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METHOD AND APPARATUS FOR SCREENING CORROSION
INHIBITORS IN BOILER WATER
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Fig. 1.

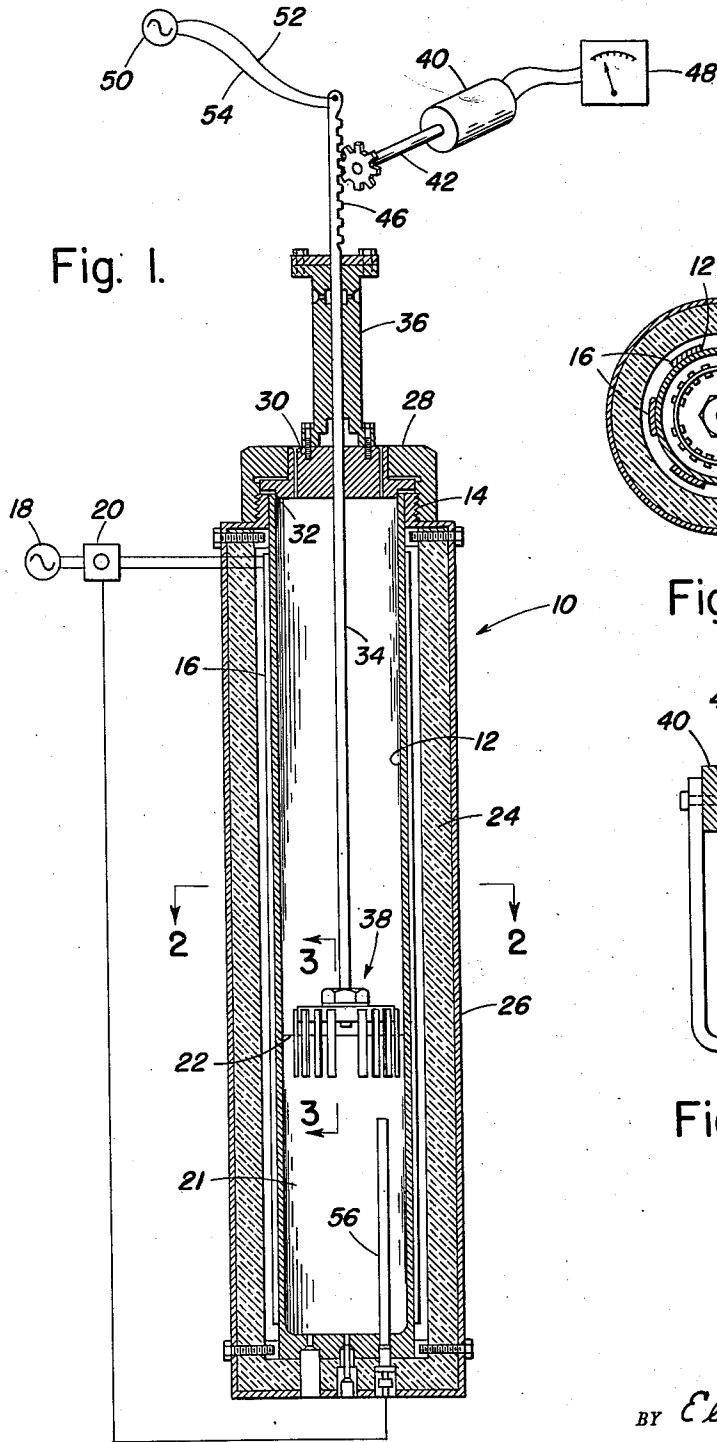


Fig. 2.

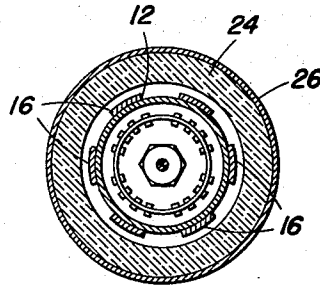
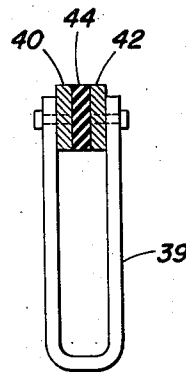


Fig. 3.



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METHOD AND APPARATUS FOR SCREENING CORROSION INHIBITORS IN BOILER WATER

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5 Claims. (Cl. 23-230)

This invention pertains generally to a method and apparatus for testing the effectiveness of corrosion water treatment or inhibitors and particularly for testing or screening corrosion inhibitors employed in the steam generating art.

It is the purpose of the invention to provide an apparatus and process for testing a substantial number of specimens in a short time to determine the effectiveness of a corrosion inhibitor for use with steam generators under the conditions that prevail in the steam generator. In steam generators various inhibitors are employed to prevent or deter corrosion of the metallic parts of the steam generator and in the operation of steam generators the conditions under which corrosion is a problem include the intermittent wetting of the metallic tubes and other elements in the evaporating region. In this region these metallic elements are intermittently wet and dry and as a result of the evaporating action concentrations of boiler water constituents build up or accumulate on these elements.

