

# PATENT SPECIFICATION

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## (54) METHOD FOR PROTECTING SHIPS AGAINST FOULING

(71) I, OYSTEIN RASMUSSEN, a Norwegian citizen of Hoseleveien 119, 1340 Bekkestua, Norway, do hereby declare the invention, for which I pray that a Patent may be granted to me, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The invention relates to a method for protecting ships against fouling and corrosion through the application of a coating of wax to the underwater surfaces, this wax layer optionally being applied on top of an intermediate layer of an anti-fouling composition. The invention also extends to subaqueous structures protected by the method of the invention.

The most common method of protecting the underwater surfaces of a ship against fouling is to apply a coating which includes an anti-fouling composition to these surfaces. However, experience has shown that, under unfavorable conditions, fouling can occur relatively quickly even on these coatings, with a resultant decrease in speed or increase in fuel consumption for the ship. Therefore, brushing systems for regularly brushing the underwater surfaces to remove the fouling matter have been developed. In practice, however, it has been shown that fouling of the waterwater surfaces occurs again relatively soon after such brushing.

Attempts to reactivate the anti-fouling coating have also been made, where one grinds off the outermost layer of the coating with stiff brushes, thus exposing an inner layer of the anti-fouling composition, such that the preventive toxicants can once more work actively on the surface of the coating. However, during this process some of the toxicants in the film of paint will be brushed off and will sink to the bottom, thereby contaminating the environment. The same problem occurs when the toxic paint is applied to the ship in dry dock, because re-

mains of paint will be rinsed off in the sea when the ship is launched.

Recently, new anti-fouling systems have been developed based on the use of wax, either alone, since the wax by itself will have a certain antifouling effect, or in systems where the wax is added to an anti-growth composition. Such systems have the advantage, among other things, that when using this system to protect a ship which is lying still for a long period of time and which thus will also be severely fouled, the entire coating of wax can be removed by washing it down or by brushing it off. Under normal operating conditions, any fouling agents which are firmly attached to the underwater ship surfaces can also be removed much more easily from the wax coating than from the conventional coatings, since the roots, especially of algae, do not penetrate deeply into the wax coating, but remain on the surface. With the conventional anti-fouling paints, one has not been able to remove these roots by brushing, so that one has in reality merely cut off the "grass" that has grown on the side of the ship.

It has proved to be a frequent occurrence, in today's shipping conditions, that a ship is forced to lie up for an extended period of time, either because of a lack of cargo or due to cargo accumulating in the harbors. When a ship lies still over an extended period of time, its underwater surfaces will become fouled to a greater degree than under normal operation, and it will be necessary to dock the ship earlier than usual. One also has the same problem with ships which are laid up, where one often experiences a greater degree of fouling when the ship is in operation. Problems of this nature have become especially prevalent in recent years, and no satisfactory solution to these problems has been found.

Therefore, the present invention seeks to

10 provide a method for protecting ships against fouling and corrosion, whereby these problems are solved. Preferred embodiments of the invention provide a system of protection which will give longer and better protection for ships in normal operation than the systems known at present.

5 According to the present invention a method for protecting a ship or subaqueous surface against fouling and corrosion by applying a coating of wax to the surface or underwater surfaces of the ship, is characterized in that several successive layers of wax are applied to the underwater surface(s) in sequence, each layer differing in physical properties from its adjacent layer(s) so that the layers can be removed successively when the surface of the outermost layer has been subjected to growth formation.

20 The different physical properties may be different melting points and/or different degrees of hardness. Since the melting temperatures of the preferred waxes lie under 100°C, one can utilize the hot water or steam which can be produced on board most ships for the layer-stripping operation. By adjusting the water to the correct temperature, one can quite simply melt a layer of wax on the side of a ship by supplying an amount of heat sufficient to melt the wax, and one can also rinse off the wax layer with this water, because the stream of water can be carried to the ship's hull via an enclosure, closed to the outside, in which there is an overpressure. By adjusting the water temperature appropriately, it will thus be possible to supply a specific amount of heat sufficient to melt one layer of wax having a specific melting temperature, without removing an underlying layer of wax having a higher melting temperature. The melting temperature of each layer can be at least 2°C higher (and preferably is between 5°C and 10° higher) than the melting temperature of the next innermost layer. Another possibility for removing the wax is by brushing, where one adjusts the brushing pressure or the hardness of the brush in accordance with the hardness of the wax, such that underlying, harder layers of wax are not attacked. A combination of these two possibilities can also be used. In this way, one can remove layer after layer of wax, thus exposing, at regular intervals, a completely new surface on the underwater parts of the ship's hull. Also, as mentioned previously, because the roots of the algae have only attached themselves to the surface of the outermost layer of wax, one will at the same time remove entirely even the incipient fouling, as opposed to the conventional process of brushing the ordinary anti-fouling coating, where the roots of the algae remain embedded in the coating. One thus obtains a significantly more effective cleaning of the

surface.

