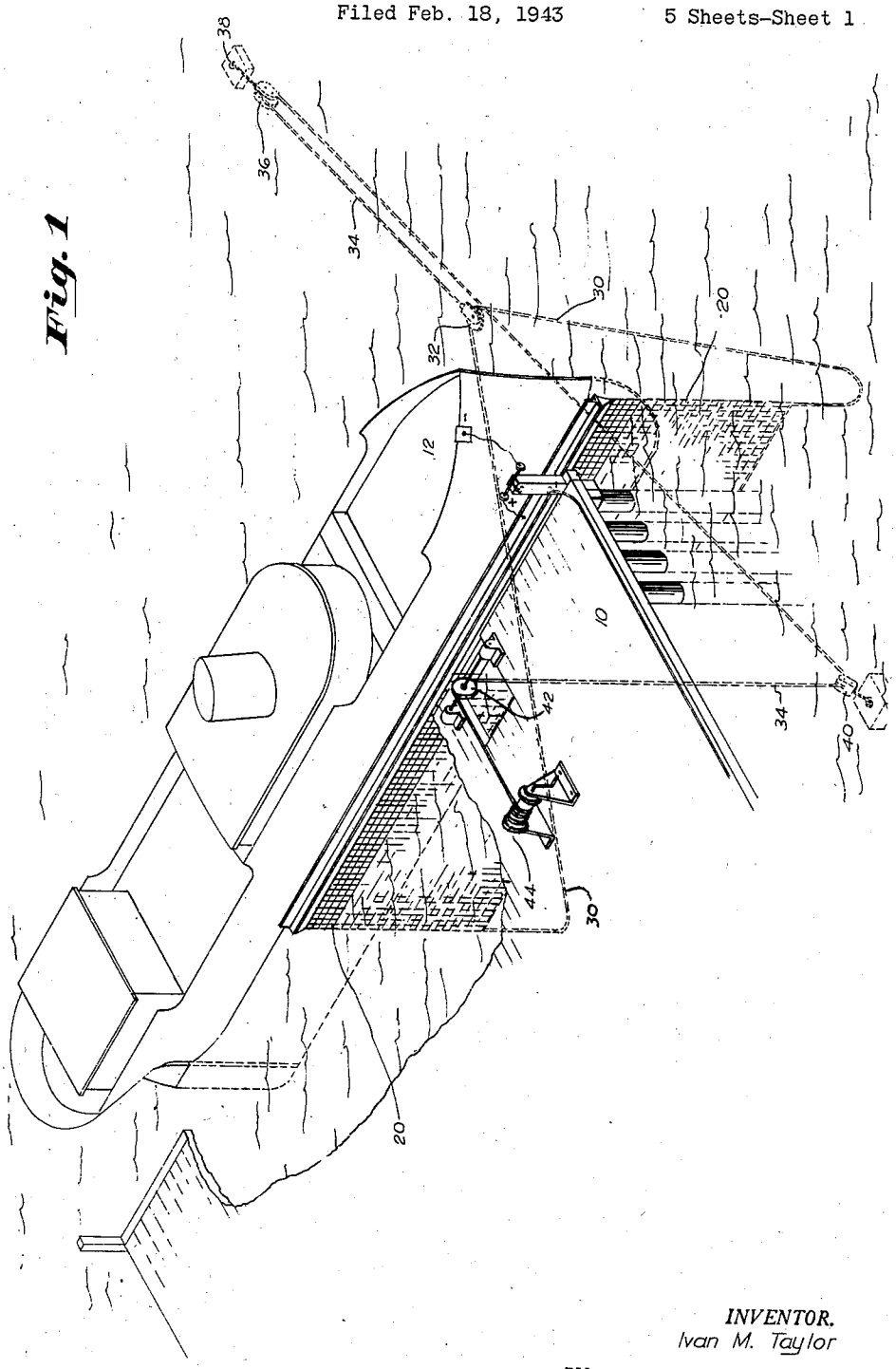
Feb. 17, 1948. I. M. TAYLOR 2,435,986

ANTIFOULING DEVICE

Filed Feb. 18, 1943 5 Sheets-Sheet 1

Fig. 1



INVENTOR.
Ivan M. Taylor

BY Everett Kent
ATTORNEY

Feb. 17, 1948. I. M. TAYLOR 2,435,986

ANTIFOULING DEVICE

Filed Feb. 18, 1943 5 Sheets-Sheet 2

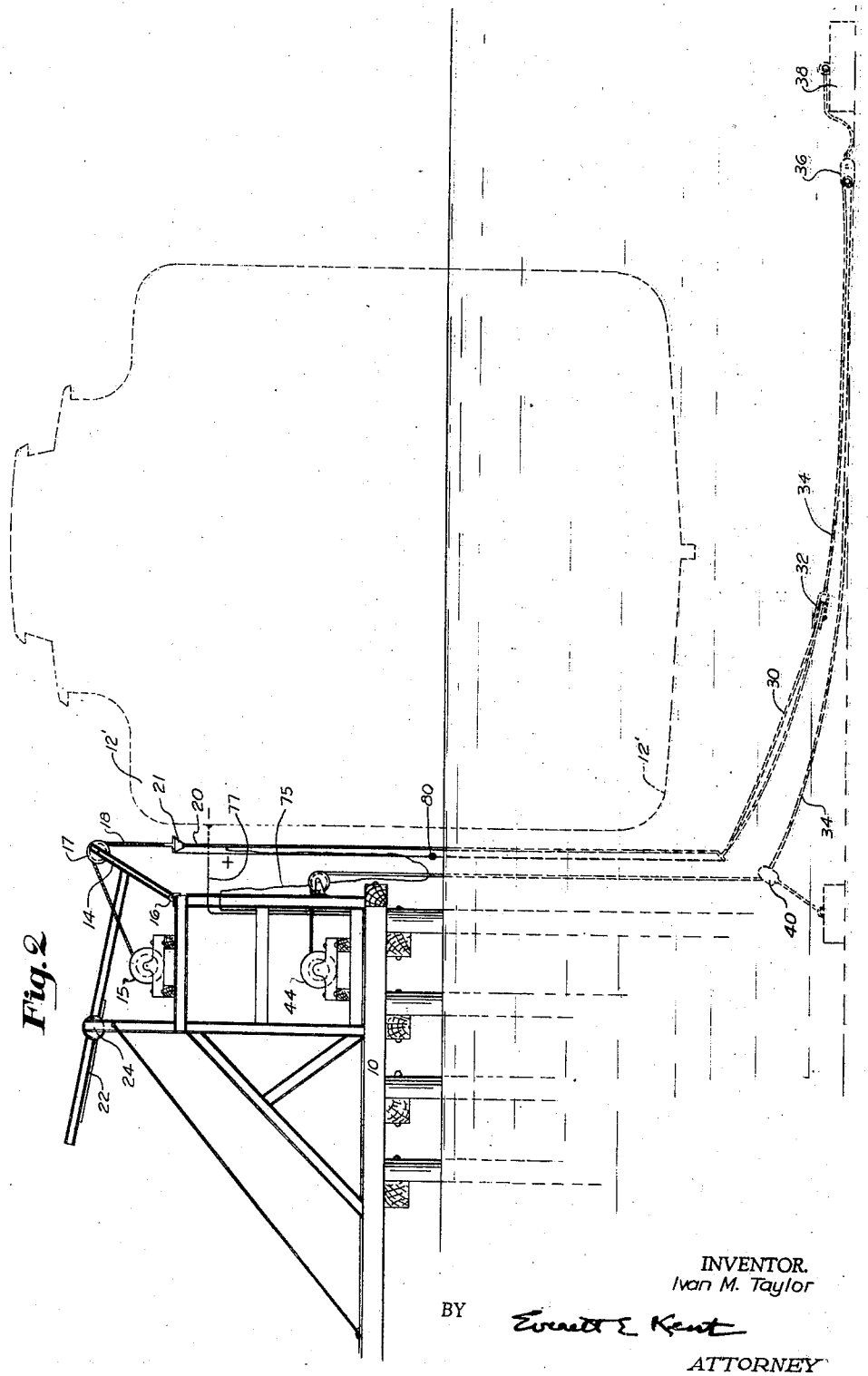


Fig. 2

INVENTOR.
Ivan M. Taylor

BY Everett E. Kent

ATTORNEY

Feb. 17, 1948. I. M. TAYLOR 2,435,986

ANTIFOULING DEVICE

Filed Feb. 18, 1943 5 Sheets-Sheet 3

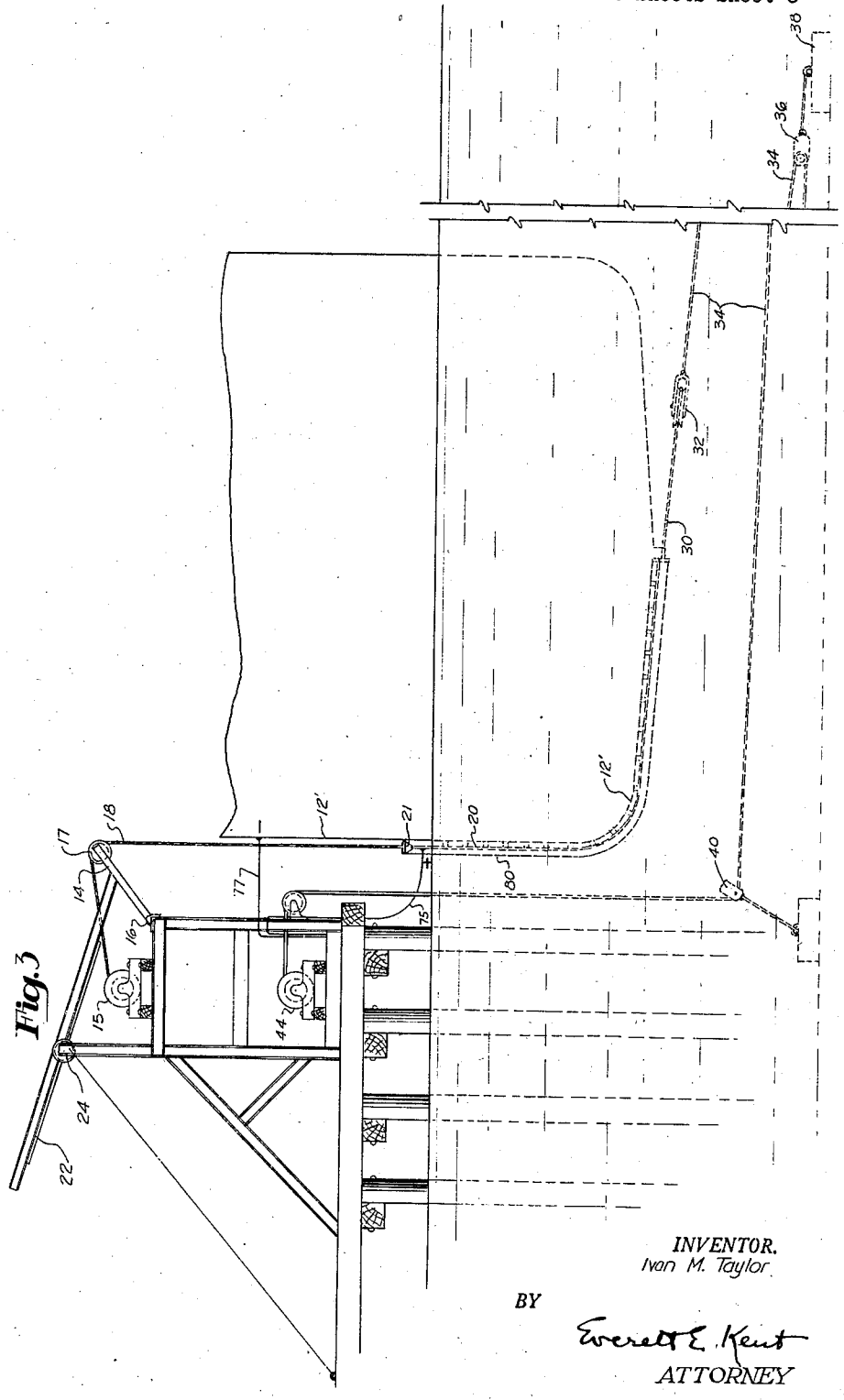


Fig. 3

INVENTOR.
Ivan M. Taylor

BY

Everett E. Kent
ATTORNEY

Feb. 17, 1948. I. M. TAYLOR 2,435,986