The method and apparatus of the present invention provides a relatively simple and effective way to duplicate, relatively accurately, these operating conditions and so test the effectiveness of the inhibitors that are dissolved in the boiling water to inhibit corrosion of the parts of the steam generator. The invention is particularly well adapted to test the effectiveness of water treatments or inhibitors to prevent or inhibit stress corrosion cracking of austenitic stainless steel employed with steam generators particularly in the evaporating region. This problem, with regard to stress corrosion cracking of this type of material, is an extremely serious one, with it having been found that austenitic stainless steel, when under stress and disposed in boiler water which contains chlorides, which all boiler water does, is very susceptible to this particular deterioration or corrosion.

In accordance with the invention there is provided a pressure container or vessel which includes electric heating elements disposed about the vessel to heat water disposed therein and in which extends a rod which is provided with a head at its end or inner extremity. A suitable motor drive is connected at the upper end of the rod to move the same up and down at a predetermined rate or period of reciprocation. The head carries the specimens which are to be immersed in the boiler water that contains the particular inhibitor being tested and the lower region of this vessel contains this water with the water being heated by the aforementioned electric heaters to the desired temperature. The head is moved up and down so as to raise and lower the specimens above and below the water level. Accordingly, the specimens are intermittently wetted.

It is desirable to dry the specimens when they are located in the region above the water level so as to produce the evaporating effect in the steam generator. Furthermore, since the action that takes place in a steam generator is to have the metallic elements heat the water or be at a higher temperature than the water such is the condition which prevails in the organization of the invention. In order to heat the specimens, there is provided a source of electrical potential which is connected to the specimen so as to pass a high current through them and

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accordingly heat them wherefore when the specimens are withdrawn from and are above the liquid the liquid will quickly evaporate.

The head is designed so that a large number of specimens may be mounted thereon and accordingly a large number of specimens may be simultaneously tested and the operation of the organization is such that the conditions in the steam generator are closely duplicated and an accurate and satisfactory test may be effected in a short time.

Accordingly, it is the object of this invention to provide an improved method and apparatus for testing corrosion inhibitors as employed in boiler water and under the conditions existing in the steam generator.

Other and further objects of the invention will become apparent to those skilled in the art as the description proceeds.

With the aforementioned objects in view, the invention comprises an arrangement, construction and combination of the elements of the inventive organization in such a manner as to attain the results desired as hereinafter more particularly set forth in the following detailed description of the invention as shown by the accompanying drawings wherein:

FIG. 1 is a somewhat diagrammatic representation of the organization of the invention with this representation being in the nature of a vertical section;

FIG. 2 is a transverse section taken generally along line 2-2 of FIG. 1;

FIG. 3 is a fragmentary sectional view through one portion of the rim that forms part of the head of the organization of the invention.

Referring now to the drawing, wherein like reference characters are used to designate like elements throughout, the illustrative and preferred embodiment of the invention depicted therein includes a pressure vessel or container 10 which is comprised of an inner cylindrical member 12, preferably made of Monel metal or the like, and provided at its upper end with threaded collar 14. Disposed about member 12 are a plurality of electric strip heaters 16 which are connected with an electric potential 18 through electric control device 20. These heaters are effective to heat the boiler water 21 which partially fills vessel 10 with 22 being the level of this boiler water.

Disposed about cylindrical member 12 and heater elements 16 is a layer of thermal insulation 24 with this insulation layer being contained within the shell or casing 26.

The upper end of vessel 10 is provided with a removable closure in the form of a threaded nut 28 which is threadably received on collar 14 and which is provided with a radially inwardly extending flange that overlays a complementary outwardly extending flange on the cover member 30 as disclosed. A fluid tight seal is provided by the gasket 32 disposed intermediate cover member 30 and the upper end of cylindrical member 12.

Extending downwardly through and generally coaxial of cover member 30 is the drive rod 34 and in order to insure a fluid tight seal a suitable stuffing box 36 is provided which is secured to and extends up from member 30 as shown.

At the lower end of rod 34 there is mounted a head member 38 which includes a hub portion and a rim portion that is supported from the hub. This rim portion is of laminated construction as disclosed in FIG. 3 and includes outer and inner metallic annuluses 40 and 42 respectively which are separated by a layer of electrical insulation 44. The metallic specimens are supported from this rim and the specimens are preferably U bent as shown in FIG. 3, having their upper ends connected with the annuluses 40 and 42.

The head member 33 with its attached specimens is periodically reciprocated so that the specimens are moved up and down to and from a position above the liquid level 22 and a position below the liquid level. This latter position being depicted in FIG. 1. In order to provide this reciprocating action a suitable motor drive is connected to the upper region of rod 34 with this drive, as illustrated, including reversible electric motor 40 which has connected with its shaft 42 a pinion and with this pinion engaging suitable teeth 46 formed on the rod 34. The operation of motor 40 is preferably controlled by timer 48 and the resulting drive that is produced is effective to maintain the specimens in the position shown in FIG. 1 for a predetermined time, such as five minutes, and thereafter elevate the specimens into a region above level 22 for another predetermined time, again such as five minutes, and continuously repeat this operation.

