

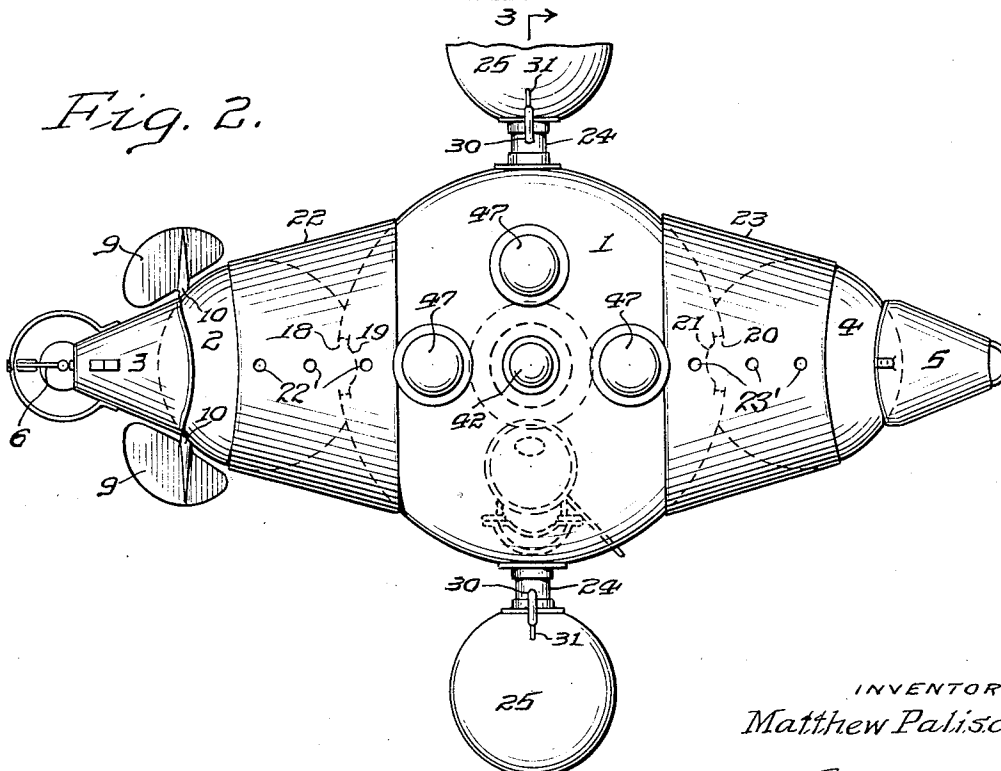
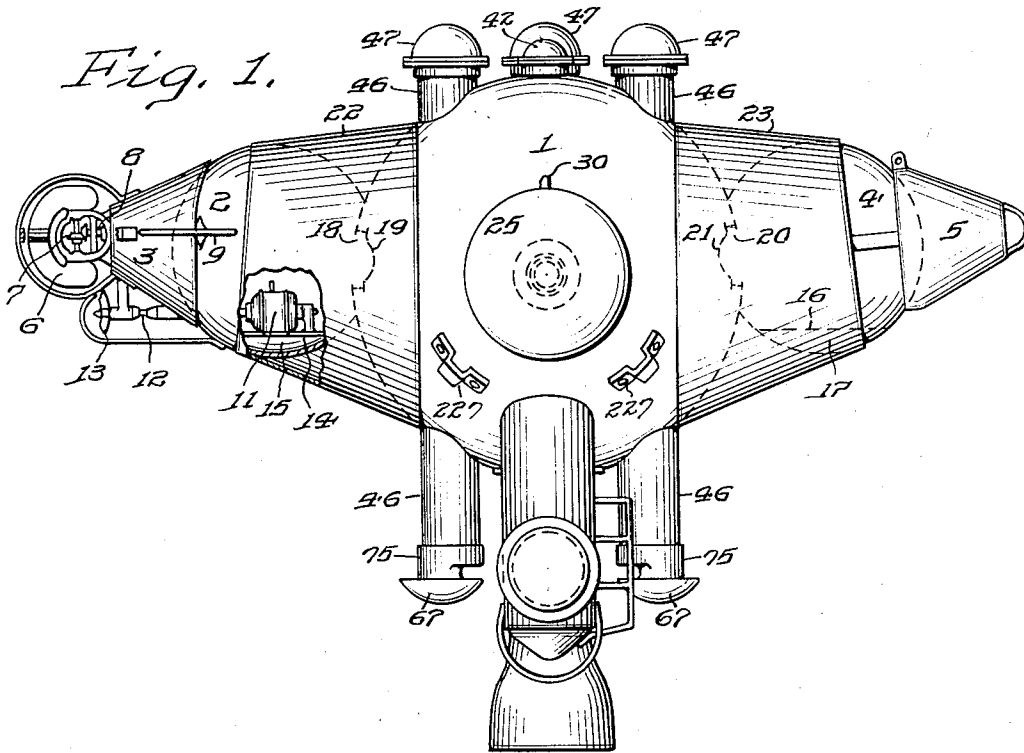
July 11, 1933.

M. PALISCA

1,917,850

SUBMERSIBLE APPARATUS FOR THE RESCUE OF THOSE ENTOMBED IN SUNKEN VESSELS

Original Filed Dec. 27, 1928 4 Sheets-Sheet 1



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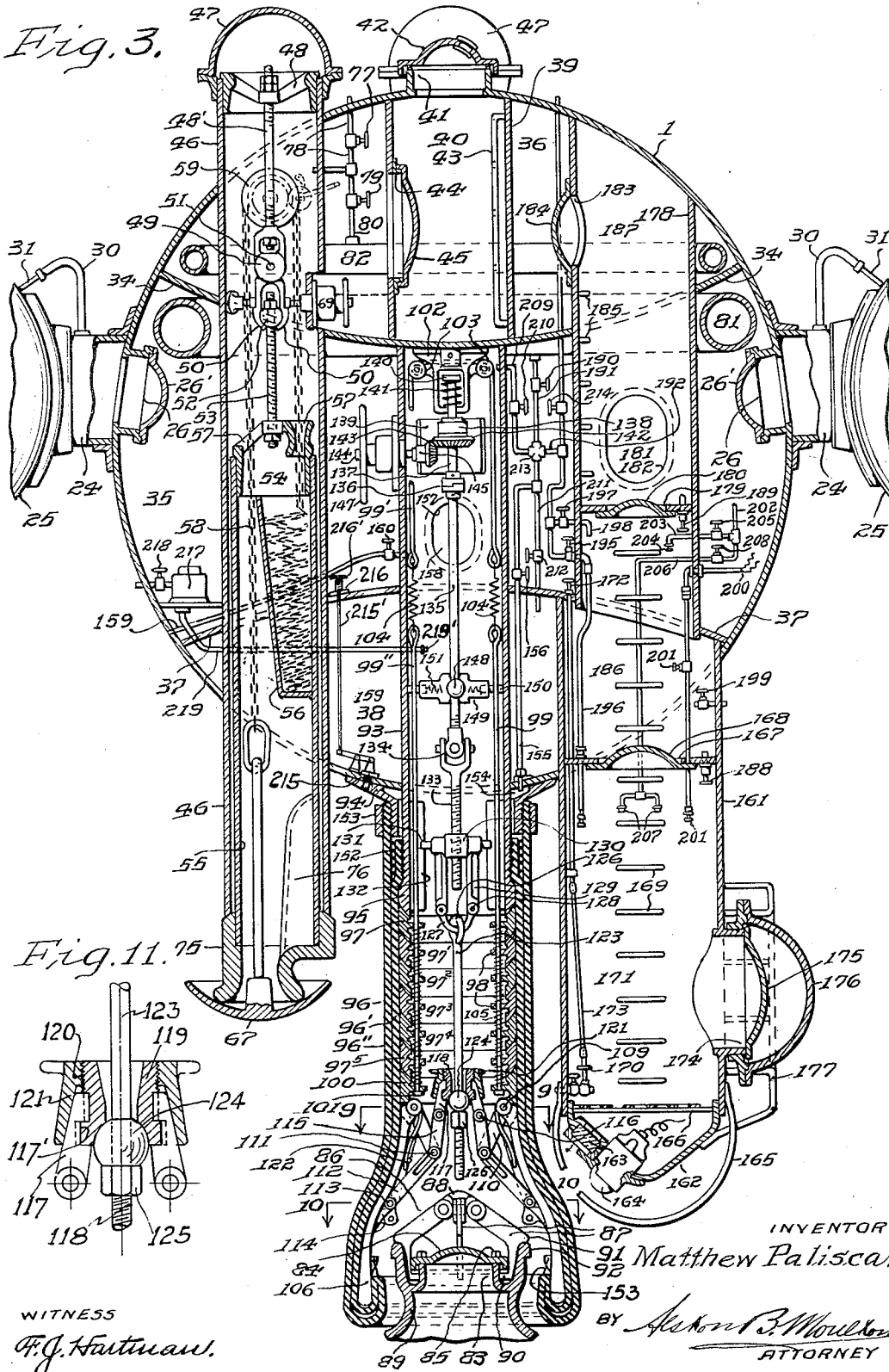
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4 Sheets-Sheet 3

Fig. 4.

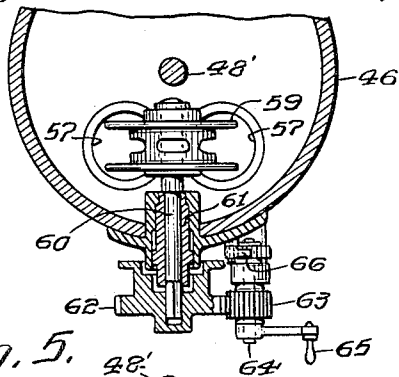


Fig. 6.

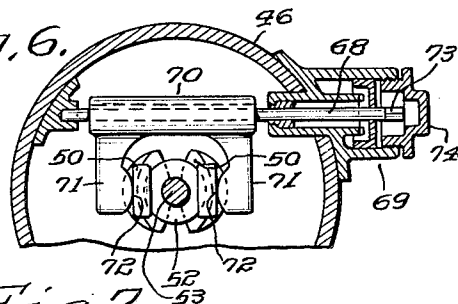


Fig. 5.

