

Aug. 15, 1967

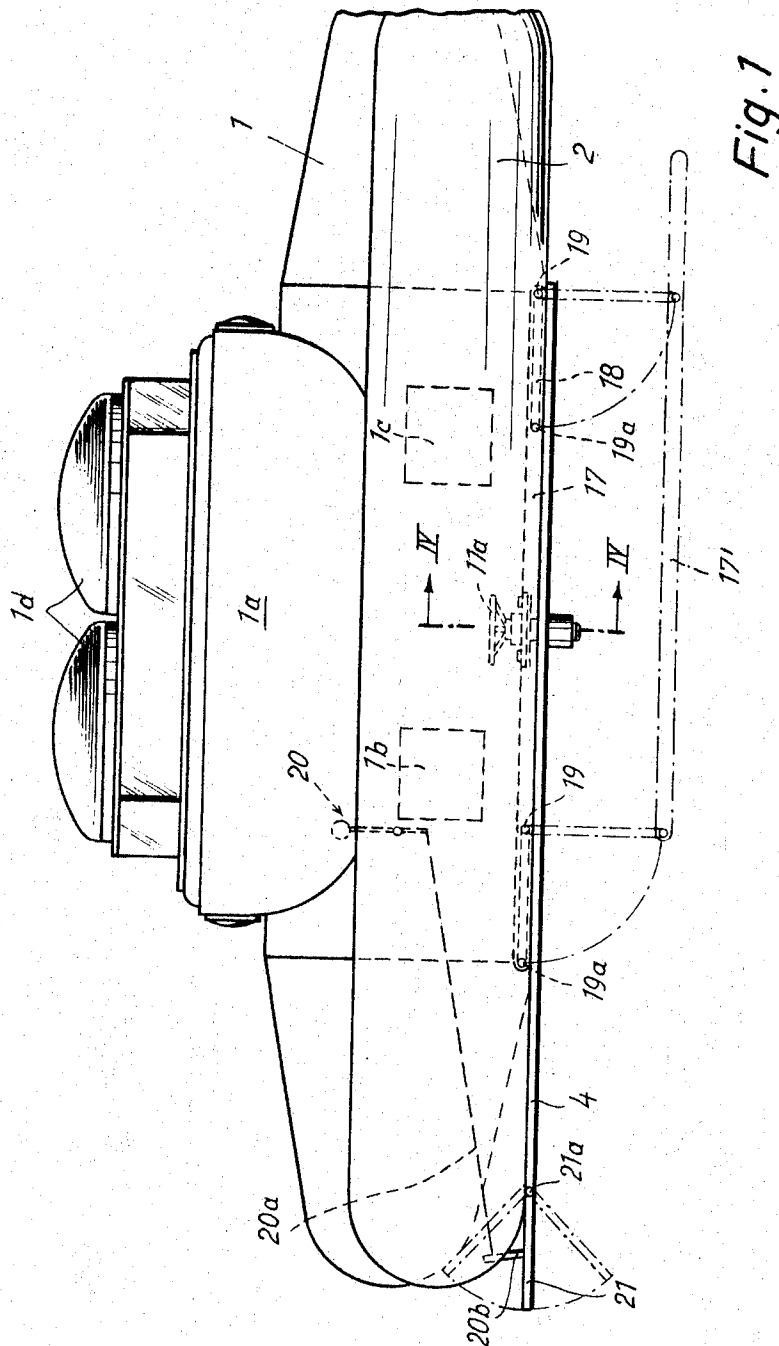
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3,335,684

