(54) Title: SPRAYING ELEMENT FOR APPLYING A PAINT LAYER TO A WALL

(57) Abstract: The invention relates to a spraying element for applying a paint layer to a wall while the spraying element moves along the wall, wherein the spraying element is provided with a carrier, at least one spray nozzle located on the carrier and connectable to a paint pump for directing a cone of paint mist toward the wall, the axis of this paint mist cone being substantially at a right angle to the wall, and a spray hood which is connected to the carrier, surrounds the at least one paint mist cone during operation and is provided with a spray aperture through which the at least one paint mist cone leaves the spray hood, characterized in that the spray hood is provided with at least one air exchange opening arranged on the side of the spray hood opposite the spray aperture. The air exchange opening prevents the formation of such vortices caused by the hood, so that the paint mist cone is disrupted less and the paint can be applied uniformly more easily. The invention likewise relates to such a method.
— before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))
Spraying element for applying a paint layer to a wall

The invention relates to a device and a method for applying a paint layer to a wall, such as a ship’s hull, while a ship is in dry dock. The stay of a ship in a dock for repair or renovation is usually used to apply a new paint layer to the hull of the ship. After the cleaning and optional removal of old paint layers a new paint layer is applied to the hull of the ship by means of spraying. At present this is usually carried out manually. It has been found that a considerable part of the paint does not come to lie on the ship’s hull but is lost, which results in loss of paint, in contamination of structures lying in the surrounding area and in air contamination. This phenomenon is known as overspray.

In order to obviate these drawbacks US-B-7 334 742 provides a spraying element for applying a paint layer to a substantially flat wall while the spraying element moves along the wall, wherein the spraying element is provided with a carrier, at least one spray nozzle placed on the carrier and connectable to a paint pump for directing a cone of paint mist toward the wall to be painted, the axis of this paint mist cone extending substantially at a right angle to the wall, and a spray hood which is connected to the carrier, surrounds the at least one paint mist cone during operation and is provided with a spray aperture through which the at least one paint mist cone leaves the spray hood.

This prior art device is suitable for use in a hall, particularly for painting aircraft. Overspray is particularly undesirable in a hall. This device limits the overspray considerably. The presence of the spray hood however results in a less uniform distribution of the paint, which is caused by disruption of the pattern of the paint mist cone by the spray hood.

The present invention has for its object to provide a spraying element, wherein the least possible overspray occurs and wherein the disruption of the paint mist cone by the spray hood is as small as possible, so that the paint is applied as uniformly as possible to the wall to be sprayed.

The invention provides for this purpose a spraying element of the above stated type, wherein the spray hood is provided with at least one air exchange opening arranged on the side of the spray hood opposite the spray aperture.
The inventors have found that arranging the spray hood in many cases causes the paint mist cone to generate vortices inside the spray hood which greatly disrupt the structure of the paint mist cone, whereby applying a paint layer with a uniform thickness is made very difficult. The air exchange opening prevents the formation of such vortices caused by the hood, so that the paint mist cone is disrupted less and the paint can be applied uniformly more easily.

It has further been found that the presence of the air exchange opening in many cases reduces the influence of the wind on the paint mist cone. It is assumed that this is partly the result of the discharge of wind which enters the hood via the gap between the edge of the hood and the wall. Although it is possible in principle for the spraying element to be advanced along the wall manually, which is usually not easy in respect of the dimensions and the weight of the spraying element, it is more attractive for the spraying element to be advanced along the wall to be painted by means of an advancing device. It is noted that in order to apply a uniform paint layer it is relevant for the movement of the spraying element to be steady and to have the correct speed.

The invention not only relates to the spraying element elucidated above, but the invention also relates to a spraying device comprising a spraying element according to the above elucidated type, wherein the spraying device is provided with a paint pump coupled to a paint reservoir for supplying paint for spraying to the spray nozzle.

The invention moreover provides a method for applying a paint layer to a substantially flat wall while a spray nozzle moves along the wall by directing a cone of paint mist, the axis of which extends substantially at a right angle to the wall, toward the wall to be painted using the spray nozzle, and for shielding the paint mist cone from wind by means of a spray hood surrounding the paint mist cone, which spray hood is held at a distance from the wall, wherein the paint mist cone leaves the spray hood through a spray aperture, wherein a vortex is prevented from being created inside the spray hood by means of an air exchange opening located opposite the spray aperture.

The inventors have found that the surface area of the air exchange opening preferably has a minimal size in order to prevent a vortex being created. The starting point here is a
surface area which amounts to at least 10% of the surface area of the spray aperture. It is however also possible to obtain good results at a value greater than 5%, 20%, 30%, 40% or 50% of the surface area of the spray aperture. The surface area of the spray aperture is understood to mean the whole surface area which is taken up by the aperture and which can optionally be filled with cloth.

