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(71) Applicant: **AGIP S.p.A.**
**Via Borgonuovo, 18**
**I-20121 Milano (IT)**

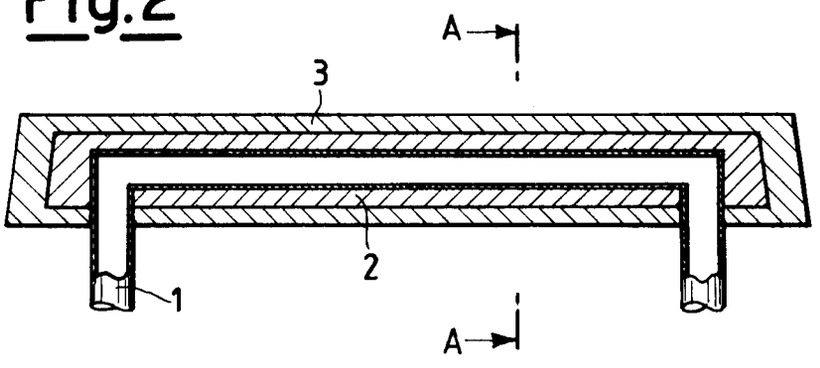
(72) Inventor: **Draghetti, Mario**
**Via Marocchetti, 23**
**I-20139 Milano (IT)**
Inventor: **Valla, Gianluigi**
**Via Giovanni Paolo I, 15**
**I-20070 Vizzolo Predabissi(Milano) (IT)**
Inventor: **Bonora, Pierluigi**
**Via Marighetto, 128**
**I-38100 Trento (IT)**

(74) Representative: **Fusina, Gerolamo et al**
**Ing. Barzanò & Zanardo Milano S.p.A,**
**Via Borgonuovo, 10**
**I-20121 Milano (IT)**

(54) **Improved spendable anode for anticorrosion protection of offshore structure, and process for manufacturing it.**

(57) A spendable anode for the anticorrosion protection of offshore structures, is constituted by a composite structure in which a first anodic material, which constitutes an external coating on the same anode carrier means, with said material having a more negative electrochemical potential than of the material which constitutes the offshore structure to be protected, is provided, in its turn, with an external coating constituited by a second anodic material the electrochemical potential of which is still more negative than of said first material. Furthermore, some types of anodic material, as well as a process for manufacturing such a spendable anode are specified.

Fig.2




EP 0 615 002 A1

The present invention relates to a novel spendable anode for the anticorrosion protection of offshore structures, which anode, thanks to its particular composite-structure configuration, besides making it possible the necessary amount of anodic material to be decreased with self-explanatory economic advantages, also improves the protection state of the surfaces of the offshore structure, with protective compact deposits being formed in a larger amount.

The present invention also relates to the process for accomplishing such a spendable anode.

According to the prior art, the anticorrosion protection of offshore structures by means of spendable anodes represents today one of the most used techniques in this field, and its developments made it possible optimal anodic material from the viewpoints of efficiency and weight and cost savings to be found out, such as aluminum, zinc and magnesium alloys.

According to such a technique, the spendable anode, made of an anodic material having a more negative electrochemical potential than of the material which constitutes the offshore structure to be protected, generates a bias which in its turn causes a protection current to be established, which causes protective calcareous deposits to be formed on the same strucuture.

Such a bias clearly is the higher, the more negative the electrochemical potential of the anodic material used.

On the other hand, the above said necessary protection current for the adequate protection of the offshore structure depends, besides such marine conditions as temperature, salinity, oxygen content, and so forth, also, and above all, on the surface conditions of the offshore structure to be protected, i.e., whether calcareous deposits are present or less. From the above it results hence that during the early steps of the life time of the offshore structure to be protected, during which the protective calcareous deposits have not been adequately formed yet, the need exists for having the maximal protection current, which may then decrease during the subsequent life steps of the structure, as a function of the quality of the calcareous deposit formed during said initial step.

From the above, it derives that an essential element in the design of any spendable anode is the ability of the latter to supply the high demand of starting protection current during the initial step of the life of the offshore structure, besides being capable of preserving the protection state of said structure throughout the subsequent steps of the useful operating life of the latter. Inasmuch as, however, the starting current which a spendable anode is capable of supplying depends, besides the marine conditions and its electrochemical potential, also on its surface and, consequently, its geometry, the above said condition practically results in that the geometric dimensions and the weight of the spendable anode have to be determined as a function of the starting current required by the offshore structure to be protected, and, respectively, of the protection current which must be generated during the subsequent operating steps of the same structure, after the formation of the protective calcareous deposit.

