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Herman

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[54] **NOVEL ANODE FITTING**

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[52] **U.S. Cl.** ..... **204/197,** 204/148, 174/74 R

[51] **Int. Cl.** **C23f 13/00**

[58] **Field of Search** ..... 204/147, 148, 196, 197; 174/74 R

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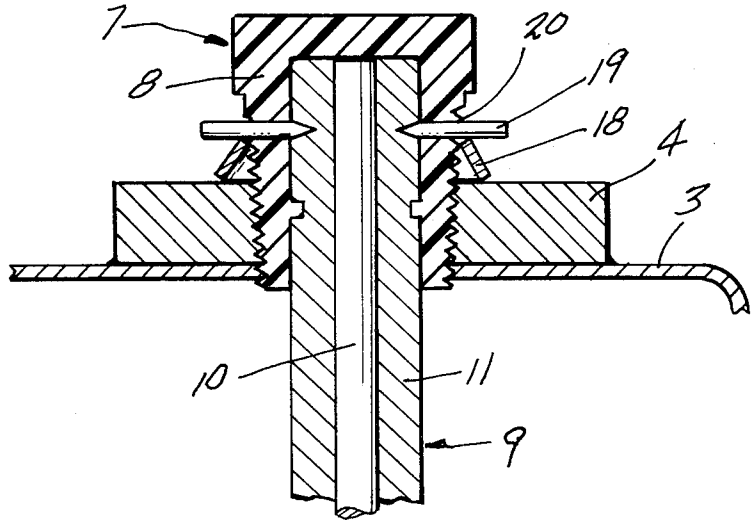
Primary Examiner—T. Tung

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[57] **ABSTRACT**

An anode fitting for use in hot water tanks and the like is disclosed which comprises a non-metallic cap or plug member adapted to be threadedly received within an opening in the water tank, and a cylindrical anode telescoped into the plug member and secured thereto. Electrical contact between the anode and the tank wall is externally provided. In a modification of the invention, the non-metallic cap is provided with a fluid passageway which permits the fitting to serve as an outlet port for the tank.

