

SACRIFICIAL ANODE AND FASTENING DEVICE.

5 The present invention relates to a sacrificial anode for providing cathodic protection of metal in ballast tanks, for example water ballast tanks on board a ship or on an offshore structure, where the anode substantially is produced of a metallic material which corrodes, or sacrifices, faster than said metal. The invention also relates to a fastening device for such an anode, comprising a first fastening bracket connected to said anode.

10 It is known to use sacrificial anodes in the fight against corrosion, in order to reduce corrosion in for instance ballast tank of vessels. Applications for such anodes also include ship hulls, tank interiors, offshore structures, submerged pipelines, piers, pilings, etc.

15 The high cost of corrosion can be substantially reduced by installing a cathodic protection system to transfer the corrosion from the structure being attacked to a suitable anode system, such as the sacrificial anode, also called galvanic anode. Corrosion takes place when an anode and cathode are electrically connected and are surrounded by an electrically conductive electrolyte, such as
20 fluid in a tank or moisture in the soil. When these conditions are met, an electrical current will flow, and the anode will be consumed, so called active corrosion.

25 The known sacrificial anodes are traditionally manufactured with different rectangular shapes and non-profiled surfaces. These known anodes are normally attached to the interior of a tank by either welding or by bolting. Because of their rather heavy weight, it takes at least to workers for properly attachment or detachment of the sacrificial anode in the tank, which is a rather cost and time consuming operation. Further, a ships ballast tank is always
30 exposed to vibration, in which the known anodes may come loose and fall down in the tank. Hence, the electrical contact, i.e. conductivity, will be lost, and the anodes sacrificial function will no longer be achieved. In that the anodes may

fall down in the tank, there is also a risk of causing sparks, which might lead to an explosion in the tank.

5 If the known anodes are to be detached and replaced, a welding torch must normally be used, independent of the known attachment methods, i.e. welding or bolting. As most ballast tanks are certified to be 100% gas free as to performing "hot work" in the tank, most old anodes must be left in the tank, as no welding can be performed in the tank. From an economical and safety point of view, this is not desirable.

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It is therefore a need for a sacrificial anode with a much longer lifetime than traditional anodes, and which is easy to attach to the interior of a tank. Improved performance is also needed.

15 The object of the present invention is therefore to provide a sacrificial anode with a much longer lifetime than traditional anodes, and which starts polarization almost immediately in the electrolyte. Traditional rectangular anodes normally take 10 – 14 days before effective polarization starts.

20 It is a further object of the present invention to provide an improved attachment/fastening device for the anode, in where the anode easily can be attached and detached.

It is also an object of the present invention to provide an improved
25 attachment/fastening device for any anode, in where the anode easily can be attached and detached.

The objects according to the invention are achieved by a sacrificial anode according to the independent claim 1, in where the sacrificial anode primarily
30 comprise an anodizing body with an encased reinforcement, and the surface of said body comprise a number of raised parts providing auxiliary corrosive surface area, in order to reduce corrosion of said metal by faster polarization of the sacrificial anode.

35 Alternative preferred embodiments of the sacrificial anode are characterized in the dependent claims 2-10. The raised parts can be designed with a pyramidal pattern, or a partly spherical pattern, and can cover at least one of the sides of the anode. The anode can be of a circular cylindrical shape, where the

pyramidal pattern, or the partly spherical pattern, covers at least the front side and/or the rear side of the anode, or the anode can be of a rectangular shape, where the pyramidal pattern, or the partly spherical pattern, covers at least one of the sides, preferable two sides.

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Further, the encased reinforcement can comprise a galvanized tension grid, adapted to provide optimal adhesion between the material of the anode and the reinforcement of the anode. The encased reinforcement can be arranged in the anode in such a way that the reinforcement covers approximate all of the anode's cross section in diametrical and/or lengthwise direction, and that the reinforcement is arranged at a distance from one of the sides of the anode at approximately 3/5 of the thickness of the anode. The galvanized tension grid is preferable produced of a flat rolled material, preferable with quality EN S235JRG2.

