Aug. 16, 1955 R. G. SOLHEIM 2,715,379

DIVING BELL

Original Filed Jan. 22, 1951 4 Sheets-Sheet 1

Fig. 1.

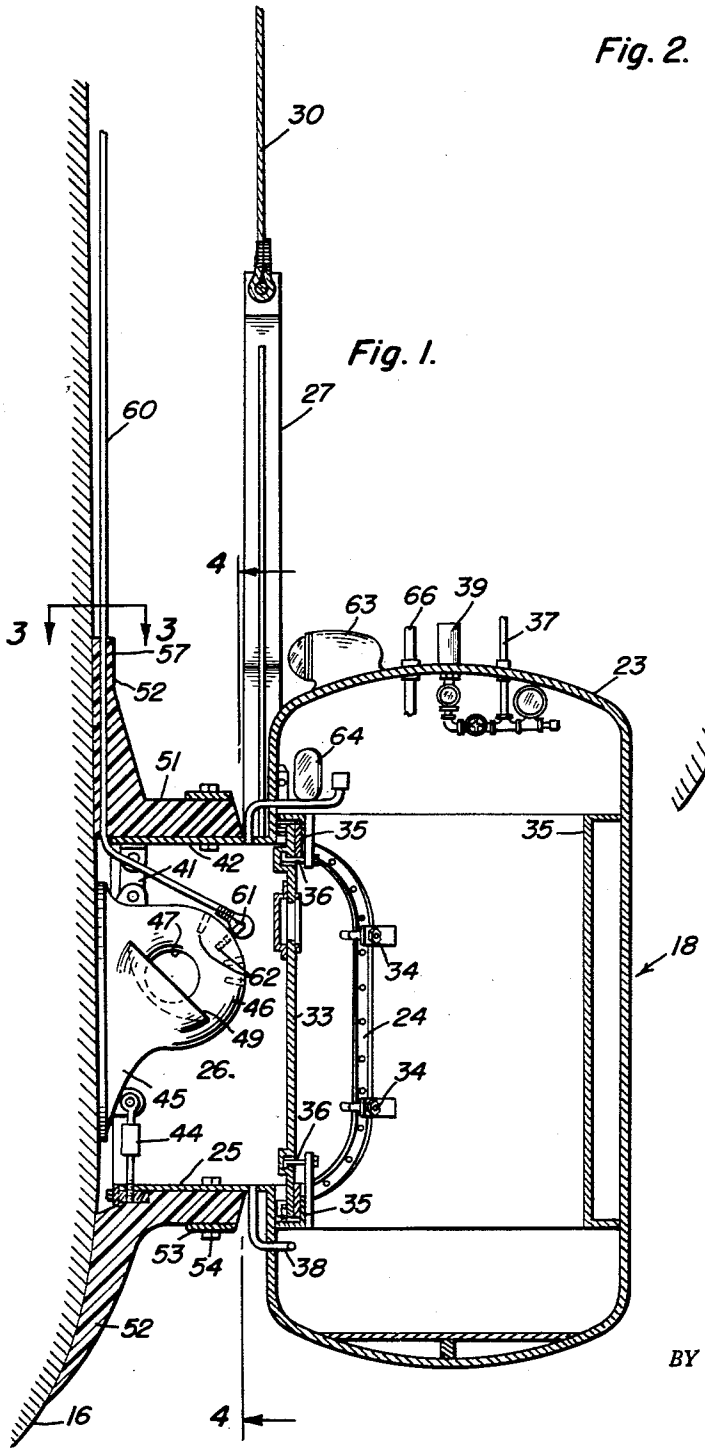


Fig. 2.

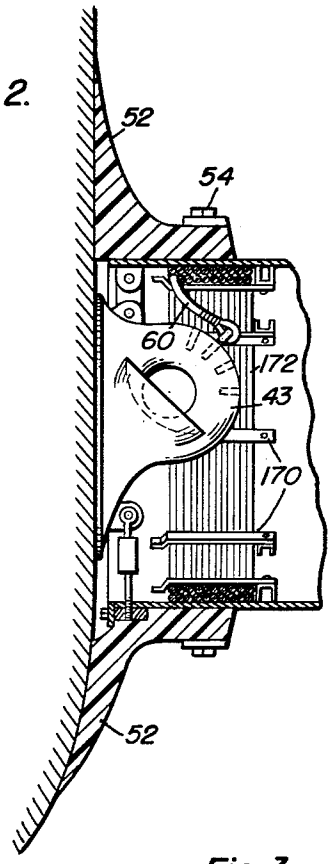
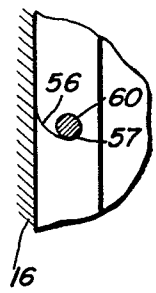


Fig. 3.



