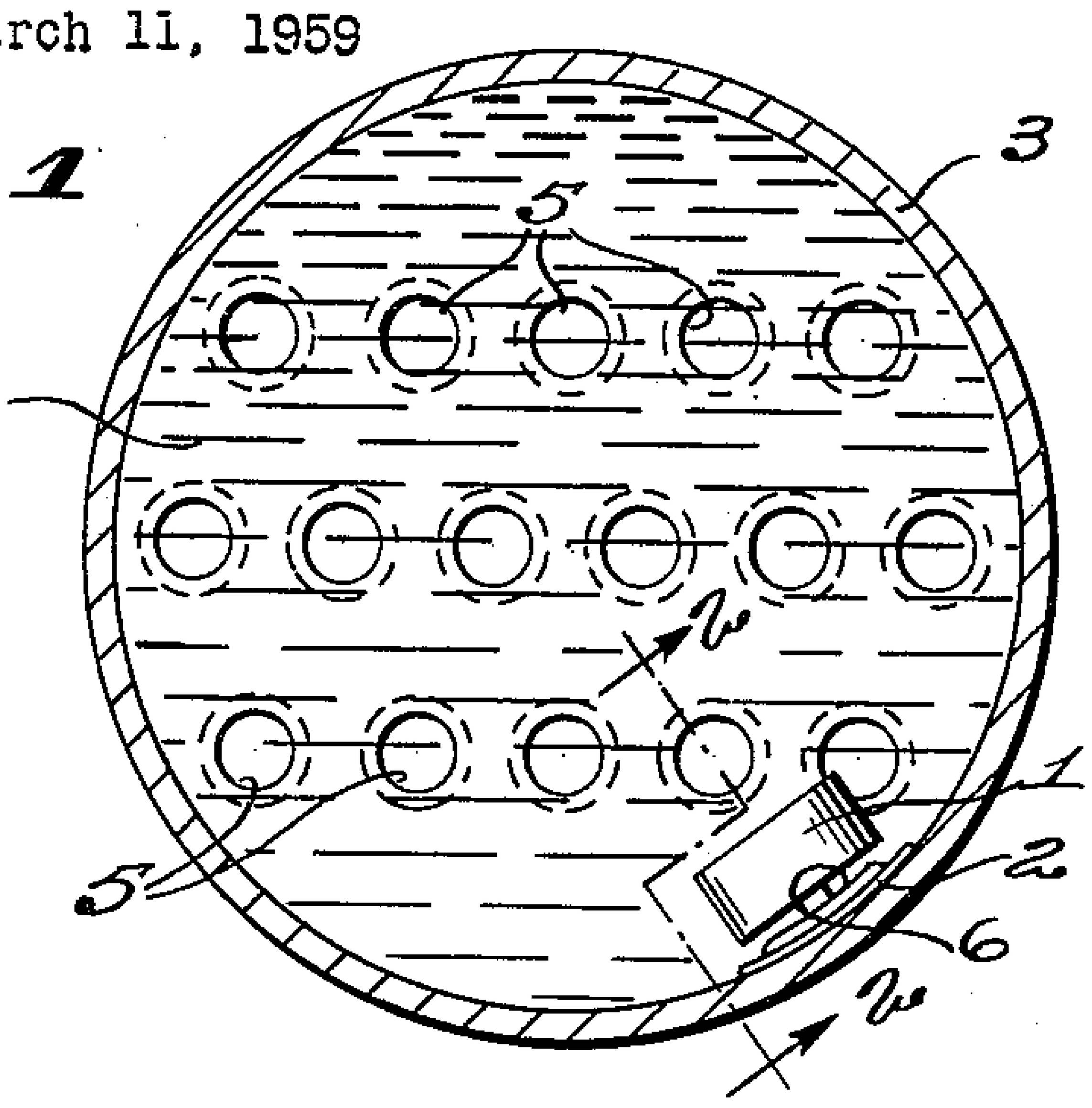
Dec. 12, 1961 K. N. BARNARD 3,012,959

