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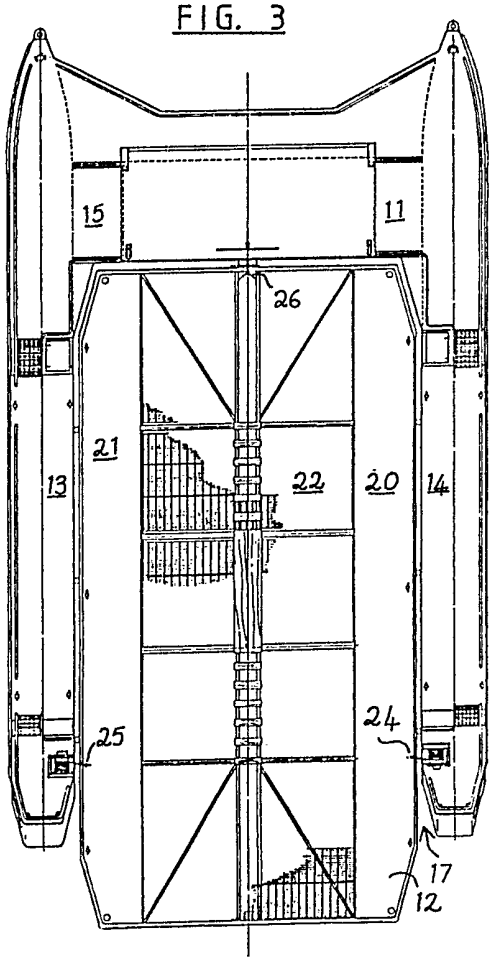
(56) Documents cited
GB 1549753 GB 0296655
GB 1462047

(58) Field of search
B7A

(54) Floating dock

(57) A floating dock comprises a docking vessel 11, typically in the form of a catamaran, together with a submersible platform 12. The docking vessel has an open area 17 for reception of a ship or other secondary vessel, and the submersible platform is beneath the opening 17 and is capable of being raised or lowered to raise or lower a ship positioned over it. Means for controlling the buoyancy of said platform to raise or lower it may comprise buoyancy tanks in the platform. Regulating means mounted on the docking vessel to control the lifting or lowering of the platform relative to the docking vessel to keep the platform on an even keel may comprise a plurality of winch cables (from winches 24, 25, 26) arranged to haul on any side of the platform which might be tipping down, or a plurality of hydraulic rams arranged to push down on any side of the platform which might be tending to tip upwardly.

FIG. 3



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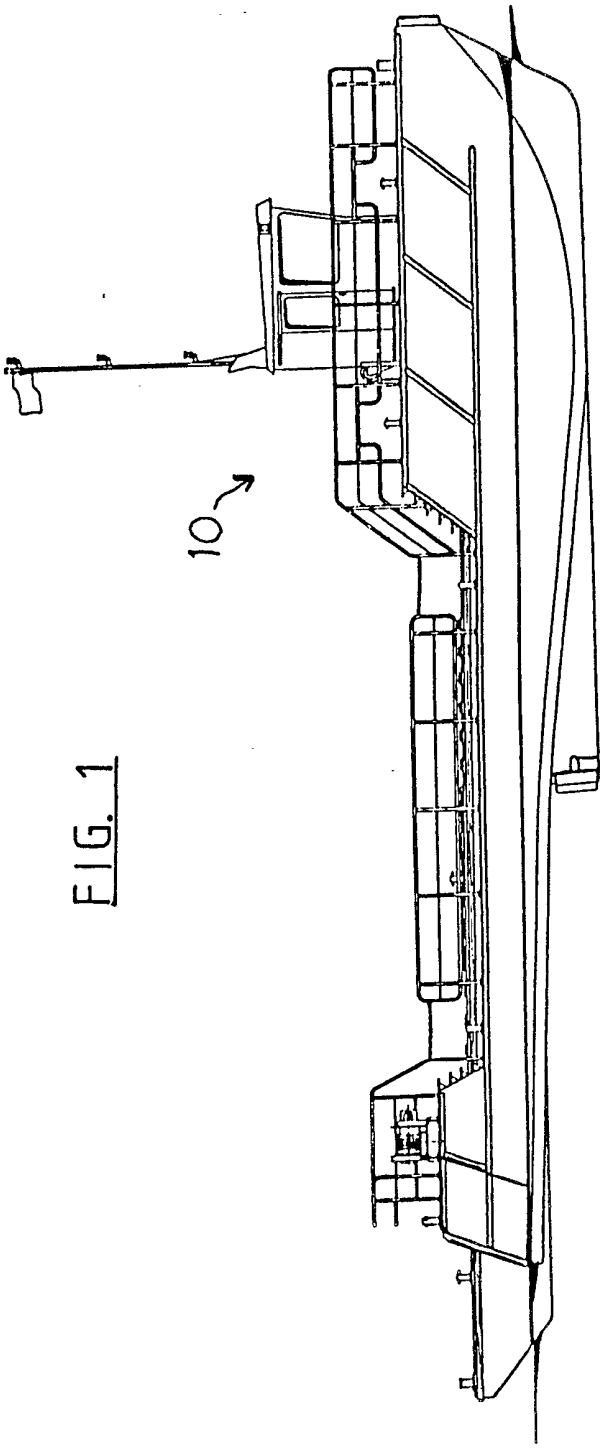


