

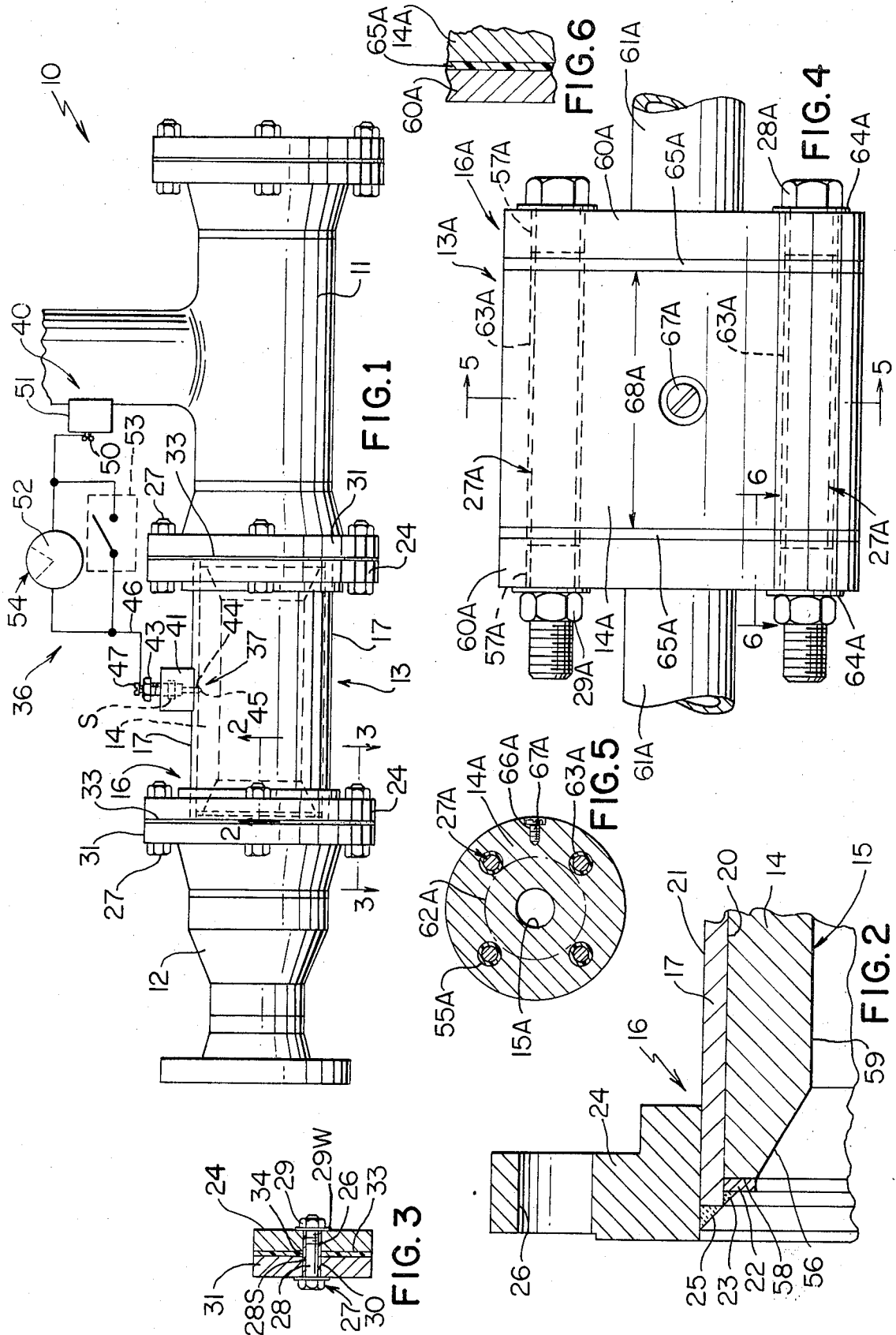
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DEVICE FOR CATHODICALLY PROTECTING METAL CONDUIT SYSTEM

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DEVICE FOR CATHODICALLY PROTECTING METAL CONDUIT SYSTEM

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ABSTRACT OF THE DISCLOSURE

A metal conduit system particularly adapted to flow an electrolyte therethrough is provided with a sacrificial anode having an inside tubular surface adapted to receive the electrolyte against substantially its entire area and such anode serves as a containment member for the electrolyte.