Since excessive wind can still result in disruption of the spray pattern it is recommended for flow limiting means to be arranged in the air exchange opening.

This embodiment moreover provides a method of the above stated type, wherein the flow limiting means prevent disruption of the paint mist cone. The flow limiting means otherwise have a secondary function as filter for paint particles.

According to a simple embodiment, the flow limiting means comprise a cloth. This cloth can be formed by a fabric but also by a non-woven material. The cloth can further have an almost closed structure so that the airflow through the air exchange opening is made very difficult, but it is also possible for the cloth to have an open structure. For the time being it is assumed that it is attractive to apply a cloth with an open structure, i.e. a cloth of which more than half of the surface area is open. A cloth is further suitable for performing the filtering function for the paint entrained by the airflow from the hood.

According to an alternative embodiment, the air exchange opening is connected to an air channel. The air channel serves to supply air to the air exchange opening or to discharge air from the air exchange opening. The air channel enables the connection between the air exchange opening and the surrounding area to be displaced, for instance to a location where there is less wind.

It is further possible to place an air pump or fan in the air channel. With an air pump or a fan the flow inside the spray hood is made even less susceptible to the wind.

It is possible in principle to arrange the air exchange opening at the position of the spray nozzle. In order to prevent disruption of the paint mist cone exiting the spray nozzle as far as possible it is however recommended for the plane of the air exchange opening to extend parallel to the plane of the spray aperture and for the air exchange opening to be
arranged in an extension of the spray hood extending on the side of the carrier remote from the spray aperture. It has been found that the paint mist cone is disrupted less and the tendency of a vortex which disrupts the paint mist cone to be formed is reduced with these measures.

It is structurally attractive for the spray hood to take a substantially cylindrical form.

According to a structurally attractive embodiment, the extension of the spray hood has a smallest cross-section smaller than the smallest cross-section of the spray hood.

Wind can enter the spray hood via the gap between the spray hood and the wall. Such an airflow can likewise result in a vortex being formed and in disruption of the paint mist cone. In order to prevent this an embodiment provides at least one air discharge channel connectable to an air pump and having a suction opening in the vicinity of the edge of the spray aperture for drawing in air at edges of the spray aperture. The airflow from outside to the interior of the spray hood is hereby at least partially carried away. The overspray can otherwise also be prevented in this way.

This embodiment moreover provides a spraying device according to the above elucidated type, wherein the spraying device is provided with a discharge channel with a mouth which lies in the vicinity of the edge of the spray hood and an extraction channel which is connected to a pump.

This embodiment further provides a method of the above stated type, wherein air present in the gap between the spray hood and the wall is at least partially discharged. The air can be formed here by wind or by air co-displacing with overspray.

It is structurally attractive for the jacket wall of the spray hood to be double-walled and for the space between the double walls to form a part of the discharge channel. A suction opening extending all around the spray hood is hereby obtained.

The thus removed air is usually contaminated with paint. In order to prevent contamination of the surrounding area it is recommended for an air filter to be placed in
the discharge channel in the space between the double walls. It is likewise possible to place an air filter elsewhere in the discharge channel.

This embodiment moreover provides a method wherein the carried away airflow is filtered.

A structurally attractive embodiment results when the space between the double walls transposes into at least one discharge channel at the position of the carrier.

In order to obviate the drawbacks of manually displacing the spraying member along the wall to be sprayed it is recommended for the spraying device to be provided with an advancing or moving mechanism for advancing or moving the spraying element along the surface to be painted.

The present invention will be elucidated hereinbelow with reference to the accompanying drawings, in which:

Figure 1 is a schematic cross-sectional view of a first embodiment of the invention;
Figure 2 is a schematic cross-sectional view along the line II-II in figure 1;
Figure 3 is a cross-sectional view corresponding to figure 2 of a second embodiment;
Figure 4 is a schematic perspective view of a third embodiment;
Figure 5 is a top view corresponding to figures 2 and 3 of the third embodiment; and
Figure 6 is a cross-sectional view corresponding to figure 1 of the third embodiment.

Figure 1 shows a ship’s hull with a wall 1 which has to be provided with a new paint layer. This figure shows a spraying element designated as a whole with 2 and provided with three wheels 3 with which it is advanced over wall 1. It is otherwise possible for swivel wheels to be applied instead of fixedly mounted wheels. The method of driving is not shown in figure 1, although it is possible to envisage the spraying element being moved along the vertical wall manually, particularly when it is not made too great, although it is also possible for use to be made of a macromanipulator for transporting
the spraying element in vertical direction. It is otherwise also possible for use to be made of a carriage with a macromanipulator which moves along the vertical wall automatically and on which the spraying element is mounted. In this latter case wheels 3 can be dispensed with. Although the principle of the invention is elucidated above on the basis of a vertical wall, it will be apparent that the invention can also be applied with walls extending in a different direction or in curved walls, even in double-curved walls.