ANTIFOULING DEVICE

Filed Feb. 18, 1943 5 Sheets-Sheet 4

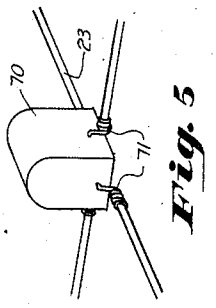


Fig. 5

Fig. 4

INVENTOR.
Ivan M. Taylor
by
Everett E. Kent
ATTORNEY

Feb. 17, 1948. I. M. TAYLOR 2,435,986

ANTIFOULING DEVICE

Filed Feb. 18, 1943 5 Sheets-Sheet 5

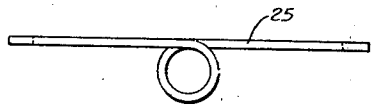


Fig. 8

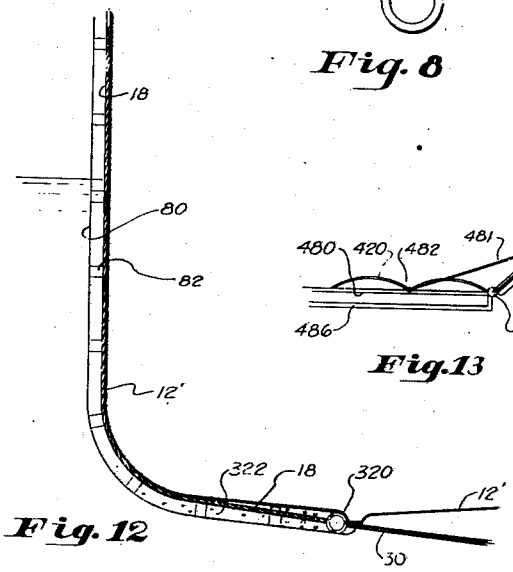


Fig. 12

Fig. 13

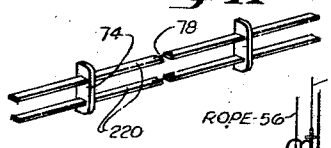


Fig. 11

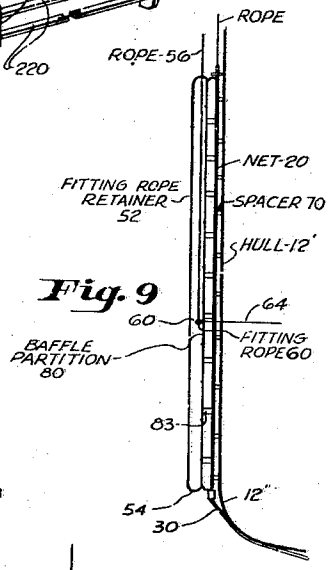


Fig. 9

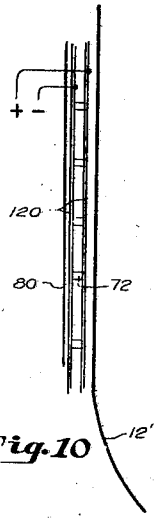


Fig. 10

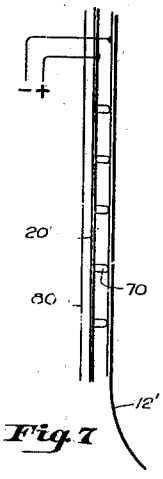


Fig. 7

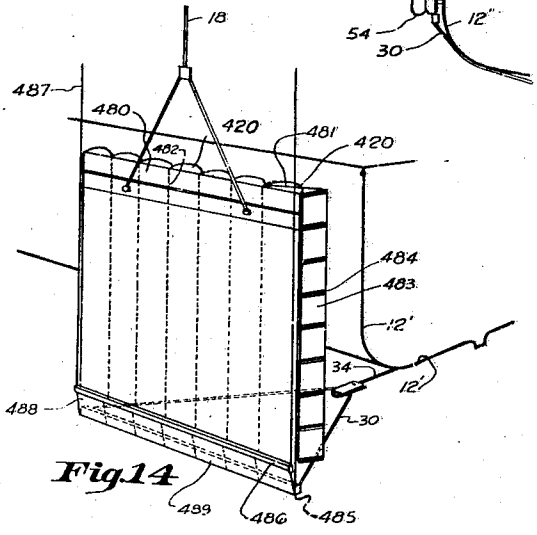


Fig. 14

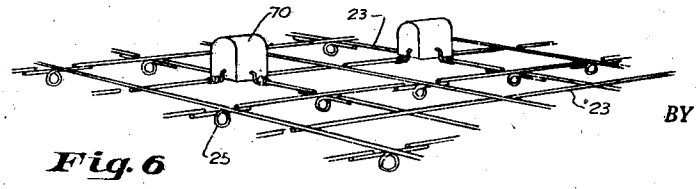


Fig. 6

INVENTOR.
Ivan M. Taylor

BY Everett E. Kent

ATTORNEY

Patented Feb. 17, 1948 2,435,986

UNITED STATES PATENT OFFICE

2,435,986

ANTIFOULING DEVICE

Ivan M. Taylor, Boston, Mass.; Innes Henry, Boston, Mass., administrator of said Taylor, deceased

Application February 18, 1943, Serial No. 476,359

25 Claims. (Cl. 204—224)

1

This invention relates to improvements in anti-fouling devices.

More particularly it relates to methods and means for removing adhering animal and vegetable organisms from the under-water surfaces of ships and from other under-water surfaces.