13 Claims, 8 Drawing Figures



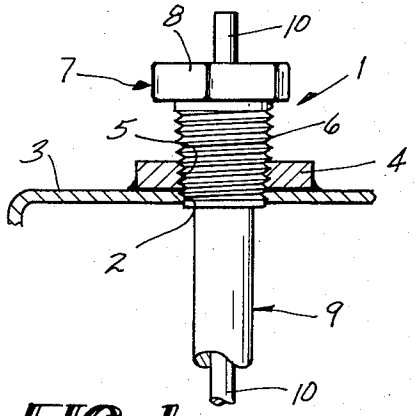


FIG-1

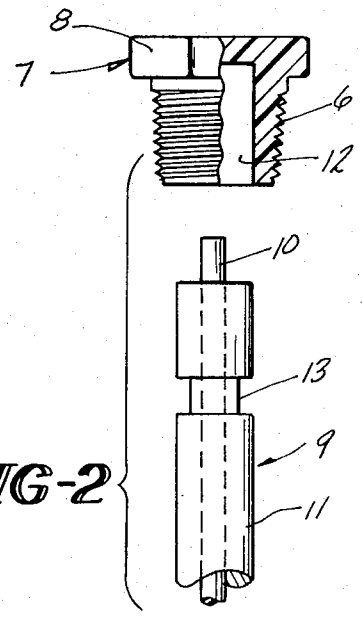


FIG-2

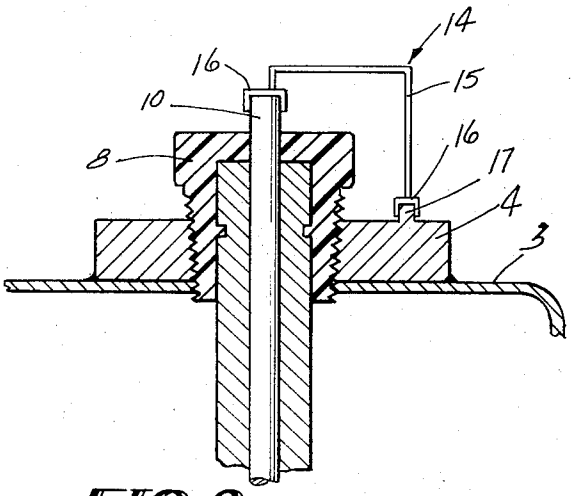


FIG-3

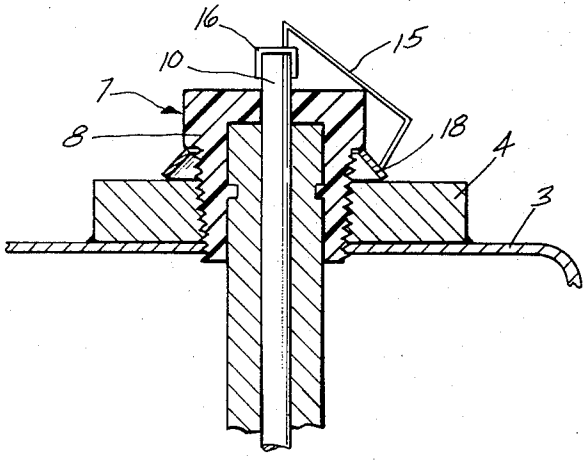


FIG-4

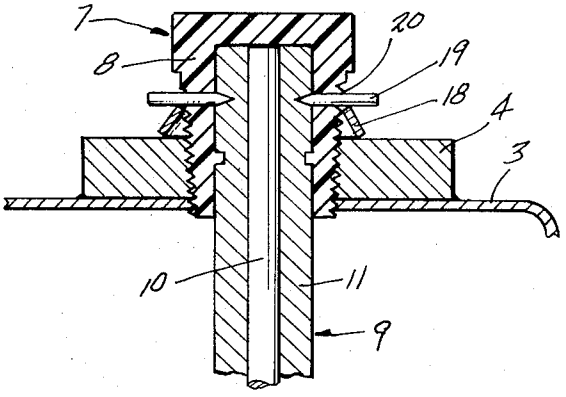


FIG-5

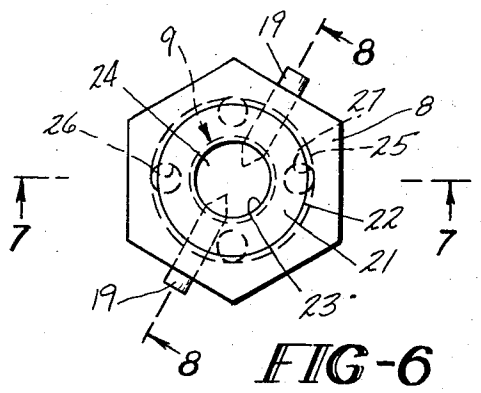


FIG-6

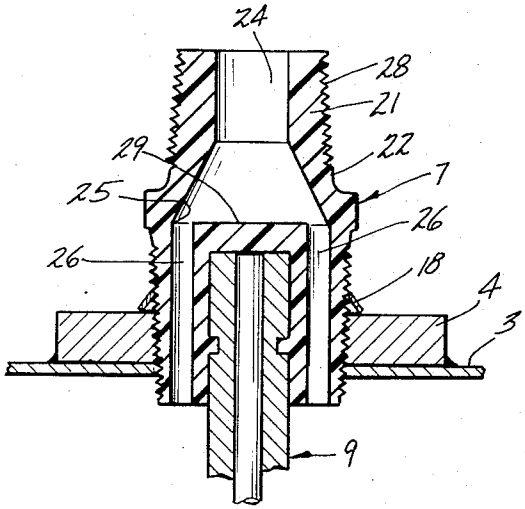


FIG-7

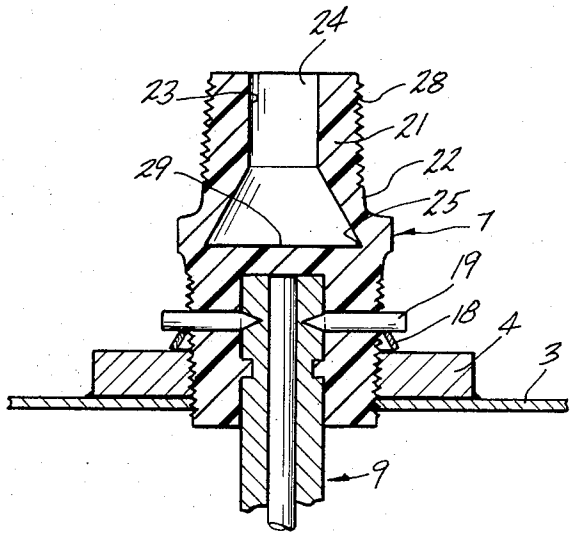


FIG-8

NOVEL ANODE FITTING

BACKGROUND OF THE INVENTION

This invention generally concerns the electrochemical protection of iron or other metals through cathodic protection, and relates to an improved anode fitting for use in the cathodic protection of metal surfaces such as the internal walls of water heaters, water tanks, pipelines, heat exchangers and the like.

The primary function of this invention is to provide a galvanic anode assembly or fitting adapted to be introduced into a water heater, water tank, pipeline or the like. The fitting comprises a metal that is more active than the metal comprising the water heater, water tank, pipeline or the like. The more active metal is electrically connected to the metal to be protected. The difference in activity of the two metals induces a current to flow between them, producing corrosion of the more active metal and furnishing cathodic protection to the less active metal.

Several anode fitting designs have been proposed in the prior art to produce corrosion of an active anode member while furnishing cathodic protection for the less active member. These prior art anode fitting assemblies generally comprise a plug member adapted to be threadedly received in the wall of a water heater or the like, and an electrode secured to the plug member. A number of disadvantages of the prior art anode fittings of this type have been observed. Generally the plug members of the prior art have been fashioned from metal stock such as, for example, steel, and have been in direct electric contact with both the anode and the wall of the water heater, the water tank, pipeline or the like. This relationship has resulted in two significant disadvantages. The metallic cap or plug member is cathodic with respect to