

Aug. 9, 1960

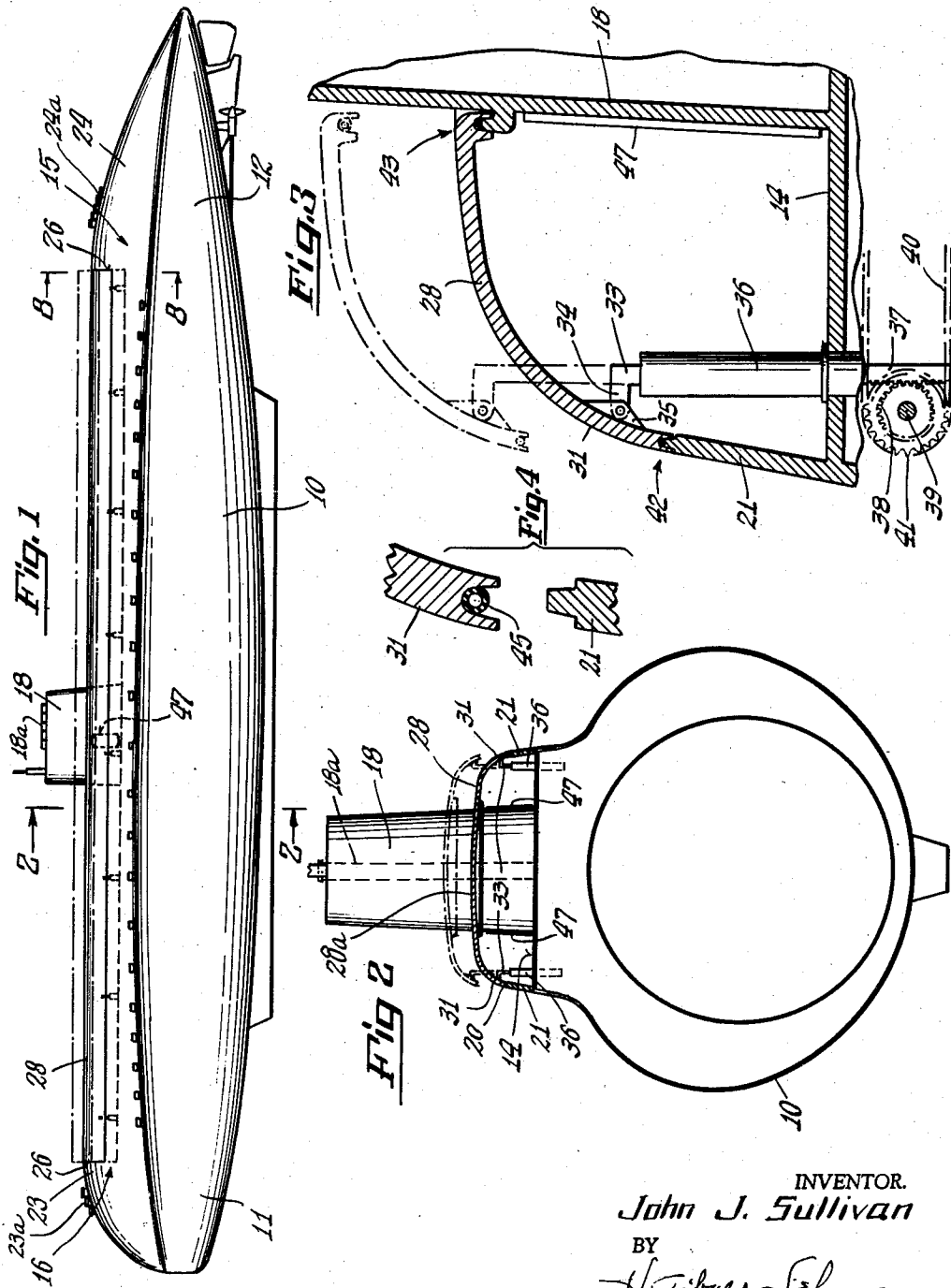
J. J. SULLIVAN

2,948,246

SUBMARINE DECK AND MISSILE-LAUNCHING CONSTRUCTION

Filed April 14, 1958

2 Sheets-Sheet 1



INVENTOR.
John J. Sullivan

BY

H. Gibner Schumann

AGENT

Aug. 9, 1960

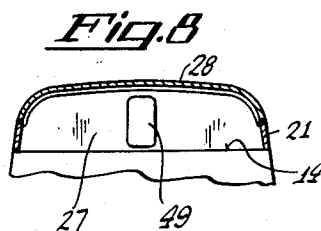
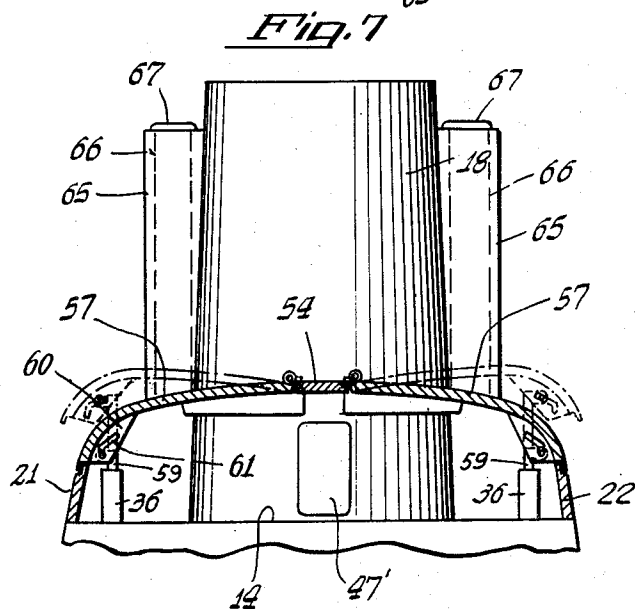
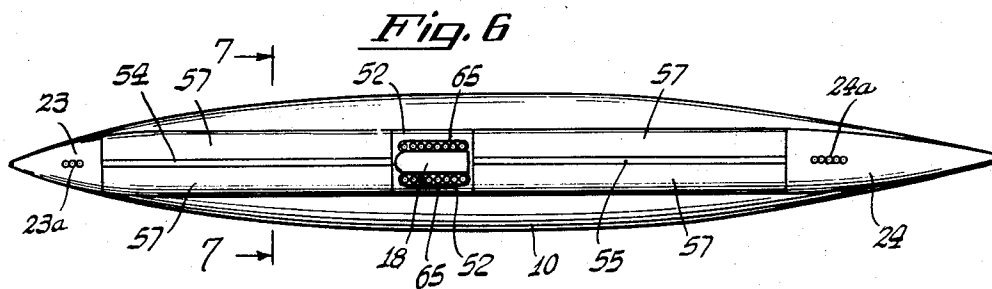
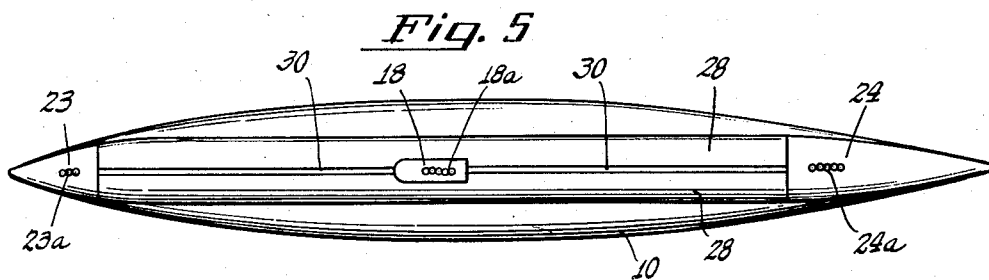
J. J. SULLIVAN

2,948,246

SUBMARINE DECK AND MISSILE-LAUNCHING CONSTRUCTION

Filed April 14, 1958

2 Sheets-Sheet 2



INVENTOR.
John J. Sullivan

BY
H. Gibner Schumann
AGENT

1

2,948,246

SUBMARINE DECK AND MISSILE-LAUNCHING CONSTRUCTION

John J. Sullivan, 3920 Granby St., Norfolk, Va.

Filed Apr. 14, 1958, Ser. No. 728,335

11 Claims. (Cl. 114—16)

This invention relates to underwater craft such as submarines and similar craft, and more particularly to the deck structures and missile-launching facilities of such craft.

With the advent of atomic-powered submarines, and the development of intercontinental ballistic missiles, rocket-propelled space ships, projectiles and the like, the concepts dealing with defense of the country as they concern water travel and navigation are undergoing considerable and radical change. The development of radar and other, more advanced types of detection equipment, and the development of sonic and supersonic interceptors have made surface vessels particularly vulnerable to attack and interception, and have outmoded such time-honored battle equipment as battleships and aircraft carriers, to the extent that battleships no longer form a part of either the defensive or offensive means of the country.

However, this is not true of the submarine, and recent, progressive thinkers are placing the submarine in a much more prominent and essential place than even the most optimistic proponents of this type of vessel had hoped for in the past.

Huge submarine merchantmen, tankers and the like are being considered, proposed and built. The trend is clearly to the larger sizes of underwater craft, and it is now known that even intermediate and long range ballistic missiles may be carried and launched from a submarine with great reliability and accuracy.

The changing role of the submarine or underwater boat poses a number of problems, not the least of which is provision for adequate deck spaced and missile-launching equipment without placing undue encumbrance and limitation on speed and travel while fully submerged.

One object of the present invention is to provide a novel and improved submarine or underwater craft having a large and expansive deck space which is available both when the submarine is submerged and when it is surfaced, the said deck facilities being convertible easily and quickly to suit either one of these two modes of travel.

