covering the metallic boss.

[0018] The resulting high pressure tank has therefore a better resistance to failure and improved burst performance than pressure thank with winded layer of dry fibres of one type only.

[0019] Furthermore, thanks to the winded layers being made of dry fibres, winding of the fibres onto the plastic vessel may be carried out at higher speed than when using preimpregnated fibres, i.e., fibres embedded in a polymer matrix, either liquid or solid.

[0020] Moreover, as there is no full impregnation of the winded layers with a resin, before and/or after winding, there is no curing time of the resin; thus, a reduction in process time. Indeed, winding of the different layers may take up to 20 minutes whereas curing of the resin fully impregnating the winded layers takes generally hours. Curing also consume energy as it is generally carried out in an oven.

[0021] According to some embodiments, the dry fibres of the first type may have a lower stiffness than the dry fibres of the second type.

[0022] The dry fibres of the first type may be more prone to accommodate shear stress during pressurizing and depressurizing of the high pressure tank than the dry fibres of the second type.

[0023] According to some embodiments, the winded layer of dry fibres of the first type may include helical winding.

[0024] When the winded layer of dry fibres of the first type is fully sandwiched between the plastic liner and the winded layer of dry fibres of the second type, helical winding may allow covering fully an external surface of the plastic liner and partially the external surface of the metallic boss with less dry fibres than hoop winding.

[0025] The winded layer of dry fibres of the first type may include sub-layers. Sub-layers are defined as the layer of dry fibres that is formed by winding from a starting point to the return of the dry fibres at the starting point.

[0026] Each sub-layer may have different winding angle or some sub-layers may have the same winding angle.

[0027] According to some embodiments, the winded layer of dry fibres of the second type may include a hoop winding sub-layer and a helical winding sub-layer.

[0028] Helical winding may allow covering fully the plastic liner (directly and indirectly) and partially the metallic boss (indirectly) with less dry fibres than hoop winding and hoop winding may allow providing stronger mechanical reinforcement to the plastic liner. The combination of both winding may allow obtaining the reinforcement without using as much dry fibres as it would using only hoop winding, as covering a given surface with hoop winding request more dry fibres than covering the same given surface with helical winding.

[0029] As a non-limiting example, the hoop winding sub-layer may be sandwiched between the winded layer of dry fibres of the first type and the helical winding sub-layer.

[0030] As a non-limiting example, the hoop winding sub-layer may be sandwiched between the plastic liner and the winded layer of dry fibres of the first type.

[0031] As a non-limiting example, the helical winding sub-layer may be sandwiched between the winded layer of dry fibres of the first type and the hoop winding sub-layer.

[0032] As a non-limiting example, the winded layer of dry fibres of the second type may include more than two sub-layers.

[0033] Each sub-layer may have different winding angle or some sub-layers may have the same winding angle.

[0034] According to some embodiments, the dry fibres of the first type and/or the second type may be bundles of dry fibres.

[0035] Winding may be more efficient with a bundle of dry fibres than with single fibre.

[0036] According to some embodiments, the bundles of dry fibres may be overlapping one another in a winded layer.

[0037] The bundle of dry fibres may have a given width and one bundle may partially cover the previous bundle in a layer or sub-layer so as to obtain a better coverage than

when bundle of dry fibres have no overlapping or are disposed space apart from one another.

[0038] According to some embodiments, the dry fibres of the second type may be dry carbon fibres.

[0039] Carbon fibres are known to have superior mechanical properties, specifically regarding burst pressure.

[0040] According to some embodiments, the dry fibres of the first type may be dry aramid fibres.

[0041] Aramid fibres have a good abrasion resistance.

[0042] Aramid fibres have a relative low stiffness.

[0043] When used in combination with carbon fibres, aramid fibres have a higher abrasion resistance than carbon fibres.

[0044] When used in combination with carbon fibres, aramid fibres have a lower stiffness than carbon fibres.

[0045] According to some embodiments, the high pressure tank may include a protection layer, the winded layer of dry fibres of the second type being sandwiched between the winded layer of dry fibres of the first type and the protection layer.

[0046] The protection layer may prevent damages to the high pressure tank, in particular the winded layer of dry fibres of the second type, such as blows during handling of the high pressure tank.

