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(54) Marine antifouling system

(57) A marine antifouling system employing sacrificial anodes to which a low D.C. electric current is applied, so that electrolytic protection can be maintained after the sacrificial anodes (26, 28) have become worn away before the vessel is due for a re-fit, the system includes valve assemblies (22, 30) on opposite sides of an anode housing (24), the arrangement allowing the opening of the anode housing for the replacement of a worn anode (26, 28).

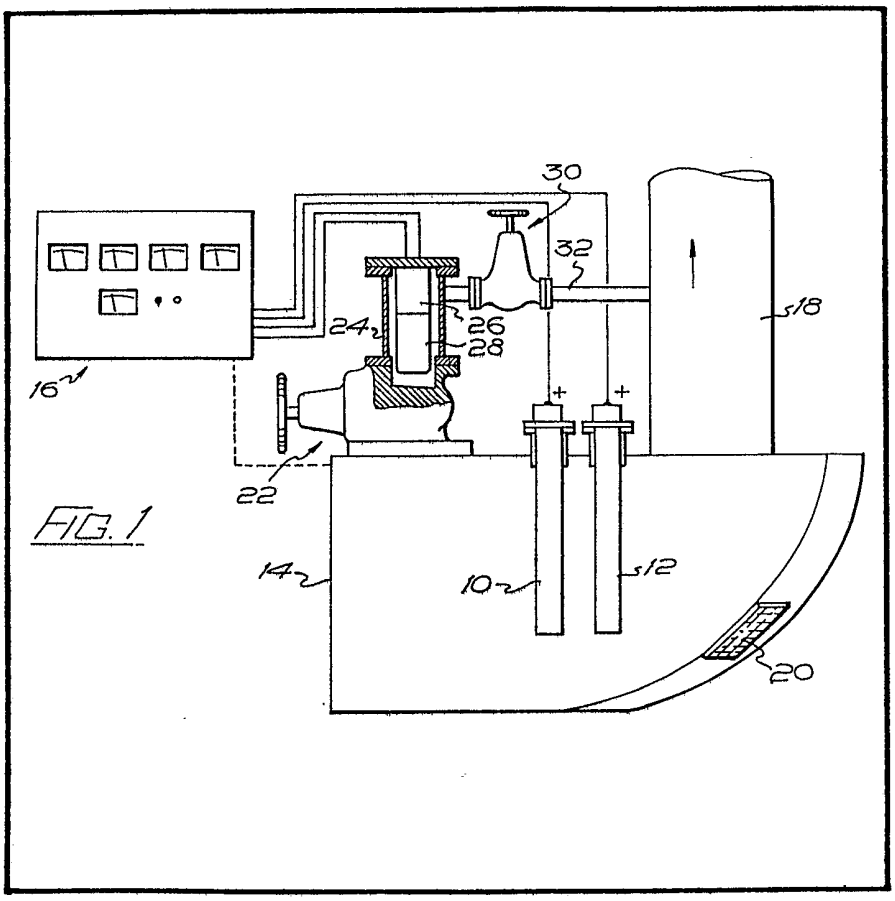


FIG. 1

GB 2 118 972 A

The drawings originally filed were informal and the print here reproduced is taken from a later filed formal copy.