DEVICE FOR HOLDING MAGNESIUM OR OTHER GALVANIC ANODES

Filed March 11, 1959

Fig. 1



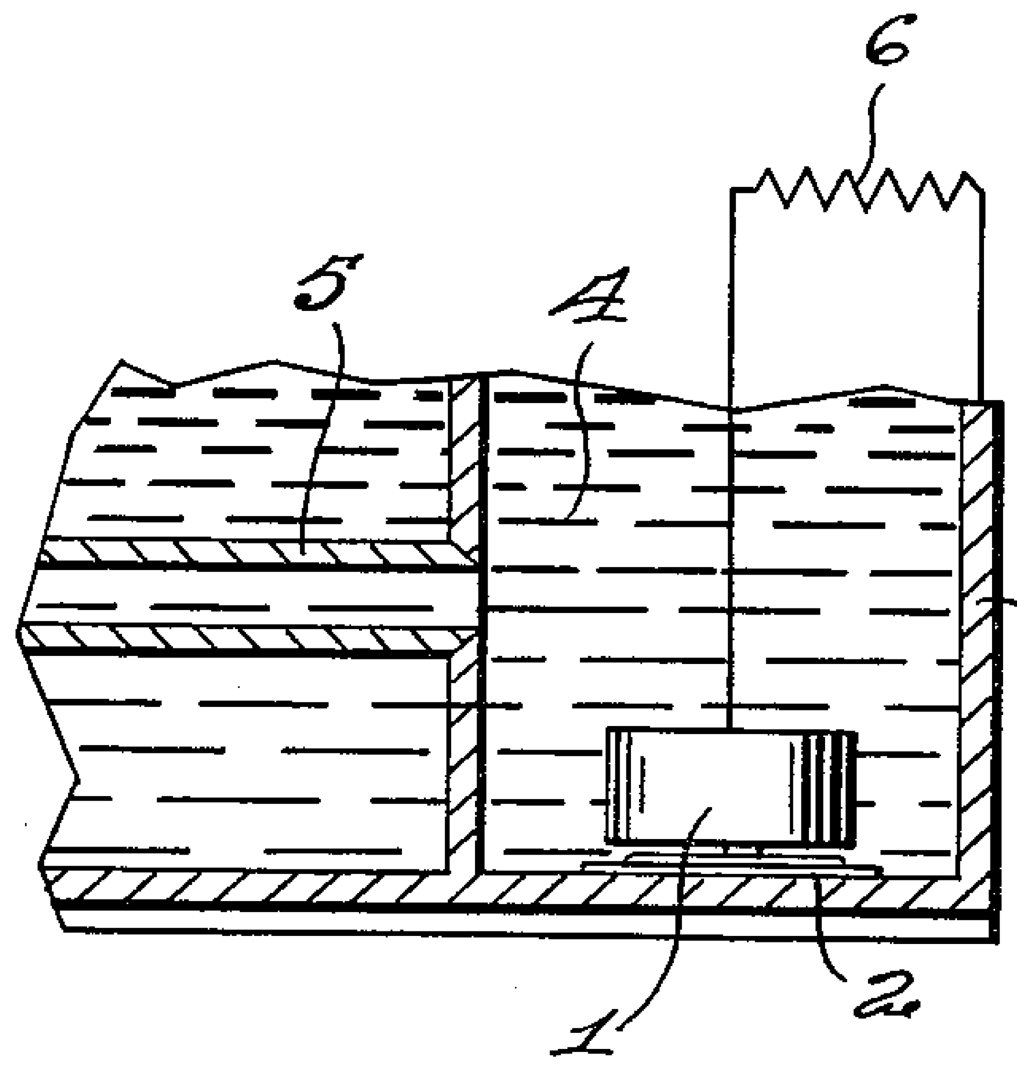
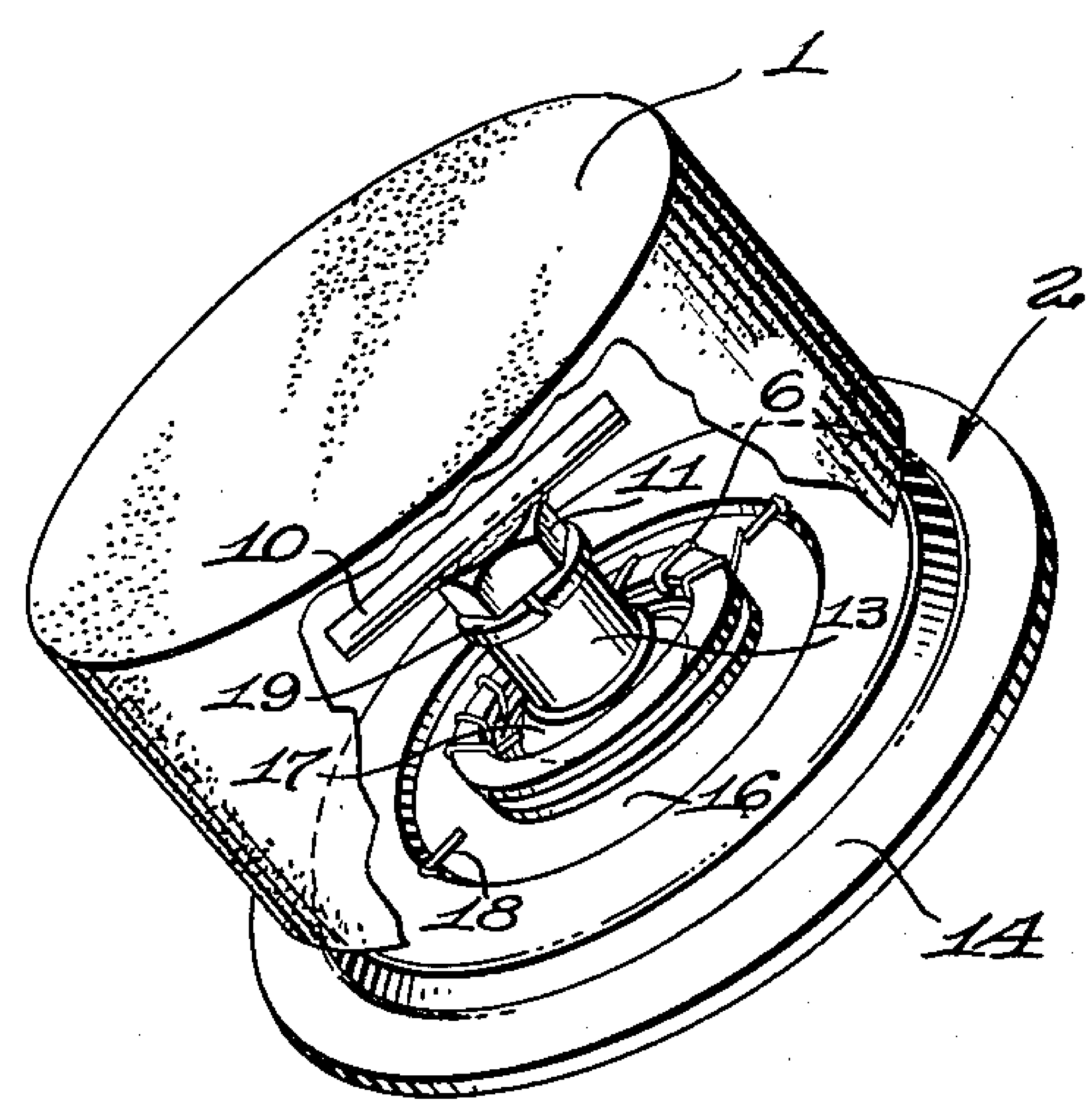