SUBMERSIBLE WATERCRAFT

Filed Jan. 18, 1965

5 Sheets-Sheet 1



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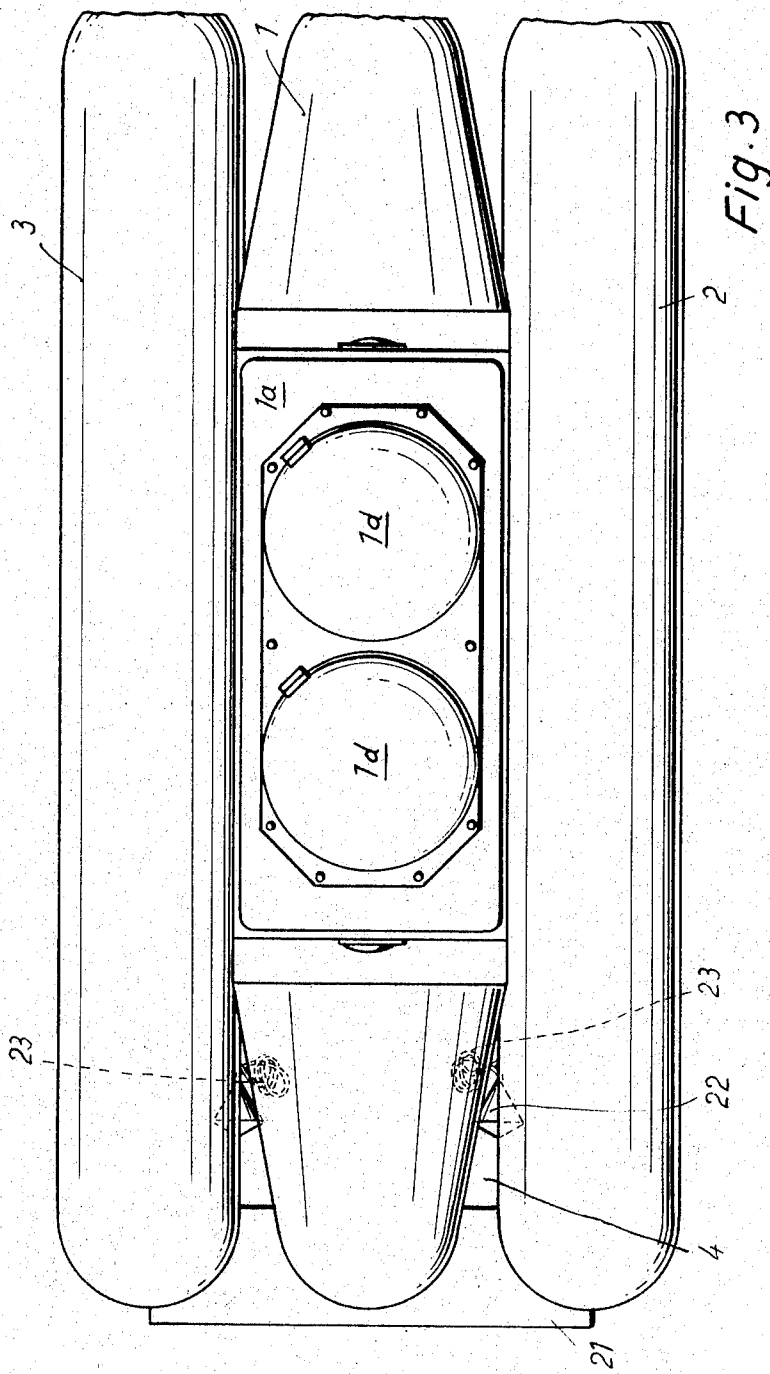
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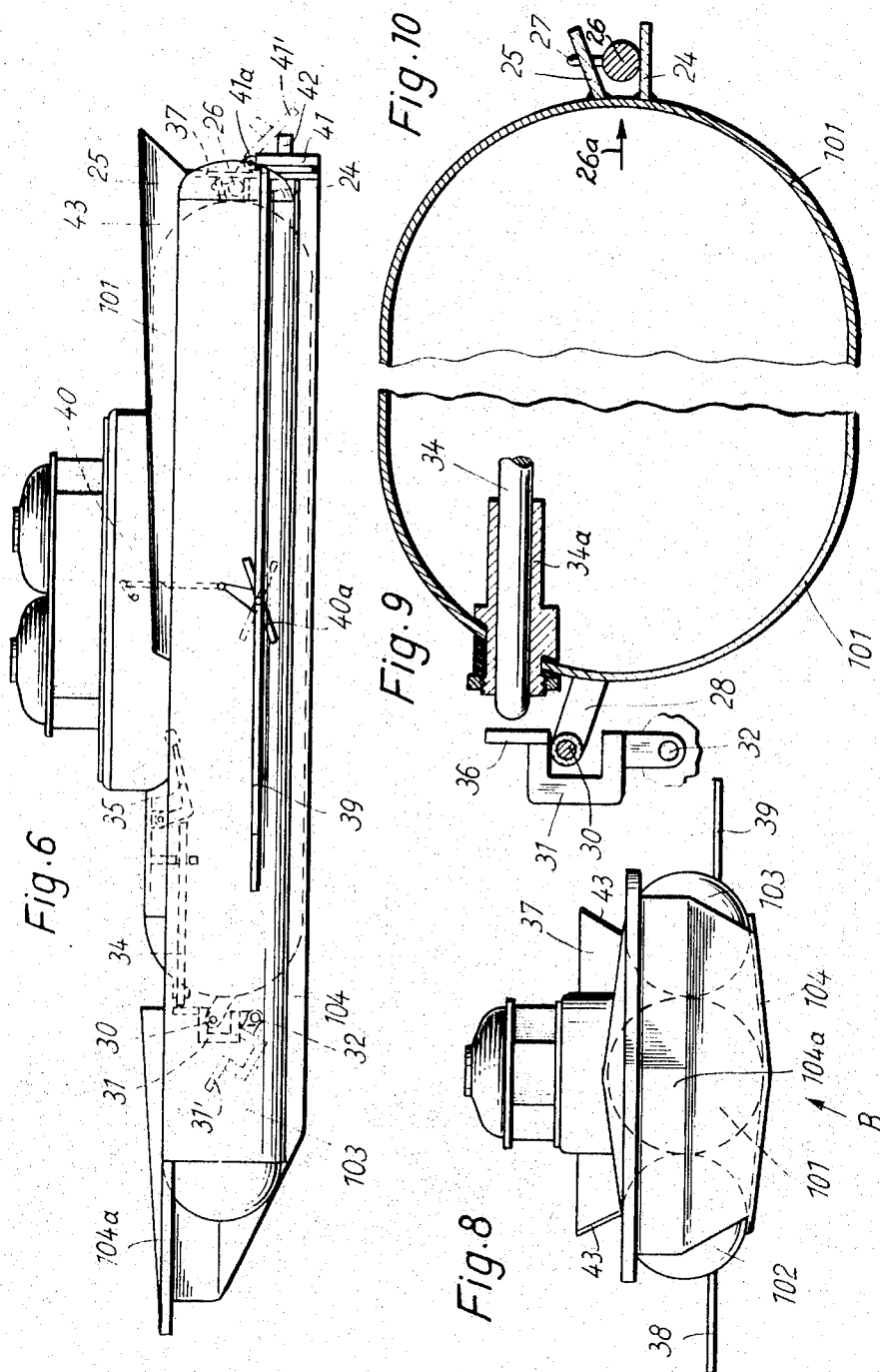
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3,335,684