the anode, and consequently the anode's ability to provide cathodic protection to the primary structure is reduced by the amount of current used in the protection of the cap or plug member. Also, the anode metal at the junction of the anode with the cap or plug member is disproportionately consumed, a phenomenon known as "necking," with the result that after a short period of time the anode metal closest to the fitting is entirely consumed and the anode breaks away from the fitting and stops functioning. This is due to the fact that the electrolytic path is shortest at this junction.

In the conventional anode fitting, electrical contact is predicated upon a steel-to-steel threaded joint. Because of oxide films present on the surfaces of the threads, and corrosion which often occurs at this interface, the electrical resistance of this type of connection is increased and the anode's efficiency is correspondingly diminished. Another problem associated with the conventional anode assembly is that a lubricant and/or sealing compound is usually required for the joining of the anode cap to the metal structure to be protected, and that this, too, results in electrical resistance between the surfaces.

The prior art sought to remedy some of the above noted problems by the employment of a non-metallic sheath which encloses a portion of the anode and is telescopically received within a threaded metallic connector member which serves to anchor the anode assembly in the wall of the metal structure to be protected, and likewise provides the electrical contact between the anode and that structure. This type of arrangement in its variations is disclosed in U.S. Pat. Nos. 3,542,663 and 3,753,888 to Alewitz. The structures described therein, however, still suffer from some of the disadvantages of the prior art metallic cap member, in that interfacial corrosion between the connector member and the structure to be protected decreases anode efficiency, while diminishing the anode's useful life by itself requiring cathodic protection.

Accordingly, it is a principal object of the present invention to develop an anode fitting which increases the anode's efficiency and useful life.

