

A tool for cleaning large surfaces

The invention relates to a tool for cleaning large surfaces, especially boat hulls, comprising at least one tool body and at least one nozzle body whose nozzles are positioned substantially radially originating from the surface central point of the nozzle body, wherein two rotating nozzle bodies are arranged on the tool body and in addition at least one sealing element.

A tool of the kind mentioned above is disclosed in WO 1996/12570 A2, wherein a substantially cylindrical tool body is provided, on the circular base area of which a nozzle body is arranged with a plurality of nozzles. Said nozzle body, which rotates in operation, has a substantially rectangular base area. It is disadvantageous in this apparatus that the removal rates in removing layers of the lacquer from a boat hull are very low due to the relatively low effective area of the tool.

A tool of the kind mentioned above is described in AT 401 147 B, wherein a nozzle head with a rotatably mounted nozzle carrier and an extraction hood enclosing the nozzle head is provided. The extraction hood carries a seal arranged circumferentially on the bottom edge, rests on the surface to be cleaned and is rigidly attached to the exterior part of the nozzle head by way of a spacer ring.

It is the object of the invention to provide a tool of the kind mentioned above which shows high effectiveness, requires little maintenance and is environmentally friendly to operate.

This object is achieved in accordance with the invention such a way that the at least one sealing element is arranged by way of at least one spring device on the tool body. A high removal rate is achieved by arranging two rotating nozzle bodies on the base area of the tool body. Since the tool is preferably used on non-flat surfaces such as boat hulls, and large amounts of waste material which should not reach the environment are produced when removing impurities and lacquer layers by means of waterjet and/or sandblasting technology, it is provided in accordance with the invention that at least one resilient sealing element is arranged on the nozzle body. As a result of the resilient bearing, the sealing element adjusts to the contour of the surface to be processed and the tightness of the tool is thus improved substantially.

The sealing element is arranged as a substantially annular brush body in a preferred embodiment of the invention. Said brush body encloses the two rotating nozzle bodies and seals the tool body on the surface to be processed against the ambient environment, so that the removal material can be extracted by suction via the nozzle body.

The tightness of the sealing element is further improved significantly in an especially preferred embodiment of the invention when the sealing element additionally comprises a substantially flat plastic seal, especially made of neoprene, which encloses the brush body at least in part. The combination of a flexible flat plastic seal with a brush body substantially increases the tightness, thus reducing the required power of the suction system.

It is provided in an especially preferred way that the nozzle body has three rotor arms in which the nozzles are positioned. This rotor system can realise a high removal rate because said nozzle body is especially suitable for high rotational speeds. At the same time, this form of the nozzle body produces a suction effect which additionally supports the extraction by suction of the waste material.

It is provided in an especially preferred way that nozzles are arranged along the longitudinal axis of the rotor arm of the nozzle body, wherein the longitudinal axes of the nozzles intersect the base area of the rotor arm in a substantially orthogonal fashion. Examinations conducted by the applicant have shown that this arrangement allows optimal removal of impurities and lacquer layers from the surface to be treated.

If the surface to be processed is not to be cleaned entirely, but only in specific regions, as is usually the case when repairing boat hulls, it is demanded concerning the coating or lacquering of the surface which follows the cleaning that the transition between the cleaned area and intact area does not occur suddenly but continuously. That is why it is provided in an especially preferred embodiment of the invention that at least one nozzle is provided on at least one rotor arm, which nozzle is arranged at the distal end of the rotor arm and which intersects the base area of the rotor arm under an angle which deviates between 2° and 10°, preferably 5°, from the orthogonal on the base area of the rotor arm. The term "distal end of the rotor arm" is understood in this connection as such end of the rotor arm which faces away from the surface central point of the nozzle body. As a result of this inclination of the last nozzle, the removal rate is reduced in this area, thus producing the desired "soft" transition between processed and unprocessed surface.

An important point in using the tool in accordance with the invention is avoiding the escape of waste materials to the ambient environment. A suction system is provided for this purpose, wherein the tool body comprises one suction opening, and preferably two or four suction openings, for the connection of a suction system. It is provided in an especially preferred way that the shape of the tool body substantially corresponds to an open cylinder with elliptical base area, wherein preferably two suction openings are arranged on the longitudinal sides of the base area and two suction openings on the tool body wall in the region of the vertices of the elliptical base area. It is understood that all suction openings can also be arranged in the tool body wall and/or the base area.

The suction power is improved further if according to a further embodiment of the invention at least one suction channel is provided in the tool body wall, which suction channel opens into at least one suction opening. This improves the flow conditions within the tool body, so that the suction power also substantially increases in combination with the sealing element.

In an especially preferred embodiment of the invention, the nozzle bodies can be driven by a drive system with a hydraulic motor and a gear.

The invention will be explained below in closer detail by reference to a non-limiting embodiment with the associated drawings, wherein:

Fig. 1 shows a first perspective view of the tool from the front, and

Fig. 2 shows a sectional view of the tool body.

The tool 100 in accordance with the invention and according to Figs. 1 and 2 comprises a tool body 110 having a substantially elliptical base area 111 on which two nozzle bodies 200 are arranged. Furthermore, a tool body wall 112 which stands substantially orthogonally to the base area 111 encloses the two nozzle bodies 200.

