May 27, 1969 H. MEIJER 3,446,027

APPARATUS FOR DEPOSITING A LAYER OF FLOWABLE MATERIAL UNDERWATER

Filed Aug. 14, 1967

Sheet 1 of 2

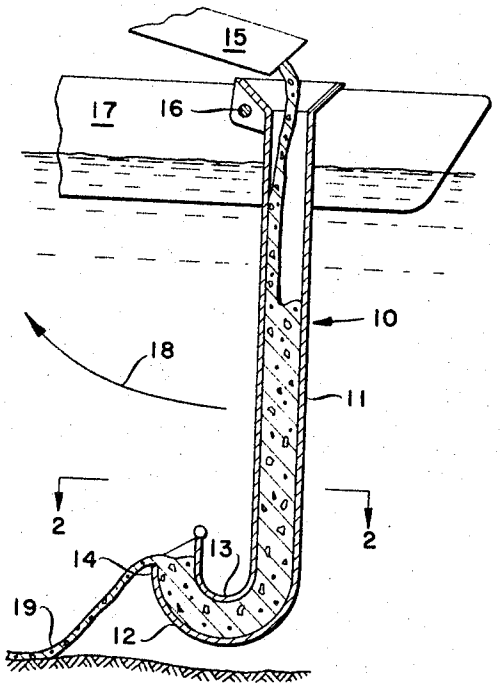

FIG. 1

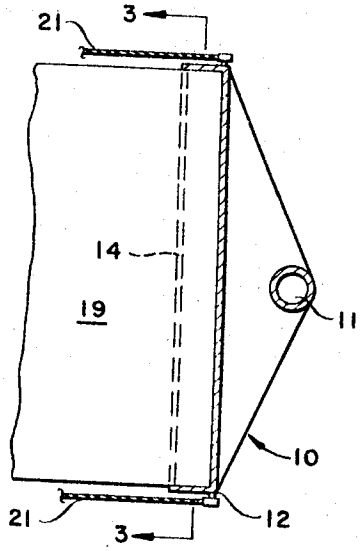

FIG. 2

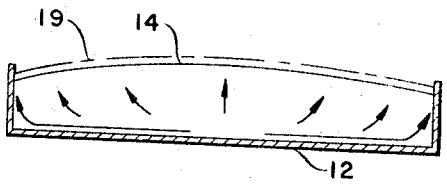

FIG. 3

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Sheet 2 of 2

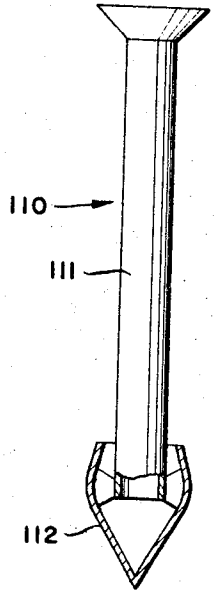

FIG. 4

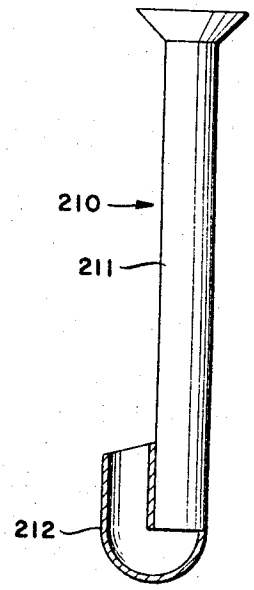

FIG. 5

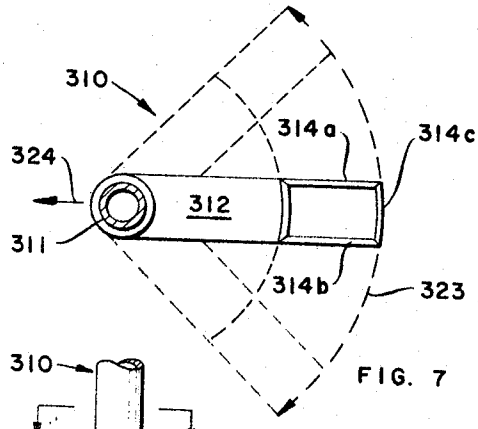

FIG. 7

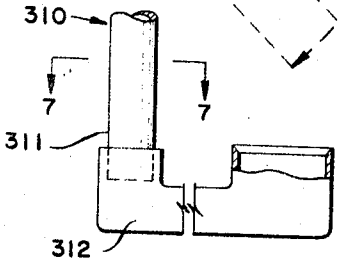

FIG. 6

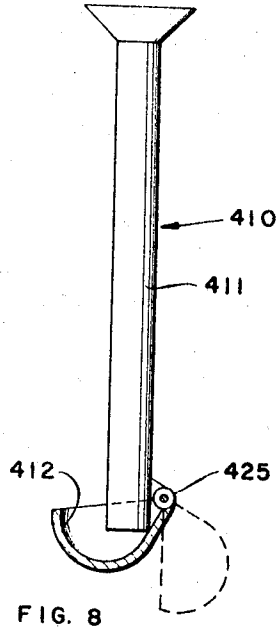

FIG. 8

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3,446,027

APPARATUS FOR DEPOSITING A LAYER OF FLOWABLE MATERIAL UNDERWATER

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Claims priority, application Netherlands, Aug. 16, 1966, 6611475
Int. Cl. E02b 3/12
U.S. Cl. 61—63 8 Claims

ABSTRACT OF THE DISCLOSURE

An apparatus for depositing flowable material, e.g., asphalt, underwater in which a supply conduit extending from the water surface to the point the material is to be deposited is provided at its lower end with a flow reversing device, such as a bent tube, having an outlet positioned above the lower end of the supply conduit. The flow reversing device thus forms a liquid trap to prevent the ingress of seawater into the supply conduit.

Background of the invention

The invention relates to an apparatus for the deposition of a layer of bituminous material underwater on the bottom or talus of a waterway, by leading a stream of liquid bituminous mass to the bottom or talus of the waterway, or for depositing flowable materials on the ocean floor around offshore oil well platforms or around underwater wellheads or other facilities to prevent erosion.

The invention also relates to an apparatus for the deposition of a layer of bituminous material underwater on the bottom or talus of a waterway, comprising a supply conduit for liquid bituminous mass with at least one inlet and one outlet.