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Fig. 4.

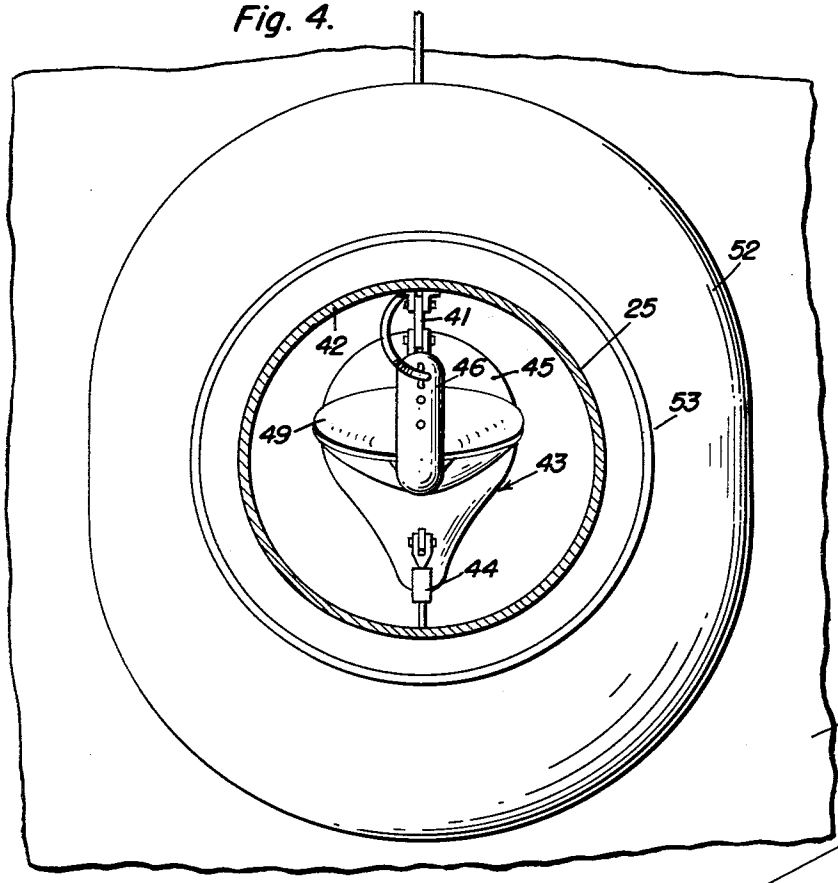
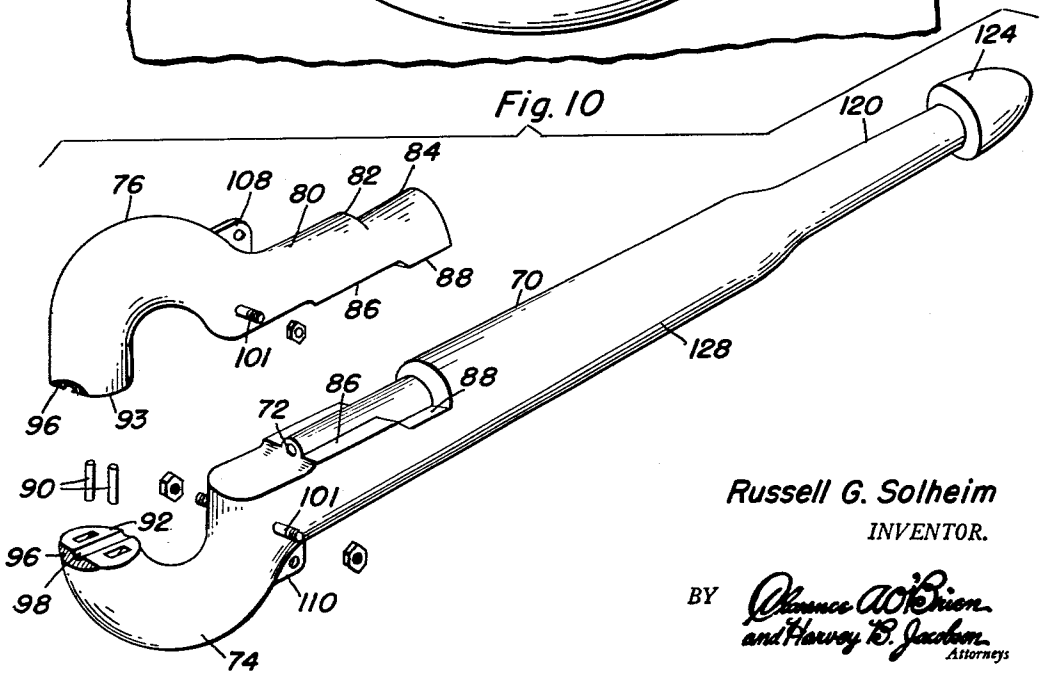


Fig. 10



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Fig. 8.

