United States Patent [19]

Laarman

[11] **3,815,267**

[45] **June 11, 1974**

[54] **METHOD AND APPARATUS FOR SUCKING UP MATERIAL FROM THE BOTTOM OF A BODY OF WATER**

[75] Inventor: **Johannes Bertus Laarman,** Zwijndrecht, Netherlands

[73] Assignee: **N.V. Industrieele Handelscombinatie Holland,** Rotterdam, Netherlands

[22] Filed: **Sept. 15, 1972**

[21] Appl. No.: **289,292**

[30] **Foreign Application Priority Data**

Sept. 23, 1971 Netherlands 7113102

[52] **U.S. Cl.** **37/58,** 37/72, 37/195, 37/DIG. 8, 302/14

[51] **Int. Cl.** **E02f 3/88**

[58] **Field of Search** ..... 37/56, 58, DIG. 8, 72, 37/195; 302/14–16

[56] **References Cited**

UNITED STATES PATENTS

3,260,004	7/1966	Brooks	37/DIG. 8
3,415,068	12/1968	Casey, Jr. et al.	37/56 X
3,591,936	7/1971	Van Geuns	37/56
3,593,533	7/1971	Washington	37/56 X
3,620,572	11/1971	Krutein	37/56 X
3,693,272	9/1972	Gariel	37/72 X

Primary Examiner—Robert E. Pulfrey
Assistant Examiner—Clifford D. Crowder
Attorney, Agent, or Firm—Young & Thompson

[57] **ABSTRACT**

Material is sucked up from the bottom of a body of water through a suction pipe into a wholly submerged container. The container is filled with water to submerge and trim the container, and this water is pumped out to create the suction that raises the material and to balance the added weight of the material so that the container remains at a constant depth. Material is discharged in a stream of water upwardly from the bottom of the container, and water is simultaneously admitted to the ballast tanks to maintain the container submerged. The container is in the form of two conical frusta that open into each other and are traversed by a vertical shaft for the various conduits. The container for the material is centrally disposed and the ballast tanks are peripherally disposed.