One method for the deposition of a layer of bituminous material on the bottom of a waterway is known in the art. In this method a liquid bituminous mass is led in a downward direction by means of a supply conduit before being deposited. In order to overcome difficulties due to penetration of water into the outlet mouth of the apparatus used for the deposition, the apparatus described in said specification is provided with narrowed outlet nozzles, arranged in a row.

The volume flowing from a given opening depends to a great extent on the viscosity of the bituminous mass. This viscosity is, in turn, strongly dependent on the temperature and composition of the mass. The temperature may vary at the different openings, for example, because the liquid bituminous mass reaching the outer nozzles has been transported over a greater distance after leaving the supply conduit than liquid bituminous mass reaching the more centrally located nozzles, and consequently has been cooled down further. For that reason it is not always easy to ensure the same outlet volume per time at all nozzles. There is also a risk of one of the nozzles becoming blocked, so that the flow pattern is disturbed, and while it is normally the intention to cover the bed with one continuous layer, there is a risk with the use of the known apparatus of gaps occurring in the layer of bituminous material applied. At such points the bed is insufficiently protected against water flows.

Summary of the invention

The invention provides an apparatus as referred to hereinbefore, in which the said problems are solved by giving each particle of the liquid bituminous mass under the water surface at least once a flow in an upward direction. A particle is to be said to have a flow in an upward direction if its velocity or the component of its velocity along a vertical axis is directed opposite to the gravitation. According to the invention, each particle of the liquid bituminous mass must at least once under the water surface have a flow in an upward direction during transport of the liquid bituminous mass to the bottom or the talus of the waterway.