BACKGROUND OF THE INVENTION

There are numerous fluid systems in present use which employ components made of dissimilar metals and which have a fluid flowing through the system which acts as an electrolytic fluid. Under these conditions there is substantial electrolytic corrosion of certain of these components whereby it is necessary to eliminate or minimize such corrosion in order to assure reliable system operation. For example, in a desalinization system or apparatus numerous components including conduits, fittings, connectors, heat exchangers, valves, etc. are employed many of which are made of dissimilar metals including ferrous and aluminous metals and there is considerable corrosion of certain components due to the electrolytic action of the salt water flowing through the apparatus.

To eliminate or substantially reduce this problem of electrolytic corrosion in a system of the character mentioned above it has been found that a sacrificial anode may be employed which is made of a metallic material which is more susceptible to electrolytic corrosion than the other components of the system within which the anode is employed, whereby the sacrificial anode serves to make the other components of the system comparatively cathodic and current flow created by galvanic action serves to deteriorate, i.e., sacrifice the sacrificial anode instead of the components of the conduit system. However, most sacrificial anodes proposed heretofore to protect associated fluid system components are usually physically located externally of the fluid conduit system which contains the electrolytic fluid and as a consequence they are not very efficient in their operation. In those instances where sacrificial anodes have been placed in the fluid flow stream they have been either of very complex and expensive construction or have created undesirable pressure drops or flow characteristics for the fluid flowing through the system whereby these previously proposed anodes or devices have generally been unacceptable.

SUMMARY

This invention provides a simple and economical device for cathodically protecting a metal conduit system which is adapted to flow an electrolyte therethrough wherein such device has an inside tubular surface adapted to receive said electrolyte against its entire area and serves as a containment member for the electrolyte. The device is particularly adapted to be used in a desalinization apparatus wherein the electrolyte is salt water.

Other details, uses, and advantages of this invention will become apparent as the following description of the exemplary embodiments thereof presented in the accompanying drawing proceeds.

BRIEF DESCRIPTION OF THE DRAWING

The accompanying drawing shows present exemplary embodiments of this invention, in which

FIG. 1 is a view with parts broken away and other parts shown schematically illustrating one exemplary embodiment of the device of this invention installed in position between components comprising a water desalinization apparatus;

FIG. 2 is a greatly enlarged fragmentary cross-sectional view taken on the line 2—2 of FIG. 1;

FIG. 3 is a fragmentary cross-sectional view taken on the line 3—3 of FIG. 1;

FIG. 4 is a view with parts broken away illustrating another exemplary embodiment of the device of this invention installed in position between associated conduits of a conduit system;

FIG. 5 is a cross-sectional view, to a reduced scale, taken on the line 5—5 of FIG. 4; and

FIG. 6 is a fragmentary cross-sectional view taken essentially on the line 6—6 of FIG. 4.

DESCRIPTION OF ILLUSTRATED EMBODIMENTS

Reference is now made to FIG. 1 of the drawing which illustrates a portion of an exemplary system or apparatus which is designated generally by the reference numeral 10 and requires cathodic protection. The apparatus 10 is a desalinization apparatus which flows salt water therethrough and such salt water acts as an electrolyte which causes electrolytic corrosion of certain components of the system depending on the composition of the metals used to make the system components and as is well known in the art. The apparatus 10 may include numerous components in its fluid flow system including heat exchangers, valves, conduits, reservoirs, connectors, fittings, etc. which may be made of dissimilar metals; however, in this presentation only a few representative components have been illustrated and comprise a T-connector 11 made of an aluminum alloy, a reducer fitting 12 made of steel, and one example of a device 13 of this invention interconnected therebetween. The components 11 and 12 are connected to common metal supporting structure whereby there is a metal electrical path therebetween.

The device 13 comprises a tubular sleeve-like sacrificial anode 14, see FIGS. 1 and 2, having an inside substantially tubular surface 15 which is adapted to receive the electrolyte, i.e., the salt water, against substantially its entire surface area. The anode 14 also serves as a containment member for such electrolyte during flow thereof through the conduit system or apparatus 10 whereby there is intimate contact between the electrolyte and the sacrificial anode 14 which assures that cathodic protection may be provided for the apparatus 10 with optimum efficiency.

The device 13 comprises means fastening the anode 14 in the conduit system in a fluid-tight manner and in this example such fastening means is designated generally by the reference numeral 16. The fastening means 16 comprises a tubular housing 17 having a right circular cylindrical inside surface 20 and a right circular cylindrical outside surface 21 and the sleeve-like anode 14 is inserted within the housing 17 so that its outside surface firmly engages inside surface 20 in electrically conducting relation.