[0047] As non-limiting example, the protection layer may be elastomeric polyurethane.

[0048] According to some embodiments, the winded layer of dry fibres of the second type may be partially impregnated with the protection layer.

[0049] As non-limiting example, the protection layer may be applied in liquid form onto the winded layer of dry fibres of the second type, and thus impregnate partially the winded layer of dry fibres of the second type, before being cured.

[0050] The present disclosure relates to a method for producing a high pressure tank as described above. The method includes:

- winding dry fibres of the first type fully covering the plastic liner and partially covering the metallic boss;
- winding dry fibres of the second type on the dry fibres of the first type.

[0051] According to some embodiments, the dry fibres of the first type and/or the second type may be bundles of dry fibres.

[0052] According to some embodiments, winding of dry fibres of the first type may include helical winding.

[0053] According to some embodiments, winding of the dry fibres of the second type may include hoop and helical winding.

[0054] According to some embodiments, the method may include covering the dry fibres of the second type with a protection layer.

[0055] It is intended that combinations of the above-described elements and those within the specification may be made, except where otherwise contradictory.

[0056] It is to be understood that both the foregoing general description and the following detailed description are exemplary and explanatory only and are not restrictive of the disclosure, as claimed.

[0057] The accompanying drawings, which are incorporated in and constitute a part of this specification, illustrate embodiments of the disclosure and together with the description, serve to explain the principles thereof.

BRIEF DESCRIPTION OF THE DRAWINGS

[0058]

Fig. 1 shows a partial cut out view of a high pressure tank according to embodiments of the present disclosure;
Fig. 2 shows a schematic view of a segmented high pressure tank according to embodiments of the present disclosure;
Fig. 3 shows another schematic view of a segmented high pressure tank according to embodiments of the present disclosure;
Fig. 4 shows a schematic view of winding pattern according to embodiments of the present disclosure;
Fig. 5 shows a schematic view of winded layer of dry fibres of the first type according to embodiments of the present disclosure;
Fig. 6 shows a schematic view of winded layer of dry fibres of the second type according to embodiments of the present disclosure; and
Fig. 7 shows a flow chart of the method according to embodiments of the present disclosure.

[0059] It is to be noted that Figs. 1-6 are schematic drawings and that no dimension and/or ratio may be derived from Figs. 1-6.

DETAILED DESCRIPTION

[0060] Reference will now be made in detail to exemplary embodiments of the disclosure, examples of which are illustrated in the accompanying drawings. Wherever possible, the same reference numbers will be used throughout the drawings to refer to the same or like parts.

[0061] Fig. 1 shows a representation of a partial cut out view of an exemplary high pressure tank 10 according to exemplary embodiment of the present disclosure. The high pressure tank 10 has a nominal working pressure equal to or greater than 200 bar.

[0062] As a non-limiting example, the high pressure tank 10 may be a high pressure tank for compressed hydrogen.

[0063] The high pressure tank 10 of Fig. 1 includes a plastic liner 12 having a cylindrical central part 12A and two dome-shaped extremities 12B. One of the dome-shaped extremities 12B has a first metallic boss 14 having an opening 24, for example for accommodating a

valve.

[0064] In the embodiment of Fig. 1, the other dome-shaped extremity 12B also has a second metallic boss 30 having a hollow central part 26. The second metallic boss 30 may be a closed metallic boss, i.e., not having a through hole contrary to the first metallic boss 14.

[0065] The high pressure tank 10 may include one metallic boss 14, i.e., the first metallic boss 14, the second metallic boss 30 not being mandatory.

[0066] It is to be noted that the diameter of the hollow central part 26 may be the same as the diameter of the opening 24 as shown on Fig. 1 or the different as shown on Figs. 2 and 3.

[0067] In the non-limiting example of Fig. 1, the plastic liner 12 is fully covered with a winded layer of dry fibres of a first type 16. The first metallic boss 14 and the second metallic boss 30 are partially covered with the winded layer of dry fibres of the first type 16. The winded layer 16 of dry fibres of the first type is covered by a winded layer of dry fibres of the second type 18.

[0068] As non-limiting example, the winded layer of dry fibres of the first type 16 may be obtained by helical winding, as shown on Fig. 2.