Each of the specimens 39 is heated by having a relatively high current pass therethrough and for this purpose there is provided a source of electrical potential 50 which is electrically connected with these specimens by means of insulated conductors 52 and 54 that extend centrally down through drive rod 34 with one of these connectors being connected with annulus 40 and the other with annulus 42. The potential source 50 is of low voltage, high current capacity and is adjusted so that the elements 39 will be heated to a temperature that is above the temperature of the boiler water in vessel 10. For example the value of this potential source may be set to raise the temperature of the specimens 10° to 20° above the temperature of the water while the specimens are in the water phase and when the specimens are raised above the water level the temperature will increase because of the poorer heat dissipation qualities of steam as compared to water. When thus raised, the liquid adhering to the specimens will quickly evaporate.

At the beginning of a run, current will be supplied to the strip heaters 16 and to the specimens 39, when the desired water temperature is reached and which temperature is detected by the thermocouple 56 the strip heaters 16 will be energized intermittently to maintain the water temperature at its desired value while the specimens will be heated continuously.

By forming specimens 39 in the manner disclosed the U bent portion thereof which is immersed intermittently in the body of water is, of course, under stress as a result of bending the metal strip and accordingly the effect of the inhibitor to prevent corrosion of this stressed region will be determined.

It will be appreciated that a relatively large number of specimens can be simultaneously tested, i.e. 12 to 18 and as previously mentioned, the organization is well adapted for testing the effectiveness of chloride stress corrosion water treatments. In testing these treatments or inhibitors the specimens 39 would be austenitic stainless steel of various types and make ups and the production of stress corrosion cracks at the stressed U bend portions of the specimens would be determined with this determination representing the actual conditions prevailing in the steam generating region of a boiler.

Accordingly a relatively simple, yet effective method and apparatus is provided in accordance with the invention for screening corrosion inhibitors for use in the boiler water of steam generators.

While we have illustrated and described a preferred embodiment of our invention, it is to be understood that such is merely illustrative and not restrictive and that variations and modifications may be made therein without departing from the spirit and scope of the invention. We therefore do not wish to be limited to the precise details

set forth but desire to avail ourselves of such changes as fall within the purview of our invention.

What is claimed is:

1. The process of screening corrosion inhibitors for boiler water comprising providing in an enclosed container a heated bath of water having the inhibitor dissolved therein, periodically immersing a plurality of metallic test specimens into the bath and withdrawing the same into the space thereabove, passing a current through said specimens and thereby heating the same to a temperature above said bath and so the specimens quickly become dry when moved from the water bath into said space, and continuing the periodic emersion and withdrawal for a substantial period.

2. The process of testing the effectiveness of inhibitors of stress corrosion cracking of austenitic stainless steel in boiler water comprising providing a heated bath of boiler water having the inhibitor dissolved therein, providing a bent specimen of austenitic stainless steel so that stresses are developed at said bend, for a predetermined time, periodically immersing the bent portion of the specimen in said bath and withdrawing the same into the space and passing a current through said specimen to heat the same to a temperature above said bath and so it will quickly become dry when moved from the water bath into said space.

3. An organization of the type described comprising a generally fluid tight vessel partially filled with boiler water having a corrosion inhibitor dissolved therein, means for heating said water to a desired temperature, means operative to support a metal specimen in said vessel and periodically move the same into and out of said water, a source of electric potential and means connecting said source to said specimen so as to pass current therethrough, said source being such as to heat said specimen to a desired temperature above the temperature of the water.

4. A device for testing the effectiveness of a stress corrosion cracking inhibitor in boiler water comprising a pressure vessel partially filled with boiler water having said inhibitor dissolved therein, support means extending through the upper end of the vessel, a plurality of bent strips of austenitic stainless steel supported by said means within said container, means operative to periodically move said support to move the bent portion of the strips into and out of the water, a source of electric potential connected with said strips to pass current therethrough, said source being such as to heat said specimen to a desired temperature above the temperature of the water.

5. Testing apparatus for testing the effectiveness of corrosion inhibitors in boiler water comprising a pressure vessel, partially filled with boiler water having the inhibitor dissolved therein, electric heater means disposed about the vessel to heat the water therein, a vertically disposed shaft extending through the upper end of the vessel in a generally fluid tight manner, a head secured to the lower end of the shaft, a plurality of metal specimens supported on said head for periodic immersion in the water, motor means connected with the upper end of the shaft and operative to periodically reciprocate the same to effect said periodic immersion, a source of electric potential, means connecting this source with said specimens to pass current therethrough, said source being such that the specimens are heated to a temperature above that of the water.

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