Fig. 2

Fig. 3



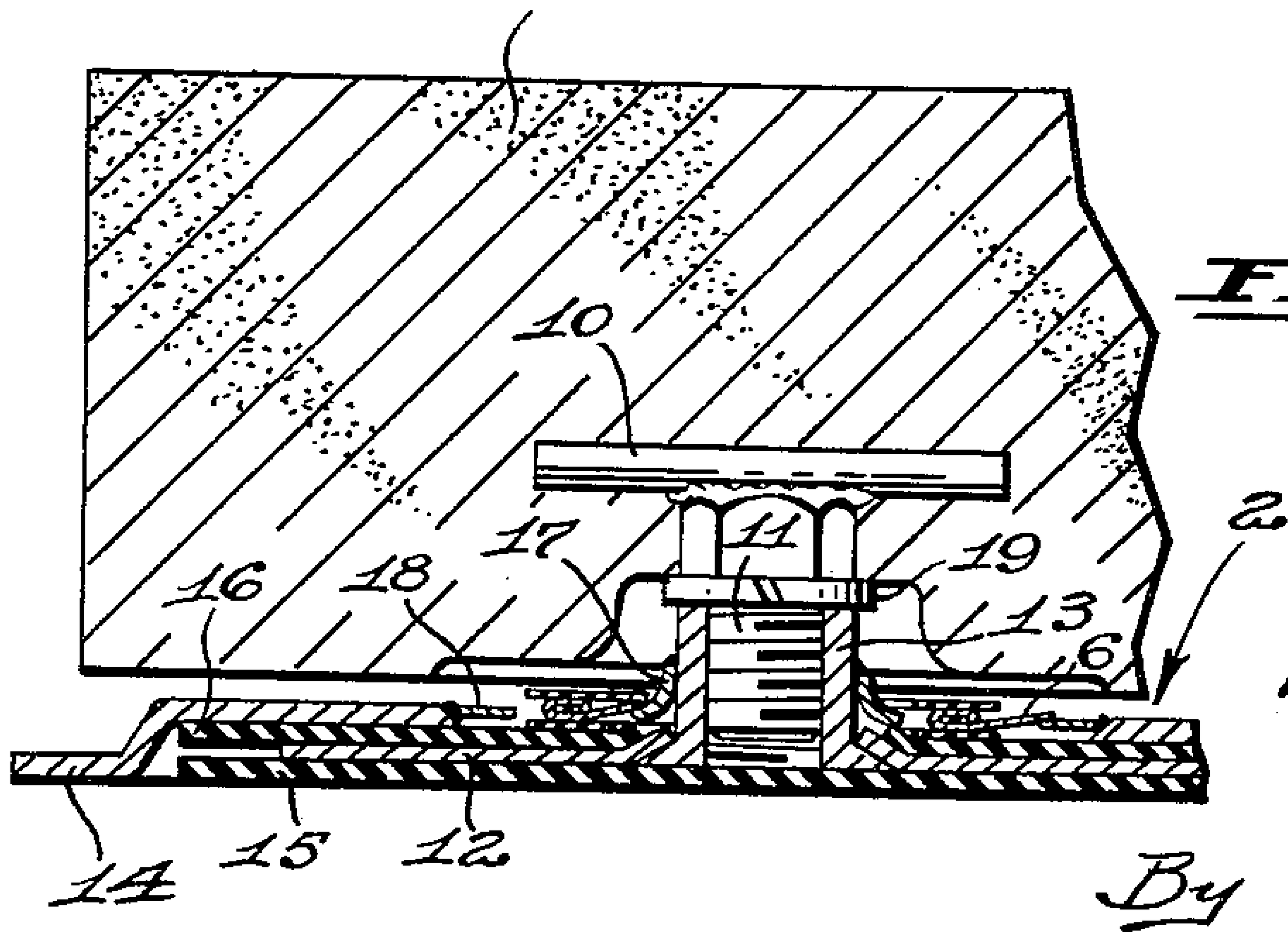


Fig. 4

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3,012,959

## DEVICE FOR HOLDING MAGNESIUM OR OTHER GALVANIC ANODES

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1 Claim. (Cl. 204—197)