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The sacrificial anode according to invention can comprise a bore for reception of part of a first fastening bracket, in where said bore can be provided with internal threads providing a radial load, such as SPIRALOCK threads.

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A fastening device according to the invention is characterized by the independent claims 11 and 21, in where a first fastening bracket comprises an extension with a U-shaped middle section, adapted to abut a second fastening bracket with a corresponding outer surface, the second fastening bracket being secured to the interior of a ballast tank, or on a offshore structure, and a locking element adapted to be inserted in the second fastening bracket and to abut about the first fastening bracket, in order to lock the two fastening brackets securely together, and in such a way that the anode is suspended by the fastening device.

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Alternative preferred embodiments are characterized in the dependent claims 12-20, and 22-28, respective. The fastening device according to invention comprise a first fastening bracket with an upper part running perpendicular relative to the diametrical or lengthwise direction of the anode and/or the protruding part, and comprises a stud adapted to cooperate with a recess in an upper part of the second fastening bracket.

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A first leg of the locking element can be inserted in an opening in the second fastening bracket, adjacent the U-shaped middle section of the second

fastening bracket, and the second leg of the locking element can be mounted on the outside of the first fastening bracket, in such a way that the second leg partly enclose the U-shaped section of the first bracket. Or, a first leg of the locking element can be inserted in a recess in the second fastening bracket, in
5 the U-shaped middle section of the second fastening bracket, and the second leg of the locking element can be mounted on the outside of the first fastening bracket, in such a way that the second leg partly enclose the U-shaped section of the first bracket. The locking element is preferable a lock pin, comprising two legs and an intermediate section, and the locking element basically encircles
10 the U-shaped sections, with the two legs in different planes.

Further, the second fastening bracket can comprise a number of legs, in where the second fastening bracket is secured to the tank by welding of the legs to the interior of said tank.

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The second fastening bracket can alternative comprise a number of legs and a locking mechanism in one of the legs, in where the second fastening bracket is secured to the tank by being locked to a profile in said tank. Said one leg can comprise a threaded opening for reception of a threaded bolt, and the legs can
20 be arranged in a U-shaped relationship for reception of a profile of said tank, in where the second fastening bracket can be locked to said profile by tightening of the threaded bolt. The threaded opening in said one leg can advantageous be provided with internal threads providing a radial load, such as SPIRALOCK threads.

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It should also be noted that the present invention will improve safety on board ships or installations, in that for instance explosions can be avoided. Such accidents have occurred due to the fact that traditional anodes with several screw connections have caused such explosions.

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A faster polarization of the anode will also be beneficial for short ballast journeys, as corrosion often is more intensive on such cases. Further, the anode according to the invention will also provide better utilization of the anode material, which also will improve cost savings.

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The working environment will also be improved with the anode according to the invention, for instance in connection with installation or replacement of anodes. Also, the time consuming work normally carried out with traditional anodes will

be drastically reduced with the anode and fastening device according to the invention.

5 The invention shall now be described with reference to the enclosed drawings, in where:

Figure 1 shows a preferred embodiment of a sacrificial anode, according to the invention.

Figure 2 shows the anode attached to a profiled part of a tank, with a fastening device according to the invention.

10 Figure 3 shows an alternative embodiment of a fastening device, connected to the anode and the interior of a tank.

Figure 4 and 5 shows the two alternative embodiments of the fastening device.

Figure 6 show an alternative preferred embodiment of the sacrificial anode.

15 Figure 7 and 8 shows suspension/fastening of an anode to a fastening device according to the invention.

Figure 9 shows a locking element according to the invention.

Figure 10 shows an enlarged view of one embodiment of the fastening device, according to the invention.

20 The sacrificial anode shall preferable be produced of a material such as Zink or Aluminum, or in some cases Magnesium.

