

[54] **SALVAGE WORK VEHICLE**

[72] Inventors: William T. Odum, Panama; James H. Elkins, Lynn Haven; Thomas M. Coggings, Panama City, all of Fla.

[73] Assignee: The United States of America as represented by the Secretary of the Navy

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[51] Int. Cl. B63g 8/24

[58] Field of Search 114/16 E, 16.7, 16.8; 61/69 R

[56]

References Cited

UNITED STATES PATENTS

3,625,171	12/1971	Bailey.....	114/16.8
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Primary Examiner—Trygve M. Blix

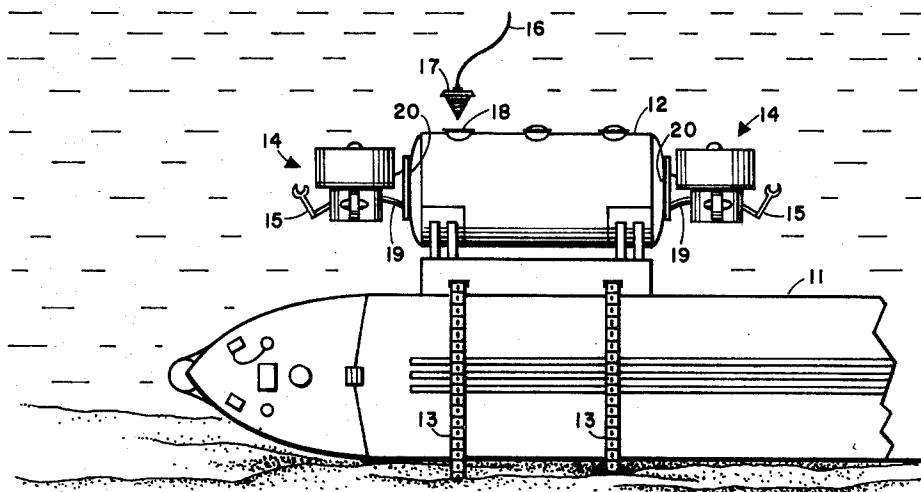
Attorney—Richard S. Sciascia, Don D. Doty and William T. Skeer

[57]

ABSTRACT

A salvage work vehicle having attachment means to provide propulsive engagement with large salvage pontoons is disclosed. The attachment of vehicle and pontoon is accomplished by means of a vacuum attachment coupler.

