

A dredge vessel system

The invention refers to a floating dredge vessel dedicated to a floating dredge vessel dedicated to recover materials from seabed and discharge said recovered materials outboard, into a barge.

In the prior art, from figures 1-4 of either JP201247077 or JP2001348905, is known such a dredge vessel having:

- 10 - a structure comprising a hull and a deck,
- steering means and a motor for steering and moving forward the dredge vessel,
- a reel on said deck,
- an elongated flexible suction hose adapted to be rolled
15 onto said reel and unrolled down to water,
- an inert rigid dredging head connected to a first end of the flexible suction hose and having a first free end opened downward for sucking from below, when rested on the seabed,
- 20 - a pump connected to the flexible suction hose for sucking therethrough a mixture of said materials and water,
- hoisting means disposed on said deck and provided with hanging ropes, adapted to be wound and unwound, and
25 connected to both the rigid dredging head and a hanging rope length controller, for:
 - * moving the flexible suction hose and rigid dredging head (11) between an inactive position located onboard and an active position located outboard,
 - 30 * immersing and elevating the flexible suction hose and rigid dredging head,
- at least one delivering tube which is:

* connected through a first end to the flexible suction hose, and

* extended at a second end by a delivering head for discharging therethrough the recovered materials,
5 outboard, into said barge,

said delivering tube and delivering head being adapted to move relative to said deck, for being :

* stored above the deck, in a stored zone,

* and deployed outside the dredge vessel, in a
10 deployed zone, when said recovered materials have to be discharged outboard.

Globally, the invention intends to speed up the recovery of the dredged materials, all the more when the vessel has to dredge on an open sea, far away from any
15 harbour where the dredged materials can be delivered ashore.

Specifically, considering the above disclosure of either JP201247077, or JP2001348905, a problem to be solved is :

20 -improving the celerity of exploring all the seabed concession,

- together with improving the efficiency and safety of sucking the materials and then the transfer to the barge(s) of said sucked materials.

25 As a consequence, speeding up the extraction, on one side, and the delivery of the dredged materials, on another side, are taken into consideration.

For at least approaching some of such issues, the following is recommended:

30 - the hoisting means are adapted for:

- * towing the immersed flexible suction hose and rigid dredging head when the dredge vessel is moving frontward and materials are being sucked,
- * while controlling a tilt of the rigid dredging head
- 5 which has its first free end directed backward and rested on the seabed, under water,
- a suction hose length controller is provided for controlling the length of the flexible suction hose unrolled from said reel,
- 10 - a main length controller connected to both the flexible suction hose length controller and the hanging rope length controller is provided for adjusting according to one of the other the unrolled length of the flexible suction hose and an unwound length of the hanging ropes,
- 15 in such a way that the flexible suction hose, which has a determined length between the rigid dredging head and the sea surface, when the dredge vessel is moving forward and said materials are being sucked, is curved along said determined length, whatever the tilt of the rigid
- 20 dredging head.

Among possible additional specifications which can be further provided in relation with the above issues, it is recommended that the connection between the delivering tube and the flexible suction hose is adapted for having

25 all the sucked mixture, including sucked water, discharged outside the dredge vessel, into said barge, through said delivering head, with neither pit nor hopper for storing recovered materials on the dredging vessel.

Is furthermore presently under consideration a

30 dredging method (including partly designing or implanting vessel components and manoeuvring it in sailing) intending to strive for solving at least some of the

above drawbacks for recovering immersed materials from a seabed concession and discharging them, the method comprising:

- from a first free end of an immersed dredging head
5 which is connected to a sailing dredge vessel through a flexible hose adapted to be rolled and unrolled on a rotative reel disposed on said dredge vessel, sucking a mixture of water and materials (3) through said flexible hose,
- 10 - delivering the materials from the dredge vessel to one of a series of barges,
characterized in that:
 - the step of sucking comprises sucking said mixture while:
15 * the dredge vessel is sailing frontward over the seabed concession,
* the immersed dredging head and flexible suction hose are towed by said dredge vessel(1),
* an under water tilt of the immersed dredging head is
20 controlled, so that said dredging head has its first free end directed backward and rested on the seabed, and,
* the flexible suction hose, which has a variable immersed length, has said immersed length adapted so
25 that the flexible suction hose is curved therealong, whatever the tilt of the dredging head,
- the step of delivering comprises delivering said materials, while said mixture is sucked.
while said mixture is sucked through the flexible suction
30 hose, immediately delivering the sucked mixture to said one of the series of barges 27 that is sailing alongside,

with no storage of accumulated materials 3 on said dredge vessel.

