

Tool for cleaning surfaces

The invention relates to a tool for cleaning surfaces, in particular ship hulls, having a tool body which has at least one nozzle body which is arranged in an ablation space of the tool body and the nozzles of which are positioned substantially radially starting from the surface center of the nozzle body, wherein the at least one nozzle body can be driven in rotation via a drive system, and the axis of rotation of the nozzle body is arranged substantially parallel to and spaced apart from the axis of symmetry of the tool body.

In particular, the paint condition of ship hulls is usually checked at regular intervals. The defective areas discovered in this way can be small areas (spot processing) to full areas and must then be removed in order to be coated again. This ablation is usually carried out using maximum-pressure water jet technology, using high-pressure nozzles arranged in an appropriate tool. The individual high-pressure nozzles have only a small effective range so that in the known devices these ablation nozzles are arranged on a rotating nozzle body, which is essentially star-shaped, in order to achieve an increased ablation performance. This results in an essentially ring-shaped ablation of the damaged paint, which means that the ablation tool must be moved, especially for larger surfaces, in order to achieve a full-surface removal.

Such a tool can, for example, be taken from WO 2013/164487 A1.

It is the object of the invention to provide a tool of the type mentioned above that eliminates the disadvantage of the known prior art and ensures full-surface removal.

According to the invention, this object is solved by moving at least one nozzle body within the tool body along a plane which is essentially normal to its axis of rotation.

In a first embodiment of the invention, it is provided that the distance between the axis of symmetry of the tool body and the axis of rotation of the nozzle body is constant during operation, namely during the removal of layers of a surface to be treated. The nozzle body is essentially moved in a circle around the symmetry axis of the tool body so that due to the rotation of the nozzle body during operation, a spiral-shaped and subsequently full-surface removal takes place by means of water jets under maximum pressure.

The term "axis of symmetry" is used in this disclosure to mean the (central) axis of the tool body, which, during operation, is substantially normal to the surface to be machined and passes through the center of the bearing surface of the tool body on the surface to be machined.

Here it is particularly preferably provided that the at least one nozzle body is arranged on an eccentric disk. In this embodiment, the axis of rotation of the eccentric disk is arranged concentrically with the axis of symmetry of the tool body, while the axis of rotation of the nozzle body and the connected drive unit are arranged eccentrically on the eccentric disk.

Here it is particularly preferably provided that the drive unit itself is rotatably mounted on the eccentric disk, thus preventing the drive unit from rotating with the eccentric disk. In order to absorb the torque generated by the drive of the nozzle body at the drive unit, the drive unit is connected to the ablation tool by means of a torque support. This torque support introduces the reaction torque of the drive unit into the housing of the ablation tool without impairing the motion sequence of the drive unit and nozzle body specified by the rotation of the eccentric disk. Such a torque support is, for example, a kinematic system with a tension-compression rod.

The distance between the axis of rotation of the nozzle body and the axis of symmetry of the tool body remains constant and preferably corresponds at least to the maximum distance between the nozzles.

In an alternative embodiment of the invention, the distance between the axis of symmetry of the tool body and the axis of rotation of the nozzle body can be changed during operation. Here it is provided that the at least one nozzle body can be moved within the tool body along a plane which is substantially normal to its axis of rotation. This in turn results in an essentially complete full-surface removal, without the tool body itself having to be moved. The movement is effected along a movement vector which is essentially perpendicular to the axis of rotation of the nozzle body.

It is particularly preferably provided that the at least one nozzle body is movable by means of at least one linear guide. The linear guide causes a to-and-fro movement of the simultaneously rotating nozzle body via a corresponding drive, which in turn results in full-surface removal. This linear guide is located outside the removal area of the tool body and is sealed against environmental influences, wherein the sealing takes place over the entire stroke length in order to prevent water and overburden residues, for example paint residues, from escaping into the environment.

It is also provided that the nozzle body can be driven via a drive system with a hydraulic motor and a gear. This type of drive is particularly suitable for the aforementioned embodiments of the invention.

Preferably it is provided that during operation the minimum distance between the axis of symmetry of the tool body and the axis of rotation of the nozzle body corresponds to the maximum distance between the nozzles of the nozzle body in order to achieve the highest possible full-surface removal.

In the following, the invention will be explained in more detail using non-restrictive embodiment examples with associated figures, wherein:

- Fig. 1 shows a side view of a first embodiment of the tool according to the invention with a linear guide;
- Fig. 2 shows the tool from Fig. 1 in a sectional view;
- Fig. 3 shows the tool from Fig. 1 in a plan view of the nozzle body;
- Fig. 4 shows the view from Fig. 3 without nozzle body;
- Fig. 5 shows a second embodiment of the tool according to the invention with an eccentric disk in a side view;
- Fig. 6 shows the tool from Fig. 5 in a sectional view;
- Fig. 7 shows the tool from Fig. 5 in a plan view of the nozzle body; and
- Fig. 8 shows the view from Fig. 7 without the nozzle body.

