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## (54) STABILISING WATER-BORNE CRAFT

(71) WE, TRONOH MINES LIMITED, a British company, of 7, Rolls Buildings, Fetter Lane, London EC4A 1HX, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

According to one aspect of the invention there is provided a dredge comprising a hull, means supported by the hull for raising material from the bottom, a plurality of substantially vertical arms each mounted for movement along a substantially vertical path with respect to the hull, means for raising the arms, means for locking each of the arms at any chosen one of a number of end and intermediate positions in its said path and stabilisers outside the hull and mounted on the lower ends of said arms, each of which stabilisers has in a plurality of said positions its top at least a metre below the surface of the water and has at least one major surface which is substantially flat and horizontal.

Preferably, the stabilisers mentioned above are four in number and distributed around the outside of the hull so that in plan view they are seen to be at the corners of a quadrilateral having two parallel sides. There could be further stabilisers additional to these four. Alternatively, there may be only three of the stabilisers in all.

Each stabiliser preferably includes at least one container which contains compressed gas. Each stabiliser advantageously includes at least one container having means for admitting water to it when desired and compressed gas when desired, which gas displaces the water. In a preferred construction each stabiliser includes four containers arranged at the corners of a rectangle, as seen in plan view, and containing compressed gas and a container at the centre of the rectangle having means for admitting water to it when desired and compressed gas when desired, which gas displaces the water.

Each stabiliser is preferably mounted on at least three of said substantially vertical arms.

The top of each stabiliser is preferably at least a metre lower than the bottom of the hull in each of said plurality of positions.

According to another aspect of the invention, there is provided an elongate water-borne craft having a longitudinal centre-line and having outside it and secured to it stabilisers each having at least one major surface which is substantially flat, the stabilisers being pivotally mounted on arms which are pivotally mounted on the craft, all the pivot axes being substantially parallel to said longitudinal centre line so that the stabilisers can be raised and lowered with respect to the craft by swinging them about the axes of the pivotal connections of the arms to the craft from lowered positions in which, when the craft is floating on the water, their tops are at least a metre below the surface of the water to raised positions in which they are higher, there being struts for connecting the stabilisers to the arms for holding the stabilisers rigid with respect to the arms, with each said major surface substantially horizontal, when the stabilisers are in their lowered positions. The craft may be a dredge.

Again, when the stabilisers are in the lowered positions they are preferably distributed around the outside of the craft so that in plan view they are seen to be at the corners of a quadrilateral having two parallel sides. Each stabiliser preferably includes at least one container which contains compressed gas. Advantageously, each stabiliser includes at least one container having means for admitting water to it when desired and compressed gas when desired, which gas displaces the water. In a preferred construction, each stabiliser includes four containers arranged at the corners of a rectangle, as seen in plan view, and containing compressed gas and a container at the centre of the rectangle having means for admitting water

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to it when desired and compressed gas when desired, which gas displaces the water.

Preferably, each stabiliser can be fixed at any chosen one of a number of lowered positions at different depths in the water. Advantageously, each stabiliser, in each said lowered position, has its top at least a metre lower than the bottom of the craft.

It is desirable for the stabilisers to be in lowered positions when the craft is to remain stationary and in raised positions when the craft is to be moved, since raising them enables the craft to be moved more easily. When the stabilisers are lowered they are preferably at a depth which is related to the prevailing conditions in the water, the idea being to have each stabiliser below the region in the water at which there is substantial wave motion so that the stabilisers reduce the up and down movement of the craft when the craft is anchored.

The craft may, for example, be a sea dredge.

Examples in accordance with the invention are described below and illustrated in the accompanying diagrammatic drawings, in which:—

Figure 1 shows a side view of a sea dredge,

Figure 2 shows a plan view of the dredge,

Figure 3 shows an end view of the dredge,

Figure 4 shows a plan view of a stabiliser forming part of the dredge,

Figure 5 shows an end view of a modification of the dredge of Figures 1 to 4, and

Figure 6 shows a plan view of part of what is shown in Figure 5.