Preferably for the same goal, it will be preferred that:

- 5 - the curvature of the towed flexible suction hose be varied contingent to said unwound length of the hanging ropes, and/or
- the step of adapting the immersed length of the flexible suction hose comprises adjusting such a length,
- 10 so that, while the rigid dredging head is resting on the seabed and sucking operates, the flexible suction hose is longitudinally loosened.

Furthermore, is also presently under consideration, for providing a solution to the above-cited issues, an assembly comprising:

- a floating dredge vessel provided with at least some of the above features, and,
- a barge floating alongside said dredge vessel, said barge comprising a loading compartment having a
- 20 predetermined volume, said loading compartment being opened upwardly and charged with said mixture, water included, the upward opening allowing water to overflow from the loading compartment when said recovered materials charged therein are above a quantity which is
- 25 contingent to said predetermined volume.

Details of especially the dredge vessel and method are further given below, together with additional features and benefits, with reference to the attached diagrammatical illustrations in which, with no

30 limitation:

- figure 1 shows a preferred embodiment of a dredging vessel, viewed from above, together with a

symbolic illustration of a barge adapted to be loaded with the dredged mixture.

- figure 2 shows said dredging vessel viewed from one lateral side (arrow II),

5 - figure 3 shows some elements of the dredging vessel (barge essentially) viewed from above,

- figure 4 shows an example of transshipment between the dredging vessel and the barge,

10 - figure 5 is the same view as figure 2, at a reduced scale,

- figures 6 and 8 are two successive alternative embodiments viewed from one lateral side (same view as figure 2), and,

15 - figure 7 is a view from above of figure 6, together with a barge.

In figures 1, 2 is illustrated the best mode of a floating dredge vessel 1 dedicated to extract materials 3 from water 3a and discharge said materials outboard to have them transported to a determined destination.

20 Materials means sand, gravel, sediments and any other substance which can be sucked from the seabed.

Seabed means the bottom of the ocean (or sea or any water surface).

25 The vessel 1 has a structure 100 comprising a hull 1a covered by a (rear) deck 10 on which is elevated a frontward bridge deck 12.

30 On the deck 10 of the dredge vessel 1 are provided the following means: a rotative reel 5 on which a elongated flexible suction hose 7 is adapted to be rolled, hoisting means 9 for immersing elevating and towing said suction hose, a rigid dredging head 11 disposed at a first end 7a of the flexible suction hose

7, for dredging the materials 3, pumping means 13 connected to the suction hose, for sucking therethrough a mixture of materials and water, a discharging unit 15 having a series of delivering heads 15b adapted for
5 discharging the sucked mixture (materials and water) outside the dredge vessel, and a delivering pipe unit 17 disposed, on said dredge vessel, between the suction hose 7 and the discharging unit 15, for delivering the sucked mixture from the suction hose to the discharging unit.

10 The rigid dredging head 11 is an elongated structure having a longitudinal axis 11c. Said structure 11 is inert, what means it is not a (underwater) vehicle (such as vehicle 32 disclosed in FR-A-2919015).

 This rigid dredging head 11 has a first free end
15 11a opened downward for sucking from below, when rested on the seabed 30.

 The reel 5 is rotative around a horizontal axis.

 From said reel the suction hose 7 can be unrolled under water to discharge upwardly the materials, and even
20 all the mixture (water + materials to be recovered), when the pump 13 is operative.

 The suction hose 7 is preferably a tube made of flexible elastic material, possibly mechanically reinforced.

25 Since the dredging can be operated especially in open sea and the hose 7 is woundable around the reel 5, the length of said hose is higher than the length of the vessel.