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Filed Jan. 18, 1965

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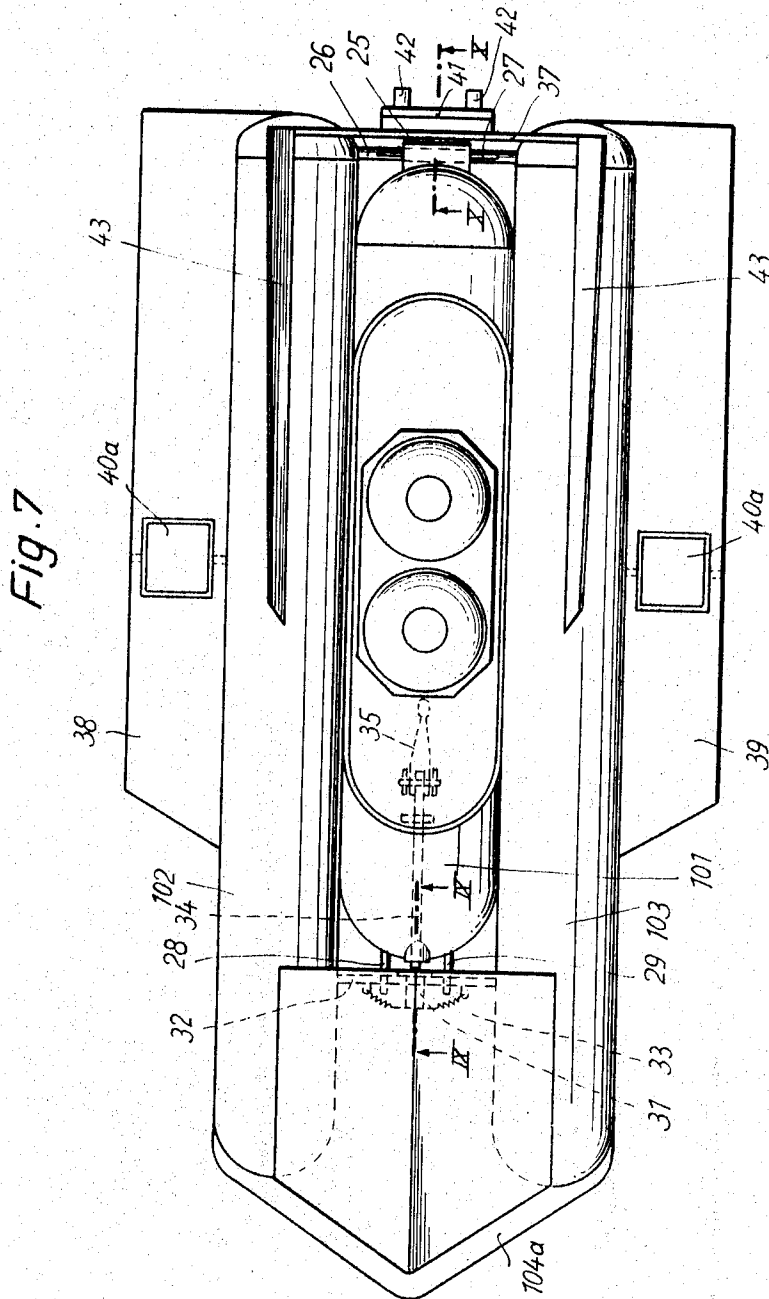
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Filed Jan. 18, 1965

