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[54] **UNDERWATER HOUSING STRUCTURE**
4 Claims, 3 Drawing Figs.

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ABSTRACT: An underwater housing structure including one or more flood tanks and having supply pipes and vent pipes which control the gases for flooding the tanks and arranged so that the gas may be supplied or vented through the highest point of the flood tank. A pressure balance pipe is provided which starts at one end of the gas chamber of the flood tanks and terminates below the flood tank in the water surrounding the outside of the structure.

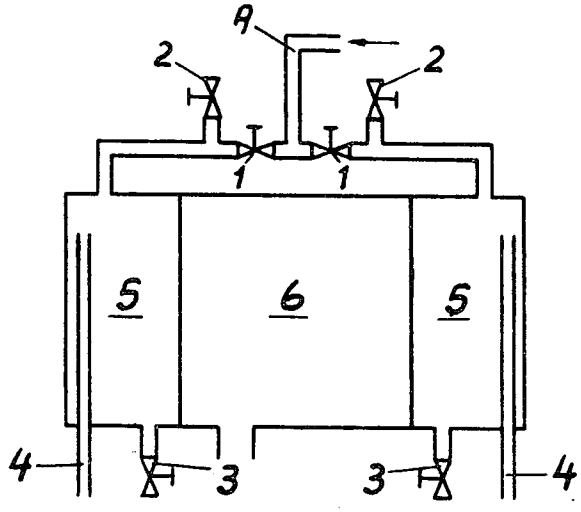


Fig. 1

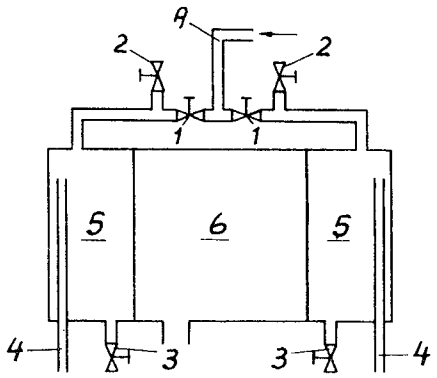


Fig. 2

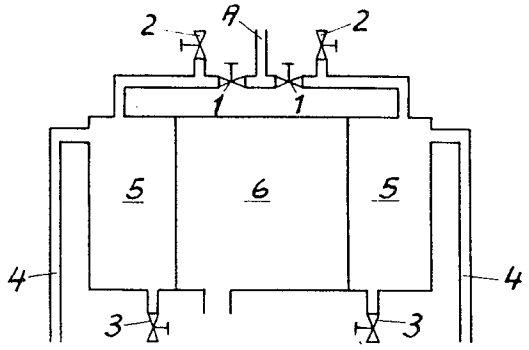
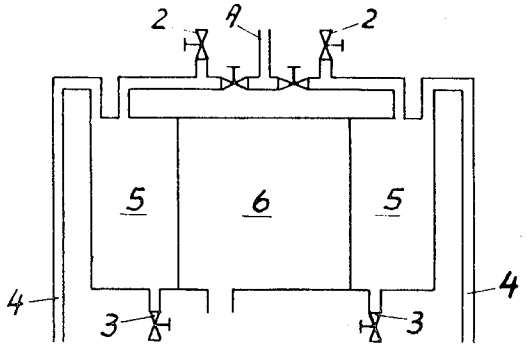


Fig. 3



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UNDERWATER HOUSING STRUCTURE

This invention relates generally to underwater structures.

More specifically, this invention relates to a driving system for underwater structures for submerging and raising the structures in a controlled manner.

In the near future, underwater housing structures will be used to a greater and greater extent in order to explore and to exploit the bottom of the oceans. The future underwater housing structures will be constructed so that their inside will contain almost the same pressure as the prevailing outside pressure of the structure. Therefore, the walls of these structures need only be strong enough to withstand the local outside water pressure, and not the absolute water pressure. The locally existing absolute atmospheric pressure of the housing structures corresponds to the maximum pressure which results from its geometric height. For example, if the housing structure has a geometric height of 5 meters, the locally existing, absolute atmospheric pressure would be 0.5 of absolute atmospheric pressure. Consequently, the wall of this structure would need only a thickness which would be able to withstand that pressure.