 For towing the dredging head 11 underwater, from a
30 zone of the vessel located forwardly (FW) with respect to the hoisting means 9 (located at a rearward location on the deck 10), the dredge vessel further comprises towing

means 21. Figure 2 shows that the towing means 21/21a will advantageously extend between a front part 10'a of the hull 1a and the dredging head 11.

And the hoisting means 9 and reel 5 will be
5 disposed on said deck so that the flexible suction hose 7, together with the dredging head 11 will be adapted to be moved between:

- a first non operative position, above the deck, on a lateral side 10a thereof, close to a first lateral side
10 100a of the hull, and,
- a second operative position, within the water, by being hoisted laterally and downwardly along said first lateral side 100a of the hull.

First lateral side 100a can be starboard or
15 portside.

With a view to making easier the movement of the assembly flexible suction hose/dredging head, the axis 5a of the reel 5 around which it rotates for rolling said flexible suction hose will preferably be substantially
20 parallel to a roll axis 1a of the vessel.

For the global stability of the vessel disposing axis 5a parallel to said roll axis 1a should be a valuable solution (see figure 1).

As also illustrated figure 2, the towing means
25 preferably comprise a cable 21a having a variable length between the vessel (hull 1a) and the dredging head 11, for an underwater steering of the dredging head while said vessel is sailing.

A role, or drum, 22a is coupled with motor(winch)
30 means 22b for allowing the length of the towing means to be adapted as a function of the water depth, referenced L on figure 2.

If, as advised and illustrated, the assembly 7/11 is hoistable along the lateral side 100a of the hull, drum 22a will preferably be disposed close to said lateral side 10a/100a, frontward. Motor means 22b will
5 preferably be operated from the bridge deck 12 located close to the prow.

A location of the drum 22a on a fore-deck 100 disposed at a higher level than the lower rear deck 10 will be advantageous: Should any problem occur, it would
10 be faster and safer to intervene, all the more since adapting the length of the towing means can be dramatically important.

Fore-deck 100 is located close to the bridge deck 12 and frontward therefrom.

15 As illustrated figure 1, the delivering pipe unit 17 provided on the deck 10 advantageously comprises rigid pipes 17a fixedly attached to the dredge vessel deck, over it, for transferring the sucked mixture from the flexible hose 7 to the discharging unit 15.

20 For improving the speed and efficiency of the dredging operation, figures 3, 4 show that the discharging unit 15 preferably comprises a rigid tube 15a connected at a first end 170a to the delivering pipe unit 17 and, at a second end 151b, to the delivering head 15b.

25 As illustrated, said delivering head 15b extends transversally to the tube 15a and is adapted to be placed outside the dredge vessel.

In said illustrations, the discharging tubes 15a and delivering heads 15b are transverse and said heads
30 extend parallel to the longitudinal axis of both the vessel and the adjacent barge (see figure 1) so that a

corresponding elongated passage is offered for the materials.

As shown figure 1, a series of parallel discharging tubes/heads 15a/15b will be provided along
5 the second lateral side 100b of the hull 1a (see also figure 4).

From the above description and the figures, it can be understood that the flexible hose 7, together with the rigid dredging head 11 and the pump 13 are adapted to be
10 lowered and elevated over one of the vessel sides (starboard or portside), 100a in the illustrations.

To that aim, the hoisting means 9 provided with cables 26 and preferably connected to the dredging head 11 are disposed on lateral side 10a of the deck 10.

15 Cables 26 define hanging ropes adapted to be wound and unwound, and connected to both the rigid dredging head 11 and a hanging rope length controller 110.

Such a hanging rope length controller 110 will preferably comprise winches which the hanging ropes 26
20 will be connected to, together with sensors and/or other length measurement devices, connected to a computer unit.

Through such a hanging rope length controller 110 the hoisting means 9 are adapted for:

- * towing the immersed flexible suction hose 7 and
25 rigid dredging head 11 when the dredge vessel 1 is moving frontward and materials are being sucked,
- * while controlling a tilt A of the rigid dredging head which has its first free end 11a directed backward (BW) and rested on the seabed 30, under
30 water.

The vessel is further provided with a suction hose length controller 120, for controlling the length of the flexible suction hose unrolled from reel 5.