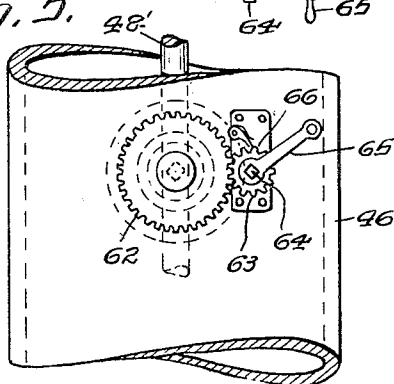


Fig. 7.

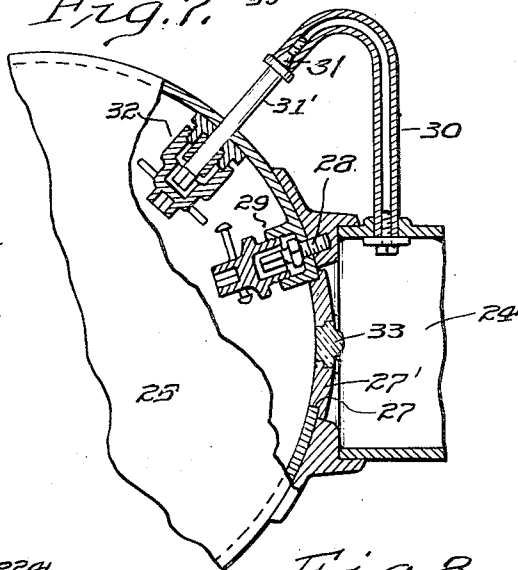


Fig. 10.

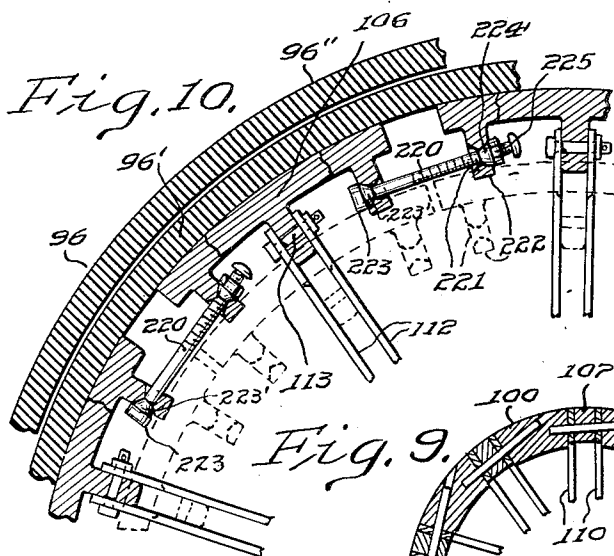


Fig. 8.

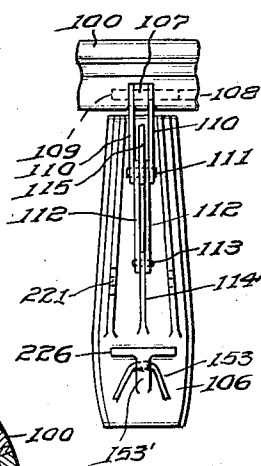
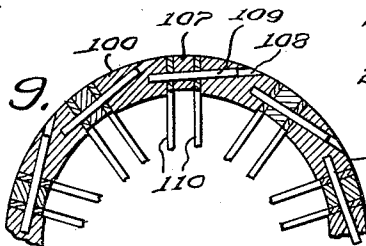


Fig. 9.



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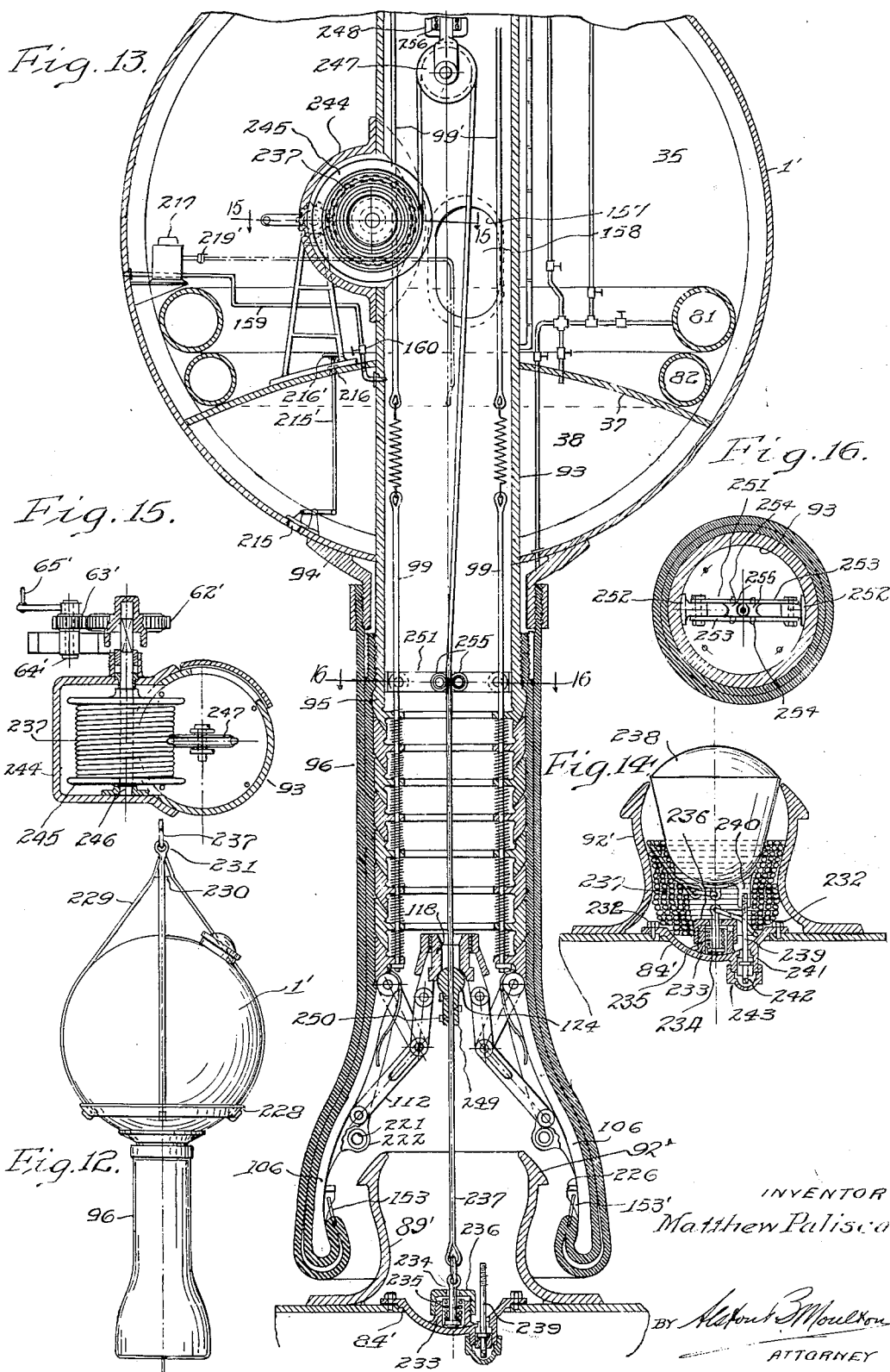
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SUBMERSIBLE APPARATUS FOR THE RESCUE OF THOSE ENTOMBED IN SUNKEN VESSELS

Original Filed Dec. 27, 1928

4 Sheets-Sheet 4



UNITED STATES PATENT OFFICE

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SUBMERSIBLE APPARATUS FOR THE RESCUE OF THOSE ENTOMBED IN SUNKEN VESSELS

Application filed December 27, 1928, Serial No. 328,728. Renewed February 18, 1931.

My invention relates to submersible apparatus, preferably in the form of a boat or submarine vessel, designed and equipped to be submerged to greater depths than those which submarine divers can operate and provided with equipment for anchoring the apparatus, attaching a rescue tube, carried by the apparatus, over a hatch of the sunken vessel to enable one of the crew of my submersible apparatus to remove the hatch from the sunken vessel within the rescue tube and thereby provide a passage through which those imprisoned on the sunken submarine may pass into my improved submersible apparatus.

My invention also has for its object the providing of the rescue tube with removable means for attaching the rescue tube to the sunken vessel and for releasing the same therefrom after rescue has been effected.

A further object of my invention is to provide an observation and diver's tube in conjunction with the rescue tube, whereby the positioning of the rescue tube around the hatch of the sunken vessel may be directed by an expert near the point where the coupling to the sunken vessel is made back into which a diver may make his exit and return, when necessary, to assist in the positioning of the rescue tube with respect to the sunken vessel.

A further object of my invention is to provide means whereby the crew of my submersible apparatus, if disabled and unable to rise from the bottom of the sea, may have a safe way of escape therefrom.

Another object of my invention is to provide the anchor housing, the rescue tube and the diver's or observation tube with means whereby they may also operate or act as water ballasting devices to control the depth to which the submersible apparatus shall descend.

A further object of my invention is to provide the escape tube with expansible inflatable means whereby the end of the tube may be fitted around the neck of the protruding hatch of the sunken vessel in a substantially water-tight manner.

A further object of my invention is to provide

a submarine with a buoy and a long cable or the like, connecting the buoy to the submarine, the buoy being releasable from within the submarine, and to provide an indicator to the rescuing party as to the exact location of the disabled submarine and to provide a guiding cable whereby the submersible may be drawn down by pulling on the cable and the open end of the safety or escape tube may be guided to position over the protruding hatch of a sunken submarine.

In the drawings forming a part of this specification and in which the same reference characters are employed throughout the various views to designate the same parts,

Fig. 1 is a side elevational view of a submersible boat embodying my invention, showing the disposition of the various parts composing the same and carried thereby.

Fig. 2 is a top plan view of the apparatus shown in Fig. 1.