8 Claims, 2 Drawing Figures

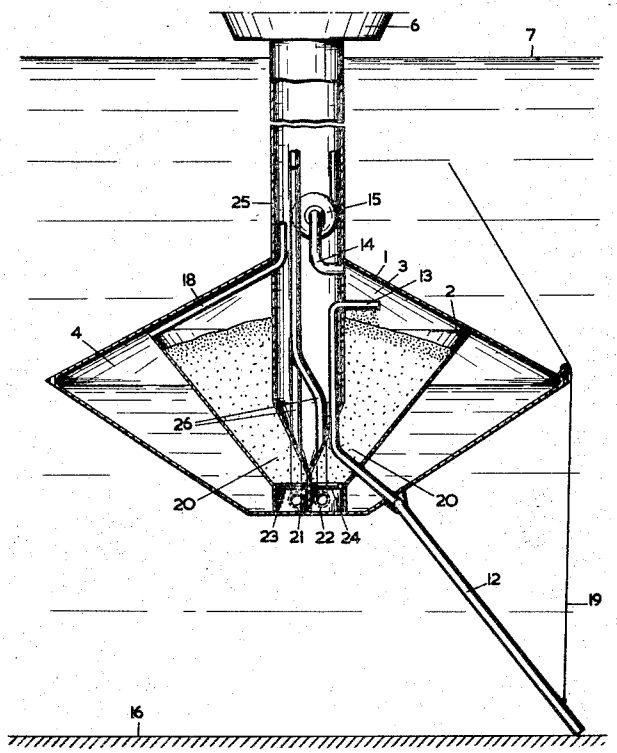


Fig. 1

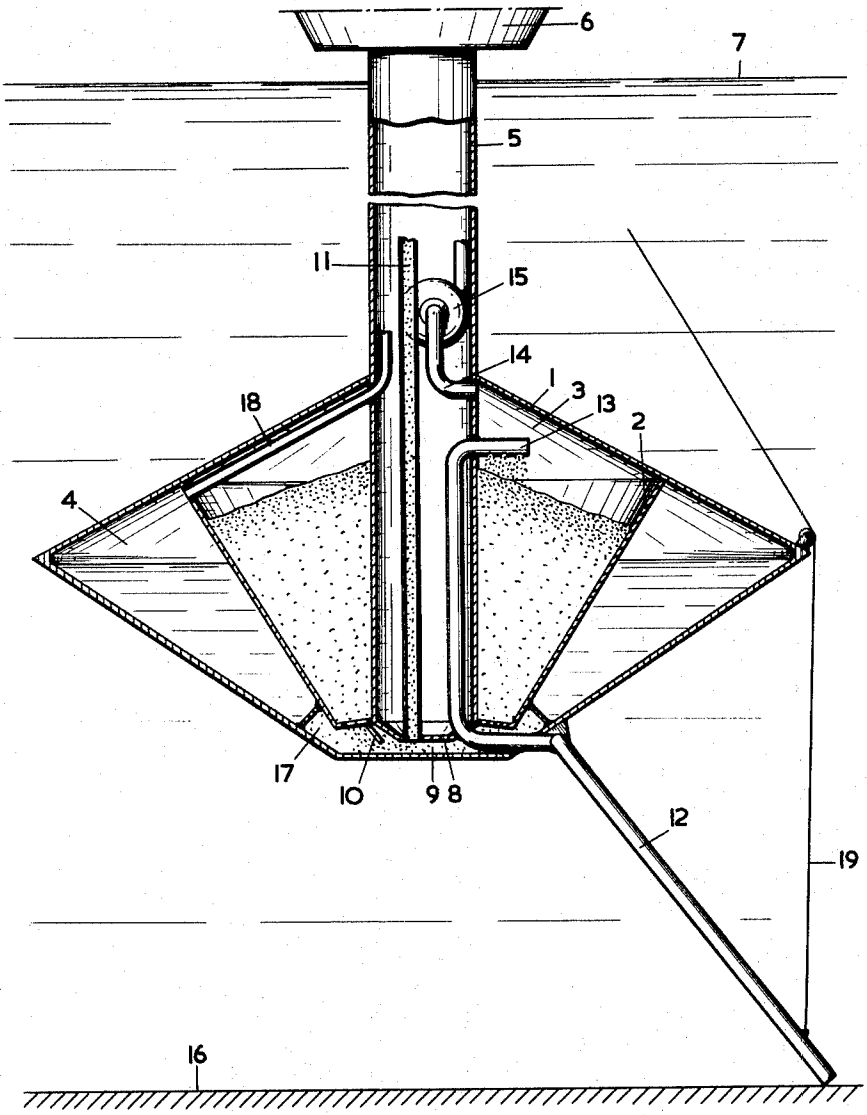
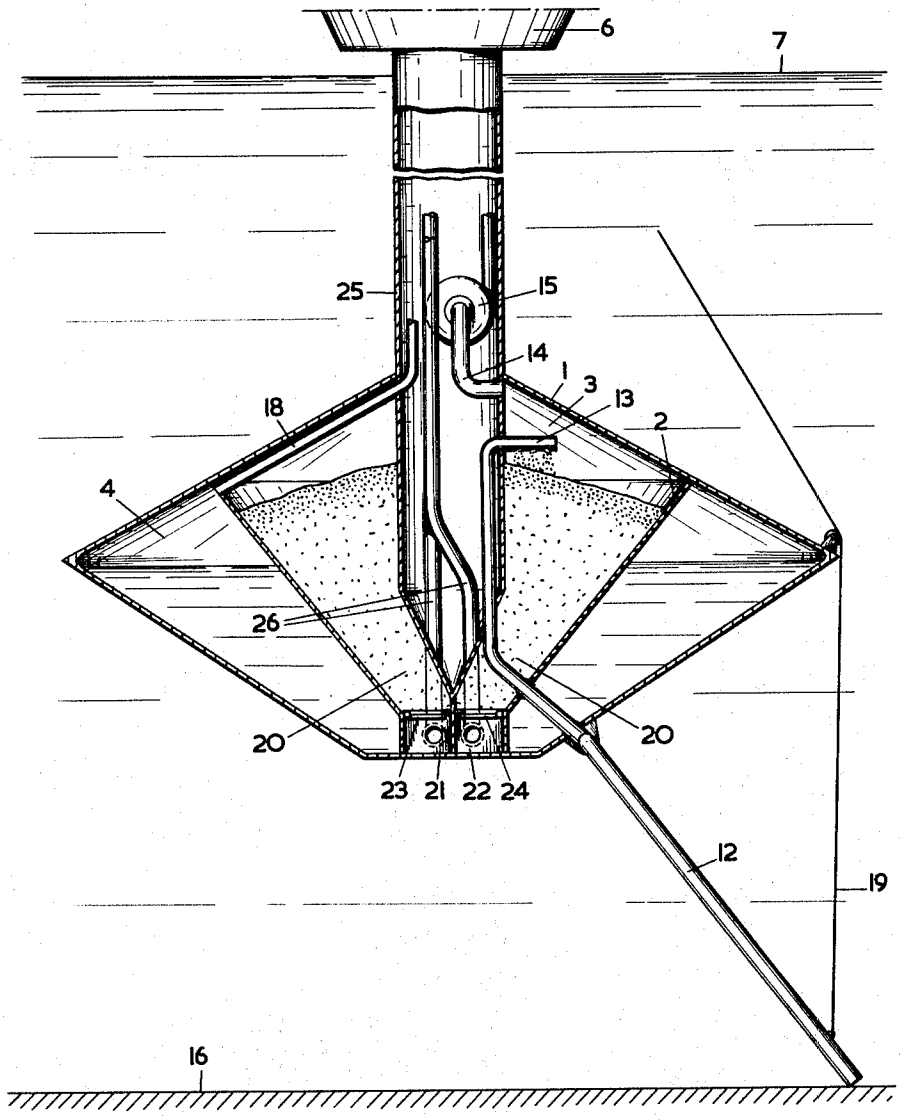


