

Maintenance device

The invention relates to an automated maintenance apparatus for large-area surfaces, comprising a mobile carrier system, wherein the carrier system comprises at least one vertical carrier tower, on which at least two arm systems are arranged, and each arm system can be moved vertically along the vertical carrier tower via a carrier unit, and to its use for the processing and/or inspection of hulls of ships and/or outside walls of steel tanks.

It is necessary in many areas of technology to examine and process the surface of large-area construction surfaces, especially those made of steel. For example, the hulls of ships need to be protected against corrosion in specific intervals. For this purpose, old defective coatings of paint are removed by special processes in order to provide the cleaned steel surface of the hull of the ship with a new coating of paint. This process is known as "re-coating". The manual performance of this process is very laborious and often represents a health hazard for the persons involved in the process. Since large areas are concerned, expensive and complex scaffolds are required in order to reach every point of the hull of the ship. Lifting platforms and crane constructions can also be used, wherein higher health hazards for the staff cannot be excluded in this case too however.

EP 0 640 440 A1 describes an apparatus for the surface treatment of freestanding, essentially vertical walls for example, especially for ships. A running gear with two mast elements is provided, on which a cabin is arranged which is movable relative to the ship wall. This apparatus concerns a large inflexible apparatus which is rather unsuitable for the processing of the bow of the ship's hull.

US Pat. No. 4,285,469 also discloses an apparatus for cleaning vertical walls, which comprises a water jet device for cleaning the hulls of ships and which is fixedly installed on the wall of a quay. Such an apparatus is entirely unsuitable for mobile use.

US Pat. No. 3,548,541 describes an apparatus of the kind mentioned above which comprises a vertical beam on which a horizontal beam is arranged with a work cabin. This apparatus generally only offers a low level of flexibility as a result of the arrangement of the horizontal beam and is only suitable for performing a single work step during re-coating, which is the performance of sandblasting.

A maintenance system is described in WO 2010/057942 A1 of the applicant, which already offers a certain amount of flexibility. The arm systems are arranged on a horizontal beam however, so that the arm systems always need to operate in the same height section.

DE 20 2009 002 519 U1 discloses a maintenance device of the kind mentioned above, wherein two lifting components with extension arms are arranged on a tower, which are only displaceable independently from one another within limits. The upper lifting component limits the second component downwardly in its upward movement, whereas the lower lifting component limits the upper lifting components in its upward movement.

It is therefore the object of the invention to eliminate the aforementioned disadvantages of the state of the art and to provide an apparatus of the kind mentioned above which offers especially high flexibility in its use.

This object is achieved in accordance with the invention such a way that the at least two carrier units are arranged on opposite edges and/or sides of the carrier tower, and are vertically movable independently from one another. As a result of this arrangement of the carrier units, they can be moved substantially along the entire length of the vertical carrier tower independently from one another without influencing each other.

In order to improve this independent vertical movement of the arm systems, each carrier unit is assigned a separate drive and control unit. Each arm system can therefore be operated entirely independently of the other arm system, even when it is not in use for maintenance purposes for example. The drive unit is arranged in an especially preferable way as a cable winch system. It is also possible to use other drive systems such as a climbing device as in WO 2010/025977 A1 of the applicant.

In an especially preferred embodiment of the invention, at least one tool holder for accommodating automated tools is arranged on at least one arm system, wherein preferably the automated tools are chosen from a group which comprises jet heads for water or different granulates, coating heads and inspection systems.

In a further embodiment of the invention, the carrier tower can be assembled in a modular manner. This offers the advantage that the carrier tower is transported in a compact manner to the desired location and can be erected there rapidly. The height of the carrier tower can be up to 36 m depending on the configuration and the number of the modules.

The carrier tower will advantageously be erected on a base on which supply devices for the arm systems and the tools disposed thereon are arranged, especially for providing electrical power, water and compressed air. The maintenance of the maintenance system in accordance with the invention is further improved by this central supply.

In an especially preferred embodiment of the invention, the carrier tower comprises at least one support device at its end facing away from the base, which support device stabilises the carrier tower in its vertical alignment in relation to the surface to be processed.

The special flexibility of the maintenance apparatus will additionally be supported in such a way that the carrier system is displaceable on a rail system. The carrier system can alternatively also be arranged on a motor vehicle.

The maintenance system as described above is especially suitable for processing and/or inspecting the hulls of ships and/or the outside wall of steel tanks.

The invention will be explained below in closer detail by reference to non-limiting embodiments shown in the relevant drawings, wherein:

Fig. 1 shows a first view of the maintenance apparatus in accordance with the invention;

Fig. 2 shows a second view of the maintenance apparatus of Fig. 1;

Fig. 3 shows a detailed view of an arm system of the maintenance apparatus of Fig. 1, and

Fig. 4 shows a detailed view of the support device of the maintenance apparatus of Fig. 1.

The maintenance apparatus 100 in accordance with the invention comprises a base 110 according to Figs. 1 and 2, which in the present embodiment of the invention is displaceable via a rail system. A carrier tower 120 is erected on said basis 110, on which two arm systems 130 are arranged which are displaceable independently from one another. In order to additionally stabilise the carrier tower 120 in its vertical alignment, a support device 140 is provided in the region of its end facing away from the base, which support device provides support of the carrier tower 120 against the surface to be processed during the work of the maintenance device 100, which in the present example is a hull 200 of a ship. A ladder 121 (Fig. 4) is additionally arranged in the interior of the carrier tower 120,

which ladder provides emergency access to the arm systems 130 and/or the supports device 140.