By using a sacrificial anode to protect a tank, the material of the tank is made cathodic in an electrolytic cell, i.e. the tank, in that the material is polarized
25 cathodic. As for cathodic protection, the anodic current for the material to be protected is approximately 0, or relative small. Thus, the external current is approximately equal to the cathodic current. In the present case, the external current is produced by the base metal such as the sacrificial anode, which is connected to the construction to be protected against corrosion.

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As corrosion speed is measured as either loss of weight or as reduction of thickness of the anode, it is imperative with an anode which shape improves the life of the sacrificial anode. The cross section and surface area of an anode will therefore influence the life of the anode. For instance, a cylindrical and circular
35 anode will help improve such life span. Figure 1 shows such a cylindrical and circular sacrificial anode, where the diametrical cross section of the anode is larger then the cylindrical length. To further improve life and also performance of such an anode, it is provided with raised parts to increase the surface area.

A sacrificial anode, according to the invention, for providing cathodic protection of metal, such as steel, is shown in figure 1. An alternative embodiment is shown in figure 6. The sacrificial anode can be used in ballast tanks, for example water ballast tanks on board a ship or on an offshore structure. However, the anode might also be used in other storage tanks filled with a fluid, in order to provide the same cathodic protection, i.e. corrosion protection. The anode is substantially produced of a metallic material which corrodes, or sacrifices, faster than the metal in the tank.

The sacrificial anode primarily comprise an anodizing body 10 with an encased reinforcement (not shown), and where the surface of said body, or at least part of the surface, comprise a number of raised parts 12, with a specific pattern, to provide auxiliary corrosive surface area, in order to reduce corrosion of said metal by faster polarization of the sacrificial anode.

The raised parts 12 are preferable designed with a pyramidal pattern and covers at least one of the sides of the anode. However, the pattern can also be of a partly spherical design, as a spherical shape will further increase the surface area, or the raised parts can be of any other suitable pattern providing similar features.

As mentioned previously, an anode of a circular shape will improve the life of the sacrificial anode. The sacrificial anode according to the invention is therefore preferable of a circular cylindrical shape, where a pyramidal pattern, or a partly spherical pattern, covers at least the front side and/or the rear side of the anode. It should be noted that the terms "front side" and "rear side" only refers to how the anode is shown in the drawings, and not to absolute terms.

An alternative anode according to the invention is shown in figure 6. This anode is of a rectangular shape, where the pyramidal pattern 12, or the partly spherical pattern, covers at least one of the sides, preferable two sides.

Said encased reinforcement comprises preferable a galvanized tension grid, which provides optimal adhesion between the material of the anode and the reinforcement of the anode. The encased reinforcement can be accommodated in the anode in such a way that the reinforcement covers approximate all of the anode's cross section in diametrical and/or lengthwise direction. Further, the

encased reinforcement is preferable arranged at a distance from one of the sides of the anode at approximately 3/5 of the thickness of the anode. The galvanized tension grid is preferable produced of a flat rolled material, preferable with quality EN S235JRG2, but can be manufactured from other suitable materials as well.

The drawback of traditional anodes is that when the anode material corrodes, or sacrifices, segments of the material loosen, due to the shape of such traditional anodes. Corrosion of the anode material is always directional, i.e. from the surface of the anode to the centre of the anode. Thus, as traditional anodes are replaced when about 75-80% of the anode material is corroded, the encased reinforcement, according to the invention, will increase efficiency to almost 100% of the anode material. The tension grid of the reinforcement hence prevents said segments of the anode material to loosen.