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3,335,684

SUBMERSIBLE WATERCRAFT

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 Filed Jan. 18, 1965, Ser. No. 426,103
 Claims priority, application Germany, Jan. 17, 1964, H 51,411; Dec. 22, 1964, H 54,665
 19 Claims. (Cl. 114-16)

The present invention relates to submersible watercraft, and more particularly to a submarine boat for use by sportsmen or other persons desirous of exploring rivers, lakes and seas below the water surface. Still more particularly, the invention relates mainly to improvements in submarine boats of the type wherein a pressure hull, designed to withstand the water pressure, is flanked by two water ballast tanks.

In designing submarine boats of the character to which my invention pertains, safety of occupants is the main consideration and comes ahead of speed, maneuverability, compactness and many other desirable features. This applies not only for surface travel but particularly for travel when the boat is submerged, while the boat is in the process of submerging and/or during resurfacing. Additional precautions must be taken to enable the boat to return to surface in the event of failure due to unsatisfactory maintenance prior to submerging, due to improper manipulation of propulsion machinery or controls during travel below the water surface and/or due to unexpected breakdown of certain essential units which are necessary in surfacing the boat. For example, it can happen that the compressed air system breaks down or that the supply of compressed air is exhausted so that the crew cannot expel water from the ballast tanks which are flooded while the boat travels below the water surface.

Accordingly, it is an important object of the present invention to provide a submarine boat which is constructed and assembled in such a way that its crew-accommodating portion can resurface even if the supply of compressed air is exhausted at the time the ballast tanks are flooded.

Another object of my invention is to provide a submarine boat of the just outlined characteristics wherein the operation to return the hull to surface can be carried out by untrained persons having little strength or experience in operating a submarine craft.

A further object of the invention is to provide a submarine boat wherein the ballast tanks are detachable from the hull and to provide the ballast tanks with devices which enable the occupants of the hull and/or the crew of a salvage boat to rapidly detect and to conveniently refloat and tow the tanks to shore or to another destination.

An additional object of the invention is to provide a submarine boat of the above outlined characteristics with ballast tanks which may be refloated while they are connected to or at the time they are separated from the hull.

Still another object of the invention is to provide the submarine boat with auxiliary steering, balancing, stabilizing and other control equipment which may be put to use in emergencies to facilitate navigation of the boat in the event that the boat must be manipulated while its hull is detached from the ballast tanks.

A concomitant object of the invention is to provide a novel system of ballast tanks which may be utilized in a submarine boat of the above outlined characteristics.

A further object of the invention is to provide a system of ballast tanks which, even if detached from the hull,

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may constitute a seaworthy craft which can be manipulated during travel to shore or during reassembly with the hull.

Briefly stated, one feature of my invention resides in the provision of a submersible watercraft, hereinafter called boat or submarine boat, which comprises a first portion defining at least one sealable chamber to accommodate the crew when the boat is submerged and including an elongated hull, a second portion which constitutes an attachment to the first portion and includes a pair of water ballast tanks located at the opposite sides of the hull and a connector rigid with the tanks and extending beneath the hull, coupling means for detachably securing the first portion to the second portion so that, in response to disengagement of the coupling means, the first portion may return to surface even if the tanks are flooded, and operating means provided in the interior of the first portion for disengaging the coupling means in an emergency, i.e., at the discretion of the crew, so that the first portion may be detached from the second portion by the person or persons occupying the interior of the hull or another part of the first section. The first portion is then free to resurface leaving the second portion submerged.

The novel features which are considered as characteristic of the invention are set forth in particular in the appended claims. The improved submarine boat itself, however, both as to its construction and its mode of operation, together with additional features and advantages thereof, will be best understood upon perusal of the following detailed description of certain specific embodiments with reference to the accompanying drawings, in which:

FIG. 1 is a somewhat diagrammatic side elevational view of a submarine boat which is constructed in accordance with a first embodiment of my invention;

FIG. 2 is a rear end elevational view of the boat as seen from the right-hand side of FIG. 1, with a portion of the hull broken away;

FIG. 3 is a top plan view of the boat;

FIG. 4 is a greatly enlarged transverse vertical section as seen in the direction of arrows from the line IV-IV of FIG. 1;

FIG. 5 is an enlarged fragmentary detail view of the structure shown in FIG. 2 and illustrates a stabilizer in vertical section and in operative position;

FIG. 6 is a side elevational view of a modified submarine boat;

FIG. 7 is a top plan view of the modified boat;

FIG. 8 is a front elevational view of the modified boat as seen from the left-hand side of FIG. 6 or 7;

FIG. 9 is a greatly enlarged fragmentary section through the hull of the modified boat as seen in the direction of arrows from the line IX-IX of FIG. 7; and

FIG. 10 is a similar section through the hull substantially as seen in the direction of arrows from the line X-X of FIG. 7.

