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MCCLEOD-ROSS(10) **Pub. No.: US 2017/0158288 A1**(43) **Pub. Date: Jun. 8, 2017**(54) **SEMI-RIGID INFLATABLE WATERCRAFT****B63H 25/46** (2006.01)**B63H 23/34** (2006.01)(71) Applicant: **BWM Ribs Ltd.**, Reading, Berkshire
(GB)**B63B 5/24** (2006.01)**B63H 11/02** (2006.01)**B63H 21/38** (2006.01)(72) Inventor: **Andrew MCCLEOD-ROSS**, Reading
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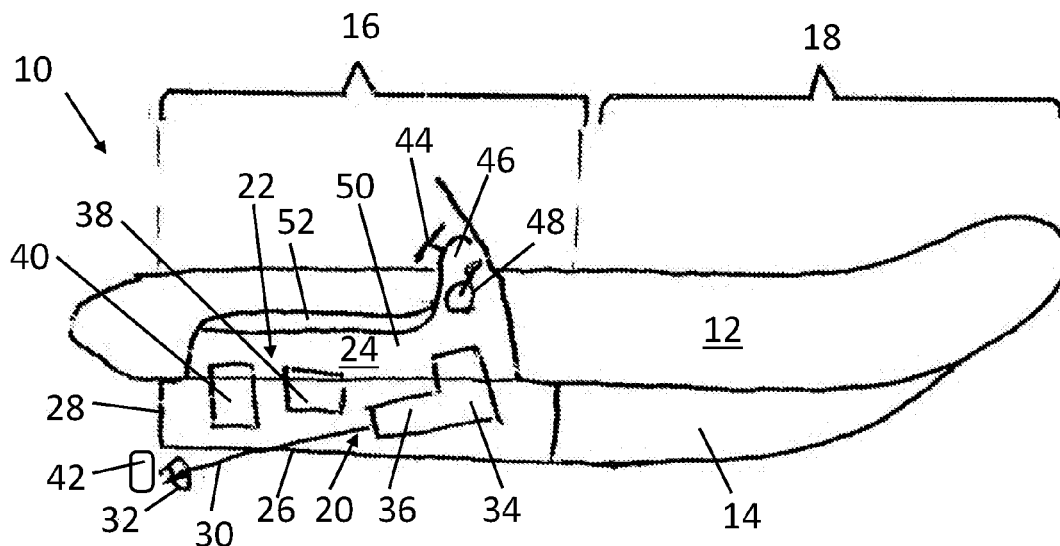
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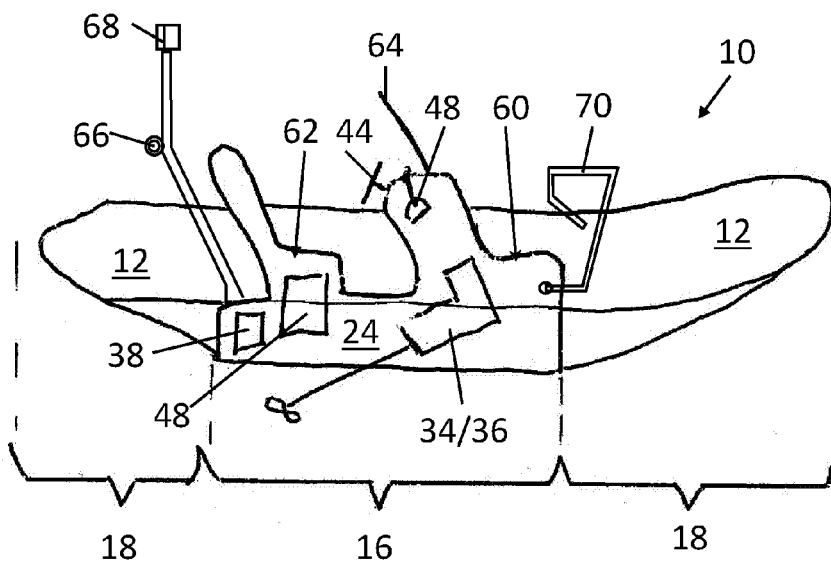
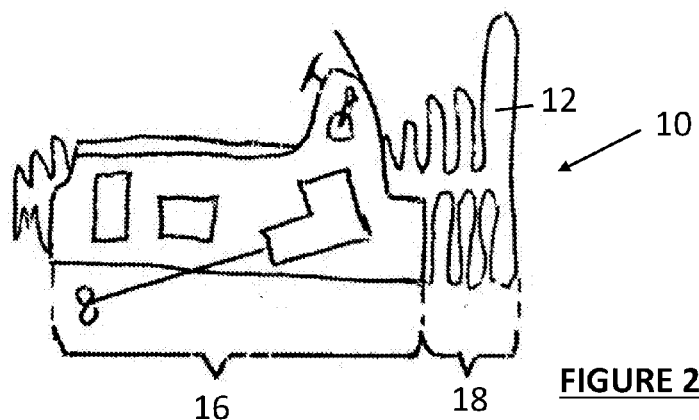
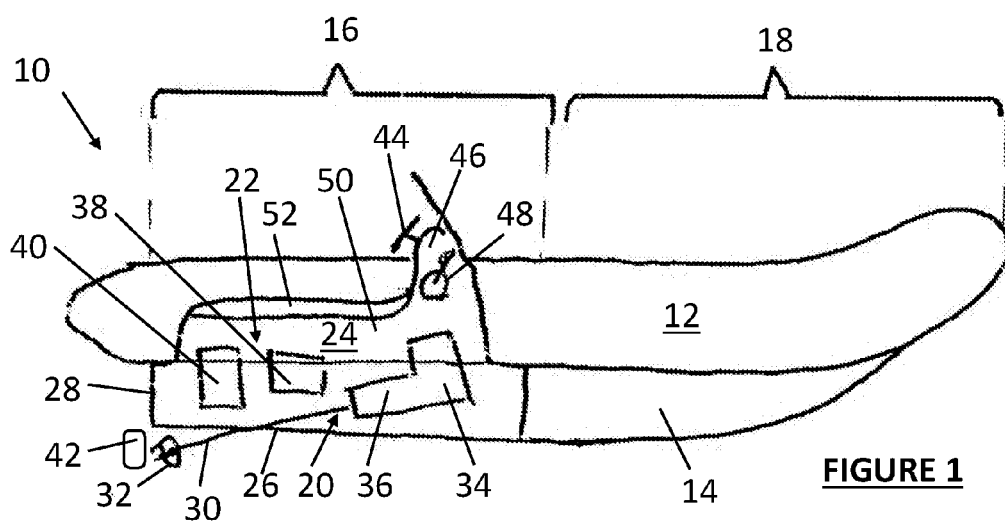
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(57)

