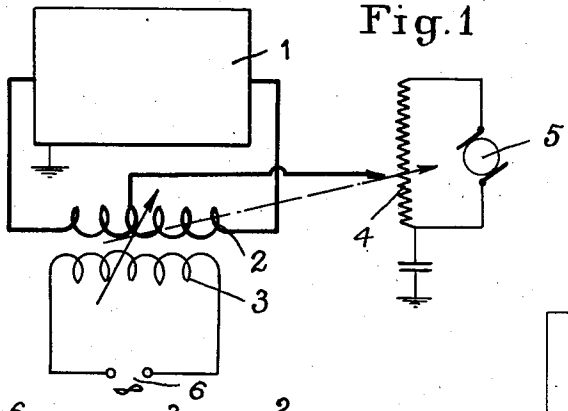
May 31, 1938. P. S. D. MAZZA 2,118,979

MEANS FOR PREVENTING CRUST FORMATIONS ON THE WALLS OF BOILERS

Filed July 3, 1934

Fig. 1



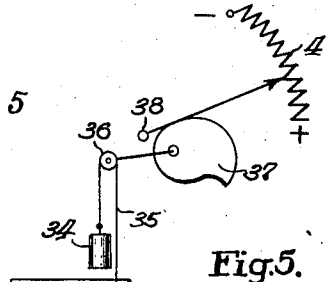


Fig. 5.

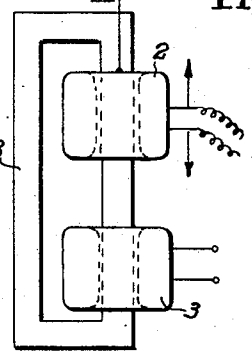


Fig. 2

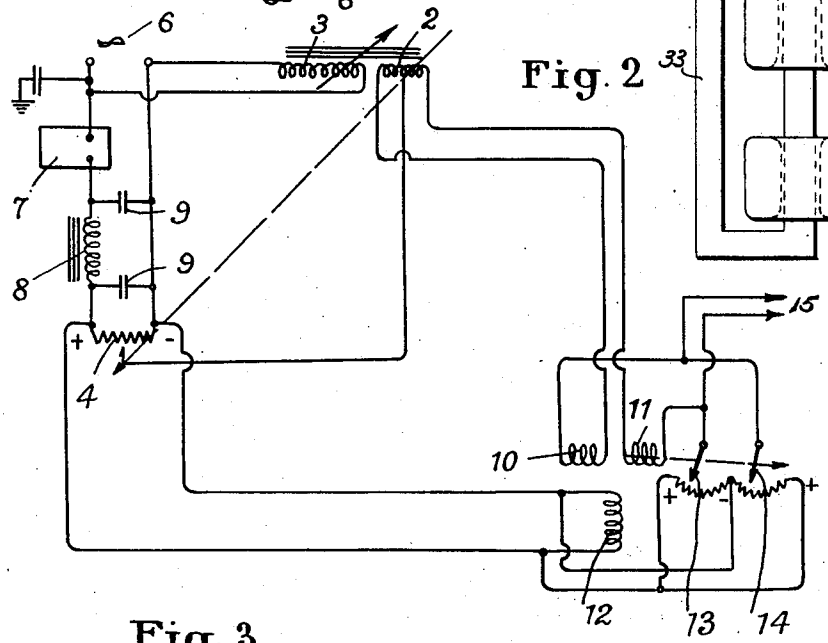


Fig. 3

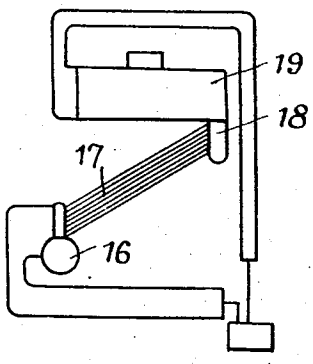
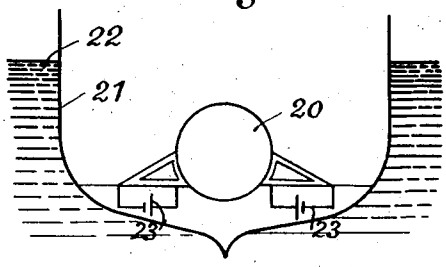


Fig. 4



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MEANS FOR PREVENTING CRUST FORMATIONS ON THE WALLS OF BOILERS

Plinio Sergio Davide Mazza, Paris, France

Application July 3, 1934, Serial No. 733,692
In France July 19, 1933

4 Claims. (Cl. 204—25)

My invention relates to means for protecting the walls of steam boilers or similar apparatus against scales, incrustations and corrosions.

It has already been proposed, for preventing the formation of boiler scales, to apply a source of electric current for causing, the neutralization of electric currents which are developed in steam boilers, resulting from the differences of temperature. It has also been proposed to pass alternating electric current through a boiler, to prevent the deposit of salts but prior efforts have not met with success.

