Dec. 5, 1967 G. W. LEHMANN 3,356,056

SUBMARINE

Filed Aug. 19, 1964 3 Sheets-Sheet 1

Fig. 1.

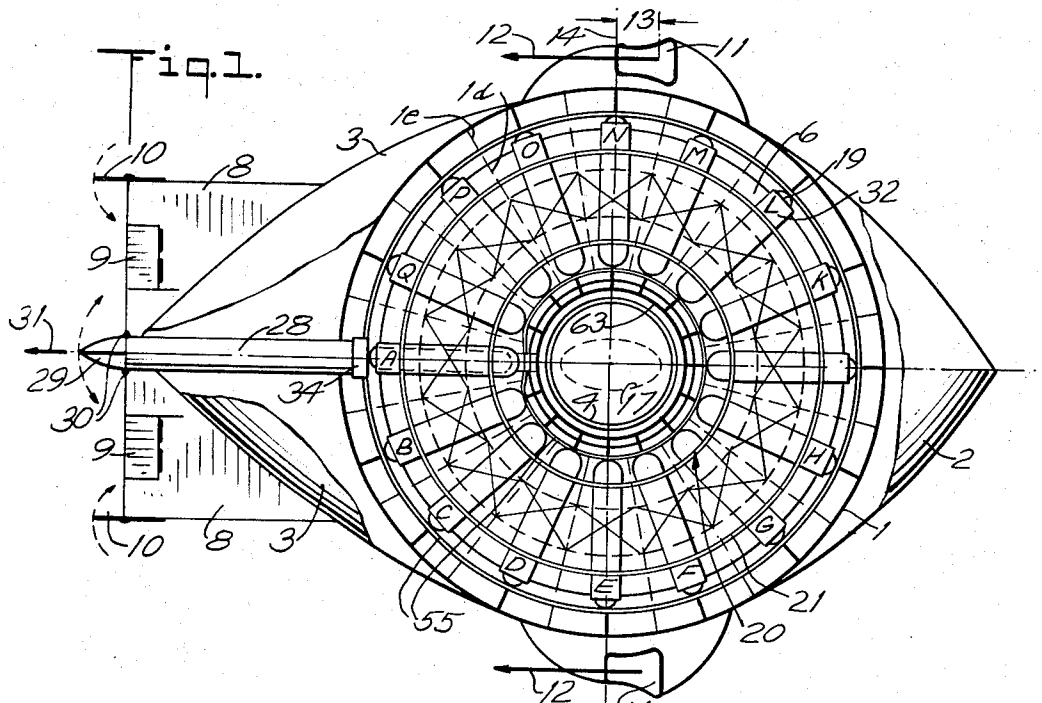


Fig. 2.

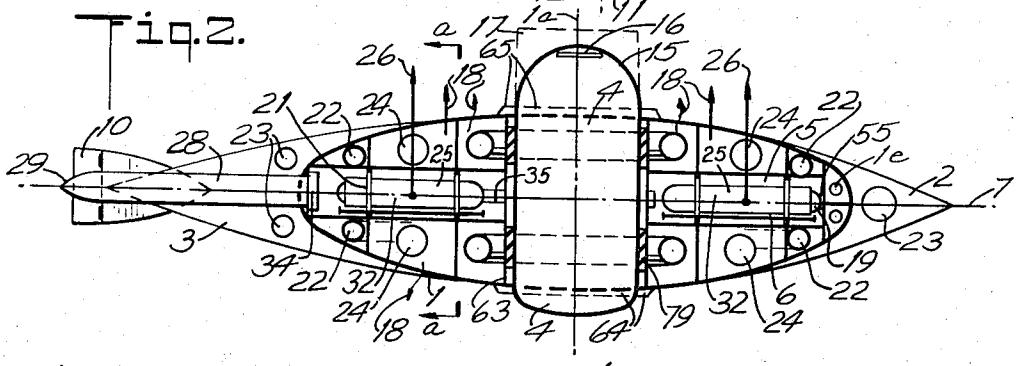
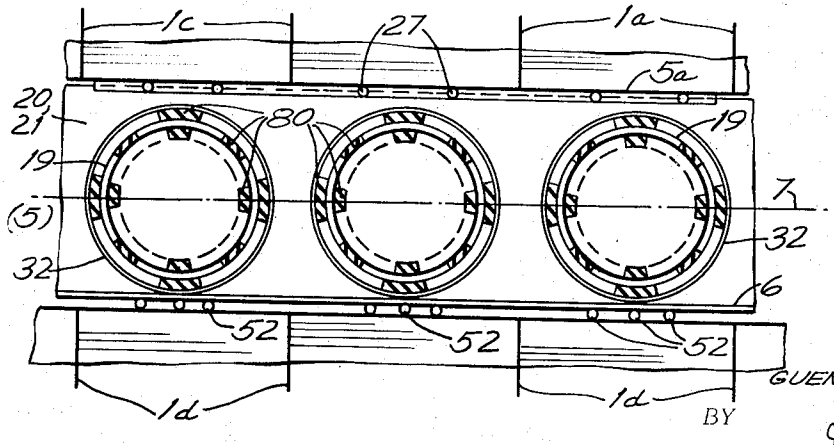


Fig. 3.