The tool 100 according to the invention and according to a first embodiment - as shown in Figs. 1 to 4 - has a tool body 110 with a star-shaped nozzle body 120 arranged in its ablation space 111. In addition, a brush element 130 is attached to the tool body 110, via which the tool 100 is in contact with the surface to be machined. To facilitate the movement of the tool 100 over the surface to be machined, the tool is equipped with rollers 300.

In this embodiment, the nozzle body 120 has three nozzle jet arms 121, which are radially equipped with nozzles 122 starting from the surface center F of the nozzle body 120 (Fig. 3). The rotation axis D runs through the surface center F, around which the nozzle body 120 rotates during operation (arrow P1).

When the tool 100 is approached to the surface to be machined, the axis of rotation D is usually congruent with the axis of symmetry L of the tool body 110 in this embodiment of the invention. During operation, a drive member 140, via

which the nozzle body 120 is rotated, is displaced along a vector (arrow P2) in a plane substantially parallel to the surface to be machined so that the axis of rotation D and the axis of symmetry L are spaced parallel to each other.

In order to achieve full-surface machining, the minimum distance A (Fig. 1) between the axis of symmetry L and the axis of rotation D during ablation corresponds to the maximum distance between two adjacent nozzles 122. The plane of movement is essentially parallel to the surface to be machined and is essentially normal to the axis of rotation D of the nozzle body 120 or the axis of symmetry L of the tool body 110.

In this embodiment of the invention, the rotational axis D of the nozzle body 120 is displaced by means of a linear guide 150. The drive unit 140 is displaced by means of this linear guide 150, wherein this lateral displacement preferably takes the form of a periodic reciprocating movement. Thus, in a preferred embodiment of the invention, the distance A between the axis of rotation D of the nozzle body and the axis of symmetry L changes continuously during operation.

The drive part 140 is guided through the housing of the tool body 110 and sealed against it in order to prevent water, paint residues and other overburden material from escaping from the ablation space 111. The linear guide 150 is also sealed accordingly.

In a second embodiment of the invention according to Figs. 5 to 8, the nozzle body 120 is arranged eccentrically on an eccentric disk 250, wherein the axis of rotation E of the eccentric disk 250 is concentric with the axis of symmetry L of the tool body 121 (Fig. 6).

In contrast to the first embodiment with the linear guide, the nozzle body 120 rotating around the axis of rotation D is moved in a circle (arrow P3) in the ablation space 111 around the axis of symmetry L of the tool body 110 during operation. In this case, the distance A between the axis of rotation D of the nozzle body 120 and the axis of symmetry L of the tool body 110 remains constant and corresponds at least to the maximum distance of the nozzles 122 of the nozzle body 120 from each other.

For this purpose, a drive unit 140 is provided for the rotation of the nozzle body 120, which itself is rotatably mounted on the eccentric disk 250 in order to prevent the drive unit 140 from co-rotating with the eccentric disk 250. In order to absorb the torque generated by the drive of the nozzle body 120 at the drive unit 140, the drive unit 140 is connected to the tool body 110 by means of a torque support 251.

The eccentric disk 250 is rotated by a drive element 252.

It is understood that the present invention is not limited to the embodiment variants described above. It is essential for the invention that the axis of rotation of the nozzle body can be moved around it at a distance from the axis of symmetry of the tool body. The tool according to the invention is suitable both for large-area use and for machining small local areas on large surfaces.

CLAIMS:

1. Tool (100) for cleaning surfaces, in particular ship hulls, having a tool body (110) and at least one nozzle body (120) which is arranged in an ablation space (111) of the tool body (110) and a plurality of nozzles (122) of which are positioned essentially radially starting from the surface center (F) of the nozzle body (120), wherein the at least one nozzle body (120) is drivable in rotation on an axis of rotation (D) via a drive system (140), wherein said axis of rotation (D) runs through the surface center (F) of the nozzle body (120), and wherein said axis of rotation (D) is arranged substantially parallel to and spaced apart from the axis of symmetry (L) of the tool body (110) at a distance (A), **characterized in that** said axis of rotation (D) of the at least one nozzle body (120) is movable within the tool body (110) along a plane which is substantially normal to its axis of rotation (D) and the distance (A) between the axis of symmetry (L) of the tool body (110) and the axis of rotation (D) of the nozzle body (120) can be varied during operation.
2. Tool (100) according to claim 1, **characterized in that** the at least one nozzle body (120) is arranged eccentrically on an eccentric disk (250).
3. Tool (100) according to claim 2, **characterized in that** the axis of rotation (E) of the eccentric disk (250) is arranged concentrically to the axis of symmetry (L) of the tool body (110).
4. Tool (100) according to claim 1, **characterized in that** the at least one nozzle body (120) can be moved by means of at least one linear guide (150).
5. Tool (100) according to claim 4, **characterized in that** the at least one linear guide (150) is arranged sealed in the ablation space (111).
6. Tool (100) according to one of claims 1 to 5, **characterized in that** the nozzle body (120) can be driven via a drive system (140) with a hydraulic motor and a gear.
7. Tool (100) according to one of claims 1 to 6, **characterized in that** the distance (A) between the axis of symmetry (L) of the tool body (110) and the axis of rotation (D) of the nozzle body (120) during operation corresponds at least to the maximum distance of the nozzles (122) of the nozzle body (120) from one another.