Aug. 9, 1960 D. I. REBIKOFF 2,948,247

TWO-SEATER SUBMARINE VESSEL

Filed Sept. 16, 1958 2 Sheets-Sheet 1

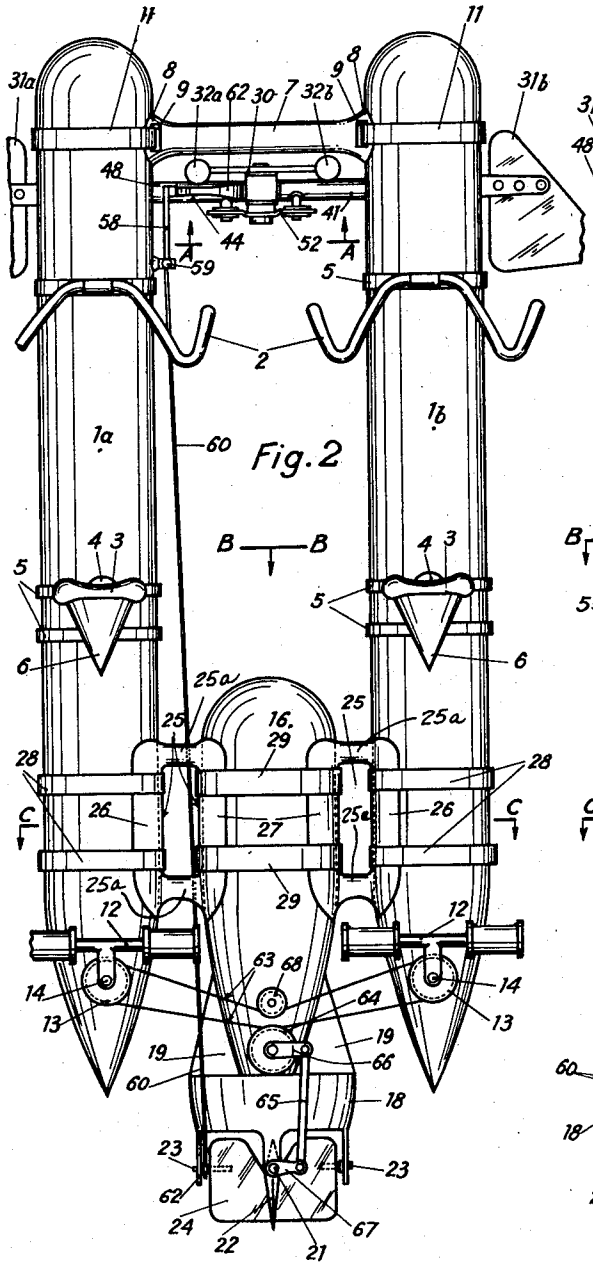

Fig. 2

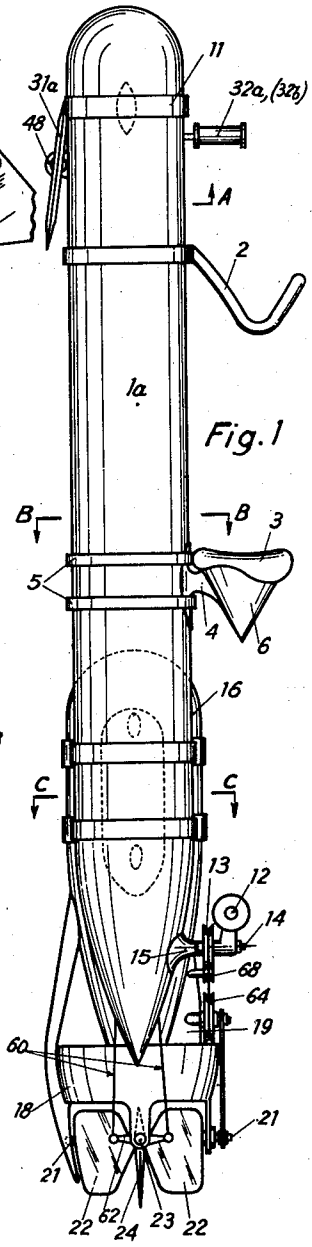

Fig. 1

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Aug. 9, 1960 D. I. REBIKOFF 2,948,247

