RAPID SALVAGE SYSTEM FOR SUBMARINES

Filed Nov. 12, 1928

Edward Ellsberg
Inventor

Wilkinson & Gusta
Attorneys
RAPID SALVAGE SYSTEM FOR SUBMARINES

Inventor

Edward Ellsberg

Attorneys
My invention relates to salvaging apparatus for use in raising sunken vessels, and is especially adapted to raise sunken submarines. It is well-known that the hulls of submarines are particularly vulnerable when struck by solid objects, and that the wounds caused by collisions have frequently caused a submarine to sink quickly carrying with her all the crew, or such of those not able to escape.

Such members of the crew as are imprisoned in water-tight compartments may exist for a limited time, but unless speedy succor is given, these imprisoned persons will inevitably succumb; and therefore, with submarines, it is especially desirable that salvaging apparatus may be available, which may be quickly and successfully operated to bring the sunken vessel to the surface.

In methods hitherto adopted, in salvaging submarines, it has been the practice to pass chains under the sunken vessel, but this is a tedious operation, and can only be effected by divers tunnelling in the mud, ooze and other materials at the bottom of the ocean, and this operation is attended with special difficulty when the water is deep, or when its surface is rough. It frequently happens that such tunnelling is impracticable, and it is a part of my invention to provide apparatus that will obviate the necessity of any such tunnelling.

Again, in raising sunken vessels, it is usually found necessary to employ pontoons, which are difficult to control, especially in a rough sea, and whose operation frequently causes serious, if not fatal, delays in the salvaging operations.

The difficulties hitherto experienced, and the methods proposed by me for improving those conditions and in securing rapid and effective operation of the salvaging system will be hereinafter more fully explained, and illustrated in the drawings.

For the rapid salvage and rescue of sunken submarine boats and their crews, all previous methods have proven slow or impracticable. There has not hitherto existed any rapid and sure means of attaching lifting gear to submarines, nor reliable and safe means of lifting under conditions of open sea work.

Derricks have been used on small submarines in shallow water in a harbor, hooked to eyes worked into the bow and stern of small submarines (under about three hundred tons); for larger submarines such eyes at the bow and stern are impracticable as they cannot be made strong enough to carry half the weight of the submarine, nor can lifting gear of such strength be conveniently provided, nor can derricks having the power to lift over one hundred fifty tons conveniently be found.

As a consequence, it has usually been necessary at great expense, danger, and delay to dig tunnels underneath the sunken submarine, to pass chains or slings under her for lifting, which is a process sometimes requiring months of work, and consequently is useless to save life. It has also been proposed to drill holes, or burn holes, or punch holes, or by other means, make holes in the sides of sunken vessels to secure lifting hooks or other attachments to the sides of submarines already sunk; but such proposals overlook the mechanical difficulties of providing the holes quickly, and the further difficulty that the sides and structure of the submarine are so light that any such hooks or attachments to holes or bolts fastened to the sunken submarine will tear out and be unable to stand the strains of the necessary lifting forces for practical work.

It is, therefore, proposed that each submarine, as a part of her hull, be fitted with a set of lifting eyes, or attachments, which shall permanently be secured to her hull in rows along each side, and so spaced and proportioned to take the lifting chains or wires from the special submersible stabilized pontoons, which are provided for the lifting means.

By using submersible stabilized pontoons of the design proposed, it becomes possible to so reduce the strain which each lifting wire or chain must take, as to make it feasible without undue weight or bulk to provide on the submarine’s hull eyes or attachments which will take the pull and not interfere with the normal operation of the submarine.
or add a prohibitive weight to its displacement; the eyes being so small that they can be attached to the structure along the outside of the hull registering with existing frames and bulkheads, where they are accessible to divers, and to which the hoisting lines or cables can be conveniently attached.

To this end it is proposed that, for submarines of about one thousand tons, more or less, a series of twelve such eyes be secured along each side, spaced in pairs, with about sixteen feet between the eyes in each pair in the fore and aft direction, and with one such pair for about each forty feet of length. For other sizes of boats, the number of eyes should be in proportion.

The eyes should preferably be just above the point of maximum width of hull at each section, and for the ordinary type of submarine construction just above the watertight flat over the ballast tanks in the double hull part of the boat. It is estimated that for the ordinary boat, a pull of forty tons will be exerted on each eye by its pontoon chain or wire, and that for this pull, the eye and its attachments will weigh about two hundred pounds. For very large and wide boats, a third row of eyes may be added along the upper center line in the deck.