A sealing element 120 is arranged on the outside of the tool body wall 112, which sealing element consists of an integral brush body 121 and a neoprene seal 122 which partly encloses the brush body 121. The sealing element 120 is fixed via four spring devices 123, which are spring bearings in this case, to the tool body 110, wherein said resilient bearing allows an adjustment of the sealing element 120 to the surface to be processed. The tool 100 in accordance with the invention offers optimal tightness against the ambient environment in operation as a result of this combination seal consisting of the brush body 121 and the neoprene seal 122 as well as the resilient bearing via the spring devices 123, so

that virtually no waste material reaches the ambient environment and the suction system can be dimensioned optimally at the same time.

Suction openings 113 are provided in the tool body 110 for extracting the waste material by suction, wherein the flow conditions within the tool body are further improved by the arrangement of suction channels 114 which lead to the suction openings 113.

In order to achieve optimal removal performance of the tool 110 in accordance with the invention, the nozzle bodies 200 respectively comprise three rotor arms 201, on which the nozzles 202 are substantially arranged in a substantially radial fashion.

As is shown in Fig. 2, the longitudinal axes A of the nozzles 202 are arranged on at least one rotor arm substantially normally to the base area E of the rotor arm 201, and only the nozzle 202' at the proximal end 203 is provided with an inclined configuration, wherein the angle α in the present embodiment of the invention is approximately 5°. A low removal rate is thus obtained in the region of the surface processed by this part of the rotor arm 201, thus obtaining the desired progression between processed and non-processed surface.

The cleaning agent such as water, abrasive media such as sand, or also mixtures of abrasive media with water or solvents are guided by means of high pressure (500 to 3000 bar) to the nozzles 202, 202' via a central feed line 115, and supplied to the surface to be treated by the nozzles 202, 202'. A hydraulic motor produces a rotation of the nozzle bodies 200 via a bevel gear for example in order to ensure even processing of the surface. The refuse of waste material produced in this way and the employed water and/or abrasive media are removed by suction by the suction openings 113 in order to minimise contamination of the ambient environment with these materials. Furthermore, the sealing element 120 in accordance with the invention supports the suction during the removal.

Finally, sensors can additionally be attached to the tool body 110, which sensors monitor and control the optimal alignment of the tool 100 on a surface. They can be proximity sensors on the basis of ultrasonic technology and the like. Inspection apparatuses such as cameras and the like can also be provided. The tool 100 is proven its worth especially for use in automated maintenance systems for processing curved surfaces such as boat hulls. In this case, the tool 100 is arranged in a tool retainer which is moved towards the surface to be processed via an arm system.

CLAIMS

1. A tool (100) for cleaning large surfaces, especially boat hulls, comprising at least one tool body (110) and at least one nozzle body (200) whose nozzles (202, 202') are positioned substantially radially originating from the surface central point of the nozzle body (200), wherein two rotating nozzle bodies (200) are arranged on the tool body (110), and comprising in addition at least one sealing element (120), **characterized in that** the at least one sealing element (120) is arranged by way of at least one spring device (123) on the tool body (110).
2. A tool (100) according to claim 1, **characterized in that** the sealing element (120) is arranged as a substantially annular brush body (121).
3. A tool (100) according to claim 1 or 2, **characterized in that** that the sealing element (120) additionally comprises a substantially flat plastic seal (122), especially made of neoprene, which encloses the brush body (121) at least in part.
4. A tool (100) according to one of the claims 1 to 3, **characterized in that** the nozzle body (200) comprises three rotor arms (201) in which the nozzles (202, 202') are positioned.
5. A tool (100) according to claim 4, **characterized in that** the nozzles (202, 202') are arranged along the longitudinal axis of the rotor arm (201) of the nozzle body (200), wherein the longitudinal axes (A) of the nozzles (202, 202') intersect the base area (E) of the rotor arms (201) in a substantially orthogonal fashion.
6. A tool (100) according to claim 4 or 5, **characterized in that** at least one nozzle (202') arranged at the distal end (203) of the rotor arm (201) is provided on at least one rotor arm (201), said nozzle intersecting the base area (E) of the rotor arm (201) under an angle (α) which deviates between 2 and 10°, preferably 5°, from the orthogonal on the base area (E) of the rotor arm (201).
7. A tool (100) according to one of the claims 1 to 6, **characterized in that** the tool body (110) comprises at least one suction opening (113), preferably two or four thereof.
8. A tool (100) according to claim 7, **characterized in that** the shape of the tool body (110) substantially corresponds to an open cylinder with elliptical base area (111), wherein preferably two suction openings (113) are

arranged on the longitudinal sides of the base area (111) and two suction openings (113) are arranged on the tool body wall (112) in the region of the vertices of the elliptical base area (111).

9. A tool (100) according to claim 7 or 8, **characterized in that** at least one suction channel (114) is provided in the tool body wall (112), said channel opening into the at least one suction opening (113).
10. A tool (100) according to one of the claims 1 to 9, **characterized in that** the nozzle bodies (200) can be driven via a drive system with a hydraulic motor and a gear.

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