INVENTOR
GUENTHER W. LEHMANN

BY

Erich M. H. Radde

AGENT

Dec. 5, 1967 G. W. LEHMANN 3,356,056

SUBMARINE

Filed Aug. 19, 1964 3 Sheets-Sheet 2

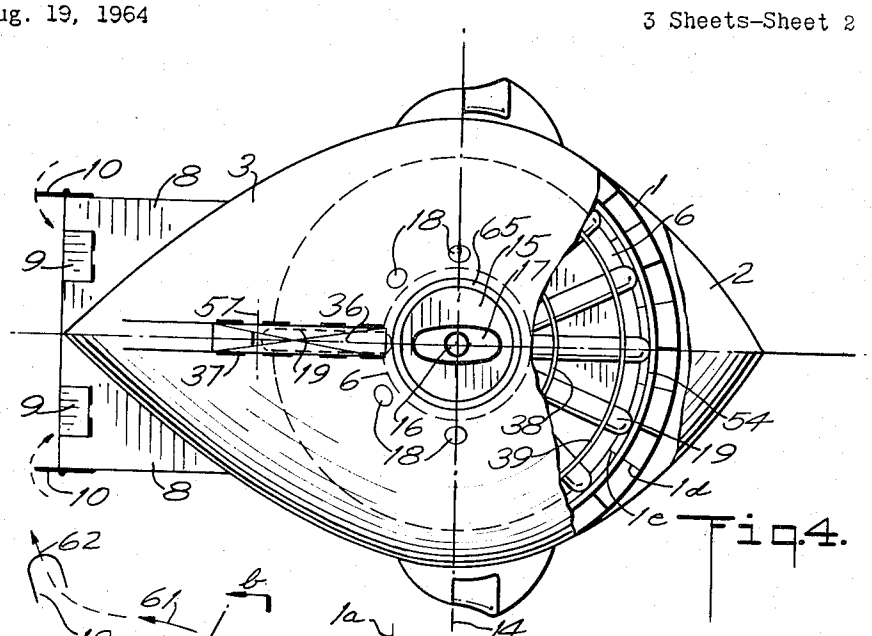


Fig. 4.

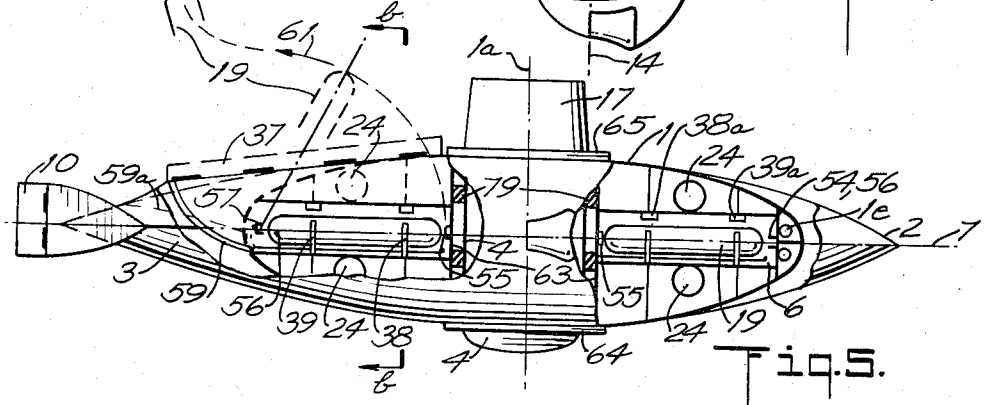


Fig. 5.

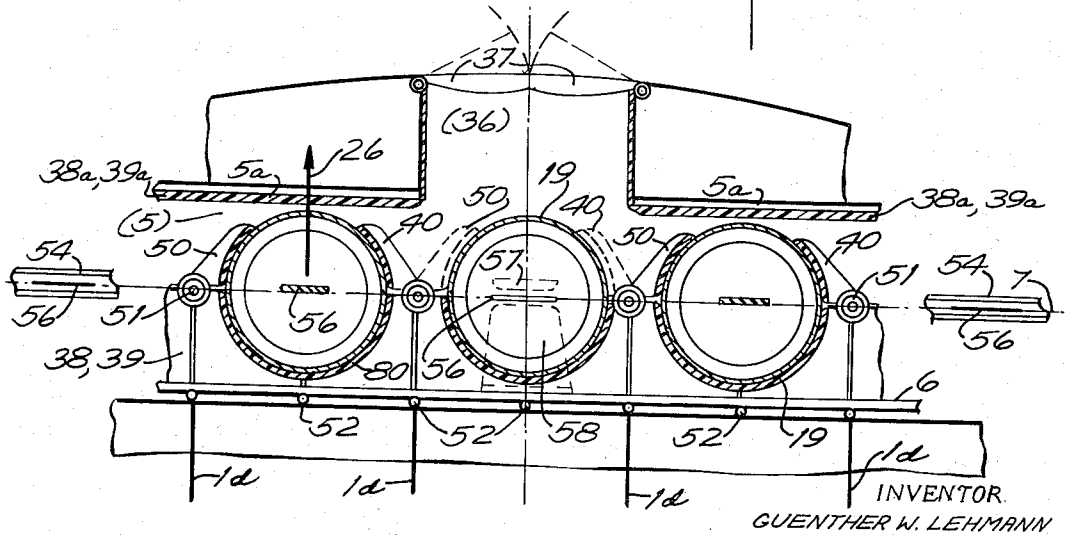


Fig. 6.

INVENTOR.
GUENTHER W. LEHMANN

BY

Irvin M. H. Radde

AGENT

Dec. 5, 1967 G. W. LEHMANN 3,356,056

SUBMARINE

Filed Aug. 19, 1964 3 Sheets-Sheet 3

Fig. 7.

