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PATENT SPECIFICATION

DRAWINGS ATTACHED

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COMPLETE SPECIFICATION

Method of Raising Sunken or Stranded Vessels

I, KARL KRISTIAN KOBS KRØYER, of Vestre Kongevej 80, Viby J., Denmark, a Danish subject, do hereby declare the invention for which I pray that a patent may be granted to me, and the method by which it is performed, to be particularly described in and by the following statement:—

This invention relates to a method of raising sunken or stranded vessels by introducing into the interior of said vessels buoyant bodies by means of a stream of water.

A serious problem encountered in carrying out a method of the said type consists in creating a stream of water containing said bouyant bodies and in introducing said stream of water into the hull of said vessel.

It is well-known to introduce big plastic balls having a diameter of e.g. 20 cm into the hull of a sunken ship through a tube having a slightly greater diameter than that of the plastic balls by directing a number of downwardly inclined water jets from spaced nozzles mounted in the wall of said tube against the surface of the plastic balls introduced into the tube on board a salvage ship.

However, this method can be used only if the buoyant plastic balls have a uniform size corresponding to the inner diameter of said tube. If balls having a significantly smaller diameter are introduced into said tube together with said big balls, the small balls may avoid the water jets from said nozzles and move towards the surface of the water. Thereby the small balls become wedged between the surfaces of said big balls and the inner walls of said tube, thus clogging the tube.

Furthermore, since each nozzle is connected to a pump on board the salvage ship by means of a separate pressure water tube, the prior art apparatus becomes very difficult to handle, especially in rough seas.

It is also well-known to introduce pieces of cork into the interior of a sunken ship by passing a stream of water through the lower part of a container filled with said pieces of cork and mounted on the suction side of a centrifugal pump. However, due to the fact that said container will have to be closed during the introduction of buoyant bodies into the stream of water, a continuous flow of buoyant bodies into the hull of said sunken ship cannot be obtained. Furthermore, said apparatus does not permit the ratio between buoyant bodies and water to be varied within wide limits, which may be necessary in order to obtain a proper control of the ship when it is no longer in contact with the sea bed.

The object of the invention is to eliminate the above-mentioned drawbacks of the prior art methods and to provide a new, simple and reliable method for introducing continuously into the interior of a sunken or stranded vessel buoyant bodies having varying sizes.

With said object in view there is provided, according to the invention, a method which is characterized by the fact that the stream of water is passed through an ejector and that the buoyant bodies are introduced into said stream of water through the suction tube of said ejector.

The term "ejector" is intended to mean ordinary ejectors as well as ejectors which are constructed in such a manner that a pressure is created in the outlet tube, the so-called injectors.

By using an ejector for introducing the buoyant bodies into said stream of water, the salvage ship need only be connected with the sunken or stranded vessel through a simple tube. Furthermore, the introduction of said buoyant bodies into the stream of water may be carried out continuously by connecting the

suction tube or the ejector with a source of buoyant bodies, e.g. a silo containing plastic balls. Thus, buoyant bodies having different sizes may be introduced into the stream of water since the movement of said buoyant bodies through the suction tube of said ejector is independent of the size of said bodies, provided, of course, that the size of said bodies is smaller than the diameter of said tube. Thus, since no selection of particular buoyant bodies is to be made said bodies may be prepared on board the salvage ship. Thus, it becomes unnecessary to provide space for storing on board said ship the space-consuming buoyant bodies to be introduced into the hull of the sunken or stranded vessel.

Such buoyant bodies are preferably gas-containing polystyrene balls having a size of between 5 and 16 mm. Such balls may be prepared e.g. by heating a commercially available granular activated polystyrene material to a temperature of 80—120°C. for a time of between 5 to 10 minutes. During said treatment the granules swell up to form balls containing a large number of cells and having a rough surface. Due to the large number of inner cells in the polystyrene balls, which have a density of from about 0.03—0.04 grams per cubic cm, said balls are elastic.

The buoyant bodies may also consist of pieces of cellular plastic material.

Since the plastic balls or pieces of cellular material introduced into the interior of the sunken or stranded vessel as buoyant bodies act as an air cushion a pressure in both vertical and horizontal direction will be created within said vessel. Said pressure will act upon the reinforced as well as upon the non-reinforced parts of the hull. Therefore, when the external pressure on the sides of the hull decreases as the vessel rises towards the sea level, the non-reinforced parts of the hull may burst. Thus, it may be desirable to cause the buoyant bodies to adhere to each other to form a coherent mass creating a force acting vertically only and exercising a buoyancy which is uniformly distributed over the structure of the vessel located above said mass.

Thus, in a preferred embodiment of the method according to the invention a thin film of an adhesive is applied to the buoyant bodies when said bodies have been introduced into the interior of the sunken or stranded vessel. By applying the adhesive to the buoyant bodies after their introduction into the interior of the vessel, a clogging of the tube through which said buoyant bodies are conveyed to the vessel is avoided.

The application of an adhesive to the buoyant bodies causes said bodies to adhere to each other when subjected to a compression resulting from the pressure created by the underlying layers of buoyant bodies in the hull of said vessel.

The adhesive used is preferably an asphalt which has a high affinity to the plastic material used.

If the buoyant bodies consist of a thermoplastic material, the adhesion between said buoyant bodies may be created, according to the invention, by heating the surface of said buoyant bodies after being introduced into the interior of said vessel. The heating may be effected e.g. by introducing steam into the hull of said vessel.

The invention also relates to an apparatus for carrying out the method according to the invention. This apparatus is characterized by the fact that it comprises a water pump which on the pressure side is connected to one end of a tube the other end of which can be inserted in the interior of a sunken or stranded vessel, and an ejector mounted in said tube, and having its suction pipe connected to a source of buoyant bodies.