By this means, when a submarine sinks in any depth of water where divers can work, it becomes possible speedily to shackle or otherwise secure to the eyes or attachments on the submarine, the necessary lines, as wires or chains for lifting. The eyes being well up on the hull are accessible to divers regardless of the list of the submarine, and the chains or attachments lowered from the surface can quickly be secured by the divers without the need or delay of digging tunnels or drilling holes or endeavoring under water to make fast means for attaching lifting lines. It thus results that such chains or wires as will stand working strains of about forty tons, which are the ordinary equipment of vessels and shipyards, available for lifting. It further results that there is no danger of the chains slipping along or out from under the hull, as occurs when they are passed underneath the keel by the methods heretofore employed, nor are the chains or wires liable to be cut or chafed in two by the keel as has frequently happened when used under the keel as in previous practice.

Furthermore, the provision of eyes along the sides gives opportunity to exert a strong rolling movement to a submarine by exerting a pull initially on one side only, thereby tending to move the submarine in her bed and break loose the suction effect, which is necessary in many cases before a submarine can by any power be torn free from the bottom.

For use in connection with the novel system of eyes mentioned above, there is necessary a readily available lifting means. Derricks are not powerful enough nor can they operate in the open sea. Salvage ships of various forms have been proposed and built, but the technical difficulties of their operation has hitherto prevented success in lifting large submarines in the open sea.

Submersible pontoons have heretofore been used with success for deep water salvage, but I have found pontoons of the type known to the prior art are unsafe to handle, and slow and difficult to lower into position properly, besides losing a considerable part of their lifting power at the time when most needed. I have, therefore, invented for use with my novel method of attachment, a novel submersible stabilized pontoon which avoids the difficulties previously obtained.

Of the available lifting power of a pontoon, represented by its interior volume or displacement, part is required to overcome the weight of the pontoon itself, and the remainder only is the net lifting force. To sink the forty tons may be floated to a volume equal to its net lift, and it will then start to sink, leaving a space filled with air, which is equal in displacement to the weight of the pontoon itself, about forty tons for a large sized pontoon. Water is admitted for sinking through valves or openings near the bottom of the pontoon. As the pontoon sinks and the pressure on it increases, the air in the pontoon is compressed and more water enters, increasing the weight on the lowering lines, and together with the surging of the ship at the surface, setting up strains which are often sufficient to part the lines.

In addition, the free water surface in the partly filled pontoons allows the water to shift causing the pontoons to be unstable and tend to stand on one end or the other, thereby throwing added strain on the line at the low end, and fouling all the lines.

This instability and increasing weight in lowering have made previous pontoon operations difficult, dangerous, and often exceedingly slow; and while I have, by closing flood valves on a pontoon about to sink, prevented the entrance of further water while sinking, I have found the operation very uncertain and dangerous to the man undertaking it.

I, therefore, designed a stabilized pontoon, which is obtained by dividing the pontoon into compartments of such size, symmetrically disposed, that when certain of the compartments are flooded, or practically flooded, and the remainder dry, or practically dry, the pontoon then has the required amount of fixed negative buoyancy, about five tons, to sink it conveniently.

The preferable arrangement of compartments to secure this in a cylindrical pontoon is to have more than two compartments, usually three. The bulkheads are so spaced that when the end compartments, for instance, are completely flooded, and the center compart-
ment dry, the pontoon will sink, but cannot get heavier in descent, and having no free water surface in any compartment, either fill or empty, it acts as a fixed weight while being lowered, and consequently avoids the outstanding defect of prior pontoons to grow heavier on descent, and to tend to go down on end first as the free water in the compartments descends from end to end, making such prior pontoons unstable.

Therefore, in lowering, the pontoon can be given such small negative weight, say three to five tons, as permits lowering under easy control with moderate sized lines, and there is wholly avoided the necessity of such dangerous practices as closing flood valves before sinking, or the dangers of the pontoon growing heavier as it descends, or the liability of shifting water causing the pontoon to stand on end and thereby tangle itself in its lowering lines and guide lines.