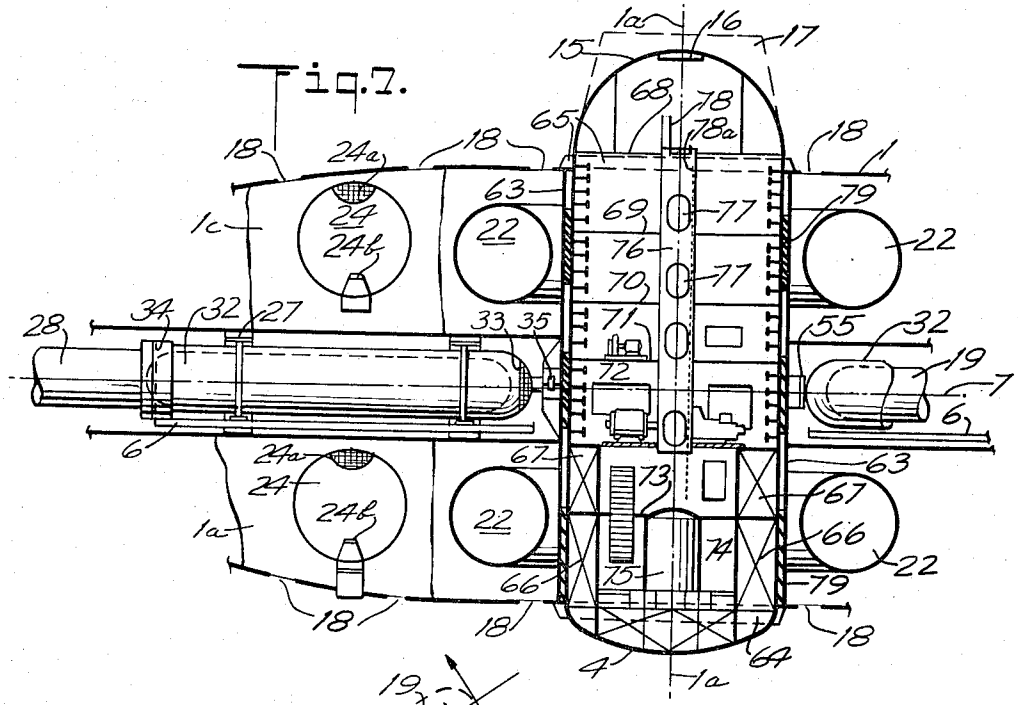
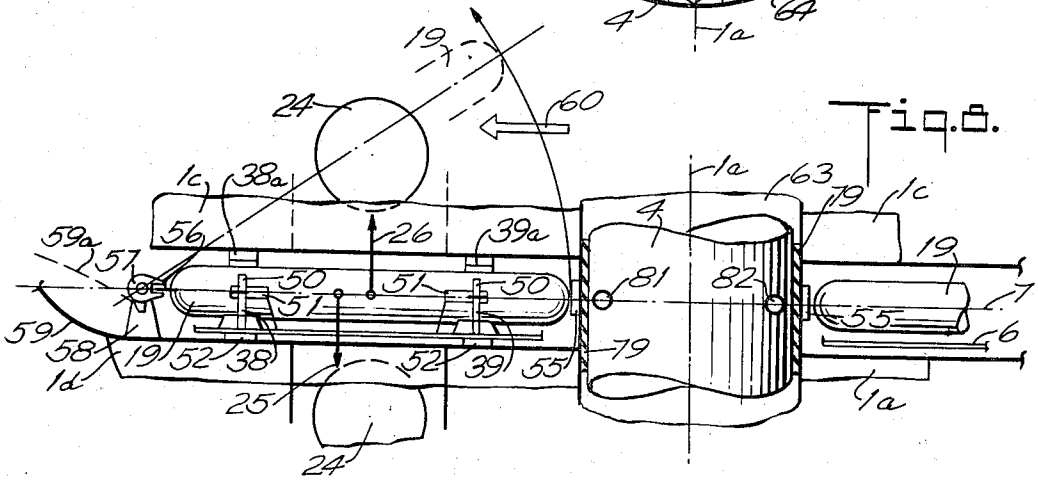


Fig. 8.



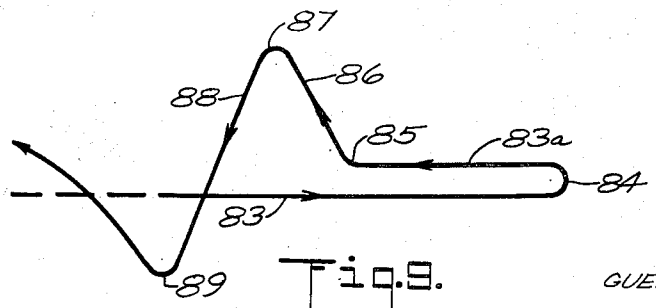


Fig. 9.

INVENTOR.
GUENTHER W. LEHMANN

BY Irwin M. N. Radolin

AGENT

United States Patent Office 3,356,056
Patented Dec. 5, 1967

3,356,056

SUBMARINE

Guenther Wolfgang Lehmann, Sunnyvale, Calif.
(140 W. Kalmia St., San Diego, Calif. 92101)

Filed Aug. 19, 1964, Ser. No. 391,079
9 Claims. (Cl. 114—17)

ABSTRACT OF THE DISCLOSURE

A missile or torpedo firing submarine carries a series of missiles on a revolving platform and ejects missiles through only one opening at the rear under full submergence speed without endangering the missile by cross-flow. The submarine is equipped with automatic ballast and trim devices for balancing released missile weights, and possesses by virtue of its lentil-shaped body, mass concentration at the center of the submarine, and arrangement of propulsion and steering means a high underwater maneuverability. Nuclear powered machinery, accommodations for the crew, and operation centers are arranged at different deck levels within a vertical pressure tube which is detachable in case of emergency.

It is generally known that submarines are ejecting missiles from moderate water depths through a number of hatches. Each missile is stowed individually in a vertical cylinder.

The missile stowage and ejecting system is accommodated within the pressure hull.

Other submergence missile firing vehicles are publicly known, consisting of submergence vehicles of different configurations which are towed to a desired site and anchored in more or less deep-submrged condition. These vehicles accommodate missiles also in upright position with or without protective capsules depending on the waterdepth. These constitute primarily stationary platforms with disadvantages of detection and possible destruction.

Still other missile carrying vehicles are known with missiles ejected in the same fashion as torpedoes. Missiles ejected from level positions while the carrier proceeds in deep-submerged condition avoid the drawbacks of crossflow common to otherwise vertically ejected missiles.