[0069] As non-limiting example, the winded layer of dry fibres of the second type 18 may include a first sub-layer 18A, for example a helical winding sub-layer, and a second sub-layer 18B, for example a hoop winding sub-layer, as shown on Fig. 6.

[0070] Due to the cut out view of Fig. 1, the winded layer of dry fibres of the second type 18 is shown not fully covering the winded layer of dry fibres of the first type 16. Nonetheless, the winded layer of dry fibres of the second type 18 is fully covering the winded layer of dry fibres of the first type 16.

[0071] The winded layer of dry fibres of the first type 16 is sandwiched between the plastic liner 12 and the winded layer of dry fibres of the second type 18.

[0072] The dry fibres of the first type have a higher abrasion resistance than the dry fibres of the second type.

[0073] The winded layer of dry fibres of the first type 16 is not adhering to the plastic liner 12, the first metallic boss 14 and the second metallic boss 30.

[0074] As non-limiting example, the dry fibres of the first type may be aramid fibres.

[0075] Aramid fibres are known to have high abrasion resistance.

[0076] Aramid fibres are known to have lower stiffness.

[0077] As non-limiting example, the dry fibres of the second type may be carbon fibres.

[0078] Carbon fibres are known to have superior mechanical properties, specifically regarding burst pressure.

[0079] Aramid fibres have a higher abrasion resistance than carbon fibres.

[0080] Aramid fibres have a lower stiffness than the carbon fibres.

[0081] The high pressure tank 10 of Fig. 1 may include a protection layer 20. The winded layer of dry fibres of the second type 18 is sandwiched between the winded layer of dry fibres of the first type 16 and the protection layer 20.

[0082] The protection layer 20 is not mandatory.

[0083] As non-limiting example, the protection layer may be a polyurethane protection layer.

[0084] Due to the cut out view of Fig. 1, the protection layer 20 is shown not fully covering the winded layer of dry fibres of the second type 18. Nonetheless, in the embodiment of Fig. 1, the protection layer 20 is fully covering the winded layer of dry fibres of the second type 18.

[0085] As non-limiting example, the hoop winding sub-layer 18B of dry fibres of the second type may be winded on the plastic liner 12, basically covering the cylindrical central part 12A of the plastic liner 12. The winded layer of dry fibres of the first type 16 may then be winded fully covering the hoop winding sub-layer 18B of dry fibres of the second type, the two dome-shaped extremities 12B of the plastic liner 12 and partially the first metallic boss 14 and the second metallic boss 30. The helical winding sub-layer 18A may be winded on the winded layer of dry fibres of the first type 16, fully covering the winded layer of dry fibres of the first type 16. Thus, the winded layer of dry fibres of the first type 16 is partially sandwiched between the plastic liner 12, in particular the two dome-shaped extremities 12B of the plastic liner 12, and the winded layer of dry fibres of the second type 18, in particular the helical winding sub-layer 18A.

[0086] It is understood that the winded layer of dry fibres of the first type 16 and/or the winded layer of dry fibres of the second type 18 may include as many sub-layers as required for reinforcing the plastic liner 12 of the high pressure tank 10.

[0087] Based on Figs. 2-7, the method 100 for producing the high pressure tank 10 of Fig. 1 is described.

[0088] As a first step 102, the winded layer of dry fibres of the first type 16 is winded on the plastic liner 12 and the metallic boss 14. The winded layer of dry fibres of the first type 16 covers fully an external surface of the plastic liner 12 and covers partially an external surface of the first metallic boss 14 and an external surface of the second metallic boss 30, in particular a part of the external surface of the first metallic boss 14 that is flush with or close to the plastic liner 12 and a part of the external surface of the second metallic boss 30 that is flush with or close to the plastic liner 12.

[0089] As non-limiting example, the winded layer of dry fibres of the first type may include helical winding.

[0090] As shown at Figs. 2 and 3, the dry fibres of the first type may be a bundle of dry fibres 22.

[0091] As non-limiting example, the plastic liner 12 shown at Fig. 2 may be divided into five segments.

[0092] As non-limiting example, the plastic liner 12 shown at Fig. 3 may be divided into eleven segments.