It is an additional object of the present invention to develop an anode fitting as aforesaid which eliminates the electrical resistance caused by corrosion of the electrical contact between the anode and the structure to be protected.

It is a still further object of the present invention to develop an anode fitting as aforesaid which eliminates the erosion of the anode at the area of joinder of the anode and the fitting.

It is still a further object of the present invention to provide an anode fitting as aforesaid which eliminates the reduction in the current capacity of the anode which results from the cathodic protection of the fitting.

Further objects and advantages of the present invention will appear from the discussion which follows.

SUMMARY OF THE INVENTION

In accordance with the present invention, it has been found that the foregoing objects and advantages may be readily obtained.

The anode fitting of the present invention comprises a nonmetallic cap or plug member which is adapted to be threadedly inserted in the wall of the metal structure sought to be protected and which provides for electrical contact between the anode and the structure to exist outside of the liquid and aggressive interior of the structure. In a modification of the present invention, the non-metallic fitting contains a fluid passageway situated in axial relation to the fitting and radial disposition with respect to the anode, so that the fitting may also serve as an outlet for the structure to be protected. The cap or plug member of the present invention is preferably constructed of a plastic material which is capable of deformation at temperatures higher than those achieved in the working environment of the metal structure to be protected, but is resistant to deformation at those latter temperatures. This quality permits the assembly of the anode fitting to be accomplished without the need of a lubricant or sealing compound. Likewise, the employment of a non-metallic cap or plug member eliminates the corrosion which normally occurs at and around the anode assembly, and insulates the electrical connection leading to the anode.

BRIEF DESCRIPTION OF THE DRAWINGS

In the detailed description of the invention which follows reference will be made to the attached drawings in which:

FIG. 1 is an elevational view partly in section showing an anode fitting of the present invention mounted in the wall of a water tank.

FIG. 2 is an exploded view of the parts comprising the fitting shown in FIG. 1.

FIG. 3 is a cross sectional view of the fitting shown in FIG. 1 illustrating an outside electrical connecting means.

FIG. 4 is a cross sectional view which illustrates a modification of the connecting means shown in FIG. 3.

FIG. 5 is a cross sectional view of an anode fitting mounted in a water tank which illustrates another embodiment of the invention.

FIGS. 6 – 8 are a top view and two cross sectional views, respectively, which illustrate an embodiment of the invention where the fitting is modified to provide a fluid passage.

For purposes of illustration only, certain of the above drawings have depicted the fittings of this invention mounted in a water tank, however, the invention should not be construed as limited thereto.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

FIG. 1 shows an anode fitting 1 according to this invention mounted within the top wall 3 of a water heater, heat exchanger, pipeline, hot water tank or the like. A spud 4 may be welded or otherwise secured to the top wall 3 so as to overlie the opening 2 and may possess internal threads 5 adapted to cooperate with external threads 6 of the plug member 7 in order to provide support for the anode fitting. Alternately, the fitting may be supported by the wall 3 alone simply by threadedly inserting the plug member 7 into the opening 2 alone. As shown in this drawing, the plug member 7 is adapted for use with a coaxial anode 9 which possesses a core element 10 extending beyond the anode body 11. In this illustration the core element 10 extends through the plug member 7 and into the outside environment to facilitate electrical connection with the tank.

FIG. 2 illustrates an exploded view of the elements of the anode fitting 1 prior to the assembly of the fitting. Plug member 7 is essentially tubular in shape, with external threads 6 over most of its length and a cylindrically shaped interior cavity 12, both of which terminate in a head 8 which seals off the member. The outer shape of the head 8 may be circular or hexagonal and though the latter is depicted throughout the specification, it is for purposes of illustration only. The plug member 7 is preferably constructed of a non-metallic plastic material which is only capable of deformation at temperatures higher than those attained in the working environment of the metal structure to be protected. Non-metallic materials suitable for the preparation of the plug member include but are not limited to materials such as thermoplastic synthetic resins such as, for example, polypropylene, polysulfones, ABS resins, and the like. Also, materials such as thermosetting resins such as polyurethanes and certain ceramics may be employed as long as their structural characteristics are compatible with the environment of their use.