In lifting submarines by pontoons, it is not possible to raise the boat horizontally, but one end or the other is bound to rise first, leaving the other end on the bottom with the boat at an angle depending on the length of the boat and the depth of water. In this position, the pontoons assume practically the same angle as the boat itself, and in pontoons, as previously constructed it becomes impossible to expel all the water remaining in the pontoon while at an angle, as the air vents itself from the high discharge valve, leaving a wedge of water in the pontoon, which considerably reduces its lifting power.

It is possible to determine beforehand which end will be lifted first by giving that end complete buoyancy in the first part of the blowing operation. I have, therefore, as a part of my invention, provided a sluice valve, or pipe, with a valve in it, which can be operated from the outside of the pontoon joining the two end compartments, as will be hereinafter described.

My invention will be more fully understood after reference to the accompanying drawings in which:

Figure 1 is a diagrammatic view, showing a sunken submarine with the various pontoons and air lines attached, parts being omitted for the sake of clearness in the drawings.

Figure 2 is a diagrammatic plan view of the apparatus shown in Figure 1.

Figure 3 shows a section along the line 3–3 of Figure 2, and looking in the direction of the arrows.

Figure 4 shows a section along the line 4–4 of Figure 2, and looking in the direction of the arrows.

Figure 5 is a plan view, partly broken away, of a pontoon constructed according to my invention.

Figure 6 shows a central vertical section through the pontoon shown in Figure 5 along the broken line 6–6, and looking in the direction of the arrows.

Figure 7 is an end view of the pontoon seen from the left of Figure 6.

Figure 8 shows a section along the line 8–8 of Figure 6, and looking in the direction of the arrows.

Figure 9 is a diagrammatic view showing two of the pontoons in operation, and the guide lines leading to the surface for guiding down another pontoon not shown.

Figure 10 shows a saddle plate carrying an eye attached to the outer hull of the submarine in the wake of one of the frames of the vessel.

Figure 11 shows a section along the line 11–11 of Figure 10, and looking in the direction of the arrows.

Figure 12 shows a modified form of pontoon adapted for use in the rapid salvage system herein described.

Figure 13 is an end view of the pontoon of Figure 12, as seen from the left of that figure, and

Figure 14 shows a section along the line 14–14 of Figure 12, and looking in the direction of the arrows.

A represents the outside plating of the hull of the vessel to be raised, which in this particular case is diagrammatically shown as a submarine, which vessel is provided with the usual longitudinal and transverse frames, one of the longitudinal frames being shown at A' in Figures 10 and 11, and one of the transverse frames at A in the said figures. The hull may also be provided with the usual or suitable transverse bulkheads, such as B in Figure 11, and the usual deck plates C, see Figures 2 and 4, and C', see Figure 11.

In other words, I do not propose to make any changes in the construction of the vessel as ordinarily built, except to permanently attach to the vessel fastening devices to which the hoisting wire, chains, or cables may be attached, such for instance as the saddle plates D, having the eyes D' secured to or integral therewith, as shown diagrammatically in Figures 1, 3, 4, and 6, and in detail in Figures 10 and 11. Referring to Figures 10 and 11, it will be seen that the saddle plates are curved to fit snugly against the deck plat- ing A, to which they are secured by bolts or rivets E.

By causing these saddle plates D to register with the transverse frames of the vessel, as shown in Figure 11, great structural strength is secured and the parts are well adapted to efficiently resist the lifting strains incident to the operation of floating the sunken vessel.

By having the attaching means in the form of eyes D', as shown in Figure 11, and placing these eyes well up on the sides of the vessel, preferably above the maximum beam, at that location, these projections will not be materially in the way in the ordinary opera-
tion of the vessel, such as docking, going alongside of another vessel, or the like; but at the same time the combined saddle plates and eyes will not add materially to the weight of the vessel; and thus this permanent addition to the structure will not materially increase the permanent load carried by the vessel.

This is especially important with submarines where the reserve buoyancy of the vessel is purposely made small, and it is not desirable to materially increase the weight carried by the vessel.

Thus in the structure of the submarine or other vessel, the only change necessary to be made to equip the vessel for salvage according to the improved system herein described is to add exterior to the watertight hull and as part of the permanent structure a series of attachments to which the lifting devices may be secured, and for this purpose, the saddle plates and eyes herein illustrated and described constitute one form of adequate and efficient attachment.

For use with the eyes and saddle plates just referred to, I provide hoisting chains or wires, such for instance as the chains E shown in detail in Figures 6 and 9. These chains are provided at their lower ends with suitable attaching means, such as the shackles E', see Figure 6, which can be readily connected by the diver to the eyes D', and their upper ends are attached to the pontoon, as by means of suitable pins, or the like, E', as shown in Figure 6, and as will be hereinafter more fully described.