In present naval and commercial experience the adhesion and growth of small organisms on ships' bottoms cause very great operational and financial losses. Such adhesions reduce a ship's speed; require excess carriage and consumption of fuel; and prolong the stays in port. In addition they impose very substantial costs for the clearing away of the adhesions. This evil is experienced with wooden ships as well as with steel. It has been an annoying problem from the earliest times, but hitherto mankind has not found a satisfactory remedy, so far as I am aware.

It is known that the passing of an electric current between a steel hull and an electrode in the adjacent sea water can clear away such adhesions to some extent. Various arrangements of electrical apparatus have been devised for putting such a process into effect; but so far as I am aware none such has hitherto proven acceptable for general use by mariners. One objection has been that the expense of making the proposed installations extensive enough to cover all necessary parts of the ship has been too great. Another is the considerable diminution of cargo carrying space that would be involved, if the necessary apparatus were introduced into the ship. And a third potent objection has been the knowledge that damaging corrosion may result when electrolysis occurs between different metals, as between bronze propellers and the adjacent steel part of the hull.

The present invention avoids all of these objections. A single apparatus of the invention can treat an indefinitely large number of ships, each for a short period, thus amortizing the installation cost by an insignificant charge per ship. The ship's cargo space is not affected, for the vessel itself does not carry any part of the apparatus. And the anti-fouling treatments are so short and so infrequent that even if electrolysis is used the resulting damage to the ship is negligible, if indeed there is any such damage at all.

The invention has other advantages over previous proposals, both in the nature of the remedial agent; in the structure by which that agent is applied to the vessel, this being adaptable to various kinds, shapes and sizes of vessels; also in the means by which its beneficial treatment

2

is distributed over a vessel's under-water surface; and, operatively, in the low cost per treatment.

The method applies an under-water clearing agent to a ship from a shore location. The application is made from a berth prepared to receive the ship, and other ships as well, in succession, for similar purposes. The loading and unloading of cargo, or the taking in of fuel, may proceed simultaneously with the treatment for anti-fouling.

So long as a hull is in water, living organisms are continually becoming attached to its under-water surfaces. The invention does not purport to prevent the occurrence of such adhesions between treatments. But, starting with a hull that is preliminarily clear of obnoxious organisms, as when the hull is new, or has been hauled out or dry-docked and scraped, the treatment is to be applied at intervals so short that bacteria, algae, larvae, ova and other forms of life which have become attached during one or more voyages will still be small, and insecurely attached—not having become so old and mineralized, or otherwise so secure, as to be unresponsive to the treatment. The specific nature of the reaction which loosens the animal or vegetable body is immaterial, whether it be a poisoning, nervous reaction, or death, or whether it be a detergent release of adhering slime in which bacteria and other small organisms are housed.

The treatment is by coaction of an applicator with the under-water surface of the ship. Forms of applicator to provide positive and quick distribution for large vessels are illustrated herein. One such may be a huge flexible network electrode. A flexible baffle partition, which may be of canvas, lines the back of the network, disjunctively separating that water which adjoins the hull from the general mass of adjacent water which is surrounding the hull.

The single or double network constitutes an applicator, such that, with conductor connections to a suitable source of electricity, electrolysis begins, and products inimical to organic life become released, close to the vessel's under-water surface, in a distribution which is spread over the whole of so much of the area of vessel as is covered by the applicator.

Chlorine, sodium hydroxide, and hypochlorites dissolve in the water which is confined against the hull by the canvas partition. Continuation of the electrolysis increases the concentrations of these noxious and detergent agents; diffusion in the confined water takes them into contact

with adhesions that are on the hull; and the agitation which is incidental to the slight flow of water caused by harbor wave and tide action aids rather than reduces the speed of attack. In a short time the resulting concentration of chlorine will far exceed what the bacteria and other small organisms can survive, it being known that for purification of municipal water supplies about one part in a million will suffice.

A similar result may be attained without the network structure, by providing the one electrode, or the two electrodes, in horizontal bar form.

However, a release of chlorine or other toxic, irritant or detergent remedial agent, with distribution over the under-water surface of the vessel may be effected without electrolysis by injecting the remedial agent into the confined water next to the hull, through an applicator which may be positioned as above described.

Devices for thus positioning an electrode or other applicator against a vessel are described in detail hereinafter and are illustrated diagrammatically in the drawings. These devices are illustrative, rather than definitive; and variations may be made within the scope of the appended claims.

It is intended that the patent shall cover by suitable expression in the claims, whatever features of patentable novelty exist in the invention disclosed.

In the accompanying drawings, which are diagrammatic:

Figure 1 is a perspective, showing an applicator and its positioning apparatus at a wharf where a vessel is alongside in position for receiving treatment; the supporting apparatus of the applicator, its water-confining partition and other details being omitted, to avoid confusion of lines;

Figure 2 is an end elevation showing a single network electrode applicator hanging in inactive position beside a wharf as it may await the coming of a vessel to the location seen in dotted outline;

Figure 3 is a similar end elevation of the same, but with the applicator positioned against the side and bottom of the vessel of Figure 2;

Figure 4 is a perspective showing a fitting rope 60 of the invention, with its holding and positioning means, at the beginning of its being drawn sidewise by tackle 64, 66, to fit a network electrode to the under-water surface of a vessel; the water and the vessel being omitted;

Figure 5 is a perspective of a detail, being a fragment of a network electrode and one of its spacing blocks for insulating it from the side of the vessel;

Figure 6 is a perspective of a fragment of a single network electrode of wire type, divided vertically and horizontally into sections which are flexibly and electrically connected so that it can fit the curved side of a vessel;

Figure 7 is a fragment seen in end elevation of a network electrode applied to the side of a hull of a vessel;

Figure 8 is a side elevation, greatly enlarged, of a flexible connector such as are seen in Figure 6;

Figure 9 is a fragment seen in end elevation showing the mounting for applying a fitting rope such as that seen in Figure 4;

Figure 10 is a fragment seen in end elevation of an electrolytic applicator in which the anode and cathode are each a network;

Figure 11 is a perspective of a fragment showing applicator electrodes which are a pair of bars insulated from each other, flexibly connected;

Figure 12 is an end elevation of a fragment of a pipe applicator for discharge of a fluid remedial agent, positioned against a keel, within the water confined to the hull by a flexible partition;

Figure 13 is a plan, of an end baffle and fragment of a combined partition and porous pocket type of applicator, by means of which chlorine may be applied as a remedial agent, issuing from bleaching powder contained in the porous pockets; and

Figure 14 is a perspective of a flexible applicator of the type of that in Figure 13.