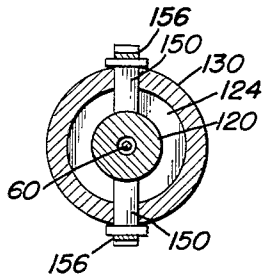


Fig. 9.

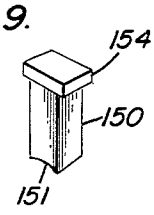


Fig. 5.

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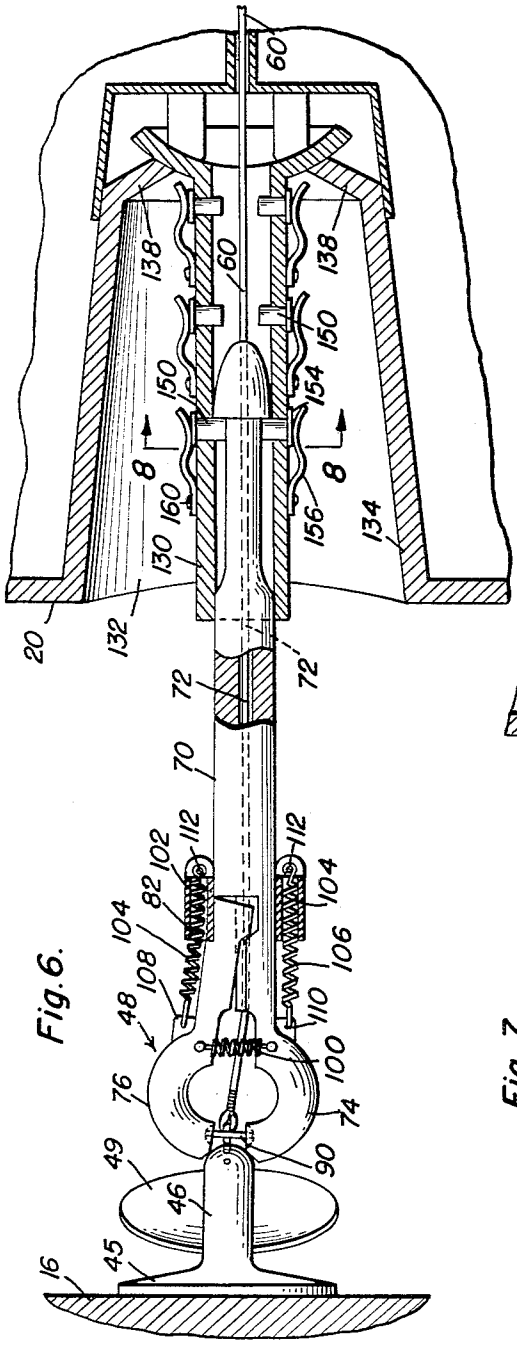


Fig. 6.

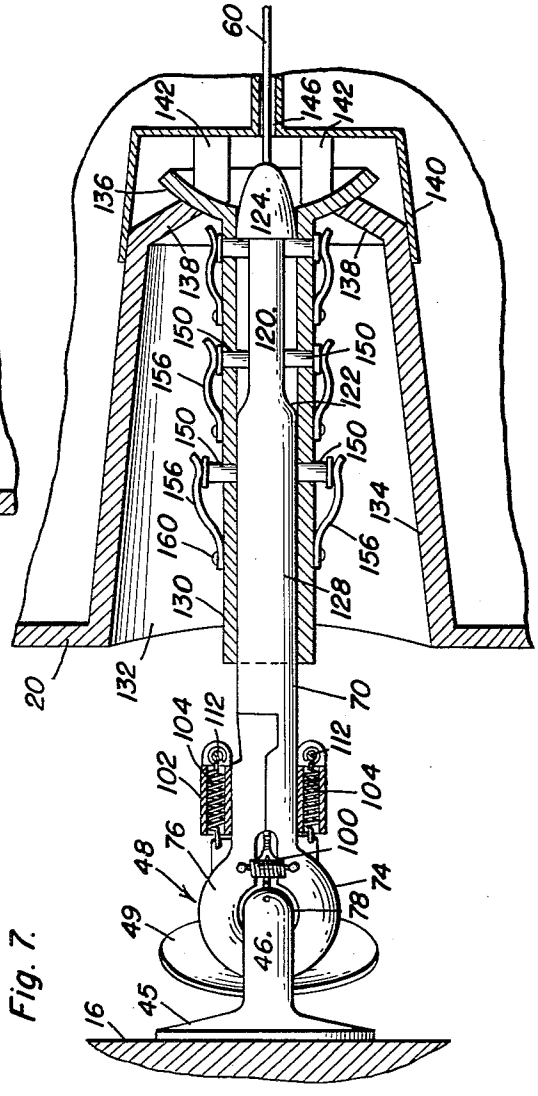


Fig. 7.