FIG. 1

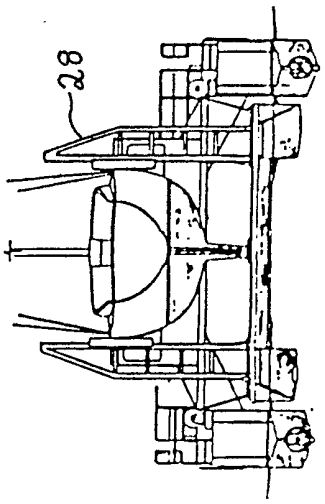


FIG. 8

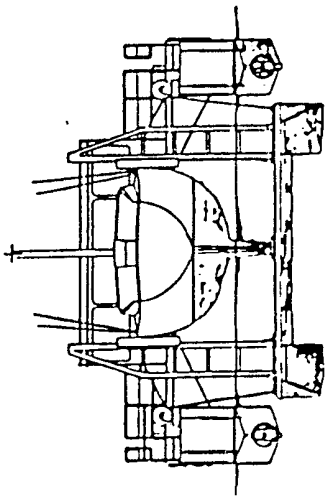


FIG. 7

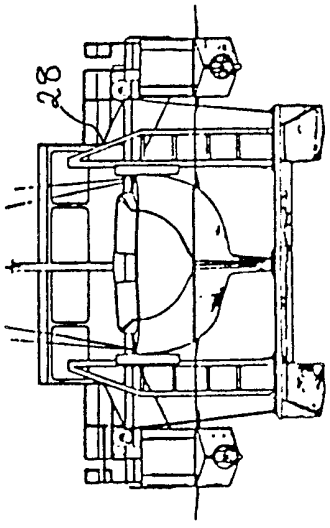