The submerging and raising of the housing structures is done by flooding or draining one or a plurality of so-called flood tanks. Preferably, the flooding and/or emptying of the flood tanks is done by using compressed air. However, in order to achieve a simple construction, it is essential that the absolute atmospheric pressure is automatically reduced, and not absorbed by a construction which has compressive strength.

When a flood tank is used having a nonsealable socket, the inside pressure of the flood tank corresponds to the local outside pressure at the beginning of the emptying operation for the flood tank. The air within the tank continuously expands, as the housing emerges higher so that the air pushes the water out of the flood tank. Consequently, the upward drive of the structure cannot be controlled.

On the other hand, if a spring and/or weight-biased return valve is used for balancing the pressure, difficulties with proper sealing are encountered. Moreover, this type of construction is expensive and not economical.

Accordingly, the present invention overcomes the above-mentioned shortcomings of conventional flood tanks by providing one or more tanks wherein the feed pipes and vent pipes for the gases are introduced near the top of the flood tanks. Furthermore, a pressure-balancing pipe is provided which begins within the gas chamber of the flooded tank, and ends near its lowest portion which is submerged and surrounded by water. In another embodiment of the invention, no point of the pipes is higher than the connecting point of the pipes into the gas chamber of the flood tank.

In the subject invention, the feedpipes and the vent pipes for the water are below the lowest water level in the tank in order to submerge the housing structure into the water. In one embodiment of the invention, the flood tanks are attached on both sides of the living space for personnel. The pipe for balancing the pressure may be arranged in spiral form beginning at the gas chamber, and running downwardly to the lowermost point of the flood tank. It is also possible, in accordance with subject invention to construct the pipe in such a way that it consists of a plurality of curves which are connected in series with respect to each other, and lead from the gas chamber of the flood tank downwardly to the lowermost point of the tank.

In still another embodiment of the invention, a separate socket may be provided for the water supply and drainage pipes to flood the tank. In this embodiment, a separate socket for the gas supply and the gas-venting outlet may be used. Despite the simple construction of the subject invention, it should be noted that the absolute atmospheric pressure is automatically reduced in a self regulated and controlled manner. Furthermore, it should also be noted that no pumping means are required for emptying the flood tanks. Therefore, good control is obtained during the submerging and emerging operation.

It is therefore an object according to the present invention to provide an underwater housing structure capable of being raised and lowered by means of flood tanks under good control.

It is another object according to the invention to provide an underwater structure which is simple in design, easy to manufacture and reliable in operation.

Other objects and features of the present invention will become apparent from the following detailed description considered in connection with the accompanying drawings which disclose the embodiments of the invention. It is to be understood, however, that the drawings are designed for the purpose of illustration only, and not as a definition of the limits of the invention.

In the drawings, wherein similar reference characters denote similar elements throughout the several views:

FIG. 1 is a schematic view of one embodiment of the invention,

FIG. 2 shows a schematic view of another embodiment of the invention, and

FIG. 3 shows a still further embodiment of the invention.

Referring to FIG. 1, there is shown two gas inlet valves 1 provided on gas feedpipe A. Valves 2 are the vent valves for the gas, and valves 3 at the bottom of tanks 5, control the supply and drainage of the water to flood the tanks.

Pipes 4 extending into tanks 5 balance the pressure and have their external end disposed in the surrounding water outside of the tank. The flood tanks in this embodiment are arranged on both sides of living space 6 for use by personnel. The tanks in this embodiment are still contained within the overall housing structure, but arranged in such a manner that they are outside of the center of mass of the housing.

The embodiment of FIG. 1 operates as follows:

All valves must be closed before the housing structure is placed into the water either from a land base, or from a ship. After the housing is placed into the water, valves 3 are partially opened to bring the housing into its horizontal floating position. After the housing reaches a horizontal floating position, valves 3 should be shut off. In order to prevent water from entering flood tanks 5 through the pressure in balance pipe 4 due to the high waves of the sea or through other circumstances, air pressure is applied to flood tanks 5 from pipe A, and through valve 1, until bubbles emerge from the pressure balance pipe. During this operation, the required armatures and seals of the pipes may be tested.