The invention thus provides an apparatus of the type referred to hereinbefore, the supply conduit at the outlet side being provided with a flow reverse device, which functions as a liquid seal, if filled up with bituminous mass.

A flow reverse device has an outlet mouth which, at vertical position of the supply conduit, is entirely situated at a higher level than the level of the highest point of the inner bend of the flow reverse device. In this flow reverse device the flow direction of each particle of the bituminous mass at least once is changed from downward to upward during passage. In general, the particles will enter the flow reverse device in downward direction, and during passage through this device they will at least once flow in an upward direction, owing to the structure of the flow reverse device.

When flowing through the flow reverse device, there is a level after passing of which each particle must have a flow in an upward direction, in order to pass the flow reverse device. This level is called the level of the highest point of the inner bend of the flow reverse device. If filled up with bituminous mass the flow reverse device functions as a liquid seal, no water being able to enter the apparatus in view of the lower specific gravity of the water as compared with the specific gravity of the liquid bituminous mass.

Since the flow reverse device functions as a liquid seal a bituminous mass which automatically shuts out the water, no special dimensions of the outlet openings are necessary in order to prevent the entrance of water.

It is particularly easy to control the discharge by controlling the supply of liquid bituminous material to the apparatus. The same amount of material flows into the apparatus as flows out, since the column of liquid bituminous material in the apparatus remains in equilibrium with the column of water above the upper edge of the outlet mouth of the flow return device. There is no need for any valves in view of the said liquid seal. The capacity of the supply conduit can also be small. In this way the apparatus of the invention is less bulky, and the construction is simple and trouble-free. The supply conduit preferably is a straight tube, in order to secure an unhindered downward flow of the liquid bituminous mass supplied.

Description of the drawings

A number of preferred embodiments of the apparatus according to the invention are elucidated, by means of the following drawings, in which:

FIGURE 1 is a diagrammatic vertical longitudinal section through an apparatus according to the invention, the flow reverse device being constructed as a bent tube;

FIGURE 2 is a plan view of a modified flow reverse device;

FIGURE 3 is a sectional view taken along the line 3—3 of FIGURE 2;

FIGURE 4 is an elevational view in partial section of an apparatus forming another embodiment of the invention;

FIGURE 5 is an elevational view in partial section of still another embodiment;

FIGURE 6 is a partial elevational view of an embodiment of the invention in which the flow reverse device is swivelly mounted;

FIGURE 7 is a sectional view taken along the line 7—7 of FIGURE 6; and,

FIGURE 8 is an elevational view of a modified form of the invention in which the flow reverse is pivoted to the supply conduit on an axis transverse to the supply conduit.

Description of the preferred embodiments

The apparatus **10** comprises a supply tube or conduit **11** and a bent tube or conduit **12**, which is attached to the supply tube. The bent tube is open at the upper side and has an upper edge **14**, which is situated at a higher level than the highest point of the inner bend **13** of the bent tube.

During operation the apparatus **10** is installed in the water in the upright position. The apparatus is, for example, suspended so as to swivel on a hinge **16** from a power-driven vessel or a movable pontoon **17**. The supply conduit **11** is filled at the top with a liquid bituminous mass from a chute **15**. An equilibrium is created between the column of bituminous mass and the column of water above the upper edge **14**, so that the same amount of bituminous mass flows out of the apparatus as is supplied to it. At the start of the operation of pouring bituminous mass onto a bed under water, the apparatus **10** is raised above water by swivelling it round the hinge **16** in the direction shown by the arrow **18**. Above water the bent tube **12** is filled to beyond the highest point of its inner bend **13** and lowered, while the apparatus **10** is filled up further. Care is taken that no water can enter. Once the apparatus **10** has reached the desired position above the bed or talus of a river or a canal or the surface of a dyke, the vessel is shifted, while as much bituminous mass is poured into the supply conduit **11** as is required to form a layer **19** of bituminous mass. Since the bituminous mass is heavier than water it spreads out as a liquid on the surface of the bottom or talus and forces the water out. A layer **19** can be very rapidly laid with the apparatus according to the invention.