The fastening means 16 includes a pair of annular rings 22 arranged at opposite ends of the anode 14 and each ring 22 is welded against the housing 17 by a weld 23 whereby the anode 14 is axially confined in position between the rings 22. The fastening means 16 further includes a pair of flanges 24 which are welded to opposite ends of the tubular housing 17 in a fluid-tight manner by welds 25 and also includes a plurality of circumferential

bores 26 extending through each flange 24 and a corresponding plurality of fasteners 27.

Each fastener 27 may be of any suitable construction and in this example comprises a threaded bolt 28 and an associated nut 29. Each bolt 28 extends through an associated opening or bore 26 and through a bore 30 provided in a flange portion 31 of either member 11 or 12 associated therewith whereupon its nut 29 is threadedly fastened in position to thereby fasten the device 13 between components 11 and 12. Each bolt 28 and its nut 29 may be made of any suitable material and are electrically insulated from an associated flange 24 and flange portions 31 by an electrical insulating sleeve 28S and electrical insulating end washers 29W.

The device 13 is fastened in position between components 11 and 12 in electrically insulated relation and for this purpose a pair of seals each designated by the same reference numeral 33 is provided at opposite ends thereof. Each seal is made of a suitable elastomeric material such as an electrical insulating material which also resists attack by the electrolytic salt water flowing through the apparatus 10. Each seal 33 has a plurality of openings 34 therein and each opening 34 is aligned with associated openings 26 and 30 and receives an associated fastener 27 therethrough, whereby once the device 13 is fastened in position between components 11 and 12 it will be appreciated that device 13 is electrically insulated from the other components of the apparatus 10 and for a purpose now to be explained.

The apparatus 10 has an electrical system 36 which has one end operatively connected to sacrificial anode 14 as illustrated at 37 and has its opposite end operatively connected to a vertically extending portion of the member 11 as illustrated at 40. In particular, it will be seen that the device 13 has a block 41 suitably welded to housing 17 and the block 41 has a terminal member 43 threadedly received through a threaded opening in its lower portion. The member 43 extends through an opening 44 in the housing 17 and member 43 has a conical point 45 which is pressed into the sacrificial anode 14 as shown at 37 to provide a firm mechanical and electrical contact. An O-ring seal S is provided between the upper portion of the member 43 and the block 41 to prevent leakage of electrolyte from within the apparatus 10.

The terminal member 43 has one end of an electrical lead 46 attached to its top portion by a threaded screw 47 and the opposite end of the electrical lead is connected to member 11, as indicated at 40, by a threaded screw 50 which is threadedly received in a threaded opening provided in a metal block 51 which is welded to the member 11. An ammeter 52 is electrically connected in the electrical lead 46 and a switch mechanism 53 is installed in parallel with the ammeter 52.

Once the electrical switch 53 is closed current flow will be therethrough due to the comparatively low electrical resistance of the parallel circuit through such switch. However, once the switch 53 is opened the ammeter 52 will indicate the amount of current flowing through the electrical apparatus 36. The various electrical resistances of the components comprising apparatus 36 and the sensitivity of the ammeter 52 is such that if the ammeter indicates current having a magnitude within a range indicated at 54 this will serve as a visual check that the sacrificial anode is being sacrificed, i.e., electrolytically corroded in the required manner.

The sacrificial anode 14 of device 13 is provided in the system with minimum interruption or obstruction of fluid flow whereby the inside surface 15 thereof is comprised of a right circular cylindrical central portion 59 adjoined at each end thereof by an outwardly diverging frusto-conical surface portion 56. Further, the anode 14 has a terminal edge 58 at each end which has a thickness which corresponds to the radial thickness of its associated retaining ring 22 whereby there is less tendency for fluid turbulence as salt water flows through the apparatus 10.

Another exemplary embodiment of this invention is illustrated in FIGS. 4-6 of the drawing. The device illustrated in FIGS. 4-6 is very similar to the device 13; therefore, such device will be designated generally by the reference numeral 13A and parts thereof which are similar to corresponding parts of the device 13 will be designated by the same reference numeral as in the device 13 also followed by the letter designation A and not described again. Only those component parts which are substantially different from corresponding parts of the device 13 will be designated by a new reference numeral also followed by the letter designation A and described in detail. Practically the entire device 13A is a sacrificial anode 14A and comprises a substantially tubular member having a tubular inside surface 15A which is a right circular cylindrical surface and defines a longitudinal passage therethrough.