10 Claims, 3 Drawing Figures



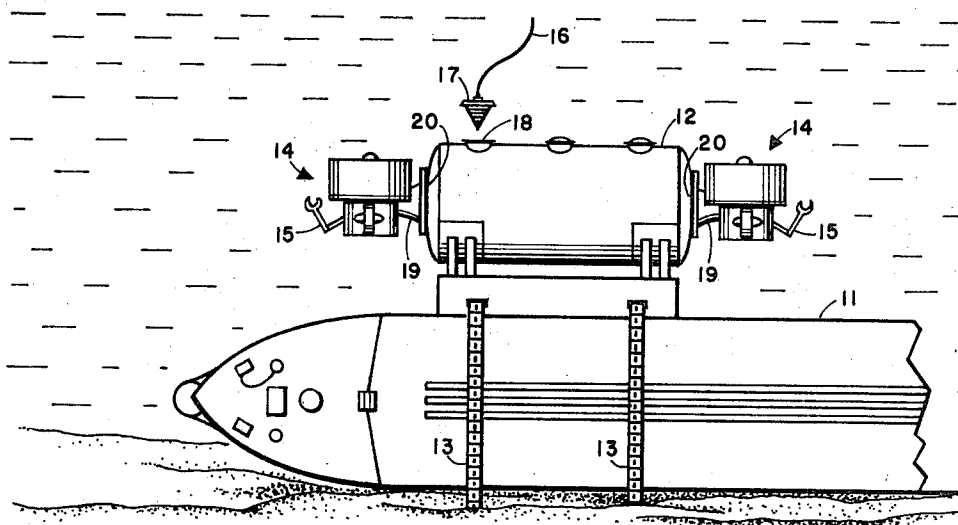


FIG. 1

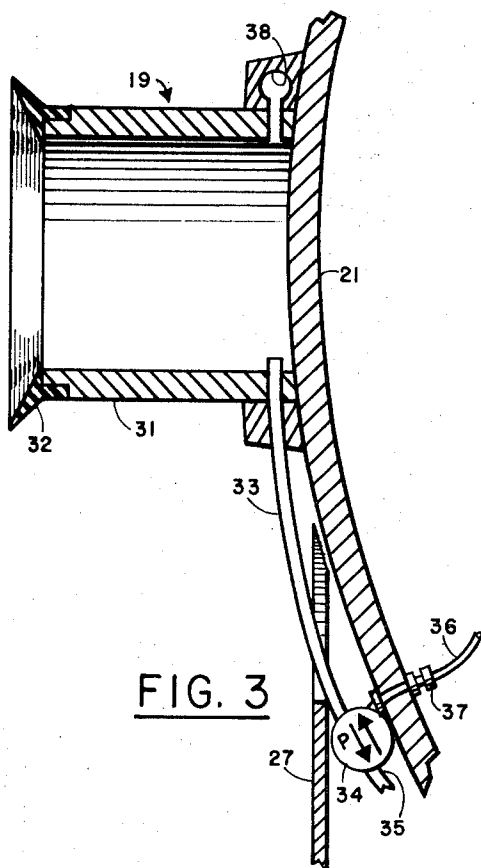


FIG. 3

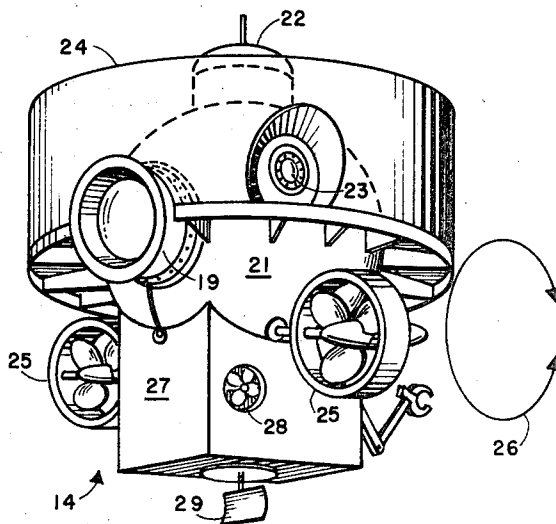


FIG. 2

WILLIAM T. ODUM
JAMES H. ELKINS
THOMAS M. COGGINS
INVENTOR.

BY *William T. Odum*
AGENT
Don D. Dwyer
ATTORNEY

SALVAGE WORK VEHICLE

STATEMENT OF GOVERNMENT INTEREST

The invention described herein may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment of any royalties thereon or therefor.

CROSS REFERENCE TO RELATED APPLICATION

The invention disclosed herein is a component part of a salvage system, another component of which is disclosed in U.S. Pat. No. 3,665,509, for "Underwater Electrical Connector," by James H. Elkins, filed Mar. 22, 1971.

FIELD OF THE INVENTION

This invention pertains to the submarine vehicle art. More particularly, the invention pertains to a deep sea manned work vehicle for salvage operations. In still greater particularity, the invention pertains to a manned deep sea work vehicle having coupling means to permit towing attachment to salvage pontoons, or other object loads, of considerable mass, and having propulsive capabilities sufficient to maneuver said pontoons into position.

DESCRIPTION OF THE PRIOR ART

Existing vehicles used in underwater salvage operations have no attachment capabilities sufficient to provide attachment or maneuvering ability to position large objects in the 100 to 500 ton displacement range. Although many vehicles of the prior art having operational capabilities of operating at depths in excess of 300 meters, none have coupling means to support massive loads or moving massive cables with lifting capabilities sufficient to raise heavy loads from the ocean floor.