[0093] As shown at Figs. 2 and 3, the segments are dividing the dome-shaped extremities 12B of the plastic liner 12.

[0094] Although shown at Figs. 2 and 3 as individual

segments for ease of understanding, the bundle of dry fibres 22 is a continuous bundle which is continuously winded on the plastic liner 12.

[0095] The bundle of dry fibres 22 of the first type may be winded with a helical winding, the bundle of dry fibres 22 having a winding angle α with an axis X of the plastic liner 12, as shown on Fig. 4.

[0096] The axis X of the plastic liner 12 is a rotational axis of symmetry of the plastic liner 12.

[0097] As non-limiting examples, Figs. 2 and 3 show a first wound circuit for a five-segment and a eleven-segment winding respectively.

[0098] As non-limiting examples, Figs. 2 and 3 show the first wound circuit 22A and the start of a second wound circuit 22B. In the second wound circuit 22B, the bundle of dry fibres 22 partially overlaps the bundle of dry fibres of the first wound circuit 22A.

[0099] More specifically, Fig. 2 shows schematically the first metallic boss opening 24 representing the place where the first metallic boss 14 and Fig. 3 shows schematically the second metallic boss hollow central part 26, the second metallic boss 30 being at the opposite of the first metallic boss 14. Although Fig. 2 and Fig. 3 show embodiments with different number of segments, the positioning of the first metallic boss opening 24 and of the second metallic boss hollow central part 26 may be the same.

[0100] As a non-limiting example, a twelve-segment winding helical layer may be obtained..

[0101] As a non-limiting example, a five-segment winding helical layer may be obtained.

[0102] The hoop winding of the plastic liner 12, the first metallic boss 14 and the second metallic boss 30is carried out until the plastic liner 12 is fully covered with the bundle of dry fibres 22 of the first type and the first metallic boss 14 and the second metallic boss 30 are partially covered with the bundle of dry fibres 22 of the first type.

[0103] The winded layer of dry fibres of the first type 16 is shown at Fig. 5 where two spindles 28 are also represented.

[0104] The winded layer of dry fibres of the first type 16 may include sub-layers of dry fibres of the first type, each sub-layer being defined as when the bundle of fibres 22 reaches the starting point.

[0105] As a second step 104, the winded layer of dry fibres of the second type 18 is winded on the winded layer of dry fibres of the first type 16. The winded layer of dry fibres of the second type 18 covers fully the winded layer of dry fibres of the first type 16.

[0106] As a non-limiting example, the dry fibres of the second type may be a bundle of dry fibres.

[0107] As a non-limiting example, the step 104 of winding dry fibres of the second type on the dry fibres of the first type may include two sub-steps: a first sub-step 106 of winding a first sub-layer 18A of dry fibres of the second type on the winded layer of dry fibres of the first type 16 and a second sub-step 108 of winding a second sub-layer 18B of dry fibres of the second type on the first sub-layer 18A.

[0108] As a non-limiting example, the first sub-layer 18A may be a helical winding sub-layer and the second sub-layer 18B may be a hoop winding sub-layer..

[0109] The winded layer of dry fibres of the second type 18A, 18B is shown at Fig. 6 where two spindles 28 are also represented.

[0110] As shown at Fig. 6, the first sub-layer 18A fully covers the winded layer of dry fibres of the first type 16 and the second sub-layer 18B partially covers the first sub-layer 18A.

[0111] The hoop winding sub-layer does not cover the dome shape of the high pressure tank 10.

[0112] As a non-mandatory step, the method 100 may include a step 110 of covering the winded layer of dry fibres of the second type 18 with the protection layer 20.

[0113] As a non-limiting example, the protection layer 20 may be made of polyurethane.

[0114] As a non-limiting example, the polyurethane may be applied in liquid form onto the winded layer of dry fibres of the second type 18, and thus the liquid polyurethane may impregnate partially the winded layer of dry fibres of the second type 18 before the liquid polyurethane is cured.

[0115] Throughout the description, including the claims, the term "comprising a" should be understood as being synonymous with "comprising at least one" unless otherwise stated. In addition, any range set forth in the description, including the claims should be understood as including its end value(s) unless otherwise stated. Specific values for described elements should be understood to be within accepted manufacturing or industry tolerances known to one of skill in the art, and any use of the terms "substantially" and/or "approximately" and/or "generally" should be understood to mean falling within such accepted tolerances.

