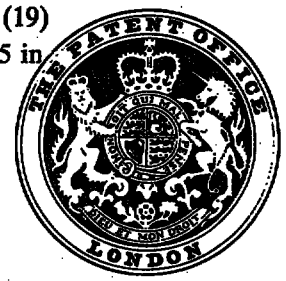


PATENT SPECIFICATION

(11) 1 546 489

1 546 489

- (21) Application No. 18379/76 (22) Filed 5 May 1976 (19)
- (31) Convention Application No. 50/053228 (32) Filed 6 May 1975 in
- (33) Japan (JP)
- (44) Complete Specification Published 23 May 1979
- (51) INT. CL.² B63B 57/00
- (52) Index at Acceptance B7A MH



(54) APPARATUS FOR CLEANING UNDERWATER SURFACES

(71) I, KIICHI HIRATA, a citizen of Japan, of 3-50, Hemi, Yokosuka-shi, Kanagawa-ken, Japan, do hereby declare the invention, for which I pray that a patent may be granted to me, and the method by which it is to be performed, to be particularly described in and by the following statement:-

The invention relates to apparatus for cleaning underwater surfaces, for use for example in cleaning materials attached to vessels and building structures below water level, such as marine life, e.g. seaweed or shell and contaminants, e.g. oil.

According to the invention there is provided an apparatus for cleaning an underwater surface, the apparatus including a passage extending from an inlet end to a discharge end, the passage being defined by a cylindrical outer shell and a housing for an impeller motor mounted centrally with respect to the outer shell, the housing being connected to the outer shell by guide vanes inclined relative to the axis of the shell, an impeller in the passage for moving water from the inlet end to the discharge end and a means at the inlet end for removing contaminant material from the underwater surface, the arrangement being such that, when the inlet end faces the underwater surface, operation of the impeller urges the apparatus towards the surface and conveys removed contaminant material to the discharge end.

Conveniently the means for removing contaminant material is a rotatable brush. Brush material may be mounted peripherally on a disc. Preferably means are provided at the discharge end for collecting removed contaminant material. The collecting means may be a net bag, fastened in a detachable manner to the discharge. Preferably a shaft is provided centrally in the passage which shaft extends toward the inlet end, and the impeller and the means for

removing contaminant material are mounted on the shaft for conjoint rotation therewith. Thus the means for removing contaminant material and the impeller may be located closely adjacent to one another and be driven through a single motor. Conveniently the impeller motor is a hydraulic motor disposed in the housing.

Advantageously the apparatus includes support means for maintaining the inlet end in a position facing the underwater surface when the impeller is operated. The support means may be formed by a plurality of wheels drivable by hydraulic motors. Suitably the apparatus includes a plurality of passages and impellers mounted in a single body and has controls for operating the apparatus manually or by remote control. Conveniently, three passages and impellers are provided extending from one side of the apparatus to the opposite side, the associated passages and impellers are arranged triangularly, and three wheels are provided which are separately controllable, each wheel being located between a pair of adjacent passages. Using such apparatus the pressure towards the underwater surface created by the impeller may cause the apparatus to adhere to the surface and to maintain proper working relationship with respect to the surface with only small diver involvement.

The invention is more particularly described with reference to the drawings in which:-

Figure 1 is a perspective view of a cleaning apparatus according to the invention;

Figure 2 is a side view of the apparatus of Figure 1; and

Figure 3 is a side view partly in section of a cleaning device of the apparatus of Figure 1.

Referring to Figures 1 and 2, a mobile cleaning apparatus 100 mounts three cleaning devices 10. The apparatus 100 has a

50

55

60

65

70

75

80

85

90

body 1 made of fibre reinforced plastics material and has a width of 1700 mm, a length of 2100 mm and a height of 700 mm. The body 1 has three wheels 2 which are drivable by hydraulic motors (not shown) powered by oil under pressure supplied through one of the connectors 30 to a hydraulic system contained inside the body 1. The movement of the wheels 2 can be separately controlled by actuation of the levers 3 by an operator or diver directly. A bar 4 is secured to the body 1 for the diver's convenience. If desired however, the cleaning apparatus 100 may be so designed that it can be automatically controlled by remote control from a control stand on shore or from a vessel using cables (not shown) and a television installation for watching the progress of cleaning. The vessel or stand may also supply pressurized oil to the connectors 30 on the apparatus 100.

The three cleaning devices 10 are arranged spaced sideways and longitudinally so as to occupy the corners of a notional triangle. The wheels 2 are similarly arranged, but the notional triangle whose corners are occupied by the wheels 2, is inverted with respect to the triangle formed by the cleaning devices providing a compact overall arrangement.