Most of the missile ejecting systems accommodate each missile in an individual chamber which contributes to more or less complicated structures. Special systems have to be provided for equalizing the ejected missile weight in regard to buoyancy, trim and stability.

The present invention concerns a deep-submergence missile vehicle with novel features contributing to the solution of problems in connection with simplifying the hull structure, improved shock absorption of depth charges, simpler stowage of a number of missiles, reduced trim and buoyancy effects of released missile weights, improved maneuver capabilities, increased safety and more efficient rescue procedures of a stricken deep-submergence submarine.

With these objectives in mind, it is proposed to take advantage of my U.S.A. Patents Nos. 3,292,564 and 3,286,-672, and to provide new structural elements resulting in an advanced design of a missile firing submarine.

Advantage is taken preferably from my suggestion of an elliptically shaped body with an independent vertical center cylinder as more fully described in the above cited patent applications. The configuration of an elliptical body allows stowage of missiles in radial arrangement on a revolving platform accommodated in an annular chamber in the center plane of the body with only one ejecting tube

at the rear of the body. In this way, it is possible to eject all missiles through only one ejecting tube instead of a number of ejecting tubes as it is the case with present submarines. When one missile is fired, the revolving platform is rotated and places the next missile in front of the ejecting tube. Here the same principle is employed as with "revolvers with several cartridge chambers set in a cylinder that turns so as to bring them one after the other in line with the barrel where each may be discharged" (Webster's).

Since the submarine is supposed to release the missiles at great waterdepth, the missiles are encapsuled. There are two principles of raising an encapsulated missile from great waterdepth to the surface.

One operational system conecrns an encapsulated missile which ascends to the surface at a high terminal speed propelled by a large positive buoyancy, and after broaching the surface, the missile is ejected in the air with the capsule expended.

The other operational system concerns an encapsulated missile with small positive buoyancy and breaking means at the rear, resulting in a moderate terminal speed which allows the ejection of a missile from the capsule while the latter is broaching the surface at slow speed with the major part of the capsule remaining in the water.

The latter operation system should be employed in the deep submergence missile carrier of the present invention for the following reasons.

Since capsules are released from great waterdepth and the capsule, due to its intended purpose, is a structure which withstands high water pressure, it is proposed to place the missile capsules on the aforementioned revolving platform in a pressure-equalized chamber, communicating with the ocean.

A missile capsule within the chamber and with only a small positive buoyancy produces a smaller buoyancy and trim change after releasing of the capsule than a capsule having a large positive buoyancy. Accordingly, means for equalizing buoyancy and trim become simpler.

Missile capsules are buoyant. They are floating up in their stowage places when the submarine is submerged resulting in uplift forces. These uplift forces have to be replaced upon ejecting of the missile.

To accomplish this, it is proposed to arrange below or above each missile in radial arrangement buoyancy tanks, preferably spheres, which are filled at first with water. When a missile is fired, water is instantly expelled from a corresponding tank sphere so that the lost uplift buoyancy force of the capsule is immediately restored by a permanent buoyancy force of the tank sphere.

Each time when the revolving platform is turned to the next missile ejecting position, the tank spheres are drained in subsequent order. Apart from a short period during draining a respective tank sphere, there is always equilibrium between weight and buoyancy forces of the system by simply replacing buoyancy forces of the missiles by corresponding buoyancy forces of the tank spheres.

It should be mentioned that encapsulated missiles produce usually trimming moments which aid them into a vertical trajectory after the capsule is expelled in level position as it is here the case. Due to the axial-symmetrical arrangement of the radially stowed capsules, trimming moments of the capsules as a whole eliminate themselves.

However, when one capsule is ejected, the trimming moment of this particular capsule becomes free. Therefore, tank spheres are arranged in such a way that each individual trimming moment is instantly replaced in order to restore also equilibrium with regard to trim in addition to equilibrium of buoyancy.

A trimming moment occurs when a capsule is ejected. This trimming moment has a beneficial effect on aiding

the missile into the vertical trajectory in addition to a certain mass inertia effect of a built-in trimming device of the capsule, which is not disclosed here.

Re-entry of water in the ejecting tube and buoyancy effects of gases from propellants, which flow off through the ejecting system, and in part through openings at the uppermost level of the hull, cause at each missile firing a temporary disturbance of equilibrium.

Another missile ejecting method is known which does not expel a missile under force. The missile capsule, due to its inherent buoyancy and trim properties, and upon release of the arresting means connecting the missile with the carrier, floats simply up and turns into the vertical trajectory under the influence of buoyancy and trimming moment of the missile.

It is, therefore, advantageous to release missile capsules from the proposed submarine in the described mode. Instead of an ejecting tube with its drawbacks of temporary disturbance of buoyancy and trim equilibrium, a recess is provided in the centerline aft portion of the hull through which the missile capsule floats up. The opening over the recess is covered by a foldable hatchcover.

The missile capsule is clamped on supporting rings mounted on the revolving platform. Heavy rotatable arms keep the missile capsule in place against buoyancy forces. The torque required to press the arms against the capsule is produced by remote controlled hydraulically operated torque-hinges of the Götaverken type which are used for foldable hatchcovers. The said type hinge produces a powerful torque at a minimum of space requirements and should be used throughout the present submarine where foldable structures are installed.

The missile capsules, while stowed on the revolving platform, are secured against axial dislocations by an elastic and polytetrafluoroethylene lined ring attached to the cylinder and to a ring at the periphery or by a channel ring, when the self-floating ejecting system is employed. In the latter case a fluke is attached to the rear of the missile capsule which engages the channel ring throughout the revolving process.