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2,715,379

Patented Aug. 16, 1955

2,715,379

DIVING BELL

Russell G. Solheim, Racine, Wis.

Original application January 22, 1951, Serial No. 207,087. Divided and this application March 30, 1953, Serial No. 349,682

11 Claims. (Cl. 114—51)

My invention relates to apparatus for raising sunken vessels and more particularly to improvements in a diving bell and a cable-threaded hook for effecting the attachment of one or more buoyant tanks or pontoons to the hull of a sunken vessel whereby the vessel can be caused to rise to the surface by the lifting action of the buoyant pontoons. The present application includes improvement features over my prior application, Serial No. 654,983, filed March 16, 1946 (now Patent 2,536,103), and is a divisional application of my copending application Serial No. 207,087, filed January 22, 1951 (now abandoned), this application comprising improvements in the mechanism for attaching a hook and guide cable means to the hull of the ship, and to novel structural features of the hook and guide cable for suitably securing buoyant pontoons to the side of a sunken vessel.

It is an object of the present invention to provide a diving bell whereby only the "ear" or hull hook which is to be secured to the ship's side is required to be carried in the diving bell, thus eliminating the need for providing a plurality of apertures in the diaphragm of the diving bell to accommodate the same.

Another object of the invention is to provide an improved cable-threaded hook for engaging and snap-fastening a pontoon or the like to a hull hook.

Other features of the invention include a diving bell which is adapted to be lowered in a position to contact the hull of a sunken vessel, means to engage the side of the sunken vessel and seal the diving bell thereto, a hull hook carried by the diving bell, a link and attached cable secured to said hook, said cable leading to the surface of the water, means in the diving bell through which access may be had to the hull hook after the bell has become sealed to the hull of the sunken vessel, to facilitate the attachment of the hook to the hull, means to seal the opening giving access to the hook after the same has been welded to the hull whereby the bell may be unsealed from contact with the hull and elevated to the surface.

Another feature includes a diving bell and working bay in which the occupant of the diving bell may work at normal atmospheric pressures and temperatures.

Still another improvement feature comprises a diving bell having a bay section in which the guide cable attached to the hull hook is stored, thus eliminating the need of providing a groove or sealing aperture in the diaphragm of the diving drum and whereby the guide cable is adapted to be payed out from the working bay section of the diving bell as the bell rises to the surface after securing the hull hook in place on the ship's hull.

Various other objects and advantages will be apparent as the invention is described in more detail.

Although the novel features which are believed to be characteristic of my invention will be pointed out more particularly in the claims appended hereto, the invention itself, as to its objects and advantages and manner in which it may be carried out, may be better understood by referring to the following description taken in connection with the accompanying drawings, in which a specific embodiment thereof has been set forth for purposes of illustration.

In the drawings:

Figure 1 is a vertical sectional view through a diving bell and associated hull hook and cable mechanism embodying novel features of the present invention, and illustrated in position for attaching the hook to the hull of a sunken vessel which is shown broken away;

Figure 2 is a modification of the diving bell and cable and hook attachment shown in Figure 1 wherein the cable is coiled up and stored in a section of the working bay of the diving bell;

Figure 3 is a fragmentary detail view taken substantially on the line 3—3 of Figure 1 and looking in the direction of the arrows;

Figure 4 is a sectional view taken substantially on the line 4—4 of Figure 1 and looking in the direction of the arrows, the hull portion of the sunken vessel being shown broken away;

Figure 5 is a fragmentary sectional view through a pontoon and showing the manner in which it is locked to the cable threaded hook member and fastened to the hull hook;

Figure 6 is a detail view illustrating the construction of the cable-threaded hook and associated structure for attaching a pontoon thereto, certain parts being shown in section and broken away to better illustrate the construction and operation of the mechanism;

Figure 7 is a similar view as in Figure 6 and showing the parts fastened together and in position for operation of the pontoon to exert the buoyancy force for raising a sunken vessel;

Figure 8 is a detail sectional view taken on the line 8—8 of Figure 6, and looking in the direction of the arrows;

Figure 9 is a perspective view illustrating the construction of a shear pin as utilized for securing the pontoon to the cable-threaded hook member as illustrated in Figures 6 and 7; and

Figure 10 is an exploded perspective view of the cable-threaded hook and illustrating the construction of the pivoted jaws and knockout pins, the spring means for closing the jaws being omitted.