Fig. 3 is a vertical longitudinal section taken on the line 3—3 of Fig. 2.

Figs. 4 and 5 are fragmentary views, the first in section and the second in side elevation, of the winch used in lowering and raising the anchor.

Fig. 6 is a horizontal sectional view through the top of one of the anchor tubes, showing in plan view, a mechanism whereby the anchor and the anchor chain pocket may be dropped free of the submersible vessel, if desired or necessary.

Fig. 7 is a detailed view, in vertical section, showing the connections between the rescue buoys and the main portion of the submersible apparatus.

Fig. 8 is a rear elevational view of one of the battens forming the means for clamping the free end of the rescue tube to the hatch of a sunken vessel.

Fig. 9 is a horizontal cross-sectional view through the ring to which the battens, shown in Fig. 8, are pivoted.

Fig. 10 is a horizontal cross-sectional view on an enlarged scale showing one complete batten and two adjacent battens and the elastic fabric covering therefor, forming the means at the lower end of the rescue tube for

attaching and detaching the tube to the hatch of a sunken vessel.

Fig. 11 is a fragmentary sectional view on a slightly enlarged scale, of a detail of construction, indicated in Fig. 3.

Fig. 12 illustrates a modified form of my invention wherein the submersible is practically a diving bell adapted to be lowered from a mother ship.

Fig. 13 is a vertical longitudinal section of the construction shown in Fig. 12, the same being provided with means for drawing and guiding the submersible down into position over the hatch of the sunken submarine.

Fig. 14 is a fragmentary view of a portion of the submarine, buoy and cable carried thereby, and the means accessible from within the submarine to release the buoy attached to a long cable connected with the submarine.

Fig. 15 is a fragmentary detailed view of the mechanism provided for drawing the submersible down into position over the hatch of the sunken submarine, the view being taken on the line 15—15 of Fig. 13, and

Fig. 16 is a transverse sectional view on the line 16—16 of Fig. 3.

Referring first to Figs. 1 and 2, my submersible boat comprises a main hollow body 1, spherical in shape and made of steel plating of a thickness capable of withstanding the pressure of the water at the depth for which the apparatus is designed for use and suitably reinforced and braced, as necessary. To insure tightness of the structural plates, welding is used throughout wherever it is practicable. A similar but smaller hollow spherical body 2, and herein referred to as a power body, is rigidly secured to the rear side of said main body by brackets and bracing, in any suitable manner, and aft of the power body is a trim tank 3. On the forward side of the main hollow body 1 is a hollow body 4, like the power body 2 but adapted to carry the storage batteries necessary for the operation of the device and this second body is herein referred to as the battery body. Forward of the battery body is the forward or bow trim tank 5. The shape of the trim tanks is substantially conical. The tank 5 terminates preferably in a spherical nose and at the smaller end of the after trim tank 3 is mounted the vertical steering rudder 6 which, through gearing 7, is operated from a shaft 8 extending forwardly through the aft trim tank 3 into the power body 2 where it may be controlled in any suitable way. On the opposite sides of the power body 2 are mounted the two horizontal rudders 9—9 by which the vertical movement of the boat is controlled. They are mounted on suitable shafts 10, 10 also extending into the power body or room 2, where they may be controlled in any suitable manner.

Within the power body or room 2 is an

electric motor 11, supplied with power from the battery body or room 4 and operative to drive the propeller shaft 12 extending rearwardly therefrom and terminating in a propeller 13. The floor 14 of the power room or body 2 forms beneath it a water-tight compartment 15 for carrying water ballast, and the floor 16 of the battery body 4 similarly provides a water ballast compartment 17. It is to be understood that the pumping of water into and out of these water ballast chambers 15 and 17 may be effected by any suitable pumping means which may be operated from the motor 11 through suitable piping.

Between the main hollow body and the power body 2 is an opening or passage 18 which is normally closed by a water-tight hatch 19. Similarly, the hollow battery body 4 may be put into communication with the main hollow body 1 by a passage or opening 20, similarly closed by a water-tight hatch 21. As shown in Figs. 1 and 2 between the bodies 1 and 2 I provide a thin conical sheet plate sheath 22 and similar sheathing 23 between the bodies 1 and 4 to give the whole boat a generally tapering shape from the nose or bow thereof to the girth of the hollow body 1 and thence tapering rearwardly to the stern. These sheathings are not water-tight; they may be perforated at suitable intervals so that the sheathing is not required to withstand the pressure of the water.

In Fig. 2 I have indicated a series of ports 22', 23' on the upper periphery of the sheathings 22 and 23 and other similar openings may be provided at suitable places through the sheathings 22 and 23 to insure the free passage of water in the chambers between said sheathings and the exterior surfaces of the spheres or balls 1, 2 and 4.

From the above it will be seen that the power body 2 forms the power and steering room for the craft and sufficient space will be provided for the storage of five or more flasks of air at a high pressure, and two or three oxygen flasks.

It will also be seen that the battery body 4 forms the room in which the storage batteries for the vessel are stored and its size is preferably ample for the storage of further flasks of compressed air, and other tools and accessories with which the craft may be provided. On each side of the main hollow body 1 and communicating therewith through tubular passages 24 is a safety buoy 25—25. The inner end 26 of each passage 24 is closed by a water-tight hatch 26' and to the outer end of the passage 24 is rigidly secured one of said safety buoys 25 by a bolt or bolts 28 which can be removed from within the safety buoy 25. Said buoy is provided with a water-tight hatch 27 which also may be held in place from within the buoy by any suitable fastening means 28.

From one side of the passages 24, I extend outwardly bent tubes 30, the free ends of which are directed radially toward the centers of the buoys 25 and the free end of these tubes 30 is held normally stopped by a tapered block 31 screwed into the end of the tube 30 and having a stem 31' passing through the wall of the buoy and into a suitable water-tight housing, the cap 32 of which can be removed from the inside of the buoy. In this way those entering the safety buoy may close the ports 26 and 27 with the closures 26' and 27', admit water into the passages 24, and bring the pressure in the chambers 24 up to that of the surrounding water. Thereupon the withdrawal of the inside fastening means 28 into the water-tight housing 29 permits the safety buoy to float to the surface of the water. The hatch 27 is provided with a glass closed porthole 33. When the buoy has risen to the surface, the men in the buoy may change their positions to bring the glass porthole 33 above the water, after which the hatch 27 may be removed and the men may make their egress. The manhole 27 and hatch 27' are preferably elliptical so that the hatch, after it has been freed, may be brought into the buoy, if desired, or may be hinged.

The above constitutes a brief description of the general arrangement and disposition of the various sections which go to make up my submersible vessel. The main body 1 is divided by a water-tight deck 34 and forming the roof or ceiling of the main operating and control room 35 and the floor of the upper emergency room 36. Another water-tight deck 37 forms the floor of the main operating room 35 and the roof or ceiling of the main water ballast chamber 38.

Extending vertically through the emergency room 36 is a large tube 39, the upper ends of which are connected to the interior of the main shell or body by a water-tight joint, and the lower ends of which are similarly connected to the deck 34 by a water-tight joint, and this forms the main passage 40 for entrance into and exit out of the body through a manhole 41 closed by a water-tight hatch 42. The interior of the tube 39 may be provided with a ladder 43 and through this wall is a port 44 closed by a water-tight hatch or door 45.

Extending vertically through the hollow body 1 are three large tubes 46—46—46, all substantially alike, and forming chambers which constitute the housing for the anchors and water ballast chambers. The upper ends of these tubes extend slightly above the upper surface of the body 1 and the upper ends are closed by caps or hatches 47 in any suitable and water-tight manner. Seated within the upper ends of the tubes 46 is a spider 48 in which is mounted a rod disposed axially of the tube and carrying at its lower end a block or housing 49 in which are mounted two co-

acting jaws 50—50, pivotally mounted on a pivot pin 51 in said block. The lower ends of these jaws 50 are somewhat concave, preferably spherical, to fit over and around a ball 52 adjustably mounted on a screw-threaded rod 53. If desired, the ball 52 may also be screw-threaded to fit the threads on the rod 53.

The lower end of the rod 53 is preferably bolted to a cap 54 rigidly mounted in the upper end of an inner tube 55 loosely fitting within the outer tube 46 and provided on the interior thereof with a chain pocket 56. The cap or closure 54 is provided with an opening 57 through which the anchor chain 58 passes outwardly to and around a suitable pulley 59 fitting the links of the chain, and mounted on a stud 60 in a suitable water-tight journal 61 extending through the wall of the top end of said shaft being provided with a gear 62 driven from a pinion 63 on a shaft 64 by a handle 65. The shaft 64 is preferably provided with a ratchet and pawl arrangement 66, by means of which the anchor 67, connected to the end of the chain depending therefrom, may be lifted and held in its lifted position, as clearly shown in Figs. 4 and 5.

Referring now to Fig. 6, I have shown a device for holding the jaws 50—50 closed around the ball 52. On a shaft 68 suitably journaled in a water-tight bearing 69 extending through a wall of the tube 46, is mounted a yoke 70 having two fingers 71—71, having their inner extremities preferably terminating in cylindrical or spherical surfaces 72—72, the distance between said surface being equal to the over-all width of the vertical sides of said jaws 50 when closed around the ball 52. This yoke is rigid with the shaft 68 and the outer end of the shaft is squared as at 73 to receive a crank or handle (not shown). The outer end of the bearing is preferably closed by a screwthreaded closure 74 to insure that the bearing around the shaft does not leak when the same is not in use. To use the device, one removes the cap or closure 74, places a wrench or handle on the squared end 73 and rotates the shaft 68, throwing the ends of the arms 71 upwardly until they pass out of engagement with the sides of the jaws, whereupon the ball 72 slips from the jaws 50 and the whole inner top 55 and all the parts carried thereby, fall free of the body upon the release of the pawl and ratchet mechanism 66 of the anchor raising hoist or winch of which the sheave wheel or pulley 59, its shaft and gearing are parts.

