Oct. 22, 1963 J. A. HAYNES 3,107,641

SUBMARINE VESSEL

Filed March 3, 1961 2 Sheets-Sheet 1

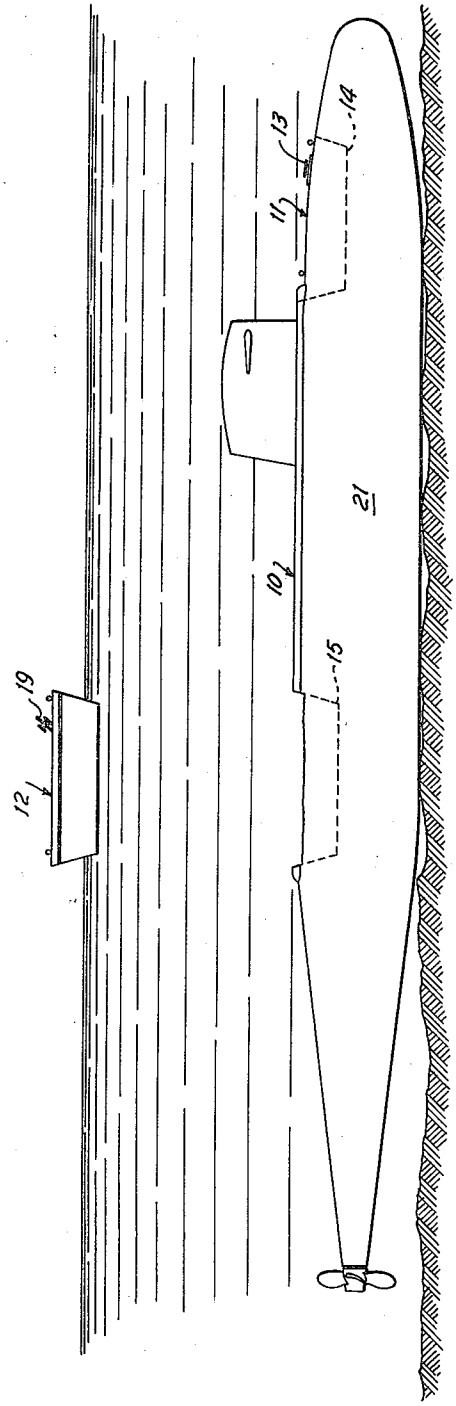


Fig. 1

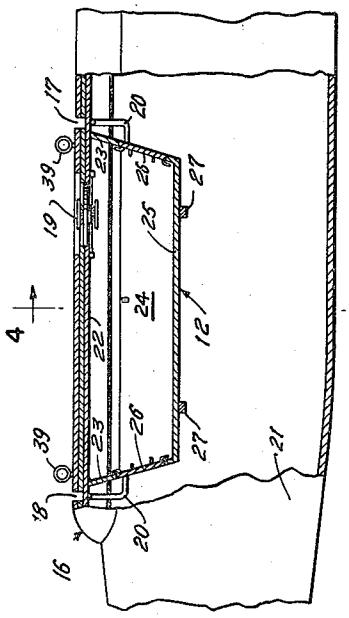


Fig. 3

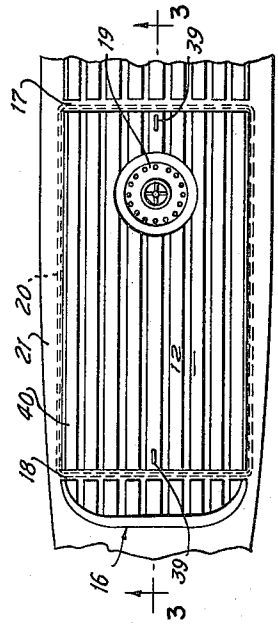


Fig. 2

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SUBMARINE VESSEL

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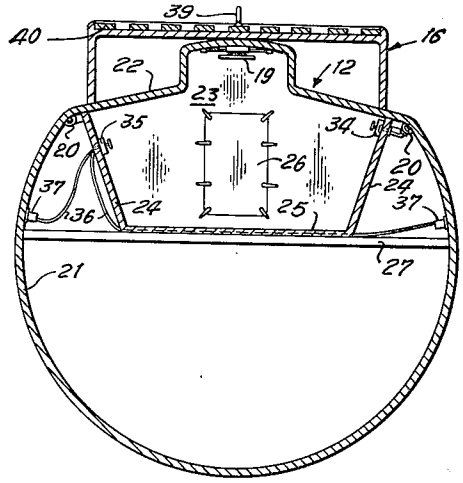


Fig. 4

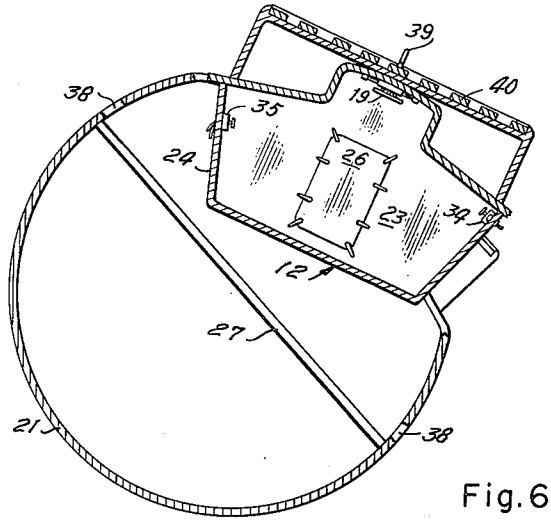


Fig. 6

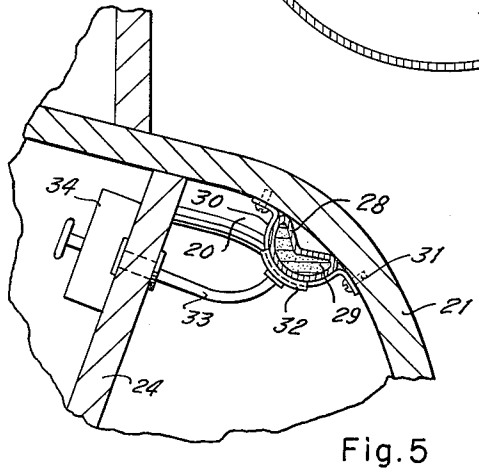


Fig. 5

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SUBMARINE VESSEL

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This invention relates to submarine vessels, and more particularly to a submarine having an escape compartment severable therefrom by means of an explosive device, especially a linear shaped charge explosive device.

It is not uncommon, particularly in time of war, for the entire crew of a submarine to perish because of damage to the submarine which prevents the submarine from returning to the ocean surface. Peacetime accidents due to collision and like causes also extract a heavy toll. Submarines are usually divided into various watertight compartments which crewmen can seal off and survive for a limited time. Aqualungs or Momsen lungs can be used by individual crewmen to escape when the submarine is in relatively warm, shallow water. Specialized rescue diving bells are usually located remote from the disabled submarine and often cannot be moved to the disaster site and put into operation before the crewmen perish. A most effective escape system for a submarine would be one that is self-contained within the submarine itself, would not require any outside assistance to operate, and would protect the survivors from an intemperate environment.

It is therefore an object of the present invention to provide an efficient, simple escape system for crewmen of submarines which is carried by the submarine and may be operated from within the submarine by the trapped crewmen, and which does not require any special training for its operation.

A further object of the present invention is the provision of a submarine escape system which will permit the crewmen to escape from a disabled submarine with safety when the submarine is submerged in very deep water.

Another object of the present invention is the provision of a submarine escape system wherein the escape means is operable when the submarine is tilted over on its side or with its nose up or down.