FIG. 6

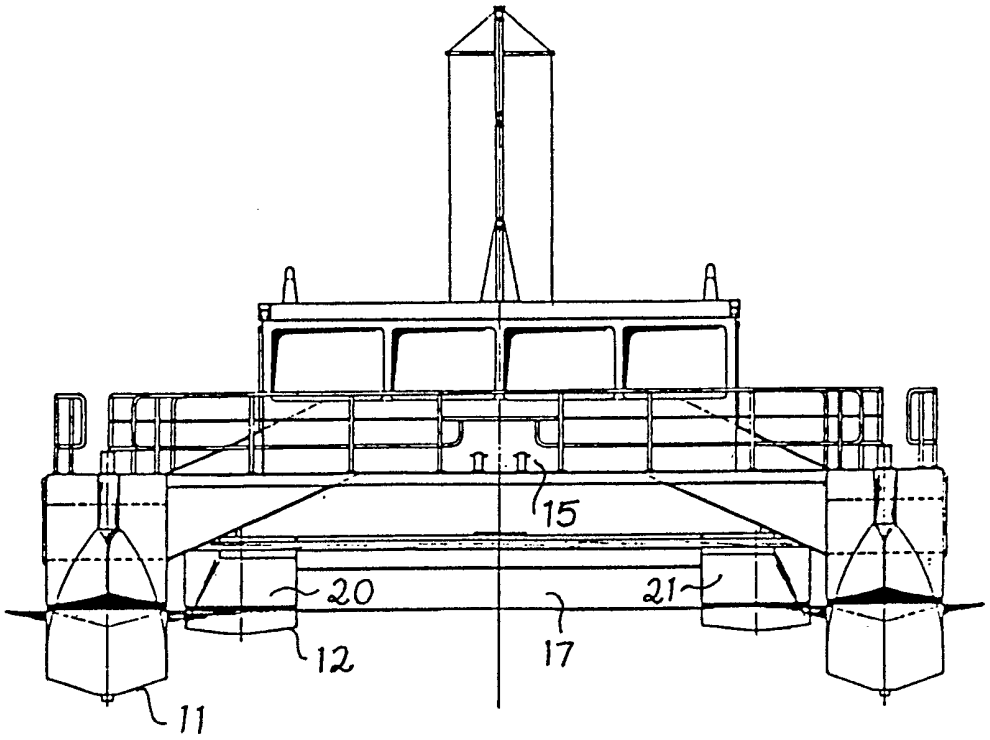


FIG. 2

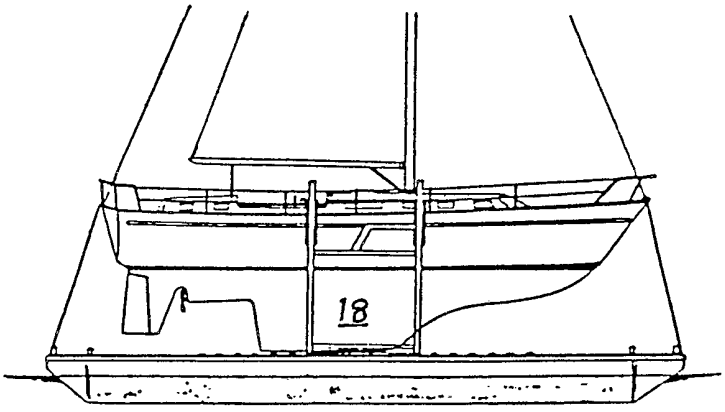
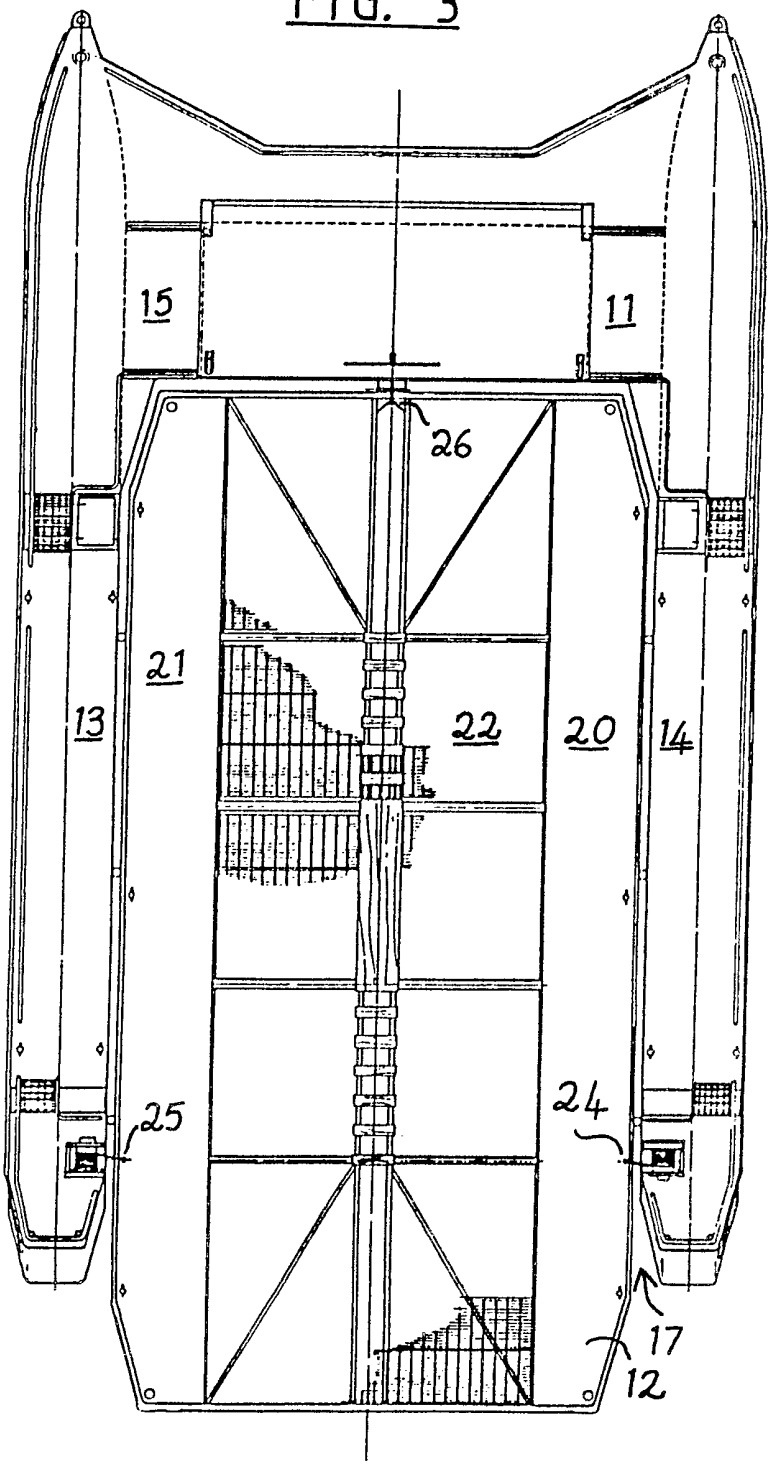