Fig. 2



METHOD AND APPARATUS FOR SUCKING UP MATERIAL FROM THE BOTTOM OF A BODY OF WATER

This invention relates to methods and apparatus for sucking up material from the bottom of a body of water with the aid of a suction pipe.

Known methods for sucking up submerged material with the aid of self-filling and self-propelling hopper craft are uneconomical where deep sea dredging and great distances are involved.

Therefore, the principal object of the present invention is to provide a method and apparatus for sucking up in particular deeply submerged material which often has to be carried over long distances as well.

This object is achieved by the method of the invention, in which the material is sucked up through the suction pipe into a wholly submerged container and this container is then unloaded. This method makes it possible for the suction apparatus proper to remain in one and the same area for quite a time, because the container serves as a loading station with a buffer stock of the material sucked up from the bottom, from which container the material can be carried off in hopper craft or the like, while it is furthermore possible to operate in deeper water than was previously the case, because the head, that is, the vertical distance the material must be sucked up, remains limited to the distance between the container and the bottom.

This object is also achieved by the apparatus of the invention, comprising a container with a suction pipe attached to the same, which is divided into at least one ballast compartment by walls, which ballast compartment has supply and discharge openings for water, and a hopper space for the sucked-up material from the bed of a body of water, which is connected with the suction pipe and with the suction side of a pump and can be connected with a delivery chamber which is connected on one side with a discharge pipe and is connected on the other side with the pressure side of a pump.

Both the suction pipe and the suction side of the pump are advantageously connected with or in the vicinity of the upper portion of the hopper space. In this manner, sucking up takes place through the hopper space on filling the hopper space, so that the pump will only suck up water and will not suck up a mixture of water and material from the bottom.

The pump is preferably disposed in a shaft extending through the hopper space, while a connection passing through the wall of the shaft serves to connect the hopper space with the suction side of the pump. This makes it possible to draw a high vacuum, relative to the water around the hopper craft, in the hopper space with the aid of the pump. In this embodiment, the lower ends of the shaft and of the container can form the boundary of the delivery space, and the discharge conduit connected with said space can extend through the shaft.

For the purpose of facilitating the discharge of the container, the dividing walls inside the container are so constructed that they have a downwardly tapered shape, so that in essence the container is divided into a funnel-shaped hopper compartment and a ballast compartment extending about the same, the narrow end portion of the hopper compartment having valve members for connecting the hopper space and the delivery space. A passage can connect the delivery space and the delivery side of the pump, in which passage openings are provided, which open into the delivery space underneath the valve members of the ballast compartment.