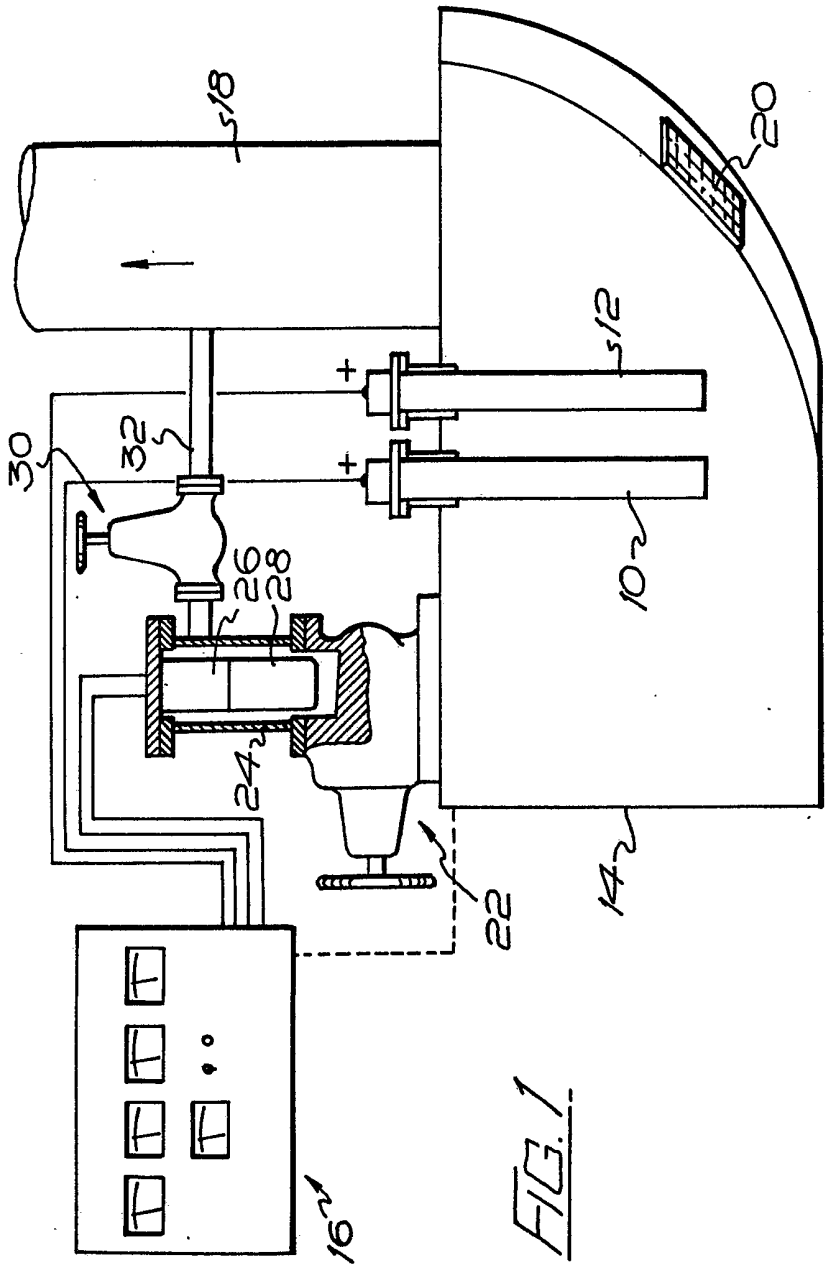


FIG. 1

FIG. 2.