The device 13A has fastening means 16A for fastening such device in an associated apparatus which requires such a device, and the device 13A may be fastened in the apparatus 10 at any suitable location. The fastening means 16A comprises a plurality of bores 55A which extend longitudinally through the anode 14A and the bores 55A are arranged radially outwardly of surface 15A and on a common circumference. The fastening means 16A also includes a plurality of fasteners 27A which are adapted to extend through bores 55A and through openings 57A provided in associated flanges 60A. Each flange 60A is fixed to an associated conduit 61A which may comprise the apparatus 10 in a fluid-tight manner.

In a similar manner as described in connection with fastener 27 each fastener 27A comprises a threaded bolt 28A and an associated nut 29A. A pair of conventional washers 64A made of a suitable plastic material may be provided at opposite ends of the anode 14A to provide added bearing surface areas. Thus, the anode 13A is installed in position by extending each bolt 28A through an associated set of openings 57A in flanges 60A and with a bore 55A arranged therebetween and then threadedly fastening an associated nut 29A in position whereby the device 13A is firmly clamped in position to provide the desired cathodic protection for its associated apparatus.

The device 13A provides cathodic protection for a maximum period of time because it has a substantial volume which can be corroded away and this volume is defined by the annular area 62A, see FIG. 5, times the height 68A of the anode 14A.

The device 13A has a plurality of tubular insulating sleeves 63A made of a suitable electrical insulating material and the sleeves 63A serve to electrically isolate the anode 14A from the fasteners 27A extending therethrough whereby in those applications where the fasteners are made of a material which is electrolytically corrodible such fasteners are protected from such corrosion.

To assure that the device 13A and hence sacrificial anode 14A is installed in position in a fluid-tight manner (and in electrically isolated relation, if desired) a pair of seals 65A made of an elastomeric electrically insulating material are provided at opposite ends of the device 13A. Each seal 65A is sandwiched between an end surface of the anode 14A and an associated flange 60A. It will also be appreciated that a suitable threaded opening 66A may be provided in the anode 14A and a threaded metal screw 67A may be used to enable attachment of the device 13A in an electrical system or apparatus similar to the apparatus 36 illustrated in FIG. 1 and for similar reasons as explained previously.

As previously mentioned, the anode 14A of device 13A has a substantial volume which can be corroded away and this volume may vary for different applications. In general, it has been found that the outside diameter of the anode 14A may range between roughly 2 and 5 times the diameter of cylindrical surface 15A. Further the diameter of the common circumference for bores 55A is slightly

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smaller than the outside diameter of the anode 14A with the diameter of each bore 55A being a fractional part of the diameter of surface 15A.

The sacrificial anode portion of each device 13 and 13A may be made of any suitable metal including suitable alloys of aluminum or of materials containing zinc or magnesium, whereby it will be appreciated that the anode material itself is not critical.

While present exemplary embodiments of this invention, and methods of practicing the same, have been illustrated and described, it will be recognized that this invention may be otherwise variously embodied and practiced within the scope of the following claims.

What is claimed is:

1. In a liquid conveying apparatus in which liquid flows from one metallic component of said apparatus through a sacrificial anode-containing conduit into another metallic component of said apparatus so as to cathodically protect said components, the improvement comprising:

said conduit being boltedly connected to both of said components; wherein electrically insulating gasket material is disposed between said conduit and said components at all points of bolted juncture so as to electrically isolate said conduit from said components;

wherein said conduit consists of a thick-walled tube having a plurality of bores extending longitudinally through the wall of said tube, wherein said bores are arranged on a common circumference radially outward from the inside surface of said tube wall, wherein the bolts which connect said conduit to said components pass through said bores, wherein said bolts in said bores are surrounded by electrically insulating sleeves to electrically isolate said bolts from said

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tube; wherein said tube is entirely fabricated of said sacrificial anode with the exception of said sleeves; an electrical lead, one end of which is electrically connected to the outside surface of said tube, the other end of which is electrically connected to one of said components; wherein said lead includes two parallel electrical connections between said tube and said one of said components; wherein one of said electrical connections includes an ammeter, wherein the other of said electrical connections includes an electrical switch.

2. The apparatus of claim 1 in which the outer surface of said tube wall has a diameter which is greater than two times the diameter of the inner surface of said tube wall.

3. The apparatus of claim 1 in which said components are composed of dissimilar metals.

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