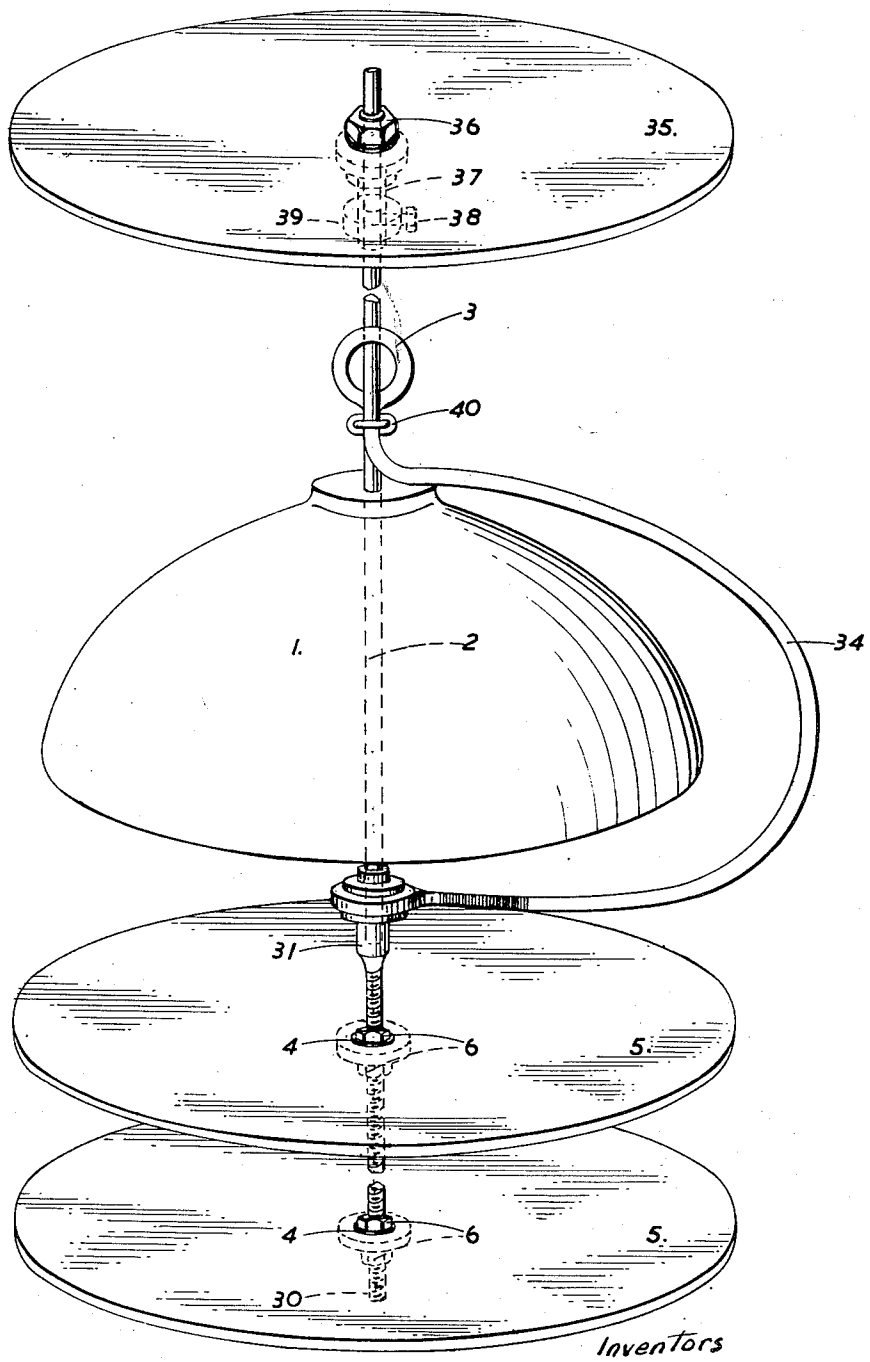
Nov. 27, 1956 W. G. WAITE ET AL 2,772,231

ANODES FOR THE PROTECTION OF METAL STRUCTURES AGAINST CORROSION

Filed Nov. 26, 1952



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United States Patent Office 2,772,231 Patented Nov. 27, 1956

2,772,231

ANODES FOR THE PROTECTION OF METAL STRUCTURES AGAINST CORROSION

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Application November 26, 1952, Serial No. 322,648

2 Claims. (Cl. 204—197)

This application is a continuation-in-part of our application No. 163,264 filed May 20, 1950, now abandoned.

This invention relates to an improved construction for consumable metal anodes used in the galvanic protection of corrodible metal structures.

