

Aug. 6, 1968

R. E. CAMPBELL

3,395,530

ROPES, STRANDS AND CORES

Filed Aug. 9, 1965

6 Sheets-Sheet 1

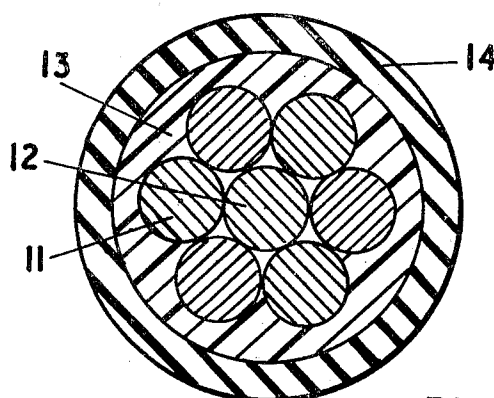


FIG. 1.

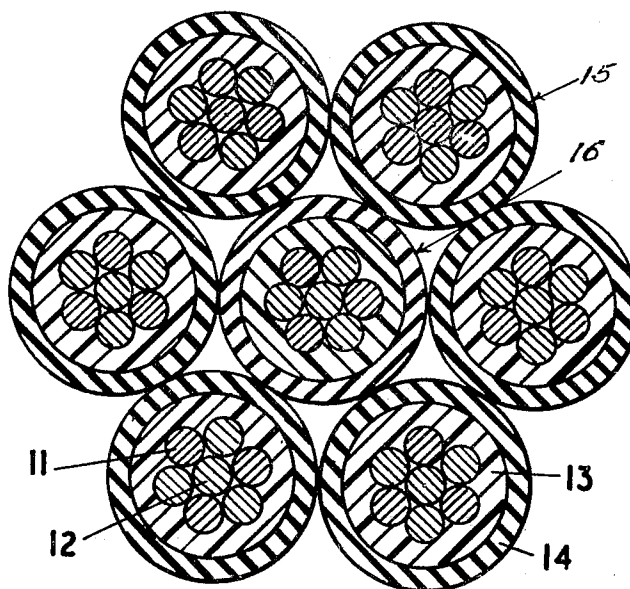


FIG. 2.

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ROPES, STRANDS AND CORES

3,395,530

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6 Sheets-Sheet 2

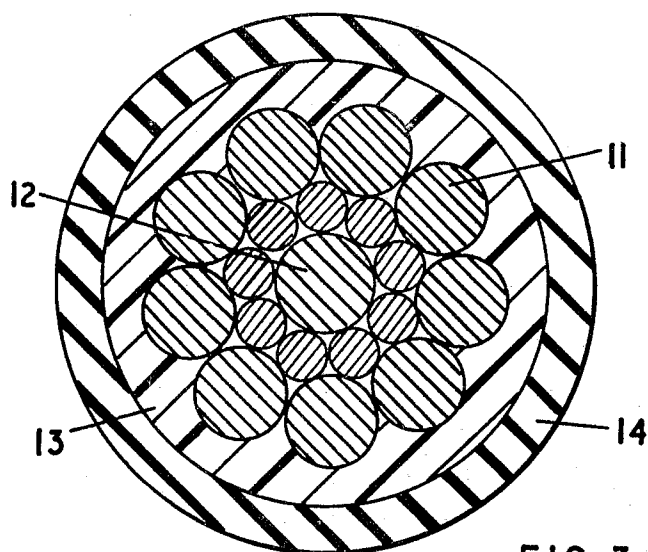


FIG. 3.

