A launch and recovery system for submersible vehicles operating from a surface support station includes a platform configured to pass through a well in the support station and descend below the surface of the water and is supported by four cables attached to the corners thereof. Provision is made for docking and launching the submersible vehicle on the lower surface of the platform. Hydraulic tensioning devices couple each of the supporting lines to the platform and, together with controllable louveris, isolate the launch and recovery platform from movements induced by the sea state acting upon the surface support station.

10 Claims, 5 Drawing Figures
The invention described herein may be manufactured and used by or for the Government of the United States of draw-twisters, for governmental purposes without the payment of any royalties thereon or therefor.

FIELD OF THE INVENTION

This invention relates to the field of marine engineering and naval architecture. In greater particularity, this invention relates to the launch and recovery of submersible vehicles from surface operating stations. In still greater particularity, the invention pertains to the launch and recovery of submersible vehicles from a surface support ship. By way of further characterization, the invention pertains to a launch and recovery system for submersible vehicles in which the launch and recovery is accomplished by underwater release and docking of the submersible vehicle and a platform which is stabilized and isolated from sea state induced motions. In and greater particularity, but not by way of limitation thereeto, the invention discloses a launch and recovery system for a deep submergence rescue vehicle to facilitate the handling thereof from a surface vessel.

DESCRIPTION OF THE PRIOR ART

When submersible vehicles, such as oceanographic research vessels and submarine rescue vessels, are desired to be deployed at a particular location, it has resulting the practice to tow such vessels behind a small tender vessel or, in the alternative, to transport such submersibles on the deck of a large surface vessel to the desired operational location. When the former system is used a great delay results from the very slow speeds at which delicate vessels may be towed. This slow speed and the requirement of a low sea state severely limit the deployment of such submarine vehicles.

When the latter method is employed, considerable time and effort is expended in removing the submarine vehicle from its mounting and, by means of a shipboard crane, lowering the vehicle into the surface of the water. In addition to the expenditure of time and man-power, this operation also requires a relatively calm sea surface for its successful accomplishment. Particularly, in the case of a deep submergence rescue vessel, it is highly desirable that the submersible be rapidly transportable to the area of operation and quickly deployable from the support vessel. In addition, it is important for the overall success of the rescue mission of such vessels that repeated dives be made possible. Of course, the necessity for repeated dives makes it imperative that individual dives be accomplished with a minimum expenditure of time. The systems of the prior art have required that crew transfer be made when a submersible vehicle is on the deck of the tender. Because of the limitations of shipboard the pegs facilities, only a limited number of successful dives could be accomplished in a twenty-four hour period.

SUMMARY OF THE INVENTION

In accordance with the teachings of this invention, a surface vessel has a well extending from the deck area through the lower surface of the hull. The platform is carried by the surface vessel and, by means of handling equipment carried on the deck thereof, is lowered through the well to a point beneath the surface of the water. The platform has docking and mooring provisions on a lower surface thereof for the submersible vehicle and a trapeze structure carried so as to cooperate with the submersible vehicle in launch and recovery operations to assist in its successful docking on the platform. The platform is stabilized in its underwater position by means of controllable lousers which alter the effective flat plate area thereof and hydraulic line attachment means which prevent variations in line tension caused by sea state action on the surface vessel from being transferred to the platform.

Although these features which are believed to be characteristic of the incident invention are particularly pointed out in the appended claims, the invention itself will be best understood upon perusal of the following detailed description of certain specific embodiments and with reference to the accompanying drawings.

STATEMENT OF THE OBJECTS OF INVENTION

It is accordingly an object of this invention to provide an improved launch and recovery system for a submersible vehicle.

A further object of this invention is to provide for an improved launch and recovery platform to which submersible vehicles may be docked and launched while under water.

Another object of the present invention is to provide a launch and recovery platform which may be suspended from a work station on the surface without being affected adversely by a high sea state at the surface.

A further object of the invention is to provide a launch and recovery platform for submersible vehicles which has a controllable flat-plate area so as to increase or decrease the force required to move the platform when submerged.

A further object of the present invention is to provide a launch and retrieval platform for submersible vehicles having hydraulic line tension regulation means and variable flat-plate area.

Another object of the invention is to provide a launch and recovery platform for submersible vehicles which has improved vehicle docking and handling means in addition to control of the platform's hydrodynamic characteristics.

These and other objects of the invention will become more readily apparent from the ensuing specification when taken with the drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a side elevational view of the system of the invention and its operational environment;

FIG. 2 is a perspective view of the platform of the invention showing the operation of the docking structure thereof;

FIG. 3 is an end elevational view of the launch and recovery platform of the invention showing the submersible vehicle in a docked position;

FIG. 4 is a sectional view taken along lines 4-4 of FIG. 3 and illustrates the operational controls of the louver system of the platform; and
FIG. 5 is an enlarged side elevational view showing the operation of the hydraulic line attention regulators.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to FIG. 1, the launch and recovery system of the invention is shown in its operational environment. A surface salvage vessel, indicated generally at 11, is shown as having deck hoisting mechanism 12 located thereon. Deck hoisting mechanism 12 is connected, via lines 13, to the launch and recovery platform 14. A submersible vehicle 15 is shown in a docked position with relation to launch and recovery platform 14.