In the drawings Figure 1 represents a network applicator in inactive position at a berth, comprising a wharf 10, with a vessel 12 alongside. Moorings for the vessel and supports for the applicator and various other details are omitted, to avoid confusion of lines, principal features to be noted here being the positioning rope system 30, 32, 34, 36, 40 and 44, comprising tackle having power at 44 and off-shore securement on the harbor bottom for a pulley block 36, with these ropes running under the position that is to be occupied by vessels to be treated, low enough so that the power and tackle can pull a network applicator from the illustrated position underneath and athwart whatever part of the vessel is opposite the applicator. The applicator hangs idle and the positioning loop 30 is slack, but, assuming the harbor bottom securement 38 to be far enough away, pull of the winch 44, it may preferably be a power winch, on the tackle will draw the sheave 32 outward so that ultimately the two ends of the loop 30 will draw the two under-water ends of the applicator 20 under the vessel until the network 20 itself lies as close as its construction permits to the under-water forward portion of the vessel illustrated. If one end of the applicator engages the vessel before the other end does, the sheave 32 will run along in the loop 30 until both limbs of the loop are taut and the applicator itself is tautly wrapped about the part of the vessel which it covers, as far as the keel.

Figures 2 and 3 show what may be considered to be the same network electrode 20, having a stiffening top bar 21, to indicate any means which may be chosen for preventing too much sagging, and a supporting rope 18 passing over a sheave 17 at the top of an oblique spar 14 whose foot is pivoted at 16 on superstructure of the wharf 10.

Conductors 75 and 77 are in a circuit for causing current to pass between the electrode 20, indicated in these figures as the anode, and the hull of whatever vessel may come to constitute the cathode, for electrolysis or other electrical treatment.

Any suitable means, as a power winch 15, may be provided to control the rope 18 for controlling the elevation of the electrode 20. And any suitable means, as a beam with rack and pinion 22, 24 control may be provided to change the angle at which the oblique strut 14 stands, to set the applicator 20 out from the wharf into proximity with the side of the vessel 12', or the reverse, this difference of position being seen in Figures 2 and 3. Figure 3 shows the electrode network 20 let down and positioned against the hull of a freighter 12' by this combination of top support and the bottom tackle 30, 34 and 44. Some

vessels of different types may have the hull curved concavely inward below water. It may be expected that the curvature, if any, will not be too great for the apparatus to function satisfactorily even though the applicator lies as a chord across a concavity; but if it is desired to draw the applicator into the concavity the fitting rope **60** indicated in Figure 4 can serve that function when pulled sidewise by its tackle **64** at one end and **66** at the other end, these being each a rope passing through pulley blocks off-shore and coming back to power means **69** on the wharf. The pulley blocks **68** are secured at the bottom of the harbor and are spread apart lengthwise of the berth far enough so that they have components that operate endwise in opposite directions on the fitting rope **60**. The latter normally hangs loose from the electrode within a retainer comprising a horizontal succession of vertically hanging rope loops, in each of which one limb **50** is secured vertically on the back of the network **20** and the other limb **52** of which hangs close behind the first limb **50**, and bight **54** at the bottom prevents the rope **60** from escaping if dropped too low. A series of supporting ropes **56** whose tops are held at **57** on the wharf permits the level at which fitting rope **60** stands to be adjusted within the guideways extending vertically which are constituted by the loops **50, 54, 52**. Figure 4 illustrates the position this fitting rope **60** occupies when it has begun to be drawn sidewise by the tackle under water holding its ends apart, marked **64** and **66**, the network **20** having already been drawn as in Figure 3 under the location of a vessel assumed to be at the berth but not shown in Figure 4.

Thus the hanging applicator **20** can be spread over a large area of the vessel's hull, the underwater tackle having purchase on the applicator at its bottom, through the loop **30**, and desired mid-level through a fitting rope **60**, the falls being conveniently hauled from a station on the wharf.

Figures 5, 6, 7 and 8 show details of a structure which the network electrode may have if it is made of wires **23** crossing at short distances apart. At some of the crossings insulating blocks **70** may be secured, as by wires **71** wrapped around strands of network, to keep the network face from the hull **12'** as indicated in Figure 7, which is necessary when the hull and the network are cooperating electrodes. If more flexibility of the network is needed than is provided by the strands thereof this can be had by the device illustrated in Figure 6, wherein each four squares of the network constitute a separate section, connected to its neighbors electrically and mechanically by the flexible wires **25** which are welded to each section and have 360° of curvature between the ends of the connector, thus permitting the slight bending of each section relative to its neighbors that may be required for closely fitting the curvature of the ship.

However, the flexible network electrode may be otherwise constructed as may be suitable, one form which has merit is that known as "expanded metal," which has the advantage that by suitable design any desired proportion of metal surface to air spaces can be had, with the conductivity high because of the integrality of the constituent metal, and tending to favor efficiency in electrolysis because the flatness of metal gives relatively large surface; and being lower in cost because of not needing hand labor for welding wires at crossings to make good electrical connection. The network may be of any other lattice work, but must be a conductor of electricity and preferably should have a superficial coating of graphite sufficient to prevent attacks by chlorine, as is well understood. Such a coating can be made by applying graphite paint or by other known methods.

Figure 9 illustrates the combination of an electrode network **20** having hull-spacers **70** with a flexible partition **80** which if desired may have similar spacers **83** keeping it away from the back side of the network **20**, and a fitting rope **60** with its support rope **56** which is retained by a vertical rope guide **52** and by the loop at the bottom **54** so that it cannot escape from close behind the baffle partition **80**, whatever may be the level at which it is adjusted by its supporting ropes **56**. This complete structure can be pulled to the right by the drawing rope **64** in Figure 9, to fit closely into a concavity in a hull, if the draft of the positioning rope **30** is not sufficient. However, the hull **12'** illustrated in Figure 9 has no such concavity and the fitting rope combination is not needed for that hull.