ABSTRACT

A semi-rigid inflatable boat (10), or "S-RIB", comprising permanently interconnected inflatable gunwale (12), a flexible bow hull (18) portion and a rigid hull (18) portion located aft of the flexible bow hull portion (18). The S-RIB may additionally comprise a flexible hull portion (18) located aft of the rigid hull portion (16). The flexible hull portions (18) are suitably inflatable, and in certain embodiments comprise an air cell structure, but in preferred embodiments, comprise a drop-stitch structure, which renders them substantially rigid when inflated.





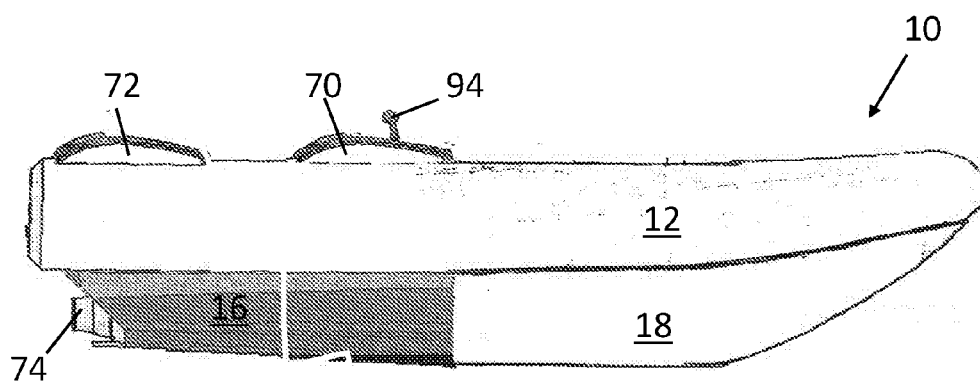


FIGURE 4

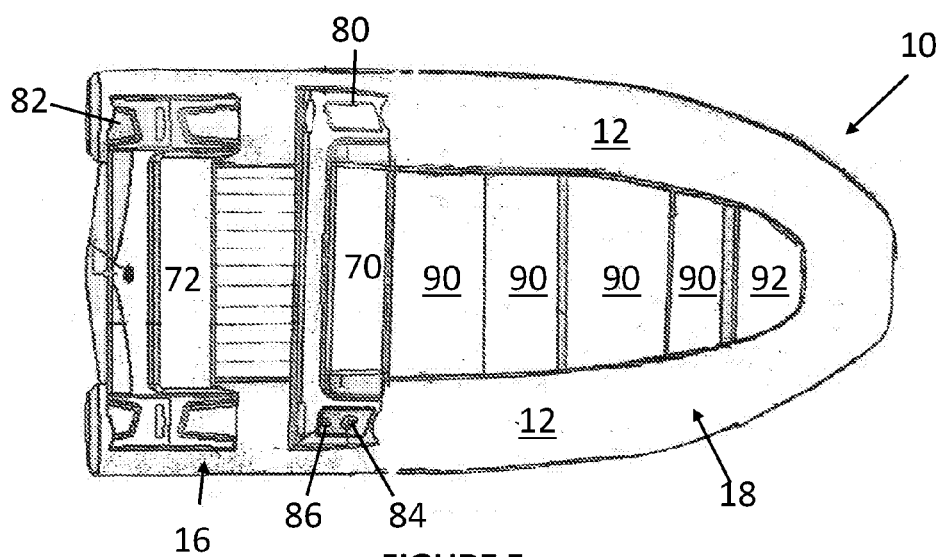


FIGURE 5

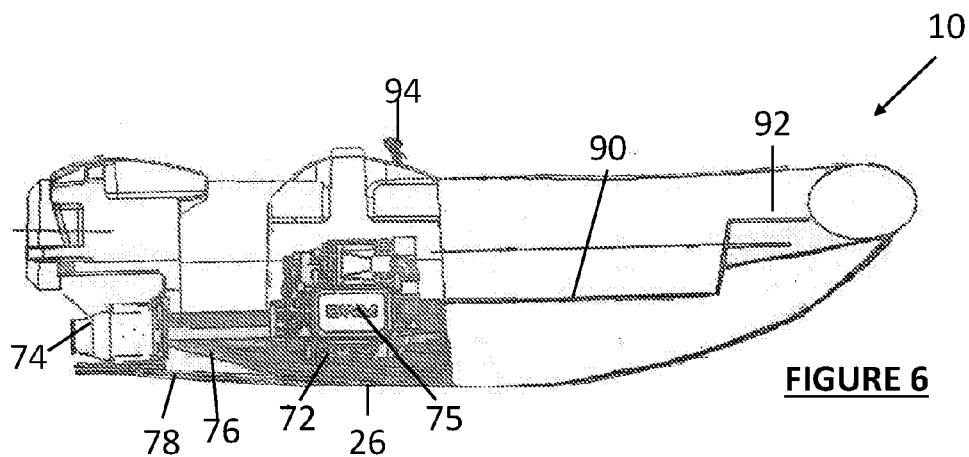


FIGURE 6

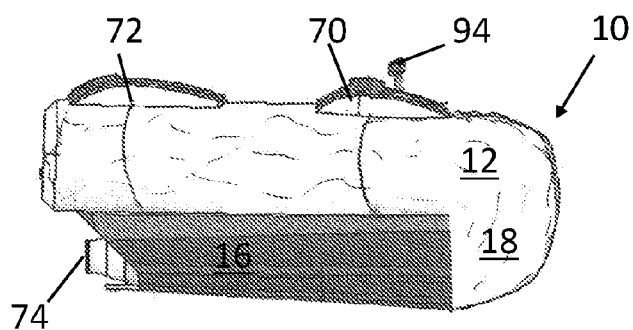


FIGURE 7

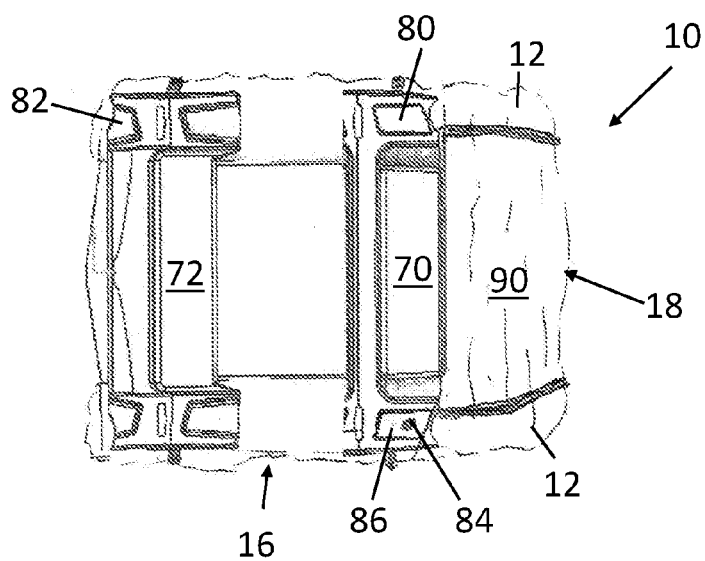


FIGURE 8

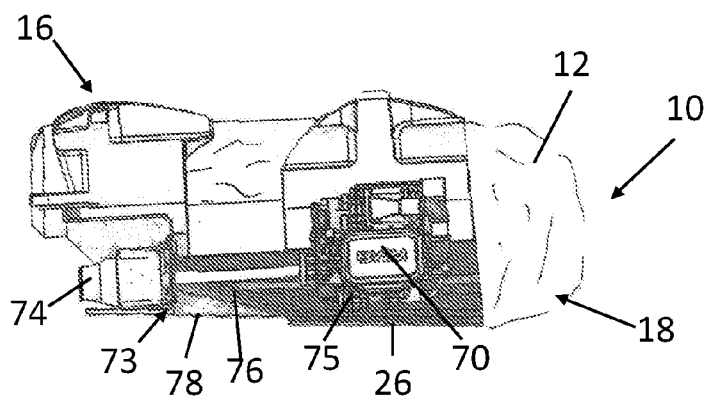


FIGURE 9

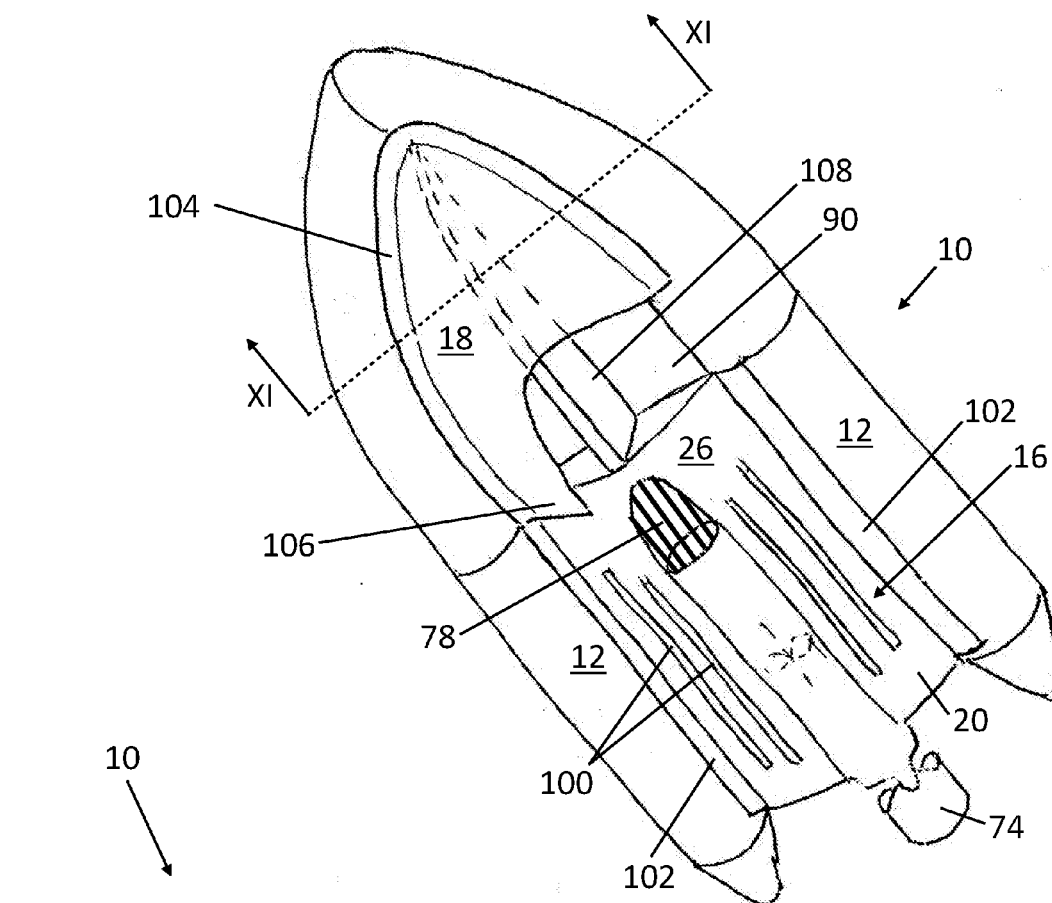


FIGURE 10

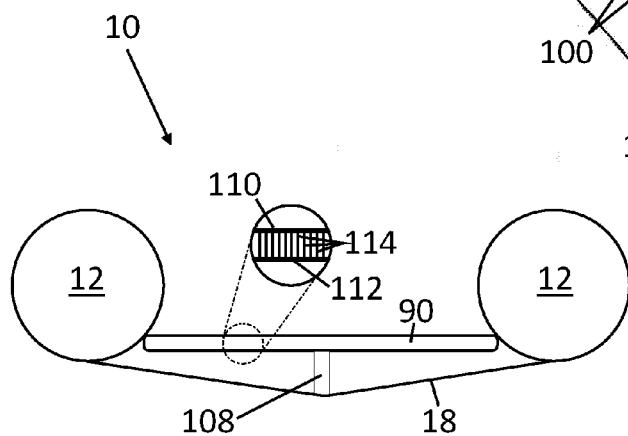


FIGURE 11

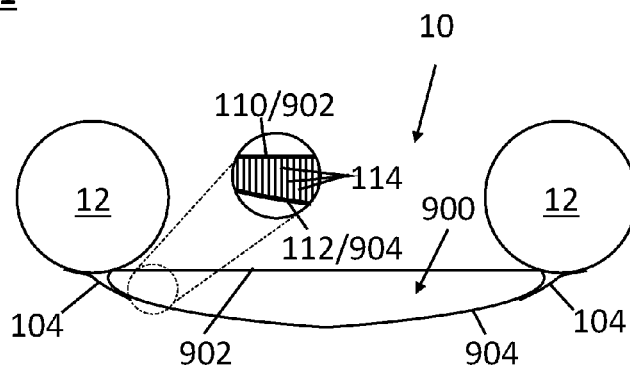


FIGURE 12

SEMI-RIGID INFLATABLE WATERCRAFT

