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B. L. GOEPFERT

3,393,525

DIVER ACCESS TUBE

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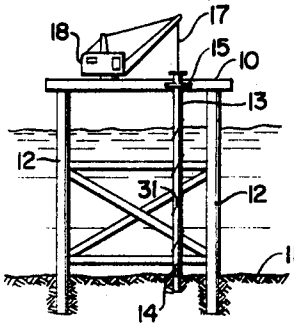


FIG. 1

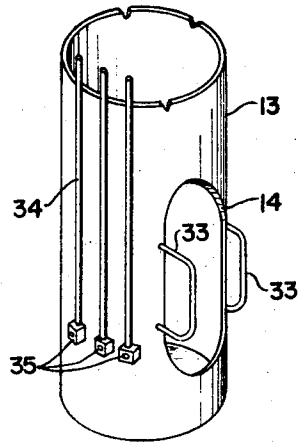


FIG. 2

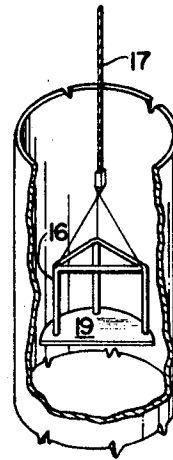


FIG. 4

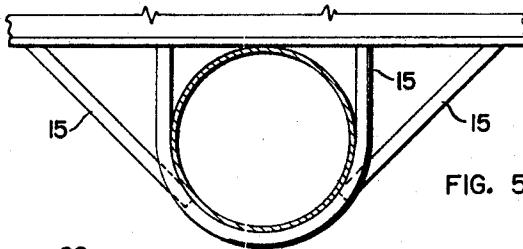


FIG. 5

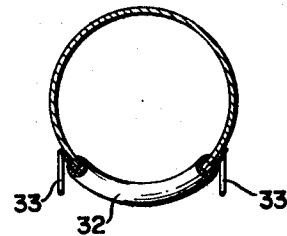


FIG. 3

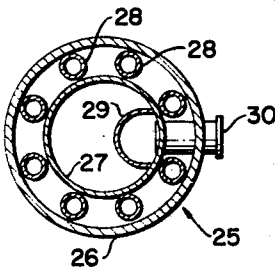


FIG. 8

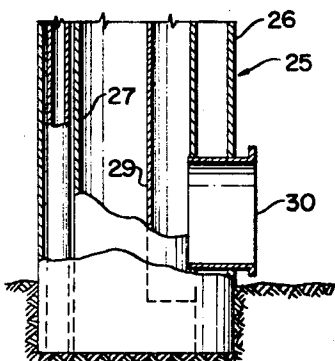


FIG. 9

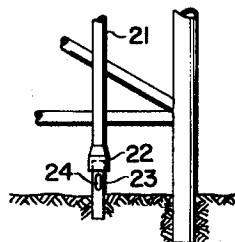


FIG. 7

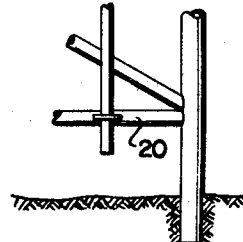


FIG. 6

INVENTOR:

B. L. GOEPFERT

BY: *A. H. McCarthy*

HIS AGENT

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3,393,525

DIVER ACCESS TUBE

Benjamin L. Goepfert, West Covina, Calif., assignor to Shell Oil Company, New York, N.Y., a corporation of Delaware

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ABSTRACT OF THE DISCLOSURE

An apparatus for protecting deep-sea divers whereby a tube having diver access openings at each end is attached to an offshore installation and provided with a diver-carrying elevator disposed within the tube and arranged for axial movement.

This invention relates to deep-sea diving apparatus and more particularly to such apparatus associated with an offshore installation or "platform" for protecting a diver from water currents, ice floes, etc., while descending to and ascending from an underwater location.

A need frequently arises in the operation of an offshore installation, like an oil or gas well production platform, to use a deep-sea diver operating from the platform. Such divers may be required to make pipeline connections, perform operations on the platform, recover lost articles, and the like. In tidal waters, where the ebb and flood tides produce relatively strong currents, a diver's ability to ascend and descend is greatly impaired and may even become hazardous due to the currents acting on the diver. For example, hazardous diving conditions are experienced at the Cook Inlet in southern Alaska where tides ranging up to 30 feet are experienced. Such tides result in very rapid currents which dictate that the diver ascend and descend during slack tide; that is, the transition period at high tide and low tide when currents are at a minimum. In addition, a diver is only capable of effectively performing underwater functions during slack tide. Thus, a diver's effective work period is reduced if he has to also ascend and descend during the slack tide period.

Therefore, it is apparent that if the diver is permitted to remain on bottom for the full period of slack tide, his working time is significantly increased. It is to this end that the present invention is directed by providing a diving apparatus for protecting a diver from water currents while descending and ascending. The invention also serves to protect a diver from ice floes, debris and the like that may be present in the water.