The lower ends of the tubes 55 are preferably provided with a heavy cast iron head 75 having a passage therethrough for the chain, the ends of the head preferably fitting against the curved inner or upper side of the anchor when the anchor is lifted and held in its uppermost position. Supported upon the head 75 and within the tube 55 and out of the line

of the travel of the chain, may be seated or secured a mass or lump 76 of metal, operative to act as solid ballast for the boat.

From the above it must be plain that if for any reason it is desired to lighten the submersible boat for the purpose of rising, it is possible to free the boat of the weight of its anchors and of the solid ballast contained in the inner tubes 55, as well as the weight of the anchor chains, by lifting the fingers or arms 71 upwardly out of their engagement with the jaws 50.

The three anchor tubes and the anchor housings therein are preferably alike.

It has been stated that these tubes also act as water-ballast tubes. By releasing the air from the upper ends of said tubes as by opening the valve 77, the air will be allowed to escape as by pipe 78 passing through the wall of the body 1, the water will rise in said tubes to any desired height and when so filled with water, said tubes will act as water ballast chambers. To expel the water from the tubes, it is merely necessary to provide a valve 79 operative to admit compressed air into the tubes, as by pipe 80, whereupon the water content of the tubes will be expelled through the lower open end of the tube.

While I provide emergency and extra high pressure air flasks above referred to for connection to various chambers, if needed, I provide for the storage of the normal supply of compressed air by mounting within the main body 1 two rather large compressed air containers, consisting of the two ring cylinders 81 and 82, the ring 81 being larger and located in the main control room 35 just below the deck 34 and the other, 82, in the emergency room 36 adjacent the deck 34. These rings are seamless drawn steel to withstand pressure up to 2500 pounds per square inch and are preferably built into the structure of the submersible body. And it may here be stated that while I have indicated valves and tubing connecting one or the other of these cylindrical rings 81 or 82 with the various chambers to which air must be admitted, and for the purpose of discharging air from the chambers out through the vessel into the sea, such as showing of valves and piping is to be considered as merely diagrammatic, for in the submersible as constructed for actual use, the valves and controls will be duplicated in both the main operating room 35 and the emergency operating room 36. For the sake of simplifying the drawings, the control of compressed air to each of the various chambers is shown as an independent convention and located in a convenient space in the drawings of the main control room of the emergency room.

Substantially all the above description has to do with the means for guiding, moving and directing the submersible boat for the purpose of bringing it into operative rela-

tionship with a sunken disabled submarine and as preliminary to the description of my improved means for providing communication between the disabled submarine, I will state that I have shown my invention as adapted for use in connection with submarines which are provided with one or more ports or hatches closed with caps or closures which can be opened from the outside of the submarine and, referring to Fig. 3, I have shown such a hatch or port 83 on the disabled submarine closed by a gate or cap or closure 84 with bolts 85 for opening the same, accessible from the outside of the disabled submarine. I have also shown this port or head as being provided with a guide frame 86, consisting of a plurality of legs 87, equally spaced from each other and radiating downwardly from and hinged to a central member 88 to provide an upwardly tapering guide frame over which the open end of my rescue tube or hose (to be described below) may be guided into position around the hatch on the submarine.

After the submersible has been navigated in any manner to a position substantially over the sunken submarine, the lower end of the safety tube may be exactly positioned in line with the protruding hatch by the three anchors and by tilting the vessel by manipulating the trim tanks or by admitting or discharging water into or from the escape buoys 26, in any approved manner to produce any desired list of the vessel.

This hatch or pulley 83 should project from the body of the submarine and provide a circular neck 89 around the projection below the hatch closure 84, so that when the open end of the rescue hose or tube is fitted over the hatch and contracted around the hatch in the neck 89 thereof, there will be no danger of the hose being pulled off from the projection forming the hatch or port by any rise and fall or float of the submersible boat. The legs 87 are preferably provided with toes 90 for taking hold of the flange of the closure 84 and with heels 91 resting on the annular flange 92 surrounding the port or hatch 83. It will be observed that when the bolts are removed from the hatch closure 84 and the closure lifted, the guide frame 86 will be lifted therewith, or the frame may be used to lift the closure when unbolted.

A steel cylinder 93, having an internal diameter or bore of about 30 inches or larger and of a thickness to withstand the pressure outside of the vessel, runs from the upper deck 34 through the lower deck 37 and thence downwardly through the spherical wall of the main body 1 and through a ring 94 of slightly larger diameter than the outside diameter of the tube 93. The lower end of the tube 93 depends well below the ring 94 and is preferably enlarged circumferentially at its end to provide a head or low flange 95

over which may be telescoped a flexible fabric hose 96, as will be referred to again below.

The lower surface of the head or flange 95 is a convex spherical surface adapted to fit against a corresponding and coacting concave spherical surface forming the upper edge surface of a steel ring 97, as plainly shown in Fig. 3. The lower edge surface of the steel ring 97 is provided with a convex spherical surface like that at the end of the flange or head 95, which in turn fits against a corresponding coacting concave spherical surface on the upper edge of a like ring 97' immediately below it. The rings 97, 97', 97², 97³, 97⁴, 97⁵ are all alike, are arranged in a series and each ring is free to be moved slightly with respect to the ring immediately above it on the spherical bearing surfaces between contacting rings. It is, if course, to be understood that there may be as many rings, like the ring 97, as may be needed to make a flexible steel hose made of these rings, as long as may be desired. The inner surface of these rings 97 is each provided with four equally spaced inwardly projecting lugs 98—98—98—98 and when the lugs on the contacting rings are in alinement, two steel cables 99—99 are passed through each series of rings, each cable through two diametrically opposite series of lugs 98. Below the last ring 97⁵ is an end ring 100 also provided on its upper edge with a concave spherical surface to fit against the convex spherical surface of the ring 97⁵ immediately above it and it is also provided on its inner surface with two lugs 98—98, as are the other rings through which the lower ends of the cables 99—99 may pass, and said ends of said cables may be provided, in any suitable way, with heads 101 on the ends thereof, below the lugs on the ring 100 as clearly indicated in Fig. 3.

Within the tube 93 and at the top thereof and supported in any suitable manner as by the upper deck 34 and its bracing, is a heavy bracket 102 providing a support for four idler pulleys 103 from opposite pairs of which pass the intermediate sections 99' of the cables 99. Each cable is provided with a pair of coiled springs 104 in the vertical stretches thereof, as indicated in Fig. 3. But in Fig. 3 only one cable 99, two series of lugs 98, one pair of pulleys 103 and one pair of springs 104 are shown, the substantially duplicate sets being omitted from the drawings for the sake of clearness. In Figs. 15 and 16, however the positions of the vertical stretches of the two cables 99 are clearly indicated and from this the construction will be plain. By the mechanism above described, the series of steel rings numbered 97, with or without an index character, and the lowest ring 100 are held in engagement each with the next or adjacent ring, to form a heavy steel flexible hose or tube. In or-

der that the rings may slide freely on each other, I prefer to mount between the lugs of adjacent rings like compression springs, 105, surrounding the length of cable 99 between said adjacent rings and operative to make it certain that each ring is yieldingly pressed into engagement with the ring immediately next to it. Hinged to the lower edge of the lowest ring 100 are a circular series of battens 106, all alike and made of forged steel. The upper ends 107 of these battens are pivoted to said ring 100 by pivot pins 109.

These rings 97 so assembled and articulated in a columnar series, render the tube non-collapsible and laterally flexible so that the open end thereof may be guided to a position in alinement with and then telescopically slid over the protruding hatch of the disabled submarine.

In order to mount said battens pivotally on said lower ring 100 in circular series, the lower edge of the ring is notched as shown in Fig. 9 and holes 108 for the pivot pins 109 are drilled into the ring in the manner shown in Fig. 9. This manner of pivoting the battens to the ring 100 leaves the outer surface of the ring smooth and the inner diameter of the ring is not substantially obstructed. When these battens hang free on their pivot pins 109, they will almost, if not quite, be in engagement at the sides thereof with each other, that is to say, they will form a circular frame or head with substantially no space between adjacent battens. On the same pivot pins 109 and on opposite sides of each lug 107, through which the pivot pin passes, are a pair of links 110—110, each connected at one end to the ring 100 by the pin 109, while their lower ends are pivotally connected to a pivot pin 111. Extending through said pivot pin 111 and downwardly are two like links 112, 112, the lower ends of which are pivotally connected by a pin 113 to the lug 114 on the inside of the batten 106.

Also pivotally connected at its lower end to the pivot pin 111 and between the two links 112 is an upwardly extending link 115 having its upper end pivotally connected by a pin 116 to a notched bar 117, having a notch on its edge adjacent the top thereof adapted to fit over a circular flange 118 at the lower edge of a sleeve 119, the top end of which is provided with screwthreads 120 over which is screwed a nut 121 having a downwardly extending flange fitting over the opposite edge of said notched bar 117. When, therefore, the notches in the notched bars 117 are fitted over said flange 118 and the nut 121 is screwed down into the position shown in Figs. 3 and 11, these bars 116 will be rigidly secured to the sleeve 119. When the nut 121 is removed therefrom, the bars 117 will swing on their pivot pin 116 free of the sleeve 119. The ring 110 also carries a plurality of leaf

springs 122, one for each batten, the tension on which is such as to tend to throw the lower end of the battens 106 outwardly from the axis of the ring 100.

5 Passing through the hollow sleeve 119 is a rod 123, the lower end of which is provided with a ball 124, the position of which may be adjusted on the rod by a nut 125 and the ball is preferably seated against a spherical surface at the lower end of the sleeve 119, but it is of a size that it may not pass upwardly through the bore of the sleeve 119. The upper end of said rod 123 is provided with a loop or ring 126 through which passes a U-shaped member 127, one or both ends of which may be connected by pivot pins 128 to the downwardly extending arms 129 from a steel forged block 130, having a pair of fingers 131 extending outwardly laterally therefrom and adapted to slide in guideways 132, rigid with the interior of the end of the tube 93. Said block 130 is provided with a screw-threaded opening therein into which is fitted the lower end of a threaded rod 133, the upper end of which is connected by a universal joint 134 with the lower end of a length of shafting 135, the upper end of which is connected by a clutch member 136 to the lower end of a stud shaft 137 journaled in a bearing 138 carried by a bracket 139 rigidly bolted to the inside of the tube 93. The upper end of said stud shaft preferably extends into the bracket 102 and is provided with an enlarged head or flange 140 at the end thereof between which the lower part of the bracket 102 is a compression spring 141, tending to force said stud shaft and the parts carried thereby upwardly.