The spraying device 2 likewise shown in figure 2 comprises a framework 4 which functions as carrier 4 and in which openings 5 are arranged. A cloth 5a is arranged in the openings. Arranged in the centre of framework 4 is a spray head 6 configured to generate a paint mist cone 7. Spray head 6 is connected to a pump 9 by a hose 8 for the purpose of supplying pressurized paint. A spray hood 10 extends in the direction of paint mist cone 7 on the edge of framework 4. Spray hood 10 is provided with three layers 11, in each of which is mounted a wheel 3 whereby spray hood 10, and thereby the whole spraying device 2, can roll over wall 1. Wheels 3 are placed such that a gap 13 remains between edge 12 of spray hood 10 and wall 1. Paint mist cone 7 leaves spray hood 10 via spray aperture 14 and comes to lie on wall 1.

Hardly any overspray takes place while the spraying operations are being carried out since spray hood 10 keeps paint mist cone 7 inside. The presence of openings 5 prevents a vortex being formed inside the spray hood, so that the structure of paint mist cone 7 is hardly affected and the paint comes to lie evenly on wall 1. Wind can of course enter spray hood 10 via gap 13 between wall 1 and edge 12 of spray hood 10, although the wind only displaces paint mist cone 7 slightly and the wind hardly disrupts the flow pattern of paint mist cone 7. Cloth 5a or the other flow limiting means in opening 5 damp the influence of the wind so that a vortex is prevented from being formed inside the spray hood.

Figure 3 shows a second embodiment which differs from the embodiment shown in figures 1 and 2 due to the shape of spray hood 10, which in this embodiment is rectangular or even square. It is otherwise possible to apply other shapes of spray hood 10, such as hexagonal or oval. In this and in the above discussed embodiment spray head 6 always generates a paint mist cone 7 with an elliptic cross-section. It is however
possible to use spray heads 6 which generate a paint mist cone 7 with a circular cross-section.

The third embodiment shown in figures 4, 5 and 6 differs from the above elucidated embodiments in that wheels 3 are absent and in that means are present for extracting possibly contaminated air at edge 12 of spray hood 10. The absence of the wheels requires other means to be present to move the spraying element along the wall and to hold the spraying element at a distance from the wall.

In this embodiment carrier 4 comprises a plate 4 in which a single large aperture 15 is made and a U-shaped bracket 16 which is mounted on plate 4. An arm 17 of an advancing device which moves the spraying element along the wall is mounted on U-shaped bracket 16.

A spray head 6 is placed in the space between bracket 16 and plate 4. As in the foregoing embodiments, a spray hood 10 extends from the edges of plate 4 in the direction of the axis of paint mist cone 7, albeit that spray hood 10 is double-walled in the present embodiment. The space 18 between the two walls 10a and 10b of spray hood 10 is open on the side of wall 1 and on the other side leads to two connecting pieces 19 which are configured to be connected to a vacuum pump. An annular filter 20 is further arranged in space 18.

Spray hood 10 is provided with an extension 20 with a cross-section smaller than that of the actual spray hood. This extension 20 extends at the position of the U-shaped bracket. Arranged on the side of extension 20 remote from wall 1, on either side of U-shaped part 16, is an aperture 21 which is provided with filter cloth. Since the cross-section of extension 20 is smaller than that of spray hood 10 space is created for coupling pieces 19 on either side of extension 20.

In use of this spraying element 1 it is advanced along wall 1 by the advancing device, wherein a gap 13 is maintained between wall 1 and the edge of spray hood 10. Spray head 6 sprays a paint mist cone 7 toward wall 1, which paint mist cone is not greatly disrupted since a vortex is prevented from being formed in spray hood 10.
Air, which may be contaminated with paint mist as a result of contact between paint mist cone 7 and the air, moves via the gap 13 between spray hood 10 and wall 1. This air is drawn in via the opening between the two walls 10a, 10b and the space 18 located therebetween. This air is then filtered in filter 20 and pumped away to the vacuum pump via connecting pieces 19. In addition to this function, which reduces the spread of the contamination by the paint, extraction of the air further results in the airflow of aperture 21 and gap 13 being even more controllable, so that the influence of wind is reduced even further and a vortex is prevented from being formed inside the spray hood.

In addition to the above elucidated embodiments an air channel, optionally provided with a pump or a fan, can be connected to the air exchange opening for the purpose of controlling the airflow through the spray hood. This air pump or fan can be configured to guide air to the air exchange opening or away from the air exchange opening.

