

BOAT HULL CLEANING EQUIPMENT

DESCRIPTION

5 OBJECT OF THE INVENTION

The object of the invention falls within the technical field corresponding to electromechanical engineering, specifically, the sector belonging to cleaning equipment for boats or aquatic structures.

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The invention relates to boat hull cleaning equipment for cleaning boat hulls autonomously or by action of an operator using acoustically treated pressurised water and/or rotating brushes while collecting water with residues of said hulls and subjecting it to filtration in order to avoid pollution of the aquatic environment, said equipment being
15 adhered to the surface of the hull by means of adhesion modules which facilitate cleaning tasks against the forces of marine currents and/or irregularities on the surface of hull of the boat.

BACKGROUND OF THE INVENTION

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The adhesion of bacteria, barnacles, algae and other marine organisms to structures on boats is called biofouling. Biofouling is produced by the very nature of the marine environment, that is, the accumulation of biological elements on the hulls of ships and elements which remain submerged for long periods of time or which are constantly under
25 water is normal.

This effect is counterproductive in several aspects, both for the environment and at economic levels, and it is why such structures must be subjected to frequent cleaning.

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With respect to the environment, there is an increase in the fuel used by ships for their operation due to the increase in friction on sea surfaces and the weight of the ship itself due to the amount of marine organisms adhered to the surface of the hull. Likewise, pollution is produced by the adhesion of organisms not native to the environment when they are transported by said ship, with the possibility of causing damage to certain
35 ecosystems due to the invasion of said organisms.

With respect to economic levels, the increase in fuel consumption implies a higher cost of transportation and the increase in organisms adhered to the boat enables premature aging or a decrease in the service life of the coatings and paints used on the surface of the hull of the boat.

Likewise, an act of pollution of the marine environment also occurs when using cleaning techniques that do not collect the mass of dirt or do not do so to an adequate extent, as occurs with most of the systems used to date, affecting the native marine fauna of each place where the ship is taken.

Although the use of antifouling paints manages to delay the growth of marine microorganisms, they do not prevent it, in addition to the fact that said paints are increasingly more expensive due to international legislation against pollution, and those that are available are less effective.

Underwater cleaning of ship hulls can be carried out in different ways: by means of professional divers, robots or remotely operated underwater vehicles.

The cleaning of marine microorganisms by divers equipped with cleaning material is impossible to carry out on medium to large ships. On the other hand, remotely operated underwater vehicles show great adaptation, but are difficult to control and exhibit notable energy consumption.

Finally, robots for cleaning ship hulls mainly consist of the use of wheels or caterpillar tracks to move around the hull, achieving adhesion to the hull with suction and/or magnets, which means that they cannot avoid obstacles on the hull, virtually being used to clean flat surfaces. To avoid direct magnet-hull contact, a series of coatings are used, bringing about the possibility of these coatings being damaged and needing to exchange them due to wear, facilitating friction and damage to the surface of the hull if said exchange is not carried out on time.

DESCRIPTION OF THE INVENTION

The present invention intends to offer a solution to the problems posed by means of the use of a device that carries out cleaning tasks by means of a cleaning module and a suction module, which are connected to a hydraulic installation and a water collection and filtration installation, respectively, in order to clean the hull of the boat and the organic and inorganic residues that are sucked in and later filtered to return the water to the sea, avoiding pollutants from said cleaning tasks, such as paint residues, oxides, invasive species, etc.

To perform the cleaning and suction actions, the equipment must be in contact with the surface of the hull; however, it incorporates at least one adhesion module, which allows the adhesion of the equipment against the surface of the hull of the boat without direct contact, avoiding damage to said hull due to friction, blows or other actions that may lead to material defects thereof.

Specifically, the equipment that is the object of the invention comprises a frame, a cleaning module associated with the frame in its lower area, wheels coupled to the frame and allowing it to move along the surface of the hull of the boat, rotation motors, connected to the wheels to allow the movement thereof, a control module connected to the motors and a power module electrically powering the control module.

The adhesion of the equipment to the surface of the hull of the boat, as previously mentioned, is facilitated thanks to the adhesion modules, distributed throughout the lower area of the frame and linked to the control module; where said adhesion can also be produced with the help of the rotation of the brushes, creating a suction current that makes it possible for the equipment to contact the surface of the boat.