The anode 9, as previously noted, possesses a cored structure common to galvanic anodes. The choice of materials comprising the elements of the anode of this invention may vary depending upon particular requirements. Since water heaters, water tanks and pipelines are usually constructed of ferrous metal, the material comprising the anode body 11 may be selected from a group including but not limited to more active electrochemical metals such as magnesium, aluminum, zinc, and their alloys. Similarly, core element 10 may be manufactured from materials such as iron or steel. The particular choice of material in each case will depend upon many factors including the characteristics of the metal to be protected.

In the embodiment illustrated in FIG. 2, the core element 10 axially extends beyond the anode body 11. This enables the core element 10 to extend from the plug member 7 into the outside environment upon the assembly and installation of the fitting as shown in FIG. 1, for the purposes of securing electrical contact between the anode and the wall of the metal structure to be protected. This latter feature will be discussed in greater detail hereafter.

Assembly of the fitting may be accomplished in several ways depending in part upon the materials employed in the plug member 7. Thus, for example, the plug member may be injection molded directly over the anode or ultrasonically or adhesively bonded to the anode if synthetic resins are employed in the plug member, or could be slip-cast in the instance where the plug member is being prepared from ceramic material.

As an example of the assembly of an anode fitting of the invention, a thermoplastic synthetic resin such as polypropylene is first molded to the shape of the plug member 7, and, thus formed, is then ultrasonically bonded to the anode 9. The method of ultrasonic bonding or "staking," as it is called, comprises the application of ultrasonic vibrations upon an insert, which, in this case is composed of metal, as the insert is driven into a hole previously provided in the plastic base material. Ultrasonic vibrations travel through the driven part until they meet the joining area between metal and plastic. At this point the employment of the ultrasonic vibrations is released as heat. Intensity of heat created by the vibration between the plastic and the metal is sufficient to melt the plastic momentarily, permitting the insert to be driven into place. Ultrasonic exposure time is generally less than one second, but during this time the plastic will reform itself around any surface indentations or irregularities to encapsulate the insert. Thus, for example, an annular indentation 13 may be defined in the anode 9 so that the plastic flow of the wall of the interior cavity 12 during ultrasonic bonding will fill the indentation and serve to further secure the anode in place in the plug member. The employment of an indentation is shown here for purposes of illustration only and does not, itself, constitute a critical aspect of the invention. To obtain the plastic flow during ultrasonic bonding, the diameter of the interior cavity 12 should be slightly less than that of the anode 9. With regard to the extension of the core element 10 through the plug member 7, it has not been found necessary to prepare a hole in the head 8 prior to "staking," though such practice is generally followed in other instances, as the dimensional stability of the area immediately surrounding the point of extension is not critical. In a further embodiment of the invention which will be discussed with reference to FIGS. 5 – 8, dimensional stability may be critical and, accordingly, the preparation of a hole in the plastic prior to staking is advisable.

As stated earlier, electrical contact between the anode and the wall of the water heater, water tank, pipeline or the like is maintained outside the liquid and aggressive interior of such structure. FIGS. 3 and 4 illustrate two types of electrical connecting means used in conjunction with the anode fitting represented by FIG. 1. In FIG. 3, electrical contact is provided by an

electrical connecting means **14** which comprises a wire **15** leading from the portion of the core element **10** extending from the head **8** of the plug member to the spud **4.** Clamps **16** are provided at both ends of the wire to secure contact to core element **10** and to the projection **17** similarly provided on the spud **4.** Alternately, the projection **17** could be placed on the wall **3** if the structure does not employ a spud. In FIG. **4** the electrical connecting means is modified by the substitution of a metallic cup-shaped spring-type washer **18** for the clamp contact with the spud (or wall). This particular type of washer is employed because it exerts tension on the joint between the anode fitting and the spud (or wall) which serves to compensate for any discrepancies in the manufacturing tolerances of the fitting which would affect the sealing quality of the joint, and ensures a strong electrical connection with the spud (or wall). The washer is placed over the exterior threaded portion of the plug member **7,** and is compressed between the head **8** and the spud **4** (or wall **3**) by the fastening operation of the fitting to the tank or the like. Wire **15,** which is attached to the washer **18** is then attached to core element **10** by clamp **16.**