FIG. 9

FIG. 3



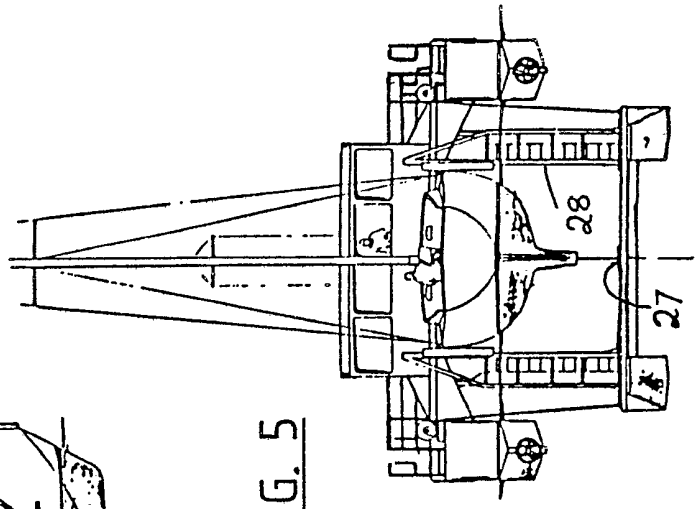


FIG. 5

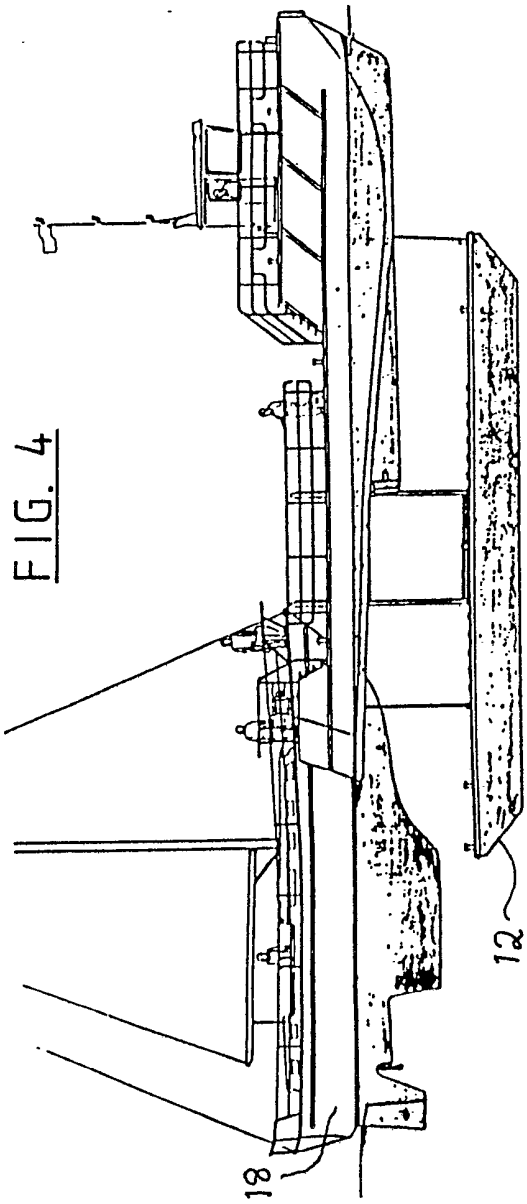


FIG. 4

SPECIFICATION

Floating dock

This invention relates to floating docks and has particular application to methods of operating floating docks.

It is an object of this invention to provide an improved floating dock, and/or method of operating floating docks, or one that will at least provide the public with a useful choice.

In one aspect, the invention provides a floating dock comprising in combination, a docking vessel having an opening for reception of a secondary vessel, and a submersible platform capable of being raised or lowered beneath said opening, and means for controlling the buoyancy of said platform during lifting and lowering, and regulating means capable of connecting the platform to the docking vessel to control the lifting or lowering of said platform.

Preferably, the means for controlling the buoyancy of the platform comprises a regulated supply of compressed air connected to buoyancy tanks forming part of the barge thereby to vent water from the buoyancy tanks.

The regulating means may consist of any suitable connection between the barge and docking vessel whereby a stabilizing force can be applied to the barge. For example, the regulating means may consist of hydraulic rams connecting the barge to the docking vessel thereby to impart a small but controlled stabilizing force to the barge, or the regulating means may consist of cables, chains or the like controlled by appropriate winches. It will readily be appreciated that the main lifting force is achieved by controlling the buoyancy of the barge by pumping, or by compressed air, or the like, while the slight stabilizing force imposed by the regulating means serves to provide a small but additional lift or downward acting force whose purpose is primarily to regulate the lifting operation.

In another aspect, the invention provides a method of operating a floating dock comprising a docking vessel and submersible platform, wherein the platform is submerged beneath the floating dock, and is connected thereto by regulating means, and lifting of the platform is controlled by controlling the buoyancy of the platform and by applying a stabilising force to the regulating means whereby the stability of the platform is controlled by balancing the respective stabilising force against the buoyancy of the platform.