Such a controller is very similar to the hanging
5 rope length controller 110, since both are adapted to control, and if necessary adjust, the length of a structure which can be rolled/unrolled or wound/unwound. As a consequence, means identical to the above-cited ones can be used.

10 Furthermore, the vessel is also provided onboard with a main length controller 130 connected to both the flexible suction hose length controller 120 and the hanging rope length controller 110.

The main length controller 130 is a supervisor
15 controller provided for adjusting, according to one of the other, the unrolled length of the flexible suction hose 7 and the unwound length of (at least one of) the hanging ropes 26, in such a way that the flexible suction hose is curved along length L1, whatever the tilt A of
20 the rigid dredging head (see figures 1, 6, 8), when (precisely while) the dredge vessel is moving forward (FW) and said materials (presently all the mixture) are being sucked through hose 7.

As illustrated, L1 is the hose length, along its
25 axis 11a, between the rigid dredging head (connection 7a) and the sea surface 300, at the location 7b where said hose 7 enters water (see figures 5, 6, 8).

As a consequence L2 (rectilinear length between the rigid dredging head and the sea surface 300) is then
30 less than L1. Similarly, the unwound lengths of cables 26a, 26b are less than L1, when sucking operates.

The curvature can change contingent to the forward speed of the vessel and the resistance of water.

Further, the remaining length rolled around the reel 5 and/or the remaining length wound around at least one of said hanging ropes 26 could be used instead of the respective unrolled and unwound lengths.

This main length controller 130, or supervisor controller, comprises a computer connected to both the above-cited computers of the flexible suction hose length controller 120 and the hanging rope length controller 110.

The reference (zero) can be the respective lengths unwound when the dredging head 11 is on the deck 10 (see figure 1, full line).

A measurement device 140 disposed on board is adapted to measure or calculate the water depth between the sea surface 300 and the seabed 30, or a distance, such as the vertical distance D (figure 8) between the seabed (in front of the dredging head, forward) and the vessel.

A sensor 150 can be used, such as a "sonar".

If used, measurement device 140, possibly including sensor 150, is preferably connected to respective length controllers 110, 120, 130 (at least connection to supervisor length controller 130).

According to the data registered by the measurement device 140, the respective controllers 110, 120, 130 operate individually or commonly to adjust the corresponding length under control.

Such a solution prevents the flexible solution hose 7 and the suction operation to be affected if the seabed level is modified and/or the waves are too high.

It will be understood that the cited unrolled/rolled and unwound/wound lengths will each be measured or calculated with reference to a predetermined reference length.

5 For avoiding the delivering head to be excessively responsive to the swells and waves, on the open sea, the discharging unit 15 is adapted to move, notably rotate, in the figures, relative to said dredge vessel, for having its discharging head:

- 10 - stored above the deck 10, in zone SZ; figure 3,
- and deployed outside the dredge vessel, in a deployed zone (DZ figure 3), when the sucked mixture is to be discharged outboard.

In this embodiment the/each of said axis is
15 parallel to axis 1a. The axis of rotation of the discharging unit 15 are referenced 23a, 23b in figure 3.

Specifically, it is preferred that said discharging unit be adapted to rotate relative to the dredge vessel deck about a first and a second horizontal
20 axis, respectively 23a, 23b, for rotating between said stored and deployed positions, and for an up and down movement of its/each delivering head 15b.

As a consequence, the discharging unit can move up an down around horizontal axis.

25 Such a solution is efficient for limiting the space reserved for said discharging unit, on the deck. Especially, it allows the discharging unit to preferably be stored in an upright position, in the non-operative state (see figures 1, 3 dark continuous lines).

30 Each tube 15a will advantageously comprise at least a first and a second elongated (tube) portions, respectively 153a, 153b, articulated at an intermediate

zone of the tube, around the horizontal axis 23b. Further, the first elongated portion 153a will preferably be articulated at a lower end 155 where it is connected to the deck 10 (horizontal axis 23a, figure 1).