Another object of the invention is to provide a convertible outboard deck for underwater craft as above characterized, which is also readily adaptable to existing submarines, particularly those in the larger range of sizes.

A still further object of the invention is to provide an improved and novel submarine and deck structure thereof, which will make possible a maximum amount of mobility of the personnel, both when the craft is surfaced and when it is submerged.

Yet another object of the invention is to provide a novel and improved convertible outboard deck for under-

2

water craft and the like, which is particularly adaptable for use in preparing and setting up projectiles and other types of similar, defensive and offensive equipment while the craft is still submerged, whereby the desired launching or other operation may be performed with the greatest facility and speed by means of a quick surfacing and subsequent submerging maneuver.

A feature of the invention resides in the provision of novel and improved convertible outboard deck facilities for an underwater craft, which when the craft is surfaced will function as an open deck area with a protective canopy above the entire said area.

Another feature of the invention resides in the provision of an improved convertible outboard deck for submarines and the like having all of the above advantages and features, which structure nevertheless has extreme simplicity, reliability of operation, and relatively low fabrication and installation cost.

A further object of the present invention is to provide an improved submarine deck structure and combination missile-launching means, in conjunction with a convertible outboard deck as above characterized, which provides for the preparation and launching of missiles with the maximum degree of facility, either while the craft is submerged or else when it is surfaced.

Other features and advantages will hereinafter appear.

In the drawings accompanying this specification, similar characters of reference are used throughout the several views to designate like components.

Figure 1 is a side elevational view of an improved submarine or underwater craft and convertible outboard deck therefor, as provided by the present invention.

Fig. 2 is a transverse vertical sectional view, taken on the line 2—2 of Fig. 1.

Fig. 3 is a fragmentary vertical sectional view showing details of the raising and lowering means for the cover or canopy portion of the convertible deck structure.

Fig. 4 is a fragmentary detail in elevation, showing one type of sealing means found suitable for use with the convertible deck structure.

Fig. 5 is a top plan view of the submarine and convertible outboard deck structure shown in side elevation in Fig. 1.

Fig. 6 is a top plan view of a submarine and convertible outboard deck illustrating a modification of the invention.

Fig. 7 is a fragmentary vertical sectional view taken on the line 7—7 of Fig. 6.

Fig. 8 is a fragmentary vertical sectional view taken on the line 8—8 of Fig. 1.

Referring first to Figs. 1—5, there is shown a submarine having a hull 10 in the form of a large, elongate tube tapered at both its front and rear ends 11 and 12 respectively. The hull 10 is, in accordance with this invention, provided with an expansive or large deck 14 extending longitudinally thereof from a point or location 15 adjoining the stern to a location 16 adjoining the bow.

As seen in Figs. 2 and 5, the deck 14 has an average width which is substantially greater than the width of the usual conning tower 18 for a submarine of the hull size shown. The conning tower 18 is shown as substantially midway between the bow and stern; however, this location is not limiting, and it will be understood that such conning tower may be disposed either more forward or more rearward to suit particular conditions.

In accordance with the invention, I provide along the opposite longitudinal edges of the deck 14 a pair of solid, watertight railings 20 and 21, said railings extending substantially for the full length of the deck. Also, at the bow and stern of the hull 10 and beyond the ends of the deck 14 I provide a pair of upright enclosures 23 and 24, said enclosures projecting upward above the railings 20, 21 for a distance which may be roughly on the order of three feet.

The enclosures 23 and 24 may be streamlined and tapered as shown, and such enclosures are characterized by relatively wide, flat walls 26 and 27, see Figs. 1 and 8.

Further, in accordance with this invention, I provide means which in conjunction with the railings 20, 21 and the enclosures 23 and 24 are adapted to constitute a watertight enclosure above the deck 14, said means being spaced a sufficient distance above the deck to enable personnel to walk on the deck in upright position. The said means is so arranged as to be openable or separable at the sides of the deck 14 above the railings 20 and 21, and is characterized by at least one inflexible, inverted shell indicated at 28 in Figs. 1 and 2. In these figures, the shell 28 is seen to have a length equal to that of the deck 14, and to have a width approximately the same as the deck, as well as a similar contour or outline. The shell 28 may be formed in any suitable manner, by means of structural steel framing supporting a surfacing structure; it is shown in the drawings in outline form mainly, it being understood that longitudinal and transverse struts and braces are to be used, in conjunction with curved steel or other metal plates. As seen in Fig. 5 the inverted shell 28 may be generally of rectangular outline, with a pair of rigid central spars 30 disposed fore and aft of the conning tower 18. The shell 28 is cut out to provide clearance for the conning tower, as shown in Fig. 2, and further has downwardly curved or depending side portions 31 providing the shell with a depth roughly on the order of three or four feet. The water-tight railings 20, 21 have a height of approximately three to four feet and thus it will be seen that when the inverted shell 28 is resting on the railings 20, 21 as in Fig. 2 there will be sufficient space under the shell and above the deck 14 to permit personnel to walk about without stooping over.