The control and supply devices 150 are further arranged on the base 110, by means of which the individual elements of the maintenance apparatus 100 and the arm systems 130 in particular are supplied with electrical power, compressed air, different cleaning and coating media, hydraulics and the like. Two cabins 151 are similarly provided for the operation of the two arm systems 130 on the base 110 in particular, in which the operating staff performs the control and the supervision of the arm systems 130 and the maintenance apparatus 100 in its entirety independently from one another in an ambient environment which is protected from the outside area.

Fig. 3 shows an arm system 130 in detail. The arm system 130 is arranged via a carrier unit 131 on one side of the carrier tower 120, wherein running wheels 132 of the carrier unit 131 which are arranged on both sides respectively cooperate with one edge 122 of the carrier tower 120 and are driven by a cable pull system for example in order to produce a vertical displacement of the arm system 130. Deflection pulleys 123 of the cable system are shown in Fig. 4 at the upper end of the carrier tower 120.

The carrier unit 131 further comprises a platform 133, on which a substructure 134 of a telescopic arm 135 is fixed, which telescopic arm is rotatably arranged on said substructure. Instead of the illustrated arm 135 which can be telescoped four times, other arm systems such as multiple bending arms or other devices for supplying a tool 136 attached to the end of the arm can be attached to the carrier unit 134.

The tool 136 is advantageously controlled in a fully automated manner and is used for example for inspecting, cleaning or coating the surface. A collecting container 137 is additionally arranged on the carrier unit 134, in which the waste material produced in the cleaning of the surface by means of the tool 136 is separated at first from fluid components by means of a cyclone for example and is collected.

Since the two carrier units 134 are arranged on two mutually opposite sides of the carrier tower 120 (as shown in Figs. 1 and 2), they can be moved independently from one another virtually over the entire length of the carrier tower 120 without impairing one another in their movement. As a result, the surface to be inspected and/or processed, especially the hulls 200 of ships, can be processed efficiently, especially in different heights. Similarly, only one arm system 130 can be used for example, whereas the second arm system 130 is

maintained in the region of the base 110. As a result, standstill times of the maintenance apparatus will be reduced significantly.

The support device 140 is shown in Fig. 4. It comprises two bendable supports 141 which act independently from one another and comprise running wheels 142, and which support the upper end of the carrier tower 120 against the ship's hull 200. Merely one support 141 is necessary for a functional support of the maintenance apparatus 100. The second support 141 is especially used as an evading possibility when the first support 141 cannot be used effectively due to constructional conditions (e.g. hatches).

If the maintenance apparatus 110 in accordance with the invention is moved further along the rail system in order to reach another area of the ship's hull 200 with the arm systems and to subsequently process this area, the distance between the carrier tower 120 and the ship's hull 200 may optionally change due to the different curvatures of the ship's hull 200, which is compensated by a change in the bending angle of the two supports 141. At the same time, the running wheels 142 allow simple displacement of the carrier tower 120 along the ship's hull 200 without damaging its surface.

It is understood that the present invention is not limited to the embodiment as described above. A further relevant advantage of the invention is its low need for space by the combination of a vertical carrier tower with two arm systems which are vertically displaceable independently from one another and which can reach every area of the surface to be processed.

CLAIMS

1. An automated maintenance apparatus (100) for large-area surfaces, comprising a mobile carrier system, wherein the carrier system comprises at least one vertical carrier tower (120), on which at least two arm systems (130) are arranged, and each arm system (130) can be moved vertically along the vertical carrier tower (120) via a carrier unit (131), characterized in that the at least two carrier units (131) are arranged on opposite edges (122) and/or sides of the carrier tower (120) and are vertically movable independently from one another.
2. A maintenance apparatus (100) according to claim 1, characterized in that each carrier unit (131) is assigned a separate drive and control unit.
3. A maintenance apparatus (100) according to claim 1 or 2, characterized in that the drive unit is arranged as a cable winch system.
4. A maintenance apparatus (100) according to one of the claims 1 to 3, characterized in that at least one tool holder is arranged on at least one arm system (130) for accommodating automated tools (136).
5. A maintenance apparatus (100) according to claim 4, characterized in that the automated tools (136) are chosen from a group which comprises the jet heads for water or different granulates, coating heads and inspection systems.
6. A maintenance apparatus (100) according to one of the claims 1 to 5, characterized in that the carrier tower (120) can be assembled in a modular way.
7. A maintenance apparatus (100) according to one of the claims 1 to 6, characterized in that the carrier tower (120) is erected on a base (110) on which supply devices (150) for the arm systems (130) and the tools (136) that are disposed thereon are arranged, especially for providing electric power, water and compressed air.
8. A maintenance apparatus (100) according to one of the claims 1 to 7, characterized in that the carrier tower (120) comprises at least one support device (140) at its end facing away from the base (110), which support device stabilises the carrier tower (120) in its vertical alignment to the surface to be processed.

9. A maintenance apparatus (100) according to one of the claims 1 to 8, characterized in that the carrier system is displaceable on a rail system.
10. A maintenance apparatus (100) according to one of the claims 1 to 8, characterized in that the carrier system can be arranged on a motor vehicle.
11. The use of a maintenance apparatus (100) according to one of the claims 1 to 10 for processing and/or inspecting ship's hulls (200) and/or outside walls of steel tanks.