FIG. **5** illustrates an alternate embodiment of the anode fitting of this invention, where, the core element **10** is of the same length as the anode body **11,** and does not extend through and beyond plug member **7.** Though this embodiment, and the embodiment illustrated by FIGS. **6 – 8,** depicts an anode having a coaxial structure, the invention is not meant to be limited thereto, and is intended to include the preparation of fittings which employ anodes possessing a solid, uncored structure. Electrical connection is provided by several press fit metal pins **19** which are driven through the threaded exterior portion **20** of the plug member **7** just below head **8,** perpendicular to anode **9** and to a depth sufficient to partially embed in the anode body **11.** The pins **19** are of such a size that they project from the plug member so as to provide electrical contact with the spud (or wall) through a spring-type washer **18** which is situated over the threaded portion of the plug member in the same manner described with reference to FIG. **4,** above.

The plug member **7** of the fitting of this embodiment is prepared for assembly in a slightly different manner than that of the embodiment of FIG. **1.** The insertion of the pins **19** occurs at locations on the wall of the plug member where dimensional stability may be critical, and, as noted earlier, it is advisable to prepare holes in those locations prior to assembly of the fitting.

The anode fitting of this invention may be modified to serve the additional function of providing a fluid passageway, as shown by FIGS. **6 – 8.**

FIG. **6** is a top view of the combined fitting-passageway partially in phantom intended to illustrate the location of the passageway in relation to the anode and its electrical contact with the structure to be protected. The head **8** is again represented as having a hexagonal shape though its exact shape is considered a matter of choice. The plug member is extended upwardly from head **8** to define a tubular shaped member **21** possessing an outer surface **22** which may be adapted to receive a water line or the like, and an inner wall **23** which defines the fluid passageway **24.** As the passageway approaches the anode, it enlarges to the circumference **25** and divides into several smaller passageways **26** which travel to the interior of the structure to be protected in paths which are radially displaced and run parallel to the long axis of the anode. The smaller passageways **26** are depicted as having cylindrical inner walls **27** and being four in number, however, the invention is not limited to this configuration, except as noted in the following discussion.

Electrical connection is of the same type described in FIG. **5.** Pins **19** enter the body of the plug member in the same manner and embed in the anode **9,** and communicate with a cup-shaped washer, not shown in this figure. As noted above, the size and number of the smaller passageways **26** must be limited so as to avoid intersection with the paths taken by the pins which would expose the pins, and possibly their contact with the anode to the corrosive action of the circulating fluid.

FIG. **7** is a vertical cross-section taken through line **7 — 7** of FIG. **6** which is provided to illustrate the enlargement of the fluid passageway **24** to circumference **25** and the separation into the smaller passageways **26.** The end wall **29** of the fluid passageway **24** is placed at the same depth as circumference **25** so as to provide a separation of suitable thickness between the anode **9** and the circulating fluid. The anode **9** is situated in the plug member **7** such that there is no contact with the fluid in the passageways. The portion of the plug member **7** which engages the spud **4** (or wall **3**) possesses the same structure as the earlier disclosed embodiments except for the presence of the smaller passageways **26.** As stated earlier, electrical contact is achieved in the same manner set forth in FIG. **5,** and FIG. **7** shows the washer in position around plug member **7** to be held in contact with the spud (or wall) by pins, not shown. The outer surface **22** of tubular member **21** of the plug member of this embodiment may be modified by placing threads **28** on its upper portion as shown in FIG. **7** to engage water lines and the like.