TWO-SEATER SUBMARINE VESSEL

Filed Sept. 16, 1958 2 Sheets-Sheet 2

Fig. 3

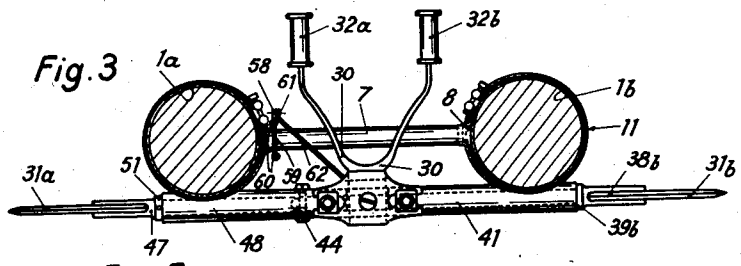


Fig. 5

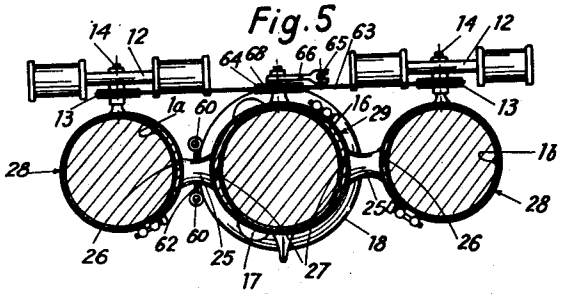


Fig. 4

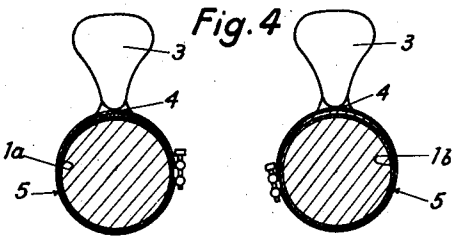


Fig. 6

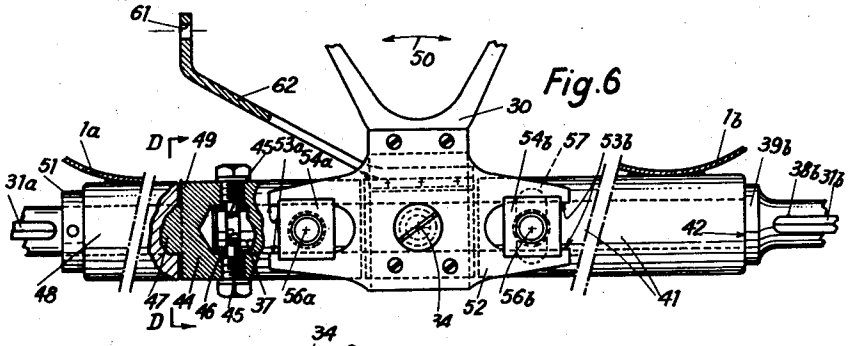


Fig. 7

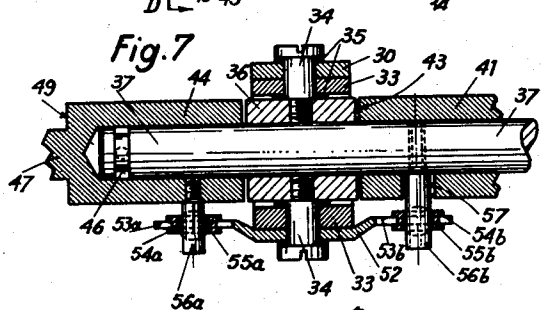
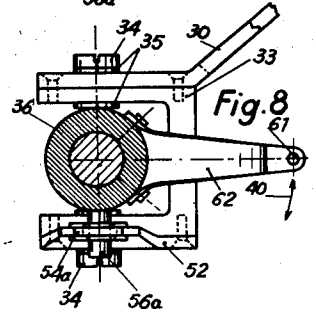


Fig. 8



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TWO-SEATER SUBMARINE VESSEL

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6 Claims. (Cl. 114—16)

Light-weight submarine vehicles for divers equipped with independent respiratory apparatus are known in which the equipped diver is immersed in the water in direct contact therewith, carried on a water-tight shell with which he forms a unit, this shell enclosing, protected from the water, driving means actuating an external propulsion system and supporting diving controls operated by the pilot by means of his hands and feet.