[0001] This invention relates to watercraft and in particular to inflatable watercraft.

[0002] Inflatable watercraft (and in particular, boats) have been in existence for many years, and offer several benefits over rigid-hulled watercraft. An inflatable boat generally comprises a hollow tubular gunwale that can be inflated to define the outer periphery of a boat, and a floor spanning the lower edge of the gunwale that is often manufactured from a sheet of watertight, such as rubberised canvas. The gunwales and floor together define the interior of the boat, which can be used for transporting passengers and cargo.

[0003] Flexible floors in inflatable boats, whilst in use in many cases, are impractical because they move as loads or people are placed on them, which tends to be unstable and also affects the hydrodynamics of the boat. It is therefore commonplace for a rigid insert, in the form of floorboards, to be used within the boat, to provide a rigid, stable floor surface. A keel element can also be placed between the underside of the floor boards and the upper surface of the floor of the boat to improve the boat's handling characteristics. Such boats are often used as tenders or recreational watercraft, and can be propelled by an outboard engine affixed to a transom, or by oars.

[0004] More sophisticated versions of inflatable boats are of the semi-rigid type, often referred to as RIBs (Rigid Inflatable Boats), which comprise a rigid hull portion to which an inflatable gunwale tube is affixed. RIBs are more useful because of their improved rigidity and handling characteristics than inflatable boats. Further, the provision of a rigid hull structure means that it is possible to fit an inboard engine to a RIB: an option that is not possible on an inflatable boat. Modern RIBs can be used as tenders to larger vessels, but are also used as watercraft in their own right, such as for ski boats, recreational watercraft, safety boats and the like. The RIB's inflatable gunwale makes them particularly suited to use in and around other watercraft and personnel in the water (i.e. as tenders and as rescue boats) due to the inflatable gunwale, which provides all-round fendering, and which make climbing on-board the boat from the water much easier.