The fluke fits in a rotatable claw which is mounted at the rear of the missile releasing chamber. When the missile capsule is placed in the releasing chamber, the fluke, engaging the claw, keeps the missile capsule in centered position while the missile, upon release of the clamping means, rotates around the fulcrum of the claw when it is floating up.

It is suggested to rotate the missile capsule against the crossflow and not vice versa. The inherent trimming moment of the missile capsule is then assisted by forces and moments from the crossflow acting on the missile capsule. Upon reaching a vertical position, the buoyancy forces of the missile capsule cause the latter to float up whereupon the fluke disengages from the claw automatically. The claw switches back under a spring force into receiving position for the next missile capsule.

Regarding safety and rescue features it should be appreciated that an independent and vertical center cylinder is advantageous in many respects.

Contrary to customary submarine designs, a vertical center cylinder accommodates in vertical sequence of decklevels first in the uppermost space navigation and operational center, followed by accommodations for operating personnel, electronic equipment and auxiliary machinery, turbo-generators and condensers, heat exchangers and steam drums, and in a lowermost compartment a nuclear reactor. The nuclear reactor is surrounded by annular ballast tanks. The various decklevels are connected by an elevator tube with an emergency ladder. The elevator tube serves at the same time as a space for refueling the reactor.

The neutral buoyancy of the surrounding submarine hull is attained all the time by following means.

There are within the boundaries of the hull torus bodies and spheres as permanent buoyancy bodies which, due to their shape, are efficient pressure vessels with regard to high water pressures and shock loads from depth charges. The net space of the hull communicates with the ocean and is pressure-equalized.

The combined buoyancy force of these bodies is equivalent to the weight of the submarine less the weight of the vertical center cylinder and the uplift forces of the buoyant missile capsules. The uplift forces of the missile capsules and their trimming moments are replaced by special spherical tanks, which are first filled with water, as mentioned before, and become permanent buoyancy bodies upon releasing of the missiles.

Spherical tanks for replacing buoyancy forces of the missiles are blown by gases from chemicals which are automatically ignited when a missile is released. Chemicals and catalysts are housed in special capsules placed within the spherical tanks. Water is ejected through a spring-biased valve which closes after surplus gas has escaped. The gas pressure inside the spherical tanks is the same as the ambient water pressure. When the submarine ascends, gas is released through the valve in accordance with the pressure difference between gas inside and the prevailing ambient water pressure. When the submarine seeks greater waterdepths upon releasing of the missiles or for other reasons, the spherical tanks are closed by the valve, and water does not enter the tanks. Once the spherical tanks are blown, the buoyancy of the spherical tanks is permanent and not affected by any change of water depth.

The center cylinder is a first buoyancy system, the surrounding hull is a second buoyancy system. It is suggested to distribute buoyancies and weights as follows.

The central cylinder is neutral buoyant with a first tank filled with ballast water, and a second tank partly filled with ballast water. The surrounding submarine hull is designed for neutral buoyancy at full loaded condition.

When both tanks of the center cylinder are empty, positive buoyancy is present, and the submarine floats at the surface with a certain freeboard. When the first tank is filled with ballast water, there is still a small buoyancy of the entire system present. After flooding of both tanks, the submarine sinks. The filling degree of the second tank regulates the amount of negative buoyancy and the sinking velocity. When it is desired to ascend under buoyancy forces, the first and second tank are emptied producing positive buoyancy of the center cylinder and consequently of the entire system, since the surrounding hull is all the time in the state of neutral buoyancy. If the second tank system is out of order, the first tank is emptied and provides still positive buoyancy which propels the submarine to the surface or, upon detachment in case of emergency, propels the center cylinder to the surface as an independent floating body.

In order to leave the center cylinder upon detachment not helpless, for instance, against currents which may drift the center cylinder to undesirable areas, the center cylinder may be equipped with small propulsion means in form of two water jet tubes at the periphery of the cylinder. The jet tubes do not protrude the boundaries of the center cylinder, and do not establish a hindrance for the detachment of the center cylinder in case of emergency.

One reservation has to be made in regard to the weight and buoyancy balance of the center cylinder. In case of a nuclear power plant, heavy weights are present which may upset the proposed buoyancy weight balance at a practical diameter and depth of the center cylinder. However, similar to the development of diesel engines, nuclear power plants are rapidly improving as to weight and space requirements, so that nuclear power plants may be available in the foreseeable future, which suit the weight and space requirements of the presently proposed detachable center cylinder of a deep diving submarine.

In case of emergency the center cylinder is detached

from the surrounding hull structure by means as more fully described in my U.S.A. Patent No. 3,292,564, resulting in rescuing not only the operating personnel but also in salvaging the entire machinery. If the cylinder is not destroyed by enemy action during ascending to and after reaching the surface, and if it can be salvaged, the center cylinder can be placed in another surrounding structure of the same missile vehicle type. Insofar, there is a chance that the main and most valuable part of a submarine of the described type may be re-commissioned in full intact condition, including the personnel.

Regarding the structural layout of the proposed submarine with special reference to the annular missile stowage chamber, it should be appreciated that the configuration of the proposed submarine lends itself favorably to efficient statical conditions.

The backbone of the structure is the vertical hull cylinder which accommodates the detchable center cylinder. Heavy girders, radially arranged from the hull cylinder up to the periphery of the ellipsoidal hull and extending from the upper and lower level of the missile chamber to the bottom and the upper shell, respectively, constitute a rigid framework. Since there are two suspension points of the radial girders with a considerable depth inwardly and tapered to the periphery, where the upper and lower girders are connected by heavy webs, it is possible to create an annular missile stowage chamber which is free of obstructive structures allowing free revolving of the missile stowage system.

The submarine of the present invention offers also advantages with regard to shock absorption of depth charges. The entire center cylinder is considered as a foundation, and the space between the independent center cylinder and the hull cylinder is occupied by rubberized material with polytetrafluoro ethylene linings facilitating vertical motions of the center cylinder when the latter detaches from the vehicle in case of emergency.