These vessels are generally of tapered torpedo form and the enclosed driving means are usually accumulators and an electric motor. They can be enclosed with the pilot in a casing which is at least partially transparent and not water-tight, and which can be opened to permit access of the pilot and may or may not be provided with temporarily inflatable floats, by which the assembly is tilted hydrodynamically.

Such single-seater vessels permit a great variety of evolutions in the water since they are piloted more in the manner of an aircraft capable of assuming more positions than a conventional submarine, which does not readily exceed positions slightly inclined with respect to the horizontal.

It is desirable, especially for the training of new pilots, to be able to use a two-seater apparatus with dual controls, in which the pupil can see and sense the manoeuvres of the instructor or act as pilot himself within the limits to which the instructor allows him to take control.

The arrangement of the single-seater machine cannot be converted into a two-seater machine for this purpose, and on the other hand it is desirable that the changeover from a two-seater to a single-seater machine does not essentially change the manner in which the pilot is supported by the machine and the manner in which the latter is piloted.

The object of the present invention is to provide a suitable two-seater vessel.

The invention provides a two-seater submarine vessel for independent divers, which vessel is constituted by two similar streamlined shells each carrying one of the divers in known manner, particularly characterised in that these two shells are disposed substantially symmetrically with respect to one another on each side of a plane and are connected to one another by at least one transverse brace or strut at the front, the two shells being fixed at the rear end by cross members disposed between the said symmetrical shells and a third streamlined shell disposed with its plane of symmetry coinciding with the first said plane, this third shell containing a propulsion unit of the assembly which is provided in known manner with diving ailerons at the front and steering and diving governors at the rear, these governors being adapted to be controlled simultaneously by the two divers acting manually in known manner on the device controlling the ailerons at the front, and the other diving means at the rear, and with the feet on the steering means of the vessel.

The description of one embodiment of such a vessel,

its control means and a preferred assembly is given by way of non-limitative example, accompanied by diagrammatic drawings, in which:

Figure 1 shows a two-seater submarine vessel according to the invention seen in side elevation;

Figure 2 is a corresponding plan view;

Figure 3 is a first transverse section on the line A—A of Figure 1;

Figure 4 is a second transverse section on the line B—B of Figure 1;

Figure 5 is a third transverse section on the line C—C of Figures 1 and 2.

Figure 6 is a fragmentary transverse elevation, partly in section, showing a manual control of the inclinations of the front ailerons and of the rear depth governors;

Figure 7 is a plan view, partly in section, corresponding to Figure 6;

Figure 8 is a transverse section on the line D—D of Figure 6.

The symmetrical torpedo-like shells are shown here at 1*a* and 1*b* respectively without the divers riding them, who are stretched out in known manner with the arms of handlebars 2 underneath them, which they push under the armpits while keeping the curved portions of said handlebars facing forwardly. The divers are also held firm and pushed by supports which are advantageously obtained by bicycle saddles 3 fixed one on each torpedo substantially perpendicular to the latter and with the pointed end facing the said torpedo, symmetrically in parallel vertical planes, by means of supports 4 held on the float of torpedo form by clips 5 of known type. These supports are here tapered at 6. The diver holds the saddle 4 between his thighs and thus forms one with the torpedo.

As the handlebars 2 and the supports 4 are fixed by clips 5, they are readily adjustable to the height of the divers.