Said adhesion modules are formed by a series of magnets with one face facing, without contact, the surface of the hull of the boat; metal plates which are located on the opposite face of the magnet and can incorporate an electronic or mechanical drive, which can be formed by a cylinder that mechanically extends and retracts, coupling with the metal plates and bringing the metal plates closer to or further away from the magnet or magnets in order to increase or reduce the attraction of the magnet, and therefore, of the equipment to the surface of the hull, in order to overcome irregularities on its surface or

overcome the different currents and pressure changes when the equipment is submerged, avoiding the uncoupling of the equipment.

5 This physical phenomenon is produced because the magnetism of the magnet increases on one of the faces if the other face is insulated with a treated metallic material; and the smaller the distance between the metal plate and the face of the magnet, the greater the magnetism on the free face of the magnet against a surface.

10 It is used in the case of the equipment of the invention with the intention of being able to move the equipment along the hull of the boat without damaging said hull by direct contact, because it avoids, for example, the wear of the paint on said hulls, or the wear of the equipment due to the friction forces to which it may be subjected in the event that the magnets are in contact with the surface. Equipment-hull of the boat contact is due solely to the positioning of the wheels on the surface of the hull.

15 On the other hand, the cleaning module incorporates one or more rotating brushes, also connected to the rotation motors and a water impulse module, equipped with a water outlet and a water inlet connected to one another, wherein the water inlet can preferably be located in the rear area of the frame and the water outlet in the lower area of the frame.

20 The water inlet can be coupled to a hydraulically powered installation, for example, receiving water from the sea, being collected in a tank and impelled towards the water inlet of the impulse unit of the module by means of an impulse pump. Prior to being impelled through the water outlet, the water is acoustically treated, that is, the equipment object of the invention incorporates cavitation nozzles linked to the control module and located in the water impulse module, said cavitation nozzles being able to be incorporated at the water outlet, responsible for varying the wave frequency of the water expulsion flow from the equipment, allowing the creation of a pressure flow within the marine environment through shock waves of said water expelled against the surface of the hull when the equipment performs cleaning tasks on the hull of the boat when submerged.

30 Independently, the equipment object of the invention also comprises a suction module, which sucks organic and inorganic residues (biofouling, paint, etc.), equipped with a

suction inlet and a suction outlet, the suction inlet being located in the lower area of the frame and the suction outlet extended towards the upper area of the frame, with the possibility of connecting the latter to a water collection and filtration installation, by means of connection means such as hoses, to return the water to the sea without said residues
5 mentioned and thus avoid pollution of the aquatic ecosystem.

The filtration installation can be formed by a suction pump that conducts the water from the cleaning equipment to the filtration unit by decantation levels, in a first stage, in which the larger residues are collected in filter trays and after this process, if necessary, the
10 water collected by the cleaning equipment circulates from that first stage to a second filtration stage, which can be a filtration by means of filter socks, where smaller particles suspended in the sucked water stream are collected.

To perform the movement on the surface of the hull, at least one of the wheels is a
15 steering wheel and the rest are drive wheels, also located in the lower area of the frame.

Also, thanks to the control module, the equipment can be controlled remotely because it is possible to connect it to a remote control module, or the equipment can be controlled by using steering means, preferably a steering wheel, located on the frame and linked to
20 the rotating shaft of the steering wheels, where such means can be the front wheels of the equipment.

To facilitate cleaning tasks, the equipment can include a series of display modules, preferably cameras, connected to the control module, and these may be connected to
25 the remote control module, facilitating the viewing of the elements of the hull of the boat that are going to be cleaned by the user who is not controlling the equipment manually.

Also, the equipment object of the invention incorporates one or more floats incorporated internally on the frame and they can be connected to the control module of the invention,
30 the task of which, when manually or remotely activated, is to facilitate the emergence of said frame, creating a slightly positive flotation.

Finally, the frame of the equipment can be formed by a casing and can include a protective structure fixed below the casing and protecting the cleaning module, the

adhesion means and the suction module, in order to avoid impacts against them that can harm them.

DESCRIPTION OF THE DRAWINGS

To complement the description that is being made and in order to help make the features of the invention more readily understandable, according to a preferred practical
 5 exemplary embodiment thereof, a set of drawings is attached as an integral part of said description wherein, for illustrative and non-limiting purposes, the following has been represented:

Figure 1 shows a top perspective view of the boat hull cleaning equipment.

10 Figure 2 shows a bottom view of the boat hull cleaning equipment.

Figure 3 shows a block diagram of the boat hull cleaning equipment.

PREFERRED EMBODIMENT OF THE INVENTION

15 With the aid of Figures 1 to 3, a preferred embodiment of the boat hull cleaning equipment object of the invention is described.