The sacrificial anode according to invention also comprises a fastening device for securing the anode to a profile in a tank or to the interior of the tank. Preferable is a first fastening bracket 14 partly encased in the anode, or connected to the anode by other means. However, the first fastening bracket 14 might also be secured to the anode by conventional means, such as for example screws. The bracket comprises a protruding element 16 with a U-shaped middle section 16a, adapted to abut a second fastening bracket 18 secured in a ballast tank, or on an offshore structure. The second fastening bracket 18 has preferably an outer shape corresponding to the protruding element 16 of the first fastening bracket 14. The fastening device also comprise a locking element 20, such as a lock pin, adapted to be inserted in the second fastening bracket 18 and to abut about and/or partly enclose the first fastening bracket 14, in order to lock the two fastening brackets 14, 18 securely together. The sacrificial anode is thus suspended by the fastening device

An upper part 22 of the first fastening bracket 14 is bent and runs at an angle, preferable right angled, relative to the diametrical or lengthwise direction of the anode, and comprises a stud 24 adapted to cooperate with a recess 26 in an upper part of the second fastening bracket 18.

A first leg 20a of the locking element 20 is inserted in an opening 28 in the second fastening bracket 18 (as seen in figure 4), adjacent a U-shaped middle section 16b of the second fastening bracket, and the second leg 20b of the

locking element is mounted on the outside of the first fastening bracket, in such a way that the second leg and an intermediate section 20c between said legs 20a,20b, partly enclose the U-shaped sections 16a,16b. The locking element 20 basically encircles the U-shaped sections, but with its two legs 20a,20b in
5 different planes.

In the alternative embodiment (as seen in figure 5), the first leg of the locking element 20 is inserted in a recess 28 formed in the U-shaped middle section 16b of the second fastening bracket 18, and the second leg of the locking
10 element is mounted on the outside of the first fastening bracket, in such a way that the second leg partly enclose the U-shaped sections 16a,16b, as described with reference to figure 4.

As mentioned previously, the invention comprises at least two embodiments of the fastening device. The second fastening bracket 18 of the two embodiments is shown in figure 4 and 5. According to figure 5, the second fastening bracket 18 comprise a number of protruding legs, preferable two legs 19a,19b. The second fastening bracket 18 will normally be secured to the tank by welding of the legs to the interior of said tank.
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According to an alternative embodiment, as shown in figure 4, the second fastening bracket 18 comprise a number of protruding legs, preferable two legs 21a,21b, and a locking mechanism 30 in one of the legs, in where the second fastening bracket 18 is secured to the tank by being locked to a profile in said
25 tank. One of said legs 21a comprise a threaded opening for reception of a threaded bolt, and the legs are further arranged in a U-shaped relationship for reception of a profile 32 of said tank, in where the second fastening bracket 18 is locked to said profile by tightening of the threaded bolt.

30 The invention also relates to a fastening device for any sacrificial anode for providing cathodic protection of metal in ballast tanks, for example water ballast tanks on board a ship or on an offshore structure, the anode is substantially of a metallic material which corrodes, or sacrifices, faster then said metal, and the fastening device comprise a first fastening bracket 14 connected to the anode.
35 The first fastening bracket 14 comprise a protruding element 16 with a U-shaped middle section 16, adapted to abut a corresponding second fastening bracket 18 secured to the interior of a ballast tank, or on a offshore structure, and a locking element 20 adapted to be inserted in the second fastening

bracket 18 and to abut about and/or partly enclose the first fastening bracket 14, in order to lock the two fastening brackets 14,18 securely together. The anode is thus suspended by the fastening device.

- 5 Other features of the fastening device are the same as for the fastening device already described, and will thus not be described any further.

Figure 7 and 8 shows the mounting of the sacrificial anode to the interior of for example a tank, with help of the fastening device. As figure 7 shows, an
10 embodiment of the fastening device is secured to a profile 32 of a tank (only the wall of the tank is shown). The second fastening bracket 18 is releasable secured to the profile 32 by the locking mechanism 30. One leg 21a of the bracket 18 comprises a threaded opening for reception of a threaded bolt, which by tightening of the threaded bolt secures the bracket to the profile. The anode
15 is suspended by inserting the stud 24 of the first fastening bracket 14, in the recess 26 of the second fastening bracket 18, and thereafter lowering the anode such that the first and second fastening bracket are adjacent. Afterward, the first leg of the locking mechanism 20 is inserted in the opening or recess 28, and the rest of the locking mechanism, i.e. the other leg, is being arranged around the
20 two fastening brackets, as previous explained. Inserting of the locking mechanism and fastening of the mechanism can be carried out with a suitable tool, such as a hammer.