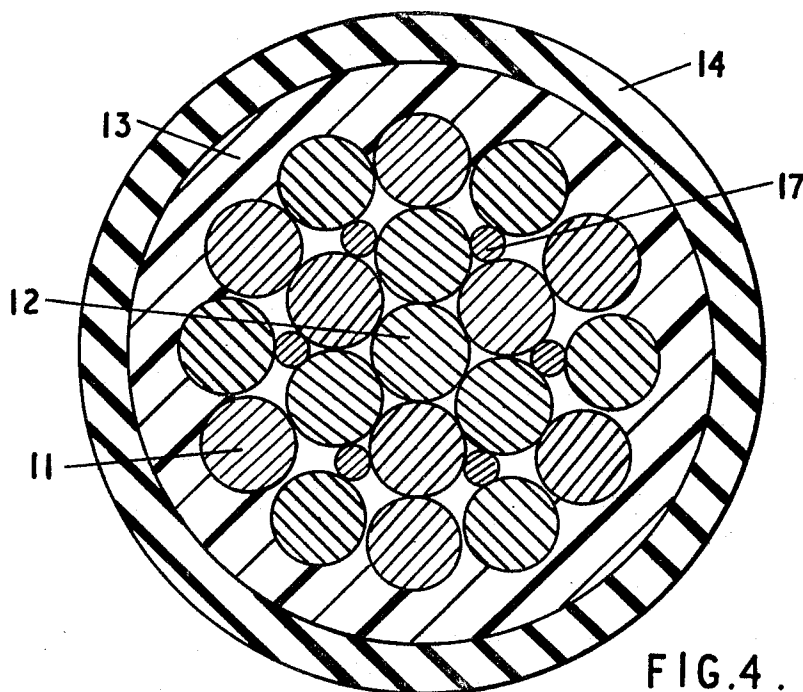


FIG. 4.