The stud shaft 137 is provided with a beveled gear 142 rigid with said shaft and meshing with a pinion 143 mounted on a shaft 144 journaled in a bearing 145 carried by the bracket 139 and thence passing outwardly through an opening in the tube 93 and through a water-tight bearing 146 on the outside of the tube 93 and terminates in a hand wheel 147 by means of which the shaft 144 and the sectional shaft 137, 135, 133 may be rotated through the gears 143, 142. The shaft 135 is preferably provided with a ball 148 and I may provide two or more steady blocks 149, having on their inner faces a cylindrical surface substantially fitting against the shaft adjacent the ball and also having a substantially semi-circular recess therein, fitting around and engaging the ball 148. Said steady blocks are preferably provided with plungers 150 at the other ends thereof, forced outwardly therefrom into engagement with the interior wall of the cylinder 93 by the action of compression springs 151 within said members and engaging the inner ends of said plungers.

From the above it will be seen that by the rotation of the hand wheel 147 and the parts

driven thereby, the threaded rod or shaft 133 may be rotated in the block 130 and in such a manner as to draw upwardly on the block which will not rotate by reason of the engagement of the fingers 131 in the guides 132. The upward movement of the block 130 will draw the lower ends of the battens 106 inwardly, swinging on their pivot pins 109 and against the tension of the leaf springs 122, and the rotation of the hand wheel in the opposite direction will cause the block 130 to slide downwardly with a consequent swinging outwardly of the lower ends of the battens.

Around the lower end of the steel tube or cylinder 93 and above the low flange or head 95 on the lower end thereof is telescopically fitted the upper end of the inner ply 96' of the flexible fabric slightly elastic hose 96. This ply is bound or clamped to the lower end of the steel cylinder 93, in any suitable manner, as by a band or by wrapping the same with wire 152. Preferably, the surface of the tube 93 just above the head 95 is roughened or grooved to afford a suitable surface against which the upper end of the ply 96' may be tightly bound. The flexible fabric hose also comprises an outer ply 96'', fitting over the inner ply 96' and its upper end is telescopically fitted over the downwardly extending flange 94' of the ring 94, the outer surface of the flange or sleeve 94' being similarly threaded or grooved and surrounding said upper end of said outer ply 96'' is a ring or clamp which rigidly holds and secures the upper end of the said ply to the ring 94. The lower ends of the two plies fit over the outsides of the battens 106 and are bent or curled around the lower ends thereof and the ends of said plies are firmly secured together by binding or in any other suitable manner. The united lower ends of the plies are secured by suitable elastic means, as by a relatively heavy elastic rubber cord or rope 153 to lugs 153' on the inner surface of said battens 106 near the lower ends thereof. This allows the lower end of the elastic woven fabric forming the hose 96 to expand and to take up, on contraction, and hold that portion of the hose surrounding the lower end of the batten tightly against the adjacent surface of the battens.

Now will be apparent the function of the spring 141, for it will be seen that as the hand wheel is turned and the block 130 is drawn upwardly to draw the ends of the battens 106 inwardly toward the center thereof, the pull of the linkages within the battens on the battens will be a yielding pull and when the end of the tube is closed around the hatch of the sunken submarine, the ends will be gently, but firmly drawn against the outer surface or neck 89 of the hatch.

It will be observed that the ring 94 surrounding the lower end of the tube or cylinder

der 93 provides a small chamber 154 which communicates with the space between the plies 96' and 96'', and I provide a tube 155 communicating with said chamber and running through the bottom of the body 1 and through the deck 37 into the main operating room or chamber 35, where a valve 156 may be provided for admitting air at high pressure from the high pressure reservoir 81 through pipes 191 and 155 to the said chamber 154 and between the plies 96' and 96'', as will be referred to again below in the description of the device.

Access to the interior of the cylindrical safety or escape tube 93 is made possible by a port 157 closed by a water-tight closure 158.

A pipe 159 communicating with the sea through the bottom of the body 1 and extending through the main operating room 35 and through the wall of the tube 93 to the interior thereof and provided with a valve 160, permits the operators of the craft to flood the tube or cylinder 93 when necessary.

I also provide my submersible boat with an observation chamber, which also may be used as a diver's chamber. This comprises a steel cylinder 161, about four feet in diameter, made of steel plates of a thickness sufficient to withstand the heavy pressure of deep sea diving. This cylinder 161 preferably extends from the lower deck 37 downwardly through the spherical wall of the body 1 to a point adjacent but somewhat higher than the lower end of the flexible steel and fabric escape tube. The lower end of a somewhat conical shaped closure 162, which may be provided with a heavy porthole glass window 163 and an electric light 164, the window and light being directed generally toward the lower end of the escape tube. I preferably project the lower end of the cylinder 161 and the closure 162 therefor by one or more curved projection rods 165. A portable floor 166 may be provided in the bottom of the tube or closure therefor upon which the diver may stand for the purpose of getting into his diver's suit, if it be necessary to make his exit from the tube in order to assist in coupling the escape tube to the port or hatch 93 of the sunken submarine. The tube or cylinder 161 is provided with a hatch 167 with a water-tight closure 168 therefor, with a ladder 169 and with a sea gate or flood valve 170, operable from within the diver's chamber 171 when the hatch 167 is closed, or by an operator within the main control room through the hand wheel 172 and flexible shafting 173 extending longitudinally of the tube 161.

The chamber 171 is also provided with a porthole 174, which is normally closed by a porthole closure 175, operable from within the inside or the outside of the chamber and when my submersible boat is to be used to depths greater than 200 feet, I prefer to

provide an extra water-tight cover or closure 176 which can be also locked from within or the outside of the chamber after the inner closure 175 has been removed. It is to be understood that this porthole 174, as well as the hatch 167, is preferably oblong in shape, so that the closures, after having been removed therefrom, can be taken into the chambers through the ports or hatches, if necessary. Outside of the tube or cylinder 161 and adjacent the porthole 174, I provide a ladder 177 by means of which the divers may descend to the bottom of the submarine or to the bottom of the sea. The upper end of the tube 161 communicates with a slightly smaller tube or cylinder 178 extending from the lower deck 37 through the upper deck 34 to the inside of the wall of the hollow body 1. It is provided with a hatch 179 provided with a water-tight closure 180 and with a port 181 through the side wall thereof, also closed with a water-tight closure 182 communicating with the main operating or control room, and the upper end of the tube 178 is provided with another port 183 provided with a water-tight closure 184 which gives communication with the upper emergency room 36. A ladder 185 enables one to climb from the hatch 179 up to and through the port 183. This upper cylinder 178 forms the means of communication by means of which the operators may pass from the main control room 35 to the emergency room 36 and return.

The chamber 186 between the partitions 167 and 179 is an intermediate room or emergency diver's chamber, while the chamber 187 above the partition 179 constitutes a passage providing access between the emergency chamber and the main chamber and communication with the observation tube or chambers 186 and 171 from either the main operating room or the emergency room or chamber. Through the partition closed by the hatch 168 is a valve 188 which, when open, equalizes the pressure between the chambers 171 and 186 and similarly, in the partition closed between the chambers 186 and 187 is a similar pressure equalizing valve 189. Air at high pressure from a source of air supply, as for example the ring-like chamber 81, may be supplied to the lower chamber 171 by the valve 190 and pipes 191, 192, 193, 194, valve 195 and pipe 196 and similarly, high pressure air may be admitted to the chamber 186 by valve 197 and pipe 198. The intermediate chamber 186 should also be provided with a flooding valve 199 by means of which the water from the surrounding sea may be admitted into the intermediate chamber for the purpose of equalizing the pressure on both sides of the closure 168 of the hatch 167 to enable a diver to pass from the intermediate chamber 186 to the lower chamber 171 when the latter is flooded. It is, of course, to be

understood that electric wiring 200, suitably insulated and provided with connections 201 for diver's air lines will be provided from the interior of the main chamber 1 to the divers' chambers 171 and 186.

The electric light 164 may also be electrically connected to the said wires 200, as indicated in Fig. 3. These wires 200 are, of course, preferably enclosed in a water-tight conduit.

I have also indicated, more or less diagrammatically, a means for supplying divers in the chambers 186 and 171 with air to be supplied to their diving suits. Thus I have shown a pipe terminal 202 adapted to be attached to any suitable source of diver's air supply, such as a pump or a flask of compressed air and provided with a branch 203 extending through the wall of the tube 178 below the hatch closure 180 and terminating in a connection 204 for connecting the same to the diver's air line. This branch 203 may be controlled by a valve 205. The pipe 202 is also preferably provided with another branch 206 also running through said wall and thence downwardly into the chamber 171 where it may be provided with two connections 207, 207 for attaching the same to the life lines of two divers. This branch 206 is also preferably controlled by a valve 208 in the main operating chamber. The tube 155 may also be connected by any suitable piping with the pipe 191 leading from the source of high pressure air.

To permit of the introduction of air at high pressure into the tube of the steel cylinder 93, a pipe 209, controlled by a valve 210 may also communicate with a high pressure pipe 191. To place the main water ballast tank 38 into communication with the high air pressure supply, I may provide a pipe 211 provided with a valve 213 which is in connection with the pipe 191. For the sake of simplicity, I have shown the pipes 191, 192, 211 and 209 all communicating with a four-way coupling 213 and the pipe 193 extended upward from its point of connection with the pipe 192 through the emergency chamber and out through the top wall of the body 1 to the sea, and controlled by a valve 214. In this way, when the valve 192 is open and the valves 210, 156, 212, 197 or 195 are open, the chambers controlled by said valves are placed in communication with the outside sea by the pipe 193 for the purpose of admitting water to said chambers or equalizing water pressure on both sides of said chambers.