[0005] It will be appreciated from the common general knowledge and from the foregoing discussion that RIBs offer a number of practical advantages over inflatable boats, and economic advantages over rigid-hulled boats. Nevertheless, they are not used universally due to a number of drawbacks.

[0006] The packed-down size (its size when the gunwale is deflated) of a RIB is not much smaller than its fully-inflated size, and is in any event comparable to that of a rigid-hulled boat of a similar specification. In short, the rigid hull part of a RIB limits the extent to which it can be reduced in size for storage and transport when not in use. Thus, RIBs tend not to be packed-down at all, or only rarely so. On the other hand, an inflatable boat can be packed-down much smaller than a RIB, but inflatable boats suffer from the drawbacks outlined above.

[0007] The rigid part of the RIB needs to be capable of carrying all of the loading of the boat, and the inflatable tube is rarely a structural element of the RIB itself. Thus, a RIB tends to weigh approximately as much as an equivalent rigid-hulled boat.

[0008] As such, there are situations, for example, tenders for smaller vessels that need to be packed-down to a small

size when not in use, where the advantages of an inflatable boat outweigh those of a RIB, and other situations, for example, in equipment laden vessels that need more "structure" to which equipment can be secured, where the advantages of a rigid-hulled boat outweigh the advantages of a RIB.

[0009] A need therefore exists for a new type of watercraft that overcomes one or more of the above problems, and/or which provides an alternative choice of vessel in certain situations.

[0010] According to the invention, there is provided a semi-rigid inflatable boat as set forth in the appendent claims.

[0011] By providing the combination of a rigid hull portion and a flexible hull portion, some of the shortcomings of existing RIBs and inflatable boats can be overcome. Specifically:

[0012] By providing a flexible portion of the hull, the hull itself can be packed-down. This means that by deflating the gunwale and the collapsing the flexible hull portion, the overall size of the boat can be reduced, compared with an equivalent-sized RIB.

[0013] By providing a rigid hull portion, it is possible to install an inboard engine in the boat, which would not be possible in the case of an inflatable boat, which has no rigid portion to which an inboard engine can be affixed.

[0014] The rigid hull portion enables fixed items, such as seats, a driver's console, fuel tanks, electrical items etc. to be installed permanently, whereas the remainder of the boat, e.g. the gunwales and cargo areas can be deflated and/or collapsed for storage and transport purposes.

[0015] The flexible hull portion tends to reduce the weight of the boat compared with an equivalent-sized rigid-hulled boat.

[0016] Other advantages of the invention will be readily apparent from the following description.

[0017] Suitably, the flexible hull portion comprises an inflatable hull portion. The inflatable hull portion may comprise an air cell structure, or a drop-stitch structure, that is: comprising a pair of spaced-apart, flexible skins interconnected, at intervals, by space yarns. A drop-stitch structure can be rendered flexible or collapsible by deflation, or under-inflation, or rendered rigid by inflation whereby the space yarns become tensioned by the stress exerted on them by the flexible skins that are forced apart by the inflation pressure of the gas therein. A drop-stitch structure is preferred because, when inflated, it provides a hard, rigid surface equivalent to a floorboard deck.

[0018] Suitably, the inflatable gunwale has an air-cell structure, that is a hollow interior bounded by flexible walls that are held taut by the inflation pressure of air (or another gas) within it. The gunwale may comprise a closed-ended tube that surrounds the bow and sides of the boat, and optionally the stern of the boat. The inflatable gunwale may comprise a number of independently-inflatable gunwale portions, which reduces the likelihood of the entire gunwale deflating in the event of a puncture.

[0019] The inflatable gunwale may additionally comprise a Hypalon tube with handles, pressure relief valves and inflation points, an air deck, removable seat pads and straps for binding the flexible/inflatable portions of the boat when deflated.

[0020] The rigid and flexible/inflatable hull portions suitably seal to the underside of the inflatable gunwale to form the underside, and interior floor, of the boat, in use.

[0021] The rigid hull portion can be manufactured from any suitable material, such as wood or plastics; although it will be appreciated sheet plastics are generally preferred due to their ease of manufacture/moulding, rigidity, toughness and longevity. In one embodiment of the invention, the rigid hull portion is manufactured from vacuum-formed plastics sheet. In another embodiment of the invention, the rigid hull portion is manufactured from glass- or carbon fibre-reinforced plastics (GRP or CFRP). Suitably, the rigid hull portion comprises a sandwich structure, for example, comprising a polymer foam layer, or a honeycomb layer, interposed between external and internal skins: a sandwich structure providing greater specific strength and rigidity compared with single-skinned equivalents, as well as providing thermal and acoustic insulation properties.

[0022] The rigid hull portion may comprise any one or more of an integrally formed seat, engine compartment, battery compartment, fuel tank compartment, superstructure, cabin, etc. Additionally or alternatively, the rigid hull portion may comprise any one or more of the group comprising: a fixed fuel tank; an exhaust system; a solid floor (optionally comprising real teak decking); a ride plate (underside in contact with the water) and an intake grate (for cooling water, or the intake of a jet pump propulsion system); an electric inflator and deflator; a seat/engine cover; and storage compartments. The rigid hull portion may also incorporate conveniences/accessories including: a boarding step; a towing point; fixed navigational lighting; a fixed fuel filling point; cushioned seats; a joystick for steering and throttle; inflator and deflator buttons; and a control panel.