The inverted inflexible shell 28 is adapted to be raised and lowered with a vertical, translational movement from the lowered position shown in full lines in Figs. 1, 2 and 3 to a raised position shown in broken lines in these figures. In order to accomplish this, I provide a mechanism comprising a plurality of vertically movable plungers 33 disposed along the inner sides of the railings 20, 21 and supported by the deck 14 and by the deck-supporting structure below the deck. The plungers 33 have outwardly offset upper extremities 34 which are connected, by means of suitable fittings 35, with the depending side portions 31 of the shell 28. While pin connections are shown at the fittings 35, it will be understood that any other suitable type of connection, including rigid connections, may be used instead.

The plungers 33 may be powered by any suitable means, as for example by pneumatic or hydraulic cylinders, and preferably all of the plungers 33 on a side of the deck 14 are coupled together for conjoint movement. This may be accomplished by providing teeth 37 on the plungers whereby they are constituted as racks, and by providing a plurality of pinions 38 meshing with said teeth and carried by a common shaft 39. The shaft 39 at one side of the deck 14 may be coupled to a corresponding shaft at the other side, by which conjoint movement of the other set of plungers is established, through the use of any suitable drive device as for example a sprocket chain 40 passing around a sprocket wheel 41 on the shaft 39. A corresponding sprocket may be provided on the shaft at the other side of the deck 14, and with such organization all of the plungers 33 will be coupled for simultaneous and uniform raising and lowering movement.

At the same time, the major portion of the raising force of each plunger will be supplied by the associated piston and cylinder (not shown), and the said cylinders may be connected by an equalizing line (not shown) to supplement the action of the pinions 38, shafts 39, etc. By employing a suitable number of the plungers 33, disposed at intervals along the shell 28, an adequate and uniform lifting force may be exerted on said shell to shift it between its lowered and raised positions.

As seen in Fig. 1, when the shell 28 is in its lowered position wherein it effects a water-tight enclosure above the deck 14, the top or roof section 28a of the shell is aligned and flush with the top surfaces of the stationary upright enclosures 23 and 24 located respectively at the bow and stern at the hull 10.

It will now be apparent that, by the above organization, there is provided on the hull 10 a large or expansive, elongate deck surface extending virtually for the full length of the hull and having an appreciable width substantially greater than the width of the conning tower 18. The said deck may be completely enclosed and have water excluded from it by the provision of the inverted shell 28, and accordingly the full deck space is made available to the personnel of the underwater craft not only when the craft is surfaced, but also during submerging and cruising under the surface. As seen in Fig. 2, when the shell 28 is in its raised position, the deck becomes open and an appreciable space exists between the upper edges of the railings 20, 21 and the lower edges of the depending portions 31 of the shell. Such space may, for example, be on the order of several feet, providing full visibility from the deck 14, which is of great advantage when cruising on the surface in calm seas.

As seen in Figs. 3 and 4, interlocking edge portions 42 and 43 may be provided on the railings 20, 21 conning tower 18 and shell 28, and any suitable form of resilient sealing means such as the pressurized tubular sealing strip 45 shown in Fig. 4 may be employed to effect a reliable and water-tight seal. Similar interlocking edges are provided between the shell 28 and the adjoining walls of the upright enclosures 23 and 24, to effect a water tight seal.

Further, in accordance with the invention, the conning tower 18 is provided with doorways and doors, indicated at 47 in Figs. 1 and 3 which are of full and standard height, thereby to enable personnel to rapidly enter or leave the conning tower, and the walls 26 of the enclosures 23 and 24 are also provided with similar full-sized doors and doorways, one such being shown in Fig. 8 at 49.

By this construction a very desirable mobility of the personnel of the submarine is had, which is of great advantage not only in conserving manpower since some seamen can be assigned to a number of different duties requiring their presence not only in the seamen's quarters but also in the officers' quarters, for instance. Moreover, by the above arrangement the deck 14 may be quickly cleared of personnel when this is found to be necessary, since the doors in the enclosures 23 and 24 may be utilized as well as the doors of the conning tower 18.

As seen in Figs. 1 and 5, the conning tower 18 may be advantageously provided with a plurality of missile or rocket launching tubes 18a, and these may be of appreciable length, since they not only extend down through the conning tower but also have the full depth of the hull 10 as well. The launching tubes 18a will not interfere with the use of the conning tower as provided by the doors 47, yet they enable launching tubes of appreciable length to be incorporated in the submarine, without requiring that the tubes project beyond the conning tower to any great extent. This is of importance where the missiles or rockets require relatively long launching tubes, and as will be later brought out, shorter launching tubes are provided at other advantageous locations in the submarine.

