CLAIMS

1. A hollow roto-moulded article, having an inner wall defining an interior of the article and integrally formed structure with the inner wall, the integrally formed structure protruding away from the interior of the article, the article formed of a first layer including one or more thermoplastic polymers, and a second layer including one or more fibrous materials.

2. The hollow roto-moulded article of claim 1, wherein the one or more fibrous materials is at least partly infiltrated with the one or more thermoplastic polymers.

3. The hollow roto-moulded article of claim 1 or 2, wherein the structure is configured to provide fluid communication between the interior of the article and an environment exterior of the article.

4. The hollow roto-moulded article of claim 3, wherein the structure includes one or more nozzles.

5. The hollow roto-moulded article of claim 4, wherein the or each nozzle includes a nozzle body having, at or towards a first end thereof, a nozzle base formed with the inner wall of the article and, at or towards a second end thereof, a nozzle opening configured to provide said fluid communication between the interior of the article and the environment exterior of the article; and/or

   wherein the or each nozzle includes a substantially curved base transition portion between the inner wall of the article and the nozzle, thereby defining a smooth transition profile between the inner wall of the article and the nozzle.

6. The hollow roto-moulded article of claim 5, wherein a radius of curvature of the base transition portions is in the range of 1 mm to 1000 mm.

7. The hollow roto-moulded article of claim 5 or 6, wherein the or each nozzle includes a flared region adjacent the nozzle opening, whereby a diameter of the flared region is greater than a diameter of the nozzle body.

8. The hollow roto-moulded article of claim 7, wherein the flared region includes a flanged end configured to facilitate connection of one or more components to the article.

9. The hollow roto-moulded article of any one of claims 5 to 8, wherein the or each nozzle base is formed with a tangent of a main wall of the article; or

   wherein the article includes one or more recesses directed towards the interior of the article and the or each nozzle base is formed in a respective recess, wherein the or each nozzle substantially resides within its respective recess; or

wherein the article includes one or more protrusions directed away from the interior of the article and the or each nozzle base is formed on a respective protrusion.

10. The hollow roto-moulded article of any one of claims 4 to 9, wherein the article includes reinforcement to increase the strength and/or stiffness of the or each nozzle; and/or

wherein the or each nozzle is reinforced by a fibre reinforced polymer and one or more thermosetting polymers, wherein the fibre reinforced polymer and the one or more thermosetting polymers are disposed on the second layer about the nozzle and the one or more fibrous materials is at least partly infiltrated with both the one or more thermoplastic polymers and the one or more thermosetting polymers.

11. The hollow roto-moulded article of any one of the preceding claims, wherein the one or more thermoplastic polymers in the first layer include one or more of ethylene homopolymers, ethylene co-polymers, propylene homopolymers, propylene co-polymers, fluoropolymers, polyvinylchloride, polyvinylidene chloride, polyaryl ether ketone and polyamide; and/or wherein the one or more fibrous materials in the second layer include one or more of glass fibre, carbon fibre and basalt fibres, or precursors thereof.

12. The hollow roto-moulded article of any one of the preceding claims, wherein the article includes a third layer including a plurality of filaments selected from one or more of carbon, glass, aramid and basalt filaments, and one or more thermosetting polymers, wherein the second layer is disposed between the first layer and the third layer, and wherein the one or more fibrous materials is at least partly infiltrated with both the one or more thermoplastic polymers and the one or more thermosetting polymers.

13. The hollow roto-moulded article of claim 12, wherein the one or more thermosetting polymers of the third layer comprise one or more of vinyl ester, bismaleimide, polyester, polyacrylate, epoxy, and polyurethane.

14. The hollow roto-moulded article of any one of the preceding claims, wherein an inner wall of at least one of the one or more nozzles, or a portion of said inner wall, is angled with respect to a longitudinal axis of the nozzle, such that a channel defined by said inner wall, or said angled portion, is wider at an exterior facing end of the channel, wherein said angled inner wall, or said angled portion, defines a sealing surface configured to engage a sealing device.

15. The hollow roto-moulded article of any one of the preceding claims, wherein the or each nozzle is configured to receive one or more component parts that form one or more respective nozzles of the article, wherein the one or more component parts include a first adaptor configured to be connected to a respective one of said nozzles, said first adaptor including a flanged end, wherein said first adaptor is configured to facilitate connection of external component(s) to the article.