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ROPES, STRANDS AND CORES

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6 Sheets-Sheet 3

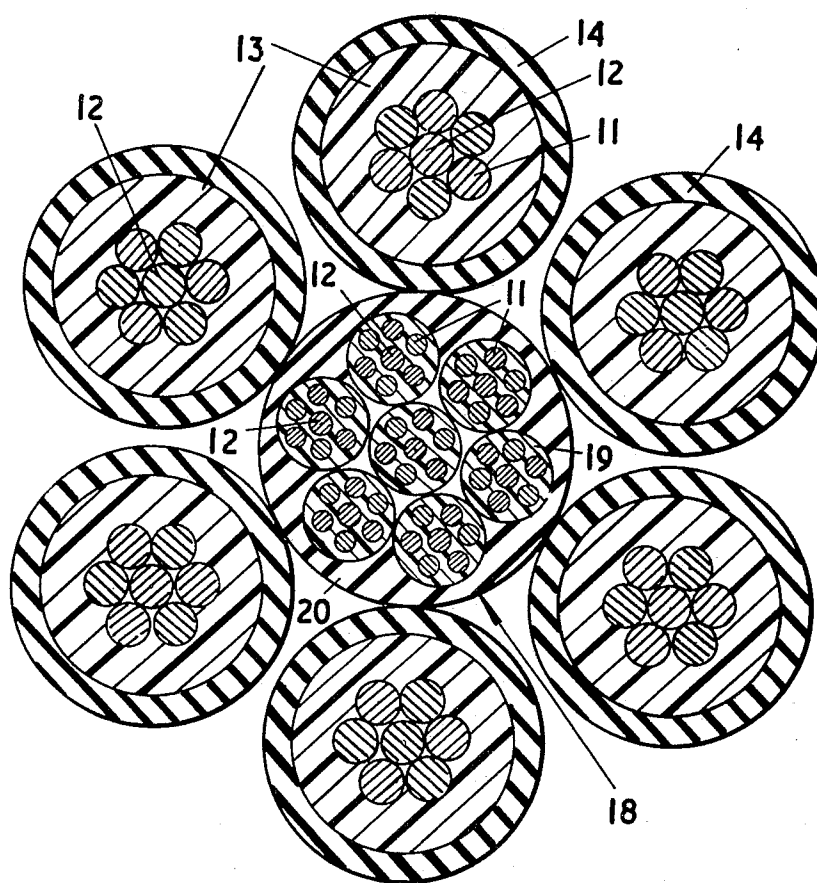


FIG. 5

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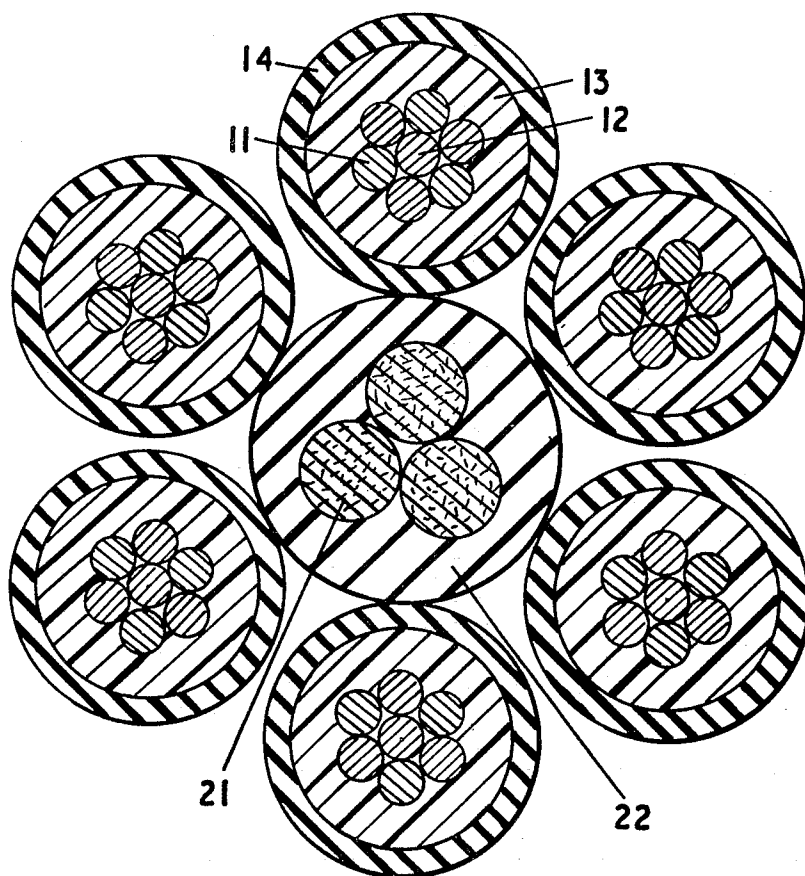
3,395,530

ROPES, STRANDS AND CORES

Filed Aug. 9, 1965

6 Sheets-Sheet 4

FIG. 6.



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3,395,530

ROPES, STRANDS AND CORES

Filed Aug. 2, 1965

6 Sheets-Sheet 5

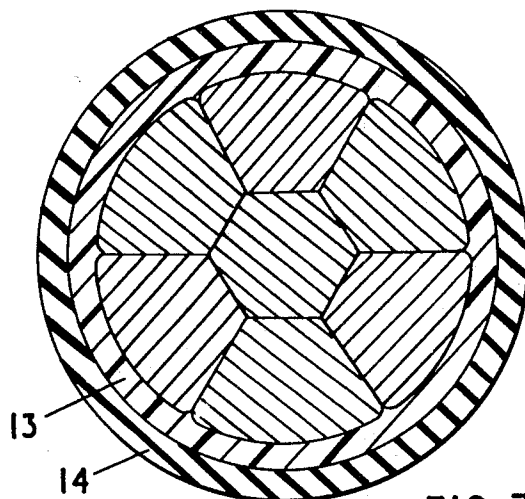


FIG. 7.

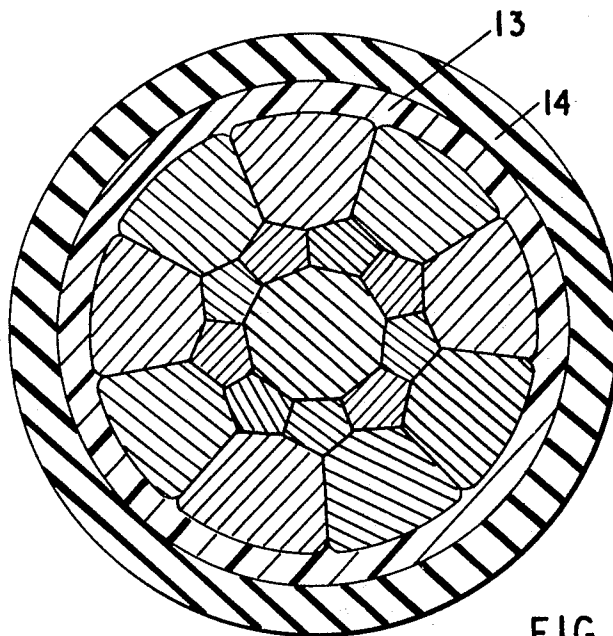


FIG. 8.