FIG. **8** is a vertical cross-section taken through line **8 — 8** of FIG. **6** to illustrate the placement of the pins **19** in contact with the anode **9** by insertion in plug member **7** at points which do not intersect with any smaller passageways. Again, the same mode of electrical contact employed in the embodiment described with reference to FIG. **5** is employed. Threads are likewise shown on both upper and lower portions of the plug member, as is the widening of fluid passageway **24** to circumference **25.** The end wall **29** is continuous with the circumference **25** as the smaller passageways are not present in this view.

This invention may be embodied in other forms or carried out in other ways without departing from the spirit or essential characteristics thereof. The present embodiment is therefore to be considered as in all respects illustrative and not restrictive, the scope of the invention being indicated by the appended claims, and all changes which come within the meaning and range of equivalency are intended to be embraced therein.

What is claimed is:

1. An anode fitting for use in the prevention of the corrosion of a metallic structure containing a corrosive liquid which comprises:

A. a non-metallic plug member comprising a threaded outer portion adapted to be threadedly received within an opening in the structure and a hollow cylindrical inner portion;

B. a cylindrical anode telescoped to said inner portion and secured thereto; and

C. means for electrically connecting said anode and said structure which comprises several metal pins in perpendicular relation to the long axis of said anode and partially embedded therein and extending beyond said plug member, and a metallic cup-shaped washer placed over the threaded portion of said member and adapted to be compressed between said pins and the exterior wall of said structure.

2. The fitting of claim **1** wherein said plug member comprises a material selected from the group consisting of thermoplastic resins and thermosetting resins.

3. The fitting of claim **1** wherein the anode possesses a coaxial structure and comprises an outer anode body and an inner core element.

4. The fitting of claim **1** wherein two of said metal pins are employed in said connecting means.

5. An anode fitting for use in the prevention of the corrosion of a metallic structure containing a corrosive liquid which comprises:

A. a non-metallic plug member comprising a threaded outer portion adapted to be threadedly received within an opening in the structure and a hollow cylindrical inner portion adapted to provide a fluid passageway for said structure;

B. means located on said plug member for attachment to a water line;

C. a cylindrical anode telescoped into the plug member and secured thereto; and

D. means for electrically connecting said anode and said structure which comprises several metal pins in perpendicular relation to the long axis of said anode and partially embedded therein and extending beyond said plug member, and a metallic cup-shaped washer placed over the threaded portion of said plug member which houses said anode, and adapted to be compressed between said pins and the exterior wall of said structure.

6. The fitting of claim **5** wherein said attachment means comprises a tubular extension of said plug member leading away from said anode and possessing an outer connecting surface and an inner fluid passageway.

7. The fitting of claim **6** wherein threads are defined on said outer connecting surface.

8. The fitting of claim **6** wherein said fluid passageway comprises:

a first fluid passageway in said tubular extension; and

a plurality of smaller passageways located in said plug member radially displaced in relation to said anode and parallel thereto, extending past said anode to communicate with said first fluid passageway.

9. The fitting of claim **5** wherein said plug member comprises a material selected from the group consisting of thermoplastic resins and thermosetting resins.

10. The fitting of claim **5** wherein the anode possesses a coaxial structure and comprises an outer anode body and an inner core element.

11. The fitting of claim **5** wherein two of said metal pins are employed in said connecting means.

12. An anode fitting for use in the prevention of the corrosion of a metallic structure containing a corrosive liquid which comprises:

A. a non-metallic plug member comprising a threaded outer portion adapted to be threadedly received within an opening in the structure and a hollow cylindrical inner portion;

B. a cylindrical anode telescoped into said inner portion and secured thereto which comprises an outer anode body and an inner core element, said core element axially extended beyond the anode body and through said plug member; and

C. means for electrically connecting said anode and said structure which comprises a wire attached at one end to a clamp secured to the axial extension of said core element, said wire attached at the opposite end thereof to a metallic cup-shaped washer which is placed over said threaded outer portion and adapted to be compressed between said plug member and the exterior wall of said structure.

13. The fitting of claim **12** wherein said plug member comprises a material selected from the group consisting of thermoplastic resins and thermosetting resins.

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