Referring to the drawings more in detail, and wherein like reference characters refer to like parts throughout the several figures, a hull of a vessel to be salvaged is designated generally **16**, a diving bell generally **18**, and a pontoon or buoyant tank generally by the reference numeral **20**. Further, it will be understood that the diving bell and pontoon equipment as illustrated and described will be used with a suitable salvage vessel and tender means stationed on the surface of the body of water, and which salvage vessel is equipped with the customary winches, electrical power generators, motors, air compressors, cranes and masts such as referred to in my prior aforementioned patent application.

The diving bell **18**, which is of similar construction and operation as illustrated and described in my aforementioned patent application, comprises, as shown in Figure 1, a hollow substantially cylindrical drum or capsule **23** having a port or opening **24** in its side which is surrounded by an integral extension or collar **25**, forming a work chamber **26**, and from diametric points of the collar extend trunnion means, not shown, the outer ends of which are suitably attached to the legs **27** of an inverted U-shaped yoke to which a suspension cable **30** is secured.

Slidably mounted in the opening **24** is a door **33** which, in one position, is adapted to close the port **24** and provide sealing engagement with the inner wall **35** of the cylindrical body **23** of the diving bell and adja-

cent the opening **24**. A gasket **36** is positioned between the door **33** and wall **35**. The door **33** is suitably held in sealing contact with the inner wall by the bolts **34** which are made accessible from the interior of the diving bell for manipulation by the occupant thereof. A liquid discharge pipe **38** communicates with the interior of the work chamber **26** and is suitably connected through a pump, not shown, and conduit means connected to a discharge nozzle **39** extending outwardly through the top of the diving bell. This discharge nozzle is preferably of the venturi type, being operated by air pressure which is supplied through a line **37** connected to an air compressor located on the tender or surface salvage vessel. The venturi discharge nozzle, however, may be operated by water under pressure. Utilizing water pressure in this manner eliminates the need of high pressure air line to the diving bell where sufficient air (or oxygen) is stored in the bell to sustain the diver during his stay at the bottom.

Suitably suspended on detachable links **41** at the mouth of the chamber **26** and secured to the top portion **42** is a hull hook, generally designated **43**. Cooperating with the links **41** is a turnbuckle **44** by means of which tension may be released from the links to permit dismounting of the hook **43** from its position in the mouth of the chamber **26**, whereby the same can be welded or otherwise attached to the hull **16** of the sunken vessel. The hull hook **43** comprises a base portion **45** of substantially cone-shaped configuration and having a circular ear-shaped integral portion **46** which is provided with an opening or eye **47** for receiving a cable-threaded hook, such as generally indicated as **48**, and as hereinafter to be more fully described. Extending laterally of the eye **47** is an integral dish-shaped portion **49** which provides a centering cavity or depression which centers and assists in bringing about the closure of the cable-threaded hook **48** as illustrated in Figures 6 and 7.

Surrounding the collar **25** and yieldingly engaging it is a sleeve **51** formed of a soft pliable waterproof material, such as rubber or synthetics. The outer end of the sleeve **51** is flared outwardly forming a diaphragm or flange **52**, the outer edges of which are feathered to form a suction cup member, the purpose of which will be more fully explained hereinafter. The sleeve **51** and integral flange portion **52** are permanently attached to the collar **25** by means of a ring **53** and attaching bolts **54**. A curved slit **56** and longitudinal groove **57** are formed in the flange **52** for accommodating the guide cable **60**, the groove being substantially parallel to a central vertical axis through the diving bell **18**. The cable **60** is attached at its lower end to the hull hook **43**, as by being suitably fastened to an eye bolt **61** threaded into the ear portion **46** of the hook, the cable being fastened at its upper end to a winch located on the salvage vessel or tender, not shown, and located on the surface of the water. The eye bolt **61** is adapted to be threaded into alternate tap holes **62** in the ear portion **46** of the hook depending upon the angular position of the hull surface to which the hook **43** is to be attached.

The diving bell **18** is provided with convenient search light lamps **63** and ports **64** which are sealed against the entrance of water in order to aid in visibility when working at great depths, and leading from the tender or surface vessel to the diving bell **18** is electrical conduit means which extend through the top of the diving bell, as at **66**, by means of which power may be supplied from a generator aboard the tender to light the lamps and supply power to electrical welding equipment by which the hull hook **43** may be suitably welded to the hull **16** of a sunken vessel.