This invention relates to an improved device for retaining magnesium or other galvanic anodes in position so that such anodes perform as satisfactorily as possible for their whole useful life in the prevention of corrosion by sea water and the like in relatively confined spaces, the mechanical and electrical features of the device being superior to those incorporated in previously known retaining devices.

It is known that the corrosion of metals in contact with corrosive electrolytes may be prevented by the application of electric current of appropriate polarity and intensity. The electric current may be applied "externally" as from batteries or a generator, or "internally" by the use of galvanic anodes electrically connected to the structure desired to be protected from corrosion.

It is the latter type of circumstances to which the present invention is directed, and particularly where magnesium anodes are used.

Serious corrosion problems can occur when a corrosive electrolyte is in contact with a metallic structure. The corrosion is likely to be particularly severe when the structure consists of different metals connected together electrically. For a discussion of background information see, for example, the Dow Chemical Company, Midland, Michigan, U.S.A., publication entitled "The Magnesium Anode," volume 5, No. 1. A typical structure causing difficulty is a heat exchanger in contact with sea water where the heat exchanger consists of copper alloy tubes in a cast steel vessel. It is apparent that with such an arrangement a strong galvanic cell is set up in which the cast steel disintegrates just as the zinc casing of an ordinary dry cell battery disintegrates, and in due time the equipment in question is rendered useless.

In the heat exchanger structure cited above, the use of a magnesium anode largely overcomes the corrosion due to galvanic action, and the magnesium anode is consumed over a period of time, rather than steel or other metal of the structure. Typically the anode will consist of a slab of magnesium, mechanically but not electrically fastened to a solid surface of the structure sought to be protected. The magnesium slab is so placed as to be in contact with the corrosive liquid, and an electrical connection is made between the magnesium slab and the surface to which the slab is fastened through a resistor to regulate the flow of current to the desired value.

In the absence of the magnesium slab, connected as aforesaid, current flows through the liquid from a metal higher in the electrochemical series to a metal lower in the series. In the example given above where copper tubes are in a cast steel vessel containing sea water, the current flow is away from the steel toward the copper, thus decomposing the steel. When the magnesium slab is connected to the steel through a resistor, a slightly different type of galvanic cell is produced, but one which is harmless so far as the steel and copper are concerned. The galvanic cell now has as its negative "plate" the magnesium slab, and as its positive "plate" the combined steel and copper structure, since both steel and copper are lower in the electrochemical series than magnesium. In the result, the magnesium anode is gradually decomposed and the steel and copper remain practically unharmed.

Although theoretically very adavntageous, the use of magnesium slabs in the manner just described presents



certain practical difficulties. It is apparent that such slabs must be large and relatively heavy if protection over a long period is desired. It is also apparent that such slabs may be subjected to vibration, shocks, sudden changes of temperature, liquid turbulence and other disturbing forces. Because of the necessity of rugged mechanical attachment combined with electrical isolation from the structure to be protected, all this in the presence of corrosive and conductign liquid, the ordinarily simple problem of attachment has become one of considerable difficulty. One structure heretofore used has employed bolts surrounded by insulating sleeves passing through the magnesium slab, with the slab separated from the supporting structure by means of an insulating pad or layer. This functions satisfactorily initially, but as the slab decomposes, the region around the bolt holes disintegrates and the slab tends to work loose. When this occurs, the electrical function of the anode is upset, if not destroyed altogether. At best the corrosion protection would suffer because of partial or complete interruption of the protective current flow, and at worst the anode would become detached mechanically and cause damage such as by blockage of heat exchanger tubes.