These chains are lowered from the salvaging vessel (not shown) by means of lines F indicated in dotted lines in Figure 6 and shown in full lines in Figure 9.

These lines F serve to guide the pontoons down into engaging relation with the chains E, as will be hereinafter described.

As will be noted later, these chains E are attached to the pontoons, and serve, when the water is blown out of the pontoons, to take the entire weight of the vessel to be salvaged without the assistance of any derricks, or other hoisting lines from the surface.

Having thus described the construction of the vessels and the lifting chains to be directly connected to the same, I will now proceed to describe the construction and operation of the pontoons used in the herein described system.

I have shown in Figures 1 to 4 groups of cylindrical pontoons attached to a vessel to be salvaged, the vessel in Figure 1 being shown resting on the bottom on a substantially even keel; and in Figures 5 to 8, I have shown details of one form of cylindrical pontoon especially adapted for use in the herein described system; while in Figures 12 to 14, I have shown another form of cylindrical pontoon which is adapted to be used with the system described.

Either form of pontoon just referred to is suitable for use in the system shown in Figures 1 to 4, and also in Figure 9.

In this latter figure, I have shown two of the pontoons in section as attached to the vessel, and the guide lines attached to the chains in position for the lowering of the third pontoon, if such be needed.

In this latter figure, however, it is probable that two pairs of pontoons will be sufficient to overcome the negative buoyancy of the partly submerged vessel.

Referring first to the pontoons shown in detail in Figures 5 to 9, H represents a cylindrical shell, having the closed ends k and k', and with the transverse watertight bulkheads k 2 and k 3 , which separate the interior of the cylinder into three chambers H 2, H 3 and H 4. The central chamber H 2 is preferably made of shorter axial length than the other two chambers H 3 and H 4, and the chambers H 2 and H 4 are preferably of the same dimensions.

While I have shown, in Figures 5 and 6, the relative proportions of the chambers, H 2 may be relatively larger or smaller than the chambers H 3 and H 4, but for clearness in the drawings, I have made the central chamber somewhat larger than would ordinarily be required in practice.

Extending vertically through the chambers H 2 and H 4 and equidistant from the ends of the pontoons are the two hawse pipes H 2 and H 4, which are made watertight with the pontoon, as by welding or riveting, or in any convenient way, and which permit the passage therethrough of the lifting chains and guide lines. These hawse pipes H 2 and H 4 are parallel to each other, and cut across the longitudinal axis of the pontoon at right angles thereto, so that these hawse pipes will be centrally located relative to the vertical axis of the pontoon.

Thus when the lifting chains are drawn through the hawse pipes, as shown in Figure 6, these chains may be held against withdrawal through the hawse pipes as by suitable locking means, such as the wedges E'.

In order to properly control the operation of raising and lowering the heavy pontoons, I provide suitable air and water connections to the interior thereof, which will now be described.

Referring to the construction shown in Figures 5 and 9, and assuming this construction to be that used in the system illustrated diagrammatically in Figures 1 to 4, the end chambers H 2 and H 4 of the pontoon are provided with flood pipes I, which may be used for either flooding these chambers or draining the water out of the same, during the blowing operation. The flood pipes are controlled by valves Y, which are manipulated...
by the diver, as will be hereinafter described.

These flood pipes are preferably in the form of goose necks bent downward as at \( i \) and nearly touching the bottom of the chamber.

Opposite the flood pipes, two air vents \( J \) and \( J' \) are provided near the opposite end of the top of the chamber \( H^2 \), and similar air vents \( J^2 \) and \( J^2' \) are provided at the top and near the end of the chamber \( H^3 \), which are controlled by the valves \( j \) manipulated by the diver.

In the central chamber \( H^2 \), there are two air vents \( J^2 \) and \( J^2' \), one of which \( J^2 \) is connected by the air hose \( K \) to the surface, the other of which \( J^2' \) is connected to a telltale pipe \( L \), which projects down into the chamber \( H^2 \) nearly to the bottom thereof. One of the air vents \( J^2 \) of the end chamber \( H^3 \) is connected by the hose \( K' \) to the surface. In practice it will be desirable to have the pipes \( K \) and \( K' \) as close together as possible, as shown in Figure 6.