Contrary to conventional submarines where foundations are directly connected to the pressure hull and, therefore, directly exposed to shocks, the present invention provides an independent and elastically mounted center cylinder to which foundations and decks are attached. The center cylinder is in addition protected by the surrounding submarine structure which absorbs a part of the shock before the shock wave affects the center cylinder.

The same is true for the missile capsules which can be mounted within the framework of the revolving platform on rubber lined structures as shock absorbing means protecting the missiles inside the capsules against the shock of depth charges.

With reference to the configuration of the hull as disclosed by my U.S.A. Patent No. 3,286,672, it is suggested, for reason of smaller resistance, to add fairing bodies fore and aft resulting in a higher speed of the submarine at comparatively same output.

Concerning the arrangement of propulsion means, stabilizing, braking and rudder planes, I refer to my above cited patent. With this propulsion, braking and rudder system, it is possible to maneuver a submarine in an unexcelled manner as described herein-after in more detail.

Other advantages and features of the invention become more apparent when the description of now preferred embodiments of the invention proceeds in conjunction with the drawing, wherein

FIG. 1 is a plan view of the submarine with an ejection tube at the tail section;

FIG. 2 is an inboard elevation of FIG. 1;

FIG. 3 is a view on the revolving structure along lines *a—a* of FIG. 2;

FIG. 4 is a view on the submarine with a partial cutaway showing the revolving platform and a hatchcover over the missile releasing space;

FIG. 5 is in part an outside profile and in part an inside profile of FIG. 4;

FIG. 6 is a view on the revolving structure along lines *b—b* of FIG. 5;

FIG. 7 is a partial and detailed inboard elevation of FIG. 2;

FIG. 8 is a partial and detailed inboard elevation of FIG. 5;

FIG. 9 is a typical maneuver diagram.

Referring now to the drawing and particularly to FIGS. 1 and 2, there is a submarine **1** of preferably elliptical shape around the smaller revolving axis **1***a* with fairing bodies **2** and **3**. The center of the submarine **1** is occupied by a detachable cylinder **4** for accommodating operating personnel and machinery, and a hull structure cylinder **63**. An annular chamber **5**, and a revolving platform **6**, are arranged in the symmetry plane **7** of the submarine **1**. Stabilizing planes **8** with flaps **9**, **10** are attached to the rear. Propulsion means **11** are arranged peripherally on port and starboard of the submarine **1**. Propulsion forces **12** on port and starboard are acting at a distance **13** ahead of the midship axis **14** of the submarine **1**. The cap **15** of the center cylinder **4** contains an access hatch **16** and may be covered by an elliptical conning tower **17**.

Encapsulated missiles A through Q are mounted in cylinder **32**, which, in turn, are mounted in preferably two plate rings **20**, **21**, connected to the revolving platform **6**, as best shown in FIG. 3.

Torus buoyancy bodies **22** and spherical buoyancy bodies **23** are arranged within the space of the submarine **1**, as shown in FIGS. 2 and 7. The remaining space of the submarine communicates with the ocean through holes **18**.

Below or above each missile there are radially arranged tanks **24** of preferably spherical shape which replace buoyancy and trimming moments of ejected missile capsules. **24***a* are gas producing means, **24***b* are valves.

When the missile capsules are loaded while the submarine **1** is in a drydock, the weight **25** of the missile capsules is carried by the revolving platform **6**. The missile capsules are floating up when the submarine **1** is submerged, producing forces **26** at the upper structure of the revolving system which are transferred to the submarine structure by anti-friction bearings **27**, as illustrated in FIG. 3.

A missile ejecting tube **28** is arranged in the tail section of the submarine **1** with a fairing nose **29**. The fairing nose **29** is swung aside by hydraulic means **30**. The missile ejecting chamber **28** communicates all the time with the ocean. When a missile capsule is ejected from the tube **28**, water within the tube **28** is first expelled in direction of arrow **31**.

Missile capsules A through Q are housed in a special cylinder **32** which is open at the outer end and closed by a half-sphere at the inner end. The inner end of the cylinder **32** contains a propellant chamber **33**, as indicated in FIG. 7. Pressure gases are produced by ignition of the propellant which expel the missile capsule to outside through the tube **28** in the fashion of torpedo firing.

The forward end of the tube **28** has a special ring **34** forming a receptacle for the cylinders **32** when the latter are moved backwards by hydraulic means **35**, as shown in FIG. 7. In this way a continuous tube, consisting of the cylinder **32** and the ejecting tube **28**, serves as ejecting chamber for the missile capsule. While the missile capsule is ejected, the cylinder **32** recoils allowing free revolving of the platform **6** until the next missile is in front of the tube **28**.

In the instant of ejecting a missile the uplift force **26** becomes free and is instantly replaced by blowing the adjacent tank sphere **24**. Blowing of the tank spheres **24** follows in subsequent order. For instance, after missile A is ejected, the revolving platform **6** turns B in front of the tube **28** and the tank sphere **24** below or above Q is drained. When missile C is placed in front of the tube **28**, A is turned above the original place of the missile P, and the tank sphere **24** below or above the original missile

P is drained, and so forth. From this it appears that tank spheres 24 are subsequently blown from Q over J up to A, so that, when all missiles are ejected, the original uplift buoyancy forces 26 of all missiles are replaced by corresponding uplift buoyancy forces of the tank spheres 24. The original weight and buoyancy forces are preserved throughout the entire missile ejecting procedure.

This refers also to trimming moments and level trim because tank spheres 24 are arranged so as to produce the same trimming moments of the missile capsules.

FIGURES 4, 5 and 6 show a structure especially designed for releasing missiles under their own buoyancy and trim. The submarine 1 has a recess 36 with foldable hatchcovers 37. Missile capsules 19 are clamped in their stowage places on the revolving platform 6 by clamping arms 40, 50 on rings 38, 39, which are rotated by torque hinges 51. In retracted position clamping arms 40, 50 serve also as guidance means when the missile capsules 19 are rising through the recess 36.