It is accordingly the principal object of this invention to provide a mounting for anodes used in cathodic corrosion protection which will hold such anodes securely in place during the entire useful life of such anodes, and will combine proper mechanical attachment with proper electrical connection.

Other objects and advantages will become apparent to one skilled in the art from an examination of the present specification and the accompanying drawings.

The invention will now be described with the assistance of the accompanying drawings, illustrating an embodiment of the invention by way of example. In the drawings,

FIGURE 1 shows an embodiment of the invention in use in a heat exchanger, the latter being shown in lateral cross-section;

FIGURE 2 shows diagrammatically the electrical function of the embodiment of the invention;

FIGURE 3 shows an oblique, partly diagrammatic, partly cut-away view illustrating the embodiment of the invention in service; and

FIGURE 4 shows a medial cross-sectional view of substantially what is shown in FIGURE 3, for greater certainty of disclosure of the invention.

In the present disclosure like parts are denoted by the same reference numerals throughout.

Referring first to FIGURE 1, a magnesium anode is shown at 1, mounted by means of a pedestal denoted by 2 in a vessel indicated by 3. In any uses of the invention contemplated at this time, the anode would be made of magnesium, but the principle involved here is of general application and other materials could be used. For example particularly if metals lower in the galvanic series than steel were to be protected, it might be found more advantageous to use anodes of aluminum or zinc alloys. In practice, overall economic considerations dictate the selection of anode material.

It will be seen that the pedestal 2 does not require bolts attached to the vessel 3 in order that the pedestal 2 may be mounted on vessel 3, but welding is contemplated instead. It might be thought that welding is obvious in such circumstances, but it must be kept in mind that the pedestal 2 mechanically attaches but electrically isolates the anode 1 from vessel 3. Accordingly, the structure of pedestal 2, to be discussed below, must be carefully considered. It may be mentioned here, however, that the form of pedestal 2 is used herein such that the anode 1 can readily be mounted on structures having thin surfaces and which must be kept liquid and air tight.

The vessel 3 has sea water therein, denoted by 4 and tubes indicated at 5 are part of the structure. If the vessel shell is made of cast steel and the tubes are of copper, the presence of sea water will result in a galvanic cell and vessel 3 will be rapidly damaged.

The anode 1 is electrically connected to a resistor denoted at 6, which is in turn connected to the vessel 3. This cannot be seen in detail in FIGURE 1, but will be discussed in more detail below.

The electrical relationship can be seen with reference to FIGURE 2. Here the anode 1, vessel 3 and tubes 5 are shown in the form of a simple cell. The resistor 6 connects the vessel 3 and the anode 1 and limits the current flow to the desired value. No very specific directions can be laid down for the value of resistor 6, and the value must be determined by the circumstances in a particular case. Factors involved are the conductivity and geometrical configuration of the liquid involved, the potential difference available (governed by the anode material selected and the cathode materials to be protected), and the polarization characteristics of the metal surfaces involved. The resistance chosen should permit a sufficient current to flow to polarize the structure to a potential at which corrosion is arrested. For bare steel in sea water, a minimum current of about 10 milliamperes per square foot is required for protection.

Where for example magnesium anodes are to be used for protecting structures consisting wholly or partly of steel, if the value of resistor 6 tended to zero ohms the consumption of anode 1 would be uneconomically large, whereas if the value of resistor 6 were 1000 ohms there would be insufficient current flow for complete protection. For anodes of magnesium in cylindrical shape, approximately six inches in diameter and four inches in height, resistance values of from one to five ohms have been successfully used for steam condenser applications with sea water as coolant, and in sea chests, bilge compartments, etc.