The chambers \( H^2 \) and \( H^3 \) are connected together by a sluice pipe \( M \) controlled by the valve \( m \), which valve \( m \) is operated by the valve stem \( m' \), which projects up through the top of the pontoon and may be manipulated by the operator by the use of any convenient wrench or handle.

The chamber \( H^2 \) is emptied into one of the end chambers by the bent drain pipe \( N \) (see Figure 6), which leads down nearly to the bottom of the chamber \( H^2 \), as at \( n \), and opens into the chamber \( H^3 \), as at \( n' \). This drain pipe \( N \) is controlled by a valve \( n' \), having a stem \( n^2 \) projecting above the top of the pontoon, so that the valve \( n^2 \) may be controlled from without the pontoon, by the operator.

For convenience in controlling the pontoon, eyes \( O \) and \( O' \) are provided to which suitable lines (not shown) may be attached. Assuming the guide lines \( F \) to be fed through the empty hawse pipes of the pontoon, and it to be in position for beginning the operation of lowering, and assuming the guide chains at the end of these hauling lines to be shackled or otherwise fastened to the eyes \( D' \), and assuming the air hoes \( K \) and \( K' \) to be attached to the vents \( J \) and \( J' \), the central chamber \( H^2 \) will then be filled with air. The end chambers \( H^2 \) and \( H^3 \) will then be flooded by opening the valves \( I' \) until the negative buoyancy of the pontoon is sufficiently great; in practice three to five tons of negative buoyancy would be proper for a pontoon having lifting power of forty tons.

When the chamber \( H^2 \) is blown, if air comes up through the vent pipe \( J' \), it will be known that the chamber is clear of water; while if water comes up through the pipe, the chamber can be blown until substantially all the water is removed and likewise the flood valves \( I' \).

The chambers \( H^2 \), \( H^3 \) and \( H^4 \) are preferably so dimensioned that when the two end chambers \( H^2 \) and \( H^4 \) are completely filled with water, and the central chamber is filled with air the pontoon will have the negative buoyancy necessary to sink. At this time, there will be little, if any, tendency of either end of the pontoon to tilt up.

The end chambers may be completely filled with water as the pontoon submerges by leaving the air vents \( J \), \( J' \), \( J^2 \) and \( J^2' \) open, and likewise the flood valves \( I' \).

The two ends of the pontoon being thus completely filled with water and empty of air, and the central chamber being filled with air, the pontoon will be stabilized, and there will be little, if any, tendency of either end to tilt up, and thus it may be readily controlled as it is lowered down the guide lines \( F \) until it slips over the chains \( E \). When the ends of these chains appear above the top of the pontoon, the diver slips in the wedges, or other suitable locking devices, \( E^2 \), and the pontoon is securely attached to the vessel, or vice versa. Now the negative buoyancy of the pontoon is changed to positive buoyancy as follows:

The diver closes the vents \( J \), \( J' \), and \( J^2 \), the vent \( J^2' \) meantime being closed, and opens the valve \( n^2 \), the valve \( m \) being closed; then air is applied under pressure through the hoses \( K \) and \( K' \).

The air hose \( K \) will blow the air from the chamber \( H^2 \) through the drain pipe \( N \), into the chamber \( H^3 \), which will be emptied through the flood pipe \( I \). Similarly, the air pressure from the hose \( K' \) will blow water from the chamber \( H^4 \) out through its flood pipe \( I \). If the water is not substantially all expelled from the two end chambers \( H^2 \) and \( H^4 \) due to one end of the pontoon being lower than the other when the submarine has one end already up, then by closing the outlet valve \( I \) on the high end of the pontoon and opening the sluice valve \( m \), all the remaining water will be forced out of the valve \( I \) at the low end. This will permit the pipe \( M \) to bypass the liquid from the chambers \( H^2 \) to the chamber \( H^3 \) if the right end of the pontoon be elevated, or the liquid will be dispelled in the opposite direction if the left end of the pontoon is tilted.

At this time the pontoon will be securely connected to the vessel to be salvaged, and the complete positive buoyancy will aid in lifting the vessel. By having an adequate number of pontoons, as shown for instance in Figures 1 and 2, the total required lifting power may be applied without there being...
any lifting lines connected to the surface of the water.