During loading the submarine with missile capsules the revolving platform 6 rests on the submarine structure over rollers 52. When the submarine is submerged the missile capsules are floating up together with the revolving structure in the limit of a predetermined small clearance and touch the upper boundary 5*a* of the annular chamber 5 at upper rubberized and solid polytetrafluoroethylene lined sliding ways 38*a*, 39*a*.

An annular channel 54 and a rubber ring 55 keep the missile capsules 19 in place against axial displacements under the influence of trim or shockloads. A fluke 56 engages the channel 54 throughout the revolving process.

When a missile capsule reaches the releasing chamber 36 the fluke 56 engages a rotatable claw 57 mounted on a support 58 at the rear of the recess 36. The bottom of the recess 36 may run out in lines 59 and 59*a* providing clearance when the missile capsule 19 detaches after rotating around the fulcrum of the claw 57 by its own buoyancy force, further assisted by the crossflow 60 in case the submarine proceeds. When the missile capsule has turned in about vertical position as indicated by arrow 61, the fluke 56 disengages automatically from the claw 57 while the missile rises along a line as indicated by 62.

Referring now to FIG. 7, reference is made to my U.S.A. Patent No. 3,292,564. The center cylinder 4 is movably arranged within a special cylinder 63 which is part of the structure of the submarine 1.

A lower ring 64 prevents the central cylinder 4 from moving up at the presence of positive buoyancy of the center cylinder 4. An upper ring 65 prevents the center cylinder 4 from sagging through at the presence of negative buoyancy of the center cylinder 4. In case of emergency the lower ring 64 is detached by explosive means which allows the center cylinder 4 to float up, detaching itself from the submarine structure. The center cylinder 4 ascends then to the surface.

The center cylinder 4 has in case of emergency positive buoyancy attained by blowing the annular ballast tanks 66, 67, which are designed to produce a distinct buoyancy. Blowing of tanks 66, 67 precedes detachment of the lower ring 64.

The center cylinder 4 is subdivided in different deck levels. Atop there is a deck 68 for navigation and serving as an operational center. Decks 69, 70 follow for accommodations, mess, galley, proviant, revitalization equipment. The lower part of the center cylinder 4 is occupied on deck 71 by heavy weights, such as pumps, electronic equipment and auxiliary machinery, turbo-generators and condenser on deck 72, heat exchanger and steam drums on deck 73. The lowermost compartment 74 is reserved for the nuclear reactor 75 and ballast/buoyancy tanks 66 and 67.

A vertical tube 76 with access hatches 77, a lift 78 and an emergency ladder 78*a* connects all decks and the machinery spaces.

As a protective measure against shocks from depth charges the center cylinder 4 is mounted within heavy rubber pads 79, lined with polytetrafluoroethylene.

Missiles A through Q are also protected against shocks from depth charges by heavy rubber pads 80 between the missile capsule and the structure of the revolving platform 6, as typically shown in FIG. 3.

The structure of the revolving system is dimensioned so as to withstand shock effects not only in respect to strength and vibrations but also particularly for securing the revolving system against becoming clocked after heavy shock loads and vibrations. 1*c*, 1*d* are radially arranged girders, attached to the cylinder 63 and connected by webs 1*e* at the periphery of the hull.

Jet propulsion tubes 81, 82 are arranged at the periphery and within the boundaries of the cylinder 4 for self-propulsion of the latter in case of emergency.

A submarine with propulsion, steering and breaking means, as more fully described in my U.S.A. Patent No. 3,286,672, offers unique maneuver capabilities which submarines of present design do not possess.

For instance, as illustrated in FIG. 9, a submarine of the present invention may proceed at high speed on course 83, and may encounter depth charges at 84, where the submarine not only may be brought to a quick stop by placing flaps 9 in vertical position and flaps 10 swung at 90° to inside setting in this way a powerful brake, but at the same time the submarine can be turned quickly by reversing the propulsion force 12 on portside.

After the submarine is turned 180°, flaps 9 and 10 are swung back in neutral position, and the propulsion force 12 on portside is reverted to backward thrust. These operations follow in quick succession. The submarine assumes then speed on return course 83*a*.

The nature itself gives an example how a bird or rabbit tries to evade a pursuing enemy by assuming a zigzag course. The same evading procedure, which may confuse a submarine destroyer or submarine killer, can be accomplished with the present submarine.

When it is desired to go quickly on zigzag course at point 85 without losing substantial speed, the propulsion force 12 on starboard is reversed to forward thrust for a short instance, flap 9 on starboard is swung in vertical position, and flap 10 inside, both also for a short instance, whereupon the submarine is quickly turned on course 86, proceeding with high speed up to point 87, where propulsion means and flaps are used in a similar manner for turning the submarine on a new zigzag course 88 up to point 89 and so forth. It is obvious that a submarine chaser or killer has difficulties to follow a zigzag course as described or to predict by hydrophones the probable course of the chased submarine for proper advanced placing of depth charges with a certain probability of success.

It should be appreciated that the high degree of maneuverability is not only attained by the special arrangement of propulsion means and flaps but is to be contributed also to the fact that masses are concentrated in the center of the system resulting in a smaller radius of gyration and, consequently, smaller mass inertia forces and moments. The concentrated arrangement of the entire machinery within a center cylinder contributes greatly to the increased maneuverability of the submarine. Contrary hereto, the masses of conventional submarines are distributed along a longitudinal axis resulting in a larger radius of gyration. In addition to the mass inertia effect and comparatively small hydrodynamical effect of customary rudder arrangements at the stern, a conventional submarine of elognated shape cannot turn as quickly as a submarine of the present configuration because of hydrodynamic greater turning resistance.