The provision of the large and expansive, fully enclosed

5

deck 14 which is available not only when the craft is on the surface but also when it is submerged, is of great advantage in providing recreation space and boosting the morale of personnel by enabling physical activity and sports to be indulged in; also it makes possible the setting up of ballistic and other equipment, as for example in preparation for launching intercontinental ballistic missiles, missile-intercepting rockets and the like. Such missiles may be completely set up and serviced utilizing the fully enclosed deck 14, and may be fired or launched at a moment's notice either submerged or by a quick surfacing operation followed by immediate submerging, merely by suitably adapting the deck 14, shell 28 and/or the conning tower 18 for the functions required.

Moreover, the deck 14 and canopy structure 28, together with the upright enclosures 23 and 24 may be adapted to existing submarines of appreciable size and tonnage, as will be readily appreciated. But little additional superstructure is required, comparatively, whereby the adaptability of the craft to the latest developments of science and technology is greatly enhanced.

The provision of the novel upright enclosures 23 and 24 is of considerable importance in connection with missile or rocket launching facilities. For example, as seen in Figs. 1, 5 and 6, the enclosures 23 and 24 may be provided with rocket or missile launching tubes 23a and 24a, and such launching tubes may extend downward into the hull structure to the bottom thereof, or substantially to the bottom, thereby to have the greatest possible length without projecting appreciably above the upper streamlined surfaces of the submarine. This construction is clearly seen in Fig. 1, for example, wherein the launching tubes 23a and 24a project but a small extent above the top surfaces of the enclosures 23 and 24. By this organization the launching tubes are substantially wholly enclosed except for the muzzles, and any operations incidental to preparing missiles for launching may be carried on with adequate space, as provided by the hull 10 and enclosures 23 and 24, either while the submarine is submerged or surfaced.

An important feature for the invention resides in the provision of high collars of sleeves 36, see Figs. 2 and 3, which are rigidly supported on and immovable with respect to the deck 14, the said sleeves enclosing the major, lower portions of the plungers 33 and preventing inadvertent contact of such portions of the plungers by personnel.

A modification of the invention is illustrated in Figs. 6 and 7. In this form of the invention, I provide a pair of rigid, side braces 52 extending to the railings 21 and 22 at opposite sides of the conning tower 18, the braces 52 being rigidly affixed to the conning tower. I further provide a pair of elongate, centrally disposed bracing members 54 and 55, extending from the conning tower 18 fore and aft to the upright enclosures 23 and 24. The bracing members 54 and 55 are also fixed and rigid with respect to the deck 14. In conjunction with the members 52, 54 and 55 I provide four inverted shells 57, hingedly connected with the members 54 and 55 and arranged to seal against the same, and against the railings 21, 22, the enclosures 23, 24, and the side braces 52. The inverted shells 57 are raised and lowered by means of plungers 59 operated in a manner similar to the plungers 33 above described. The plungers 59 may be connected with the shells 57 by connector fittings 60 constituting angularly disposed track members having angle-shaped slots 61, the said members being attached to the shells. Such slots, see Fig. 7, may have lower vertical portions and upper sloping portions whereby an advantageous action is had, enabling the plungers 59 to securely pull downward and seal the shells 57, and also to readily raise the shells without requiring arcuate or pivotal movement of the plungers.

As in the embodiment of the invention illustrated in Figs. 1-3, the plungers 59 may be all coupled to each

6

other for simultaneous or conjoint movement, both while raising and lowering the shells 57.

It will be noted that with the forms of the invention illustrated and described above, water pressure on the exterior on the inverted shells while the craft is submerged will tend to force the said shell more tightly in their closed positions, thereby rendering the sealing means more effective in keeping out the water.

Referring again to the showing of Figs. 6 and 7 I provide, in accordance with the invention, a novel and advantageous missile-launching construction in conjunction with the conning tower 18. As shown, on opposite sides of the conning tower 18 there are provided upwardly extending housings 65 carrying a multiplicity of launching tubes 66. The launching tubes 66 may extend appreciably below the deck 14, even so far as to a point adjacent the bottom of the hull 10. At their upper ends, the launching tubes 66 are provided with hatches 67 which may be operated in any suitable manner, to open and permit the discharge of missiles, rockets or the like.

As seen in Fig. 6, the housings 65 and missile tubes 66 may be supported not only by the deck 14 but also by the rigid side braces 52 which are affixed to the conning tower 18 and to the deck. By such organization, a further support and reinforcement of the missile launching tubes 66 is had.

It will be understood that with the above missile-launching construction it is possible to discharge or launch missiles without interfering in any manner with the canopy construction which encloses the deck 14 of the craft, and this is an important feature and advantage.

Variations and modifications may be made within the scope of the claims, and portions of the improvement made be used without others.