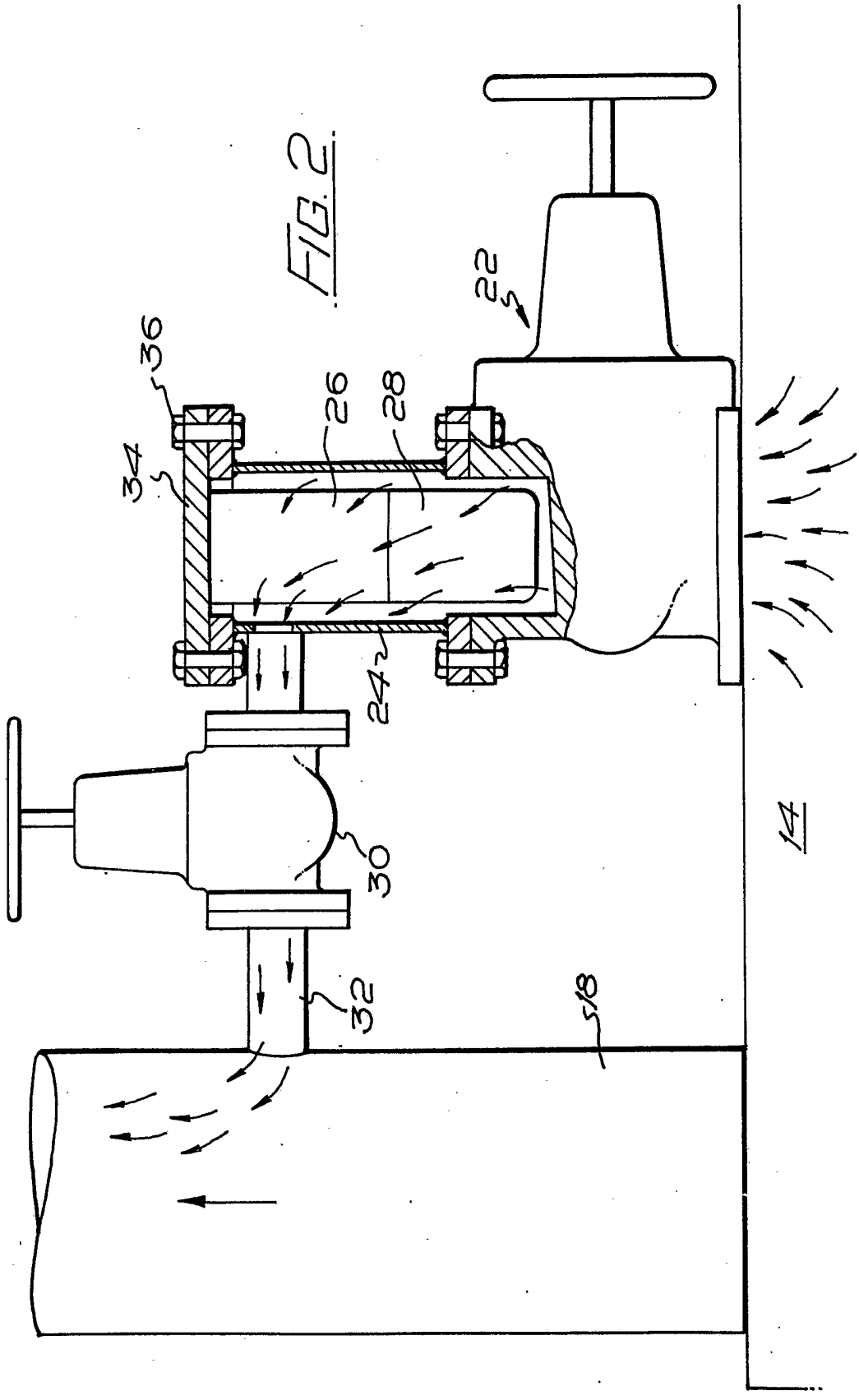
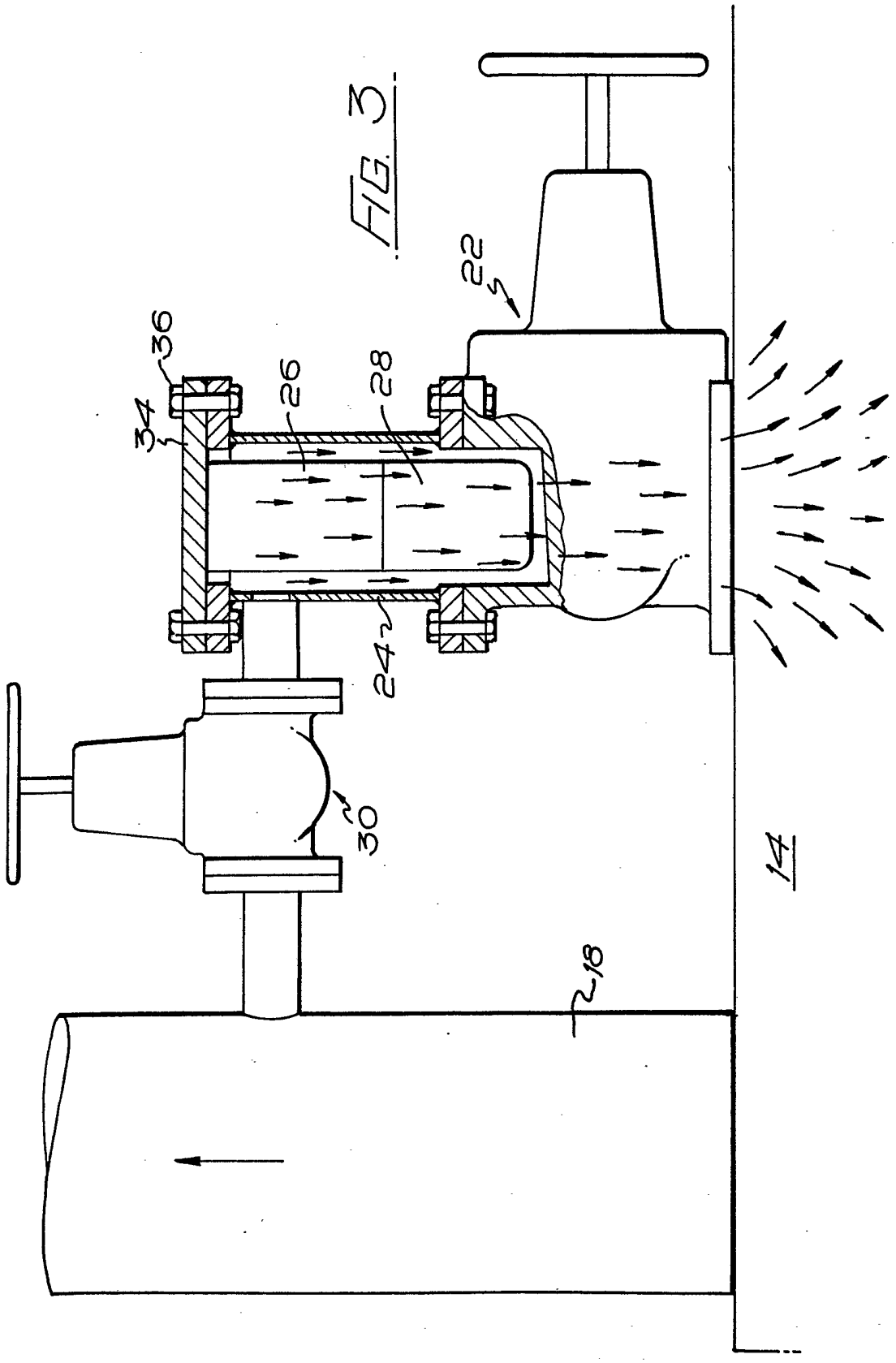