The beforementioned objectives of the present invention are achieved in a submarine including a first pressure hull and a second pressure hull extending into the interior airspace contained within the first pressure hull. The second pressure hull has sidewall partitions, end wall partitions, and a floor partition separate from the first pressure hull, and a roof common and integrally formed with an upper section of the outer wall of the first pressure hull. The sidewall partitions, end wall partitions, and floor partition are the sole partitions separating the interior airspace of the second pressure hull from the interior airspace of the first pressure hull. At least one of the partitions provides an opening therethrough to permit crewmen access to the second pressure hull from the first pressure hull. Watertight and airtight openable door means close the opening. A linear shaped charge explosive device is positioned to sever the outer wall of the first pressure hull completely around and adjacent to the upper section forming the roof of the second pressure hull to free the second pressure hull from the first pressure hull.

In the drawings:

FIG. 1 is a side elevational view of a submarine embodying the present invention shown lying on the ocean floor with one of the escape compartments floating on the surface of the ocean;

FIG. 2 is a plan view of a section of the submarine of FIG. 1 showing the top of an escape compartment with the severing means shown in dotted outline;

FIG. 3 is a vertical, longitudinal, sectional view taken along line 3—3 of FIG. 2;

FIG. 4 is an enlarged sectional view of the escape compartment taken along line 4—4 of FIG. 3;

FIG. 5 is a fragmentary, further enlarged, sectional view showing details of the escape compartment severing means; and

FIG. 6 is a sectional view taken on the same section line as FIG. 4 but showing the severed escape compartment floating up out of the submarine.

Referring now to FIG. 1 of the drawings, a submarine, designed 10 generally, is shown which is provided with a forward escape compartment, designated 11 generally, and an after escape compartment, designed 12 generally. The forward compartment is within the silhouette of the submarine and is depicted in dotted outline at 14. The forward escape compartment is provided with a watertight hatch cover 13 which is operable from both within and without the escape compartment. The after escape compartment 12, as shown in FIG. 1, has been severed from the submarine and is floating on the surface of the ocean. The position occupied by the after escape compartment within the silhouette of the submarine before it is severed therefrom is shown in dotted outline at 15.

Referring now to FIG. 2, the submarine deck structure, designated 16 generally, is discontinuous at the forward end 17 and the rearward end 18 of the after escape compartment 12. The after escape compartment is provided with a water-tight hatch cover 19 similar to that of the forward compartment. Suitable slats 40 may be fixed to the upper surface of the deck structure to provide a sure footing for the crewmen when they are topside the submarine. A linear shaped charge explosive device 20, to be described more fully hereinafter, is shown in dotted outline as completely surrounding the after escape compartment 12. A similar linear shaped charge explosive device (not shown) also surrounds the forward escape compartment 11.

While the following description of structure and manner of operation refers particularly to the after escape compartment 12, it is to be understood that the forward escape compartment 11 may also be of similar construction and operation. Further, the escape system of the present invention is not limited to the use of any specific number of escape compartments within a submarine, but may utilize any number of such compartments depending upon the particular design of a specific submarine.

Referring now to FIGS. 3 and 4, the submarine has an outer or first pressure hull 21 which partially surrounds the forward escape compartment 11 and the after escape compartment 12, which compartments may be considered as second pressure hulls. The outer hull 21 and the after escape compartment 12 have a common, integrally formed, outer wall or roof section 22 which is exposed by the breaks in the deck structure to the hydrostatic pressure of the ocean when the submarine is submerged. The remainder of the after escape compartment 12, including the upwardly diverging end walls 23, the upwardly diverging side walls 24, and the floor 25, is contained within the first pressure hull 21 of the submarine. The side walls and end walls of the escape compartment are attached to the common outer wall section 22 of the outer hull 21 by welding or other suitable means to provide an airtight, watertight, pressure-resistant escape compartment substantially within the interior of the submarine. The end walls 23 of the escape compartment are provided with openings therethrough to permit the crewmen access to the escape compartment from the interior of the submarine. The openings are closed with watertight and airtight doors 26 to seal the escape compartment off from the interior of the submarine prior to separation of the escape compartment from the submarine hull. The