Using wax also has the advantage of reducing contamination of the environment. Wax is lighter than water and will therefore float up to the surface of the water, where it can be collected within a barrier. The coating remains can be collected in this way whether or not the wax has incorporated an anti-growth composition, so that all of the coating material which is removed from the sides of the ship can thus be collected in a simple manner and removed.

The wax is applied in layers each having a thickness which would typically lie in the range of a few tens of microns to a few hundreds of microns. Preferred thicknesses would be in the range 50 to 150 microns. Six layers, for example, can be applied, and experience has shown that it will probably be sufficient to remove one layer every year. One thus obtains a protection extending over six years, without any fouling of the sides of the ship to speak of. In addition, there can be a layer of ordinary anti-fouling composition under the layers of wax, which gives a further extension of protection time.

The wax can be applied in whatever suitable manner is desired, and it can be applied, for example, as a melt, or in the form of a dispersion, emulsion, or the like, by spraying. When applying the various coats of wax, it is practical if one waits until one layer has set before applying the next, but it is also possible to let the layers overlap each other by applying several layers in quick succession. To save time, equipment can be used with which several layers are applied immediately following one another.

A further aspect of the invention relates to a ship whose hull is coated with a plurality of layers of wax applied one after the other, each layer but the first having a successively lower melting point and/or lower degree of hardness than the immediately preceding layer whereby the layers can be removed one by one as, in turn, each outer layer is fouled with growth formations.

The invention will be explained further in the following, examples of embodiments of the method.

#### EXAMPLE 1

To the underwater hull of a ship carrying a conventional anti-fouling toxic layer, a wax dispersion of a microwax having a melting point of 71°C is applied by spraying. Over this layer, additional layers of paraffin wax having melting points of 61°C, 55°C, 50°C, and 45°C, respectively, are applied by spraying. Each layer is about 100 microns thick.

After one year's operation of the ship, a washing down of the underwater hull is undertaken using hot water from the ship's own system. The washing-down is performed by a diver, and the temperature of the water

is held between 45°C and 50°C when it strikes the surface of the wax. Only the outermost layer of paraffin wax will therefore melt and loosen from the side of the ship, together with the growth of fouling agents it has accumulated. This treatment is repeated once every year, or whenever it is found to be necessary. The temperature of the water used for the washing down, is increased with each treatment having regard to the melting point for the layer of wax which is then outermost. After five years, all of the layers of wax will have been removed, and the underlying anti-fouling toxic layer of conventional type is then exposed and forms a final protective layer.

#### EXAMPLE 2

The underwater surfaces of a ship are coated, in a manner corresponding to that in Example 1, with six layers of wax having different degrees of hardness, where hardness is defined as the needle penetration factor at 25°C. The overall thickness of the coating is about 600 microns. The innermost layer will thus have a needle penetration factor of 5, and the following layers, 11, 18, 30, 40, and 100, respectively. When the ship's bottom has become sufficiently fouled to require cleaning for the first time, the outermost softest layer of wax is removed by brushing, using brushes of the type commonly used in the brushing of ships. The brushing pressure or the hardness of the brush is regulated in accordance with the degree of hardness of the outermost layer of wax. This process is repeated five more times, increasing the severity of brushing each time, after which the ship must again be coated with a new system of wax layers.

It should be noted that when using a system of wax coatings, one must make certain that a system which is in accordance with the conditions where the ship is to operate, is applied, such that, for example, in tropical waters, in the area between the light and heavy cargo lines on the hull, a wax is used which does not melt before reaching a temperature of approximately 58-60°C.

It should also be noted that it is of course possible to remove more than one layer at a time, should this for some reason be desirable.

#### EXAMPLE 3

The application is carried out in accordance with Example 1, except that the first layer is applied by spraying on a micro-crystalline wax in melted state. An especially good adhesion to the foundation is thereby achieved.

At least some of the wax layers could be coloured differently from adjacent layers to facilitate complete removal of just the chosen layer.

The invention is applicable to any sub-

aqueous surface which requires protection from fouling.

#### WHAT I CLAIM IS:—

1. A method for protecting a ship or sub-aqueous surface against fouling and corrosion by applying a coating of wax to the surface or underwater surfaces of the ship, characterized in that several successive layers of wax are applied to the underwater surface(s) in sequence, each layer differing in physical properties from its adjacent layer(s) so that the layers can be removed successively when the surface of the outermost layer has been subjected to growth formation.

2. The method according to claim 1, in which the layers are applied one at a time and subsequently removed one at a time.

3. The method according to claim 1 or claim 2, in which an anti-fouling composition has been added to at least one of the layers of wax used.

4. The method according to any preceding claim, in which the layers of wax are applied by spraying.

5. The method according to any preceding claim, in which the layers of wax are applied in a melted state.

6. The method according to any of claims 1 to 4, in which the layers of wax are applied as dispersions or emulsions.

7. The method according to any preceding claims, in which the layers of wax are removed by brushing, where the brush pressure is regulated in accordance with the hardness of the outermost wax layer about to be removed.

8. The method according to any of claims 1 to 6, in which the layers of wax are removed by washing down with liquid, the temperature and the volume of liquid supplied being adjusted to correspond to the amount of heat which is necessary to melt the outermost wax layer about to be removed.