[0023] Suitably, the flexible/inflatable hull portion is suitably sealingly connected to the rigid hull portion, for example, by an elastomeric strip, or by a flange portion sealingly adhered thereto.

[0024] Suitably, the boat is provided with propulsion means, which suitably comprises an inboard engine formed integrally with the rigid hull portions. The engine may comprise a diesel, petrol or electric engine. The inboard engine may be connected to a gearbox and drivetrain, which could be connected to a screw propeller, or to a jet pump.

[0025] The jet pump, where provided, suitably comprises an axial flow jet pump comprising a stainless steel impeller (for corrosion resistance and durability), a closed loop cooling system (which may be incorporated into the jet pump, or form part of a steering nozzle assembly therefor (such as that described in published PCT application number WO2014/080218), a reverse mechanism, a steering nozzle, and an electric steering system adapted to adjust the steering nozzle.

[0026] Preferred embodiments of the invention shall now be described, by way of example only, with reference to the accompanying drawings in which:

[0027] FIG. 1 is a schematic longitudinal section of a first embodiment of a boat in accordance with the invention;

[0028] FIG. 2 is a schematic longitudinal section of the boat of FIG. 1 in a deflated condition;

[0029] FIG. 3 is a schematic longitudinal section of a second embodiment of a boat in accordance with the invention;

[0030] FIGS. 4 to 6 are side, plan and schematic longitudinal sections, respectively, of a third embodiment of a boat in accordance with the invention;

[0031] FIGS. 7 to 9 are side, plan and schematic longitudinal sections, respectively, of the boat of FIGS. 4 to 6 in a deflated condition;

[0032] FIG. 10 is a partially cut-away view from below of a fourth embodiment of a boat in accordance with the invention;

[0033] FIG. 11 is a schematic cross-section of FIG. 10 on XI-XI; and

[0034] FIG. 12 is an alternative schematic cross-section of a different embodiment of the boat of FIG. 10 (notionally on X-X).

[0035] Referring to FIG. 1, a semi-rigid inflatable boat 10 in accordance with the invention comprises an inflatable, tubular gunwale 12 and a hull portion 14 comprising a rigid portion 16 and a flexible portion 18. The rigid portion 16 is manufactured from a lower GRP moulding 20 and an upper GPR moulding 22 defining a hollow interior cavity 24.

[0036] The lower GRP moulding 20 comprises a ride plate 26 terminating at its trailing edge in a transom 28. Protruding through the ride plate 26 is a propeller shaft tube 30 surrounding a prop shaft (not visible) carrying at its free end, a screw propeller 32. The propeller 32 is driven by an inboard engine 34, via a gearbox 36, which are located within the hollow interior 24 of the rigid portion 16, along with a fuel tank 38 and a battery/electrical system 40.

[0037] The boat 10 can be steered by a rudder 42 located aft of the propeller 32, which is controlled by an electronic steering wheel 44 mounted on a driver's console 46 formed integrally with the upper GPR moulding 22 of the rigid portion 16. A throttle lever/gear selector 48 is also mounted on the driver's console 46 enabling the engine 34 and gearbox 38 to be controlled.

[0038] The driver (not shown) can straddle a seat 50 formed integrally with the upper GRP moulding 22, which seat 50 has a removable cushion 52 that provides access to the engine/stowage compartment 24 below it.

[0039] The bow of the boat 10 comprises the inflatable, tubular gunwale 12 (which extends to the stern of the boat) and the flexible hull portion 18, which comprises a flexible outer skin that shall be described in greater detail below.

[0040] Referring now to FIG. 2, it can be seen that the gunwale 12 can be deflated, thereby collapsing it and enabling it to be folded-crumpled. The flexible hull portion 18 likewise folds/crumples thus shortening the bow of the boat 10. Retaining straps (not shown) or a bag (not shown) can be used to secure the deflated gunwale 12 and flexible hull portion 18 in the stowed configuration, this facilitating transport and/or storage of the boat 10 when not in use. However, when the boat 10 is in the folded configuration, as shown in FIG. 2, it will be appreciated that all of the structural components, such as the engine 34, seat 50, fuel tank 38 etc. remain unaffected by the collapsing/folding of the remainder of the boat. This means that the main components of the boat 10, i.e. the propulsion, steering, accommodation etc. can be manufactured as a complete unit. The complete unit, of course, could be fitted to flexible portions (gunwales 12, flexible hull portions 18) of different configurations, thus providing a modular system that can be adapted/modified for different situations.

[0041] Turning now to FIG. 3 of the drawings, an alternative embodiment of the invention is shown, whereby the

modular rigid portion 16 previously described has been adapted for use as a recreational pleasure craft. In this case, the lower GRP moulding 20, engine 34, gearbox 36, controls 44, 48, 42 etc. are the same as that described previously, but the upper GRP moulding 22 has been manufactured in a slightly different configuration, that is to say, with integrally-formed forward-facing front 60 and rear 62 seats. It will also be noticed from FIG. 3 that the rigid hull portion 16 is now located amidships, with flexible hull portions 18 located forrad and aft of the rigid hull portion 16. The boat 10 can be deflated and collapsed in much the same way as that described previously, except this time both the bow and stern sections of the boat 10 are collapsed aft and forrad, respectively to shorten the length of the boat 10.