Taking by comparison all these effects in combined account, a submarine of the present invention offers far improved maneuver capabilities over customary submarines, which in a deciding moment may save the submarine from destruction.

It should also be appreciated that due to the vertical mass distribution within the center cylinder, a favorable effect is attained with reference to dynamic stability when the center cylinder is detached from the submarine structure in case of emergency as an independent floating body.

Pipes and wires for remote controlled stations outside of the center cylinder penetrate the center cylinder 4 at one point only which facilitates cutting off the lines by explosives for unobstructed rising of the center cylinder in case of emergency.

It is understood that the present invention is also applicable to other underwater weapons, such as torpedos, subroc-type missiles, mines, and similar weapons.

While the invention has been described and illustrated by certain preferred embodiments, it will be understood that many variations and modifications may occur to the skilled in the art, particularly after benefiting from the present teaching without departing from the spirit and scope of this invention as defined in the appended claims.

I claim:

1. A submarine, comprising an ellipsoidal hull with its vertical axis being the smaller and revolving axis, fairing bodies fore and aft of said ellipsoidal hull, an independent first center cylinder, a second structural center cylinder accommodating said first cylinder, an annular chamber within said hull and in the horizontal symmetry plane of said hull, a revolving platform in said annular chamber, missile capsules mounted in radial arrangement on said revolving platform, propulsion means at the periphery of said hull and slightly set forward of the midship plane of said hull, stabilizing, rudder and breaking planes at the stern of said hull, and fairing planes fore and aft of said propulsion means.

2. The submarine of claim 1, comprising further a number of storage cylinders accommodating said missile capsules, said storage cylinders being open at one end and closed at the other end by cap means, said storage cylinders being movably mounted in at least two annular vertical plate girders fixedly attached to the revolving platform, an ejecting tube in the centerline and in the aft section of the hull, a turnable fairing nose at the rear of said ejecting tube, a recess at the forward end of said ejecting tube matching said storage cylinders, guidance rings with elastomeric linings at the second center cylinder and at the periphery of the hull in alignment with the storage cylinders and the missile capsules, respectively, piston means at the second cylinder in alignment with the axis of the ejecting tube, propellant chambers at the rear of said storage cylinders, at least two annular sliding ways above said storage cylinders, and rollers at the upper edge of said annular girders in way of said sliding ways.

3. The submarine of claim 1, comprising further a series of missile capsules radially arranged on the revolving platform, at least two annular plate girders on the revolving platform, said annular plate girders having circular incuts matching the missile capsules, clamping means on said annular plate girders, said clamping means engaging the missile capsules, a releasing chamber aft of the midship plane of the hull, foldable hatchcovers above said releasing chamber, a guidance ring with elastomeric linings at the second center cylinder and in alignment with the missile capsules, the missile capsules having at the rear a fluke, said fluke engaging a channel guidance ring at the periphery of the hull, a rotatable and spring-biased claw at the rear of said releasing chamber, said claw mounted on a support and in alignment with said flukes, a recess aft of said support and in continuance of the releasing chamber, at least two annular sliding ways with elastomeric linings, said annular sliding ways fixedly attached to the hull structure and above and in alignment with the annular plate girders on the revolving platform.

4. The submarine of claim 1 comprising further a first buoyancy system, defined by the first cylinder, and a second buoyancy system, defined by the hull surrounding the first cylinder, said first cylinder having a first and second buoyancy/ballast tank in annular arrangement at the lower portion of said first cylinder, said first cylinder being at neutral buoyancy with the first tank ballasted and the second tank partially ballasted, said second buoyancy system having spheres and toroid bodies as permanent buoyancy bodies producing neutral buoyancy of said second buoyancy system in combination with buoyancy/ballast spheres above and below each missile capsule, said buoyancy/ballast spheres having a distinct buoyancy volume corresponding with the buoyancies of the missile capsules, said buoyancy/ballast spheres being filled with water prior to ejecting missile capsules, and constituting permanent buoyancy bodies after ejecting of missile capsules, said buoyancy/ballast spheres having built-in propellant capsules and gas escaping valves.

5. The submarine of claim 1 wherein the net space of the hull surrounding the first cylinder is pressure-equalized and open to the sea, and the first cylinder is a pressure vessel.

6. The submarine of claim 1 wherein said first cylinder accommodates deckstructures in vertical order, heavy machinery foundation structures in the lower portion of said first cylinder, a center tube within said first cylinder, a lift and an emergency ladder within said center tube, access hatches in said center tube at different decklevels, at least two propulsion jet tubes at the periphery and within the boundaries of said first cylinder, an annular ballast tank structure in the lower portion of said first cylinder, rings overjutting the rim of the second cylinder, the lower ring being detachable by explosive means, one outlet structure for cables and other means for remote controlled stations outside the first cylinder, said outlet structures being destructible by explosive means.

7. The submarine of claim 1, comprising further a radially arranged girder system, said girder system consisting of upper and lower girders in vertical alignment extending from the upper edge of the annular missile storage chamber to the upper shell, and from the floor of the annular missile storage chamber to the lower shell, respectively, said girders fixedly attached inwardly to the second structural center cylinder, and connected to each other by webs at the periphery of the hull.

8. The submarine of claim 1, wherein the annular space between the first and second cylinders is occupied by elastomeric material, said elastomeric material being fixedly attached to the second cylinder and being lined with polytetrafluoroethylene on the surface facing the first cylinder.

9. The submarine of claim 1, wherein supports for the storage cylinders and missile capsules, and the annular space between the storage cylinders and the missile capsules, respectively include an elastomeric material associated therewith.

References Cited

UNITED STATES PATENTS

2,311,539	2/1943	Hanley	114—17
2,361,949	11/1944	Langdon	114—17

MILTON BUCHLER, *Primary Examiner.*

T. M. BLIX, *Assistant Examiner.*