Previously salvage items of such bulk were raised to the ocean surface by a plurality of small lifting pontoons. The problems of positioning and controlling of great numbers the prior art pontoons required for heavy lifts has limited the depths at which salvage may be successfully accomplished and the size of loads which may be recovered.

SUMMARY OF THE INVENTION

This invention provides a deep sea submarine salvage vehicle with an attachment means having sufficient strength to support very large loads for positioning and maneuvering. This attachment means employs a vacuum attachment device which cooperates with a flat surface on the object to be gripped thereby such that it is held in place by the hydrostatic pressure associated with the ocean depth at which the object is submerged. Large size propulsion motors are provided to move both the vehicle and the attached load.

With the foregoing description in mind, it is an object of this invention to provide an improved salvage work vehicle.

A further object of the invention is to provide an improved object attaching means for submarine vehicles.

A further object of this invention is to provide a salvage work vehicle with an improved coupling means.

A further object of this invention is to provide a submarine vehicle improved propulsion means.

Another object of this invention is to provide a salvage work vehicle having vacuum operated coupling means for attaching objects to said work vehicle.

Another object of this invention is to provide a salvage work vehicle with steerable motor propulsion units having sufficient power to move both the salvage work vehicle and loads attached thereto.

A further object of this invention is to provide a salvage work vehicle having a hydrostatic vacuum coupling means for the attachment of suitable loads thereto and propulsion means for maneuvering the work vehicle together with the attached load in relation to a predetermined location underwater.

Other objects and many of the attendant advantages will be readily appreciated as the subject invention becomes better understood by reference to the following detailed description, when considered in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is an elevational view showing the environment in which the salvage vessel of the invention is used;

FIG. 2 is a perspective view showing the deep submergence salvage work vehicle of the invention; and

FIG. 3 is a sectional view through the hydrostatic vacuum coupler portion of the deep submergence salvage work vehicle of the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to FIG. 1, a load, such as a sunken ship 11, to be raised is shown as resting on the sea bottom. A salvage pontoon 12 is attached thereto by suitable arms 13. A deep submergence salvage work vehicle 14 is attached to each end of pontoon 12 for positioning thereof relative to ship 12 prior to the attachment of arms 13 thereto. Deep submergence vehicle 14 has an external manipulator arm 15 which is used to assist in attaching arms 13 to ship 11, implanting connector plug 17, and for other purposes. When pontoon 12 is positioned in cooperative relation to ship 11, deep submergence vehicles 14 may separate therefrom and maneuver independently.

An electrical conductor 16 is lowered from the sea surface or a nearby control box and has a connector plug 17 secured to the distal end thereof. As will be understood by those familiar with salvage operations, plug 17 is grasped by arm 15 and inserted into a receptacle 18, which is mounted on pontoon 12.

Attachment of the deep submergence salvage work vehicles to salvage pontoon 12 is accomplished by means of a suitable vacuum or hydrostatic coupler 19. Couplers 19 cooperate with a substantially flat portion 20 on each end of salvage pontoon 12 to attach salvage vehicles 14 thereto. If desired, the salvage vehicles 14 may be interconnected so that control thereof may be exercised from a single vehicle. This control interconnection may be accomplished by a fixed wire communication link within salvage pontoon 12, or, if desired, by an acoustic wave, i.e., sonar-like, communication link through the water. Both of these arrangements may be incorporated, one serving as a back-up system for the other, if desired. The exact nature and functioning of the control system has no direct bearing to the present

invention and, since prior art systems capable of providing the communication link are well known, the selection of a suitable system is left to the choice of the skilled worker making and using the invention.

Referring to FIG. 2, salvage vehicle 14 is shown detached from pontoon 12. As may be seen, the spherical cabin 21 is surmounted by a hatch 22 and a cylindrical passageway, through which entry to salvage 14 is obtained. Hatch 22 and the cylindrical passageway may, if desired, have viewing ports, not shown, therein for the purpose of affording the occupants a view of the upper surrounding environment. Other viewing ports, such as port 23, may be provided in the wall of spherical cabin 21 at desired positions, as is conventional in the deep submergence vehicle construction arts.