It has been found that the phenomenon of incrustation is due to the fact that the metal of boiler walls, under the action of heat, emits electrons in a manner similar to what occurs in the cathodes of thermionic tubes. When said electrons have moved out of the metal, said metal acquires a positive charge which keeps the electrons at an infinitely small distance away from the wall. The negative charges of said electrons act upon the positive charges of the anions of salts and acids which are dissolved in the water of the boiler and attract the same towards the wall. The equilibrium between all those forces is realized when anions have reached the wall upon which they strongly adhere. The positive charges of the wall act in the same manner upon the cations. The equilibrium or cancellation of charges is realized when said cations have placed themselves above the bed of anions. All charges being cancelled, the metal continues emitting electrons and the above described phenomenon occurs again indefinitely.

The method according to my invention consists, providing in the several parts of the steam boiler or similar apparatus in which incrustations are to be prevented, electric charges which are equal but opposite to those which appear under the influence of a temperature increase. The invention also provides for passing pulsating current or preferably alternating current through the boiler in order to cancel the natural charges or the charges which naturally occur in several parts of the boiler. The molecules or substances which are precipitating are taken off from the action of charges. The molecules are caused to receive a vibratory movement with a view of preventing or destroying the adhesion of the salts to the boiler walls, thus preventing either salt or other incrustations from taking place in said boiler.

In the accompanying drawings there is shown diagrammatically by way of example a preferred embodiment of plant which realizes the method according to my invention:—

Fig. 1 is a diagram showing a simple arrangement for performing the method according to my invention,

Fig. 2 diagrammatically shows another arrangement,

Fig. 3 diagrammatically shows the arrangement of the circuits which lead the electric current through the boiler,

Fig. 4 diagrammatically shows the arrangement of the plant with a boiler which is in a position to receive electric charges from an external source,

Fig. 5 is a diagrammatic view illustrating the movable mounting of the transformer secondary.

In Fig. 1, the boiler or similar apparatus in which incrustations are to be prevented, is diagrammatically represented at 1. On opposite ends of the boiler, and in conveniently determined points of same, are connected the terminals of an electric circuit which include the secondary winding 2 of a transformer. The transformer may be provided with a magnetic core, and the primary 3 is connected with the terminals of a source of alternating current 6 of any voltage and frequency. The approximate mid-point of the secondary 2 of the transformer is electrically connected with a potentiometer 4 which is fed by a source 5 of direct current having a suitable voltage. Both windings 2 and 3 of the transformer are magnetically coupled with each other and the winding 2 is movable relatively to the winding 3, in order that, the electro-dynamic reactions between the coils which are created in both windings, may automatically vary according to the current which flows in the same. The winding 2 is brought back to its resting position by any suitable means, for instance by gravity or by the action of a direct electric field. The secondary winding 2 is mechanically connected with the arm of the potentiometer 4.

Fig. 5 illustrates a suitable arrangement wherein the secondary winding is movable relative to the primary winding. The primary winding 3 is stationary and the secondary winding 2 may slide along the magnet core 33. The weight of the secondary winding is balanced by the counterweight 34 connected therewith by means of a flexible wire 35, the latter passing around a pulley 36 which actuates a cam 37. The cam 37 acts upon a contact arm 38 of the potentiometer 4.

The circuit which permits electric current to flow through the boiler is arranged in such a manner that the several parts of said boiler are

connected in series and according to their decreasing temperatures.

The boiler 1 is connected with one pole of the direct current source 5 by the potentiometer 4 and the other pole of said source is provided with a ground connection in which a condenser is interposed as diagrammatically represented in the drawing. The direct current voltage thus applied to the boiler provides all parts thereof with charges which are equal and opposed to the natural charges occurring in said boiler. Thus the electric field which keeps the electrons near the boiler wall is cancelled and the electrons are attracted far away from the wall by the anions of salts. The charges of the electrons are cancelled, and the salts which precipitate deposit themselves on the bottom of the boiler in the form of a mud which does not adhere to the metal.

Furthermore, the alternating current has a disintegrating effect upon the first layers of scale, because it communicates a vibratory movement to the molecules which adhere to the walls and moreover said vibrations, the amplitude of which is a function of the voltage, are larger in the hotter points which are more susceptible to scaling or incrustations.

The current which flows through the boiler is maintained constant as a result of the self regulation obtained with the transformer 2, 3. Each change of working conditions in the boiler causes a change of voltage at the terminals of the secondary 2 of the transformer, and a corresponding change of voltage due to the modification of flux and the displacement of said secondary winding relatively to the primary winding by reason of the electro-dynamical reactions between the currents which flow in both windings. The reactions are balanced as above described, either by the weight of winding 2 or by a direct current magnetic field, or a counterweight as shown in Fig. 5.