FIG. 3



SPECIFICATION

Marine antifouling system

The invention relates to a marine antifouling system and has for its object to provide an improvement therein.

It is a particular problem that the use of sea water in various systems in sea going vessels causes serious fouling and corrosion unless steps are taken to prevent or at least limit the effects of sea water in the systems concerned. Sea water is used, for example, for engine cooling and in fire fighting systems. The uncontrolled growth of marine life such as shell fish, particularly mussels, and barnacles and the growth of algae, and also uncontrolled corrosion by sea water can very seriously impede the flow of sea water through such a system. Consequently, the proper cooling of the engines can be seriously affected and the proper functioning of a fire fighting system can be prevented by loss of water pressure.

The sea water is generally drawn through suitable filter grids into what are termed "sea chests", that is to say closed compartments in the hull of the ship. The various systems utilising sea water draw the water from the sea chests. A relatively small ship may have only one sea chest but larger ships may have several. All sea going vessels are of course required to have regular re-fitting and maintenance but such re-fits are generally scheduled at relatively long intervals of time, for example at two year intervals. At these times it is generally found that the systems using sea water require clearing of marine growth, the worst affected places being the sea chests where the various organisms first enter the ship. To clear these areas it is often necessary for men working inside the sea chests, when the ship has been put into dry dock, to use pneumatic drills to displace mussels and other limpets. If no means have been employed for limiting such fouling of the water systems cost of clearing the fouled areas during re-fitting can be considerable and of course it is not always possible to gain access to areas of fouling in pipework and in valves for example through which sea water has been drawn from the sea chests.

It is known that marine growth, such as the growth of barnacles, is particularly severe in warmer inshore waters and it is thought that when a vessel which has remained for some time in such waters subsequently moves into colder or less saline waters the existing build-up of marine growth tends to become detached from the primary fouling sites (that is to say from the sea chests) and to be drawn into the condenser tubes and other systems of the vessel which can very soon become blocked. This tendency may be particularly marked when the vessel moves from warmer inshore waters to waters which are to some extent polluted as well as colder.