A cylindrical buoyancy chamber 24 is fitted about the upper portion of salvage vehicle 14. Although extending circumferentially about the entire upper portion of vehicle 14, portions thereof are relieved around the viewing ports, such as shown in FIG. 2 around viewing port 23, so as not to obstruct vision therethrough. Buoyancy chamber 24 is a conventional arrangement in the deep submergence vehicle art. A plurality of lead discs, not shown, of approximately 20 cm in diameter and 50 mm thickness are releasably held in vertical tubes within buoyancy chamber 24. Floodable ballast tanks, not shown, but also contained within buoyancy chamber 24, provide fine adjustment of the overall buoyancy of salvage vehicle 14. The selective filling and evacuating of the floodable ballast tanks obtain neutral buoyancy and small departures therefrom for salvage vehicle 14.

Suitable propulsion motors 25 comprising an electrical motor driven screw or marine propeller, are located on opposite sides of salvage vehicle 14 on a common mounting axis. Propulsion motors 25 are rotatable, as indicated by the double headed arrows 26, about their mounting axis in such a manner as to provide propulsive force for ascent and descent as well as fore and aft motion. Propulsion motors 25 are of such high power ratings, approximately forty horsepower each, that a battery supply of a size sufficient to furnish the electrical power therefor is too large to house within cabin 21. Accordingly, a suitable battery supply is housed in a battery compartment 27 external to cabin 21 and attached to the lower portion thereof.

Battery compartment 27 need not be pressurized as cabin 21 must be, but may be at ambient pressure. The batteries contained therein, not shown, are immersed in a suitable insulating oil. Direct contact with the ambient sea water may, nonetheless, be avoided by the use of a water impervious but flexible and pressure transmitting membrane or wall. Such arrangements will be familiar to persons versed in the deep submergence vehicle arts and, accordingly, need not be further described to understand the invention.

A suitable thruster unit 28 is also housed in battery compartment 27. Thruster unit 28 may, like propulsion motors 25, comprise an electric motor driven screw. Unlike propulsion motors 25, thruster unit 28 is fixed in relation to salvage vehicle 14 and provides thrust at right angles to that provided by motors 25. Although not as powerful as propulsion motors 25, which must overcome buoyancy forces, thruster units 28 operating in each salvage vehicle 14, at opposite ends of salvage

pontoon 12, produce sufficient thrust to effect transverse movements of the entire massive combination.

An electroacoustic transducer 29 extends from the lower surface of battery housing 27. Transducer 29 may be a component part of a sonar system used in navigation of salvage vehicle 14, or it may be a component part of a compressional wave communication system. In some arrangements, it may serve both of the aforesaid functions, as desired. It should also be noted that electroacoustic transducer 29 may be housed within suitable acoustically transparent housing means, if desired.

Referring now to FIG. 3, the structural details of coupler 19 will be discussed. As may be seen, coupler 19 comprises an outwardly extending barrel portion 31. A gasket 32 extends outwardly from the outer end of barrel 31. The innermost end of barrel 31 is closed by the wall of cabin 21 of salvage vehicle 14. A conduit 33 communicates with the inside volume of barrel 31 and is operatively connected to a reversible pump 34. Barrel 31 and gasket 32 cooperate with a complementary surface on pontoon 12. However, additional cooperating surfaces may be placed on salvage vehicles 14, if desired. This permits two or more salvage vehicles 14 to be joined together in such a manner as to work in tandem where more thrust is required.

Reversible pump 34 may be of any suitable type, so long as it is capable of delivering the required pressures and has suitable power consumption requirements. A number of such pumps are available and selection among them is regarded as within the scope of a proficient worker. Reversible pump 34 is located within the confines of battery compartment 27 for protection purposes. Another suitable fluid conduit 35 connects reversible pump 34 with the free-flooded portion of battery compartment 27.