When the housing is brought to its intended area of operation, flood tanks 5 are vented through valves 2, and valves 3 remain closed. After a pressure balance is achieved, water flows through valves 3 into flood tanks 5. The housing structure is kept in a horizontal position during the submergence by opening and/or closing air outlet valves 2. After the water level has reached the height of pressure balance pipe 4, valves 3, and subsequently valves 2 must be closed so that more air may be released by opening valves 2 after a balance in pressure is reached between the flood tank, and the pressure exerted by the outside water. With this pressure balance, it is possible to achieve good control of the housing structure during the submerging operation. As soon as the housing starts to submerge, valves 2 should be closed. In order to avoid an afterflow of water, air is supplied through valve 1, after the desired submerging speed is achieved. The submerging speed may be reduced by opening valves 3. After the bottom of the ocean floor is reached, flood tanks 5 may be vented by closing valves 1 and opening valves 2.

In order to bring the housing structure back to the surface, the valves should be operated in the following sequence:

Valves 3 should first be opened, followed by air outlet valves 2, so that the water for flooding tanks 5 is pressed out of the tanks. Should, for example, the housing contact the ocean floor with only one leg, it may be brought into a horizontal position by closing valves 1 and opening one of the air outlet valves 2. After the structure reaches a horizontal position on the ocean floor, valves 2 are closed, and air is pressed into flood tanks 5 through opened valves 1. As soon as the housing

structure starts emerging, valves 3 have to be closed. In the last part of the sequence, the air supply through valves 1 is disconnected. The emerging speed of the housing may be adjusted by opening and closing valves 2.

In the embodiments of FIGS. 2 and 3, the same elements include the same character numerials. However, it should be noted that pressure-balancing pipes 4 are differently arranged in FIG. 2 with respect to the embodiments of FIGS. 1 and 3. During the emerging operation, the embodiments of FIGS. 1, 2 and 3 operate in the same manner. Pressure balance pipe 4 in all three embodiments functions as a safety valve.

The embodiment of FIG. 3, has the disadvantage in that during the final phase of the floating operation, no water can enter through pipes 4 into flood tanks 5 due to the upwardly directed siphon. Therefore, tanks 5 must be flooded through valve 3 until the housing structure is submerged.

In contrast to the embodiment of FIG. 3, the embodiments of FIGS. 1 and 2 permit water to enter into flood tanks 5 through pressure-balancing pipe 4 during the final phase of the floating stage. Therefore, tanks 5 may be flooded through pressure balance pipe 4 at the beginning of the submerging operation. Water would not have to be supplied through valves 3.

While only a few embodiments of the present invention have been shown and described, it will be understood that many changes and modifications may be made thereunto without departing from the spirit and scope of the invention.

What is claimed is:

1. An underwater housing structure, having a personnel compartment, for submergence or elevation in a body of water, comprising;

a plurality of flood tanks coupled to the structure and arranged on both sides of the personnel compartment,

flood valve means, coupled to said flood tanks at the lowest possible water level thereof, for controlling the supply and drainage of the water to flood said tanks,

supply pipes, coupled to the highest point of said flood tanks, for supplying gases to said flood tanks and thereby controlling the flooding of said tanks,

vent pipes, coupled to said supply pipes, for venting the gases from said flood tanks,

supply valve means for controlling the gas supply to said flood tanks,

vent valve means for venting the gases from said flood tanks, and

pressure balance pipes mounted on said flood tanks at a point below said supply pipes and vent pipes, so as to have one end thereof disposed within the gas chamber of said flood tanks and the other end thereof terminating below said flood tanks in the water surrounding the outside of the structure.

2. The underwater housing structure as recited in claim 1 wherein said pressure balance pipes are mounted on and disposed through the bottom surfaces of said flood tanks so as to have one end thereof extending up within the gas chamber of said flood tanks and terminating in the upper portion of the chamber, and the other end thereof extending out through the bottom surfaces of said flood tanks and terminating below said flood tanks in the water surrounding the outside of the structure.

3. The underwater housing structure as recited in claim 2, wherein said pressure pipes are vertically disposed within said flood tanks and have a substantially linear configuration.

4. The underwater housing structure as recited in claim 1, where said pressure balance pipes are mounted on the top surfaces of said flood tanks adjacent to said supply pipes and are substantially U-shaped so as to have one end thereof connected to the gas chamber of said flood tanks and the other end thereof disposed in the water surrounding the outside of the structure and terminating below said flood tanks.

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