

SPECIFICATION

An assembly for treating vessel hulls

5 The present invention relates to an assembly for treating, primarily cleaning, underwater surfaces of fixed or floating constructions, for example ships' hulls, the assembly having a frame which supports at least one motor-driven, rotatable treatment device
10 which may be moved into abutment against the construction surfaces.

Such assemblies are normally used for the removal of marine growth, for example seaweed, shells, etc. on ships' hulls, oil drilling platforms etc,
15 the assemblies being normally either remote-controlled or diver-operated.

In remote-controlled assemblies, one great problem is that the operator has poor supervision over the work being carried out. For supervising the work being carried out, it is necessary to send down a diver for visual checking of the work and, in such an instance, often touch up the work on those surfaces which have been missed or which have been insufficiently cleaned. Consequently, the entire
20 treatment will be both time-consuming and expensive.

In the majority of attempts to solve this problem, the normal practice has, therefore, been to send down one or more divers during the entire operation
30 for continuously following and, to a certain extent, guiding the assembly during its work. This entails, in turn, that the divers, being few in number, must be down for long periods of time. If there are several divers, these may take it in turns at the working site,
35 but such a large number of divers renders the operation rather expensive.

As an alternative to having the divers simply follow and supervise the assembly, the assemblies may be of such dimensions that the divers may
40 operate them directly, one example of such a diver-operated assembly being shown and described in British Patent No. 1560318. These diver-operated assemblies possess, because of their ease of movement and simplicity of operation,
45 obvious advantages as regards cleaning relatively small surfaces which may also often be of complex form and contour. However, with such diver-operated assemblies, it takes rather a long time to clean such great surfaces as may be involved
50 in modern tankers with a dead weight of several hundred thousand tons.

The object of the present invention is to realise an assembly which is effective for cleaning relatively large surface areas and which, for its operation, does
55 not require diver supervision but operates more or less fully automatically.

According to the invention, there is provided an assembly for treating, primarily cleaning fixed or floating objects below a water line, for example a
60 ship's hull, the assembly comprising a frame; at least two motor-driven rotatable treatment devices, which are arranged for abutment against the object to be treated, the devices being supported in the frame; an elongate member which is connected at
65 one end to the frame and, at its other end, is pivotally

connected to a joint; and a movable unit supporting the frame and the member by the joint, the movable unit having at least two suction cups which are movable into releasably retentive engagement with
70 the object and are alternately movable in a direction of movement, the treatment devices treating mutually subsequent portions of the object as a result of the pivoting of the member and the movement of the movable unit, and the treatment
75 devices inclining somewhat towards the object such that the devices realise a force for their own reciprocal driving along mutually subsequent portions of the object, the direction of rotation of the devices being reversible and/or the angle of
80 inclination being adjustable for reciprocal driving of the frame.

To help understanding of the invention, a specific embodiment thereof will now be described with reference to the accompanying drawings:-

85 *Figure 1* schematically illustrates, in side view, an assembly according to the invention and its use in a ship's hull;

Figure 2 shows in side view, a preferred treatment device for use in the assembly of *Figure 1*, seen from that side thereof which is turned to face the surface which is to be cleaned; and

Figure 3 is a section taken along the line VII-VII *Figure 2*.

The assembly shown in *Figure 1* and generally designated 1 is primarily intended for the cleaning of
95 ship's hulls 2 below the water line and is, more precisely, particularly intended for the removal of such marine growth as seaweed, shells, etc. on such hulls. A portion of the vertical side of the hull 2 is
100 shown on the drawing, but the assembly 1 may, without modification (or with but minor modifications) be used for cleaning the underside of the hull.

The assembly 1 has a frame 3 in which two circular
105 brushes 4 having preferably mutually overlapping paths of movement are mounted, the brushes 4 each being driven by its hydraulically, electrically or pneumatically driven motor 5. The motors 5 are connected by the intermediary of suitable hoses 6 to a power source 8 disposed above the water line. The brushes 4 may, in a conventional manner, be provided with a hard brushing attachment which is movable into abutment with the hull 2 for cleaning thereof. Alternatively, one or both brushes 4 of the assembly
110 1 may be designed in the manner illustrated in *Figures 2 and 3* as described below.

In the embodiment according to *Figure 1*, the frame 3 is connected to one end of an elongate member in the form of an arm 9 which may be of
120 variable length in that it is, for example, telescopic, the arm 9 being typically variable in length from about 5m to about 20m. At its other end, the arm 9 is pivotally connected to a joint 10 which, is connected to a movable unit including two suction cups 22
125 which are located in spaced apart relationship and are interconnected by means of a rod 23. To advance the assembly, the suction cups 22 are manoeuvred by means of suitable valves and motors (not shown) in such a manner that they are alternately moved
130 in the direction of movement 17 to a new position

advanced by a distance corresponding to the total working width of the brushes. This new position is shown by means of broken lines in Figure 1.

The arm 9 extends substantially horizontally in a forward direction from the joint 10 seen in the direction of movement 17 and is, together with the frame 3 and the brushes 4 supported thereby, pivotable upwardly and downwardly in the direction of the double arrow 18. The brushes 4, after an operative cycle from above on a level with the water line 7, downwardly to a level with the bilge 19 of the vessel, and upwardly again to the position indicated by dash-dot lines, are advanced. In this manner, the brushes 4 will treat mutually subsequent arcuate portions of the surface of the hull 2, the demarcation line between treated and untreated hull being shown by means of an arc line 20. The surface area to the left of the arc line 20 is, thus, treated, whereas the surface area to the right of this line is still untreated.