Obviously, submersible vehicle 15 may be of any desired type but, for the understanding of the invention, it is illustrated as a manned deep submergence rescue vehicle. Other type submersible vehicles which would benefit from the system of the invention include manned remotely controlled oceanographic research vehicles, salvage work vehicles, and other submersibles. Because the mission and operational details of each of these classes of vehicles may vary widely from those of other classes as well as other vehicles in its own class, a complete description of the operation of the submersed vehicle has been omitted as unnecessary surplusage in the complete description of the instant invention.

A control line 16 connects platform 14 to salvage vessel 11. Of course, this control line provides for operational control of platform 14 from surface vessel 11. The control functions may be either hydraulic or electrical or a combination of the two. A variety of motor control arrangements are known in the art and choice as between various available controls is considered a matter of design choice within the purview of the proficient marine engineer or naval architect, the parallel to

Referring to FIG. 2, it will be seen that platform 14 comprises a marginal frame 17 and has four pylons 18 extending downwardly from the bottom surface thereof. At each corner of platform 14, secured frame 17, an upright hydraulic damper 19 is located. As shown, lines 13 are attached to hydraulic dampers 19 and support platform 14 through this connection. A generally triangular trapeze 21 is also supported by frame 17 and pivotally extends downwardly below the platform 14. Trapeze 21 is configured to facilitate attachment to submergence vehicle 15, as shown in the illustration.

Although platform 14 and its included structure is relatively massive so as to depend substantially vertically beneath vessel 11, it is necessary to provide additional guide means to ensure that platform 14 is centered in and has sufficient clearance with respect to the sides with the well extending through surface vessel 11. This guidance function is performed by a plurality of vertically extending guides 22. As shown, these guides extend somewhat outwardly from frame 17 and for a considerable position thereabove. The upper ends of guides 22 are curved and tend to move platform 14 to one side or the other so as to ensure the platform being centered as it passes into the well through the surface support vessel 11. If desired, guides 22 may be positioned on the ends of platform 14 as well as on the sides.

Referring to FIG. 3, a front elevational view of the invention is shown. In this illustration the submersible vehicle 15 is shown as being in the docked position where with suitable mechanical linkage, not illustrated, it is securely docked to the distal ends of pylons 18. Any of many commonly known docking systems of the prior art may be used to effect this secure docking of submersible vehicle 15 to the mooring pylons 18. For example, the ends of pylon 18 may contain electromagnetic or mechanically operated latch means which cooperate with the steel hull of submersible 15 or mechanical fittings thereon.

Referring to FIG. 4, which is a sectional view taken along lines 4—4 of FIG. 3, the operational details of the louver system of the invention is illustrated. As may be seen, rather than have a solid uninterrupted lower face, the lower face of platform 14 comprises a plurality of louvers 23 which are pivoted about suitable individual hinge means 34. When open, there is little obstruction to water passing through frame 17. However, when closed, louvers 23 provide an essentially uninterrupted surface across the lower portion of frame 17 and, as a result, platform 14 exhibits a very high hydrodynamic drag. Louvers 23 may be moved simultaneously about their individual hinge means 24 by means of a suitable push bar 26 which cooperates with a plurality of bell cranks 25. Bell cranks 25 are of any suitable configuration and are attached to each louver 23 to provide operational engagement of the individual louver by push bar 26.

Push bar 26 is, in turn, operated by means of a hydraulic motor 27. Motor 27 is supplied hydraulic fluid under pressure via line 35 from hydraulic pump means, not shown, contained on frame 17 or from the surface, via control cable 16, FIG. 1.

Also shown in FIG. 4 is axle 28. Axle 28 provides pivotal support for trapeze 17. Trapeze 17 may be freely swinging or driven, as desired. If driven, trapeze 17 is rigidly attached to axle 28 and suitable drive means, such as, for example, bell-crank and hydraulic cylinder similar to those used for louvers 23, are used to move the entire assembly.

Referring to FIG. 5, the constructional details for hydraulic dampers 19 are illustrated at a more convenient scale. As shown, lines 13 are attached by means of conventional fittings to an inner hydraulic cylinder 31. Hydraulic cylinder 31 is telescopically received in an outer cylinder 32. Outer cylinder 32 is fixedly held in a suitable base 33 which, in turn, is attached to frame 17 by means of floor plate 34. When louvers 23 are closed, the great hydrodynamic drag created by platform 14 prevents the platform from following the sea state induced motions of the surface platform. This, of course, results in great line tensions being exerted in lines 13. This line tension, in turn, causes inner cylinder 31 to be withdrawn from outer cylinder 32 or returned to the interior thereof as indicated by the large arrows, FIG. 5. The rate of reciprocation is controlled by varying means internally located within cylinders 31 and 32, as is conventional in the hydraulic damper arts. Thus, it may be seen that hydraulic dampers 19 act much in the same fashion as suspension dampers in terrestrial vehicles. Since the operation of such hydraulic dampers is well known in the art, and since dampers 19 are used for their intended, well-known purpose, the constructional details of the particular dampers used in the practice of the invention is not considered neces-
sary for the understanding of the invention and, accordingly, have been omitted.