Referring now to FIGURES 3 and 4, it will be seen that the anode 1 is held by a single bolt denoted by 11 imbedded in anode 1. Attached to bolt 11 is a bar denoted by 10, and bolt 11 with its attached bar 10 are cased in anode 1. Being relatively near the center of anode 1, corrosive disintegration does not affect the firm attachment of anode 1 until the anode has completed or very nearly completed its useful life. This is in contrast to attachment by bolts through holes in anode 1, as is known in the art. The general appearance of anode 1 with its attaching bolt 11 is that of a bolt with a very large magnesium head.

The pedestal 2 consists of a circular flange denoted by 12, a threaded collar denoted by 13 centrally disposed thereon, an annular flange denoted by 14 arranged coaxially about collar 13, and layers of insulating material denoted by 15 and 16. It is seen that when flange 14 is welded to a supporting structure such as vessel 3 the anode is rigidly fixed mechanically, but at the same time insulated from vessel 3.

The resistor 6 is in annular form as shown, although this is not essential, and the resistor 6 could, for example, be imbedded in layers of insulating material 16. In the form shown, two connecting collars are provided, shown at 17 and 18. Collar 17 is soldered to collar 13, which is in turn connected to anode 1, and collar 18 is soldered to flange 14 which is of course connected to the supporting structure. Thus, when resistor 6 is connected between collars 17 and 18, connection is made through



resistor 6 between the anode 1 and the supporting structure.

The use of the embodiment of the invention is the essence of simplicity. The flange 14, which is appropriately "dished" to receive flange 12 and the layers of insulating material, is assembled with the other parts mentioned in the "dished" portion, and welded around its edges to the supporting structure. When this is done, the collar 13 with its internal thread for the reception of bolt 11 will be left in exposed position, and the bolt 11, carrying anode 1 may be simply attached by turning anode 1. A lock washer denoted by 19 may be used if desired.

If the dimensions of the parts of pedestal 2 are chosen so that the depth of the "dished" portion of flange 14 is equal the thickness of flange 12 and the layers of insulating material 15 and 16, the collar 13 will be retained firmly in place coaxially within flange 14. However, if desired, the aforementioned parts may be pre-bonded together before flange 14 is welded to the supporting structure.

What is claimed is:

A device for the cathodic protection of a metallic body which is subject to corrosive action, comprising a relatively bulky block of metal having a high position in the electro-chemical series, an attaching bolt of a metal lower in the electro-chemical series than the metal of said block, means at least partially embedded in said block for rigidly connecting said attachment bolt to said block, and a mounting arrangement for said block and said bolt for securing the same to a surface of said metallic body, said mounting arrangement comprising an attachment plate including an annular flange which is adapted to be welded to said surface of said metallic body and constructed to define a housing bounded at its base by a portion of said surface of said metallic body, a first layer of insulating material for overlying said surface and disposed within said annular flange, a mounting pedestal for said block overlying said first insulating layer and to be separated from said metal body thereby, said mounting pedestal including a pedestal flange abutting said first insulating layer and a collar supported thereby and in threaded engagement with said attaching bolt, a second layer of insulating material on the side of said pedestal flange remote from said first insulating layer and overlying said pedestal flange, said pedestal flange being sandwiched between said first and second layers of insulating material, the sandwiched assembly of said first and second insulating layers and said pedestal flange being maintained in assembled relation with respect to each other by a portion of said attachment plate which overlies said second insulating layer, said portion of said attachment plate being spaced relative to said surface and being offset with respect to said annular flange.

**References Cited** in the file of this patent

UNITED STATES PATENTS

| | | |
|---|---|---|
| 526,357 | Wells et al. | Sept. 18, 1894 |
| 2,779,729 | Jorgensen | Jan. 29, 1957 |
| 2,934,485 | Sabins | Apr. 26, 1960 |

FOREIGN PATENTS

| | | |
|---|---|---|
| 11,216 | Great Britain | May 14, 1906 |
| 721,712 | Great Britain | Jan. 12, 1955 |
| 780,348 | Great Britain | July 31, 1957 |
| 783,348 | Great Britain | Sept. 25, 1957 |