In accordance with this invention, an offshore platform is provided with a vertical diver tube extending vertically from the platform down into the water, and having access openings near the upper and lower ends. The interior of the tube is fitted with an elevator operated by a hoist located on the platform. In operation the diver enters the tube through the upper access opening and is lowered on the elevator. The diver then remains in the tube until slack tide at which time he exits through the lower access opening and performs his work on the ocean floor. At the end of slack tide he again enters the tube and is brought to the surface. The invention will now be described in greater detail with reference to the accompanying drawings in which:

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FIGURE 1 is an elevation showing an offshore platform with a diver tube attached;

FIGURE 2 is an isometric view in enlarged detail of the lower portion of the tube showing the access opening;

FIGURE 3 is a cross-sectional view of the diver tube showing the diver access opening;

FIGURE 4 is a cut-away view of the tube showing the diver-carrying elevator;

FIGURE 5 is a cross-sectional view of the tube showing typical means for attaching the tube to the platform;

FIGURE 6 is a detail elevation of the lower end of the tube showing one modification;

FIGURE 7 is a detail elevation of the lower end of the tube showing another modification;

FIGURE 8 is a view taken in enlarged cross-section of one of the legs of the platform showing an alternative construction for the diver tube; and,

FIGURE 9 is a cross-section in elevation of one of the legs disclosing the same alternative construction.

Referring now to FIGURE 1, an offshore installation to which the present invention is adapted is shown in the form of an offshore platform 10 fixedly secured to an ocean floor 11 by means of legs 12. Secured to the platform and extending to the ocean floor is a diver access tube 13. The lower end of the tube, shown in detail in FIGURE 2, is formed with an access opening 14 large enough to permit a deep-sea diver and diving equipment to exit and enter the tube. The tube is preferably formed with helical spoilers 31 about its exterior to minimize the eddy current effect caused by the water flowing past the tube although the use of spoilers does not constitute a part of the present invention.

The tube may also be fitted with service conduits 34 running the length of the tube for supplying acetylene, air and the like from the platform 10. The diver may make connection with the conduits by means of suitable connectors 35 normally closed by check-valves.

FIGURE 3 shows a cross section of the tube taken through the access opening. Although the diameter of the tube is not a significant part of the invention it will be observed that the diameter must be at least large enough to permit a diver and diving equipment to ascend and descend freely within the tube. Preferably, the tube is made somewhat larger to permit a diver to carry tools, pipe, welding equipment and the like to the ocean floor. The mouth of the opening 14 is preferably fitted with a gasket 32 of rubber or other suitable material to protect the diver's suit and hoses. In addition, suitable hand rails 33 may be provided adjacent the opening 14 to assist the diver in entering the tube 13.

A typical arrangement for fixedly securing the tube to the platform 10 is shown by the cross section in FIGURE 5 which is taken through the tube where it joins the platform 10. Straps 15 surround the tube and are secured to the platform 10 by suitable means such as welding. The tube is preferably driven into the ocean floor 11 to anchor the lower end as shown in FIGURE 1, but the tube may also be terminated short of the ocean floor as will be described later.

The diver tube is open at or near the upper end and carries an elevator 16 attached to a hoisting cable 17 suspended from a crane 18. It will be apparent that manipulation of the crane hoist serves to lower and raise the elevator within the diver access tube.

The elevator 16 may take any form suitable for carrying at least one diver. As shown, the elevator floor 19 is

semi-circular in order to permit the diver to leave the elevator and pass by it within the confines of the access tube. This elevator design is but a preferred form and others skilled in the art may utilize any particular elevator shape without departing from the spirit of the invention. For example, the elevator may be constructed with two levels for carrying two divers down the access tube at the same time.

The location of the tube on the offshore installation does not form a part of the invention, for it will be readily apparent that the tube may be located anywhere on the installation so long as the upper end of the tube is accessible to a platform on the installation and the tube extends substantially to the ocean floor. In addition, it may be desirable to move the tube to different points on the installation so that the diver exits nearer an intended work area. Also, a plurality of tubes may be secured to the installation; for example, one at each leg. Such an arrangement is particularly suitable for large installations where the distance between legs may run several hundred feet.

Although it is preferred that the diver access tube extend into the ocean floor to secure the lower end as shown in FIGURE 1, the tube may also terminate short of the ocean floor as disclosed by the modification shown in FIGURE 6. In this arrangement, the lower end of the tube may be fixedly secured to the cross-bracing 20 supporting the platform legs. The access tube is open at the bottom to permit the diver to enter and exit directly through the end of the tube thereby obviating the need for an access opening door as shown in the preferred embodiment in FIGURES 1 and 2. Since the end of the tube is not lodged in the ocean floor, the arrangement has the advantage that the tube may be more readily recovered to the surface.