For admitting sea water to the main ballast tank 38, I provide a suitable sea valve 215, diagrammatically illustrated as operated by a rotatable rod 215' threaded in the housing 216 and provided with an operating wheel 216', it being understood that the lower end of the rod 215' is rotatably attached to the end of the valve lever 215'' in any suitable

manner. This valve however may be any suitable valve ordinarily used for the admission of water into the submersion tanks of a submersible vessel, as for instance, a Kingston valve.

I may expel water from the ballast tank 38 by admitting air, at high pressure thereto, through the valves 190 and 212 and driving the water out of the tank through the opening controlled by the valve 215. A pump 217, a pipe controlled by the sea valve 218 and a pipe 219 extending into the tube 93 and provided with a nipple 119' for the attachment of a length of flexible hose (not shown) provides means for pumping out any water which may accumulate in the escape tube 96 after the open end of the tube 96 has been clamped around the protruding hatch 83.

The trim tanks 3 and 5 may also be provided with the usual means for admitting and discharging the proper amount of water thereto in any well-known manner approved in submarine construction.

For the purpose of holding the open end of the escape tube tightly connected around the neck 87 of the hatch of the submarine, I preferably connect the adjacent battens 106 by bolts 220 passing loosely through suitable openings 221 in the lugs 222. These bolts 220 are provided at one end with a rigid head 223 having a spherical surface 223' pulling against the lug in one batten and having at the other end a semi-spherical head 224 slidably adjustable on the bolt 220 by a nut 225. This feature of construction will be referred to again below.

The lower ends of the battens are provided with transverse lugs 226 over the vertical lugs 153' and adapted to take under the flange 92 above the neck 89 of the port or hatch 83 on the submarine when the battens are in their closed position and thereby hold the hose tightly around the upper end of the hatch 83. (See Fig. 8.)

I prefer to provide the body 1 with a series of straps 227 or other suitable means for the attachment thereto of cables for raising my improved submersible, if the same should become disabled on the bottom of the sea. And this will make it plain that, so far as the main chamber 1 is concerned and the parts carried thereby and operable from within the body 1, this body 1 may be used alone and without the spherical bodies 2 and 4 as a bell or submersible structure to be lifted and lowered by cables from a mother ship.

The operation of the device is, briefly, as follows: The position of the sunken submarine having been definitely ascertained, my submersible boat is submerged and steered to a position over the same and a diver or observer is stationed in the observation chamber 171. Through the glass port or window 163, and by the aid of an electric light 164,

he can direct the steering of the submersible to bring the lower end of the flexible hose 76 directly over the port or hatch 83 of the sunken submarine. The three anchors 67 are lowered and by them my submersible boat may be drawn or guided to a position directly over the port 83 of the sunken submarine. If the submarine lies in such a position that the hatch 83 is not vertical, my submersible may be listed in the usual manner by admitting or discharging water from the trim tanks 3 and 5, and the safety buoys as will be well understood by those acquainted with the manipulation of a submarine, and the axis of the escape tube may be alined with the axis of the hatch 83.

If the depth to which the submersible is submerged is greater than 200 feet, then the fitting of the open end of the fabric hose over the port or hatch of the sunken submarine, may be directed by the observers in the diver's chamber 171. But if less than that depth, then I have provided a means whereby one or more divers may make their exit from the chamber 177 to assist in fitting the hose over the hatch. To do this, the diver will put on his suit in chamber 171, connecting his air line to the coupling 207, his telephone wires to the cable 201 and then he will slowly admit water to the compartment through the flood valve 170 until the pressure in the chamber is equal to the pressure of the air on the outside of the vessel. He may then remove the closure 175 of the hatch 174 from the inside and if in place, the outer hatch closure 176, and make his exit through the port 174.

After the lower end of the fabric hose is telescoped over the projecting end of the hatch of the submarine, then by the revolution of the hand wheel 147, the pinion 143 is rotated and by it the bevel gear 142; the shafts 137, 135, 133 drawing the block 130 vertically upwardly on the screwthreads on the rod 133, the block 130 being prevented from rotation by the engagement of the fingers 131 with the guides 132. The upward movement of the block 130 draws upwardly on the rod 123 and the nut 125 to which the notch bars 117 are attached for moving upwardly with the nut 121, drawing on the links 115 which draw the joint formed by the pivot pins 111 connecting the links 110 with the links 112 axially inwardly around the pivots 107 at the upper end of the batten, and drawing the pivotal connection 113 of the links 112 with the battens 106 inwardly toward the axis of the hose until the united ends of the plies 96', 96'' within the battens bear air and water-tight against the neck 89 of the hatch of the sunken submarine. Now in order to insure that the said ends of the rubber hose bear tight against said neck, air at high pressure is admitted to the chamber 154 through the pipe 155, pipe 191 and through valve 190 from the high pressure

air container 81, and the air will pass downwardly between the plies 96' and 96'' and around the curved ends of the battens to force the inner ply firmly against the outer ends of the batten and the outer ply firmly against the neck of the hatch, it being understood that the lugs 226, near the ends of the batten, will engage under the flange 92 and prevent the end of the hose from slipping off from the hatch of the submerged submarine.

As soon as this closure is effected, the pressure within the steel tube 93 may be reduced, in any suitable way, and the hatch closure 158 may be removed, whereupon any water trapped in the tube may be pumped out by a hose inserted into the tube through the hatch. As soon as the hose and steel tube are empty of water, the mechanism for closing the lower end of the hose around the hatch of the submerged submarine, may be removed. An operator will enter the cylinder 93 through the open hatch 157; will disconnect the clutch 136 and will remove the steady blocks 149 and then swing the shaft 135 on the universal bearing 134 until it rests against the inside of the cylinder. He may then disconnect the universal joint 134 and then remove the section 135 of the shaft from the cylinder 93 through the hatch or port 157. He may then unthread the rod 133 from its connection with the block 130, whereupon the said block and rod 123 may fall slightly in the tube and hose. After this rod 133 has been removed through the hatch, the operator removes one of the pivot pins 128 and thus frees the block 130 from the rod 123 and the block may then be lifted up and taken out of the tube. Descending further on the rope ladder 227, the operator unscrews the sleeve 119 from the nut 121 which permits the notched bars 117 to swing free away from and clear of said nut 121, the pivot pins 111 sliding down in the slotted guideways at the upper ends of the links 112. The operator is now free to remove the rod 123 with the nut 121 and to remove the sleeve 119 which are taken out through the hatchway 157. By swinging the levers 112 inwardly against the battens, space is provided wherein the operator may remove the bolts 85 which hold the closure 84 against the port or hatch 83 of the sunken submarine and reaching down to the heads of the bolts 85 between the legs 87 of the guiding frame 86. When the bolts 85 have been removed, the closure 84 may be lifted by drawing upwardly on the guide frame 86 and when the closure 84 has thus been removed from the hatch 83, the frame 86 may be collapsed or folded into small compass and passed up out of the tube through the port 185 and the closure 84 may similarly be passed upwardly out of the tube and into the chamber 35.

As soon as access is obtained to the lower end of the escape tube and before removing

the hatch 84, the battens may be firmly bolted together and held tight to the neck 89 by tightening the nuts 225 (see Fig. 10).

After the rescue has been effected and the imprisoned crew of the submarine have made their escape up through the tube or hose of my submersible boat, then if it is desired to seal up again the hatch of the submarine, the reverse of the above steps, whereby the hatch was removed from the submarine, are performed, that is to say, the legs 67 of the frame are clipped around the edge of the hatch closure 84, the hatch closure is secured by the bolts 85 in place. The bolts 220 are loosened. The rod 123 and the sleeve 119 are lowered in the tube 93, the notched bars 117 fitted on to the nut, the sleeve 119 is screwed into the plates, the block 130 is lowered and fastened to the eye in the upper end of the rod 123, the section 133 of the shafting is threaded into the block 130, the universal joint 134 is reunited, the steady blocks 149 are positioned and the sleeve 136 is slipped upwardly to couple the upper end of the shaft 135 to the upper end of the stud shaft 137. The parts are now in their original position. To release the battens from their tight engagement with the hatch of the sunken submarine, it is merely necessary to close the port or hatchway 157 with the closure 158 and open the sea valve 160, whereupon water from the sea will enter the hose until the pressure on both sides of the hose is equal. Thereafter the chamber formed between the plies 96' and 96'' is depleted of air and by then turning the hand wheel 147 in the opposite direction, the block 130 will be forced downwardly in its guides 132 and the leaf springs 122 will swing the lower ends of the battens out from their locking engagement with the hatch, whereupon my submersible boat may be made to rise by lifting the anchors 67, by turning the winch handles 65 and lifting them by their anchor chains 58. The submersible may now be brought to the surface by ejecting water from the ballast tanks 38 and 6 and by emptying or partially emptying the three anchor housing tubes 46, by closing the valve 77, opening the valve 79 and admitting air at high pressure from the air containers to the upper end of the anchor 46. In like manner, the steel tube 93 may be used as a ballast tube and water forced therefrom by opening the valve 210 and admitting air to the top of the tube through the pipe 109.

If, for any reason my submersible boat could not be made to rise due to some injury received in operating the same, I have provided an escape from the submersible through the safety buoys 25. These buoys are of a size each to lift the weight of at least one-half of the combined submersible and sunken submarine crews. From the main room 35, the crew will open the hatches 26 and going therefrom through the passage

to the hatch 27' will remove that hatch and all the crew, or at least the complement of the buoy, will enter the safety buoy 25; thereupon the hatch 26' may be replaced in position, it being operable from both sides thereof, and then the hatch 27' is locked in position from the inside. The bolts 28, removable from within the safety buoy 25, are then unbolted, but it is to be understood that the outside pressure of the sea upon the safety buoy will still hold it in position tight against the passage between the hatches 26' and 27', whereupon the long taper block 31, screwthreaded in its housing, will be turned to withdraw the conical end from its engagement with the outer end of the bent tube 30, and water from the sea will then enter the passage between the safety buoy and the hatch 26' equalizing the pressure on both sides of the passage and the safety buoy will then float free of the submersible and rise to the surface. Upon reaching the surface, the position of those in the buoy may be easily changed so as to bring the glass window 33 of the port 27' above the surface of the water, whereupon the hatch may be lifted and signals displayed.