escape compartment is severed from the hull of the submarine by means of a linear shaped charge explosive device **20** which is positioned inside the pressure hull **21** adjacent the escape compartment **12** and completely surrounds the same. Beams **27** are fixed at each end to the inside wall of the pressure hull **21** and abut the underside of the floor **25** of the escape compartment in supporting relationship to the latter. If the escape compartment is located in a section of the submarine having two decks, the floor of the escape compartment may rest directly on the upper deck of the submarine but would not be attached thereto in any permanent manner.

Referring now to FIG. 5, the linear shaped charge device **20** has a metal casing **28** made from a suitable metal, such as copper, which is filled with a compressed detonating explosive **29**, such as cyclonite. Typical linear shaped charge explosive devices adaptable for use in the present invention are described, together with a process for making such devices, in the copending U.S. patent application Serial No. 67,817 of Richard F. Hatfield for "Process of Making Linear Shaped Charge Explosive Devices, Apparatus Therefor and Devices Made Thereby," filed November 7, 1960, and assigned to the same assignee as the present application. The shaped charge device is held in place on the inside of the hull **21** by means of straps **30** which are held by screws **31** tapped into the hull **21**. An electric detonator is held in position to fire the shaped charge device by means of a clip **32** on a strap **30** and is connected to a first electric generator **34** inside the escape compartment by means of an electrical cable **33**. As a safety measure to insure detonation of the shaped charge device, additional electric detonators may be placed at spaced apart locations on the shaped charge device and connected by separate electrical cables to the first electric generator **34**. Referring again to FIG. 4, a second electric generator **35** is mounted on the inside wall of the escape compartment **12** and is connected by electrical cables **36** to shaped charge explosive units **37** located on opposite walls of the pressure hull **21**. There may be a plurality of cylindrical shaped charge units located on each wall, or, if preferred, one or more linear shaped charge units may be used in place of the cylindrical shaped charge units. Shaped charge units **37** may be, and preferably are, provided to perforate the outer hull **21**, after the crewmen are safely sealed in the escape compartment, to flood the interior of the submarine, thereby tending to equalize pressures within and without the hull of the submarine and to buoy up the escape compartment before the linear severing charge **20** is fired to separate the escape compartment from the hull **21**. Under certain conditions, the expanding gases generated when the linear severing charge **20** is fired will increase the pressure of the sea water within the hull **21** to help eject the buoyant escape compartment upwardly from the submarine hull. The shaped charge units **37** are optional and may be dispensed with in some installations.

In normal operation of the submarine, it is anticipated that the escape compartments **11** and **12** would be utilized as regular operating areas of the submarine. They may be used for storage compartment, as sleeping quarters for the crewmen, or any use which may be suitable. Each of the escape compartments would be permanently equipped with oxygen tanks, emergency food rations, an electrical generator, and auxiliary radio receiving and transmitting equipment to facilitate rescue when the escape compartments reach the surface of the ocean. Any necessary electrical cables, pipes, conduits, etc., that connect the escape compartment to the main body of the submarine may be cut by suitable auxiliary shaped charge explosive devices that are fired at the same time as the linear severing charge **20**. Such an arrangement would prevent possible fouling of the buoyant escape compartment by such connections with the submarine proper.

In the event that a submarine equipped with an escape system in accordance with the present invention becomes disabled when submerged and cannot return to the ocean surface, the crewmen report to the escape compartment to which they have been previously assigned. The sections of the submarine containing the escape compartments are sealed off to prevent these sections from flooding while the escape compartments are prepared for use. Unnecessary equipment within the escape compartments is removed and left in the submarine to provide more room and less dead-weight in the escape compartments.