5 As a consequence, it can be understood from the above and figures 1-3 that, in the non-operative state, said first and second elongated portions 153a, 153b are folded substantially vertically, with axis 23b upward and backward, and discharging head 15b downward (and backward
10 too), whereas, in the operative state (dotted lines figures 1, 3) the so-called first and second elongated portions are deployed (unfolded) frontward (more or less horizontally), with horizontal axis 23a backward and discharging head 15b frontward, above the barge 27, which
15 is a motorized barge ; preferentially a tug boat or a self propelled barge.

 With a view to improving the sucking the pumping means 13 comprises a dredge pump 13a disposed near the dredging head 11, so that said dredge pump is immersed
20 when the dredging head is dredging the materials (see figure 2).

 For allowing the vessel to be precisely positioned on the dredging zone, the dredge vessel 1 will preferably be provided with one or more inboard propulsion motor
25 means 25 controlled from the bridge deck 12, for moving the vessel.

 More precisely, said inboard propulsion motor means will advantageously be adapted for positioning the dredge vessel while the materials 3 are dredged from the
30 dredging zone 30 (such as the sea bottom) and the mixture sucked.

Consequently, the dredge vessel will be free of any riverbed attaching means, seabed attaching means, riverbed anchoring means and seabed anchoring means (such as traditional anchors) which are adapted for temporary
5 maintaining a dredge vessel when materials are dredged and mixture sucked.

As a consequence, the vessel will then be a "free sailing" ship.

Figure 4, a floating barge 27 is adapted to be
10 disposed alongside the dredge vessel 1 (see figure 1, too).

As above-mentioned and illustrated figures 1, 4, such a barge 27 will be situated along said second lateral side 100b of the hull, in front of (below) the
15 discharging unit 15 extended to its deployed operative position.

Said floating barge 27 is a floating unit which is adapted to both transport and carry the materials. It has a hull 26, a deck level 28 and a loading compartment 29
20 above which the discharging unit head 15b can be disposed, outside the dredge vessel, for discharging the sucked mixture in said loading compartment.

The loading compartment 29 is open upwardly.

Further, the following system(s) improve(s) the
25 adaptability of the solution of the invention to deliver the mixture outside the dredge vessel 1, above said sediment loading compartment 29.

All the more if vessel 1 is a free sailing ship, it is preferred that unit 27 be a motorised barge. Said
30 barge will be propelled by a tug boat, or a self propelled barge.

Notably for sake of security with transshipment of the sucked mixture from vessel 1 to unit 27 when swells and/or waves are high, such a solution will allow the assembly of said vessel and unit to sail substantially
5 side by side (side 100a of vessel 1). It is possible to not use mooring means for removably attaching together the dredge vessel and the floating barge, when said mixture is to be discharged from the dredge vessel to unit 27.

10 Specifically, a follow-me positioning system could control the respective alongside positions of the dredge vessel and the floating barge, one with respect to the other.

To that aim, speed and course controls of both the
15 extraction ship and the barge could be synchronised, through the respective motor means 25, 272 connected to the rudders 250, 274 of vessel 1 and unit 27, respectively (see figure 1). Under the control of the respective tiller man/men, such means would maintain both
20 vessels 1, 27 within a predetermined distance range (laterally and longitudinally) during the dredging and/or transshipment operations.

Said rudders and a tiller located within the gangway globally defines steering means adapted to allow
25 the vessel 1 to be steered.

Alternatively, an electronic positioning system 33 could be installed on the vessel 1, for dynamically controlling the respective alongside positions of said vessel and the floating barge 27, one with respect to the
30 other, when the above-cited mixture is to be discharged from the vessel to unit 27. The positioning system 33 and motor means 25 would then be connected together.

Preferably unit 27 will also be provided with a coordinated electronic positioning means 34 wireless connected to the positioning system 33 an adapted to control motor 272 and rudder 274.

5 Anyway, mooring means and/or fendering means can be used between vessel 1 and barge 27.

 During transshipment, the discharging unit head 15b will be located in the so-called deployed zone DZ (figure 1) and will advantageously have its horizontal and/or
10 vertical position(s) adapted as a function of the degree of sediment loading of unit 27 together with the respective alongside positions of the vessel 1 and the floating barge 27, one with respect to the other.