Alternatively, the brushes 4 may, during their downward and upward movement, be slowly moved continuously in a forward direction following the arrows 17. Since the right-hand brush 4 protrudes somewhat above the water line 7, it is possible to maintain a continuous supervision of the work of the assembly 1 from a position above the water line 7, in other words, it is possible continuously to check that the brushes have not missed treating a portion of the hull 2 or do not treat the same area several times.

In order to realise the upward and downward movement of the brushes 4 between the extreme positions, the brushes 4 incline somewhat towards the hull. In the extreme positions, the direction of rotation of the brushes is reversed such that they, by their abutment against the hull 2, will drive the frame 3 and, therewith, the arm 9 upwardly and downwardly. As a complement or alternative hereto, the angle of inclination of the brushes 4 against the plane of the hull 2 may be adjusted such that they abut tighter against the hull with different portions of their periphery and, in such a manner, create an upwardly or downwardly directed driving force.

A conceivable line of connection between the centres of rotation of the two brushes 4 suitably makes an angle of the order of magnitude of 30° with respect to the arm 9. The reason for this is that the brushes 4, in the lower extreme position, shall operate effectively right down to the bilge 19 and not leave any untreated surface areas. As a result of this angle, the advantage will also be obtained that the right-hand brush 4 in Figure 1 will, in the upper extreme position, protrude somewhat above the water line 7, this property facilitating, as was mentioned above, observation of the treated surface area from a place above the water line.

In order to determine the upper and lower extreme positions of assembly 1, there is suitably provided on the frame 3 a pressure sensor (not shown) which, by sensing maximum pressure (lower extreme position) and minimum pressure (upper extreme position) reverses the direction of rotation of the brushes 4 and/or their angular positions with respect to the plane of the hull 2. However, the upper and lower extreme positions may be determined in many other ways, for example by means of limit switches

which strike fixed fittings on the hull 2.

For purposes of sensing treated/cleaned portions of the hull 2, a transducer (not shown) may be provided in each corner of the frame 3, in which instance these transducers may, in one embodiment, consist of transformers whose core is supplemented by the plating of the hull 2. The secondary voltage through the transformers varies with the distance to the plating, which voltage may be measured. Alternatively, an oscillation circuit may be provided for the above-disclosed sensing operation, in which the phase shifting or frequency between two oscillations varies in dependence upon the distance to the hull plating.

In the above described embodiment, the assembly 1 has two brushes 4, but, naturally, there is nothing to prevent the number of brushes from being increased according to desire and need.

As was mentioned earlier, the brushes 4 are suitably of the construction which is shown and described in British Patent No. 1560318, but if the growth on the hull of the vessel is so extensive or hard, for example shell, that these brushes are not capable of cleaning the hull effectively, one or both brushes 4 of the assembly 1 may have the construction which is shown in Figures 2 and 3. The brush (or perhaps more precisely scraper 4) shown in these Figures is formed of a holder 25 which is non-rotatably mounted on the drive shaft of the motor 5. The holder 25 mounts four radially outwardly directed scaper vanes 26 which are manufactured of resiliently yieldable material, suitably spring steel. The scraper vanes 26 are, at their inner end, each releasably mounted on a bracket 27 fixedly disposed on the holder 25, and each abut, intermediate of their ends, against a support 28 projecting from the holder 25. In this manner, the scraper vanes 26 yield resiliently, with the support 28 as a fulcrum when they are compressed against the vessel hull 2. At the bottom to the right in Figure 3, dash-dot lines show the course of a scraper vane in the unbiased state, that is to say when it is not compressed against the hull, a state which, on the other hand, is shown by means of solid lines in the same Figure. The scraper of Figures 2 and 3 has been illustrated with four scraper vanes 25, but there is, naturally, nothing to prevent a number of vanes from being varied upwardly or downwardly.

Naturally, the invention should not be considered as restricted to the embodiments described above and shown on the drawings, many modifications of the invention being possible. For example, not only the number of brushes 4 but also their construction may be optionally varied and they may be, for example, cylindrical instead of circular.

CLAIMS

1. An assembly for treating, primarily cleaning fixed or floating objects below a water line, for example a ship's hull, the assembly comprising a frame; at least two motor-driven rotatable treatment devices which are arranged for abutment against the object to be treated, the devices being supported in



advanced by a distance corresponding to the total working width of the brushes. This new position is shown by means of broken lines in Figure 1.

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the frame; an elongate member which is connected at one end to the frame and, at its other end, is pivotally connected to a joint; and a movable unit supporting the frame and the member by the joint,
5 the movable unit having at least two suction cups which are movable into releaseably retentive engagement with the object and are alternately movable in a direction of movement, the treatment devices treating mutually subsequent portions of the
10 object as a result of the pivoting of the member and the movement of the movable unit and the treatment devices inclining somewhat towards the object such that the devices realise a force for their own reciprocal driving along mutually subsequent
15 portions of the object, the direction of rotation of the devices being reversible and/or the angle of inclination being adjustable for reciprocal driving of the frame.

2. An assembly as claimed in claim 1 wherein at
20 least one of the treatment devices is formed by a holder which is non-rotatably mounted on the drive shaft of a motor and supports a plurality of radially outwardly directed scraper vanes which are compressible against those parts of the object which
25 are to be treated.

3. An assembly as claimed in claim 2 wherein the scraper vanes are made of resiliently yieldable material and are, at their inner end, each mounted on a bracket mounted on the holder and abut
30 between their ends each against a support projecting from the holder, the vanes on being compressed against those parts of the object which are to be treated, resiliently yielding with the support as a fulcrum.

35 4. An assembly for treating, primarily cleaning, fixed or floating objects substantially as hereinbefore described with reference to the accompanying drawings.