[0042] The boat 10 of FIG. 3 comprises driver's wind/spray screen 64, and a towing mast 66 with fixed navigation lights 68. A pushpit 70 is also provided, which bolts to the floor/deck of the rigid hull portion 16 to provide a hand hold and/or guard rail for passengers (not shown). The boat 10 of FIG. 3 can thus be used as a water ski boat, or as a recovery/safety boat, if required. It will be readily apparent that the modular nature of the boat 10 permits a great many variations or adaptations that are commonplace in the marine sector, such that the boat 10 can be adapted for a wide range of used relatively easily, albeit working from a common "chassis", i.e. drivetrain/propulsion system and lower GRP moulding 20.

[0043] FIGS. 4 to 9 of the drawings show, in greater detail, another embodiment of the invention 10, which also comprises a rigid aft portion 16, a flexible bow hull portion 18 and an inflatable gunwale 12.

[0044] The rigid aft portion 16 this time comprises a pair of lateral bench seats 70, 72 and a driver's console 46 formed integrally with the rear of the forrad seat 70. The boat 10 is propelled by a jet pump propulsion system 73, which comprises a low-profile inboard engine 75, such as that described in published PCT application number WO2014/001821. The engine 75 drives an impeller (not visible) located in a steering nozzle 74 located at the outlet of a jet tube 76, which communicates with the surrounding sea water via an intake grille 78 formed in the ride plate 26 of the rigid hull portion 16. The engine 75 has an air intake system, which comprises intake grilles 80 formed in a side of the forrad seats 70 and an exhaust system (not visible) which vents via an exhaust grille 82 formed in a side of the aft seat 72. The fuel tank (not shown) is filled via a filler cap 84 also formed in a side of the forrad seat 70, which is located alongside an inflation/deflation button 86, which controls an air compressor (not shown) located within the rigid hull portion 16. By actuating the inflation/deflation button 86, the air compressor is switched on to inflate/deflate the gunwales 12, and inflatable floor portions 90 of the flexible hull portion 18 of the boat 10.

[0045] The inflatable floor portions 90 of the boat comprise a drop-stitch structure that, when inflated, forms a hard, rigid walking surface in the bottom of the boat 10. As can be seen in FIG. 5, the floor is made up of a number of coplanar, inflatable, drop-stitch panels 90, that form the floor/deck of the boat, as well as a raised floor portion 92 located at the bow, which forms an elevated seat, or step for boarding the boat 10 from an elevated position.

[0046] The driver's console 46 comprises a joystick 94 that controls the thrust and helm of the boat 10 in an intuitive and single-handed manner. The driver's console 46 may

additionally comprise one or more display units (not shown) that can provide read-outs for the engine, navigation systems, depth sounder, radar, fish finders, electrical systems, navigation lights etc.

[0047] In FIGS. 7 to 9 it can be seen how the boat 10 can be deflated and collapsed in the manner described previously in relation to FIGS. 1 and 2, to shorten the boat 10 for ease of storage and transportation. A bag, net or retaining straps (not shown) may be provided to maintain the boat 10 in the folded configuration shown in FIGS. 7 to 9, which bag, net or straps are suitably strong enough to enable the boat 10 to be hoisted on davits or other hoisting system.

[0048] Turning now to FIG. 10, the underside of an embodiment of a boat 10 in accordance with the invention comprises a rigid rear hull portion comprising a lower GRP moulding 20 comprising an integrally formed water intake 78 for a jet propulsion system, integrally moulded chines 100 to improve the handling characteristics of the boat 10 and to increase the rigidity of the ride plate 26, an integrally formed lower portion of a jet tube 76 with a steering nozzle 74 pivotally affixed to the rear of it. The rigid hull portion 16 comprises a flange 102 having a curved profile that matches that of the inflatable gunwale 12, thereby providing a mating surface to enable the rigid hull portion 16 to be sealingly bonded to the gunwale 12 using a high strength, watertight, and durable adhesive (not visible).

[0049] The flexible hull portion 18 comprises a waterproof sheet of rubberised canvas that spans the front section of the boat between the gunwales 12, and which is likewise stuck to the gunwales 12 via an overlapping flange portion 104. The overlapping flange portion 104 extends aft slightly 106 to overlap the front edge of the rigid hull portion 18 and the front edges of the rigid portions flanges 102 to form a watertight bond using a high strength, watertight, and durable adhesive (not visible). By overlapping the flexible hull portion thus, the movement of water, as the boat moves forward, does not tend to peel the rear flange 106 away.

[0050] Referring now to FIGS. 10 and 11 together, interposed between the flexible hull portion 18 and the underside of the drop-stitch floorboards 90, is a keel 108 that holds the waterproof sheet of rubberised canvas that spans the front section of the boat between the gunwales 12 taut and in a desired shape to improve the handling of the boat 10. The keel 108 can be manufactured from an inflatable, drop-stitch member, or it can comprise a foam insert or similar. In any event, it will be appreciated that the boat 10 forrad of the rigid hull portion 16, is flexible and/or inflatable, thereby permitting the boat 10 to be collapsed and/or shortened as previously described.

[0051] In FIG. 12 of the drawings, an alternative arrangement is shown, whereby the flexible hull portion 18 is manufactured from a profiled drop-stitch panel having a planar upper surface 902 and a profiled lower surface 904, which spans the gunwales 12. The lower surface 904 connects and seals to the gunwales 12 by a separate flange portion 104 which overlaps the two. This obviates the need for a keel 108, as previously described, but may add cost to the boat 10 because drop-stitch panels are more easily manufactured in parallel-sided configurations.