I claim:

1. A submarine having a hull in the form of a large elongate tube tapered at both ends, said hull being provided with an expansive deck extending longitudinally thereof from a point adjoining the stern to a point adjoining the bow, said deck having an average width substantially greater than the width of a conning tower for such hull; a solid, water-tight railing extending along both sides of the deck substantially for the full length thereof; upright tapered enclosures disposed above the hull on the bow and stern of the same and beyond the ends of the deck, said enclosures projecting upward above the said railings and having smooth, sloping exteriors; means comprising at least one inflexible inverted shell, providing a water-tight enclosure above the said deck and openable at the sides thereof, said means having rigid, pressure-resistant roof sections adapted at the ends to engage the said upright enclosures and to constitute a continuous substantially straight and horizontal pressure-resistant roof extending between the upper surfaces of the enclosures as continuations thereof, said roof sections having dependent side portions adapted to engage the said railings and to constitute continuations of the outer surfaces thereof; and a mechanism for raising and opening the said means to provide space above the railings, and for lowering and closing the said means to effect the said water-tight enclosure.

2. A submarine having a hull in the form of a large elongate tube tapered at both ends, said hull being provided with an expansive deck extending longitudinally thereof from a point adjoining the stern to a point adjoining the bow, said deck having an average width substantially greater than the width of a conning tower for such hull; a solid, water-tight railing extending along both sides of the deck substantially for the full length thereof; upright tapered enclosures disposed above the hull on the bow and stern of the same and beyond the ends of the deck, said enclosures projecting upward above the said railings and having smooth, sloping exteriors; means comprising at least one inflexible inverted shell, providing a water-tight enclosure above the said deck and openable

at the sides thereof, said means having rigid, pressure-resistant roof sections adapted at the ends to engage the said upright enclosures and to constitute a continuous substantially straight and horizontal pressure-resistant roof extending between the upper surfaces of the enclosures as continuations thereof, said roof sections having dependent side portions adapted to engage the said railings and to constitute continuations of the outer surfaces thereof; and a mechanism for raising and opening the said means to provide space above the railings, and for lowering and closing the said means to effect the said water-tight enclosure, said upright enclosures having walls facing amidships and adapted to be enclosed by the said means, said walls having doorways and doors permitting entrance and exit of personnel with the water-tight enclosure means closed.

3. A submarine having a hull in the form of a large elongate tube tapered at both ends, said hull having a conning tower projecting upward therefrom and being provided with an expansive deck surrounding said conning tower and extending longitudinally of the deck from a point adjoining the stern to a point adjoining the bow, said deck having an average width substantially greater than the width of said conning tower; a solid, water-tight railing extending along both sides of the deck substantially for the full length thereof; upright tapered enclosures disposed above the hull on the bow and stern of the same and beyond the ends of the deck, said enclosures projecting upward above the said railings and having smooth, sloping exteriors; means comprising at least one inflexible inverted shell, providing a water-tight enclosure above the said deck and openable at the sides thereof, said means having rigid, pressure-resistant roof sections adapted at the ends to engage the said upright enclosures and to constitute a continuous substantially straight and horizontal pressure-resistant roof extending between the upper surfaces of the enclosures as continuations thereof, said roof sections having dependent side portions adapted to engage the said railings and to constitute continuations of the outer surfaces thereof; and a mechanism for raising and opening the said means to provide space above the railings, and for lowering and closing the said means to effect the said water-tight enclosure, said conning tower projecting above the said roof sections and having walls adapted to be enclosed by the said enclosure means, said walls having doorways and doors permitting entrance and exit of personnel with the water-tight enclosure means closed.

4. A submarine having a hull in the form of a large elongate tube tapered at both ends, said hull being provided with an expansive deck extending longitudinally thereof from a point adjoining the stern to a point adjoining the bow, said deck having an average width substantially greater than the width of a conning tower for such hull; a solid, water-tight railing extending along both sides of the deck substantially for the full length thereof; upright tapered enclosures disposed above the hull on the bow and stern of the same and beyond the ends of the deck, said enclosures projecting upward above the said railings and having smooth, sloping exteriors; means comprising at least one inflexible inverted shell, providing a water-tight enclosure above the said deck and openable at the sides thereof, said means having rigid, pressure-resistant roof sections adapted at the ends to engage the said upright enclosures and to constitute a continuous substantially straight and horizontal pressure-resistant roof extending between the upper surfaces of the enclosures as continuations thereof, said roof sections having dependent side portions adapted to engage the said railings and to constitute continuations of the outer surfaces thereof; and a mechanism for raising and opening the said means to provide space above the railings, and for lowering and closing the said means to effect the said water-tight enclosure, said rigid roof sections being spaced above the deck a distance to permit

personnel to walk upright on the deck when the water-tight enclosure means is closed.