On discharging the container, water is pumped through the latter passage through the delivery space and the discharge conduit. This water will mix with the flow of material coming from the hopper space through the valve members and will carry the material along, so that no material will flow through the pump even on discharging the container. It is to be understood that one and the same water pump can be used for loading and discharging the container.

The shaft in the container preferably extends to the upper part of the container over such a distance that the top of said shaft will remain above the water surface under all conditions.

In order to maintain the container at a constant depth and well trimmed, it is provided that on filling a hopper space ballast water will simultaneously be discharged, while on discharging the container, ballast water will be fed thereto. To this end, for example, depth gauges may be provided by which valves are operated in the supply and discharge conduits of the ballast compartments. When the container is loaded, the weight of ballast water pumped out of said container will simultaneously indicate what weight of material is sucked up from the bottom into said container; consequently the quantity of material sucked up from the bottom can be determined in a very simple manner.

The container preferably has the shape of a float, which in essence is comprised by two frusta with their bases against one another, and a shaft projecting above them so that the container has little flow resistance and will be little affected by the swell.

Other objects, features and advantages of the present invention will become apparent from a consideration of the following specification, taken in connection with the accompanying drawings, in which:

FIG. 1 is a somewhat schematic cross-sectional view of a first embodiment of apparatus according to the present invention; and

FIG. 2 is a somewhat schematic cross-sectional view of a second embodiment of the invention.

Referring now to the drawings in greater detail, and first to the embodiment of FIG. **1**, there is shown apparatus according to the invention in the submerged operative position. The apparatus comprises a container **1**, which is comprised by two conical frusta disposed against one another. The container **1** is divided into a hopper compartment **3** and a ballast compartment **4** by means of the conically downwardly tapering dividing wall **2**. Through the center of the container **1** extends a shaft **5** which projects from the container **1** such a distance that its top part **6** is above the water level **7** under all conditions. The bottom **8** of the shaft **5** is somewhat above the bottom of container **1**, so that these parts form the boundary of a delivery space **9** which by means of the valve members **10** can be connected with the hopper compartment **3**. A discharge conduit **11** for delivery space **9** extends up through the shaft **5**.

Suction pipe **12** is connected with a conduit **13** which extends through shaft **5** and opens in the upper part of the hopper compartment **3**. Near the top of the hopper compartment **3** a conduit **14** is connected to pump **15**.

An air vent 18 for the ballast compartment 4 and a cable 19 for swinging the suction pipe 12 are also provided.

FIG. 2 shows another embodiment of the delivery space. In this embodiment the delivery space comprises two passages 21 and 22 situated directly underneath the hopper compartment 20, which passages 21 and 22 can be placed in communication with the hopper compartment 20 through the valves 23 and 24 respectively. Each of the passages 21 and 22 has in this embodiment a connection (not shown) with the pressure side of the pump adjacent one end and a connection with the discharge pipe 26 adjacent the other end. The shaft 25 has a downwardly tapering shape.

In operation, the container 1, which is initially buoyant, is towed to the operational site with its ballast compartment 4 and hopper compartment 3 only partially loaded or even entirely empty. Water is then fed into the ballast compartment 4 and into the hopper compartment 3 through inlet openings (not shown) and this causes the body 1 to sink below the water level until a predetermined depth has been reached. The position of the container 1 is maintained by anchors (not shown), while the container can be displaced by winches (not shown). Subsequently the suction pipe 12 is lowered to the bottom 16 and the pump 15 is operated. The vacuum in the hopper compartment 3 thus produced causes material to be sucked up from the bottom through the suction pipe 12 and the conduit 13 into the hopper space 3, whereas the water carried along with said material is discharged through the conduit 14 and the pump 15. While the hopper compartment 3 is loaded, water is pumped up from the ballast tank 4, possibly with the aid of the samp pump 15 through a separate conduit (not shown), causing the container 1 to maintain its position at a constant depth below the water surface. The quantity of water pumped up from the ballast compartment 4 is an indication of the quantity of material sucked up from the bottom and passed into the hopper compartment 3.