A further modification is shown in FIGURE 7 in which the diver access tube is composed of two parts; a diver access tube 21 having a flared connector end 22 and a tube extension 23 which is driven into the ocean floor 11 and formed with an access opening 24. This modification permits the tube 21 and the extension 23 to be disconnected so that the access tube 21 may be removed to the surface when the tube is not in use such as, for example, during winter time when ice floes may cause damage to the diver tube. Also, when the tube is not in use it may be moved and employed at another location. Since the extension 23 remains in the ocean floor the diver tube may be readily reassembled by stabbing the access tube 21 onto the extension 23 from the surface. Although a flared connection 22 is shown, other connections may be utilized, for example a bayonet type connector, without departing from the spirit of the invention.

In still another form of the invention, the diver access tube may be incorporated in a leg 25 of a platform as shown in FIGURES 8 and 9. FIGURE 8 is a cross section of a platform leg 25 consisting of an outer cylindrical member 26 and a spaced concentric inner member 27. Disposed within the space formed by the two members may be a plurality of conduits 28 through which drilling operations may be performed or pilings driven to secure the platform leg. A diver access tube 29 is positioned within the inner member 27 and extends the length of the platform leg 25. Located near the lower end of the access tube is an access passage in the form of a conduit 30 passing through the inner and outer members 27 and 26 and communicating with the exterior of the leg near the ocean floor. The particular arrangement of the leg shown in FIGURES 8 and 9 is by way of example only and it will be apparent to one skilled in the art that the tube may be adaptable to other platform leg constructions so long as there is an integral passage within the leg extending substantially the length of the leg through which a diver may pass and an opening near the lower end of the leg forming a passage for the diver to exit the leg and maneuver on the ocean floor.

In operation, a diver enters the tube near the upper end and steps onto the elevator 16 or if desired the diver may first step onto the elevator which may then be subsequently placed in the open upper end of the tube. After the diver is positioned on the elevator in the tube the crane 18 and its hoist (not shown) lowers the elevator until the elevator is positioned near the access door or opening 14. This entire operation may be performed during ebb or flood tides since the diver will be protected by the access tube. At slack tide when currents are at a minimum the diver may exit from the tube through opening 14 to carry out his work function on the floor of the ocean. At the end of slack tide the diver re-enters the tube where he is brought to the surface by the elevator 16. It will be observed that sea water is in open communication with the tube through the opening 14 and thus assumes the same level in the tube as the ocean itself.

In the event that it is not desirable to lower the diver the entire distance on the elevator 16, the elevator may be lowered to some point below the water surface after which the diver may leave the elevator and descend through the water in a conventional manner. The semi-circular elevator floor 19 shown in FIGURE 4, provides sufficient space between the elevator floor 19 and the interior of the tube to permit the diver to pass by the elevator for descending in a conventional manner.

The mode of operation for the modification shown in FIGURE 7 and also for the modification shown in FIGURES 8 and 9 is the same as described above. In the modification shown in FIGURE 6 the diver merely exits through the open bottom of the access tube since the tube terminates short of the ocean floor.

Having thus described my invention, what I claim is:

1. An apparatus for protecting a deep-sea diver from water turbulence, ice floes, etc., while diving from an offshore installation comprising in combination:

an offshore installation having a plurality of substantially vertical underwater structural members positioned on the floor of a body of water and a platform portion positioned on said members above the surface of said water;

a diver tube extending down into said water and having the upper end terminating near said platform;

said tube being formed with a diver access opening in the upper end in open communication with the atmosphere and a diver access opening near the lower end in open communication with said body of water whereby water is maintained in said tube at a level substantially equal to the surface of said body of water;

means for securing said tube to said offshore installation;

a diver-carrying elevator disposed within said tube and arranged for axial movement therein; and, hoist means located on said platform and connected to said elevator to at least raise said elevator within said tube.

2. The apparatus as defined in claim 1 wherein said elevator is spaced from one side of said tube a distance sufficient to permit a diver and diving equipment to pass by said elevator.

3. The apparatus as defined in claim 1 further including at least one service line attached to said platform in communication with a fluid source on said platform and terminating near the bottom of said tube.

4. The apparatus as defined in claim 1 wherein said diver tube and said underwater structural members extend into the floor of said body of water.

5. The apparatus as defined in claim 1 wherein said diver tube terminates short of the floor of said body of water.

6. The apparatus as defined in claim 5 further including a tube extension connectable to the lower end of said diver tube and extending into the floor of said body of water, said extension having a diver access opening

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near the floor of said body of water, and said diver tube being connectable to said extension by manipulation of said diver tube from said installation.

7. The apparatus as defined in claim 1 wherein said underwater structural members comprise legs rigidly mounted on the floor of said body of water. 5

8. The apparatus as defined in claim 7 wherein said tube is formed integrally within a leg of said platform and said leg includes diver access openings near the upper and lower ends thereof.

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10 REINALDO P. MACHADO, *Primary Examiner.*