The two torpedo shells 1*a* and 1*b* are connected at the front end by a streamlined cross-member 7 with its ends 8 widened to adapt it to the corresponding shell and provided with openings 9 through which extend clips or straps 11 on the corresponding shell for tightening the assembly. At the rear end, each torpedo shell carries a rudder bar 12 adapted to be actuated by the feet of the corresponding diver.

Each rudder bar 12 is locked to a control pulley 13 and is fixed for turning movement on a shaft 14 carried vertically in a support 15 on the corresponding shell.

Disposed between the similar shells 1*a* and 1*b* in their plane of symmetry is a third streamlined shell 16, which is shorter than the other two and which contains the propulsion motor, for example an electric motor, and carries at its rear end the propulsion propeller 17 (Figure 5) driven thereby, the said propeller being protected in known manner in a streamlined guard ring 18 secured by radial fins 19 of the shell 16, and carrying in rearward extensions the spindle 21 of a conventional rudder 22 and the spindle 23 of a conventional depth governor or hydroplane 24.

The central shell 16 and the lateral shells 1*a* and 1*b* are secured together so as to form a unit by two braces formed with openings at 25 and having shoes 26 and 27 adapted respectively to be applied to the corresponding parts of the symmetrical shells 1*a* and 1*b* and of the shell 16.

The assembly is secured, for example, by clips or collars 28 and 29 respectively encircling the said shells and passing through the openings 25 to lock the shoes 26 and 27 on these shells.

The parts cross members 25*a* at the front and at the rear of openings 25 connecting shoes 26 and 27 are advantageously of streamlined section.

At the front, the arrangement of the depth ailerons or hydroplanes is of the differential control type in a manner known per se and comprises a single aileron of horizontal axis disposed externally on the outer side of each torpedo shell relatively to the assembly on the two shells.

These ailerons or hydroplanes are indicated at **31***a* and **31***b* respectively in Figure 3 and are actuated differentially in known manner by a device such as that shown, by means of a fork forming a control stick **30** with two handles **32***a* and **32***b*, which are gripped by the two divers respectively.

This control stick **30** is fixed to a U-shaped member **33** (Figures 7 and 8) which is pivoted about an axis in the plane of symmetry provided by journal screws **34** formed with shoulders and screwed with interposed washers **35** into a transverse sleeve **36** which itself turns about the cylindrical part **37** of the pin of the hydroplane **31***b*, which is provided with a fork **38***d* for fixing the said hydroplane and a shoulder **39***b*.

This cylindrical shaft **37** is journalled in a tubular part **41** welded transversely on the shell **1***b*.

This tubular part **41** is disposed with its outer end **42** serving as a stop for the shoulder **39***b* on the one hand and with its inner end **43** serving as a stop, except for clearances, for the sleeve **36** turning on the shaft **37** which traverses it.

After having traversed the ring **36**, the extension of the shaft **37** serves as a pivot for a sleeve **44** which enclosed it and holds the ring **36** (Figure 6) except for longitudinal play.

The sleeve **44** is held so that it is free to turn on the shaft **37** by headed screws **45** screwed into this sleeve, the heads of the screws penetrating without being jammed into a circular groove **46** formed in the shaft **37** towards the end thereof. The sleeve **44** is extended coaxially by the pin **47** of the hydroplane **31***a* which journals in a tubular member **48** forming a bearing and welded on the shell **1***a* between the shoulder **49** of the shaft **47** and an external stop ring **51** held by a pin on the shaft **47**.

Towards the rear end, the U-shaped member carries fixed on its surface an elongated plate **52** forming a beam or bar oscillating about the shouldered screw **34** and carrying at its ends opposed and symmetrical slide slots **53***a* and **53***b* with an axis perpendicular to the axis of symmetry of the double control stick **30**.

Sliding in the slideways **53***a* and **53***b* are rectangular cages **54***a* and **54***b*, respectively, provided with upper and lower guide grooves in contact with the straight guiding portions of the corresponding slideways **53***a* and **53***b*. The rectangular cages **54***a* and **54***b* each carry a swivel joint **55***a* and **55***b*, respectively, so as to rotate therein. These swivel joints are formed with a bore into which extend freely, with reduced clearance, cylindrical fingers **56***a* and **56***b*, respectively, with a shoulder and threaded extension.