While the container 1 is to be discharged, the water pump, either directly or through the annular passage 17 at the bottom of the container, will cause water to be fed into the delivery compartment 21 or 22 and 9 respectively, while the valve members 23 or 24 and 10 respectively will be opened, causing the material from the hopper compartments 20 and 3 respectively to be passed upwardly through the discharge pipe together with the flow of water, whereupon said material may be loaded into a hopper craft, for instance, which will carry said material to its destination.

It is to be noted that in this case the remaining part of the hopper compartments 20 and 3 respectively is entirely sealed off, causing a vacuum to be created therein and making it possible for the material to flow downwardly due to its own weight. It is to be understood that the conduits 11, 13 and 14 are provided with control valves.

From the foregoing disclosure, it will be evident that the initially recited object of the present invention has been achieved.

Although the present invention has been described and illustrated in connection with preferred embodiments, it is to be understood that modifications and variations may be resorted to without departing from the spirit of the invention, as those skilled in this art will readily understand. Such modifications and variations are considered to be within the purview and scope of the present invention as defined by the appended claims.

What is claimed is:

1. Apparatus for sucking up submerged material from the bottom of a body of water, comprising a suction pipe for said material, a submersible container into which said suction pipe discharges, said container having at least one ballast compartment and at least one hopper compartment for the material to be sucked up, pump means to create in said hopper compartment a pressure lower than the pressure outside said container thereby to draw material into said hopper compartment through said suction pipe, means to raise said material from the bottom of said hopper compartment, and a shaft extending from said container to above the surface of the water, said pump means being disposed in said shaft, said shaft extending downwardly through said container to adjacent the bottom of said hopper compartment but being spaced above the bottom of said hopper compartment thereby to provide discharge space for said material from said hopper compartment.

2. Apparatus for sucking up submerged material from the bottom of a body of water, comprising a suction pipe for said material, a submersible container into which said suction pipe discharges, said container having at least one ballast compartment and at least one hopper compartment for the material to be sucked up, pump means to create in said hopper compartment a pressure lower than the pressure outside said container thereby to draw material into said hopper compartment through said suction pipe, and means to raise said material from the bottom of said hopper compartment, said at least one hopper compartment being disposed centrally of said container and said at least one ballast compartment surrounding said at least one hopper compartment, said at least one hopper compartment having downwardly converging side walls.

3. Apparatus as claimed in claim 2, said hopper compartment being frusto-conical.

4. Apparatus as claimed in claim 3, said at least one ballast compartment being frusto-conical and having side walls that converge downwardly.

5. A method of sucking up submerged material from the bottom of a body of water with the aid of a suction pipe, comprising wholly submerging a container for a material in said body of water at a distance above the bottom of the body of water, sucking up the material through said suction pipe into said container, then raising material from said container to above the surface of said body of water by passing a stream of water through a bottom portion of said container to entrain said material in said stream of water, moving said stream of water up to above the surface of said body of water, and establishing vertically superposed compartments in said container in the upper of which said material is disposed, the lower of said compartments comprising said bottom portion of said container through which said stream of water passes, said compartments communicating with each other during said raising of material whereby water moving through said lower compartment removes said material from the bottom of said upper compartment.

6. A method as claimed in claim 5 in which said upper and lower compartments are out of communica-

tion with each other when said material is being introduced into said upper compartment.

7. Apparatus for sucking up submerged material from the bottom of a body of water, comprising a suction pipe for said material, a submersible container into which said suction pipe discharges, said container having at least one ballast compartment and at least one hopper compartment for the material to be sucked up, pump means to create in said hopper compartment a pressure lower than the pressure outside said container thereby to draw material into said hopper compartment through said suction pipe, means to raise said material from the bottom of said hopper compartment, said raising means comprising a water pump and means for conveying a stream of water discharged by said pump past a lower portion of said hopper compartment to entrain said material and then upwardly above the surface of the body of water, said means for conveying a stream of water past the lower portion of said hopper compartment comprising means defining a water passage beneath said hopper compartment, and means for establishing communication between said hopper compartment and said water compartment during discharge of material from said hopper compartment.

8. Apparatus as claimed in claim 7, and means for interrupting communication between said hopper compartment and said water compartment during introduction of material into said hopper compartment.

* * * * *