As above referred to, the buoys 25 may be flooded or emptied in the usual manner of operating ballast tanks to produce a list in the vessel to assist in fitting the end of the tube 96 over the hatch of the submarine.

I have made the description of the operation of my device as brief and comprehensive as possible, for the purpose of making plain the fact that no detail in design or construction has been omitted that makes for the safe operation of the device under the circumstances given. For submersion beyond depths of say 200 feet, it is impracticable for a diver to work outside of the diver's chamber 171.

My apparatus is further designed for the purpose of effecting the rescue of a diver, who having left the diver's chamber 171 through the port 174 is unable, for some reason, to return. In such an event, with the lower chamber 171 substantially flooded with water from the sea through the port 174, a second diver may enter the intermediate chamber 187, close the hatch 179, don his diver's suit therein, slowly flood the said chamber 186 by opening the valve 199, and when the pressure is shown to be equal to that of the sea on the outside, he may then open the hatch 167 and descend into the diver's chamber 171, passing out through the port 174 to the rescue of the disabled diver. Upon the return of two or even three divers to the diver's chamber 173, the hatch closure 175 may be replaced and then if the hatchway 167 is open (due to the descent of the rescue diver) they will climb to the closure 179 and opening the equalizing valve 189, slowly, until the divers are able to stand the reduced pressure of the

interior of the submersible boat. When the pressure on both sides of the hatch is equal, then this hatch closure 180 may be removed and the divers may climb to the ports 182 or 183 and make their exit from the tube into the emergency room 136, or the main room 35. After their escape or exit from the diver's tube into the submersible vessel, then the water in the diver's chamber may be pumped out in the usual manner and the hatches therein replaced for the next operation.

While I have described the guide frame 86 as being a part of the equipment of the hatch closure on the sunken vessel, that frame is merely for the purpose of guiding the open end of the flexible hose down into position over and around the neck of the hatch of the sunken vessel. It may, of course, be dispensed with, although, of course, it will greatly facilitate the guiding of the escape hose to proper position.

The steel ring construction 97, 97', 97'', 97³, 97⁴, 97⁵, provides a flexible steel construction which permits of the steel tube being flexed with the outer flexible fabric hose 96. It is also to be noted there is a substantial space between the battens when they are in their expanded position, as indicated in Fig. 10. When the battens are in their closed position around the end of the hatch of the sunken submarine, the sides are closed, as shown in dotted lines in Fig. 10, so that the flexible elastic fabric is substantially supported all around by the battens and is thus capable of withstanding the high pressure to which the tube is subjected. After the tube has been clamped in the manner above described to the projecting end of the hatch of the sunken submarine and the pressure within the tube is made equal to that of the interior of the submersible boat. When locked in the submarine, the pressure of the surrounding water makes it practically impossible to unclamp the battens from the neck of the submarine hatch until sea pressure has been equalized within and without the tube.

For the sake of showing the principal parts of my improved submersible apparatus in a single figure, the body 1, shown in Fig. 3, is shown somewhat smaller than it would be in the actual construction of the device and the relatively small diameter of the body 1 brings the diver's tube and chamber 161 too close to the end of the escape tube 96. In actual practice, the diver's tube 161 will be further away from the escape tube 96, thus permitting more lateral or transverse flexing of the tube 96 in the direction of the tube 161 than is possible with the proportions shown in Fig. 3; and so for the purposes of this specification, it is to be understood that the proportions shown in the drawings are not absolute but may be varied as may be found needful or desirable for the practical operation of the same.

I have above referred to the practicability of using the main body 1' alone, submerging it from and lifting it by a suitable hoisting mechanism on a mother ship by the use of straps 227 to which suitable cables or chains may be attached. In Figs. 12 to 16 I have illustrated such a modification in which the main spherical body 1' is provided with an escape tube depending therefrom, the lower end of which is expansible and contractable in the manner described in connection with Fig. 3, but the mechanism for imparting movement to the pawl 124 to open and close the battens 106 is slightly modified. The body 1' is provided with a ring 228 to which are connected suitable straps or cables 229, the upper ends of which passing around the body 1' are united in a header 230 provided with a loop or ring 231 by means of which a hoisting and lowering cable may be attached thereto.

In Fig. 14 is illustrated a hatch 83 on a submarine provided with a closure 84' bolted to the outside of the submarine by bolts 232 accessible from the outside of the submarine. In a pocket or cylinder 233 on the outside of the closure 84' is a bolt 234 surrounded by a spiral spring 235 passing through a cap or closure 236 threaded over the outside of the cylinder 233, and the upper end of the bolt is permanently flexibly connected to the lower end of a cable 237, as clearly shown in Fig. 14. This cable 237 is preferably carefully coiled within the flange 92', which corresponds to the flange 92 in Fig. 3, but provides space for the storage of said cable and a buoy 238, flexibly attached to the free end of the cable 237. This buoy 238 fits into and is retained within the pocket formed by the flange 92' in any suitable manner, by means of which the buoy may be released from the sunken submarine. In Fig. 14 I have indicated such a means as a bolt 239 threaded into a suitable lock 240 on the lower side of the buoy, said bolt 239 passing through the closure 84' into a pocket or stuffing box 241 on the inside of the closure 84' and provided with a squared head 242 normally enclosed within a water-tight cover 243. To release the buoy, it is only necessary to remove the cover 243, turn the bolt 239 by the squared head 242 until the buoy 238 is released, whereupon the buoy will rise to the surface of the sea, carrying with it the cable 237, the lower end of which is attached to the bolt 232. In this manner the approximate location of a disabled submarine is indicated on the surface of the water.

I propose to utilize this positioning indicating device, or a part of it, as a means for drawing a diving belt, such as is shown in Fig. 12, to a position over the sunken submarine and for alining the escape tube with the protruding hatch of the submarine. To accomplish this, I may provide the steel cyl-

inder safety escape tube 93 with a housing 244 within which is mounted a reel 245, rigidly mounted on a shaft 246, one end of which passes through the housing 244 and is provided with a winding device or winch comprising a gear 62' on the squared end of the shaft 246, said gear meshing with a pinion 63' on a shaft 64', suitably journaled and provided with a crank 65' and with a ratchet and pawl mechanism 66' all similar to the winch mechanism shown in Fig. 4. The winch crank 65' is, of course, mounted so as to be operable from within the chamber 35. Rigidly attached to this reel 245 is one end of a relatively short cable arranged to pass from the reel 245 upwardly over a sheave wheel 247 journaled in a suitable bracket 248 in the top end of the tube 93 and which passes downwardly out through the open end of the escape tube and then be brought upwardly to the top of the submersible. The free end of the said short cable may be attached to the free end of the cable 237 and the buoy 238 may be removed. Thereafter, upon a suitable turning of the winch operated by the handle 265. The free end of the cable 237 previously attached to the buoy 238 may now be brought upwardly into the tube 93 over the sheave 247 and wound around the reel 245. With the assistance of the ballast tanks with the proper manipulation of the amount of water admitted into the ballast tanks 238, the bell 1' may now be lowered, the crew within the chamber 35, winding up the cable 237 on the reel 245. In this way the submersible is lowered and the lower end of the tube is brought into axial alignment with the axis of the hatch 83 of the disabled submarine, if the hatch is anywhere in vertical position. The cable 237 is preferably provided with a ball 124 having a sleeve 249 surrounding the cable 237 and rigidly secured to the cable as by bolts 250, the position of the ball 124 being such that when the lower open end of the escape tube is around the neck 89 and the shoulders 226 are below the underside of the flange 92', the ball will engage the lower end of the sleeve 119 to which the members 117 are connected as in Figs. 3 and 11, and will draw upwardly on said sleeve pulling the lower ends of the battens 106 inwardly tight against the annular neck 89 of the hatch of the sunken submarine.

I prefer to fit within the lower end of the tube 93 and just above the rings 97, a guiding member 251 to maintain the cable 237 at substantially the axis of the tube 93. The frame member preferably consists of two heads 252, 252, smoothly fitting against the inner surface of the tube 93 and connected rigidly together by two bars or plates 253, 253, bolted to the opposite sides of the heads 252 and provided with two parallel shafts 254, 254 upon which are mounted two idler pulleys or sheaves 255, 255 deeply grooved so

that they substantially fit around the cable 237, as clearly shown in Fig. 16. In this way the cable is kept substantially axial to the lower portion of the tube 93 and central with respect to the sheave 247 so as to guide the cable properly to the reel 245. The sheave 247 is preferably yieldingly supported in its bracket 248 by a spring 256. Any strain caused by surge or irregular motion of the submersible toward and away from the submerged submarine is not exerted directly on the cable 237 but is absorbed by the spring 256, by means of which the sheave 247 is yieldingly mounted and by the spring 235 surrounding the bolt 234 on the sunken submarine.

The construction above described and shown in Figs. 12 to 16 embodies the same safety or escape tube as that shown in Fig. 3 and the mode of manipulating it is substantially the same except that there are fewer parts within the escape tube to be removed after the lower end has been clamped around the hatch of the sunken submarine. This having been accomplished and a water-tight joint having been formed between the open end of the escape tube and the protruding hatch, the closure 158 may be removed and a diver may enter the tube, remove the guiding member 251 and the tension on the cable 237 having been relieved, the nut 121 may be removed from the sleeve 119, thereby freeing the upper ends of the members 117 and permitting a member of the crew to have access to the hatch closure 84, preferably tightening the bolts 220 to hold the free ends of the battens 106 rigidly locked around the protruding hatch of the submarine before he removes the bolts 232 and gains access to the disabled submarine.