Referring first to FIGS. 1 to 3, there is shown a submarine boat which comprises an elongated cigar-shaped pressure hull 1 which is designed to withstand the water pressure when the boat is submerged and which supports a superstructure 1a. The parts 1, 1a together form a first portion of the boat and at least one thereof defines a sealable chamber which accommodates the crew when the boat is submerged. In accordance with my invention, the hull 1 is located between a pair of elongated parallel water ballast tanks 2, 3 which are in actual contact with the corresponding sides of the hull, see FIG. 2. The tanks 2, 3 are connected to each other by a rigid connector

plate 4 (hereinafter called traverse) which extends substantially tangentially of the lowermost point of the hull 1 and is welded or otherwise rigidly fixed to the tanks. As shown in FIG. 2, the traverse 4 is tangential not only to the hull 1 but also to the tanks 2, 3. Small stiffening brackets, 5, 6 are provided to enhance the rigidity of the attachment A which includes the parts 2-4 and which is detachably secured to the hull 1 by a disengageable coupling mechanism best shown in FIGS. 2 and 4. Thus, the attachment A constitutes the second portion of the boat.

The median portion of the hull 1 is of substantially cylindrical cross section, and its lower part is provided with a flat bottom wall 7 which is spaced from and parallel to the median portion of the traverse 4. The bottom wall 7 is formed with a circular aperture 8 which registers with a similar aperture 9 in the traverse 4, see particularly FIG. 4. The underside of the traverse 4 is welded to a cupped retainer 10a which accommodates a spindle nut 10 and holds this nut against axial and angular movement with reference to the traverse. The nut 10 meshes with a vertical spindle 11 which extends through the apertures, 8, 9 and whose upper end carries a handwheel 11a serving as an operating means for rotating the spindle in a sense to couple or uncouple the hull 1 from the traverse 4. The handwheel is located in the interior of the first portion 1, 1a so that it can be manipulated by a member of the crew while the boat is submerged to bring about rapid disengagement of the second portion 2-4. The spindle 11 is provided with an annular collar 13 which is surrounded by a cupped bracket 12 having an outwardly extending flange 12a which is bolted to the upper side of the bottom wall 7. The collar 13 rotates on a washer 14 and is surrounded by an annular gasket 16. A second annular gasket 15 is inserted between the flange 12a and the upper side of the bottom wall 7 to prevent leakage of water into the hull 1.

When the ballast tanks 2, 3 are flooded, i.e., when the boat is submerged, it happens from time to time that the air system (not shown) is out of order so that the surfacing procedure cannot be carried out in the normal way by expelling water from the tanks 2, 3. It can also happen that the skipper failed to check the flasks which contain compressed air and realizes that the boat cannot surface only at the time when the tanks 2, 3 are already filled with water. It can further happen that the one or the other tank develops a leak, that its flood ports cannot be closed and/or that the air-admitting valves are out of order. In all such instances, a member of the crew simply rotates the handwheel 11a (either by hand or by remote control) until the spindle 11 is withdrawn from the nut 10. The buoyancy of the hull 1 is now restored so that the hull returns to surface. The attachment A remains submerged but can be salvaged in a manner which will be presently described.

In order to insure that the thus resurfaced first portion of the boat can be maneuvered to return to shore, I provide the hull 1 with elongated rod-like weights 17 which are normally held in retracted or raised positions as indicated in FIG. 2 by broken lines. Thus, the weights 17 then simply rest on the upper side of the traverse 4 and are accommodated between the respective sides of the hull 1 and the ballast tanks 2, 3. The ends of the weights 17 are articulately secured to links 18 which are mounted on pivots 19, 19a whereby the pivots 19 connect the links to the hull 1. When the hull 1 rises above the traverse 4, the links 18 turn about the pivots 19 and allow the weights 17 to take the phantom-line positions 17' of FIG. 1 (corresponding to the full-line position of the weight 17 shown in FIG. 5) in which they serve as submerged stabilizers for the hull 1 and for all such parts which are connected to the hull. The links 18 are freely turnable on the pivots 19, 19a so that the weights or stabilizers 17 may descend by gravity as soon as the hull 1 is detached from and rises above and away from the traverse 4.