Figure 8 shows the same procedure for suspending the anode as described
25 with reference to figure 7, except that the this embodiment of the second fastening bracket is secured to the interior of at tank by welding, or the like.

It has previously been explained that a part of the first fastening bracket can be encased in the anode body, in order to secure the bracket to the body. However
30 it must be understood that other means of securing the bracket can be used. A first part of the first fastening bracket, i.e. the part which is to be secured in the anode body, can for instance be threaded, and also an opening, or bore, in the anode body can be threaded. Thus the first fastening bracket is being screwed onto the anode body.

35 In an embodiment where a threaded connection is used in connecting the first fastening bracket to the anode body, it will be advantageous to use a special type of threaded connection, namely SPIRALOCK, even though other types

may be used as well. The threaded opening in said one leg of the locking element can also advantageously be provided with internal threads providing a radial load, such as said SPIRALOCK threads.

- 5 The advantage of using SPIRALOCK is that the special features of this internal thread form provides exceptionally resistance to the effects of transverse vibration, and also substantially reduces the potential of failure, compared to standard threads. For further specification of the SPIRALOCK system reference is made to a report made for Chrysler Corporation, "Spiralock Vibration
10 Resistance and Stress Distribution", by P.Narayan Nayak, Massachusetts Institute of Technology, which hereby is incorporated as reference. However, it should be mentioned that SPIRALOCK threads provides a radial load on the threads, compared to standard internal threads which provides an axial load on the threads. An axial load can increase the probability of shear, especially in
15 soft materials.

Present invention provides therefore a sacrificial anode with a much longer lifetime than traditional anodes, and which is easy to attach to the interior of a tank, and with improved performance. The sacrificial anode of the invention
20 gives a much longer lifetime than traditional anodes, and starts polarization almost immediately in the electrolyte. The present invention also provides an improved attachment/fastening device for the said anode, and also for any anode. Installation time for a new anode is reduced by 60% - 80%. Anodes according to the invention create quick polarization even on short
25 ballast voyages. Easy installation even in narrow spaces. Time for replacement of anodes reduced by 70% - 85%.

Patent claims

1. Sacrificial anode for providing cathodic protection of metal in ballast tanks, for example water ballast tanks on board a ship or on an offshore
5 structure, where the anode substantially is produced of a metallic material which corrodes, or sacrifices, faster than said metal, wherein the sacrificial anode primarily comprise an anodizing body (10) with an encased reinforcement, and the surface of said body (10) comprise a number of raised parts (12) providing
10 auxiliary corrosive surface area, in order to reduce corrosion of said metal by faster polarization of the sacrificial anode.
2. Sacrificial anode according to claim 1, wherein the raised parts (12) are designed with a pyramidal pattern, or a partly spherical pattern, and cover at
15 least one of the sides of the anode.
3. Sacrificial anode according to claim 2, wherein the anode is of a circular cylindrical shape, where the pyramidal pattern, or the partly spherical pattern, covers at least the front side and/or the rear side of the anode.
- 20 4. Sacrificial anode according to claim 2, wherein the anode is of a rectangular shape, where the pyramidal pattern, or the partly spherical pattern, covers at least one of the sides, preferable two sides.
5. Sacrificial anode according to claim 1, wherein the encased
25 reinforcement comprises a galvanized tension grid, adapted to provide optimal adhesion between the material of the anode and the reinforcement of the anode.
6. Sacrificial anode according to claim 5, wherein the encased
30 reinforcement is arranged in the anode in such a way that the reinforcement covers approximate all of the anode's cross section in diametrical and/or lengthwise direction, and that the reinforcement is arranged at a distance from one of the sides of the anode at approximately 3/5 of the thickness of the
35 anode.
7. Sacrificial anode according to claim 5, wherein the galvanized tension grid is produced of a flat rolled material.