The operation of reversible pump 34 is controlled from within cabin 21 of salvage vehicle 14 by means of suitable electrical conductors 36. The penetration of the wall of cabin 21 by circuit connection is made by conventional watertight feed-through means 37 to preserve the watertight integrity of cabin 21. The control circuitry, not shown, of pump 34 is conventional and may, if desired, include pressure sensing control means to activate pump 34 to pump out any small leaks which might occur, without attention by the crew of salvage vehicle 14. The circuit may be, simply, a current reversing switch in the power mains to pump 34.

Within the upper portion of barrel 31 and communicating with the interior thereof, an expansion chamber 38 is located. A small pocket of air, or other suitable gas, is entrapped therein. This chamber prevents small leaks which might occur around gasket 32 from reducing the pressure within barrel 31 by providing a volume into which the water may flow. Expansion chamber 38 need have only a relatively small volume, since the seal of gasket 32 with its mating surface is very good and leaks therethrough are of quite small volume and well within the capabilities of pump 34. Although shown as enclosed within the wall of barrel 31, expansion chamber 38 may be disposed elsewhere on vehicle 14 as long as fluid communication is maintained with the chamber formed by barrel 31.

MODE OF OPERATION

While the foregoing description will enable a person versed in the art to make and use the invention, the invention will be more fully understood with reference to the following description of the mode of operation.

Salvage pontoon 12 is placed in the water separately from the salvage vehicle 14, but may remain lashed or otherwise secured to a suitable surface 11 work platform, such as a salvage barge, for example. Salvage vehicle 14 is manned by a crew of two who enter cabin 21 by means of hatch 22 prior to the placement thereof into the water. By means of propulsion motors 25 and thruster unit 28, the crew maneuvers vehicle 14 to salvage pontoon 12 and positions it relative thereto in such a manner as to bring coupler 19 into cooperative engagement therewith. Coupler 19 is pressed against the cooperating portion of pontoon 12 to seat gasket 32 thereagainst. Pump 34 is then started in such a manner as to reduce the pressure in the interior space of barrel 31 by extracting, or attempting to extract, water therefrom. Those familiar with hydrodynamics and fluidics will recognize that only a small amount of water need be extracted to reduce the pressure therein a considerable amount. This pressure reduction forces the salvage work vehicle to become firmly attached to salvage pontoon 12.

A second salvage vehicle 14 is launched and, following the same procedure, attaches itself to the other end of salvage pontoon 12. Salvage pontoon 12, which is self-regulating to maintain neutral buoyancy, is then set free from the surface work platform.

The crew within work vehicles 14 rotate propulsion motors to develop the desired propulsion thrusts, including ascent and descent, to bring pontoon 12 into the desired working relation with the object to be raised, such as ship 11, for example. As previously noted, the control of both work vehicles 14 may be effected from a single vehicle by means of suitable fixed wire or water-borne communication links.

When pontoon 12 is in the desired position, at least one of the vehicles 14, under direction of its crew, releases itself from pontoon 12. This release is accomplished by reversing the operational direction, so as to pump water into barrel 31 until the ambient pressure is reached or slightly exceeded.

The remaining work vehicle 14 may remain attached to pontoon 12 to provide stability therefor during the separation operation and to make minor positional corrections thereto thereafter.

Conductor 16 is then lowered from the surface or moved from a nearby central control box, when more than one pontoon is used, with connector 17 attached thereto. Connector 17 is grasped by manipulator 15 of the separated work vehicle 14 and placed in receptacle 18. Work vehicle 14 then, by means of manipulator 15, assists in placing arms 13 in cooperative engagement with ship 12 where they are attached under control from the surface, via electrical conductor 16.