[0116] Although the present disclosure herein has been described with reference to particular embodiments, it is to be understood that these embodiments are merely illustrative of the principles and applications of the present disclosure.

[0117] It is intended that the specification and examples be considered as exemplary only, with a true scope of the disclosure being indicated by the following claims.

Claims

1. A high pressure tank (10) comprising:

   - a plastic liner (12) having a cylindrical central part and two dome-shaped extremities, at least one of the dome-shaped extremities having a metallic boss (14);
   - a winded layer of dry fibres of a first type (16);
   - a winded layer of dry fibres of a second type (18);

the winded layer of dry fibres of the first type (16) being partially or fully sandwiched between the plastic liner (12) and the winded layer of dry fibres of the second type (18), the winded layer of dry fibres of the first type (16) partially covering an external surface of the metallic boss (14); the dry fibres of the first type having a higher abrasion resistance than the dry fibres of the second type;
the winded layer of dry fibres of the first type (16) and the winded layer of dry fibres of the second type (18) not adhering to the plastic liner (12) and the winded layer of dry fibres of the first type (16) not adhering to the metallic boss (14);
the high pressure tank (10) having a nominal working pressure equal to or greater than 200 bar.

2. The high pressure tank (10) according to claim 1, wherein the dry fibres of the first type have a lower stiffness than the dry fibres of the second type.

3. The high pressure tank (10) according to any of claims 1-2, wherein the winded layer of dry fibres of the first type (16) comprises helical winding.

4. The high pressure tank according to any of claims 1-3, wherein the winded layer of dry fibres of the second type (18) comprises a hoop winding sub-layer and a helical winding sub-layer.

5. The high pressure tank (10) according to any of claims 1-4, wherein the dry fibres of the first type and/or the second type are bundles of dry fibres (22).

6. The high pressure tank (10) according to claim 5, wherein the bundles of dry fibres (22) are overlapping one another in a winded layer.

7. The high pressure tank (10) according to any of claims 1-6, wherein the dry fibres of the second type are dry carbon fibres.

8. The high pressure tank (10) according to any of claims 1-7, wherein the dry fibres of the first type are dry aramid fibres.

9. The high pressure tank (10) according to any of claims 1-8, wherein the high pressure tank (10) comprises a protection layer (20), the winded layer of dry fibres of the second type (18) being sandwiched between the winded layer of dry fibres of the first type (16) and the protection layer (20).

10. The high pressure tank (10) according to claim 9, wherein the winded layer of dry fibres of the second type (18) is partially impregnated with the protection layer (20).

11. A method (100) for producing a high pressure tank (10) according to any of claims 1-10, the method comprising:

- winding dry fibres of the first type (102) fully covering the plastic liner and partially covering the metallic boss;
- winding dry fibres of the second type (104) on the dry fibres of the first type.

12. The method (100) according to claim 11, wherein the dry fibres of the first type and/or the second type are bundles of dry fibres.

13. The method (100) according to claim 11 or 12, wherein winding of dry fibres of the first type comprises helical winding.

14. The method (100) according to any of claims 11-13, wherein winding of the dry fibres of the second type comprises hoop and helical winding.

15. The method (100) according to any of claims 11-14 in combination with claim 9 or 10, wherein the method comprises covering (110) the dry fibres of the second type with the protection layer (20).

Amended claims in accordance with Rule 137(2) EPC.

1. A high pressure tank (10) comprising:

- a plastic liner (12) having a cylindrical central part and two dome-shaped extremities, at least one of the dome-shaped extremities having a metallic boss (14);
- a winded layer of dry fibres of a first type (16);
- a winded layer of dry fibres of a second type (18);
the winded layer of dry fibres of the first type (16) being partially or fully sandwiched between the plastic liner (12) and the winded layer of dry fibres of the second type (18), the winded layer of dry fibres of the first type (16) partially covering an external surface of the metallic boss (14);
the dry fibres of the first type having a higher abrasion resistance and a lower stiffness than the dry fibres of the second type;
the winded layer of dry fibres of the first type (16) and the winded layer of dry fibres of the second type (18) not adhering to the plastic liner (12) and the winded layer of dry fibres of the first type (16) not adhering to the metallic boss (14);
the high pressure tank (10) having a nominal working pressure equal to or greater than 200 bar,
characterized in that
the winded layer of dry fibres of the first type (16)

comprises helical winding.