The front end portion of the traverse 4 carries a depth regulating rudder 21 which is swingable about a transversely extending horizontal hinge 21a and whose angular position may be regulated by remote control, for example, through a mechanical system of actuating levers and links 20, by a Bowden wire, by a system of pulleys and cables, or in any other suitable way. When the boat is not submerged, the rudder 21 is held in a horizontal plane and improves the stability of the craft. The arrangement is such that a portion of the actuating system 20 is automatically detached from the rudder 21 as soon as the spindle 11 is withdrawn from the nut 10 and the hull 1 begins to rise above the traverse 4 or the traverse begins to descend away from the bottom wall 7. For example, the front end of the rod like member 20a shown in FIG. 1 may be slipped off a cooperating stud like member 20b which is fixed to the rudder 21 as soon as the hull is separated from the attachment A.

The traverse 4 supports one or more marker buoys 22. In the illustrated embodiment, the traverse supports two buoys 22, one for each ballast tank, and such buoys are stored in the spaces between the sides of the hull 1 and the respective tanks. Each buoy 22 is attached to its tank by a flexible hollow connector cable 23 which enables the buoy to rise to surface and to thereby indicate the position of the submerged attachment A when the latter is disconnected from the hull. Each cable 23 may be used to admit compressed air into the respective tank 2 or 3 so that such tanks may be refloated by expelling water ballast therefrom. In fact, it is often sufficient to surface the attachment A by expelling water from one of the tanks 2, 3. However, if the tanks 2, 3 develop leaks and cannot be refilled with compressed air, the attachment A may be salvaged by towing the same with a rope which is attached to one or both cables 23. Therefore, the cables 23 are preferably of the armored type to withstand tensional and other stresses which arise when a partly or fully submerged attachment must be towed to shore or when a fully submerged attachment must be lifted to surface by ropes which are attached to the cables 23. Of course, the buoys 22 can rise to the surface only if the cables 23 are long enough to allow for such surfacing at the time the attachment rests on the bottom of a river or another body of water. Each tank may be provided with two or more buoys.

The boat is propelled by propulsion machinery which may include one or more battery-operated electric motors 1b, 1c, one or more internal combustion engines and one or more inboard or outboard motors of familiar design. Inboard and/or outboard motors will be used for surface travel. When the boat is submerged and is to be propelled by one or more internal combustion engines, such engines receive air through breathing tubes (snorkels) of known construction which form no part of the present invention.

FIGS. 1 to 3 show lids 1d which can be opened when the superstructure 1a rises above the water surface. In a simple version of my boat, the first portion including the hull 1 and superstructure 1a defines a single sealable chamber which accommodates a single crew member of two or more persons when the boat is submerged.

FIGS. 6 to 8 illustrate a modified submarine boat wherein the hull 101 is shorter than the ballast tanks 102, 103. Also, the construction of the disengageable coupling means for normally connecting the traverse 104 and tanks 102, 103 to the hull 101 differentiates from that of the coupling means shown in FIG. 4.

The coupling means for the second boat portion or attachment B of FIGS. 6 to 8 comprises two sections including a rear section which is located at the after end portion of the hull 101 and a front section which connects the attachment with the front end portion of the hull. The rear section includes two substantially horizontal plate-like guides 24, 25 which extend transversely of the hull 101 and define between themselves a recess for recep-

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tion of a transverse rod 26 whose ends are fixedly secured to the tanks 102, 103. Thus, when the rod 26 extends into the recess between the guides 24, 25 (see FIG. 10), the rear end portions of the hull 101 and attachment B are coupled to each other against all movements excepting against movement of the rod 26 in a direction as indicated in FIG. 10 by an arrow 26a. The ends of the rod 26 (which may be replaced by a tube) are welded or otherwise securely affixed to the tanks 102, 103. Small locating pins 27 are secured to the rod 26 and are received in complementary cutouts of the guide 25 to hold the rod in requisite coupling position. It is clear that the rod 26 could be fixed to the traverse 104 and/or that it could be replaced by a connector of non-circular cross section.

The front end of the hull 101 carries a pair of forwardly extending arms 28, 29 whose free ends are connected to a transversely extending horizontal coupling bar 30. This bar is normally straddled by a U-shaped coupling element 31 which is turnable on a pintle 32 extending between and secured to the tanks 102, 103. The coupling element 31 is biased by one or more resilient elements here shown as helical springs 33 which normally hold this element in engagement with the bar 30 so that the entire attachment B is actually suspended on the bar 30 and guide 24.