Figure 10 illustrates an applicator like that of Figure 7 or Figure 9 except that there are two network electrodes **120** which cooperate in the electrolysis, with separators **72** between them, and preferably with a partition backing **80**. This is useful if the vessel has a wooden hull or if a steel hull is so covered with paint that it does not serve well as an electrode.

Figure 11 illustrates two bar electrodes **220**, with separators **74** and flexible connectors **78**, so that, if desired, the electrolysis can be effected by one or more sets of bars extending as electrodes lengthwise of the vessel, at one or more levels like a grid. These can be suspended, and positioned relative to the vessel, by the means hereinbefore shown, and may well be enhanced in practical effect by a confining flexible partition, such as is shown in Figures 10 and 12 although not seen in Figure 11.

Figure 12 illustrates how the invention may be applied with a bactericide, as chlorine, or a cleaning agent as sodium hydroxide, or other materials which it may be desired to apply to a vessel's hull, without using electrolysis. In this figure the applicator is a pipe **320**, positioned by a supporting rope **18** and bottom tackle **30** as in the other cases and backed by a flexible partition **80** having frequent means **82** to space it from the hull **12'**, thus confining the body of water next to the hull into which whatever fluid is forced from a shore connection through the perforated pipe **320** can enter and do its work on the adhesions on the outside of the hull. Such a pipe may be in sections flexibly connected. If the injected fluid is chlorine it will go into solution; and if it be forced in under pressure, so that more enters than can be immediately dissolved, it will move in bubbles **322** upward within the confined water space, and thus a single pipe **320** may cause distribution of the toxic remedial agent over an area of the ship's hull having a considerable upward dimension. For expediting the effect similar pipes may be applied at higher locations if desired.

The applicator may however be arranged to treat the hull with an algicide, as chlorine or copper sulfate, obtained from the convenient solid source by apparatus illustrated in Figures 13 and 14, which may be positioned against and wrapped around a part of the hull by supporting means **18** and underwater tackle **30** as in the other cases,

A flexible partition 480 in Figures 13 and 14, may be of stout canvas, as may the corresponding partition 80 in the other figures, resistant to passage of water; and a sheet of lighter weight canvas may be stitched in loops on its face which is toward the hull, so as to constitute pockets 420, extending vertically and open at the top as hoppers, into which charges of bleaching powder or other suitable solid may be thrown. The lines 482 indicate stitches and show the vertical channels of these pockets to the bottom, where there is a valve closing them. This valve may be made in any convenient way, the means indicated being a bar 489 extending horizontally along the partition at a level a little above the bottoms of the pockets, and a parallel bar 486 at the bottoms of the pockets, whence cords 487 rise to some convenient place of access on the wharf. Upward pull on the cords 487 will fold upward a flap, which includes bottom parts of the channels of the pockets to the position indicated in Figure 14. The canvas bends as a hinge at the level of the bar 489, or a hinge may be provided in any other convenient way at the level of the bar 489, so that the bottoms of all of the pockets become closed. The faces of the pockets toward the hull are of porous material, or may be made to facilitate water flow through this face by setting eyelets in punch holes in the pocket wall which is toward the hull. The cords 487 having been drawn upward and made fast, this up-turning of the bottom flap closes the bottoms of the pockets at the bend where the upfold occurs. The pockets 420, may be charged with bleaching powder or other algicide, as, for example, copper sulfate. The substance in the pockets can then deliver its lethal charge freely into water which is confined between the flexible partition 480 and the hull 12', quickly making a strong concentration in the region of the organisms which are to receive the treatment. After the treatment a releasing of the cord 487 will let the bottom bar 486 and the flap 488 fall, thus opening all of the pockets for dumping their contents of waste residue.

Figures 13 and 14 illustrate how the vertical edges of the flexible partition, 480 in those figures and 80 in other figures, may flexibly carry oblique end baffles 483 for improving the confinement of water between the partition and the hull. These end baffles may each be made in a vertical succession of sections, to provide flexibility around the curve from the vessel's side to its bottom. They may be canvas, which may be made stiff by a doubling with canvas or expanded metal supplemented if desired by a gaff 484 at the top of each section, both canvas and gaff being hinged as at 485 to the vertical edge of the main partition 480 or 80, and being prevented from opening too widely by a strap 481. In use, these end baffles will be tautened against the hull by the stress between the bottom tackle 30 and the top support 18. Casual pressure of wind, wave or tide at either end will tend to close the baffle at that end the more firmly, against inflow of water, thus tending to maintain concentration of chemicals introduced by the applicator into the water which is confined.

Owing to its action in confining the remedial agent in proximity to the surface of the hull the flexible partition may be considered to be a part of the applicator. It will be understood that there may be as many ropes 18 and 56 as are convenient or necessary, or that other apparatus may be provided, for holding the top of the applicator 20, 80 spread and holding it and the fitting rope 60 without too much sag at any place; also that other holding or operating parts of the apparatus may be multiplied, according to practical procedure for good construction in dealing with the dimensions concerned, the drawings herewith being diagrams.

The electrodes and their operation are herein described as they may be used for electrolysis, in which case the character of the current with low voltage and high amperage will be determined, connected and operated with due regard to the dimensions concerned, according to principles which are well known in the art of electrolysis. However, the structure described is also available, if desired, for application of high tension electricity for electrification of water in the immediate vicinity of a hull, if it be desired to apply electricity in this previously proposed method for preventing aquatic adhesions. Also the same apparatus can be an instrument for applying alternating current, if desired.

When electrolysis is used the soluble chemical reagents released thereby become diffused through the confined water, increasing in concentration while the electrolysis continues. The sodium hydroxide constitutes a detergent substance tending to eat away and to open out the slime, which bacteria and some other organisms have emitted, and which holds still other organisms to the vessel. If the ship's hull is the cathode, it is aided in this physical separating of such organisms from the ship by the cathodic evolution of hydrogen, which tends mechanically to lift the adhering slime and film from the ship's surface, and so to facilitate emulsification by the hydroxide.