Figures 1 to 4 show a sea dredge which is substantially rectangular as seen in plan and has a flat bottom 1, a ladder 2, shown at the maximum digging position, and stone chutes 3, tailing chutes 4 and an overburden chute 5 for discharging unwanted material back into the sea, the level of which is shown at 6. An arrangement for raising and lowering the ladder 2 is referenced 2A.

Near each corner of the dredge there are two guides, each comprising two parts 7 and 8 fixed to the side of the dredge and one part 9 pivotally connected to the part 8. Each guide can receive an arm 10 of L-shaped cross-section when the arm is vertical, as shown in Figure 3 in full lines, and when it does so the parts 7 to 9 of the guide and the side of the dredge together surround the arm and can clamp it when this is desired. There are eight arms 10 in all and they can occupy not only positions in which they are vertical but also positions in which they are inclined, as shown in dotted lines in Figure 3, and then the parts 9 of the guides are swung away from the parts 7. Each arm 10 has an upper end portion 11 which is inclined and the uppermost extremity of it engages in an elongate, vertical guide 12 which is fixed in the side of the

dredge and is formed with two vertical rows of holes 13 to receive a pivot pin which pivotally connects the upper end portion 11 of the arm 10 to the guide 12 so that the arm can be swung from one to the other of its positions shown in the left-hand side of Figure 3. The pivot axes are not shown but would be represented by horizontal lines in Figure 2 if they were shown in that Figure, i.e. they are parallel to the longitudinal centre-line (not shown) of the craft.

To the lower end of each arm 10 is pivotally connected, a flange 14 fixed to a stabiliser 15. There are four stabilisers 15 in all, each pivotally connected in this way to the lower ends of two arms 10, which arms are inter-connected by braces 10A. The axes of these pivotal connections are also parallel to the longitudinal centre-line of the craft. Struts 16 connect the arms 10 to the stabilisers 15 to prevent the latter turning relatively to the arms when the arms are vertical but when the arms are to be brought to their inclined positions fastenings at the tops of the struts are released by operation of remote control means and this enables the parts 15 and 16 to occupy the positions shown in dotted lines in Figure 3.

Each stabiliser is in the form of a framework supporting five tanks, described below, and covered at the top with sheet metal 15A so that the stabiliser has a substantially flat upper major surface which is substantially horizontal when the arms 10 carrying the stabiliser are vertical.

Instead of or in addition to the sheet metal 15A at the top, the framework of each stabiliser could have sheet metal covering it at the bottom, so that the stabiliser has a substantially flat lower major surface which is substantially horizontal when the arms 10 are vertical. The holes in the guides 12 which are selected to receive the pivot pins which pivotally connect the guides 12 to the arms 10 determine the vertical distance from the upper surface of the stabiliser to the surface of the water. The drawings show different values of this distance for different ones of the stabilisers but generally this distance will be the same for all four stabilisers, in the illustrated example 6 metres, 12 metres or something between the two according to which holes in the guides 12 are used. The value of this distance is chosen to give the best effect in the prevailing conditions but it will usually be enough to ensure that the stabilisers are in water which is subjected to little, if any, wave motion.

Each stabiliser comprises four buoyancy tanks 17 arranged at the corners of a rectangle, as seen in plan view, each being filled with compressed air or another gas or foamed material, for example polystyrene, and a ballast tank 18 containing water positioned

at the centre of the rectangle. The stabilisers are all similar, each being symmetrical about a line passing centrally between and parallel to its major sides, and when the dredge is viewed in plan the centres of the stabilisers are seen to be at the corners of a rectangle, although they could instead be at the corners of a trapezium, and the stabilisers project beyond the ends of the dredge. When it is desired to carry out a dredging operation in conditions where stabilising the dredge against heaving is required, the arms 10 are brought to their vertical positions, with the stabilisers at the appropriate depths, and when the dredge is to be moved the arms 10 are raised by winches 19 so that the stabilisers float on the water and the arms 10 are inclined. When the arms 10 are vertical and are to be raised or lowered whilst still vertical, to alter the depths of the stabilisers, this is done by slackening the guides 7, 8, 9, but not swinging the parts 9 away from the parts 7, and supplying compressed air to the ballast tank or allowing air to escape from and water to enter the ballast tank, as the case may be, and then tightening the guides 7, 8, 9. The winches may also be used in raising or lowering the arms 10.