Various methods have previously been used for preventing or at least reducing the fouling and corrosion caused by the user of sea water in the various systems in sea going vessels. For example, chlorination (by gas injection) and other chemical processes have been used but these methods have been far from successful, in particular because they cause environmental pollution, because of the fact that very large quantities of sea water are used, at least whilst a vessel is at sea, and because of the high cost involved in the use of such processes.

A further method which has been used is an electrolytic system employing sacrificial anodes to which a low D. C. electric current is applied, the sacrificial anodes usually being made of copper or aluminium or iron. For example, when two sacrificial anodes have been used, one being made of aluminium, it has been found that aluminium hydroxide has been caused to flocculate upon particles of released copper, this copper/aluminium hydroxide floc being carried through the water system concerned and, being highly gelatinous tends to spread out in areas of low turbulence where marine growth larvae are most likely to settle. The process is continuous and its effects are cumulative throughout the water system concerned so that, although the amounts of copper and aluminium being released are extremely small, the cupro-aluminium film built up on the internal surfaces of pipes, valves and the like of the water system over a period of time creates a thin, non-heat-insulating protective coating which very effectively inhibits marine growth and corrosion.

In such an electrolytic system the sacrificial anodes are generally located in the sea chest or sea chests of the vessel concerned since this is where the fouling mainly takes place. However, as already pointed out, when the vessel is at sea the hydroxide floc or other anode product is carried through the sea water systems concerned as the sea water is drawn from the sea chest or sea chests. When the vessel is in harbour (and it will be understood that the vessel is most susceptible to attack by creatures such as mussels and the like when inshore) the hydroxide floc or other anode product may not be drawn from the sea chest or sea chests because many of the normal water systems will be inoperative, but is still reduced therein to protect that most vulnerable area. However, a problem which is often found is that due to the fact that the sacrificial anodes can only be renewed when the vessel is in dry dock, they are completely worn away before the vessel is due for a re-fit. Measures are usually taken to guard against this happening. For example, anodes which are expected to last approximately three years of continuous use may be fitted in a vessel which regularly has re-fits at two year intervals. This employment of a generous factor of safety may work well for some time until for some reason the anodes cannot be replaced when originally planned. It may at that time be tempting to observe that the old anodes still have a further year or so of useful life but unless steps are taken to conserve them the time inevitably comes when they are completely worn away and at that time the vessel concerned may not be due for a further

re-fit for a further 12 months or so. During that time the sea water systems, and particularly the sea chest or sea chests, will be without any kind of protection against the growth of marine life and against corrosion. If it is known that the anodes are becoming seriously worm away certain steps can be taken to conserve them. For example, the D.C. electric current supplied to them may be reduced. Alternatively, or in addition to this, the current may be cut off completely whilst the vessel is on the open sea or in very cold waters. However, these are measures which can only be taken at the risk of serious fouling and corrosion taking place. The invention has for its aim to at least alleviate this problem.

According to one aspect of the invention, a marine antifouling system of a sea going vessel includes a first valve assembly installed in a flow line for sea water leading from a sea chest of the vessel; a housing for at least one sacrificial anode, said housing also being installed in or forming a part of said flow line; and a second valve assembly in said flow line and connecting the anode housing a pipeline through which sea water is drawn from the sea chest at least when the vessel is under way, the arrangement being such that when the valve assemblies are open, a flow of sea water through the anode housing and into the pipeline effects the distribution of the anode products concerned to the various pipes and valves in the various systems using the sea water, and that when the at least one sacrificial anode in the housing has become worn away the first and second valve assemblies can be closed and the anode housing opened so that the or each anode can be renewed. The sea chest will preferably be provided with at least one main sacrificial anode mounted within it and arranged to be renewed whenever the vessel concerned undergoes a re-fit. The at least one anode in the anode housing referred to may in that case be regarded only as an auxiliary apparatus to be used when the or each main anode has been worn away or needs to be conserved.