The finger **56***a* is screwed and locked by its shoulders in a radial hole of the sleeve **44**, with which it is thus fast without contacting the shaft **37**. The finger **56***b* is fixed in a similar manner on and through the shaft **37**. Disposed in a plane symmetrical with the plane in which **56***b* turns about the shaft **37** in relation to the plane of symmetry of the assembly, the finger **56***b* passes with its cylindrical portion into a sector-shaped slot **57** formed through the wall of the fixed tubular part **41** so as to permit a sufficient circular displacement of the said finger, driving the shaft **37** in rotation.

The manner of operation is clear. When the double control stick **30** is inclined from front to rear or vice versa along the sector indicated by the arrow **40** (Figure 8), the rotation of the plate **52** not turning about the shaft **34** causes the shafts **37** and **47** and thus the hydroplanes **31***a* and **31***b* to rotate about equal angles and in the same direction.

On the contrary, a transverse rotation according to the sector shown by arrows **50** (Figure 6) by **30** and **33** driving the bar **52** about the same fixed axis **34**, causes for example a downward rotation of the shaft **37** and an equal rotation in the upward direction of the shaft **47**, with consequently equal and opposite inclinations of the respective cheeks of the hydroplanes **31***a* and **31***b*.

Any displacements of the control stick **30** will impart to the two hydroplanes inclinations about their axes, the differential result of components of rotation in the two longitudinal and transverse rectangular planes, received by the control stick **30**.

In order to obtain the conjugation in rotation in opposite directions of the hydroplanes **31***a*, **31***b* and of the plane **24** of the rear depth governor or hydroplane under the influence of the longitudinal components of the displacements of the double control stick **30** about the shaft **37**, a connecting rod **58** is operated, this acting on a lever **59** connected by cables **60** to a lever **62** giving a rotational movement to the plane **24**, by pivoting it on a shaft extending through a hole **61** in the end of a part **62** fast with the rotating sleeve **36** (Figure 3).

The end of the part **62** carrying the hole **61** is cranked and arranged so as to provide in the suitable transverse plane a lever having its fixed axis coaxial with that of **37** and driving the connecting rod **58** under the sole influence of the rotations of the sleeve about the axis **37**.

The movement of the rocker bars **12** is conjugated by the passage of an endless cable **63**, which is wound around the pulleys **13** and, between these latter, by the run of the cable to the rear of these pulleys, on a fixed receiving pulley **64** turning with its shaft in the plane of symmetry of the apparatus on the shell **16** and connected for example by a rod **65** disposed between an arm **66** fast with the pulley **64** and a lever **67** keyed on the shaft **21** of the check **22** of the steering governor (Figure 5).

A loose return pulley **68**, the shaft of which is fixed parallel to and in front of that of the pulley **64** on the shell **16** permits at the same time as a displacement of the bars toward the front of their axes of rotation, the free return of the feel of the divers without contacting the front run of the cable **63** connecting the pulleys **13**.

The shells **1***a* and **1***b* will be able to serve as storage means for accessories other than the motor contained in the shell **16**, more especially propulsion accumulators in the general case where this motor is an electric motor.

They may contain all other accessories of the submarine vessel or equipment carried by it and carry all the control members not shown herein, connections by insulated cables or fluid-tight tubes being provided between these lateral shells and the central shell.

Without departing from the invention, many modifications can be incorporated into the embodiment of such a two-seater submarine vessel, while remaining within the scope thereof. Instead of the double control stick which has been described, it is possible to use two control sticks connected to one another, for example, by a deformable parallellogram device for connecting them in their transverse movements.

In any known manner, one of the control parts on which the hand of the pupil can act and of the control system by rudder bars actuated by the said pupil can be disconnected from this control system by the instructor in order that the latter ensures that he alone is in control.