This herein described arrangement of stabilizing the pontoons is especially desirable when it is desired to connect the pontoon to a vessel, which is submerged in a tilting position, as for instance shown in Figure 9. Obviously, where a vessel is tilted at an angle, it has some remaining buoyancy, and a less number of pontoons may be used to accomplish the desired lifting result; and in Figure 8, I have shown two sets of pontoons as probably capable of lifting the stern of the vessel therein shown.

By having the eyes D' high up on the hull of the vessel, the lifting chains E may be attached to the lower side of the vessel as she lies on the bottom on her bilges, and the vessel may be rolled to an even keel or beyond, and similar application of pontoons to the other side may roll the vessel in the reverse direction; and thus the hull may be loosened in the mud or ooze at the bottom of the sea, and that suction ordinarily experienced in raising sunken vessels will be in a large measure obviated or minimized.

The foregoing description has set out the operation of the apparatus employing the three chambered pontoons, as shown in Figures 5 to 9. In Figures 12 to 14 I have shown a pontoon P, having two superposed chambers P' and P" separated by the arched partition P³. The lower chamber is intended to be filled with water through the flood pipes I at each end thereof, controlled by the valves J.

The upper chamber P' is normally filled with air, which is forced in through the hose K into either one or the other of the air inlets J'. Should any water leak into the upper chamber this may be blown out through the vents J³ and J'. I provide vent pipes Q and Q' passing through the air chamber and opening into the water chamber, as shown to the left of Figure 12, and air may be blown into one of these pipes by means of the hose K², the other pipe Q' being closed.

I provide one of these air vents J' near each end of the pontoon, and also one of the pipes Q and Q' near each end of the pontoon, so that either may be used to blow in air, the other being closed, and when it is desired to fill the water chamber with water, either, or both, of these vents Q and Q' may be opened, and the water may be allowed to flow in through the flood pipes I.

The pontoon shown in Figures 12 to 14 is provided with the hawse pipes H² and H' for use with the lifting chains, as already fully described with regard to Figures 5 to 9.

In using this form of pontoon, it will be obvious that the air chamber at the top will serve to keep the pontoon in the stabilized position, and that the water chamber can be completely filled with water, and thus there will be no sloshing around of water in this chamber, and the same can be controlled like a solid log.

With this form of pontoon, eyes O and O' may be provided for use of controlling lines. Any other means may be provided for controlling either form of pontoon herein described.

When preparing for lifting, the end of the submarine to be lifted first is determined on, and divers then close all the water discharge valves on the ends of the pontoons, which will be high when the first end of the submarine lifts, while they open the sluice valves at the same time.

During the lifting operation all water is therefore expelled from the lowest point in the pontoon after it assumes an angle, and no air can vent till the pontoon is practically dry. The total lifting force of the pontoon is thus realized in raising, which has not hitherto been the case in submersible pontoons.

It is, therefore, possible to use the above system and avoid wholly the following delays which have made submarine salvage sometimes a matter of weeks and months:

(a) Making watertight and buoyant the undamaged interior compartments, which is a slow and hazardous job for the divers.

(b) Digging tunnels underneath the boat for slings, which is slow, very difficult, and extremely dangerous to the divers.

(c) Levelling of and lashing the pontoons before lifting, to prevent them and the slings from slipping off the boat while at an angle during lifting, which levelling and lashing process is slow and difficult for the divers.

(d) Providing additional buoyancy either inside the boat or by extra pontoons, to make up for the unavailable buoyancy of water left in the pontoons as previously built when the pontoons assume an angle during the first state of the lifting process; which additional buoyancy however provided means much extra work and delay.

The use of the above system of eyes on the boat and of stabilized submersible pontoons makes it possible to secure the necessary lifting power in sections, one pontoon at a time, and avoids the necessity for having more lines running to the surface at any time than are required for handling the pontoon being secured.

With this system no lifting lines are required from the submarine to the surface, whereas in using derricks or surface lifting vessels, as has been proposed in other nations, a multiplicity of lifting lines must be run from the surface to the submarine and attached thereto in some manner, and it is not possible in deep water and the open sea to keep such a mass of lines from fouling each other; moreover, if bad weather forces a suspension, such lines to surface vessels must be
buoyed off and will be found a tangled mass when the storm is over.

On the other hand, with the system I propose, each pontoon when secured to the sunken vessel is a finished job, no lines to the surface are thereafter required; and if a storm comes along, operations can be suspended with no lines to the surface to be buoyed off, and consequently work can be resumed promptly when conditions permit.