The upper edge of the outlet mouth of the bent tube **14** may have a great length compared with the diameter of the supply tube, extending laterally from the supply tube. FIGURE 2 shows diagrammatically a horizontal section of this embodiment of the invention. In this way a broad area of the bottom or talus of a waterway can be covered with a bituminous layer in one operation. In this case, the liquid surface of the bitumen along the upper edge **14** is not flat but somewhat curved, since the viscous flow of the bituminous mass at places at a greater distance from the supply tube is decreased in view of temperature decrease of the liquid bituminous mass. The upper edge **14** can be adapted to this curved liquid surface, so that even in these circumstances a layer **19** of a uniform thickness can be laid.

FIGURE 3 represents a vertical section along the line **3—3** of FIGURE 2, showing an upper edge **14** adapted to the curved liquid surface, being highest at places nearest to the supply conduit. If the thickness of the layer at one end of the bent tube **12** is desired to be greater than at the other end, the apparatus is moved somewhat out of the vertical plane, for instance, by making the cable **21** at one end of the tube **12** longer than the other cable **21**.

In another embodiment of the apparatus according to the invention, the flow reverse device is constructed as a cistern which is open at the top, the upper edge of which is entirely situated at a higher level than the outlet of the supply conduit at a vertical position of the latter. The apparatus **110** according to FIGURE 4 is an example of such an embodiment. A supply conduit **111** ends in a cistern **112**. The cistern **112** may have a circular cross-section or have any other form, such as a rectangular one. An upper edge having a great length compared with the diameter of the supply conduit is preferred. If the flow of bituminous mass is to be led in one direction, the cistern can be constructed in such a way that the upper edge in the desired direction of flow of the liquid bituminous mass is lower than the upper edge in other directions. In view of viscosity increase of the liquid bituminous mass at places at greater distance of the supply conduit, the liquid surface in the cistern may be curved and it may be of advantage to adapt the edge to the curved liquid surface as discussed above.

If a cistern with a circular cross-section is chosen, from which the bituminous mass can flow out on all sides, as depicted in FIGURE 4, the apparatus is especially suited for local deposition of bituminous mass.

Apparatus **210** depicted in FIGURE 5 differs from apparatus **10** in that the supply tube **211** and the flow reverse device **212** have part of their wall in common. This apparatus is of more compact design, with the result that there is less heat loss.

In another embodiment of the apparatus according to the invention, the flow reverse device or the apparatus as a whole can be swivelled around the axis of the supply conduit or an axis parallel therewith. FIGURE 6 represents diagrammatically a vertical longitudinal section of such an embodiment of the apparatus according to the invention, while FIGURE 7 depicts a view on a horizontal section taken on the line **7—7** of FIGURE 6.

Apparatus **310** has a cistern (which may be a bent tube) **312** extending horizontally for some distance from the supply conduit **311**. The cistern or bent tube **312** can swivel round the supply conduit **311**, or the apparatus as a whole can swivel together round the vertical axis of the supply conduit **311**, in the direction of the arrows **323**, so that the bituminous mass flows alternately over the upper edge **314***a* and the upper edge **314***b*, as the cistern or bent tube **312** swivels back and forth while the apparatus **310** is shifted in the direction of the arrow **324**. In this way a broad coating is laid composed of wide arcs of a circle blending into each other. Of course, it is also possible to direct the flow of the bituminous mass entirely over the upper edge **314***c*, by increasing the height of the other edges of the outlet mouth.

FIGURE 8 represents diagrammatically a vertical section through an apparatus according to the invention provided with means to empty the apparatus at any moment, if desired.