5. A submarine having a hull in the form of a large elongate tube tapered at both ends, said hull being provided with an expansive deck extending longitudinally thereof from a point adjoining the stern to a point adjoining the bow, said deck having an average width substantially greater than the width of a conning tower for such hull; a solid, water-tight railing extending along both sides of the deck substantially for the full length thereof; upright tapered enclosures disposed above the hull on the bow and stern of the same and beyond the ends of the deck, said enclosures projecting upward above the said railings and having smooth, sloping exteriors; means comprising at least one inflexible inverted shell, providing a water-tight enclosure above the said deck and openable at the sides thereof, said means having rigid, pressure-resistant roof sections adapted at the ends to engage the said upright enclosures and to constitute a continuous substantially straight and horizontal pressure-resistant roof extending between the upper surfaces of the enclosures as continuations thereof, said roof sections having dependent side portions adapted to engage the said railings and to constitute continuations of the outer surfaces thereof; and a mechanism for raising and opening the said means to provide space above the railings, and for lowering and closing the said means to effect the said water-tight enclosure, said inflexible inverted shell having an area and configuration roughly equivalent to those of the said deck and being vertically translationally movable thereover.

6. A submarine having a hull in the form of a large elongate tube tapered at both ends, said hull being provided with an expansive deck extending longitudinally thereof from a point adjoining the stern to a point adjoining the bow, said deck having an average width substantially greater than the width of a conning tower for such hull; a solid, water-tight railing extending along both sides of the deck substantially for the full length thereof; upright tapered enclosures disposed above the hull on the bow and stern of the same and beyond the ends of the deck, said enclosures projecting upward above the said railings and having smooth, sloping exteriors; means comprising a pair of inflexible inverted shells providing a water-tight enclosure above the said deck and openable at the sides thereof, said means having rigid, pressure-resistant roof sections adapted at the ends to engage the said upright enclosures and to constitute a continuous substantially straight and horizontal pressure-resistant roof extending between the upper surfaces of the enclosures as continuations thereof, said roof sections having dependent side portions adapted to engage the said railings and to constitute continuations of the outer surfaces thereof; and a mechanism for raising and opening the said means to provide space above the railings, and for lowering and closing the said means to effect the said water-tight enclosure, said water-tight enclosure means including an elongate, centrally-disposed brace member extending longitudinally of and rigid with the deck and spaced upward therefrom a distance to permit upright walking thereunder, said brace member being hingedly connected with said shells and the latter having arcuate vertical movement above the said deck.

7. A submarine having a hull in the form of a large elongate tube tapered at both ends, said hull being provided with an expansive deck extending longitudinally thereof from a point adjoining the stern to a point adjoining the bow, said deck having an average width substantially greater than the width of a conning tower for such hull; a solid, water-tight railing extending along both sides of the deck substantially for the full length thereof; upright tapered enclosures disposed above the hull on the bow and stern of the same and beyond the ends of the deck, said enclosures projecting upward above the said railings and having smooth, sloping exteriors; means com-

prising at least one inflexible inverted shell, providing a water-tight enclosure above the said deck and openable at the sides thereof, said means having rigid, pressure-resistant roof sections adapted at the ends to engage the said upright enclosures and to constitute a continuous substantially straight and horizontal pressure-resistant roof extending between the upper surfaces of the enclosures as continuations thereof, said roof sections having dependent side portions adapted to engage the said railings and to constitute continuations of the outer surfaces thereof; and a mechanism for raising and opening the said means to provide space above the railings, and for lowering and closing the said means to effect the said water-tight enclosure, said mechanism including a plurality of upright plungers connected with said shell and disposed between said railings.

8. A submarine having a hull in the form of a large elongate tube tapered at both ends, said hull being provided with an expansive deck extending longitudinally thereof from a point adjoining the stern to a point adjoining the bow, said deck having an average width substantially greater than the width of a conning tower for such hull; a solid, water-tight railing extending along both sides of the deck substantially for the full length thereof; upright tapered enclosures disposed above the hull on the bow and stern of the same and beyond the ends of the deck, said enclosures projecting upward above the said railings and having smooth, sloping exteriors; means comprising four inflexible inverted shells providing a water-tight enclosure above the said deck and openable at the sides thereof, said means having rigid, pressure-resistant roof sections adapted at the ends to engage the said upright enclosures and to constitute a continuous substantially straight and horizontal pressure-resistant roof extending between the upper surfaces of the enclosures as continuations thereof, said roof sections having dependent side portions adapted to engage the said railings and to constitute continuations of the outer surfaces thereof; and a mechanism for raising and opening the said means to provide space above the railings, and for lowering and closing the said means to effect the said water-tight enclosure, said water-tight enclosure means including an elongate, centrally-disposed brace member extending longitudinally of and rigid with the deck and spaced upward therefrom a distance to permit upright walking thereunder, said brace member being hingedly connected with said shells and the latter having arcuate vertical movement above the said deck and said water-tight enclosure means including a pair of laterally-extending side braces connected between the said railings and the central brace member at a location amidships, said shells at their proximal ends being adapted to engage and seal against said side braces, the said raising and lowering mechanism including a plurality of upright plungers and driving connections therefor, having angularly-disposed tracks carried by the shells.