In operation, the applicator, of whatever style, is positioned against the vessel by manipulation of its top support and its bottom tackle, indicated respectively by the suspending rope 18 and the under-water rope 30. Movement of the rope 18, up or down and out or in, by its winch 15 and spar 14, can set the top of the applicator into desired proximity to the vessel, and to desired level with respect to the water or the keel. By the under-water tackle 30 the bottom of the applicator can be drawn athwart under the vessel so as to wrap it about a considerable area of the vessel's side and bottom. If desired this positioning can be aided by one or more fitting ropes 60. The applicator is then to be activated, as by introducing electricity through supply conductors 75, 77 to electrodes 20, 120 or 220 for electrolysis or other electrification; or by forcing a fluid remedial agent into the pipe 320 through a supply pipe (not shown); or by charging the pockets 420 with bleaching powder or other substance or mixture of substances, such as detergents or algicides of which examples are found in copper sulfate, general poisons such as arsenicals, and synthetic organic compounds which may be found to be effective as remedial agents. When action has proceeded to a sufficient extent the applicator is to be released from the vessel; and the vessel may then be moved so as to present similarly a fresh portion of its under-water surface for treatment. It should have a repetition of the treatment after an interval in which fresh adhesions have not had time to become secure beyond the removal power of this type of treatment. The rates at which bacteria, slimes, and other adhering matter become attached, and increase, vary greatly depending on the character and condition of the surface of the vessel's hull, the locality, contents and temperature of the water where the vessel goes, and other conditions.

Although the invention is herein described as it may be operated with apparatus based on a stationary support, indicated as being a wharf, and thus requires no apparatus on the vessel except the usual mooring, it will be recognized that the applicator might be based on a floating support, and so could be moved about a harbor to the off-shore sides of various vessels at their own particular berths. In such a case arrangements would ordinarily be made in advance at each berth to have under-water tackle available there, for drawing the applicator athwart under the vessel. Also, the applicator may in some cases find its top support by being hung over the side of the vessel from the deck on the side of the hull which is to be treated. A support of this type can be improvised at foreign ports not equipped with an installation. In such cases suitable under-water tackle equivalent to that above described can be arranged for wrapping the under-water portion of the applicator under the vessel.

Thus the invention is available for application to and treatment of all sorts of under-water surfaces stationary or mobile, including flying boats; wooden or steel floating or fixed structures; painted or not; in salt water or fresh.

In the appended claims it will be understood that the term "hull" is used to signify not only the under-water surface of a floating vessel but under-water surface of any structure to which the described anti-fouling device is applicable with such modifications as are within the range of engineering skill; also that the word "station" signifies a fixed place affording a stand for haulage of tackle under the hull, and that although this stand preferably is apart from the vessel, and is a shore station, as at a wharf, it is not necessarily so but may be a float or even may be on the vessel itself which is to be treated.

I claim as my invention:

1. In apparatus of the class described, means for setting a hanging applicator against the hull of a vessel, comprising tackle whose fall, extending from a hauling station, passes under the position of the hull, through a pulley block of the tackle fast beyond the remote side of the hull, and thence returns under said hull position for purchase on a bottom portion of the hanging applicator.

2. Means for setting a hanging applicator against the hull of a vessel, as in claim 1, further characterized in that for the purchase on the applicator there is a loop of rope whose ends are spread apart lengthwise of the hull for attachment to the applicator; and there is a sheave in the bight of that loop, from which sheave the tackle runs through the remote pulley block to the hauling station.

3. Means for setting a hanging applicator against the hull of a vessel, as in claim 1, further characterized in that there is a wharf station from which the fall of the tackle extends down to and through a pulley under water below that station; and that said remote pulley is at an anchorage on the sea bottom under water.

4. In apparatus of the class described, means for setting a hanging applicator against the hull of a vessel, there being a wharf station and said applicator hanging therefrom; said means comprising a rope, supported on the wharf and supporting the applicator, combined with means to move the rope's support out from and in toward the wharf for setting the top of the applicator laterally toward and from a hull berthed at the wharf; and means under water at said station, outrigged and acting outward therefrom, for engaging and positioning a lower part of the applicator toward the hull berthed at the wharf.

5. In apparatus of the class described, means for setting a hanging applicator against the hull of a vessel, there being a wharf station and said applicator hanging therefrom; said means comprising a rope, supported on the wharf and supporting the applicator, combined with means to haul in and let out the rope over its support, for setting the applicator vertically relative to a hull berthed at the wharf; and means under water at said station, outrigged and acting outward therefrom, for engaging and positioning a lower part of the applicator toward the hull berthed at the wharf.

6. In apparatus of the class described, an applicator for anti-fouling treatment of the hulls of successive vessels at a shore station, comprising a discharging holder for treating means, said holder being in sheet form extending up and down and along a berth for the hulls of vessels that are to be treated, being applicable for broadside coverage of a considerable area of only the shore side of a hull at the berth, and being flexibly conformable to curvature of the surfaces of the hulls to which it is applied, combined with the said shore station alongside the berth; and rope tackle means supported at the station for positioning the holder with respect to the successive hulls, said tackle having elements holding the applicator in vertical suspension and having an element for positioning the lower part of the applicator laterally with respect to the hull, comprising tackle extending horizontally under the hull berth between the shore station and a sea-bottom anchored pulley beyond and below the hull, thence returning with purchase on the lower edge of the applicator.

7. Means for setting a hanging sheet-form anti-fouling applicator against the hull of a vessel, comprising, in combination, a fitting rope extending lengthwise of the hull and means supporting that rope in engagement with the applicator sheet at a mid-height of that sheet; and tackle to shift the fitting rope sidewise toward the hull to move a mid-portion of the sheet toward the hull.

8. Means for setting a hanging sheet-form anti-fouling applicator against the hull of a vessel, as in claim 7, further characterized in that the fitting rope is on that side of the sheet which is away from the hull.