Operation of the escape system of the present invention will be described with particular reference to the after escape compartment **12**. It is to be understood that all other escape compartments operate in a similar manner. After removal of unnecessary equipment, the crewmen enter the escape compartment and seal off the watertight doors **26**. The second electric generator **35** is then energized, firing the shaped charge units **37** to perforate the outer pressure hull **21** of the submarine with openings **38**, as seen in FIG. 6. Water enters through the openings **38** and partially fills the section of the submarine between the outer hull **21** and the escape compartment **12**. The flooded section of the submarine will then be at the same pressure as that of the ocean outside the submarine. By perforating the pressure hull **21** slightly above the floor level of the escape compartment, an air pocket will be formed between the side and end walls of the escape compartment and the upper wall section of the pressure hull. This air pocket provides a cushion for detonation forces created when the linear severing charge device **20** is fired. Cushioning the detonation forces will prevent damage to the seam where the side and end walls of the escape compartment join the outer pressure hull. After sufficient time has elapsed to equalize the pressure within the flooded section of the submarine, the first electric generator **34** is energized to detonate the linear shaped charge device **20** which completely surrounds the escape compartment. The linear jet formed by the detonation of the severing charge **20** will cut through the outer pressure hull **21** entirely around the escape compartment **12** to separate it from the hull of the submarine. Water pressure within the interior of the pressure hull will be increased by detonation of the severing charge and the buoyant escape compartment will be ejected upwardly to float free of the submarine and rise to the surface of the ocean. Cross beams **27** are provided underneath the escape compartment to prevent the escape compartment from being forced downwardly inside the pressure hull **21** by the force of the water flowing in to fill the air space remaining in the submarine. This force would be minor if the interior of the submarine were substantially flooded as described hereinbefore. But, if for any reason the interior of the submarine could not be flooded before the severing charge was fired, the cross beams **27**, or equivalent support means, would prevent the escape compartment from being forced downwardly into the pressure hull by inrushing water and possibly wedging therein. The upwardly diverging end walls **23** and side walls **24** of the escape compartment prevent the compartment from wedging in the opening cut by the linear severing charge. As can be seen in FIG. 6, even if the submarine is resting on its side, the buoyant escape compartment will float into an upright position and rise to the surface of the ocean. If by accident the escape compartment did wedge in the opening in the pressure hull, a radio buoy could be sent to the surface to summon a rescue ship to send divers down to free the wedged escape compartment. After arrival on the surface of the ocean, the hatch cover **19** may be opened for ventilation of the compartment.

Limitations imposed by the design of a particular submarine may preclude the provision of escape compartments which are buoyant. In such cases, the escape system of the present invention may still be utilized effectively to rescue submarine crewmen with the assistance of a surface rescue ship equipped with divers or diving bells

and cable winches. The non-buoyant escape compartments may be of the same or similar design as that shown and described herein with the added provision of hook eyes 39 located on the upper surface near each end of the escape compartments, as shown in FIGS. 2 and 3. Each escape compartment would be provided with a radio buoy in a watertight compartment which, upon release, would rise to the surface of the ocean. The buoy would be connected to the escape compartment by an electrical cable to prevent the buoy from drifting away from the submarine and to permit sending of distress signals by an operator within the escape compartment. Rescue forces would obtain a radio fix on the buoy and dispatch a suitably equipped rescue ship to the location of the disabled submarine. On arrival at the site, divers from the rescue ship would descend to the deck of the submarine and attach lifting cables to the hook eyes 39 of the escape compartment. After the divers had returned to the surface rescue ship, the trapped crewmen would fire the shaped charges to flood the submarine and then the linear severing charge device to cut the escape compartment free from the submarine. As a safety measure, additional electrical leads for the detonator to fire the linear severing charge may be extended through the pressure hull for connection to an electrical energy source outside the submarine. Thus, if any malfunction occurs in the firing mechanism inside the escape compartment, the rescue divers could energize the detonator to fire the severing charge from a safe distance outside the submarine to release the escape compartment. The non-buoyant escape compartment would then be hoisted to the surface of the ocean by the cables and associated winches on the rescue ship.