In yet a further aspect, the invention provides a docking vessel suitable for use with the floating dock of this invention, the vessel including a catamaran having regulating means positioned thereon for connection to a submersible platform to regulate the submerging or surfacing of the submersible platform.

Other aspects of this invention, which should be considered in all its novel aspects, will become apparent from the following description, which is given by way of example only, with reference to the accompanying drawings in which:

Figure 1 illustrates a preferred floating dock in side elevation.

Figure 2 is a front view thereof.

Figure 3 is a top plan view thereof.

Figure 4 shows a side view of the dock with its barge submerged in preparation for the vessel about to be slipped.

Figure 5 is a stern view of the dock with a vessel in position.

Figures 6 - 8 show the vessel being raised.

Figure 9 shows the barge and vessel removed from the dock.

The preferred floating dock 10 illustrated in the drawings preferably has a docking vessel 11 and a submersible platform in the form of a barge or pontoon 12. The dock 10 is preferably in the form of a twin hulled vessel, or catamaran, with the hulls 13 and 14 being connected by a forward working platform 15, thereby providing an open area 17 for the barge 12, and providing access for a vessel 18 (Figures 4 through 9).

The preferred barge 12 has a pair of pontoons 20, 21 separated into individual buoyancy tanks, with said pontoons being connected together by appropriate structural reinforcement to support the load of a slipped vessel. This reinforcement can conveniently be covered by perforate decking 22, which may typically be steel mesh or the like.

Each buoyancy tank, (not shown) is provided with appropriate control valves to regulate the admission of compressed air and/or the discharge of sea water.

The barge 12 has means for connection to appropriate regulating means from the docking vessel. Typically, the regulating means consists of steel cables driven by winches 24, 25, 26 on said docking vessel. Any type of winch may be utilised, although it is preferred that hydraulically driven winches are used to facilitate the control of the winch speed during lifting or lowering.

The operation of the dock will now be described with reference to Figures 4 through 9.