[0052] As can be seen from the insets of FIGS. 11 and 12, the drop stitch floor panels 92 comprise spaced apart upper 110 and lower 112 skins that are interconnected by regularly-spaced space yarns 114. When inflated, the upper 110 and lower 112 skins tend to move apart, but are restrained by

the space yarns **114** that become taut. The skin tension in the upper and lower skins **110**, **112**, in combination with the tension in the space yarns **114**, gives rise to a hard, rigid structure, which can be readily walked upon and used as a deck for cargo or occupants of the boat **10**.

[0053] The invention is not restricted to the details of the foregoing embodiments, which are merely exemplary of the invention. For example, the shapes, configurations and materials described are illustrate, rather than limiting, and the boat could be modified in any number of ways to suit different end uses or applications.

1-33. (canceled)

34. A semi-rigid inflatable boat, comprising:

a hull and

an inflatable gunwale, the hull comprising a rigid hull portion and a flexible bow hull portion, the rigid hull portion being located aft of the flexible bow hull portion, and the inflatable gunwale, rigid hull portion and flexible bow hull portions of the semi-rigid inflatable boat being permanently interconnected.

35. The semi-rigid inflatable boat of claim **34**, further comprising a flexible hull portion located aft of the rigid hull portion.

36. The semi-rigid inflatable boat claim **35**, wherein the flexible hull portion comprises an inflatable hull portion, comprising an air cell structure.

37. The semi-rigid inflatable boat of claim **35**, wherein the flexible hull portion comprises an inflatable hull portion comprising a drop-stitch structure.

38. The semi-rigid inflatable boat of claim **37**, wherein the drop-stitch structure comprises a pair of spaced-apart, flexible skins interconnected, at intervals, by space yarns.

39. The semi-rigid inflatable boat of claim **38**, comprising a drop-stitch construction floor, which when inflated, forms a hard, rigid surface in the bottom of the boat, the floor comprising either: a parallel-sided drop-stitch panel comprising a planar upper surface and a planar lower surface, and further comprising a keel interposed between the planar lower surface and a flexible skin extending between lower portions of the inflatable gunwales, whereby the keel defines the profile of the underside of the boat; or a profiled drop-stitch panel comprising a planar upper surface and a profiled lower surface defining the profile of the underside of the boat.

40. The semi-rigid inflatable boat of claim **39**, wherein floor comprises a plurality of interconnected, coplanar floor panels.

41. The semi-rigid inflatable boat of claim **34**, wherein the inflatable gunwale comprises an air-cell structure comprising a closed-ended tube that surrounds the bow and sides of the boat, and optionally the stern of the boat.

42. The semi-rigid inflatable boat of claim **41** wherein the inflatable gunwale comprises a number of independently-inflatable gunwale portions.

43. The semi-rigid inflatable boat of claim **35**, wherein the flexible hull portion comprises a waterproof sheet spanning a front section of the boat between the gunwales.

44. The semi-rigid inflatable boat of claim **43**, wherein the rigid and flexible hull portions seal to an underside portion of the inflatable gunwale.

45. The semi-rigid inflatable boat of claim **35**, wherein the flexible hull portion comprises a flange portion adhered to a lower portion of the gunwales using a waterproof adhesive, the flange having a curved profile that matches that of the inflatable gunwale, thereby providing a mating surface for sealingly bonding the rigid hull portion to the gunwale using a waterproof adhesive, and optionally comprises a further portion that overlaps the rigid hull portion and which is bonded to the rigid hull portion by a waterproof adhesive.

46. The semi-rigid inflatable boat of claim **34**, wherein the rigid hull portion comprises a modular assembly to which the gunwale and flexible hull portion can be sealingly affixed, the modular assembly comprising a lower rigid hull portion forming a chassis to which is affixed, a propulsion system, a steering system, a fuel tank and controls for the propulsion and steering systems.

47. The semi-rigid inflatable boat of claim **34**, wherein the rigid hull portion further comprises an upper rigid hull portion affixed to the lower rigid hull portion forming a cavity therebetween for housing the propulsion system, steering system, fuel tank and controls.

48. The semi-rigid inflatable boat of claim **37**, wherein the upper rigid hull portion comprises an integrally formed seat, or driver's console.

49. The semi-rigid inflatable boat of claim **34**, wherein the rigid hull portion comprises a propulsion system, being an inboard engine, connected to a screw propeller via propeller shaft and gearbox; or arranged to drive the impeller of a jet propulsion system.

50. The semi-rigid inflatable boat of claim **35**, wherein at least a portion of the jet propulsion system is formed integrally with the rigid hull portion.

51. The semi-rigid inflatable boat of claim **35**, wherein the inboard engine comprises a closed loop cooling system comprising a heat exchanger forming part of a jet tube or a steering nozzle of the jet propulsion system.

52. The semi-rigid inflatable boat of claim **34**, wherein the rigid hull portion is at least partially manufactured from sheet plastics such as vacuum-formed plastics sheet; or glass- or carbon fibre-reinforced plastics.

53. The semi-rigid inflatable boat of claim **34**, wherein the rigid hull portion comprises a sandwich structure comprising a polymer foam layer, or a honeycomb layer, interposed between external and internal skins of sheet plastics.

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