The escape system of the present invention is ideally suited for use in present day atomic energy powered submarines which often operate for extended periods of time in the polar regions. A person cannot survive more than a few minutes when immersed in near-freezing polar waters. Since in the present escape system the crewmen are completely enclosed in a dry, watertight compartment, they could survive for an extended period of time even in weather conditions that exist in the polar regions.

From the foregoing description, it will be apparent to those skilled in the art that various modifications in construction and arrangement can be made in the submarine escape system of the present invention without departing from the spirit of the invention.

I claim:

1. A submarine vessel comprising:
(*a*) a first pressure hull;
(*b*) a second pressure hull substantially within said first pressure hull;
(*c*) said hulls having a common outer wall section;
(*d*) a first shaped charge explosive device operable from within said second pressure hull to sever said first pressure hull completely around said common outer wall section and adjacent thereto;
(*e*) and a second shaped charge explosive device operable from within said second pressure hull to perforate said first pressure hull to flood the interior of that portion of said first pressure hull surrounding said second pressure hull prior to operation of said first shaped charge explosive device.

2. A submarine vessel comprising:
(*a*) a first pressure hull;
(*b*) a second pressure hull substantially within said first pressure hull;
(*c*) said hulls having a common outer wall section;
(*d*) a first shaped charge explosive device operable from within said second pressure hull to sever said first pressure hull completely around said common outer wall section and adjacent thereto;

(*e*) support structure on said first pressure hull abutting said second pressure hull to support said second pressure hull within said first pressure hull after said common outer wall section is severed; and
(*f*) a second shaped charge explosive device operable from within said second pressure hull to perforate said first pressure hull to flood the interior of that portion of said first pressure hull surrounding said second pressure hull prior to operation of said first shaped charge explosive device.

3. A submarine vessel comprising:
(*a*) a first pressure hull;
(*b*) a second pressure hull extending into the interior airspace contained within the first pressure hull;
(*c*) said second pressure hull having sidewall partitions, end wall partitions, and a floor partition separate from said first pressure hull, and a roof common and integrally formed with an upper section of the outer wall of said first pressure hull;
(*d*) said sidewall partitions, end wall partitions, and floor partion being the sole partitions separating the interior airspace of said second pressure hull from the interior airspace of said first pressure hull;
(*e*) at least one of said partitions providing an opening therethrough to permit crewmen access to said second pressure hull from said first pressure hull;
(*f*) watertight and airtight openable door means closing said opening; and
(*g*) a linear shaped charge explosive device positioned to sever the outer wall of said first pressure hull completely around and adjacent to said upper section forming the roof of said second pressure hull to free said second pressure hull from said first pressure hull.

4. A submarine vessel comprising:
(*a*) a first pressure hull;
(*b*) a second buoyant pressure hull extending into the interior airspace contained within the first pressure hull;
(*c*) said second pressure hull having sidewall partitions, end wall partitions, and a floor partition separate from said first pressure hull, and a roof common and integrally formed with an upper section of the outer wall of said first pressure hull;
(*d*) said sidewall partitions, end wall partitions, and floor partition being the sole partitions separating the interior airspace of said second pressure hull from the interior airspace of said first pressure hull;
(*e*) at least one of said partitions providing an opening therethrough to permit crewmen access to said second pressure hull from said first pressure hull;
(*f*) watertight and airtight operable door means closing said opening; and
(*g*) a linear shaped charge explosive device positioned to sever the outer wall of said first pressure hull completely around and adjacent to said upper section forming the roof of said second pressure hull to free said second pressure hull from said first pressure hull to permit said second pressure hull to rise to the surface of the ocean.

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