9. The method according to claim 1, in which the wax used for each layer, has a melting temperature which is higher than the melting temperature of the next innermost layer by at least 2°C.

10. The method according to claim 9, in which the difference in melting temperature between successive layers is between 5°C and 10°C.

11. The method according to claim 1, in which the wax used for each layer has a hardness which is higher than the hardness of the next innermost layer.

12. A method for protecting a ship against fouling and corrosion by applying a coating of wax to the underwater surfaces of the ship, characterized in that several successive layers of wax coating are applied to the underwater surfaces in sequence, each layer having a successively lower melting point



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is held between 45°C and 50°C when it strikes the surface of the wax. Only the outermost layer of paraffin wax will therefore melt and loosen from the side of the ship, together with the growth of fouling agents it has accumulated. This treatment is repeated once every year, or whenever it is found to be necessary. The temperature of the water used for the washing down, is increased with each treatment having regard to the melting point for the layer of wax which is then outermost. After five years, all of the layers of wax will have been removed, and the underlying anti-fouling toxic layer of conventional type is then exposed and forms a final protective layer.

#### EXAMPLE 2

The underwater surfaces of a ship are coated, in a manner corresponding to that in Example 1, with six layers of wax having different degrees of hardness, where hardness is defined as the needle penetration factor at 25°C. The overall thickness of the coating is about 600 microns. The innermost layer will thus have a needle penetration factor of 5, and the following layers, 11, 18, 30, 40, and 100, respectively. When the ship's bottom has become sufficiently fouled to require cleaning for the first time, the outermost softest layer of wax is removed by brushing, using brushes of the type commonly used in the brushing of ships. The brushing pressure or the hardness of the brush is regulated in accordance with the degree of hardness of the outermost layer of wax. This process is repeated five more times, increasing the severity of brushing each time, after which the ship must again be coated with a new system of wax layers. It should be noted that when using a system of wax coatings, one must make certain that a system which is in accordance with the conditions where the ship is to operate, is applied, such that, for example, in tropical waters, in the area between the light and heavy cargo lines on the hull, a wax is used which does not melt before reaching a temperature of approximately 58-60°C. It should also be noted that it is of course possible to remove more than one layer at a time, should this for some reason be desirable.

#### EXAMPLE 3

The application is carried out in accordance with Example 1, except that the first layer is applied by spraying on a micro-crystalline wax in melted state. An especially good adhesion to the foundation is thereby achieved.

At least some of the wax layers could be coloured differently from adjacent layers to facilitate complete removal of just the chosen layer.

The invention is applicable to any sub-

aqueous surface which requires protection from fouling.

#### WHAT I CLAIM IS:—

1. A method for protecting a ship or sub-aqueous surface against fouling and corrosion by applying a coating of wax to the surface or underwater surfaces of the ship, characterized in that several successive layers of wax are applied to the underwater surface(s) in sequence, each layer differing in physical properties from its adjacent layer(s) so that the layers can be removed successively when the surface of the outermost layer has been subjected to growth formation.

2. The method according to claim 1, in which the layers are applied one at a time and subsequently removed one at a time.

3. The method according to claim 1 or claim 2, in which an anti-fouling composition has been added to at least one of the layers of wax used.

4. The method according to any preceding claim, in which the layers of wax are applied by spraying.

5. The method according to any preceding claim, in which the layers of wax are applied in a melted state.

6. The method according to any of claims 1 to 4, in which the layers of wax are applied as dispersions or emulsions.

7. The method according to any preceding claims, in which the layers of wax are removed by brushing, where the brush pressure is regulated in accordance with the hardness of the outermost wax layer about to be removed.

8. The method according to any of claims 1 to 6, in which the layers of wax are removed by washing down with liquid, the temperature and the volume of liquid supplied being adjusted to correspond to the amount of heat which is necessary to melt the outermost wax layer about to be removed.

9. The method according to claim 1, in which the wax used for each layer, has a melting temperature which is higher than the melting temperature of the next innermost layer by at least 2°C.

10. The method according to claim 9, in which the difference in melting temperature between successive layers is between 5°C and 10°C.

11. The method according to claim 1, in which the wax used for each layer has a hardness which is higher than the hardness of the next innermost layer.

12. A method for protecting a ship against fouling and corrosion by applying a coating of wax to the underwater surfaces of the ship, characterized in that several successive layers of wax coating are applied to the underwater surfaces in sequence, each layer having a successively lower melting point



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12 4 and/or degree of hardness so that the layers can be removed successively when the surface has been subjected to growth formation.

5 13. The method of protecting a ship against fouling substantially as described in any of the foregoing Examples.

10 14. A ship protected against fouling and corrosion by the method claimed in any preceding claim.

15. A ship whose hull is coated with a plurality of layers of wax applied one after the other, each layer but the first having a successively lower melting point and/or

lower degree of hardness than the immediately preceding layer whereby the layers can be removed one by one as, in turn, each outer layer is fouled with growth formations.

15 16. A ship as claimed in claim 15 in which each layer is between 50 and 150 microns thick.

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