Now referring to Figure 3, each of three cleaning devices 10 has a cylindrical outer shell 11 secured to the body 1 and a motor housing 12. The motor housing 12 is arranged centrally in the shell 11 and defines therewith an annular passage 17 which extends from the bottom of the body 1 to the top thereof. Inside the housing 12 is fixed a hydraulic motor 13 having an output shaft 14 to which is fixed a cap 15 for conjoint rotation with the shaft 14. The space 16 remaining within the housing 12 may be filled with low-density material such as foamed resin for increasing buoyance of the apparatus 100. In the annular passage 17 between the motor housing 12 and the outer shell 11 are arranged impeller vanes 18 rigidly secured to the cap 15. The shaft 14 carries apart from the cap 14, a rotatable disc 19 having a circular row of cleaning brushes 20 around its periphery. If necessary, further rows of brushes may be fixed to the disc 19. The shell 11 and the housing 12 are interconnected by guide vanes 21 which also serve to reinforce the shell 11. The vanes 21 are inclined relative to the direction of the axis of the housing 12 so as to regulate a vortex flow caused by the impellers 18 along the axis. In order to recover materials and contaminants which have been removed by the cleaning brushes 20, a net bag 22 may be detachably secured to the shell 11.

The hydraulic motor 13 has 59 horse power, a maximum speed of 600 revolutions

per minute and a normal working speed of 250 revolutions per minute. The oil may be supplied to the motors 13 from a power transmission vessel via cables or hoses. With a single cleaning device 10 having a diameter for the outer shell 11 of 700 mm and four impeller vanes 18 each inclined at 32 degrees relative to a plane normal to the axis of the shaft 14, the apparatus 100 is pressed onto a surface to be cleaned with a pressure of 450 to 500 kg/m² when the motor 13 is operated at a normal operational speed of 250 revolutions per minute. If the motor is rotated at a too high a speed, for instance over 300 revolutions per minute, cavitation may be caused, whereas at a lower motor speed, for instance below 100 revolutions per minute, sufficient pressure towards the surface to be cleaned may not result. With the cleaning apparatus described, an area of approximately 34 m² can be cleaned per minute at a normal operational speed.

The motor 13, the disc and brushes 19, 20, the cap and impellers 15, 18 and other components are all housed within the shell 11, thus providing a compact and small cleaning device for the removal of materials attached to a vessel. The removed materials are drawn into and discharged through the annular space 17 while at the same time the device itself is urged towards and adhered to a surface to be cleaned. The net bag 22 may be secured as a recovery means to the discharge side of the space 17 so as to collect all the materials and the contaminants without scattering them.

The apparatus of the invention is light and compact, easy to control and capable of cleaning large underwater surfaces without requiring much labour from a diver. A single motor is used for each brush for removing the contaminant material and the associated impeller. The scattering of contaminant material leading to pollution can be reduced and the contaminant materials can be collected. The apparatus may be conveniently controlled manually or automatically.

WHAT I CLAIM IS:-

1. An apparatus for cleaning an underwater surface, the apparatus including a passage extending from an inlet end to a discharge end, the passage being defined by a cylindrical outer shell and a housing for an impeller motor mounted centrally with respect to the outer shell, the housing being connected to the outer shell by guide vanes inclined relative to the axis of the shell, an impeller in the passage for moving water from the inlet end to the discharge end and a means at the inlet end for removing contaminant material from the underwater surface, the arrangement being such that, when the inlet end faces the underwater surface, operation of the impeller urges the apparatus towards the surface and conveys



body 1 made of fibre reinforced plastics material and has a width of 1700 mm, a length of 2100 mm and a height of 700 mm. The body 1 has three wheels 2 which are drivable by hydraulic motors (not shown) powered by oil under pressure supplied through one of the connectors 30 to a hydraulic system contained inside the body 1. The movement of the wheels 2 can be separately controlled by actuation of the levers 3 by an operator or diver directly. A bar 4 is secured to the body 1 for the diver's convenience. If desired however, the cleaning apparatus 100 may be so designed that it can be automatically controlled by remote control from a control stand on shore or from a vessel using cables (not shown) and a television installation for watching the progress of cleaning. The vessel or stand may also supply pressurized oil to the connectors 30 on the apparatus 100.

The three cleaning devices 10 are arranged spaced sideways and longitudinally so as to occupy the corners of a notional triangle. The wheels 2 are similarly arranged, but the notional triangle whose corners are occupied by the wheels 2, is inverted with respect to the triangle formed by the cleaning devices providing a compact overall arrangement.