16. The hollow roto-moulded article of claim 15, wherein the one or more component parts include a second adaptor configured to be connected to a respective one of said nozzles, said second adaptor including a flanged end, wherein, the second adaptor is configured to operatively engage the first adaptor, wherein the second adaptor is configured to be received at least in part in a channel of the nozzle body, wherein the second adaptor is sealingly engaged with the angled inner wall or said angled portion, wherein a sealing device can be received between the second adaptor and the angled inner wall or angled portion.

17. The hollow roto-moulded article of claim 22, further including a closure for preventing fluid communication between the interior of the article and the environment exterior of the article.

18. The hollow roto-moulded article of any of the preceding claims, wherein the article is a hollow composite vessel.

19. A method of producing a hollow composite vessel of claim 18, the method including:

applying one or more fibrous materials to an internal surface of a hollow mould, the hollow mould including structure protruding away from an interior of the mould;

heating and rotating the hollow mould in the presence of one or more thermoplastic polymers within the hollow mould so that the polymer melts and at least partially infiltrates the fibrous material;

cooling the mould so that the thermoplastic polymer solidifies; and

releasing a hollow thermoplastic polymer/fibrous material composite vessel having structure protruding away from an interior of the vessel from the mould.

20. The method of claim 19, further including one or more of the following:

applying a plurality of filaments selected from one or more of carbon, glass, aramid and basalt filaments to the outside of the hollow thermoplastic polymer/fibrous material composite vessel wherein prior to application the plurality of filaments are at least partly wetted with one or more thermoset polymers;

applying a plurality of filaments selected from one or more of carbon, glass, aramid and basalt filaments to the outside of the hollow thermoplastic polymer/fibrous material composite vessel followed by application of one or more thermoset polymers;

applying one or more thermoset polymers to the outside of the hollow thermoplastic polymer/fibrous material composite vessel followed by application of a plurality of filaments selected from one or more of carbon, glass, aramid and basalt filaments.

21. The method of claim 19 or 20, further including boring one or more holes through the structure of the vessel and towards the interior of the vessel.

22. The method of any one of claims 19 to 21, wherein the hollow mould includes one or more protrusions directed towards the interior of the mould, the or each protrusion forming a respective recess in the formed vessel, the structure protruding away from the interior of the mould extending into the protrusion, thereby a base of the or each nozzle being formed in the respective recess of the formed vessel.

23. The method of any one of claims 19 to 21, wherein the hollow mould includes one or more protrusions directed away from the interior of the mould, the or each protrusion forming a respective protrusion in the formed vessel, the structure protruding away from the interior of the mould extending from the protrusion, thereby a base of the or each nozzle being formed on the respective protrusion of the formed vessel.

24. The method of any one of claims 19 to 23, further including reinforcing the or each nozzle with a fibre reinforced polymer and one or more thermosetting polymers, wherein the fibre reinforced polymer and the one or more thermosetting polymers are disposed on the one or more fibrous materials about the nozzle and the one or more fibrous materials is at least partly infiltrated with both the one or more thermoplastic polymers and the one or more thermosetting polymers.

25. The method of any one claims 19 to 24, wherein the structure of the hollow mould protruding into the interior of the mould is one or more nozzle mould portions.

26. The method of any one of claims 19 to 25, wherein the hollow mould further includes a protrusion disposed about a periphery of the structure protruding into an interior of the mould, wherein the hollow thermoplastic polymer/fibrous material composite vessel thereby includes a recess extending through an outer wall of the thermoplastic polymer/fibrous material composite, the recess disposed about a periphery of the structure.

27. The method of claim 20 or any one of claims 21 to 26 insofar as dependent on claim 20, further including boring or otherwise making one or more holes through the vessel, wherein said making a hole through the vessel is undertaken after applying the filament layer, wherein said hole is configured to receive one or more component parts that form a nozzle of the article.

28. The method of claim 43, further including assembling said one or more component parts to from the nozzle of the vessel, wherein said assembling includes connecting a first adaptor to a respective one of said nozzles, and connecting a second adaptor to the respective one of said nozzles, wherein said assembling includes providing a sealing device between the nozzle and the second adaptor before connecting said second adaptor to said nozzle.