This apparatus is easy to transport and can, therefore, be mounted upon a rather small salvage ship. Furthermore, since the apparatus is simple and reliable, it may be used even under relatively difficult weather conditions.

A preferred embodiment of the apparatus according to the invention comprises means for supplying an adhesive close to a zone in the interior of a vessel to be raised adjacent the outlet end of the tube connected to said ejector.

Another preferred embodiment of the apparatus according to the invention comprises means for introducting a heating medium into the hull of a vessel to be raised. For example, said means may consist of a steam generator connected to a steam tube communicating with the interior of the vessel and terminating in a steam nozzle.

The invention will now be described in more detail with reference to the accompanying drawing, in which

Fig. 1 is a schematic view of a salvage ship and a sunken vessel, the latter being shown in a vertical transverse sectional view, and

Fig. 2 is a side view of an apparatus for carrying out the method according to the invention.

In the drawing, 1 indicates a sunken ship and 2 a salvage ship, while 3 indicates a tube for conveying gas-containing plastic balls 4 from the salvage ship 2 into the interior of the sunken ship 1. The tube 3 is connected to buoys 5 keeping the tube 3 floating in the water in a manner such that no angles or sharp bends are formed.

The appparatus for introducing buoyant bodies into the hull of the sunken ship 1 is mounted on board the salvage ship 2 and comprises a centrifugal pump 6 which on its suction side is connected to a tube 14 communicating with the sea water. The pressure side of said centrifugal pump 6 communicates with a connecting tube 13 which in turn is

connected to an ejector 7 having a suction pipe 8 connected to a silo 9 for said gas-containing plastic balls.

A gate 12 is mounted in said suction pipe 8 to control the dosing of said plastic balls 4 to the stream of water passing through the ejector 7. The silo 9 may contain a supply of plastic balls 4 or may be connected to an apparatus for continuously preparing plastic balls 4.

The outlet pipe of said ejector 7 is connected to said tube 3 communicating with the interior of said sunken ship 1.

A nozzle 10 is provided at the lower end of said tube 3.

When using the apparatus shown in the drawing a stream of water generated in the centrifugal pump 6 is passed through the pipe 3 communicating with the interior of the sunken ship 1.

When said stream of water passes the ejector 7, a vacuum is created in ths suction tube 8. Thus, plastic balls 4 are sucked through the pipe 8 into said ejector 7 in which said plastic balls are introduced into said stream of water and carried into the tube 3.

After being released through the nozzle 10 in the hull of the sunken ship 1 the plastic balls 4 rise in a vertical direction until they contact the deck or another solid structure of said sunken vessel 1. In case the hatches of the sunken ship are lost it may be necessary to use a diver to close the hatch openings of the sunken ship 1.

Immediately after the discharge of the plastic balls 4 from the nozzle 10 an adhesive supplied through a tube 11 is applied thereon. The adhesive is preferably liquid asphalt or an emulsion of asphalt because asphalt has a high affinity to the plastic balls and tends to stick to said balls.

The plastic balls having a thin layer of adhesive applied thereon will be strongly compressed under the influence of the pressure created by the underlying layers. Thereby the plastic balls will adhere to each other to form a coherent mass. Thus, the adhesive serves both to eliminate forces other than the vertical ones and to seal small holes, if any, in the hull of the sunken ship.

WHAT I CLAIM IS:—

1. A method of raising sunken or stranded vessels by introducing into the interior of said vessels buoyant bodies by means of a stream of water, characterized in that said stream of water is passed through an ejector and that the buoyant bodies are introduced into said stream of water through the suction tube of said ejector.

2. A method as claimed in claim 1, characterized in that a thin film of an adhesive is applied to said buoyant bodies after their introduction into the interior of said sunken or stranded vessel.

3. A method as claimed in claim 2, characterized in that the adhesive used is asphalt.

4. A method as claimed in claim 1, characterized in that the buoyant bodies are made from a thermoplastic material and are subjected to a heating after their introduction into said vessel to cause said buoyant bodies to adhere to each other.

5. An apparatus for carrying out the method as claimed in claim 1, characterized in that it comprises a water pump which on its pressure side is connected to the inlet end of an ejector having its suction pipe connected to a source of buoyant bodies, the outlet end of such ejector being connected to one end of a tube, the other end of which can be introduced into the interior of a sunken or stranded vessel.

6. An apparatus as claimed in claim 5, characterized in that it also comprises means for supplying an adhesive to a zone in the interior of a vessel to be raised adjacent the outlet end of the tube connected to said ejector.

7. An apparatus as claimed in claim 5, characterized in that it further comprises means for introducing a heating medium into the interior of a vessel to be raised.

8. A method of raising sunken or stranded vessels substantially as herein described with reference to the accompanying drawing.

9. An apparatus for carrying out the method of claim 8 substantially as herein described with reference to the accompanying drawing.

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1 SHEET This drawing is a reproduction of the Original on a reduced scale

FIG. 1

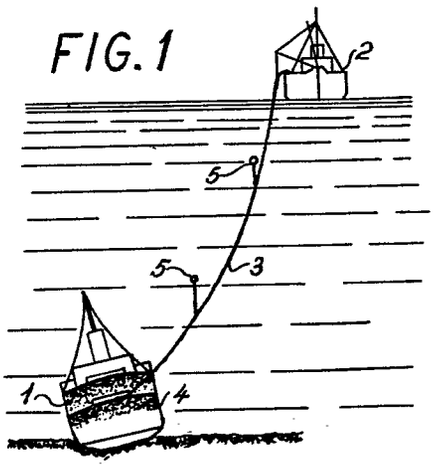


FIG. 2