The primary lifting force to the barge 12 when submerged, is by means of compressed air, delivered via flexible hoses, forcing the evacuation of ballast water from the buoyancy tanks in the barge. The compressed air is supplied from a compressor on the docking vessel. Typically, it is located inside one of the catamaran hulls, and is driven by the main engines.

The stabilising force is provided to the barge when being raised or lowered by a control system which applies force at selected points to counteract any tendency of the barge to capsize or to develop significant heel or trim. This force is supplied by the regulating means which, in the preferred embodiment illustrated, consists of winches. It will be appreciated, however, that hydraulic rams or other mechanical systems may be used and this control system may, in some cases, contribute a small part of the effort required to raise the barge. It is preferred that a minimum of three control points be used and, in the drawings, these are shown as hydraulically powered winches.

It is preferred that the stabilising and lifting systems are controlled by an operator and are monitored by instruments to show the performance

of these systems and the state of the submerged barge. It will be appreciated that an automated control system can be provided if required. In the case of an operator controlled system, it is preferred that automatic fail-safe devices be provided.

When the barge is raised to the surface, it can be readily disengaged from the dock and handled separately. Thus, one dock can service a number of submersible barges.

Turning now to Figure 4, it will be seen that the barge is in a submerged state and is connected to the docking vessel by means of three regulating means, which in this case comprise wire ropes attached to winches on the docking vessel. The buoyancy tanks in the barge have openings in the bottom to the surrounding water, and compressed air inlets at the top which are connected by flexible piping to control valves on the docking vessel.

The barge is lowered into the position as shown in Figure 4 by venting the tanks to atmosphere and allowing the winches to unreel at a controlled rate. The buoyancy tanks fill with water, whereupon the weight of the barge makes it descend until the winches are stopped in the position shown in Figure 4.

It will be appreciated that the optimum size of the barge and the preferred size of the buoyancy tanks will depend upon the load to be raised. For example, to provide a nominal lifting capacity of 25 tons, the barge may have a submerged weight of three tons, thus providing a load at each winch of one ton, which would be well below the safe working load of each winch. In this case, the safe working load of each winch could be a nominal two tons. The control system can be regulated so that during the lifting operation the load on each winch will be maintained at approximately one ton. The additional weight on the barge caused by the raising of the vessel shown in the drawings will be closely balanced during the lifting operation by providing the barge with additional buoyancy, by use of compressed air to force ballast water out of the buoyancy tanks.

To maintain the stability of the barge and its load, and to keep equal loads on all winches, it is necessary to keep the centre of gravity of the barge and load combination directly over their combined centre of buoyancy. As the vessel is lifting, the location of its contribution to the combined buoyancy of the barge and vessel will vary, and this must be compensated for by controlling the compressed air flow to different buoyancy tanks, and thus shift the combined effective centre of buoyancy as required.

After the barge has been submerged, the vessel to be lifted is floated into the recess within the dock and it positioned over the keel blocks 27 of the barge, and the winches are used to bring the barge up into contact with its keel. If required the barge can be inclined to match the rake of the keel for this part of the operation. The vessel is placed so that its centre is located as near as possible to a position over the barge's centre, and is secured in place by a remotely operated shoring system 28, which is synchronised about the barge's centre line. (See Figures 5 and 6).

To raise the barge from the position shown in Figure 6, the winches are set to reel in at a controlled synchronous speed, and compressed air is supplied to all the buoyancy tanks. The operator can control the winch, and he is aware of the load on each winch by means of the instrumentation at the control panel.

As compressed air is continuously pumped into the barge's ballast compartments, as required to maintain correct trim, the displaced ballast water escapes through vents in the floor of the tanks. Thus the barge and vessel are gradually raised as shown in Figure 7.

If the barge begins to rise unevenly, due to a shift of the centre of buoyancy away from the centre of gravity, this will be apparent to the operator from the changing loads on the winches. A winch in the direction of the centre of buoyancy shift will show a reduced load, and the situation can be corrected by reducing the air supply to the tanks adjacent to that winch.

If all the winches show a resonably consistent change in load, then the operator must operate either the synchronised winch speed or the total air supply, to maintain a winch load of one ton for each winch.

By controlling the lifting operation as described above, the operator can bring the barge and its load to the surface, at which point the tanks are all fully evacuated of water and the air inlets sealed shut. The barge may now be disconnected from the dock, if desired.