The operating means for disengaging the coupling between the hull 101 (first boat portion) and attachment B comprises a reciprocable pusher 34 which is guided in a horizontal sleeve 34a of the hull 101 (see FIG. 9) and whose tip bears against a stop plate 36 on the upper horizontal leg of the coupling element 31. The pusher 34 may be reciprocated by a manually operable lever 35 (see FIG. 7) which is accommodated in the cabin or at another point where it is readily accessible to the skipper or to another member of the crew when the boat is submerged.

When the lever 35 is rotated in a clockwise direction, as viewed in FIG. 6, the pusher 34 moves forwardly and causes the coupling element 31 to rotate in a counter-clockwise direction and to move to the phantom-line position 31'. The fore part of the attachment B begins to sink and, as the hull 101 continues to move forwardly, the rod 26 is automatically withdrawn from the recess between the guides 24, 25 so that the attachment is entirely disconnected from the hull 101. If the boat is submerged and the lever 35 is operated in the just described manner, the front end portion of the hull will begin to rise while the tanks 102, 103 remain submerged and the hull entrains the guides 24, 25 to thus withdraw the rod 26 from its recess and to complete the disengagement of the attachment B.

The attachment B is constructed in such a way that it may form a separate watercraft as soon as it is disconnected from the hull 101. As shown in FIGS. 6 to 8, the front end portion of the traverse 104 is provided with an upwardly extending front wall 104a which is of triangular outline and resembles a prow. The prow 104a closes the front end of the space between the tanks 102, 103. The rear end of this space is closed by a transversely extending rear end wall or bulkhead 37 which extends upwardly from the rear end portion of the traverse 104. Thus, the attachment B actually forms a separate boat including the traverse 104, the prow 104a, the tanks 102, 103 and the bulk head 37. This attachment may be used as a surface craft with or independently of the hull 101.

In order to improve the maneuverability of the attachment B, regardless of whether this attachment is secured to or disconnected from the hull 101, the tanks 102, 103 are provided with laterally extending horizontal fins 38, 39 each of which may be formed with a depth regulating rudder 40a located in the plane of the center of gravity of the submarine boat and operable by remote control through the intermediary of a linkage 40 or in another suitable way.

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Upwardly inclined stabilizing fins 43 provided on the rear portions of the tanks 102, 103 serve to further enhance the stability of the submarine boat. It is clear that the fins 38, 39, 43 may be used with equal advantage on the attachment A of FIGS. 1-5.

The bulkhead 37 is formed with a water-evacuating opening which is normally closed by a weighted flap 41. The flap 41 is located at the outer side of the bulkhead 37 and its upper edge portion is pivotable about a horizontal hinge 41a so that the flap may move to the phantom-line position 41' of FIG. 6 and allows water to escape from the space between the tanks 102, 103, traverse 104, prow 104a and bulkhead 37 when the boat rises to surface. The weights 42 on the flap 41 are adjustable or replaceable by different weights to make sure that this flap offers a predetermined resistance to pivoting during surface travel. During forward movement and during simultaneous surfacing of the boat B, the water pressure at the inner side of the bulkhead 37 exceeds the water pressure at the outer side of the flap 41 so that the latter allows water to escape. The flap 41 automatically returns to sealing position as soon as the interior of the attachment B is free of water because the water pressure against the outer side of the flap then suffices to keep the opening in the bulkhead 37 sealed.

The marker buoys 22, the cables 23, the engines 1b, 1c and certain other component parts of the modified boat were omitted in FIGS. 6 to 10 because their construction and mounting are the same or analogous to those described in connection with FIGS. 1 to 5. A very important advantage of the boat shown in FIGS. 6-10 is that the attachment B will form a seaworthy craft which can be manipulated with great ease as soon as it is returned to surface or as soon as it is disconnected from the hull 101 for a reason other than the failure of the air system. The manner in which the hull 1 or 101 may be recoupled to the corresponding attachment will be self-evident upon perusal of the preceding disclosure.

Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can, by applying current knowledge, readily adapt it for various applications without omitting features which fairly constitute essential characteristics, of the generic and specific aspects of this invention and, therefore, such adaptations should and are intended to be comprehended within the meaning and range of equivalence of the following claims.

What is claimed as new and desired to be secured by Letters Patent is:

1. Submersible watercraft, comprising a first portion defining at least one sealable chamber to accommodate the crew when the craft is submerged and including a hull having horizontally spaced oppositely outwardly directed walls; a second portion constituting an attachment to said first portion and including a pair of spaced water ballast tanks each located adjacent one of said horizontally spaced oppositely outwardly directed walls outwardly from the respective wall and a connector secured at opposite ends to said tanks and extending under said hull firmly connecting said spaced tanks; coupling means detachably securing said first portion to said second portion; and operating means provided in the interior of said first portion for disengaging said coupling means so that said first portion may resurface independently of said second portion in response to disengagement of said coupling means even if said tanks are flooded.