8. Sacrificial anode according to any of the preceding claims, wherein the anode comprises a fastening device, where a first fastening bracket (14) is connected to the anode, comprising a protruding element (16) with a U-shaped middle section (16a), adapted to abut a second fastening bracket (18) secured in a ballast tank, or on a offshore structure, and a locking element (20) adapted to be inserted in the second fastening bracket (18) and to abut about the first fastening bracket (14), in order to lock the two fastening brackets securely together, and in such a way that the anode is suspended by the fastening device.

9. Sacrificial anode according to claim 8, wherein the anode body (10) comprises a bore for reception of part of the first fastening bracket (14), said bore being provided with internal threads providing a radial load.

10. Sacrificial anode according the any of the preceding claims, wherein the sacrificial anode is in accordance with the enclosed drawings.

11. Fastening device for a sacrificial anode according to claims 1-10, the anode comprises a first fastening bracket (14) connected to the anode, wherein the first fastening bracket (14) comprises, from the anode, a protruding element (16) with a U-shaped middle section (16a), adapted to abut a second fastening bracket (18) with a corresponding shaped form, the second fastening bracket (18) being secured to the interior of a ballast tank, or on a offshore structure, and a locking element (20) adapted to be inserted in the second fastening bracket (18) and to abut about the first fastening bracket (14), in order to lock the two fastening brackets (14,18) securely together, and in such a way that the anode is suspended by the fastening device.

12. Fastening device according to claim 11, wherein an upper part (22) of the first fastening bracket (14) runs perpendicular relative to the diametrical or lengthwise direction of the anode and/or the protruding part (16), and comprises a stud (24) adapted to cooperate with a recess (26) in an upper part of the second fastening bracket.

13. Fastening device according to claim 11, wherein a first leg of the locking element (20) is inserted in an opening (28) in the second fastening bracket (18), adjacent the U-shaped middle section (16a) of the second fastening bracket,

and the second leg of the locking element (20) is mounted on the outside of the first fastening bracket (14), in such a way that the second leg partly enclose the U-shaped section of the first bracket.

5 14. Fastening device according to claim 11, wherein a first leg of the locking element (20) is inserted in a recess (28) in the second fastening bracket (18), in the U-shaped middle section (16b) of the second fastening bracket, and the second leg of the locking element (20) is mounted on the outside of the first fastening bracket (14), in such a way that the second leg partly enclose the U-
10 shaped section of the first bracket.

15 15. Fastening device according to claim 14, wherein the locking element (20) is a lock pin, comprising two legs (20a,20b) and an intermediate section (20c), and that the locking element (20) basically encircles the U-shaped sections (16a,16b), with two legs (20a,20b) in different planes.

20 16. Fastening device according to claim 14, wherein the second fastening bracket (18) comprise a number of legs (19a,19b), in where the second fastening bracket is secured to the tank by welding of the legs to the interior of said tank.

25 17. Fastening device according to claim 13, wherein the second fastening bracket (18) comprise a number of legs (21a,21b) and a locking mechanism (30) in one of the legs, in where the second fastening bracket (18) is secured to the tank by being locked to a profile in said tank.

30 18. Fastening device according to claim 17, wherein said one leg (21a) comprise a threaded opening for reception of a threaded bolt, and that the legs are arranged in a U-shaped relationship for reception of a profile of said tank, in where the second fastening bracket (18) is locked to said profile by tightening of the threaded bolt.

35 19. Fastening device according to claim 18, wherein the threaded opening in said one leg (21a) is provided with internal threads providing a radial load.

20. Fastening device according the any of the preceding claims 11-19, wherein the fastening device is in accordance with the enclosed drawings.