Now, as magnesium and its alloys display the highest negative electrochemical potential, one might think that the spendable anode made of magnesium alloy is the optimal solution for the anticorrosion protection of offshore structures because it, by generating a high bias and, consequently, a high initial anodic current, is capable of supplying a very effective protection of the above said structure, by causing compact calcareous deposits to be formed, which reduce the magnitude of the required protection current during the subsequent steps of the useful operating life of said structure. Actually, however, such an anode of magnesium alloy, by displaying a low anodic efficiency, is not capable of covering the whole useful operating life of the offshore structure to be protected, unless it is used in such large amounts as to render it economically unecceptable, owing to its large weight and high cost.

In fact, the presently most largely used spendable anodes for the protection of offshore structures are aluminum or zinc alloys which secure, even when small weight amounts thereof are used, the full protection of the structure to be protected throughout the whole life span thereof, with the demand for a high initial current being satisfied by suitably increasing the geometric size of said anodes.

The purpose of the present invention precisely is of obviating the above said drawbacks and hence supplying a spendable anode for the anticorrosion protection of offshore structures which is capable of supplying the high starting current which is initially demanded in order to create an effective protective layer of calcareous deposit on the offshore structure to be protected, although its geometrical dimensions are kept small, as well as of securing the anticorrosion protection throughout the operating life span of the structure, with its weight being anyway kept small.

The above purpose is substantially achieved by using a composite-structure spendable anode in which the anodic material, generally consisting of zinc or aluminum alloys, which constitutes an external coating applied onto the carrier which supports the same anode, is externally coated, in its turn, by a second anodic material, generally magnesium alloys, having an electrochemical potential still

more negative than of the above said zinc or aluminum alloyed-based anodic material.

The advantages displayed by such a composite-structure spendable anode over to the traditional anodes known from the prior art substantially derive from the actions of initial biasing and of anodic efficiency which a spendable anode should perform being caused now to be carried out by two different anodic materials, so as to take the maximal advantage from their intrinsic properties.

In fact, in that way, the magnesium alloy which constitutes the outermost coating, with low anodic capacity and high negative electrochemical potential, will operate during the first step of the useful operating life of the offshore structure to be protected, and hence makes it possible the geometric dimension of the same anode to be reduced, whilst the internal anodic material, constituted by aluminum or zinc alloys, which starts acting only after that all of said outermost magnesium coating has been consumed, will operate on surfaces which are already biased and coated by compact calcareous deposits, which hence require low protection current values, with the weight amount of said internal anodic material, necessary in order to protect the structure during the residual portion of the useful operating life of the latter, being consequently decreased.

Experimental tests demostrated that the use of composite-structure spendable anodes according to the present invention makes it possible a considerably large economing saving, of the order of 20%, to be obtained, as compared to the use of traditional spendable anodes known from the prior art.

Summing-up, the spendable anode for the anticorrosion protection of an offshore structure, comprising a carrier means provided with an external coating made of an anodic material having a more negative electrochemical potential than of the material which constitutes said offshore structure to be protected, is characterized, according to the present invention, in that said anodic material is provided, in its turn, with an external coating of a second anodic material with a still more negative electrochemical potential than of the above said anodic material.

Then, according to a preferred feature of the present invention, the process for manufacturing such a spendable anode, suitable for the anticorrosion protection of offshore structures, comprises the steps of casting said anodic material which constitutes the external coating of the carrier means which supports the same anode into a suitable ingot mould or chill or mould and then casting, into another suitable ingot mould or chill or mould, said second anodic material around the anode formed during the preceding step.

The invention is better explained now by referring to the accompanying drawing, which displays a preferred embodiment supplied for merely exemplifying, non-limitative purposes, because technical, structural or technological changes may be always supplied without departing from the scope of the present invention. So, for example, rather than by means of sequential steps of casting into ingot moulds or chills or moulds the two anodic materials which coat, in sandwich fashion, the anode carrier means, the composite-structure anode can also be manufactured by spraying said second anodic material onto said support already coated with the above said anodic material with lower negative electrochemical potential, or coating the latter with said second anodic material by means of a plating process.

On the other hand, it is evident that all of the above said processes make it possible composite anodes with any cross-section and length features to be manufactured.

In said drawing:

Figure 1 shows a perspective view of a spendable anode for the anticorrosion protection of offshore structures, manufactured according to the invention;

Figure 2 displays a longitudinal sectional view made along the middle of the anode of Figure 1;

Figure 3 displays a front sectional view made along section line AA of Figure 2.

Referring to the above Figures, with the reference numeral 1 the carrier means is indicated of the anode to be manufactured, which carrier means, charged to a suitable ingot mould or chill or mould, not shown in Figure, is provided with an external coating by casting an anodic material 2 with a more negative electrochemical potential than of the material which constitutes the structure to be protected.

Said coated carrier means is then charged to another suitable ingot mould or chill or mould, also not displayed in Figure, and, in its turn, is provided with an external coating by casting an anodic material 3 with a more negative electrochemical potential than of the anodic material 2.

## Claims

1. Spendable anode for the anticorrosion protection of an offshore structure, comprising a carrier means provided with an external coating made of an anodic material having a more negative electrochemical potential than of the material which constitutes said offshore structure to be protected, characterized, in that said anodic material is provided, in its turn, with an external coating made of a second anodic material with a still more negative electrochemical

potential than of the above said anodic material.