The only lines to the surface required for lifting are the air hoses; these can always be buoyed off, and if they foul each other, it is a matter of no moment and they do not require to be cleared thereafter.

The salvage system here proposed makes it possible to lower and secure pontoons at the rate of one per hour; making allowances for interruptions, night work, etc., a properly equipped diving ship can lower and secure twelve pontoons in less than two working days and raise a thousand ton submarine immediately thereafter, making it possible to rescue the crew if still alive, and to salvage the boat at trifling expense compared to the present methods which require months of work.

While I have described the system and apparatus especially designed therefor, it will be obvious that changes might be made in the construction, combination, and arrangement of parts, which could be used without departing from the spirit of my invention, and I do not mean to limit the invention to such details except as particularly pointed out in the claims.

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

1. A rapid salvage system for raising sunken vessels substantially by buoyancy alone, comprising a series of chain attaching devices permanently secured to the exterior of the watertight hull of the vessel, a series of submersible horizontally stabilized pontoons each including a central air chamber having no direct inlet to the outer water, whereby the volume of water admitted to the remaining portions of the pontoons constitutes the entire effective liquid weight in submerging and each provided with hawse pipes near each end thereof, and lifting chains passing through said pipes and attached near the upper ends to the pontoon above said pipes and at their lower ends to said attaching devices.

2. A rapid salvage system for raising sunken vessels substantially by buoyancy alone, comprising a series of chain attaching devices permanently secured to the exterior of the watertight hull of the vessel, in the wake of transverse frames of the vessel, a series of submersible horizontally stabilized pontoons each including a central air chamber having no direct inlet to the outer water, whereby the volume of water admitted to the remaining portions of the pontoons constitutes the entire effective liquid weight in submerging and each provided with hawse pipes near each end thereof, and lifting chains passing through said pipes and attached near the upper ends to the pontoon above said pipes and at their lower ends to said attaching devices, and guide lines secured to the upper ends of said lifting chains, and adapted to be rove through said pipes, and to lead above the surface of the water.

3. A rapid salvage system for raising sunken vessels substantially by buoyancy alone, comprising a series of saddle plates permanently secured to the exterior of the watertight hull of the vessel, in the wake of transverse frames of the vessel, and each including a central air chamber having no direct inlet to the outer water, whereby the volume of water admitted to the remaining portions of the pontoons constitutes the entire effective liquid weight in submerging and each provided with hawse pipes near each end thereof, and lifting chains passing through said pipes and attached near the upper ends to the pontoon above said pipes and at their lower ends to said attaching devices.

4. A rapid salvage system for raising sunken vessels substantially by buoyancy alone, comprising a series of chain attaching devices permanently secured to the exterior of the watertight hull of the vessel, a series of submersible horizontally stabilized pontoons each including a central air chamber having no direct inlet to the outer water, whereby the volume of water admitted to the remaining portions of the pontoons constitutes the entire effective liquid weight in submerging and each provided with hawse pipes near each end thereof, and lifting chains passing through said pipes and attached near the upper ends to the pontoon above said pipes, and at their lower ends to said attaching devices, and guide lines secured to the upper ends of said lifting chains, and adapted to be rove through said pipes, and to lead above the surface of the water.

5. A rapid salvage system for raising sunken vessels substantially by buoyancy alone, comprising a series of chain attaching devices permanently secured to the exterior of the watertight hull of the vessel, in the wake of transverse frames of the vessel, and each including a central air chamber with no direct inlet to the outer water, whereby the volume of water admitted to the remaining portions of the pontoons constitutes the entire effective liquid weight in submerging and each provided with hawse pipes near each end thereof, and lifting chains passing through said pipes and attached near the upper ends to the pontoon above said pipes and at their lower ends to said attaching devices, and guide lines secured to the upper ends of said lifting chains, and adapted to be rove through said pipes, and to lead above the surface of the water.
through said pipes, and to lead above the surface of the water.

6. A rapid salvage system for raising sunken vessels substantially by buoyancy alone, comprising a series of saddle plates permanently secured to the exterior of the water-tight hull of the vessel, in the wake of transverse frames of the vessel with eyes carried by said saddle plates, a series of submersible horizontally stabilized pontoons each including a central air chamber having no direct inlet to the outer water, whereby the volume of water admitted to the remaining portions of the pontoons constitutes the entire effective liquid weight in submerging and each provided with hawse pipes near each end thereof, and lifting chains passing through said pipes and attached near the upper ends to the pontoon above said pipes and at their lower ends to pairs of said eyes, and guide lines secured to the upper ends of said lifting chains, and adapted to be rowed through said pipes, and to lead above the surface of the water.