9. Means for applying anti-fouling treatment to the under-water surface of a hull by a sheet-form hanging applicator as in claim 7, further characterized in that there are ropes suspending the fitting rope at intervals; and a vertical guideway for up and down adjustment of the fitting rope, comprising vertical ropes secured to the applicator on its side which is away from the hull, at upper and lower points, retaining the fitting rope in proximity to the back of the sheet-form applicator between those upper and lower points.

10. Means for setting a sheet-form hanging applicator into a concavity in the hull of a vessel, comprising a fitting rope extending lengthwise of the vessel and combined with the applicator for moving it toward the vessel; there being tackles with purchases on the ends of the fitting rope, having pulley blocks in positions spread apart in the direction which is lengthwise of the vessel, to positions which are beyond the ends of the fit-

ting rope and are on the side of the hull which is the more remote therefrom, whereby the hauling of the tackles both maintains the fitting rope stretched and sets it sidewise toward the hull.

11. In apparatus of the class described, a flexible sheet partition which when unconstrained hangs vertically; means comprising rope tackle, acting laterally of the partition, engaging the partition at at least two levels, respectively high and low relative to each other, for setting the partition broadside toward the surface of a hull; and means associated with the partition between the partition and the hull for releasing anti-fouling substance, thereby to charge the water confined by the partition and the hull.

12. In apparatus of the class described, a partition and substance-releasing means as in claim 11, combined with baffle extensions of the partition at its ends, obliquely inclined from the said partition toward the hull's surface, for closing the ends of the confined space; the end edges of the partition being flexible, and each said baffle extension being a vertical series of sheet sections joined to the end edge of the partition, so that that series is flexible edgewise of the baffle-sheet-sections.

13. In apparatus of the class described, a partition and substance-releasing means as in claim 11, combined with baffle extensions of the partition at its ends, flexibly joined to the partition and obliquely inclined from the said partition toward the hull's surface for closing the ends of the confined space; the vertical extent of said baffles being divided into sections which are separately movable, whereby a fitting of the partition and baffles around curvature of the hull's surface is facilitated.

14. In apparatus of the class described, a partition and substance-releasing means as in claim 11, combined with baffle extensions of the partition at its ends obliquely inclined from the said partition toward the hull's surface for closing the ends of the confined space; the vertical extent of the baffles being divided into sections, said sections being of canvas combined with means stiffening them against collapse inward toward the hull, and with retaining straps limiting their swing away from the hull.

15. In apparatus of the class described, an applicator for releasing anti-fouling active substances under water beside a hull, comprising a discharging device for treating means, which device is structurally independent of the hull but has extent in shape which adapts it to occupy a position that extends along the hull's surface which is to be cleaned; a station with means independent of the hull for sustaining said device there; and rope tackle means at the station for applying the applicator to said position; said discharging device being flexible to conform to curvature of the hull; and the said means at the station for applying the applicator to said position having parts at a plurality of locations along the extent of the discharging device, which parts are projectable to various distances outward for seting out various parts of the discharging device, to position the said device as a whole in conformity with the curvature of the hull.

16. In apparatus of the class described, an applicator as in claim 15 further characterized in that the said device is a foraminous electrode and there is electrical circuit means for passing current through it and through a cooperating electrode of opposite sign.

17. In apparatus of the class described, an applicator as in claim 15 further characterized in that the said device is a pair of parallel electrodes, of opposite signs at least one of which is foraminous and there is means for passing current between them.

18. In apparatus of the class described, an applicator as in claim 15 further characterized in that the said device contains one or more network foraminous electrodes extending over an area of the hull, and there is electrical circuit means for passing current through that electrode and through a cooperating electrode of opposite sign.

19. In apparatus of the class described, an applicator as in claim 15 further characterized in that the said device contains two or more parallel bars constituting electrodes, arranged foraminously as a grid extending lengthwise of the hull, and there is electrical circuit means for passing current between the bars.

20. In apparatus of the class described, an applicator as in claim 15 further characterized in that it is the releasing means for the active anti-fouling substance and is a pipe having lateral discharge openings and extending lengthwise along the hull there being connecting means to supply the active substance from the station to the pipe.

21. In apparatus of the class described, an applicator as in claim 15 further characterized in that the applicator is a flexible hanging partition on whose side that is toward the hull are pockets for holding a solid substance and gradually releasing therefrom into the water an aqueous solution of that substance that will release the active anti-fouling substance.

22. In apparatus of the class described, an applicator as in claim 15 further characterized in that the applicator is a flexible hanging partition on whose side that is toward the hull are pockets which extend vertically for receiving a solid substance and gradually releasing therefrom into the water an aqueous solution of that substance that will diffuse the active anti-fouling substance, the walls of said pockets which are toward the hull being foraminous for ingress and egress of water.

23. In apparatus of the class described, an applicator as in claim 15 further characterized in that the applicator is a flexible hanging partition on whose side that is toward the hull are pockets which extend vertically for receiving solid substance and gradually releasing therefrom into the water an aqueous solution of that substance that will diffuse the active anti-fouling substance, the walls of said pockets which are toward the hull being foraminous for ingress and egress of water; there being at the bottom of said partition and pockets a flap which is bendable up to fold and close the bottoms of the pockets, and when released falls and lets the bottoms open and dump contents.

24. In apparatus of the class described, an applicator as in claim 15 further characterized in that the applicator is a flexible hanging partition on whose side that is toward the hull are pockets for holding a solid substance and gradually releasing therefrom into the water an aqueous solution of that substance that will diffuse the active anti-fouling substance.

25. In apparatus of the class described, an applicator as in claim 15 further characterized in that the applicator is a flexible hanging partition on whose side that is toward the hull are pockets for holding and gradually releasing into the water an aqueous solution of that substance that

will diffuse the active anti-fouling substance: the substance contained in the pockets being bleaching powder.

IVAN M. TAYLOR.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
632,919	Farley	Sept. 12, 1899
1,079,208	Browne	Nov. 18, 1913
663,180	Mason	Dec. 4, 1900
623,961	Quimby	Apr. 25, 1899
820,105	Frazier	May 8, 1906
469,538	Buchanan	Feb. 23, 1892