Figure 1 shows a top perspective view of the boat hull cleaning equipment, intended to adhere to and clean the surface of said hulls, controlled remotely and/or manually,
 20 comprising a frame (1) equipped with a lower area (2), an upper area (3), a rear area (4), a front area (5) and an internal space (6), likewise, the frame (1) can be formed by a casing (26) and a protective structure (27) fixed below said casing (26).

As a complement to Figure 1, Figure 2 shows a bottom view of the boat hull cleaning
 25 equipment, where it can be seen that it further comprises a cleaning module (7) linked to the frame (1) and intended to clean the hull of the boat, wheels (16) located in the lower area (2) of the frame (1) and moving the frame (1) along the surface of the hull of the boat, rotation motors (17) located in the internal space (6) of the frame (1) and to which wheels (16) are connected, a control module (18) associated with the rotation
 30 motors (17) and sending movement orders to said rotation motors (17), and a power supply module (31) connected to the control module (18) and electrically powering said control module (18).

On the one hand, the invention comprises one or more variable magnetic field adhesion
 35 modules (15) coupled to the lower area (2) of the frame (1) and formed by one or more

magnets (20) equipped with a first face (28) facing the upper area (3) of the frame (1) and a second face (29) facing the lower area (2) of the frame (1), said magnets (20) being intended to adhere by their second face (29), by magnetic attraction, to the frame (1) against the surface of the hull of the boat, and one or more metal plates (21) coupled
 5 on the first face (28) of the magnets (20) modifying the field of attraction of the second face (29) of the magnets (20) with respect to the surface of the hull of the boat.

The cleaning module (7) of the invention can incorporate one or more rotating brushes (8) located in the lower area (2) of the frame (1) that are connected to the rotation motors
 10 (17), the rotation of which about the axis thereof is caused by the action of the rotation motors (17), and at least one water impulse module (9) equipped with a water outlet (10) and a water inlet (11) communicated with one another, wherein the water inlet (11) of the cleaning module (7) is located in the rear area (4) of the frame and is intended to be coupled to an impulse pump of a hydraulically powered installation and the water outlet
 15 (10) is located in the rotating brush (8) and/or in the lower area (2) of the frame (1).

With the help of Figures 1 and 2, it can be seen how the boat hull cleaning equipment can further comprise a suction module (12) associated with the frame (1) and incorporating at least one suction inlet (13) configured to collect organic and inorganic
 20 residues from the hull of the boat towards the internal space (6) of the frame (1), and at least one suction outlet (14) that communicates with the suction inlet (13), wherein said suction outlet (14) can be coupled to a suction pump of a water collection and filtration installation.

25 In addition, Figure 2 includes a detail of the arrangement of the magnets (20) and the metal plates (21) of the adhesion module (15), wherein the magnets (20) are equipped with a first face (28) and a second face (29), wherein the first face (28) is facing the upper area (3) of the frame (1) and the second face is facing the lower area (2) of the frame (1); and the metal plates (21) are linked to the first face (28) of the magnets (20) in order
 30 to increase or decrease the magnetic field of attraction of the magnets (20), by their second face (29), against the surface of the boat hulls.

With the support of Figures 1 and 2 on Figure 3, which shows a block diagram of the operation of the boat hull cleaning equipment, said equipment can incorporate one or
 35 more cavitation nozzles (19) linked to the control module (18) and located in the water

impulse module (9), which is intended to vary the frequency of the water impulse wave to create an impact flow against the hull of the boat. Preferably, said cavitation nozzles (19) are located at the water outlet (10) of the water impulse module (9) with which the cleaning module (7) is equipped.

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Additionally, the adhesion modules (15) can include an electronic or mechanical drive (25) connected to the control module (18) and configured to bring the metal plates (21) closer to or further away from the magnets (20), and accordingly to vary the field of attraction of said magnets (20) with respect to the surface of the hull of the boat, increasing or decreasing it the closer or further away said metal plate(s) (21) is/are with respect to the magnets (20).

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For steering along the hull of the boat of the invention, the equipment can be equipped with a manual steering element (22) located in the upper area (3) of the frame (1) and associated with the wheels (16), facilitating the rotation thereof, said steering element (22) preferably being a steering wheel; or it can be linked to a remote control module (23), which wirelessly connects with the control module (18) and allows a user to steer and modify the speed of the rotation motors (17) and remotely control the cleaning tasks of the equipment.