The tank **412** of the apparatus **410** swivels round a shaft **425** between the operating position shown by unbroken lines and the discharge position shown by dotted lines. In this way, the apparatus **410** can be emptied completely at any desired moment. In the discharge position the upper edge of the flow reverse device is situated at a lower level than the highest point of the inner bend thereof and the particles of the liquid bituminous mass leaving the apparatus need not have had a flow direction, which is in the upward direction or have had an upwardly directed component.

It is obvious that the apparatus according to the invention can be used in the oblique position as well as in the vertical position. The position of the supply conduit is adapted to the depth of the waterway. The upper edge of the outlet of the flow reverse device is preferably kept at a given distance from the bed by means of a feeler device.

The bituminous mass can be passed to the bed from the upper edge of the outlet mouth of the flow reverse device with the aid of a guide means (not shown) comprising, for example, a corrugated plate, the corrugations of which extend in the direction of flow. This corrugated plate can be hingeably secured to the upper edge and can drag its lower end along the bed to be coated.

The apparatus according to the invention may be provided with heating elements (not shown) for keeping the bituminous mass in the liquid state. These heating elements will usually not be required. It is, however, advisable to insulate the apparatus according to the invention with a view to preventing too great a loss of heat.

It is obvious that the part of the upper edge at the top of the outlet of the flow reverse device over which no

bituminous mass may flow will be at a higher level than the part of this upper edge which is equipped for the discharge of the bituminous mass. Under certain circumstances, for instance, in a test apparatus, the upper edge of the flow reverse device is preferably divided into sections, which can be secured to the flow reverse device in such a way that they can be adjusted in height independent of each other. In this way the flow pattern of the bituminous mass flowing from the apparatus can be controlled as desired.

Since no parts of the apparatus according to the invention need to have a narrowed passage, uninhibited flow of the liquid bituminous mass is secured. For that reason liquid bituminous mass with a higher viscosity can be applied, than could be used in known apparatus hitherto. For the same reasons fillers and aggregates of greater diameter can be used in the liquid bituminous mass to be deposited on the bottom or talus of a waterway, than was possible up till now.

What I claim is:

1. An apparatus for the deposition of a layer of flowable materials underwater comprising:

movable buoyant means carried on the surface of the water;

depending imperforate conduit means carried by said buoyant means and having an upper inlet end above the surface of the water and a lowermost end portion disposed in the water near the point said material is to be deposited;

flow directing means carried by the lowermost end portion of said conduit means and having a material-conveying passageway with flow communication therewith for substantially reversing the flow of said material upwardly from said end portion;

said flow directing means terminating in an outlet means positioned above the lowermost end portion and said passageway; and,

supply means in communication with the upper inlet

end of said conduit means for supplying said material to said conduit means.

2. An apparatus as defined in claim 1 wherein said buoyant means comprise a movable vessel.

3. An apparatus as defined in claim 1 wherein said passageway of said flow directing means being defined by a cup-shaped member concentrically attached to and spaced from the lowermost end portion of said conduit means wherein the rim of said cup-shaped member is higher than the lowermost end portion of said conduit means and defines said inlet means.

4. An apparatus as defined in claim 1 wherein said flow directing means is journalled to said lowermost end portion to permit said flow directing means to swivel about the axis of said conduit means.

5. An apparatus as defined in claim 1 wherein said flow directing means is pivotally attached to said lowermost end portion to permit said flow directing means to pivot out of communication with the lowermost end portion about an axis transverse to the axis of said conduit means.

6. An apparatus as defined in claim 1 wherein said conduit means is pivotally attached to said buoyant means.

7. An apparatus as defined in claim 1 wherein said passageway of said flow directing means is formed of a bent U-shaped portion continuous with said lowermost end portion.

8. An apparatus as defined in claim 7 in which said outlet means is elongated in a direction transverse to the centerline of said conduit means.

References Cited

The Oil & Gas Journal; June 5, 1961; p. 54.

EARL J. WITMER, *Primary Examiner.*

U.S. Cl. X.R.

61—1, 37, 72.2