9. A submarine having a hull in the form of a large elongate tube tapered at both ends, said hull being provided with an expansive deck extending longitudinally thereof from a point adjoining the stern to a point adjoining the bow, said deck having an average width substantially greater than the width of a conning tower for such hull; a solid, water-tight railing extending along both sides of the deck substantially for the full length thereof; upright tapered enclosures disposed above the hull on the bow and stern of the same and beyond the ends of the deck, said enclosures projecting upward above the said railings and having smooth, sloping exteriors; means comprising four inflexible inverted shells providing a water-tight enclosure above the said deck and openable at the sides thereof, said means having rigid, pressure-resistant roof sections adapted at the ends to engage the said upright enclosures and to constitute a continuous substantially straight and horizontally pressure-resistant roof extending between the upper surfaces of

the enclosures as continuations thereof, said roof sections having dependent side portions adapted to engage the said railings and to constitute continuations of the outer surfaces thereof; and a mechanism for raising and opening the said means to provide space above the railings, and for lowering and closing the said means to effect the said water-tight enclosure, said water-tight enclosure means including an elongate, centrally-disposed brace member extending longitudinally of and rigid with the deck and spaced upward therefrom a distance to permit upright walking thereunder, said brace member being hingedly connected with said shells and the latter having arcuate vertical movement above the said deck, and said water-tight enclosure means including a pair of laterally-extending side braces connected between the said railings and the central brace member at a location amidships, said shells at their proximal ends being adapted to engage and seal against said side braces.

10. A submarine having a hull in the form of a large elongate tube tapered at both ends, said hull being provided with an expansive deck extending longitudinally thereof from a point adjoining the stern to a point adjoining the bow, said deck having an average width substantially greater than the width of a conning tower for such hull; a solid, water-tight railing extending along both sides of the deck substantially for the full length thereof; upright tapered enclosures disposed above the hull on the bow and stern of the same and beyond the ends of the deck, said enclosures projecting upward above the said railings and having smooth, sloping exteriors; means comprising at least one inflexible inverted shell, providing a water-tight enclosure above the said deck and openable at the sides thereof, said means having rigid, pressure-resistant roof sections adapted at the ends to engage the said upright enclosures and to constitute a continuous substantially straight and horizontal pressure-resilient roof extending between the upper surfaces of the enclosures as continuations thereof, said roof sections having dependent side portions adapted to engage the said railings and to constitute continuations of the outer surfaces thereof; and a mechanism for raising and opening the said means to provide space above the railings, and for lowering and closing the said means to effect the said water-tight enclosure, said mechanism including a plurality of upright plungers connected with said shell and disposed between said railings, and including stationary hollow guides for said plungers, extending upward from the deck a distance at least as great as the height of the railings.

11. A submarine having a hull in the form of a large elongate tube tapered at both ends, said hull being provided with an expansive deck extending longitudinally thereof from a point adjoining the stern to a point adjoining the bow, said deck having an average width substantially greater than the width of a conning tower for such hull; a solid, water-tight railing extending along both sides of the deck substantially for the full length thereof; upright tapered enclosures disposed above the hull on the bow and stern of the same and beyond the ends of the deck, said enclosures projecting upward above the said railings and having smooth, sloping exteriors; means comprising at least one inflexible inverted shell, providing a water-tight enclosure above the said deck and openable at the sides thereof, said means having rigid, pressure-resistant roof sections adapted at the ends to engage the said upright enclosures and to constitute a continuous substantially straight and horizontal pressure-resistant roof extending between the upper surfaces of the enclosures as continuations thereof, said roof sections having dependent side portions adapted to engage the said railings and to constitute continuations of the outer surfaces thereof; and a mechanism for raising and opening the said means to provide space above the railings, and for lowering and closing the said means to effect the said water-tight enclosure, the depth of said inverted shell

11

being of the same order of magnitude as the height of the railings.

References Cited in the file of this patent

UNITED STATES PATENTS

971,676 Hertzberg et al. ----- Oct. 4, 1910
1,314,059 Grieshaber ----- Aug. 26, 1919

5

1,363,937
1,370,467
1,828,655
1,864,837
1,870,263
2,349,009
2,727,254
2,859,721

12

Wagner ----- Dec. 28, 1920
McMahon ----- Mar. 1, 1921
Greuniesen ----- Oct. 20, 1931
Lake ----- June 28, 1932
Neff ----- Aug. 9, 1932
Schwab ----- May 16, 1944
Johnson ----- Dec. 20, 1955
Endrezze ----- Nov. 11, 1958