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R. E. CAMPBELL
ROPES, STRANDS AND CORES

3,395,530

Filed Aug. 9, 1965

6 Sheets-Sheet 6

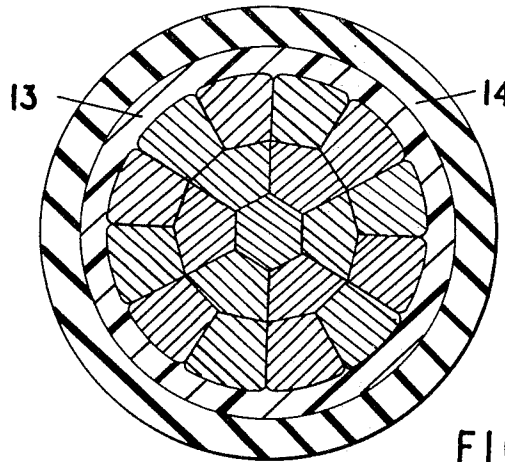


FIG. 9.

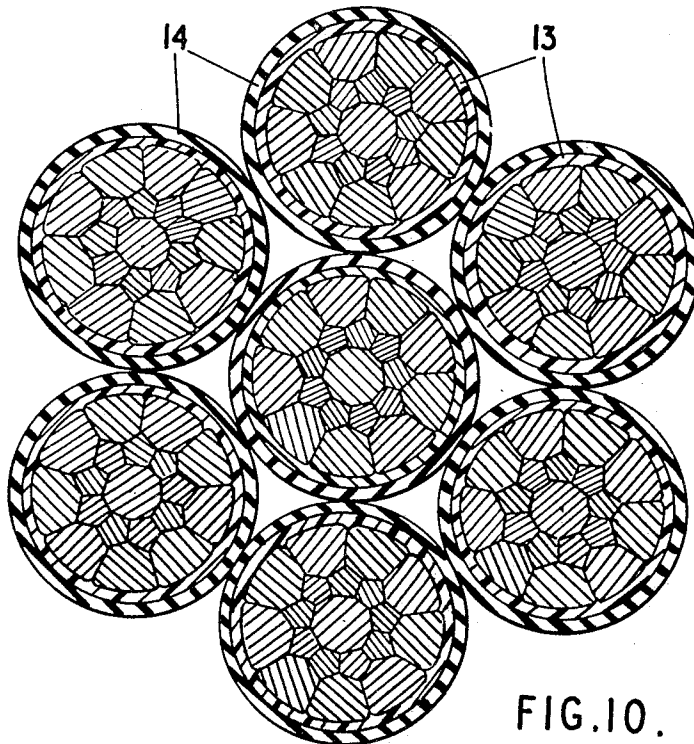


FIG. 10.

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1

3,395,530

ROPES, STRANDS AND CORES

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Filed Aug. 9, 1965, Ser. No. 478,063

Claims priority, application Great Britain, Aug. 20, 1964,

34,039/64

10 Claims. (Cl. 57—153)

ABSTRACT OF THE DISCLOSURE

A method of forming a rope for use in environmental conditions which cause rotting including the steps of dispersing an anti-fouling agent into an elastomeric medium and then applying said medium as a coating to a pre-formed rope.

This invention relates to strands, ropes or cores of steel or other wire or fibrous or filamentary textile material, of any diameter, or generic construction, which are subjected to total or intermittent immersion in environmental conditions conducive to the induction of progressive fouling by marine, or fresh water, fauna and flora.

Fouling, and the attendant undesirable features which result from its occurrence, is commonly countered by applying to the hulls of ships, and the underwater structures of offshore installations, slow release poisons as a dispersion in a fluid, or semi-fluid, base capable of application in the same manner as a paint.

The aforesaid treatment is effective but, when applied to strands, ropes or cores, is subject to the following deficiencies:

(1) The initial efficiency is high, but is not maintained at a constant value and is exhausted relatively quickly. Ropes and the like are a vital, and integral, part of underwater installations, and are required to remain in situ for many years with little or no attention, so that this deficiency is very serious.