 For improving the speed and the efficiency of
15 charging on barge 27 the sucked mixture, it is preferred that the loading compartment 29 opens upwardly on the deck level 28 and be adapted to freely communicate with outside, so that water of the discharged sucked mixture will progressively overflow outboard as said mixture is
20 progressively charged in the loading compartment 29.

 Advantageously, the floating barge 27 will even be free of any cover means adapted for covering loading compartment 29 (see figure 4).

 Furthermore, for speeding the discharging
25 operation of the sucked materials when unit 27 is full of materials and water has escaped from the mixture delivered in said compartment 29, the floating barge 27 could be a split-barge adapted to be loaded from an open top and discharged through the bottom of its hull (see
30 zone 32 figure 4 where movable flaps can be disposed in the bottom of compartment 29, as a part of the hull).

From the above description, it is clear that using a barge 27 having an upwardly opened loading compartment 29, together with the above-cited discharging unit 15, will allow the barge to be charged with the recovered mixture, water included, the upward opening allowing water to overflow from the loading compartment when (while) the recovered materials 3 charged therein are above a quantity which is contingent to the predetermined volume of the loading compartment 29.

It is also clear that the connection between the(each) delivering tube 15a and the flexible suction hose 7 will preferably be adapted for having all the sucked mixture, including sucked water, discharged outside the dredge vessel, into the barge 27, through the delivering head(s) 15b, with neither pit nor hopper nor compartment (such as compartment 29), for storing on the dredging vessel the recovered materials 3 sucked through said hose.

From figures 1, 6, 8, it will further noted that, preferentially:

- the hoisting means 9 will comprise front and rear hoists 9a, 9b provided with respective front and rear hanging ropes 26a, 26b,
- the reel (5) will be disposed on deck 10:
 - * either between the front and rear hoists,
 - * or ahead the front hoist 9a,
- and the flexible suction hose 7 will be connected laterally, from above, to the rigid dredging head 11, 13:
- * either with an angle B relative to the rigid dredging head axis 11a,

* or, coming from ahead, along a direction parallel to said rigid dredging head axis 11c (see fig.5).

Figure 8, the angle B is substantially a right angle, whereas it is a slanted angle on figure 6, for
5 allowing hose 7 coming from above and the rear (BW) to connect the rigid dredging head 11.

Figure 2, in which reel 5 is disposed in front of the front hoist 9a, the flexible suction hose 7, coming from ahead (FW) and above, is connected to said rigid
10 dredging head 11,13 along a direction parallel to the so-called rigid dredging head axis 11a.

In the three illustrated embodiments, both the front and rear hanging ropes 26a, 26b are attached to the rigid dredging head 11, 13, for adjusting said tilt A.

15 Such an issue improves the efficiency of the tilt control A, since it can operate frontward and backward.

Considering now the so-called dredging method which can be operated with all or part of the above described means, it is adapted for recovering the
20 immersed materials 3 from the seabed concession 30 and discharging them into a barge, preferably immediately.

As far as it is still useful to give additional, this method comprises :

- from a first free end of the immersed dredging head 11,
- 25 sucking a mixture of water and materials 3 through said flexible hose 7,
- delivering the materials from the dredge vessel to one of a series of the barges 27,
- the step of sucking comprising:
- 30 - sucking said mixture while:

- * the dredge vessel is sailing frontward over the seabed concession 30,

- * the immersed dredging head 11 and flexible suction hose are towed by the dredge vessel,
 - * the under water tilt A of the immersed dredging head is controlled, so that said dredging head has its first free end 11a directed backward (BW) and rested on the seabed 30, and,
 - * the flexible suction hose has its immersed length adapted so that the flexible suction hose 7 is curved therealong, whatever said tilt A, and,
- 10 - the above step of delivering the materials to the barge comprises delivering said materials while the mixture is sucked through the towed suction hose.

Further, as above indicated:

- the curvature of this hose 7 will preferably vary contingent to the unwound (or wound) length of the hanging ropes 26, 26a, 26b, and,
- the above step of delivering will comprises, while the mixture materials + water is sucked through the flexible suction hose, immediately delivering the sucked mixture to said one of the series of barges that is sailing alongside, with no storage of accumulated materials 3 on vessel 1.