It will also be possible to provide the shutting-off of the motor controls which normally will be actuated by each of the two divers. These arrangements are especially to be provided in the case where the second diver is essentially only a passenger for a journey or a submarine exploration, but is not a trainee pilot or a second pilot.

What I claim is:

1. A first and second seater submarine vessel comprising two streamlined shells each adapted to be mounted by a diver, means interconnecting said shells at the front end thereof, a third streamlined shell disposed between said two shells at the rear end thereof, means connecting said third shell with said two shells, propulsion means disposed in said third shell, hydroplanes mounted at the front of said vessel, steering and diving planes mounted at the rear of said vessel, common manually operable control means coupled to said hydroplanes and said diving planes first and second handles connected to said control means, each of said handles adapted to actuate said control means, said first handle extending closer to said first shell than said second handle and said second handle extending closer to said second shell than said first handle and two sets of operating pedals coupled to said steering planes one of said sets mounted to said first shell and the other of said sets mounted to said second shell.

2. A two-seater submarine vessel comprising first and second streamlined shells each adapted to be mounted by a diver, means interconnecting said shells at the front end thereof, a third streamlined shell disposed between said two shells at the rear end thereof, means connecting said third shell with said two shells, propulsion means disposed in said third shell, hydroplanes mounted at the front of said vessel, steering and diving planes mounted at the rear of said vessel, common manually operable control means coupled to said hydroplanes and said diving planes and common operating pedals coupled to said steering planes, support means mounted on said first and second shells and adapted to be gripped between the thighs of said divers.

3. A vessel as described in claim 2, said support means comprising bicycle-saddles disposed transversely of said first and second shells, the narrower portion of said saddles being directed toward said first and second shells.

4. A two-seater submarine vessel comprising first and second streamlined shells each adapted to be mounted by a diver, means interconnecting said shells at the front end thereof, a third streamlined shell disposed between said two shells at the rear end thereof, means connecting said third shell with said two shells, propulsion means disposed in said third shell, hydroplanes mounted at the front of said vessel, steering and diving planes mounted at the rear of said vessel, common manually operable control means coupled to said hydroplanes and said diving planes and common operating pedals coupled to said steering planes, said interconnecting means

having end portions shaped partially to embrace said shells, fixing clips encircling said shells and said end portions and adapted to be tightened whereby said end portions are clamped against said shells.

5. A two-seater submarine vessel comprising first and second streamlined shells each adapted to be mounted by a diver, means interconnecting said shells at the front end thereof, a third streamlined shell disposed between said two shells at the rear end thereof, means connecting said third shell with said two shells, propulsion means disposed in said third shell, hydroplanes mounted at the front of said vessel, steering and diving planes mounted at the rear of said vessel, common manually operable control means coupled to said hydroplanes and said diving planes and common operating pedals coupled to said steering planes, said connecting means comprising a pair of shoes, each adapted respectively to embrace partially one of said first and second shells and said third shell, cross members interconnecting said shoes and fixing clips encircling said shoes and said first and second shells.

6. A two-seater submarine vessel comprising first and second streamlined shells each adapted to be mounted by a diver, means interconnecting said shells at the front end thereof, a third streamlined shell disposed between said two shells at the rear end thereof, means connecting said third shell with said two shells, propulsion means disposed in said third shell, hydroplanes mounted at the front of said vessel, steering and diving planes mounted at the rear of said vessel, common manually operable control means coupled to said hydroplanes and said diving planes, pedal control means mounted to a rear portion of each of said shells, each of said control means comprising a rudder bar, a pair of pedals affixed to said rudder bar, a control pulley pivotally mounted to said shells, said rudder bar being fixedly secured to said pulley, an endless cable traveling between the control pulley pivotally mounted to said first and second shells, a rudder pulley secured to a rear portion of said third bar, said rudder pulley engaging said endless cable, said rudder pulley being connected to said steering planes whereby as either set of said pedals are rotatably displaced said steering planes are displaced.

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