2. A structure as set forth in claim 1, said hull comprising a lower portion extending downwardly between said tanks to such an extent that its lower region is at least on a level with the lower regions of said tanks.

3. A structure as defined in claim 1, wherein said connector is a transverse having a flat end portion; further comprising a rudder hinged to said front end portion of said traverse so as to be swingable about a transverse

horizontal axis; and actuating means for changing the position of said rudder.

4. A structure as defined in claim 1, wherein said connector is a traverse; further comprising a pair of weights located at opposite sides of said hull and normally resting on said traverse; and connector means articulately securing said weights to said hull so that each thereof may descend by gravity to act as a stabilizer when said first portion is detached from and risen above said second portion.

5. A structure as defined in claim 1, and further comprising stabilizing fin means provided on each of said tanks.

6. A structure as defined in claim 5, wherein said connector is a traverse having a front end portion and a rear end portion, and wherein said fin means comprises rudder means; and further comprising a prow extending upwardly from said front end portion and sealingly secured to said tanks at the respective front ends thereof, and a bulkhead extending upwardly from said rear end portion and sealingly secured to the respective rear end of said tanks so that said second portion constitutes a navigable boat-like attachment to said first portion.

7. A structure as set forth in claim 2, wherein said first coupling element comprises a spindle nut fixedly secured to said connector and said second coupling element comprises a spindle normally meshing with said nut and rotatably mounted in said hull.

8. A structure as set forth in claim 7, wherein said operating means comprises a handwheel fixed to said spindle in the interior of said hull.

9. A structure as set forth in claim 7, wherein a portion of said spindle extends through an aperture provided in said hull, and further comprising sealing means mounted in said hull for preventing flooding of the hull through said aperture.

10. A structure as set forth in claim 3, wherein said actuating means comprises a first member mounted in said first portion and a second member detachably coupled to said first member and secured to said rudder, said second member being disengageable from said first member in response to separation of said first and second portions.

11. Submersible watercraft, comprising a first portion defining at least one sealable chamber arranged to accommodate the crew when the craft is submerged and including a hull; a second portion comprising a pair of water ballast tanks located at the opposite sides of said hull and a traverse rigid with said tanks and extending beneath said hull; disengageable coupling means normally securing said first portion to said second portion so that the craft submerges when said tanks are flooded, said coupling means comprising a transversely extending horizontal bar secured to one of said portions and a spring-biased coupling element articulately secured to the other portion and normally engaging said bar to thereby connect said portions to each other; and operating means provided in said first portion and arranged to move said coupling element out of engagement with said bar at the discretion of the crew so that said first portion may be

detached from said second portion to resurface while said tanks are flooded.

12. Submersible watercraft as set forth in claim 11, wherein said bar is rigidly fixed to said hull and further comprising a pintle rigidly fixed to said tanks and supportingly connected with said coupling element.

13. Submersible watercraft as set forth in claim 12, wherein said operating means comprises a pusher reciprocally mounted in said hull and having a portion adjacent to said coupling element externally of said hull, said operating means further comprising means for moving said pusher in a sense to disengage said coupling element from said bar.

14. Submersible watercraft as set forth in claim 11, wherein said hull comprises a front end portion and a rear end portion and wherein said bar and said coupling element are adjacent to the front end portion of said hull, said coupling means further comprising a pair of substantially horizontal guides provided on the rear end portion of said hull and defining between themselves a recess, and a transversely extending horizontal rod rigid with said second portion and normally received in said recess so that each end portion of said hull is coupled to said second portion.

15. A structure as set forth in claim 14, wherein said second portion comprises a prow extending upwardly from said traverse and located in front of said tanks.

16. A structure as set forth in claim 15, wherein said second portion further comprises a bulkhead extending upwardly from said traverse and located to the rear of said tanks so that said second portion forms a boat which is navigable independently of said first portion.

17. A structure as set forth in claim 16, wherein said bulkhead is provided with a normally sealed opening which is automatically exposed while said second portion rises to surface so as to allow for evacuation of water from the interior of said boat.

18. A structure as set forth in claim 17, wherein said bulkhead has an outer side and further comprising a flap hinged to and located at the outer side of said bulkhead, and means for normally biasing said flap into engagement with said bulkhead to seal said opening.

19. A structure as set forth in claim 18, wherein said flap comprises an upper edge portion and transversely extending horizontal hinge means securing said edge portion to said bulkhead, said biasing means comprising weight means secured to the outer side of said flap so as to normally maintain the flap in sealing engagement with the bulkhead.

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