With a view to one more time preventing the flexible suction hose from being spoiled by excessive strengths, it is contemplated that the step of adapting the immersed length of the flexible suction hose comprises adjusting such a length, so that, while the rigid dredging head is resting on the seabed 30 and the mixture is being sucked, the flexible suction hose 7 is longitudinally loosened, viz. substantially untensioned, longitudinally (tension exerted by the waves, water and sailing speed excluded).

In the same way, it is recommended that:

* from the free sailing extraction ship 1, the so-called mixture of water and materials 3/3a be sucked by the pump unit 13 - preferably the submerged pump unit 13a
5 - through the suction flexible hose 7, while the ship 1 is sailing over the concession,

* and said sucked mixture be immediately delivered from the extraction ship to one of a series of free sailing barges 27... that are sailing alongside.

10 Preferably:

* during the present operations, said plurality of empty barges of the series will sail in the vicinity of the extraction ship 1 (see figure 4),

* and, when said one free sailing barge, such as
15 27, that sails alongside the extraction ship is full of sucked materials, one empty barge, such as 27a, will be substituted for the full one, as soon as possible.

As a consequence, it is recommended that the above-cited step of sucking the mixture of water and
20 sediment 3/3a, together with the step of delivering the sucked mixture - through the discharging/delivering unit 15/15b - be conducted simultaneously.

Should vessel 1 be a non self propelled vessel, it would be pushed or pulled by a push or pull tug (non-
25 preferred embodiment).

Even if the dredging vessel is especially adapted to dredge in open sea, it could also be used in any water, including rivers, lakes...

CLAIMS

1. A floating dredge vessel (1) dedicated to recover materials (3) from seabed (30) and discharge said recovered materials (3) outboard, into a barge, the dredge vessel (1) having:
- a structure (100) comprising a hull (1a) and a deck (10),
 - steering means and a motor for steering and moving forward the dredge vessel,
 - a reel (5) on said deck,
 - an elongated flexible suction hose (7) adapted to be rolled onto said reel (5) and unrolled down to water,
 - an inert rigid dredging head (11) connected to a first end (7a) of the flexible suction hose (7) and having a first free end (11a) opened downward for sucking from below, when rested on the seabed,
 - a pump (13) connected to the flexible suction hose (7) for sucking therethrough a mixture of said materials (3) and water (3a),
 - hoisting means (9) disposed on said deck and provided with hanging ropes (26), adapted to be wound and unwound, and connected to both the rigid dredging head (11) and a hanging rope length controller (110), for:
 - * moving the flexible suction hose (7) and rigid dredging head (11) between an inactive position located onboard and an active position located outboard,
 - * immersing and elevating the flexible suction hose (7) and rigid dredging head (11),
 - at least one delivering tube (15a) which is:

- * connected through a first end (150b) to the flexible suction hose (7), and
 - * extended at a second end (151b) by a delivering head (15b) for discharging therethrough the recovered materials (3), outboard, into said barge,
- 5 said delivering tube (15a) and delivering head (15b) being adapted to move relative to said deck (10), for being :
- * stored above the deck (10), in a stored zone,
- 10 * and deployed outside the dredge vessel (1), in a deployed zone, when said recovered materials (3) have to be discharged outboard,
- characterized in that :
- the hoisting means (9) are adapted for:
- 15 * towing the immersed flexible suction hose (7) and rigid dredging head (11) when the dredge vessel (1) is moving frontward and materials are being sucked,
- * while controlling a tilt of the rigid dredging head which has its first free end directed backward and
- 20 rested on the seabed, under water,
- a suction hose length controller (120) is provided for controlling the length of the flexible suction hose unrolled from said reel (5),
 - a main length controller (130) connected to both the
- 25 flexible suction hose length controller (120) and the hanging rope length controller (110) is provided for adjusting according to one or the other the unrolled length of the flexible suction hose and an unwound length of the hanging ropes, in such a way that the flexible suction
- 30 hose, which has a determined length between the rigid dredging head (11, 13) and the sea surface, when the dredge vessel (1) is moving forward and said materials

(3) are being sucked, is curved along said determined length, whatever the tilt of the rigid dredging head.