2. The high pressure tank according to claim 1, wherein the winded layer of dry fibres of the second type (18) comprises a hoop winding sub-layer and a helical winding sub-layer.

3. The high pressure tank (10) according to any of claims 1-2, wherein the dry fibres of the first type and/or the second type are bundles of dry fibres (22).

4. The high pressure tank (10) according to claim 3, wherein the bundles of dry fibres (22) are overlapping one another in a winded layer.

5. The high pressure tank (10) according to any of claims 1-4, wherein the dry fibres of the second type are dry carbon fibres.

6. The high pressure tank (10) according to any of claims 1-5, wherein the dry fibres of the first type are dry aramid fibres.

7. The high pressure tank (10) according to any of claims 1-6, wherein the high pressure tank (10) comprises a protection layer (20), the winded layer of dry fibres of the second type (18) being sandwiched between the winded layer of dry fibres of the first type (16) and the protection layer (20).

8. The high pressure tank (10) according to claim 7, wherein the winded layer of dry fibres of the second type (18) is partially impregnated with the protection layer (20).

9. A method (100) for producing a high pressure tank (10) according to any of claims 1-8, the method comprising:

- winding dry fibres of the first type (102) fully covering the plastic liner and partially covering the metallic boss;
- winding dry fibres of the second type (104) on the dry fibres of the first type.

10. The method (100) according to claim 9, wherein the dry fibres of the first type and/or the second type are bundles of dry fibres.

11. The method (100) according to claim 9 or 10, wherein winding of dry fibres of the first type comprises helical winding.

12. The method (100) according to any of claims 9-11, wherein winding of the dry fibres of the second type comprises hoop and helical winding.

13. The method (100) according to any of claims 9-12 in combination with claim 9 or 10, wherein the method comprises covering (110) the dry fibres of the second type with the protection layer (20).