Although the foregoing description is sufficient to enable a person versed in the marine engineering and naval architecture arts to construct the system of the invention, it is felt that a complete understanding of the invention such as to permit appropriate substitutions may be facilitated by reference to the following description of the preferred mode of operation of the system.

**MODE OF OPERATION**

Referring again to FIG. 1, when it is desired to lower platform 14 beneath the surface of the water to facilitate a launch or recovery of submersible vehicle 15, the platform is released from its moorings above the 6 restarts line of vessel 12, as indicated in the broken line the rapid lowering of platform 14, hydraulic motor 47, FIG. 4, is in the retract position so as to open louver 23 thereby minimizing the hydrodynamic drag acting on platform 14 which would tend to cause the platform to move in a non-vertical direction and extend beneath vessel 11. 6H)

When platform 14 is at the desired operational depth, motor 27 is actuated to close louver 23 which greatly increases the flat-plate area of the platform 14 and as a consequence, isolates submersible vehicle 15 from the sea-state-induced vertical excursions of surface vessel 11. As previously noted, the tension in lines 13 is maintained at a constant value due to the damping action of hydraulic dampers 19.

Upon command from surface vessel 12 or from submersible vehicle 15, launch is initiated by releasing the docking mechanism securing submersible 15 to pylons 18. Submersible vehicle 15 is ballasted to sink away from platform 14 and is guided by trapeze 21 in this maneuver. Once free of pylons 18, trapeze 21 is then released and submersible 15 proceeds on its independent mission.

Upon returning to platform 14 submersible 15 attaches to trapeze 21 and then ballasts itself for an ascent. Under control of trapeze 21 submersible vehicle 15 rises into engagement with mooring pylons 18. The precise longitudinal position during this ascent mode is controlled by trapeze 21 to bring submersible 15 into proper position with respect to mooring pylons 18. When contact is obtained, the mooring devices are operated to secure submersible 15 to pylons 18. At this time hydraulic motor 27 is actuated to open louver 23 and reduce the flat-plate area of a platform 14. The hoisting mechanism of deck machinery 12 then takes in line 13 to raise platform 14 to the surface. As the platform is drawn into the well passing through vessel 11, guides 22 contact the sides thereof and positions platform 14 for a safe passage to its stowed position at the deck line or slightly beneath surface vessel 11.

This completes the normal launch and recovery sequence of the system of the invention. As may be seen, the system provides a marked improvement FIG. the present methods described above.

The foregoing description taken together with the appended claims constitute a disclosure such as to enable a person skilled in the naval architecture and marine engineering arts and having the benefit of the teachings contained herein to make and use the invention. Further, the structure herein described meets the objects of the invention, and generally constitutes a meritori-
7. A launch and recovery system according to claim 1 in which said plurality of controllable apertures include a plurality of louvers extending across the surface of said platform means to cover substantially the entire surface thereof.

8. A launch and recovery system according to claim 6 in which said plurality of controllable apertures include a plurality of louvers extending across the surface of said platform means to cover substantially the entire surface thereof.

9. A launch and recovery system according to claim 1 in which said operating means includes:
bell crank means attached to each of said plurality of said controllable apertures so as to extend therefrom for providing driving attachment thereto;
push bar means connecting predetermined ones of said bell crank means for simultaneous and coordinated control thereof; and
motor means effectively connected between said push bar means and the aforesaid platform means for selective actuation of said lower means between opened and closed positions whereby the effective flat-plate area of the system is substantially altered.

10. A launch and recovery system for a submarine vehicle comprising:

platform means for providing engagable docking facilities for the submersible vehicle;
line means effectively attached to said platform means for lowering and raising the platform means with said respect to a surface operation station;
fluid chamber means effectively attached between said line means and said platform means for minimizing variations in line tension due to the sea state induced movements;
a plurality of controllable louvers extending through said platform means, covering substantially the entire surface thereof, and controllable between an opened and a closed position whereby together with the fluid chamber means the platform may be isolated from said sea state induced movements;
bell crank means attached to each of said plurality of louvers so as to extend therefrom for driving attachment thereto;
push bar means connecting predetermined ones of said bell crank means for simultaneous and coordinated control thereof; and
motor means effectively connected between said push bar means and the said platform means for selective actuation of said lower means between opened and closed positions whereby the effective flat-plate area of the system is substantially altered.

* * * * *
UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,807,335
Dated April 30, 1974

Inventor(s) Howard R. Talkington

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 1, line 7, "draw-twisters" should read -- America --.

Signed and Sealed this twenty-ninth Day of June 1976

RUTH C. MASON
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents and Trademarks