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METHOD OF INHIBITING CORROSION

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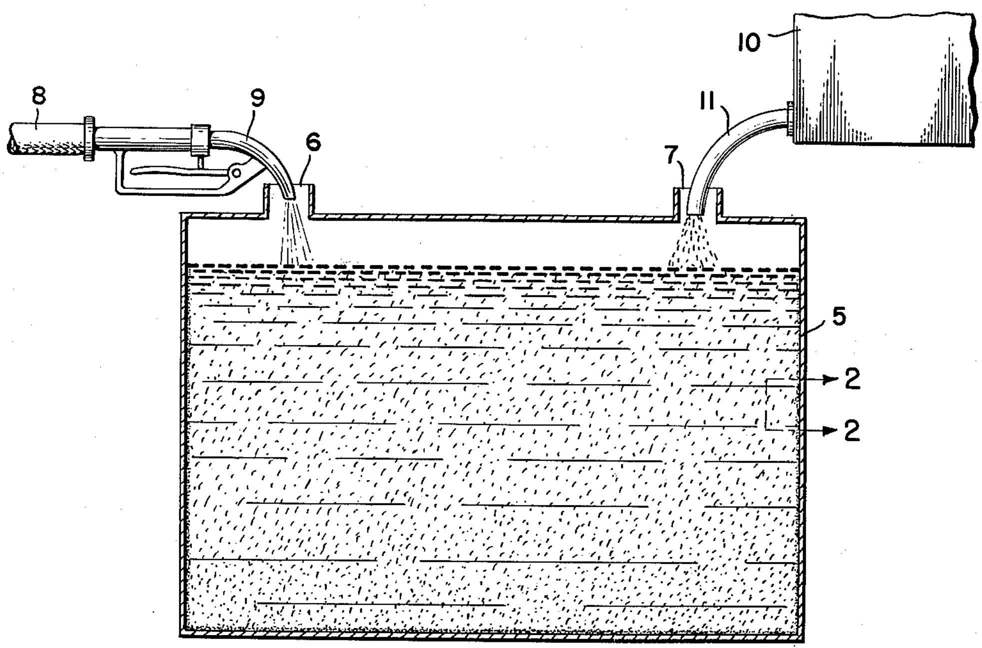

FIG. 1.

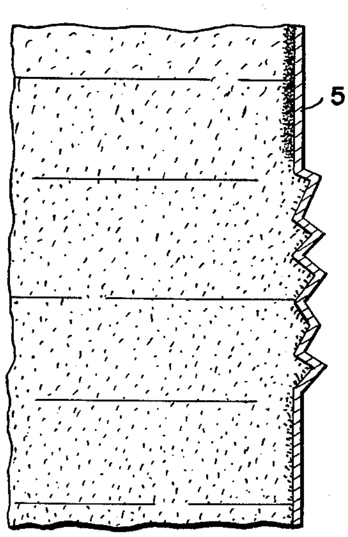

FIG. 2.

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METHOD OF INHIBITING CORROSION

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This invention relates to the inhibition of ferrous metal corrosion and more particularly to an improved method of inhibiting such corrosion by means of cathodic protection.

The control of ferrous metal corrosion has heretofore been effected through the use of the cathodic protection method whereby solid metal anodes are located within the electrolytic system which gives rise to such corrosion. For instance, ferrous metal corrosion is common in water storage tanks, such as stationary storage tanks, and also movable tanks, e.g. tank trailers and the petroleum product storage tanks of marine vessels. These petroleum product storage tanks of marine vessels are alternately filled with refined or unrefined petroleum compounds and ballast water, this water being either sea water, brackish water or fresh water. In any water storage system containing ferrous metal parts electrolytic corrosion occurs. As an example of this method of inhibiting corrosion, a typical storage tank of a petroleum product freighter is filled with at least fifty solid pieces of a magnesium metal alloy. Those pieces of magnesium are electrically grounded to the tank body and serve as anodes in the cathodic protection system. In order for this inhibition method to function properly, it is necessary to space the metal anodes approximately equidistantly throughout the surface area of the metal to be protected. Considerable expense is involved in placing these metal anodes throughout the relatively inaccessible spaces of most conventional storage systems. Furthermore, since the metal anode is expendable, that is it deteriorates during the process of cathodic protection, periodic replacement of the anodes is necessary, thereby entailing further expense. It will also be apparent that difficulty is encountered when this method of cathodic protection is sought to be extended throughout other parts of a liquid storage system, such as pipe lines, valves, pumps and the like. Installation of solid metal anodes of efficacious sizes within these structures is a practical impossibility. It is obvious that the presence of the metal anodes in a petroleum product storage tank is necessary only when the tank is being used to contain ballast water, as no electrolytic corrosion would occur while the tank contained an organic liquid. Therefore, the solid metal anode and the structure required to mount the anodes is excess cargo during approximately one-half of the life of the ship.

It is an object of this invention to provide an economical method of cathodic protection for ferrous metal-water systems.

It is another object of this invention to provide such cathodic protection wherein no permanent installation of solid anodes and their supporting structures is required.

Another object of this invention is to enable the cathodic protection process of corrosion inhibition to be utilized throughout complete water storage systems, including valves, pipe lines, pumps and the like.

Another object of this invention is to permit the establishment of cathodic protection reactions during only that period of time in which storage systems are used to contain water or aqueous solutions.

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The method of this invention comprises introducing into a ferrous metal-water system a quantity of particulate magnesium metal as a cathodic protection anode. This method will be understood from a reading of the following description and the schematic drawings wherein:

FIG. 1 is a schematic diagram of a water storage tank in use in accordance with the method of this invention.