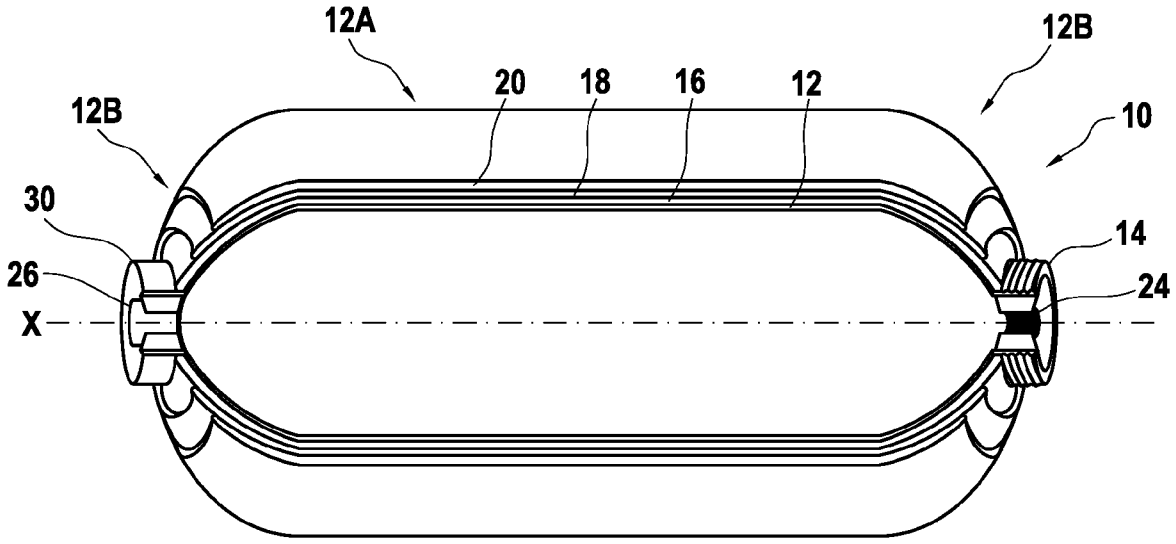

FIG. 1

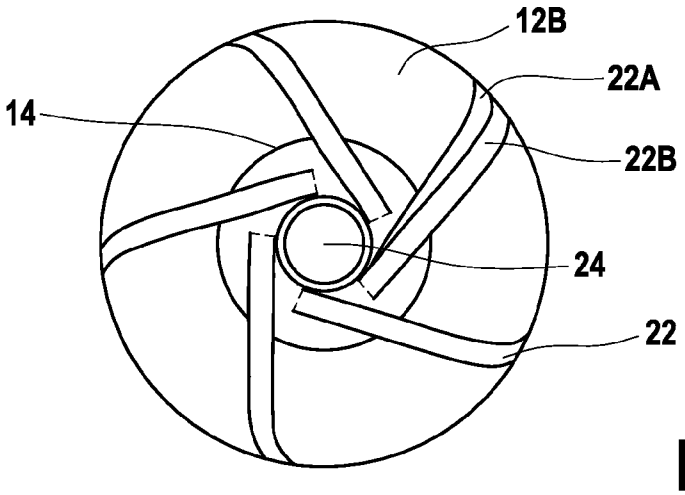

FIG. 2

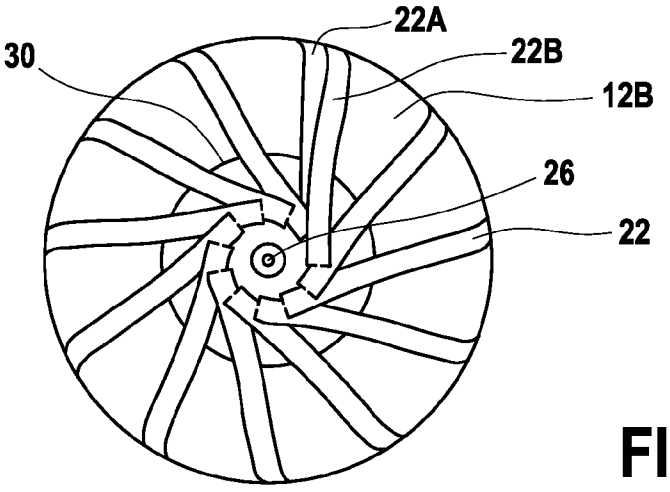

FIG. 3

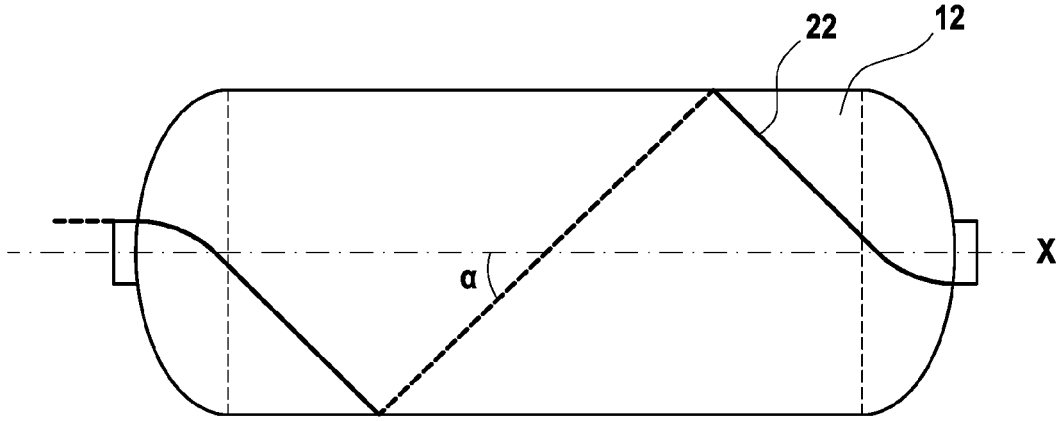

FIG. 4

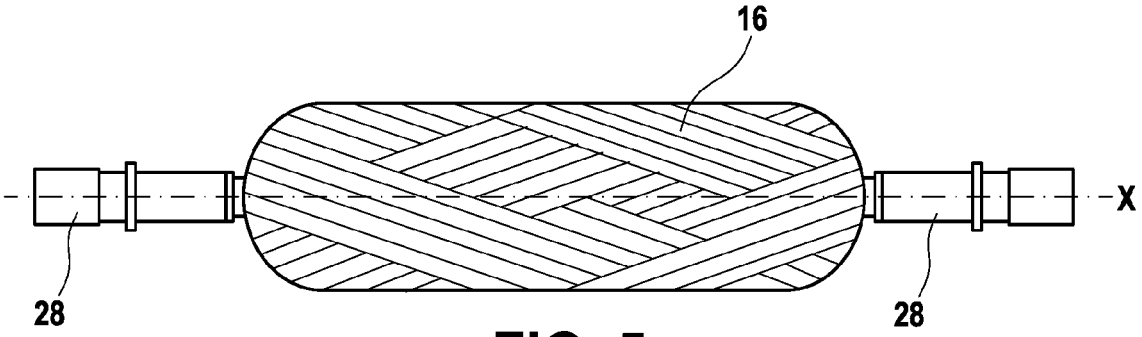

FIG. 5

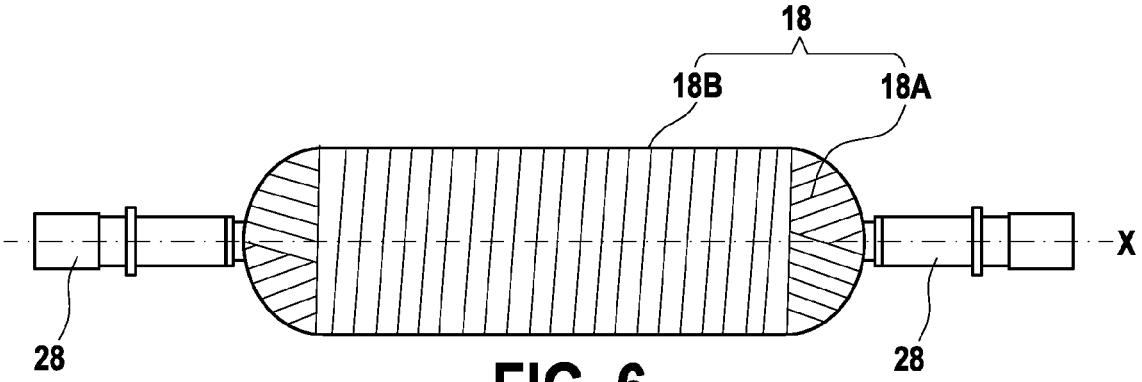

FIG. 6

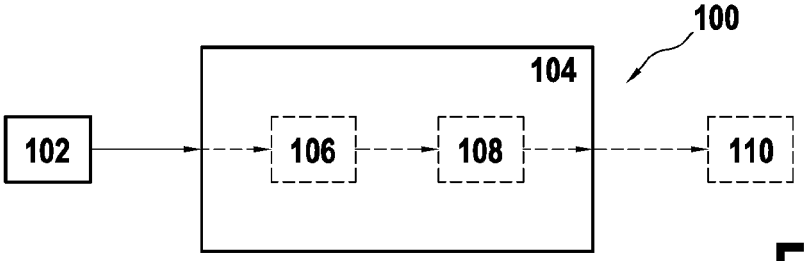

FIG. 7

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EUROPEAN SEARCH REPORT

Application Number
EP 23 18 0003

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X	WO 2019/068813 A1 (PLASTIC OMNIUM ADVANCED INNOVATION & RES [BE]) 11 April 2019 (2019-04-11) * page 7, line 1 - line 8; figure 5 * * page 6, line 30 - page 35 * * page 11, line 14 - line 20 * * page 16, line 21 - line 30 * * page 2, line 1 - line 4 * * page 7, line 27 - page 8, line 28 * * page 16, line 32 - page 17, line 2 *	1-15	INV. F17C1/06
A	US 2021/247025 A1 (NOUWEN GEERT [BE] ET AL) 12 August 2021 (2021-08-12) * paragraphs [0044], [0109] *	1-15	
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	23 November 2023	Forsberg, Peter

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