This operation secures pontoon 12 to ship 11. The remaining salvage vehicle 14 may now separate from pontoon 12 and assist the first in further securing of pontoon 12 to ship 11, if required. When pontoon 12 is made fast to ship 11, work vehicles 14 may return to the surface for an additional salvage pontoon 11, or may simply take a safe position nearby and monitor the

raising operation which proceeds under the control of surface workers.

Obviously, other embodiments and modifications of the subject invention will readily come to the mind of one skilled in the art having the benefit of the teachings presented in the foregoing description and the drawings. It is, therefore, to be understood that this invention is not to be limited thereto and that said modifications and embodiments are intended to be included within the scope of the appended claims.

What is claimed:

1. A deep submergence salvage work vehicle to be used in combination with a salvage pontoon or other object comprising in combination:

cabin means for enclosing operating personnel therein;

buoyancy chamber means attached to the upper portion of said cabin means for providing neutral buoyancy therefore;

propulsion means attached to said cabin means and relatively movable with respect thereto for moving said salvage work vehicle;

battery compartment means attached to the lower portion of said cabin means and extending downwardly therefrom for containing electrical power supplies therewithin;

thruster means mounted in said battery compartment means and fixedly directed with respect thereto for moving said salvage work vehicle in directions at right angles to said propulsion; and

coupling means attached to said cabin means and extending outwardly therefrom so as to extend beyond said buoyancy chamber means for attaching an object thereto.

2. A deep submergence salvage work vehicle according to claim 1 in which said cabin means is of a spherical shape.

3. A deep submergence salvage work vehicle according to claim 1 in which said propulsion means comprise a plurality of electric motor driven propellers for producing propulsion forces, said motor driven propellers being rotatable about an axis, so as to direct their propulsive forces in a desired direction.

4. A deep submergence salvage work vehicle according to claim 1 in which said coupling means includes a hollow cylindrical body portion.

5. A deep submergence salvage work vehicle according to claim 4 in which said coupling means further includes a gasket means attached to the outermost end of said hollow cylindrical body portion and extending circumferentially thereabout, for effecting a watertight seal between said body portion and said object attached thereto.

6. A deep submergence salvage work vehicle according to claim 5, further comprising an expansion chamber means enclosed within a wall of said hollow cylindrical body portion and in fluid communication therewith, so as to provide vacuum retention therein in the event of leakage.

7. A deep submergence salvage work vehicle according to claim 6 further comprising pressure alteration means effectively connected to the interior of said hollow cylindrical body portion for the selective reduction of pressure therewithin.

8. A deep submergence salvage work vehicle according to claim 7 in which said pressure alteration means includes a reversible electric pump.

9. A deep submergence salvage work vehicle according to claim 8 wherein said pump is located within said battery compartment and communicates with the interior of said hollow cylindrical body portion by a fluid conduit connected therebetween.

10. A deep submergence work vehicle for use in transporting a large object attached thereto to a predetermined location within an underwater environment comprising in combination:

cabin means for housing crew and controls and for providing protection therefor;

buoyancy chamber means attached to said cabin means for providing a predetermined buoyancy therefor;

propulsion means attached to said cabin means and relatively movable with respect thereto for moving said deep submergence work vehicle in a predetermined manner within said underwater environment;

battery compartment means attached to said cabin means for containing electrical power supplies

therewithin;

thruster means effectively connected to said cabin means and directed with respect thereto for moving said deep submergence work vehicle in directions at right angles to said propulsion means; cylindrical wall means attached to said cabin means in such manner as to have one of the ends thereof closed thereby and extending outwardly therefrom for effecting a hydraulic chamber therewithin;

gasket means attached to said cylindrical wall means at the other end thereof and extending circumferentially thereabout for effecting a watertight seal between said cylindrical wall means and the aforesaid object when pressed thereagainst in such manner as to close said hydraulic chamber;

releasable pump means effectively connected between the hydraulic chamber effected by said cylindrical wall means and said underwater environment for effecting a transfer of water therebetween; and

expansion chamber means disposed in communication with said hydraulic chamber for effecting pressure regulation therewithin.

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