Owing to the fact that the winding 2 is mechanically connected with the arm of the potentiometer 4, the self regulation applies also to the direct current voltage supplied to the boiler. Since the electrical resistance of metal increases with the temperature and since the circuit which feeds the boiler with current is arranged in such a manner that all its parts are connected in series and in an order corresponding to their increasing temperature, a second regulation will thus be obtained and hence the hottest metallic parts which emit the larger quantity of electrons will receive a higher voltage, so that the charges which occur in said parts of the boiler will always be exactly balanced or destroyed.

Fig. 2 diagrammatically shows another embodiment which is more adaptable to cases when the boiler or other similar apparatus may be submitted to differences of potential, as for example boilers of locomotives which roll on a right-of-way of an electrified railway line and where a current of a high intensity flows in the rails. In this modification, the source of current 6 is still connected with the primary winding 3 of a transformer. The secondary winding 2 is adapted to be rotated relative to the primary.

A rectifier 7 enables the alternating current of source 6 to be transformed into a direct current, said current being suitably filtered by a choke coil 8 and condensers 9. Said direct current passes into the potentiometer 4 the arm of which is still connected with middle part of the secondary winding 2.

The secondary winding 2 is connected with the windings 10 and 11, one of which, for instance the winding 11, may be variably coupled with a third winding 12 in a manner similar to that described in connection with winding 2 relative to the winding 3. The coil 12 is connected across the potentiometer 4 so that direct current flows therein. The winding 11 is mechanically connected with the arms of two potentiometers 13, 14, in which also flows a direct current coming from the rectifier. The windings 10, 11, and the potentiometers 13, 14, are adapted to be connected with the boiler at 15. The coupling of windings 2, 3 of the transformer may also be modified as in the preceding embodiment, so that the changes of voltage, also cause the operation of the potentiometer 4.

If a current flowing in the boiler is in a position to trouble or even to cancel the current which is sent by the winding 2, the current which flows through winding 11 induces therein a field which reacts upon the field produced in winding 12. If the current is alternating and without any effect upon the scaling phenomena of the boiler, the coupling between the windings 11 and 12 is not altered which leaves the potentiometers 13, 14, in zero position. If such current is direct, the field of the winding 11 reacts upon the field of winding 12 and modifies the coupling between both of said windings and consequently operates the potentiometers 13 and 14 so as to cause the boiler to receive a current which cancels the occasional current which was flowing through the same.

Fig. 3 diagrammatically shows the electric connections within the boiler. The current, for instance, first of all flows through the lower header 16, then the nest of tubes 17, the upper header 18 and finally through the boiler body 19. The several parts of the boiler are thus preferably arranged in series and in the order of decreasing temperature in the circuit.

Fig. 4 diagrammatically shows the arrangement of a boiler 20 mounted in the hull of a ship and electrically connected with the hull 21 and consequently with the sea 22. This arrangement has the drawback in that the appearance of charges upon the boiler walls causes a current to take place, which may oppose the effects of the current employed according to my method. For remedying this drawback, auxiliary current sources 23 are located in suitable determined places. Such sources have a suitable voltage for producing a current, which is opposite to the current, towards the boiler from the hull.

The arrangement of the several parts of boilers which are located in series in the circuit is obtained by the tentative method and obviously differs according to the type of boiler.

The plant may be provided with thermionic lamps for regulating the current sent into the boiler.

My invention applies for preventing incrustations and corrosions of boilers or similar apparatus of any type and for any use.

What I claim is:—

1. Means for protecting the walls of boilers and similar apparatus against scale, incrustations and corrosions comprising a transformer including primary and secondary windings, a boiler connected with said secondary winding, a potentiometer connected with the central point of said secondary winding, said secondary winding being movable relatively to the primary winding, and means for transmitting movement

of the secondary winding to said potentiometer to vary the adjustment of the latter.

2. Means for protecting the walls of boilers and similar apparatus against scale, incrustations and corrosions, comprising a transformer including primary and secondary windings, a boiler connected with said secondary winding, a potentiometer connected with the central point of said secondary winding, said secondary winding being movable relatively to the primary winding in response to temperature differences in said boiler, and means for transmitting movement of said secondary winding to said potentiometer to vary the adjustment of the latter.

3. Means for protecting the walls of boilers, and similar apparatus against scale, incrustations and corrosions comprising a boiler, a transformer including primary and secondary windings, the secondary winding being connected with said boiler and being movable relative to the primary winding, means for impressing an electric charge on said boiler, and means connecting said movable secondary winding with said charge impressing means to regulate the latter.

4. Means for protecting the walls of boilers, and similar apparatus against scale, incrustations and corrosions comprising a boiler, a transformer including primary and secondary windings, the secondary winding being connected with said boiler and being movable relatively to the primary winding, means for impressing an electric charge on said boiler, and means connecting said movable secondary winding with said charge impressing means to regulate the latter, said charge impressing means being connected with the center point of said secondary winding.

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