Having thus described my invention, what I claim and desire to protect by Letters Patent of the United States is:

1. In a device for rescuing a crew from a sunken submarine having a protruding escape hatch, the combination of a hollow water-tight submersible vessel, a large non-collapsible tube having a rigid portion extending vertically within said vessel and having a transversely flexible portion extending below said vessel into the surrounding sea, the lower end of said tube being open and expansible to a diameter greater than that of said protruding hatch and contractable to a diameter to fit tightly around said hatch, means operable from within said vessel to move said vessel and to thereby telescopically slide said open end of said tube over said protruding hatch, means operable from within said vessel and extending downwardly within said tube to expand the open end of said tube and to contract it around and against said hatch, a water-tight port affording a passageway from the interior of said vessel and into and out of said tube when

the lower end of said tube is tightly fitted around said protruding hatch, the portion of said means for expanding and contracting the open end of said tube, which is situated within said tube, being knock-down and removable from said tube through said port into the interior of said vessel when said tube is tightly fitted around said protruding hatch, said tube according access within said tube to the closure of said protruding hatch and affording an escape passage for the imprisoned crew through said hatch into said tube and thence into the interior of said submersible vessel when said hatch on said submarine has been opened from within said tube.

2. In a device for rescuing a crew from a sunken submarine having a protruding hatch substantially circular in cross-section and providing a circular neck around said hatch, the combination of a hollow water-tight submersible vessel, a large non-collapsible tube having a rigid portion extending within said vessel and having a transversely flexible portion depending below said vessel into the surrounding sea, the lower end of said tube being open and expansible to a diameter greater than that of said protruding hatch and contractable to a diameter to fit tightly around said neck, means operable from within said vessel to move said vessel and to thereby telescopically slide the open end of said tube over said protruding hatch, expanding members within said tube and arranged in a circular series at the open end thereof, means within said tube and connected to said members and extending through the wall of said tube into said vessel to operate said expanding members to increase and to diminish the diameter of the open end of said tube, and a water-tight port affording a passage-way from the interior of said vessel into and out of said tube when the lower end of said tube is tightly fitted around said protruding hatch.

3. In a submersible vessel having a water-tight compartment, the combination of means operable from within said compartment to position said submersible vessel over a disabled submarine on the floor of the sea, said submarine being provided with a protruding hatch, a large hollow, laterally flexible non-collapsible tube depending from said vessel and having a normally open lower end, radially expansible and contractable members within said tube at the lower end thereof to vary and adjust the diameter of the lower end of said tube, and means for operating said members, extending upwardly from said members within said tube and extending through a wall of said tube into said compartment and operable from within said compartment to expand said lower end of said tube to a size to telescope over said protruding hatch and to contract said lower end when so telescoped

tightly around said protruding hatch, and a water-tight port giving access from said compartment into and out of said tube when said tube is tightly fitted over and around said protruding hatch.

4. In a hollow submersible vessel having a water-tight compartment, the combination of means operable from within said compartment to position said submersible vessel over a disabled submarine on the floor of the sea having a protruding hatch, a large hollow, laterally flexible non-collapsible tube depending from said vessel and having a normally open lower end, a circular series of radially movable members within said tube at the lower end thereof, to vary and adjust the diameter of said lower end, knock-down means connected to said members for moving the same radially and extending upwardly within said tube and through a wall of said tube into said compartment, and operable from within said compartment to expand and contract the lower end of said tube, and a water-tight hatch to give access from said compartment, when open, into and out of said tube when said tube is tightly fitted over and around said protruding hatch.

5. In a hollow submersible vessel having a water-tight compartment, the combination of means operable from within said compartment to position said submersible vessel over a disabled submarine on the floor of the sea having a protruding hatch, a hollow laterally flexible non-collapsible tube of large diameter depending from said vessel and having a normally open lower end, a circular series of radially movable members within said tube near the lower end thereof to adjust the diameter of said lower end, and operating means extending longitudinally within said tube and extending through the wall of said tube into said compartment to operate said members to expand and contract the diameter of the lower end of said tube.

6. In a hollow submersible vessel having a water-tight compartment, the combination of means operable from within said compartment to position said submersible vessel over a disabled submarine on the floor of the sea having a protruding hatch, a non-collapsible, laterally flexible tube made of water-tight fabric and a columnar series of rigid rings fitting within said tube and articulated with respect to each other, whereby the lower end of said tube may be moved transversely in fitting it over the said protruding hatch of the sunken submarine, a circular series of members at the lower end of said tube and within the same to prevent said lower end from collapsing when subjected to high exterior pressure and to vary and adjust the diameter of the said lower end of said tube in order to telescope said end over said protruding hatch, and means for operating said members at the lower end of the tube and

extending vertically within said tube and through a wall of said tube into said compartment, a water-tight hatch affording a passage from said compartment into and out of said tube when the lower end of said tube is tightly fitted around said protruding hatch, said means for operating said members being made in separable sections removable from the interior of said tube through said hatch into said compartment to afford a clear passage-way within said tube from said submarine into the interior of said submersible vessel when the closure of said protruding hatch of said submarine has been removed.

7. In a hollow submersible vessel having a water-tight compartment, the combination of a large non-collapsible tube of water-tight fabric tightly fitting over an articulated columnar series of stiff metal rings operative to prevent the collapse of said tube from pressure outside of said tube, and a circular series of stiff radially movable members within said tube at the lower open end thereof to vary the diameter of said fabric tube and to prevent the collapse of said end under pressure exterior to said tube, and operating means within said tube and extending through a wall of said tube into said compartment for moving said members radially and to make the size of the open end of said tube larger than the protruding hatch of a sunken submarine and to draw said members radially inwardly to fit the lower end of said tube tightly around said protruding hatch.

8. The combination with a submersible vessel having a non-collapsible escape tube depending from the bottom thereof and adapted to be telescoped over and fit tightly around the protruding hatch of a disabled submarine on the floor of the sea, of a water-tight observation and diver's tube also depending from said vessel and provided with a heavy glass port opening toward the lower end of said escape tube to enable an observer in said observation tube to direct the movement of the submersible to effect the placement of the expansible end of said escape tube over and around said protruding hatch.

9. The combination with a submersible vessel having an escape tube depending from the bottom thereof, adapted to be telescoped over the protruding hatch of a disabled submarine, means within and at the end of said tube, and operable from within said vessel to vary the diameter of said end to fit it tightly around said protruding hatch, and a rigid water-tight tube also depending from said vessel and provided with a glass port opening toward the lower end of said escape tube to enable an observer in said diver's tube to direct the navigation of the submersible to effect the placement of the said expansible end of said escape tube over and around said hatch, a water-tight hatch within said diver's

tube and operable by the observer within the lower end of said tube and when closed, forming a diver's chamber in the lower end of said tube, diver's air tubes extending into said chamber, a sea-valve operable from within said chamber to flood said chamber with water at the pressure of the water outside of said tube, and a water-tight port which can be opened and closed from within said chamber, affording a passage for a diver into and out of said diver's chamber through said port.

10. In a hollow submersible water-tight vessel, the combination of an escape tube having an open lower end and a rigid normally closed upper end entering into said vessel, said escape tube comprising a two-ply flexible water-tight fabric tube and a columnar series of rigid rings fitting within the inner ply of said fabric tube to prevent said fabric tube from collapsing, said rings being articulated with respect to each other, a circular series of stiff radially movable members pivotally connected to the lower of said rings and depending therefrom and fitting within the lower end of said fabric tube, removable means within said tube to swing the lower ends of said members radially to expand and contract the lower end of said tube, the two plies of said fabric being connected together water-tight at their lower ends and covering the lower ends of said radially movable members and yieldingly secured to the inner sides of said radially movable members, and means operable from within said submersible vessel to admit air at high pressure at the upper ends of the plies of said fabric tubes into the space between said plies to expand the outer ply of said fabric tube and to force said outer ply within the lower end of said radially movable members into water-tight engagement with the projecting port of a sunken submarine after the lower end of said tube has been telescoped over said protruding hatch.

11. In a device for making rescues from sunken vessels, the combination with a hollow submersible vessel having a water-tight compartment and a hollow lateral flexible non-collapsible tube of large diameter depending from said vessel and open at the lower end thereof and a circular series of radially movable members within said tube near the lower end thereof to adjust and vary the diameter of said lower end, of means operable from within said compartment to position said submersible vessel over a disabled submarine on the floor of the sea having a protruding hatch, with the lower end of said tube fitted over said hatch and to contract said radially movable members to tightly fit the lower end of said tube around the outside of said hatch.

12. In a device for rescuing a crew from a sunken submarine having a protruding es-

cape hatch, the combination of a hollow water-tight submersible vessel, a large non-collapsible tube having a rigid portion extending vertically within said vessel and having a transversely flexible portion extending below said vessel into the surrounding sea, the lower end of said tube being open and expandible to a diameter greater than that of said protruding hatch and contractable to a diameter to fit tightly around said hatch, means operable from within said vessel to move said vessel and to thereby telescopically slide said open end of said tube over said protruding hatch, means operable from within said vessel and extending downwardly within said tube to expand the open end of said tube and to contract it around and against said hatch, a water-tight port affording a passageway from the interior of said vessel and into and out of said tube when the lower end of said tube is tightly fitted around said protruding hatch, said tube affording access within said tube to the closure of said protruding hatch and affording an escape passage for the imprisoned crew through said hatch into said tube and thence into the interior of said submersible vessel when said hatch on said submarine has been opened from within said tube.

13. In a device for rescuing a crew from a sunken submarine having a protruding hatch

substantially circular in cross-section and providing a flanged and a circular neck below said flange around said hatch, the combination of a hollow water-tight submersible vessel, a large non-collapsible tube having a rigid portion extending within said vessel and having a transversely flexible portion depending below said vessel into the surrounding sea, the lower end of said tube being open and expandible to a diameter greater than that of said protruding hatch and contractable to a diameter to fit tightly around said neck, means operable from within said vessel to telescopically slide the open end of said tube over said protruding hatch, rigid expanding members within said tube and arranged in a circular series at the open end thereof, means within said tube and connected to said members and extending through the wall of said tube into said vessel to positively operate said expanding members to increase and to diminish the diameter of the open end of said tube, and a water-tight port affording a passage-way from the interior of said vessel into and out of said tube when the lower end of said tube is tightly fitted around said protruding hatch.

In witness whereof, I have hereunto set my hand this 22nd day of December, 1928.

MATTHEW PALISCA.

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