(2) Existent anti-fouling coatings are physically allied to paint films and are not resistant to abrasion, or to severe flexion, both of which are essential characteristics in respect of ropes during handling and service.

(3) Many anti-fouling compounds in common use employ metallic oxides which would have a detrimental, electro-galvanic, action if permitted direct contact with ferrous or non-ferrous material.

(4) With the majority of anti-fouling paints, the surface to be protected needs to be immersed within a very short time of treatment to prevent drying out and hardening of the carrying agent, otherwise encapsulation of the reactive particles will occur.

(5) The anti-fouling materials in common usage are deposited as surface films having little or no penetration and, if a portion of the protected area is abraded, attack upon the unprotected substrata can proceed unchecked.

(6) Paint and like films are permeable when subjected to constant immersion.

It is an object of the invention to overcome or mitigate these disadvantages of the conventional technique and to provide a way of protecting ropes, strands and cores against fouling.

The invention consists in a method of applying an anti-fouling agent to a rope, strand or core comprising dispersing the agent in an elastomer and applying the resultant composition to the rope, strand or core as an extrusion or impregnation.

The invention further consists in a rope, strand or core having an anti-fouling agent applied thereto by a method according to the invention as set forth above.

2

The invention still further consists in a rope, strand or core having an elastomeric coating or impregnation, and an anti-fouling agent dispersed in the coating or impregnation.

5 The coating with anti-fouling agent dispersed therein may be extruded onto a sheathing providing an impervious barrier to protect the rope, strand or core from entry of water or other corrosive fluid.

10 The invention still further consists in a composition of matter comprising an elastomer having anti-fouling agents dispersed therein.

The agent may be dispersed in the elastomer by use of a rumbling technique in which the agent in powder form is intimately mixed with granules of the elastomer. An 15 extender or plasticiser may be rumbled with the granules before the anti-fouling agent is added. Alternatively the extender or plasticiser may be intimately mixed with the anti-fouling agent before rumbling with the granules of elastomer.

20 In a further alternative the granules being rumbled may be heated to soften the surface thereof to enable the anti-fouling agent to adhere.

In a preferred manner of carrying out the invention the requisite anti-fouling agents are first weighed out in their desired proportions. The agents are, essentially, either 25 the metals themselves, oxides thereof, or organo-metallic compounds of copper, tin, lead, mercury, beryllium, barium, zinc, etc.

The proportions of the respective agents are varied to suit the particular environment or conditions it is intended to combat. The selected reagents are then intimately mixed, and between 5 and 60% of the mixture added to the selected elastomers on a weight/weight basis.

Prior to adding the anti-fouling agents to the selected 35 elastomer, e.g. polyvinyl chloride, polyethylene, polypropylene, "nylon," polyvinylacetate, etc., a suitable quantity of the elastomer granules is placed in a rotating barrel or "rumbling" machine, and evenly coated with a thin film of plasticiser, e.g. di-octyl-phthalate or other appropriate 40 reagent.

The requisite charge of anti-fouling agents is then added, and mixing continued until the anti-fouling has been evenly distributed over the surface of the elastomer granules, thus ensuring complete homogeneity during the subsequent extrusion. This is an important operation, otherwise the high specific gravity of the anti-fouling agents will result in their separation from the elastomer granules and this will not only affect the actual extrusion, but the efficient operation of the extruder itself.

Alternatively, to achieve the same effect, the mixture of anti-fouling agents may be dispersed in a suitable quantity of plasticiser of extender, the whole then being added to the preferred elastomer and subsequently 45 "rumbled" until a uniform mixture has been achieved.

A further alternative method is to add the selected 55 anti-fouling agents to the requisite weight of elastomer in a rotating barrel, and, whilst mixing is in progress, heat the container to a temperature closely approaching the softening point of the selected elastomer, thus enabling a uniform dispersion of the poisonous agents to become firmly attached to the surface of the plastic granules, this would prevent gravitational separation whilst feeding to the screw of the extruder.

With this latter form of mixing it will be found desirable, in certain specific cases, to maintain an inert 65 gaseous atmosphere within a closed drum whilst the mixing is in progress; this is to prevent any reaction at the elevated temperatures involved.