The dredge shown in Figures 1 to 4 is 344 feet long and 104 feet wide and the stabilisers are 100 feet long and 60 feet wide, the distance between the two stabilisers on one side of the dredge being 202 feet and the distance between the two stabilisers on one end of the dredge being 48 feet.

In the example shown in Figures 5 and 6, which is the same as that shown in Figures 1 to 4 except for the modifications discussed below, each stabiliser 15 is constructed as described above but is connected by remotely operable quick-release connections to the lower ends of four vertical arms 10 which slide in vertical tubes 20 fixed to the dredge. The arms can be raised by winches 19 and locked by pins 21 so that each stabiliser can be fixed in any chosen one of a number of positions, i.e. two end positions and a number of intermediate positions, in a plurality of which positions the top of the stabiliser is at least a metre lower than the bottom of the hull.

It is also possible to have only three stabilisers, two positioned as shown at the left-hand sides of Figures 1 and 2 and one either extending underneath the other end of the craft and projecting beyond it at both sides or positioned beyond (to the right of, considering Figures 1 and 2) the other end of the craft and, if desired, projecting beyond it on both sides, the stabilisers in each case being symmetrical about the longitudinal centre-line of the craft.

The invention may be applied to sea going bucket dredgers, suction dredgers or cutter suction dredgers.

#### WHAT WE CLAIM IS:—

1. A dredge comprising a hull, means supported by the hull for raising material from the bottom, a plurality of substantially vertical arms each mounted for movement along a substantially vertical path with respect to the hull, means for raising the arms, means for locking each of the arms at any chosen one of a number of end and intermediate positions in its said path and stabilisers outside the hull and mounted on the lower ends of said arms, each of which stabilisers has in a plurality of said positions its top at least a metre below the surface of the water and has at least one major surface which is substantially flat and horizontal.
2. A dredge according to claim 1 in which the stabilisers are distributed around the outside of the hull so that in plan view they are seen to be at the corners of a quadrilateral having two parallel sides.
3. A dredge according to claim 1 or 2 in which each stabiliser includes at least one container which contains compressed gas.
4. A dredge according to any preceding claim in which each stabiliser includes at least one container having means for admitting water to it when desired and compressed gas when desired, which gas displaces the water.
5. A dredge according to claims 3 and 4 in which each stabiliser includes four containers arranged at the corners of a rectangle, as seen in plan view, and containing compressed gas and a container at the centre of the rectangle having means for admitting water to it when desired and compressed gas when desired, which gas displaces the water.
6. A dredge according to any preceding claim in which each stabiliser is mounted on at least three of said substantially vertical arms.
7. A dredge according to any preceding claim in which each stabiliser, in each of said plurality of positions, has its top at least a metre lower than the bottom of the hull.
8. An elongate water-borne craft having a longitudinal centre-line and having outside it and secured to it stabilisers each having at least one major surface which is substantially flat, the stabilisers being pivotally mounted on arms which are pivotally mounted on the craft, all the pivot axes being substantially parallel to said longitudinal centre line so that the stabilisers can be raised and lowered with respect to the craft by swinging them about the axes of the pivotal connections of the arms to the craft from lowered positions in which, when the craft is floating on the water, their tops are at least a metre below the surface of the water to raised positions in which they are higher, there being struts for connecting the stabilisers to the arms for holding the stabi-