FIG. 2 is an enlarged sectional view taken along the lines and in the direction of the arrows 2—2 of FIG. 1.

In the drawings there is shown a schematic representation of a liquid storage tank **5**, having two top openings **6**, **7**. Water is admitted into the tank **5** through opening **6** by means of a conventional hose **8** and nozzle **9**. Finely divided magnesium metal is shown being introduced through opening **7** by means of a container **10** and spout **11**.

The method of this invention consists of adding finely divided magnesium metal in the form of granules, powder, minute spheres, and the like, at the time of charging a quantity of water to a storage system which contains ferrous metal parts. Enough finely divided magnesium metal is added so that particles thereof are dispersed substantially throughout the whole body of water. When these minute particles of magnesium are so dispersed, a cathodic protection system is established by virtue of the fact that innumerable particles of magnesium metal make physical contact with the exposed ferrous metal surface, with the result that the tendency of the ferrous metal to corrode is greatly retarded. The cathodic protection effect protects all those ferrous metal surfaces throughout the storage system which are contacted by water having magnesium particles dispersed therein. FIG. 2 indicates a schematic representation of the physical results effected by the operation of this cathodic protection system. Certain portions of the ferrous metal surface have formed thereon a coating resulting from the electro-chemical reaction of the cathodic system. Other portions of the ferrous metal surface have no coating formed thereon, however such surfaces are also protected from further corrosion in accordance with the process of this invention. It is apparent from the drawings that complete surface protection of the storage container is made possible by the particulate dispersion of magnesium metal.

A series of tests was conducted in order to illustrate the process of this invention. In each test a 55 gallon steel drum which had been brushed clean of loose scale and corrosion was partially filled with either sea water or well water. At the beginning of each test magnesium powder was dispersed thoroughly throughout the liquid contents of one drum while a control drum of water received no treatment. The pairs of control and treated drums were stored for various periods of time, at the end of which visual comparisons were made of the liquids in the control and treated drums. The following rating scale for this visual evaluation was used:

Liquid condition:	Rating
Clear and not discolored	0
Clear and discolored	10–25
Translucent and discolored	25–50
Moderately translucent and discolored	50–75
Barely translucent and discolored	75–100

The test results were tabulated as follows:

Test No.	Duration (days)	Electrolyte	Anode	Rating
I	7	Sea Water	Control	50
I	7	do	Mg. Powder	15
II	8	do	Control	70
II	8	do	Mg. Powder	12
III	9	Well Water	Control	25
III	9	do	Mg. Powder	10
IV	4	Sea Water	Control	15
IV	7	do	do	20
IV	11	do	do	50
IV	17	do	do	90
IV	4	do	Mg. Powder	5
IV	7	do	do	10
IV	11	do	do	15
IV	17	do	do	20
V	21	do	Control	80
V	21	do	Mg. Powder	10

The above tests indicate that ferrous metal corrosion in electrolytic systems is greatly retarded by means of the process of this invention. In each of the treated drums of the tests, a calcareous coating was built up on the metal surface during the period of the test. This coating will itself act as a corrosion inhibitor in the system after the magnesium powder has been expended or the electrolyte replaced with untreated water. Comparable results are achieved regardless of the size of the magnesium particles, which may range from a fine powder to granules.

The process of this invention may be used to reduce the corrosion which occurs in the petroleum product storage tanks of marine vessels as shown by the following illustrative example:

At the time of loading the petroleum product storage tanks with ballast water for a return voyage, a quantity of magnesium metal in the form of fine particles is dispersed throughout the ballast water as it is loaded. Enough magnesium metal is added to insure the maintenance of a cathodic protection system throughout the period of time during which ballast water remains in the storage system. Continuous corrosion protection is thereby provided during ballast periods. Additionally, incidental protection of the tank bottoms results from this process during non-ballast periods by means of the carry-over coating produced during the period of cathodic protection and residual water having magnesium particles contained therein.

It is to be understood that any form of finely divided magnesium metal will function in accordance with the

method of this invention provided the metal particles will remain substantially dispersed in the body of water without substantial mechanical agitation thereof during the period of cathodic protection. Generally suitable are all particle sizes smaller than that passing a No. 20 standard mesh screen. Random motion of the suspended particles is produced by the above described electro-chemical reaction which occurs by virtue of cathodic protection.

The novel method of this invention provides an inexpensive and efficient process for inhibiting ferrous metal corrosion in water storage vessels by cathodic protection. This method requires no permanent installation of expendable anode material in the storage facility and permits selective use of cathodic protection only during those periods when a corrosive environment is established. Additionally, the process of this invention makes it possible to effectively inhibit ferrous metal corrosion in inaccessible locations, such as pipe lines, pumps and the like. As the process of this invention may readily be adapted for use in many different water storage systems, I intend my invention to be limited only as defined by the following claims.

Having thus described my invention, I claim:

1. The method of inhibiting ferrous metal corrosion in water storage systems containing ferrous metal parts which comprises adding to the body of water stored in said systems an inhibitive proportion of finely divided magnesium metal having an average particle size substantially such that it passes a No. 20 mesh screen, said metal remaining dispersed in said body of water.

2. The method of inhibiting ferrous metal corrosion in the petroleum product storage system of marine vessels, said systems containing alternately organic liquids and water, which comprises dispersing throughout said water an inhibitive amount of finely divided magnesium metal having an average particle size substantially such that it passes a No. 20 standard mesh screen, said metal remaining dispersed in said body of water.

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