In the galvanic protection of buried metallic structures or structures immersed in an aqueous solution, consumable electrodes of a metal anodic to the metal of the structure are buried in the earth or immersed in the water near the structure and are connected thereto by electrical conductors. The resulting flow of current maintains the structure cathodic with respect to the soil or water and greatly arrests the corrosion. The consumable anodes hitherto used have consisted of blocks of strongly basic metal such as zinc or magnesium or base alloys of these metals with a plain surface which is intended to be consumed at a fairly even rate. Such anodes whilst effective, maintain a fairly constant current output throughout most of their lives.

Consumable anodes when first installed should develop a fairly high current in order to protect the structure, but when the structure becomes polarized, much less current is needed. Eventually anodes therefore, tend over a long period to supply considerably more current than is actually required by the structure. This consideration has hitherto presented a practical difficulty to the engineer concerned with galvanic protection, for, if he considers only the ultimate degree of protection required, he may fit too few anodes to the structure to bring about that degree of protection necessary in the initial stages and so will never, or only very slowly, achieve the polarisation of the structure on which future economic protection depends. If on the other hand he fits enough anodes to give the desired degree of initial protection and the consequent rapid polarisation of the structure, the amount of protection (and the use of anodes) may be unnecessarily high once the structure has attained the requisite degree of protection. It is true that in the second case a certain percentage of the number of anodes first installed might be later removed, but this would entail extra operations which are regarded as undesirable if not impracticable in many cases.

The above considerations, though they are true of anode installations generally, apply with especial force to those larger anodes of high volume to surface ratio especially designed for the protection of jetties, piers, piling and the like, in harbours and in sea water applications generally.

The object of this invention therefore is to provide an anode for such protective purposes so designed that a high protective current may be provided in the initial stages and a smaller one when the necessary degree of polarisation has been achieved. If attempt is made to limit the current after the initial stages, by inserting resistance in the metallic circuit, the anodes are forced to operate at low current density under which conditions, coulomb efficiency is reduced.

According to the present invention the anode is provided with subsidiary plate-like anodes or "booster plates" adapted to be completely consumed by the electrolytic action during an initial period of use, and which are of such shape that their surface areas are not less than 0.8 of their original surface areas after half their volume has been consumed. For this purpose the subsidiary anode is thin in relation to its diameter. The surface area of the subsidiary anodes as first applied may be 0.261 to 1.72 square feet per lb. of metal. The thickness of each of the plate-like anodes may be one eighth of an inch to one inch and the diameter or mean size across may be ten to thirty-five inches preferably twenty to fifty times the thickness, giving a total surface area of 200 to 2500 square inches. A subsidiary anode of such construction will have a good mechanical strength, can be supported firmly by mechanical means, and will maintain its surface area without appreciable loss of size during the initial period of use whereby the polarising current is maintained at a high rate during the initial period until the subsidiary anode is consumed by electrolytic action (by which we mean wholly dissolved or attacked to the extent that is disintegrates).

The subsidiary anode is preferably mounted on a metal rod that passes transversely through the anode about centrally thereof.

The surface area of the main anode may be 0.071 to 0.033 (preferably 0.045 to 0.063) square feet per pound of metal.

A further object of the present invention is to enable both the ratio and the duration of the initial high current to the subsequent smaller current to be variable at the time of installing the anodes, to meet varying requirements which, in the opinion of the engineer, may be necessary. For this purpose a massive anode may be provided in which the ratio of the volume to the surface area is high, and attached to this (so that the whole functions as one unit), are the aforesaid subsidiary anodes, in any desired number, in which the ratio of volume to the surface is small. Thus for a given total weight of anode, a large superficial area is available in the early stages, thus ensuring a high current output, and in the later stages, when the subsidiary anodes have been consumed in performing their function of producing current, a normal current only, proportional to the surface area of the massive anode, will flow. For convenience, the massive anode will be referred to as the "anode" and the subsidiary anodes as "booster plates."

The invention will be more fully described with reference to the accompanying drawing which is a perspective view of one form of construction made in accordance with the invention.

A hemispherical member 1 cast of magnesium alloy forms the main anode. A bolt 2 having a ring 3 at one end and threaded at the other and preferably, but not necessarily, made of zinc galvanised steel, is cast into or rigidly mounted in the centre of the main anode 1 as shown so that the ring 3 of the bolt 2 emerges a convenient distance beyond the spherical surface of the anode 1, and provides a suitable means for swinging and for anchoring the latter. A continuation bolt 30 has an enlarged end 31 having a tapped hole whereby it is screwed on to the rod 2. Circular plates 5, preferably but not necessarily, of the same diameter as the anode, are rigidly mounted on the threaded end of the bolt 30 by means of zinc-galvanised nuts 6. The said circular plates 5 forming the booster plates or subsidiary anodes are separated from one another by means of washer plates 4 and nuts 6, which are screwed down hard to ensure continued good electrical conductivity. The booster plates may be cast in the same alloy as the main anode or in other suitable alloys.