According to another aspect of the invention, a marine antifouling system of a sea going vessel includes a first valve assembly mounted vertically above a sea chest of the vessel; a housing for at least one sacrificial anode, said housing being mounted vertically above the valve assembly, and a second valve assembly in a flow line connecting the anode housing to a pipeline through which sea water is drawn from the sea chest at least when the vessel is under way, the arrangement being such that when the valve assemblies are open, a flow of sea water through the anode housing and into the pipeline effects the distribution of the anode products concerned to the various pipes and valves in the various systems using the sea water, that when the second valve assembly is closed or when the vessel is in harbour the lack of flow of sea water through the anode housing from the sea chest causes the anode products to fall through the open first valve assembly into the sea chest where it is effective to prevent fouling therein, and that when the at least one sacrificial anode in the anode housing has become worn away the first and second valve assemblies can be closed and the anode housing opened so that the or each anode can be renewed. The sea chest will preferably be provided with at least one main sacrificial anode mounted within it and arranged to be renewed whenever the vessel concerned undergoes a re-fit. The at least one anode in the anode housing referred to may in that case be regarded only as an auxiliary apparatus to be used when the or each main anode has been worn away or needs to be conserved. The first valve assembly will preferably be constituted by a so-called sliding gate valve which when open will give unimpeded passage to the hydroxide floc or other anode products falling through it into the sea chest when the second valve assembly is closed or when there is a lack of flow of sea water through the pipeline from the sea chest.

According to a still further aspect of the invention, there is provided a one piece element constituting at least a pair of sacrificial anodes for use in a marine antifouling system of a sea going vessel, that is to say, one part of said one piece element being made of copper and another part of said element being made of aluminium of soft iron and the element being provided at one end with means whereby it can be secured in an operative position.

In order that the invention may be fully understood and readily carried into effect, the same will now be described, by way of example only, with reference to the accompanying drawings, of which:—

Fig. 1 is a diagrammatic illustration of a marine antifouling system embodying the invention, the illustration including a view of a sea chest of a sea going vessel in transverse section, and

Figs. 2 and 3 are part sectional views of a valve assembly and associated structure to which the invention relates.

Referring now to Fig. 1 of the drawings, the marine antifouling system there illustrated includes a pair of main sacrificial anodes 10 and 12 located in a sea chest 14 of a sea going vessel, the anodes being electrically connected to a control panel generally indicated 16 from which a low D.C. electric current is supplied. The electrical arrangement is such that the hull of the vessel and its pipework constitute a cathode. The anode 10 is made of copper and the anode 12 is made of aluminium and throughout the operation of the system aluminium hydroxide is caused to flocculate upon particles of released copper, this copper/aluminium hydroxide floc being carried through the water system or systems which draw sea water from the sea chest. A pipeline 18 is shown to be connected into the sea chest, the sea water being drawn into the water system or systems concerned through said pipeline.

Sea water is drawn into the sea chest through a filter grid 20 in the hull of the vessel. As

previously stated, the electrolytic process is continuous, the low D.C. electric current being supplied to the anodes whether the vessel is at sea or in harbour. Consequently, the effects of the water treatment thus carried out are cumulative so that a cupro-aluminium film is built up over a period of time on the internal surfaces of pipes, valves and the like of the water system or systems concerned and this inhibits marine growth and corrosion therein.

The fact that the anodes 10 and 12 are located in the sea chest is ideal in one sense since this is where fouling mainly takes place. It will also be understood that the vessel is most susceptible to attack by creatures such as mussels and the like when close inshore or in harbour. At such times, when the engines are stopped, very little, if any, sea water will be drawn from the sea chest. This being so, the entire hydroxide floc produced at such times remains in the sea chest. However, on the other hand, the fact that the anodes are located in the sea chest means that they can only be renewed when the vessel is in dry dock during its scheduled re-fitting. For this reason the anti-fouling system illustrated includes further elements which can be regarded as an auxiliary apparatus to be used when the main anodes have been worn away or need to be conserved.

The further elements referred to are constituted by a first valve assembly 22 mounted on the sea chest 14, a housing 24 for a one-piece element constituting an auxiliary pair of sacrificial anodes 26, 28, and a second valve assembly 30 which is disposed in a flow line 32 connecting the anode housing 24 to the pipeline 18 through which sea water is drawn from the sea chest at least when the vessel is under way. The first valve assembly is a so-called sliding gate valve.