As shown in Figure 9, the slipped vessel, and barge are removed from the dock, and can be towed by the dock or another vessel, to a maintenance berth where the barge can be left so that work can be carried out on the slipped vessel.

The dock can then be used with another barge to lift a further vessel.

The docking vessel 11 is preferably a self-propelled catamaran, enabling it to be used as a multi-role harbour work boat, as well as enabling it to tow its barges, and to move the dock from port to port. Thus, the docking vessel may have a variety of uses, and the following examples are illustrative only, and not intended to be exhaustive:

Transportation of vessels on the dock barges; transportation of cargo on the dock barges, pollution control, as a diving tender, for salvage operations, for harbour maintenance (in which case a barge can be provided with derrick and pile driving or other equipment), for dredging, for marine farming, and for many other applications.

It will be appreciated that the floating dock is independent of tides, and independent of shore mounted facilities, as the dock can travel to the vessel to be slipped, and thus the dock could, for example, follow fishing fleets or the like to provide on the spot maintenance facilities. By providing a catamaran-type docking vessel and by controlling the lifting operation by monitoring the tension of the winches, together with control of the barge and vessel buoyancy by means of compressed air, it is possible to provide a versatile floating dock having an efficient and rapid docking facility whereby slipped vessels can be regularly removed from the dock by towing the raised barge out of the dock and

thus leaving the vessel on the barge for service, and allowing the dock to be reused.

The preferred embodiment has been described with reference to a dock with a lifting capacity of 25 tons, and it will be appreciated that the invention can be applied to floating docks of different capacities. For example, larger capacity docks may have submerged members connecting the ends of the docks together, with these transverse members being below the draft of a vessel which is to be floated into the dock. Such larger docks may incorporate working platforms on each side of the dock, rather than a transverse working platform, and may optionally be provided with a crane or the like.

Finally, it will be appreciated that various alterations or modifications may be made to the foregoing without departing from the spirit or scope of this invention as exemplified by the accompanying claims.

CLAIMS

1. A floating dock comprising, in combination, a docking vessel having an opening for reception of a secondary vessel, and a submersible platform capable of being raised or lowered beneath said opening, and means for controlling the buoyancy of said platform during lifting and lowering, and regulating means capable of connecting the platform to the docking vessel to control the lifting or lowering of said platform.

2. A floating dock as claimed in claim 1, wherein the means for controlling the buoyancy of the platform or the like comprises a regulated supply of compressed air connected to buoyancy tanks forming part of the platform, thereby to vent water from the buoyancy tanks.

3. A floating dock as claimed in claim 1 or 2, wherein the docking vessel is in the form of a catamaran.

4. A floating dock as claimed in claim 1, 2 or 3, wherein said regulating means comprise a plurality of winch cables connected to the submersible platform to provide a selective lifting force to the sides of the platform as required, the winches being mounted on said docking vessel.

5. A floating dock as claimed in claim 1, 2 or 3, wherein said regulating means comprise a plurality of hydraulic rams connected between the docking vessel and the submersible platform to provide a selective downwards force to the sides of the platform as required.

6. A floating dock as claimed in any preceding claim, wherein there are at least three said regulating means.

7. A floating dock, substantially as herein described with reference to any of the accompanying drawings.

8. A method of operating a floating dock comprising a docking vessel and submersible platform, wherein the platform is submerged beneath the floating dock, and is connected thereto by regulating means, and lifting of the platform is controlled by controlling the buoyancy of the platform and by applying a stabilising force to the regulating means whereby the stability of the platform is controlled by balancing the respective stabilising force against the buoyancy of the platform.

9. A method as claimed in claim 8, wherein the stabilising force comprises one or more downward forces selectively to counteract excessive positive buoyancy in any part of the platform.

10. A method as claimed in claim 8, wherein the stabilising force comprises one or more upward forces selectively to counteract excessive negative buoyancy in any part of the platform.

11. A method of operating a floating dock, substantially as herein described with reference to any of the accompanying drawings.

12. A docking vessel for use with the floating dock of any one of claims 1 to 8, the vessel including a catamaran having regulating means positioned thereon for connection to a submersible platform to regulate the submerging or surfacing of the submersible platform.

13. A docking vessel, substantially as herein described with reference to any of the accompanying drawings.

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