The cable-threaded hook means **48** for attaching a pontoon comprises an elongated body portion **70** which is provided with a central bore **72** for accommodating the guide cable **60**. The hook **48** is provided with a bifurcated end portion having the jaws **74** and **76** which define an opening **78** for receiving the ear portion **46** of the hull hook **43**. The jaws **74** and **76** are complementary halves, the jaw **74** being integral with the body portion **70** whereas the jaw **76** is pivotally mounted thereon, as illustrated in Figures 6 and 7. The jaw **76** comprises an arcuate-shaped shank **80** and shoulder **82** with a terminal half-collar section **84**. The underside of the shank portion **80** of the jaw **76** is shaped to provide complementary flat and off-set surface portions, as shown at **86** and **88**, respectively, in Figure 10 whereby the parts are snugly fit together and interlocked when the jaws **74** and **76** are closed about the ear **46** of the hull hook, as illustrated in Figure 7.

In order to maintain the jaws **74** and **76** in position to facilitate the entrance of the hull hook ear part **46** and fasten the jaws **74** and **76** in the eye **47**, the jaw **76** is cocked open, as illustrated in Figure 6, utilizing knock-out pins **90** suitably set in the half-spherical depressions **92** of jaw **74** and complementary portions **93** of jaw **76**. To further assist in the entrance of the hull hook between the jaws of the hook **48**, the front portions of the jaws are suitably beveled, as at **96**. A longitudinal groove **98** is also provided in the engaging jaws faces to accommodate the guide cable **60**.

For urging the jaws **74** and **76** in engagement, tension springs **100** are arranged at opposite sides of the jaws, as by means of the supporting bolts **101**, and for cocking the jaw **76** a spring-actuated collar **102** is arranged about the body portion **70** of the hook and urged to slide axially and forwardly toward the jaws of the hook **48** by a pair of tension springs **104** and **106**. Springs **104** and **106** are suitably attached at one end to eye lugs **108** and **110**, respectively, and which are formed on the rear portion of the jaws **76** and **74**, respectively, and at the opposite end to a rod **112** fixed to the slidable collar **102**. In the cocked position of the jaw **76**, as illustrated in Figure 6, the shoulder **82** holds the collar **102** against the action of the tension springs **104** and **106** until the pins **90** have been knocked out and the tension springs **100** operate to pivot the jaw **76** downwardly and in engagement with the jaw **74**, in which instance the collar **102** is released from the shoulder and is drawn forwardly so as to lock the jaws together, as illustrated in Figure 7.

To fasten the pontoon to the cable-threaded hook **48**, the elongated shank **70** thereof is provided with a reduced diameter portion **120** having a tapered section **122** on the inner end and a knob or head **124** formed on the outer end. The guide cable **60** extends therethrough and is arranged to pass upwardly through the pontoon **20** through a sealed conduit **126**, the shank portion **128**, reduced diameter section **120** and knob **124** being slidably received in a sleeve **130**, as illustrated in Figures 6 and 7. Sleeve **130** is pivotably retained in a frusto-conical shaped open bottom chamber **132** which is defined by the circular side wall **134**. Integral with the sleeve **130** is an elliptical-shaped saddle **136** which is slidably engaged by the inwardly extending wall portions **138** and providing a ball and socket joint. Suitably mounted over the end of the joint and cooperating therewith is an inverted cup-shaped member **140** which comprises the inwardly projecting spaced shoulders **142** which are adapted to engage the inner concave surface portion of the saddle **136** and slidably retain the saddle between the walls **138** and shoulders **142**. A central aperture **146** is formed in the member **140** which communicates with the conduit **126** for accommodating the passage of the guide cable **60**.

To adjustably lock the knob **124** on the outer end of the shank **120** of the hook body **70** to the sleeve **130**, the same is provided with a plurality of longitudinally spaced transversely reciprocable pins **150** having an arcuate-shaped bottom surface, as at **151**, for engaging the curved surfaces of the shank of the hook **48**, and a head **154** shaped to receive the end of a leaf spring **156**. The leaf springs **156** are suitably secured to the sleeve

130, as by means of rivets 160. The structure described for attaching the pontoon 20 to the hook knob 124 provides for side play and movement of the socket so as to allow for some margin of error in attaching the hook to the hull of the ship.

In the modification shown in Figure 2, the working compartment 26 of the diving bell 18 is provided with brackets 170 which are arranged therein to receive and store coil lengths 172 of the guide cable 60 whereby the same are retained therein for paying out after the operator has fastened the hull hook 43 to the side or hull of a sunken ship and is returning to the surface. In this construction, the necessity of providing an aperture in the diaphragm 52 for receiving the guide cable 60 is thus eliminated.