The arrangement is such that when the main anodes have been worn away or need to be conserved the auxiliary pair of sacrificial anodes 26, 28, can be brought into use. This is done by electrically connecting said auxiliary anodes to the control panel 16 (conveniently by merely closing a switch) and opening the first and second valve assemblies 22 and 30 to allow a flow of sea water through the anode housing 24 and into the pipeline 18. The considerable flow of water being drawn directly from the sea chest through the pipeline 18 will cause a flow of sea water to take place through the anode housing 24 by suction. Consequently, whilst the considerable flow of water is taking place through the pipeline, that is to say whenever the vessel is at sea, the hydroxide floc produced in the anode housing 24 is distributed to the various pipes and valves in the various systems using sea water. When the vessel is in harbour and there is no appreciable flow of sea water through the pipeline, or indeed when the second valve assembly 30 is closed, the hydroxide floc produced in the anode housing 24 is caused to fall through the open first valve assembly into the sea chest below it. (The fact that the second valve assembly is constituted by a so-called sliding gate valve ensures unimpeded passage of the hydroxide floc into the sea chest). Thus it will be understood that even though the main anodes may have been completely worn away, protection against marine growth and corrosion can still be provided by the auxiliary anodes and that, even though these are not located in the sea chest, they provide protection for the latter when the vessel is in harbour and protection of the sea chest is most required. Protection for the sea chest can be provided when the second valve assembly is closed as previously mentioned and this can of course be carried out while the vessel is at sea. If the main anodes had been completely worn away for example, the D.C. electric current applied to the auxiliary anodes could be adjusted to be somewhat greater than usual and the protection provided by the auxiliary anodes could be shared on a time basis between the sea chest and the remainder of the sea water system of the vessel, that is to say the hydroxide floc being arranged to flow first to the one and then to the other.

Unlike the main anodes, the auxiliary anodes can be renewed when worn by closing the first and second valve assemblies and then removing a cover plate 34 which is normally bolted down on a flanged upper end of the housing by means of bolts 36. It will be observed that the auxiliary anodes illustrated are joined together end to end and the one piece element which constitutes said anodes is provided at one end with means whereby it can be secured in its operative position, that is to say depending from the cover plate 34, being electrically insulated from the body of the anode housing by means not shown. This is thought to be an ideal arrangement because it is found that the flow of sea water through the restricted annular space surrounding the anodes tends to keep the surface of the aluminium anode clear of the aluminium oxide film which can form on the surface of an aluminium anode and which when it has formed effectively insulates the surface against further flocculation. However, it will be understood that the anodes need not necessarily be provided in this form. For example, the anodes could depend side by side from the cover plate 34. It will also be understood that the one piece element could constitute more than a pair of sacrificial anodes by being made of three or more dissimilar metals, for example of copper, aluminium and soft iron.

Various other modifications may be made, and it will be understood that the anodes 26 and 28 need not necessarily be regarded as an auxiliary apparatus to be used only when the main anodes have been worn away. In fact, the anodes 10 and 12 could be omitted and the protection against fouling and corrosion of the sea water systems of a vessel including the sea chest or sea chests, could be provided throughout the working life of a vessel between re-fits, entirely by the anodes 26, 28. The anodes 26, 28 can of course be renewed at regular intervals of time or, if preferred, their condition can be checked at regular intervals and renewal effected when found to be necessary.

It is not essential for the auxiliary anodes to be located vertically above the sea chest. They could be located at any point in the closable flow line for sea water leading from the sea chest.

The sacrificial anodes need not be made respectively of copper and aluminium or only of copper and aluminium. Other metals could be used, for example copper and soft iron. (The floc produced when using soft iron anodes is similar to that of aluminium). It is found that the use of soft iron anodes is particularly advantageous because iron compounds released into the cooling water provide impingement corrosion protection to condenser tubes in addition to their anti-fouling function. Furthermore, at least one of the anode materials may contain a toxic addition of arsonic and/or antimony.