2. The floating dredge vessel (1) of claim 1,
5 characterized in that:

- the rigid dredging head (11, 13) has an axis along which it is elongated,
- the hoisting means (9) comprise front and rear hoists (9a, 9b) provided with respective front and rear hanging
10 ropes (26a, 26b),
- the reel (5) is disposed on said deck:
 - * either between said front and rear hoists,
 - * or ahead the front hoist,
- and the flexible suction hose (7) is connected
15 laterally, from above, to the rigid dredging head (11, 13) :
 - * either with an angle relative to said rigid dredging head axis (11a),
 - * or, coming from ahead, along a direction parallel to
20 said rigid dredging head axis (11a).

3. The floating dredge vessel (1) of claim 2,
characterized in that both said front and rear hanging
ropes (26a,26b) are attached to the rigid dredging head
25 (11, 13), for adjusting said tilt.

4. The floating dredge vessel (1) of anyone of the
preceding claims, characterized in that:
- the reel (5) and hoisting means (9) are disposed on
30 said deck for moving, immersing and elevating the
flexible suction hose (7) and inert dredging head (11),
along a first side of the hull, and

- the delivering head (15b) is disposed on said deck for discharging therethrough said dredged materials (3), outboard, into said barge along an opposite second side of the hull.

5

5. The floating dredge vessel (1) of anyone of the preceding claims, characterized in that it further comprises a towing cable (21) attached at a first end to an upper front part of the rigid dredging head, when
10 tilted upwardly, and, at a second end, to said structure (100) near a front end of the vessel, ahead the hoisting means (9) and the reel (5).

6. The floating dredge vessel (1) of anyone of the
15 preceding claims, characterized in that the connection between the delivering tube (15a) and the flexible suction hose (7) is adapted for having all the sucked mixture, including sucked water, discharged outside the dredge vessel (1), into said barge, through said
20 delivering head (15b), with neither pit nor hopper for storing recovered materials on the dredging vessel.

7. A dredging method (1) for recovering immersed materials (3) from a seabed concession (30) and
25 discharging them, the method comprising:
- from a first free end of an immersed dredging head (11) which is connected to a sailing dredge vessel (1) through a flexible hose (7) adapted to be rolled and unrolled on a rotative reel (5) disposed on said dredge vessel (1),
30 sucking a mixture of water and materials (3) through said flexible hose (7),

- delivering the materials (3) from the dredge vessel (1) to one of a series of barges (27),

characterized in that:

- the step of sucking comprises sucking said mixture
5 while:

* the dredge vessel (1) is sailing frontward over the seabed concession (30),

* the immersed dredging head (11) and flexible suction hose (7) are towed by said dredge vessel (1),

10 * an under water tilt of the immersed dredging head (11) is controlled, so that said dredging head has its first free end directed backward and rested on the seabed, and,

* the flexible suction hose (7), which has a variable
15 immersed length, has said immersed length adapted so that the flexible suction hose is curved therealong, whatever the tilt of the dredging head,

- the step of delivering comprises delivering said materials, while said mixture is sucked.

20

8. The method of claim 7, wherein the step of delivering comprises, while said mixture is sucked through the flexible suction hose, immediately delivering the sucked mixture to said one of the series of barges
25 (27) that is sailing alongside, with no storage of accumulated materials (3) on said dredge vessel.

9. The method of claim 7 or 8 comprising having said curvature of the towed flexible suction hose (7)
30 varied contingent to said unwound length of the hanging ropes.

10. The method of anyone of claims 7 to 9, wherein the step of adapting the immersed length of the flexible suction hose (7) comprises adjusting such a length, so that, while the rigid dredging head is resting on the seabed and sucking operates, the flexible suction hose (7) is longitudinally loosened.

11. An assembly comprising the floating dredge vessel (1) of anyone of Claims 1 to 6 and a barge floating alongside said dredge vessel, said barge comprising a loading compartment (29) having a predetermined volume, said loading compartment being opened upwardly and charged with said mixture, water included, the upward opening allowing water to overflow from the loading compartment (29) when said recovered materials (3) charged therein are above a quantity which is contingent to said predetermined volume.