The elastomer with the anti-fouling agents is then extruded over the rope, strand or core. The rope can be 70 pre-coated with an extruded layer of an elastomer to

provide corrosion protection so that the rope, strand or core is coated in a double sheath of plastic of which the innermost sheathing of plastic gives resistance to the permeation of water and other corrosive media, whilst the overlying sheathing of the same or another type of plastic containing the poisonous reagents, would form the external anti-fouling barrier.

It has been found that composite elastomers are frequently useful, e.g. a 60:40 mixture by weight of polypropylene and polyethylene gives toughness and improved abrasive resistance, while a 60:40 mixture by weight of polyvinyl chloride and polyethylene gives improved extrusion characteristics and requires a lower extrusion temperature when the anti-fouling agents are incorporated.

In practice, the individual steel strands would, initially, be sheathed with a non-permeable elastomer with low electrical conductivity to protect the underlying steel strand completely from any electro-chemical effects which could result from the anti-fouling agents. An example of such a material would be high density polyethylene.

The accompanying drawings show some typical examples of strand and rope constructions sheathed in accordance with the invention. It will be understood that these constructions are given by way of example only and not by way of limitation.

In the drawings, FIGURES 1 to 10 are each cross sectional views of selected constructions.

FIGURE 1 is a simple commercial strand construction of six helically spiralled wires 11 over a central, or king, wire 12 which has been subsequently sheathed with a layer 13 of non-permeable elastomer, such as high density polyethylene.

A second sheathing 14 of permeable elastomer containing a dispersion of selected anti-fouling agents is then applied to form the final external covering.

FIGURE 2 shows a six strand rope made from strands 15 of the construction shown in FIGURE 1 and treated in the same manner. The rope also includes a strand core 16 treated in a similar manner.

FIGURE 3 illustrates a rope of 9/9/1 construction having the inner sheathing layer 13 and an outer sheathing 14 permeable elastomer with a dispersion of anti-fouling agent.

FIGURE 4 shows a rope of 12/6/1 construction including fillers 17 and incorporating the two sheaths 13 and 14.

FIGURE 5 shows a rope similar to that shown in FIGURE 2 except that the strand core 16 is replaced by a wire rope core 18 in which each strand has an inner sheathing 19 similar to sheathing 13, and the whole core has a second sheathing 20 similar to sheathing 14.

FIGURE 6 shows a further modification of the rope of FIGURE 2 wherein the core is formed of a three strand synthetic or natural fibre rope 21 having an outer sheathing 22 of elastomer with dispersion anti-fouling agents.

FIGURES 7 to 9 show different constructions of strand manufactured and subsequently compacted to eliminate the voids. In each case the sheathings 13 and 14 have been successively added after compacting.

FIGURE 7 shows a 6/1 strand, FIGURE 8 shows a 9/9/1 strand, and FIGURE 9 shows a 12/6/1 strand.

FIGURE 10 shows a rope made from six strands as in FIGURE 8 twisted round a core strand of the same construction.

The particular type of anti-fouling agents dispersed in a specific elastomer, or a mixture of elastomers, largely depends upon environmental conditions, but is primarily based upon the employment of mixtures of metals, their oxides, or organo-metallic compounds of the said metals.

Typical examples of the metals or their oxides commonly employed are copper, tin, zinc, beryllium, lead,

barium and mercury, whilst tri-butyl oxides of tin may be quoted as an example of an organo-metallic compound.

The following formulation has given satisfactory results in a temperate sea-water environment:

	Percent by weight
Cuprous oxide	80.75
Mercurous oxide	2.85
Stannous oxide	11.4
Di-octyl-phthalate	5.0

After dispersion of polyvinyl chloride, followed by extrusion, the composition of the final coating was:

	Percent
Polyvinyl chloride	85.0
Di-octyl phthalate	12.10
Cuprous oxide	0.75
Mercurous oxide	0.43
Stannous oxide	1.72

The percentage of the constituent oxides may be varied to suit different environmental conditions and, in a similar manner, the overall ratio of oxides to elastomer.

This particular formulation proved to be effective against the adhesion of slimes, and the growth of sea weeds, barnacles and mussels.