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By facilitating emergence work, the cleaning equipment can further incorporate one or more floats (30) located in the internal space (6) of the frame (1), said floats (30) being intended to facilitate the emergence of said frame (1), creating a slightly positive float.

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Finally, to facilitate remote control work, the equipment can incorporate a series of cameras (24), distributed throughout the rear area (4) and/or front area (5) of the frame (1) and connected to the control module. (18).

CLAIMS

1.- Boat hull cleaning equipment intended to adhere to the surface of the boat hull and clean said boat hulls in a guided manner, comprising:

- 5 - a frame (1) equipped with a lower area (2), an upper area (3), a rear area (4), a front area (5) and an internal space (6),
- a cleaning module (7) linked to the frame (1) and intended to clean the hull of the boat,
- wheels (16) located in the lower area (2) of the frame (1) and moving the frame
- 10 (1) along the surface of the boat hull,
- rotation motors (17) located in the internal space (6) of the frame (1) and connected to the wheels (16),
- a control module (18) connected to the rotation motors (17) and sending movement orders to said rotation motors (17), and
- 15 - a power supply module (31) connected to the control module (18) and electrically powering said control module (18);

characterised in that it further comprises one or more variable magnetic field adhesion modules (15) coupled to the lower area (2) of the frame (1) and formed by:

- 20 - one or more magnets (20) equipped with a first face (28) facing the upper area (3) of the frame (1) and a second face (29) facing the lower area (2) of the frame (1), said magnets (20) being intended to adhere by their second face (29), by magnetic attraction, to the frame (1) against the surface of the hull of the boat, and
- one or more metal plates (21) linked to the first face (28) of the magnets (20)
- 25 modifying the field of attraction of the second face (29) of the magnets (20) with respect to the surface of the hull of the boat.

2.- Boat hull cleaning equipment according to claim 1, wherein the cleaning module (7) comprises:

- 30 - one or more rotating brushes (8) located in the lower area (2) of the frame (1) that are connected to the rotation motors (17), the rotation of which about the axis thereof is caused by the action of the rotation motors (17), and
- at least one water impulse module (9) equipped with a water outlet (10) and a water inlet (11) communicated with one another, wherein the water inlet (11) is
- 35 located in the rear area (4) of the frame (1) and is intended to be coupled to an

impulse pump of a hydraulically powered installation and the water outlet (10) is located on the rotating brush (8) and/or in the lower area (2) of the frame (1).

3.- Boat hull cleaning equipment according to claim 1, further comprising a suction module (12) associated with the frame (1) and incorporating:

- at least one suction inlet (13) configured to collect organic and inorganic residues from the hull of the boat towards the internal space (6) of the frame (1), and
- at least one suction outlet (14) that communicates with the suction inlet (13), wherein said suction outlet (14) can be coupled to a suction pump of a water collection and filtration installation.

4.- Boat hull cleaning equipment according to claim 3, wherein the suction outlet (14) of the suction module (12) extends towards the upper area (3) of the frame (1) and the suction inlet (13) is located in the lower area (2) of the frame (1).

5.- Boat hull cleaning equipment according to claim 1, further comprising a piezoelectric linked to the control module (18) and located in the water impulse module (9), which is intended to vary the frequency of the water impulse wave to create an impact flow against the hull of the boat.

6.- Boat hull cleaning equipment according to claim 1, wherein the adhesion modules (15) further incorporate a drive (25) connected to the control module (18) and configured to bring one or more metal plates (21) on the first face (28) of the magnets (20) closer by increasing or decreasing, depending on the approach distance, the field of attraction of the second face (29) of the magnets (20) with respect to the surface of the hull of the boat.

7.- Boat hull cleaning equipment according to claim 1, further comprising a manual steering element (22) located in the upper area (3) of the frame (1) and associated with the wheels (16).

8.- Boat hull cleaning equipment according to claim 1, further comprising a remote control module (23) connected to the control module (18) and intended to allow a user to remotely control the action of the motors (17), and, therefore, the rotation of the wheels (16) and the cleaning elements of the equipment.

9.- Boat hull cleaning equipment according to claim 1, further comprising a set of cameras (24) distributed throughout the rear area (4) and/or front area (5) connected to the control module (18).

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10.- Boat hull cleaning equipment according to claim 1, further comprising one or more floats (30) located in the internal space (6) of the frame (1), said floats (30) being intended to facilitate the emergence of said frame (1) by means of slightly positive flotation.

10 11.- Boat hull cleaning equipment according to claim 1, wherein the frame (1) is formed by a casing (26) and a protective structure (27) fixed below the casing (26).