The or each main anode and/or the or each auxilliary anode may be provided with means which, in use of the anode, constitute electrically conducting means located at or extending a predetermined distance from a datum surface or from a basal surface which in use of the anode is clamped against a supporting surface, the arrangement being such that, when the anode is in use and said electrically conducting means are electrically connected to an electrically operable monitoring arrangement, the continuous wearing away of the anode eventually exposed the electrically conducting means to the sea water so that this is indicated or able to be indicated, by the electrically operable monitoring arrangement. The or each anode may have a sea water resistant coating which tends to cause the anode to wear away across its cross sectional end surface rather than along its side surfaces.

Claims (Filed on 20 April 1983)

1. A marine antifouling system for a sea going vessel including a first valve assembly installed in a flow line for sea water leading from a sea chest of the vessel; a housing for at least one sacrificial anode, said housing also being installed in or forming a part of said flow line; and a second valve assembly in said flow line and connecting the anode housing to a pipe line through which sea water is drawn from the sea chest at least when the vessel is under way, the arrangement being such that when the valve assemblies are open, a flow of sea water through the anode housing and into the pipeline effects the distribution of the anode products concerned to the various pipes and valves in the various systems using the sea water, and that when the at least one sacrificial anode in the anode housing has become worn away the first and second valve assemblies can be closed and the anode housing opened so that the or each anode can be renewed.

2. A marine antifouling system according to claim 1, in which the sea chest is provided with at least one main sacrificial anode mounted within it and arranged to be renewed whenever the vessel concerned undergoes a re-fit.

3. A marine antifouling system according to claim 2, in which the at least one anode in the anode housing is to be regarded only as an auxiliary apparatus to be used when the or each main anode has been worn away or needs to be conserved.

4. A marine antifouling system of a sea going vessel, including a first valve assembly mounted vertically above a sea chest of the vessel; a housing for at least one sacrificial anode, said housing being mounted vertically above the valve assembly; and a second valve assembly in a flow line connecting the anode housing to a pipeline through which sea water is drawn from the sea chest at least when the vessel is under way, the arrangement being such that when the valve assemblies are open, a flow of sea water through the anode housing and into the pipeline effects the distribution of the anode products concerned to the various pipes and valves in the various systems using the sea water, that when the second valve assembly is closed or when the vessel is in harbour the lack of flow of sea water through the anode housing from the sea chest causes the anode products to fall through the open first valve assembly into the sea chest where it is effective to prevent fouling therein, and that when the at least one sacrificial anode in the anode housing has become worn away the first and second valve assemblies can be closed and the anode housing opened so that the or each anode can be renewed.

5. A marine antifouling system according to claim 4, in which the sea chest is provided with at least one main sacrificial anode mounted within it and arranged to be renewed whenever the vessel concerned undergoes a re-fit.

6. A marine antifouling system according to claim 5, in which the at least one anode in the anode housing is to be regarded only as an auxiliary apparatus to be used when the or each main anode has been worn away or needs to be conserved.

7. A marine antifouling system according to any one of claims 4 to 6, in which the first valve assembly is constituted by a so-called sliding gate valve which when open will give unimpeded passage to the hydroxide floc or other anode products falling through it into the sea chest when the second valve assembly is closed or when there is a lack of flow of sea water through the pipeline from the sea chest.

8. A marine antifouling system according to any one of the preceding claims, including condition monitoring means as described in our co-pending application for patent No. 82.02794 of 1982, that is to say, the at least one sacrificial anode being provided with means which, in use of the anode, constitute electrically conducting means located at or extending a predetermined distance from a datum surface or from a basal surface which in use of the anode is clamped against a supporting surface, the arrangement being such that, when the anode is in use and said electrically conducting means are electrically connected to an electrically operable monitoring

arrangement, the continuous wearing away of the anode eventually exposes the electrically conducting means to the sea water so that this is indicated, or able to be indicated, by the electrically operable monitoring arrangement.

9. In a marine antifouling system according to any one of the preceding claims, a one piece element constituting at least a pair of sacrificial anodes, that is to say, one part of said one piece element being made of copper and another part of said element being made of aluminium or soft iron and the element being provided at one end with means whereby it can be secured in an operative position.

10. A marine antifouling system constructed, arranged and adapted to operate substantially as hereinbefore described with reference to and as illustrated by the accompanying drawings.

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