The requisite weights of selected anti-fouling agents are first intimately mixed together by any convenient means, e.g. ball milling.

The agents may then be dispersed in the elastomer, by any suitable means and the following examples are typical:

(a) 15 parts of the milled anti-foul agent are added to 85 parts of the selected elastomer, and intimately mixed by "rumbling" for approximately 30 minutes at 100-120 revolutions per minute.

(b) The requisite weights of anti-foul agent are dry milled for say 30 minutes at 100-120 revolutions per minute, and 5 parts, by weight, of an extender or plasticiser such as di-octyl phthalate added, and milling continued for a further 30 minutes. The admixture of milled material to the requisite amount and grade of elastomer is then performed in the same manner as scheduled in (a) above.

(c) Alternatively, the requisite amount of plasticiser may be "rumbled" with the appropriate weight of elastomer to produce a tacky surface on the granules of elastomer; the milled anti-foul agents are then sifted into the mass and "rumbling" continued until such time as the anti-fouling agent is uniformly dispersed over the granules.

(d) An alternative to Examples (b) and (c) is to use a heated "rumbling" barrel at a temperature consistent with, but slightly below, the softening point of the elastomer employed, e.g. 60-80 deg. cent. for polyvinyl chloride, to achieve deeper impressment and better adhesion of the anti-foul mixture to the surface of the granules of elastomer.

(e) A further modification would be the use of elastomers which, when heated to their softening point under atmospheric conditions, are liable to undergo partial decomposition. In such cases it would be necessary to employ a totally enclosed "rumbling" barrel which would be purged, during the operation, with an inert gas such as carbon dioxide or nitrogen. This modification is applicable to Example (d).

When using a nonmetallic core, i.e. a natural fibre such as jute or sisal or a synthetic fibre such as polypropylene or polyethylene, it is possible to apply the anti-fouling agents dispersed in the elastomer directly to the core.

The core material would not, in these cases, be subjected to any galvanic attack, and the dispersion of anti-foul agents in the selected elastomer could be permitted to permeate at least into the sub-strata without the necessity of a non-permeable underlying layer of elastomer.

In such cases the core could have the anti-foul layer:

5

extruded directly onto it, or alternatively, a polyvinyl chloride latex containing the dispersed anti-fouling agents could be applied to the core as an impregnation treatment, as disclosed in United Kingdom patent specification No. 789,163.

The ends of the strands or ropes would need to be socketed, and a preferred method is by cold setting resins of the epoxy or polyester types.

Various modifications may be made within the scope of the invention.

I claim:

1. A method of applying an anti-fouling agent to a rope, strand or core comprising applying an impervious sheathing to the rope, strand or core, dispersing the anti-fouling agent in an elastomer, and applying the resulting composition outside the impervious sheathing as a coating.

2. A method as claimed in claim 1, in which the coating is extruded onto the sheathing.

3. A method as claimed in claim 1, wherein the anti-fouling agent is dispersed in the elastomer by rumbling, whereby the anti-fouling agent in powder form is intimately mixed with granules of the elastomer.

4. A method as claimed in claim 3, wherein a plasticizer is rumbled with the granules of elastomer before the anti-fouling agent is added.

5. A method as claimed in claim 3, wherein a plasticizer is intimately mixed with the anti-fouling agent powder before rumbling with the granules of elastomer.

6. A method as claimed in claim 3, wherein the granules are heated during rumbling to soften the surface thereof to enable the anti-fouling agent to adhere thereto.

7. A method as claimed in claim 6, wherein the rumbling is carried out in an inert gaseous atmosphere.

6

8. A method as claimed in claim 3, wherein the anti-fouling agent constitutes between about 5% and about 60% by weight of the elastomer in which it is dispersed.

9. A rope, strand or core having an impermeable sheathing, a coating of elastomer outside the sheathing, and an anti-fouling agent dispersed in the coating of elastomer.

10. A rope, strand or core having an elastomeric coating and an anti-fouling agent dispersed in the coating, wherein the anti-fouling agent is constituted by at least one substance selected from the group: copper, tin, lead, mercury, beryllium, barium, zinc, the oxides thereof, and organo metallic compounds thereof.

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