A galvanised iron cable 34 is fixed at one end to the

enlarged end 31 of the bolt 30 and is passed through the ring 3 and has at least one further plate 35 threaded on to it and fixed to it. The plate 35 is fixed on a tube 37 by nuts 36 and the tube 37 is threaded on to the cable and fixed by a set screw 38 carried by a collar 39. The cable 34 is clamped by a clamp 40 to the bolt 2 between the ring 3 and the anode 1.

As assembled for use, the complete anode thus consists of the main casting 1 with one or more booster plates 5 fitted on the stem of the ring bolt 2 and/or the cable 34. The number of booster plates to be used and their thickness, which may vary to give in operation a gradual reduction of surface area, is a matter which is properly determined by the requirements of each particular protection problem.

The principle has been illustrated by reference to hemispherical and cylindrical type of anodes and circular booster plates of uniform thickness but this is not restrictive and applies equally to other shapes falling within the scope of the claims.

If, desired, a still more abrupt change may be provided from the high initial rate to the lower rate than would otherwise be the case by suitable selection of the alloy to be used, on the one hand for the anode proper, and on the other hand for the booster plates. Such an abrupt change, while not perhaps essential, is sometimes at least a desirable feature of a sacrificial anode, for the protective current requirements of a structure often shown an abrupt change when it becomes completely polarised.

In the case of magnesium base alloy anodes, an alloy may be used which consists essentially of about 6% aluminium and about 3% zinc, between 0.2 and 0.5% manganese and with only small amounts of undesirable impurities, the remainder being magnesium. For special purposes however there may be used other alloys based on magnesium and incorporating varying percentages of the above and/or other elements. It is an accepted fact that the solution potential of unalloyed magnesium however, is about one tenth of a volt less noble than that of the usual magnesium base alloys such as are here considered; further that the solution potentials of the magnesium base alloys in the same conditions differ only slightly among themselves. It is one object of this invention to take advantage of these facts in the design of a composite anode incorporating booster plates of a metal or alloy the solution potential of which is less noble than that of the main anode.

One method of carrying out this form of the invention therefore is to cast the main anode in one of the standard magnesium base alloys known to be suitable for the purpose, and to cast or make the booster plates of commercially pure magnesium. In practice this procedure would result in the booster plates being anodic by about one tenth of a volt to the main anode. Thus the booster plates would operate preferentially in the protective circuit so tending to restrain the usage of the main anode until the structure to be protected was fully polarised.

In another method applying this principle, the composite anode would be made of two different alloys or metals. Thus in circumstances where the electrolytic circuit resistance is sufficiently low, advantage might be taken of the extremely long life and high efficiency available with zinc anodes, at the same time that the much more powerful potential of magnesium base alloy anodes is used to bring about rapid polarisation, by making the main anode of zinc (or of a convenient zinc base alloy) and the booster plates of a convenient magnesium base alloy.

We claim:

1. A protective system for a ferrous structure immersed in seawater, said system comprising a main anode having a surface area of 0.071 to 0.033 square feet per lb. of metal, a plurality of anode plates located adjacent the main anode and of which the surface area is between 0.261 and 1.72 square feet per lb. of metal so that they become completely consumed by the electrolytic action during an initial period of use, said plates having a smaller volume than said main anode and being between one eighth of an inch and one inch thick, and each having a total surface area of from 200 to 2500 square inches, said plates having surface areas not less than 0.8 of their original surface areas after half their volume has been consumed by dissolution from the periphery inwardly, and a metal rod-like element carrying both the main anode and the plates, said element being rigidly mounted in said main anode, said main anode and plates being made of metal selected from the group consisting of magnesium and magnesium base alloys, said plates being disposed centrally around the axis of said element at both sides of said main anode substantially parallel to each other so as to shield each other against corrosion at their juncture with said element.

2. A protective system for a ferrous structure immersed in seawater, said system comprising a main anode having a surface area of 0.071 to 0.033 square feet per lb. of metal, a plurality of anode plates located adjacent the main anode and of which the surface area is between 0.261 and 1.72 square feet per lb. of metal so that they become completely consumed by the electrolytic action during an initial period of use, said plates having a smaller volume than said main anode and being between one eighth of an inch and one inch thick, and each having a total surface area of from 200 to 2500 square inches, said plates having surface areas not less than 0.8 of their original surface areas after half their volume has been consumed by dissolution from the periphery inwardly, and a metal rod-like element carrying both the main anode and the plates, said element being rigidly mounted in said main anode, said main anode and plates being made of metal selected from the group consisting of magnesium and magnesium base alloys, said plates being disposed centrally around the axis of said element, said element substantially parallel to each other so as to shield each other against corrosion at their juncture with said element having a ring at one end, a metal cable fixed to the element at the end opposite to the ring-carrying end and passing through the ring, and a further anode plate carried on said cable on the side of the ring remote from the main anode.

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