Now referring to Figure 3, each of three cleaning devices 10 has a cylindrical outer shell 11 secured to the body 1 and a motor housing 12. The motor housing 12 is arranged centrally in the shell 11 and defines therewith an annular passage 17 which extends from the bottom of the body 1 to the top thereof. Inside the housing 12 is fixed a hydraulic motor 13 having an output shaft 14 to which is fixed a cap 15 for conjoint rotation with the shaft 14. The space 16 remaining within the housing 12 may be filled with low-density material such as foamed resin for increasing buoyance of the apparatus 100. In the annular passage 17 between the motor housing 12 and the outer shell 11 are arranged impeller vanes 18 rigidly secured to the cap 15. The shaft 14 carries apart from the cap 14, a rotatable disc 19 having a circular row of cleaning brushes 20 around its periphery. If necessary, further rows of brushes may be fixed to the disc 19. The shell 11 and the housing 12 are interconnected by guide vanes 21 which also serve to reinforce the shell 11. The vanes 21 are inclined relative to the direction of the axis of the housing 12 so as to regulate a vortex flow caused by the impellers 18 along the axis. In order to recover materials and contaminants which have been removed by the cleaning brushes 20, a net bag 22 may be detachably secured to the shell 11.

The hydraulic motor 13 has 59 horse power, a maximum speed of 600 revolutions

per minute and a normal working speed of 250 revolutions per minute. The oil may be supplied to the motors 13 from a power transmission vessel via cables or hoses. With a single cleaning device 10 having a diameter for the outer shell 11 of 700 mm and four impeller vanes 18 each inclined at 32 degrees relative to a plane normal to the axis of the shaft 14, the apparatus 100 is pressed onto a surface to be cleaned with a pressure of 450 to 500 kg/m² when the motor 13 is operated at a normal operational speed of 250 revolutions per minute. If the motor is rotated at a too high a speed, for instance over 300 revolutions per minute, cavitation may be caused, whereas at a lower motor speed, for instance below 100 revolutions per minute, sufficient pressure towards the surface to be cleaned may not result. With the cleaning apparatus described, an area of approximately 34 m² can be cleaned per minute at a normal operational speed.

The motor 13, the disc and brushes 19, 20, the cap and impellers 15, 18 and other components are all housed within the shell 11, thus providing a compact and small cleaning device for the removal of materials attached to a vessel. The removed materials are drawn into and discharged through the annular space 17 while at the same time the device itself is urged towards and adhered to a surface to be cleaned. The net bag 22 may be secured as a recovery means to the discharge side of the space 17 so as to collect all the materials and the contaminants without scattering them.

The apparatus of the invention is light and compact, easy to control and capable of cleaning large underwater surfaces without requiring much labour from a diver. A single motor is used for each brush for removing the contaminant material and the associated impeller. The scattering of contaminant material leading to pollution can be reduced and the contaminant materials can be collected. The apparatus may be conveniently controlled manually or automatically.

WHAT I CLAIM IS:-

1. An apparatus for cleaning an underwater surface, the apparatus including a passage extending from an inlet end to a discharge end, the passage being defined by a cylindrical outer shell and a housing for an impeller motor mounted centrally with respect to the outer shell, the housing being connected to the outer shell by guide vanes inclined relative to the axis of the shell, an impeller in the passage for moving water from the inlet end to the discharge end and a means at the inlet end for removing contaminant material from the underwater surface, the arrangement being such that, when the inlet end faces the underwater surface, operation of the impeller urges the apparatus towards the surface and conveys



24

3

1,546,489

3

removed contaminant material to the discharge end.

5 2. An apparatus according to claim 1 in which the means for removing contaminant material is a rotatable brush.

3. An apparatus according to any preceding claim in which means are provided at the discharge end for collecting removed contaminant material.

10 4. An apparatus according to claim 3 in which the collecting means is a net bag.

15 5. An apparatus according to any preceding claim in which a shaft is provided centrally in the passage which shaft extends toward the inlet end, and the impeller and the means for removing contaminant material are mounted on the shaft for conjoint rotation therewith.

20 6. An apparatus according to any of claims 2 to 5 in which the impeller motor is a hydraulic motor disposed in the housing.

25 7. An apparatus according to any preceding claim including support means for maintaining the inlet end in a position facing the underwater surface when the impeller is operated.

30 8. An apparatus according to claim 7 in which the support means include a plurality of wheels drivable by hydraulic motors.

9. An apparatus according to any preceding claim which includes a plurality of

passages and impellers mounted in a single body.

10. An apparatus according to any preceding claim which includes controls for operating the apparatus manually or by remote control. 35

11. An apparatus according to any preceding claim in which three passages and impellers are provided extending from one side of the apparatus to the opposite side, the associated passages and impellers are arranged triangularly, and three wheels are provided which are separately controllable, each wheel being located between a pair of adjacent passages. 40 45

12. An apparatus for cleaning an underwater surface substantially as described and shown with reference to the drawings. 50

13. A method of cleaning an underwater surface comprising using an apparatus according to any of the preceding claims and utilizing the pressure on the apparatus towards the underwater surface arising from operation of the impeller(s) to cause the apparatus to adhere to the surface. 55 60

ERIC POTTER AND CLARKSON
Chartered Patent Agents
25 The Crescent
Leicester