7. A rapid salvage system for raising sunken vessels substantially by buoyancy alone, comprising a series of eyes permanently secured to the exterior of the hull of the vessel, a series of submersible horizontally stabilized pontoons each including a central air chamber having no direct inlet to the outer water, whereby the volume of water admitted to the remaining portions of the pontoons constitutes the entire effective liquid weight in submerging and each provided with a pair of vertically disposed chain pipes passing therethrough near the ends thereof, and lifting chains attached near the upper ends to the pontoon above the chain pipes, and at their lower ends to said eyes, with means for lowering said pontoons into the attached position, and for then expelling the water from said pontoons.

8. A rapid salvage system for raising sunken vessels, comprising a series of saddle plates permanently secured to the exterior of the hull of the vessel, each plate registering with a transverse frame of the vessel, each saddle plate being provided with an eye for attaching a chain thereto, a series of horizontally stabilized pontoons each including a central air chamber having no direct inlet to the outer water, whereby the volume of water admitted to the remaining portions of the pontoons constitutes the entire effective liquid weight in submerging and each provided with a pair of vertically disposed chain pipes passing therethrough near the ends thereof, and lifting chains attached near the upper ends to the pontoon above the chain pipes, and at their lower ends to said eyes, with means for lowering said pontoons into the attached position, and for then expelling the water from said pontoons.

9. In a rapid salvage system for raising sunken vessels, a horizontally stabilized pontoon, comprising a cylindrical shell with bulkheads dividing the same into a central air chamber having no direct communication with the outside water, and symmetrically disposed end chambers separate therefrom, means for filling said end chambers with water, means for lowering the pontoon and attaching same to the sunken vessel, the volume of water admitted to the end chambers constituting the entire liquid effective weight in submerging, and means for then blowing the water from the end chambers by air under pressure, whereby the pontoon is rendered buoyant and tends to lift the sunken vessel.

10. In a rapid salvage system for raising sunken vessels, a horizontally stabilized pontoon, comprising a cylindrical shell with bulkheads dividing the same into a central air chamber having no direct communication with the outside water, and symmetrically disposed end chambers separate therefrom, with a pipe projecting vertically through each of said end chambers, means for filling said end chambers with water, means for lowering the pontoon and attaching same to the sunken vessel, the volume of water admitted to the end chambers constituting the entire liquid effective weight in submerging comprising guide lines and lifting chains rowed through said hawse pipes, and means for then blowing the water from the end chambers by air under pressure, whereby the pontoon is rendered buoyant and tends to lift the sunken vessel.

11. In a rapid salvage system for raising sunken vessels, a horizontally stabilized pontoon, comprising a cylindrical shell with bulkheads dividing the same into a central air chamber having no direct communication with the outside water, and symmetrically disposed end chambers separate therefrom, means for completely filling said end chambers with water, comprising inlet valves at the lower outer corner of each end chamber, and a sluice pipe passing through said central chamber, and opening into each end chamber, and a valve operable from the exterior of the pontoon for closing said sluice pipe, when desired, means for lowering the pontoon and attaching same to the sunken vessel, and means for then expelling the water from the end chambers, whereby the pontoon is rendered buoyant, and tends to lift the sunken vessel.

12. In a rapid salvage system for raising sunken vessels, a horizontally stabilized pontoon, comprising a cylindrical shell with bulkheads dividing the same into a central air chamber, and symmetrically disposed end chambers separate therefrom, means for filling said end chambers with water, means for lowering the pontoon and attaching same to the sunken vessel, and means for then expelling the water from the end chambers,
whereby the pontoon is rendered buoyant and tends to lift the sunken vessel, said water expelling means comprising air hoses connected, respectively, to said central chamber, and to one of said end chambers, a pipe connecting said central chamber with the other end chamber, a valve operable from the outside of the pontoon for opening and closing said pipe, a sluice pipe connecting the lower corners of said outer chambers adjacent said inner chamber, with a valve controllable from the exterior of the pontoon for opening and closing said sluice pipe, and drain locks at the outer lower corners of said outer chambers.

EDWARD ELLSBERG.