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at the centre of the rectangle. The stabilisers are all similar, each being symmetrical about a line passing centrally between and parallel to its major sides, and when the dredge is viewed in plan the centres of the stabilisers are seen to be at the corners of a rectangle, although they could instead be at the corners of a trapezium, and the stabilisers project beyond the ends of the dredge. When it is desired to carry out a dredging operation in conditions where stabilising the dredge against heaving is required, the arms 10 are brought to their vertical positions, with the stabilisers at the appropriate depths, and when the dredge is to be moved the arms 10 are raised by winches 19 so that the stabilisers float on the water and the arms 10 are inclined. When the arms 10 are vertical and are to be raised or lowered whilst still vertical, to alter the depths of the stabilisers, this is done by slackening the guides 7, 8, 9, but not swinging the parts 9 away from the parts 7, and supplying compressed air to the ballast tank or allowing air to escape from and water to enter the ballast tank, as the case may be, and then tightening the guides 7, 8, 9. The winches may also be used in raising or lowering the arms 10.

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It is also possible to have only three stabilisers, two positioned as shown at the left-hand sides of Figures 1 and 2 and one either extending underneath the other end of the craft and projecting beyond it at both sides or positioned beyond (to the right of, considering Figures 1 and 2) the other end of the craft and, if desired, projecting beyond it on both sides, the stabilisers in each case being symmetrical about the longitudinal centre-line of the craft.

The invention may be applied to sea going bucket dredgers, suction dredgers or cutter suction dredgers.

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2. A dredge according to claim 1 in which the stabilisers are distributed around the outside of the hull so that in plan view they are seen to be at the corners of a quadrilateral having two parallel sides.

3. A dredge according to claim 1 or 2 in which each stabiliser includes at least one container which contains compressed gas.

4. A dredge according to any preceding claim in which each stabiliser includes at least one container having means for admitting water to it when desired and compressed gas when desired, which gas displaces the water.

5. A dredge according to claims 3 and 4 in which each stabiliser includes four containers arranged at the corners of a rectangle, as seen in plan view, and containing compressed gas and a container at the centre of the rectangle having means for admitting water to it when desired and compressed gas when desired, which gas displaces the water.

6. A dredge according to any preceding claim in which each stabiliser is mounted on at least three of said substantially vertical arms.

7. A dredge according to any preceding claim in which each stabiliser, in each of said plurality of positions, has its top at least a metre lower than the bottom of the hull.

8. An elongate water-borne craft having a longitudinal centre-line and having outside it and secured to it stabilisers each having at least one major surface which is substantially flat, the stabilisers being pivotally mounted on arms which are pivotally mounted on the craft, all the pivot axes being substantially parallel to said longitudinal centre line so that the stabilisers can be raised and lowered with respect to the craft by swinging them about the axes of the pivotal connections of the arms to the craft from lowered positions in which, when the craft is floating on the water, their tops are at least a metre below the surface of the water to raised positions in which they are higher, there being struts for connecting the stabilisers to the arms for holding the stabi-





lisers rigid with respect to the arms, with each said major surface substantially horizontal, when the stabilisers are in their lowered positions.

- 5 9. A craft according to claim 8 in which when the stabilisers are in the lowered positions they are distributed around the outside of the craft so that in plan view they are seen to be at the corners of a quadrilateral having two parallel sides.

- 10 10. A craft according to claim 8 or 9 in which each stabiliser includes at least one container which contains compressed gas.

- 15 11. A craft according to any one of claims 8 to 10 in which each stabiliser includes at least one container having means for admitting water to it when desired and compressed gas when desired, which gas displaces the water.

- 20 12. A craft according to claims 10 and 11 in which each stabiliser includes four containers arranged at the corners of a rectangle, as seen in plan view, and containing compressed gas and a container at the centre
- 25 of the rectangle having means for admitting water to it when desired and compressed gas

when desired, which gas displaces the water.

13. A craft according to any one of claims 8 to 12 in which each stabiliser can be fixed at any chosen one of a number of lowered positions at different depths in the water.

14. A craft according to any one of claims 8 to 13 in which each stabiliser, in each said lowered position, has its top at least a metre lower than the bottom of the craft.

15. A craft substantially as described above with reference to Figures 1 to 4 of the accompanying drawings, or such a craft modified substantially according to Figures 5 and 6.

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