In operation of the ship salvaging apparatus of the invention, the eye bolt 61 to which the guide cable 60 is secured is threaded into one of the taps 62 selected as most suitable to the angular position of the hull portion of the sunken ship to which the hook 43 is to be fastened. The guide cable 60 is then drawn taut and forced into the groove 57 of the diaphragm 52, unless the cable is to be stored in the diving bell as illustrated in the modification in Figure 2.

The diving bell 18 is then lowered to the side of the ship, and after the hook 43 has been welded or otherwise fastened to the hull, the diving bell is withdrawn and the guide cable 60 slips out of its groove 57 and is drawn up tight to the surface tender. The guide cable is then threaded through the longitudinal bore 72 in the center of the hook 48 and thence through the guide tube or conduit 126 extending through the pontoon or tank 20 (Fig. 5) and back to the tender where it is secured. Two or more guide cables and hooks are generally used for each pontoon. However, by utilizing differently shaped pontoons, only one hook per pontoon may be employed. The pontoons are lowered by filling them partly with water until they sink. Where two cables are used per pontoon or tank, one is fastened at one end of the pontoon and the other at the opposite end of the pontoon. During descent of the pontoons into areas of higher exterior pressures, additional air pressure is applied to the exterior air chamber of the pontoons to boost the pressure therein to compensate for the increased outside pressure. By thus suitably controlling the amount of air pressure and water supplied to the pontoons, the buoyancy of the same will be kept substantially constant.

Pressure measuring means are installed on each pontoon which record the air pressure and the water pressure, the pressure meaurements being suitably transmitted as by electrical connections to the surface ship or tender. When submerged below the surface, derricks lower the pontoons. However, the attendant must continually add air as the pontoons sink so as to prevent undue strain on the derrick and lowering cables.

The shaft of the cable-threaded hook 48 is secured to the pontoon sleeve 130, as illustrated in Figure 6, before it is lowered and is held by the lower set of shear pins. When the open end of the hook 48 collides with the ear portion 46 of the hull hook 48, the half or jaw 76 separates, stretching tension springs 100, and after knocking out the pins 90 the jaw 76 continues to pivot outwardly until the hook jaws 74 and 76 pass through the eye 47 of the hull hook. The jaws are then drawn together by the action of the spring 100 and are aligned into proper position by the centering cavity guide 49 which also assists in closing the jaws of the hook. When the jaws reach their closed position, the collar 102 is released and drawn towards the jaws until they reach the stop lugs 108 and 10. In this position, the collar prevents the jaws from opening. The pontoon or tank 20 now, if it is not advanced up against the ship side, can descend still further and the series of shear pins 150 can take up the slack.

While in the foregoing description there has been shown and described the prefered embodiment of this invention, it will be understood, of course, that minor changes in the details of construction, and substitutions may be made in the combination and arrangement of parts without departing from the spirit and scope of the invention as claimed.

Having described the invention, what is claimed as new is:

1. In a ship salvaging apparatus, the combination of a hook adapted to be attached to the hull of a sunken vessel, a guide cable secured to said hook and means comprising an attaching hook threaded onto said guide cable and slidable thereover, said threaded hook comprising a pair of jaws which are held partly open by knockout pin means acting against yieldable means tending to close said jaws.

2. In a ship salvaging apparatus, the combination of a hook adapted to be attached to the hull of a sunken vessel, a guide cable secured to said hook and means comprising an attaching hook threaded onto said guide cable and slidable thereover, a sleeve threaded onto said guide cable and adjustably interlocked with said threaded hook, and a buoyant pontoon pivotally secured to said sleeve member.

3. In ship salvaging apparatus which includes a buoyant pontoon, an eye hook attached to the hull of a sunken vessel, a guide cable extending from said eye hook, means comprising a hook threaded onto said guide cable and engageable with said eye hook, and means comprising a sleeve and transverse attaching pins for fastening said pontoon to said threaded hook, said threaded hook comprising a pivoted jaw which is retained cocked open, and means engageable with said eye hook for uncocking said jaw and closing said threaded hook in said eye hook.

4. In a ship salvaging apparatus which includes a hull hook adapted to be secured to the hull of a sunken vessel having a guide cable leading therefrom, a latching hook adapted to engage the hull hook comprising an elongated shank having a longitudinal bore therethrough for receiving the guide cable, a fixed jaw and a movable jaw on the forward end of said latching hook, removable means maintaining said jaws in spaced apart relation to one another, resilient means urging said jaws toward one another upon release of said removable means and locking means operable in response to movement of said jaws toward one another to clamp the jaws in closed position.