It will be apparent that numerous variations of the above stated embodiments are possible within the scope of the invention as defined by the appended claims; measures of the diverse embodiments can thus be combined with each other, but the scope of protection is defined by the claims.
Claims

1. Spraying element for applying a paint layer to a wall while the spraying element moves along the wall, wherein the spraying element is provided with:
   - a carrier;
   - at least one spray nozzle placed on the carrier and connectable to a paint pump for directing a cone of paint mist toward the wall, the axis of this paint mist cone extending substantially at a right angle to the wall; and
   - a spray hood which is connected to the carrier, surrounds the at least one paint mist cone during operation and is provided with a spray aperture through which the at least one paint mist cone leaves the spray hood, characterized in that the spray hood is provided with at least one air exchange opening arranged on the side of the spray hood opposite the spray aperture.

2. Spraying element as claimed in claim 1, characterized in that the surface area of the air exchange opening is greater than one tenth of the surface area of the spray aperture.

3. Spraying element as claimed in claim 1 or 2, characterized in that flow limiting means are arranged in the air exchange opening.

4. Spraying element as claimed in claim 3, characterized in that the flow limiting means comprise a cloth.

5. Spraying element as claimed in any of the foregoing claims, characterized in that the air exchange opening is connected to an air channel.

6. Spraying element as claimed in claim 5, characterized in that an air pump or a fan is placed in the air channel.

7. Spraying element as claimed in any of the foregoing claims, characterized in that the plane of the air exchange opening extends parallel to the plane of the spray aperture and that the air exchange opening is arranged in an extension of the spray hood extending on the side of the carrier remote from the spray aperture.
8. Spraying element as claimed in any of the foregoing claims, characterized in that the spray hood takes a substantially cylindrical form.

9. Spraying element as claimed in claim 7, characterized in that the extension of the spray hood has a smallest cross-section smaller than the cross-section of the spray hood.

10. Spraying element as claimed in any of the foregoing claims, characterized by at least one air discharge channel connectable to an air pump and having a suction opening in the vicinity of the edge of the spray aperture for drawing in air at edges of the spray aperture.

11. Spraying element as claimed in claim 10, characterized in that the jacket wall of the spray hood is double-walled and that the space between the two walls of the jacket wall forms a part of the air discharge channel.

12. Spraying element as claimed in claim 11, characterized in that an air filter is placed in the air discharge channel.

13. Spraying element as claimed in claim 11 or 12, characterized in that the space between the double walls is connected to the air discharge channel at the position of the carrier.

14. Spraying device, comprising a spraying element as claimed in any of the foregoing claims, characterized in that the spraying device is provided with a paint pump coupled to a paint reservoir for supplying paint for spraying to the spray nozzle under pressure.

15. Spraying device as claimed in claim 14, characterized in that the spraying device is provided with an air discharge channel with a suction opening which lies in the vicinity of the edge of the spray hood and that the air discharge channel is connected to an air pump.
16. Spraying device as claimed in claim 14 or 15, characterized in that the spraying device is provided with an advancing mechanism for advancing the spraying element along the wall to be painted.

17. Method for applying a paint layer to a wall while a spray nozzle moves along the wall, by
- directing a cone of paint mist, the axis of which extends substantially at a right angle to the wall, toward the wall using the spray nozzle; and
- containing the paint mist cone by means of a spray hood surrounding the paint mist cone, which spray hood is held at a distance from the wall, wherein the paint mist cone leaves the spray hood through a spray aperture, characterized in that a vortex is prevented from being created inside the spray hood by means of an air exchange opening located opposite the spray aperture.

18. Method as claimed in claim 17, characterized in that an airflow flowing through the air exchange opening is limited by flow limiting means.

19. Method as claimed in claim 17 or 18, characterized in that air present in the gap between the spray hood and the wall is at least partially carried away.

20. Method as claimed in claim 19, characterized in that the carried away airflow is filtered.
**International Search Report**

**A. Classification of Subject Matter**

**INV.** B05B13/00  B05B15/04

**ADD.**

According to International Patent Classification (IPC) or to both national classification and IPC

**B. Fields Searched**

Minimum documentation searched (classification system followed by classification symbols)

B05B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, WPI Data

**C. Documents Considered to be Relevant**

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<td>WO 01/34309 A2 (VROLIK PETER WILLIAM [NL]) 17 May 2001 (2001-05-17) page 13, line 15 - line 27; figures 2,16</td>
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See patent family annex.

Further documents are listed in the continuation of Box C.

* Special categories of cited documents:
  
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Date of the actual completion of the international search:

19 May 2016

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Name and mailing address of the ISA/

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Authorized officer:

Innecken, Axel
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