2. Spendable anode according to Claim 1, characterized in that said anodic material which externally coats said carrier means is constituted by aluminum alloys.

3. Spendable anode according to Claim 1, characterized in that said anodic material which externally coats said carrier means is constituted by zinc alloys.

4. Spendable anode according to Claim 1, characterized in that said second anodic material is constituted by magnesium alloys.

5. Process for manufacturing a spendable anode suitable for the anticorrosion protection of offshore structures, according to the preceding claims, characterized in that it comprises the steps of casting said anodic material which constitutes the external coating of the carrier means of the same anode into a suitable ingot mould or chill or mould and then casting, into another suitable ingot mould or chill or mould, said second anodic material around the anode formed during the preceding step.

Fig.1

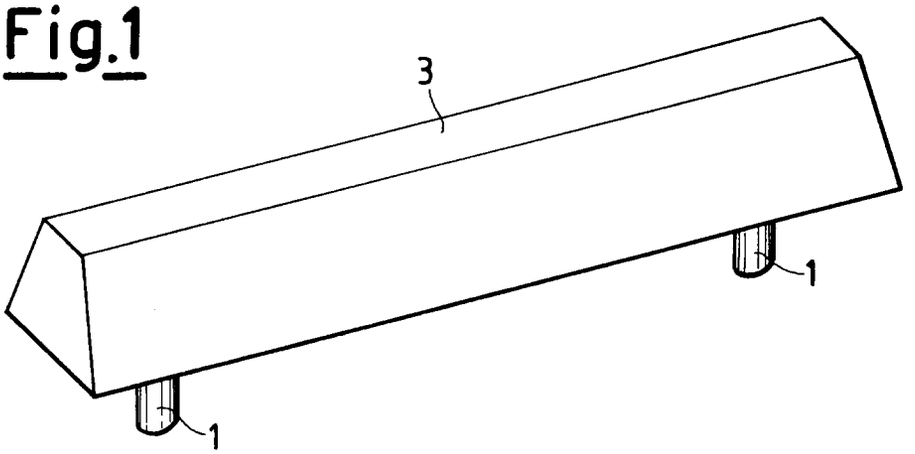



Fig.2

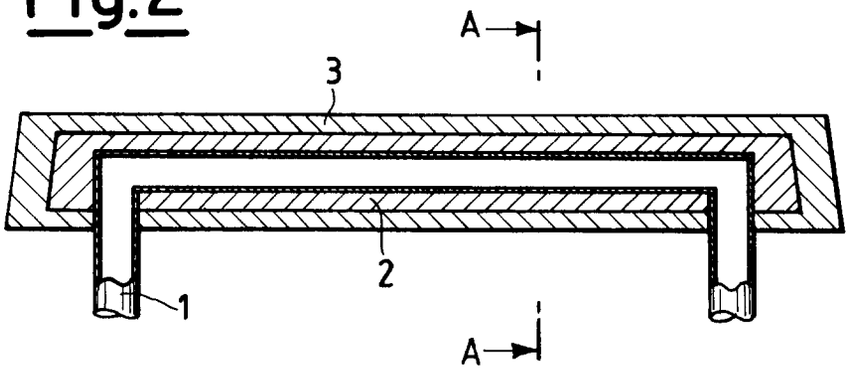
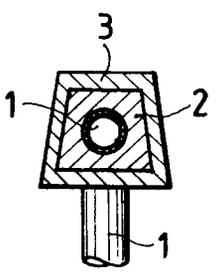



Fig.3



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# EUROPEAN SEARCH REPORT

Application Number
EP 94 20 0566

## DOCUMENTS CONSIDERED TO BE RELEVANT

| Category | Citation of document with indication, where appropriate, of relevant passages | Relevant to claim | CLASSIFICATION OF THE APPLICATION (Int.Cl.5) |
|---|---|---|---|
| X<br>Y | DE-A-18 03 523 (STEIN,HEINRICH)<br>* the whole document * | 1,3-5<br>2 | C23F13/16 |
| Y | US-A-4 409 081 (TERRASE)<br>* column 3, line 40 - line 46; claims * | 2 | |
| A | WO-A-90 08204 (HOEGBERG, J)<br>* the whole document * | 1-5 | |
| A | DE-A-27 41 015 (SOCIETE NATIONALE ELF-AQUITAINE S. A.)<br>* the whole document * | 1-5 | |
| A | DE-A-22 17 716 (SCHWEIZERISCHE ALUMINIUM AG)<br>* the whole document * | 5 | |

TECHNICAL FIELDS SEARCHED (Int.Cl.5)

C23F

The present search report has been drawn up for all claims

| Place of search | Date of completion of the search | Examiner |
|---|---|---|
| THE HAGUE | 18 May 1994 | Kaumann, E |

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