5. In a ship salvaging apparatus which includes a hull hook adapted to be secured to the hull of a sunken vessel having a guide cable leading therefrom, a latching hook adapted to engage the hull hook comprising an elongated shank having a longitudinal bore therethrough for receiving the guide cable, a fixed jaw and a movable jaw on the forward end of said latching hook, removable means maintaining said jaws in spaced apart relation to one another, resilient means urging said jaws toward one another upon release of said removable means and locking means operable in response to movement of said jaws toward one another to clamp the jaws in closed position, said removable means including at least one knockout pin separating said jaws from one another.

6. In a ship salvaging apparatus which includes a hull hook adapted to be secured to the hull of a sunken vessel having a guide cable leading therefrom, a latching hook adapted to engage the hull hook comprising an elongated shank having a longitudinal bore therethrough for receiving the guide cable, a fixed jaw and a movable jaw on the forward end of said latching hook, removable means maintaining said jaws in spaced apart relation to one another, resilient means urging said jaws toward one another upon release of said removable means and locking means operable in response to movement of said jaws toward one another to clamp the jaws in closed position, said locking means including a collar slidably received on

said shank and resilient means urging said collar toward said jaws.

7. In a ship salvaging apparatus which includes a hull hook adapted to be secured to the hull of a sunken vessel having a guide cable leading therefrom, a latching hook adapted to engage the hull hook comprising an elongated shank having a longitudinal bore therethrough for receiving the guide cable, a fixed jaw and a movable jaw on the forward end of said latching hook, removable means maintaining said jaws in spaced apart relation to one another, resilient means urging said jaws toward one another upon release of said removable means and locking means operable in response to movement of said jaws toward one another to clamp the jaws in closed position, said locking means including a collar slidably received on said shank and resilient means urging said collar toward said jaws, said movable jaw having a shoulder thereon abutting said collar when said jaws are in spaced apart relation.

8. In a ship salvaging apparatus which includes a hull hook adapted to be secured to the hull of a sunken vessel having a guide cable leading therefrom, a latching hook adapted to engage the hull hook comprising an elongated shank having a longitudinal bore therethrough for receiving the guide cable, a fixed jaw and a movable jaw on the forward end of said latching hook, removable means maintaining said jaws in spaced apart relation to one another, resilient means urging said jaws toward one another upon release of said removable means and locking means operable in response to movement of said jaws toward one another to clamp the jaws in closed position, and a bulbous enlargement on the rear end of said shank for attaching the shank to a pontoon.

9. In a ship salvaging apparatus which includes a hull hook adapted to be secured to the hull of a sunken vessel having a guide cable leading therefrom, a latching hook adapted to engage the hull hook comprising an elongated shank having a longitudinal bore therethrough for receiving the guide cable, a fixed jaw and a movable jaw on the forward end of said latching hook, removable means maintaining said jaws in spaced apart relation to one another, resilient means urging said jaws toward one another upon release of said removable means and locking means operable in response to movement of said jaws toward one another to clamp the jaws in closed position, said shank having a notched portion adjacent its forward end, said movable jaw having a portion thereof sealing in said notch, said portion of said movable jaw having a shoulder thereon engaging said locking means when the jaws are in spaced apart relation to one another.

10. In a ship salvaging apparatus which includes a hull hook adapted to be secured to the hull of a sunken vessel and a guide cable extending therefrom, a pontoon and a latching hook adapted to slidingly receive said guide cable, said pontoon including a sleeve pivotally mounted therein, longitudinally spaced spring urged projections extending transversely into said sleeve, said latching hook having a shank received in said sleeve, said shank having a reduced end portion terminating in a shouldered head, said projections fixedly retaining said shank against movement in one direction by abutment against the shouldered head, self attaching jaws on the other end of said shank adapted to clamp the hull hook therebetween upon contact therewith.

11. In a ship salvaging apparatus, a pontoon and a latching hook adapted to slidingly receive a guide cable, said pontoon having an elongated sleeve secured thereto, said latching hook including a shank having an inner end portion slidably disposed in said sleeve and an outer end portion projecting from said sleeve, attaching jaws on the other end of said hook, the inner end portion of said hook being of reduced cross-section and having an enlarged head thereon, longitudinally spaced spring urged projections extending transversely into said sleeve and contacting said shank, said head being tapered for inward movement into the sleeve and having an abutment shoulder at its juncture to said reduced end portion successively engaging said projections to prevent outward movement of the shank from the sleeve whereby the pontoon may be pulled into proximity with the attaching jaws.

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