Oct. 27, 1925. 1,558,647

W. THALHOFER

PROTECTION OF METALLIC SURFACES AGAINST INCRUSTATION AND CORROSION

Filed Aug. 14, 1923

Fig. 1

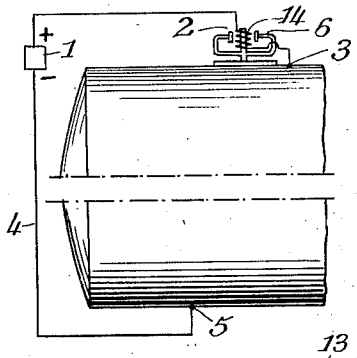


Fig. 2

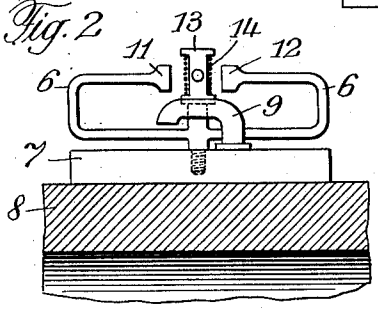


Fig. 4

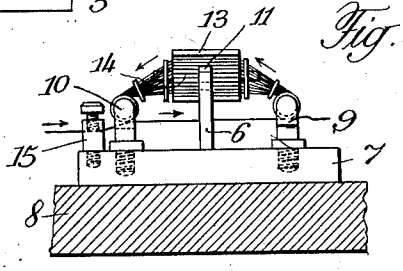


Fig. 3

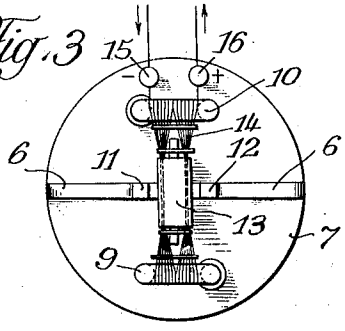


Fig. 5

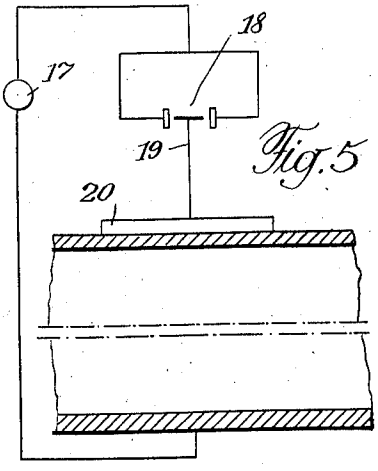
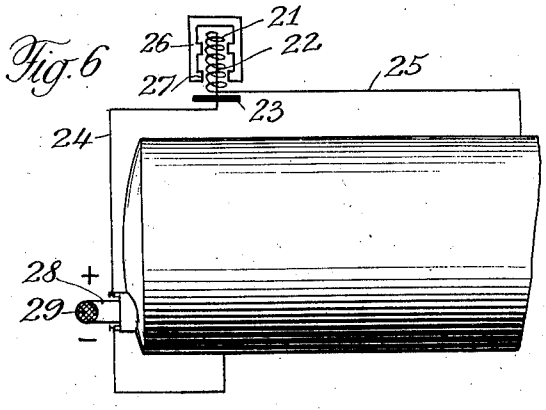


Fig. 6



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UNITED STATES PATENT OFFICE.

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PROTECTION OF METALLIC SURFACES AGAINST INCRUSTATION AND CORROSION.

Application filed August 14, 1923. Serial No. 657,457.

To all whom it may concern:

Be it known that I, WALTER THALHOFER, a citizen of Austria, residing at Vienna, Austria, have invented certain new and useful Improvements in the Protection of Metallic Surfaces Against Incrustation and Corrosion, of which the following is a specification, reference being had therein to the accompanying drawing.

This invention relates to the protection of metallic surfaces against incrustation and corrosion, more especially to the protection of boilers, evaporating vessels or the like, etc., in which hot liquids are contained, against the deposition of fur or scale.

The invention contemplates both the method of and apparatus for preventing the incrustation by the use of electric energy.

In my application Serial No. 596,774, filed October 25, 1922, I have described and claimed the use of minute impressed voltages and currents applied in closed circuit to metal surfaces such as boilers and the like, for preventing the formation of incrustations or scale. It was pointed out in said application that such a system was not only more efficient and dependable and simpler than one using much larger currents and voltages such as had been in practice, but that it enabled the protection to be had without fear of the protective currents themselves corroding or eating away the boiler shell which is to be protected from scale. The apparatus shown and described in my said application consists of a small thermo pile external of the boiler and connected in closed circuit with the boiler shell, the impressed voltage at the connections to the shell being far below that necessary to decompose water so as to avoid any possibility of electrolysis, and providing a very small continuous direct current.

The present invention is in the nature of an improvement upon the subject matter of said first application, and the object of this invention is to provide a more efficient and reliable system and apparatus for the purpose stated. The present invention contemplates the use of minute currents and voltages other than in the form of undisturbed continuous direct currents; and I will hereinafter refer to the currents contemplated by this invention as "pulsating" currents.

I have found out from practice that while minute currents and voltages in the form of undisturbed continuous direct currents as formerly used by me, protect the metallic surfaces against incrustation or scale in some cases and under some conditions met with, they fail to do so in other cases. But I have discovered that when this minute electric energy is in the form of current having a form characteristic that is periodically disturbed or varied with respect to the zero line, with or without interruptions of the current flow, i. e., is applied in the form of pulsating current, it greatly intensifies the protective effect of the current and prevents incrustation or scale in all cases where I have tried it, and therefore provides a much more efficient and reliable system. It is particularly valuable because it does not seem to be possible before actual tests, to determine in which cases undisturbed direct current will work.

I have discovered that where a "pulsating" current is applied to the object to be protected one can use an impressed voltage at the local source such for example as at the thermo pile, of say 10 millivolts or a total applied amperage to the whole of a moderate size boiler of only about 70 to 100 milliampères (which with the average resistance of a boiler of this size would give a drop of potential at the connecting points to the boiler of about .5 millivolts) with greater protective effect in all cases that I have tried, than by the use of known systems utilizing as much as several volts and currents many times above that which is considered dangerous to boilers and the like, and furthermore, the use of this invention eliminates the great danger of corrosion ever present with much larger voltages and currents.

It is known that a current flow or density of about .75 milliampères per square decimeter of iron boiler surface will begin to cause injurious corrosion of the boiler if applied directly to the same. This density of current will result in .08 millimeters of the thickness of the iron boiler to which it is applied being dissolved or eaten away in one year. Considering that this corrosion is probably not uniform one will no doubt with the use of said density of current get a very considerably greater corrosion of the boiler in some places. It will appear from

this that a density of one or two milliampères per square decimeter of boiler surface would be extremely injurious and may in a short time impair the boiler.

My invention consists in the novel method hereinafter set forth according to the preferred manner of practicing same, and in the apparatus for carrying out same, and the invention will be more particularly pointed out in the appended claims.

Further objects and advantages of the invention will more fully appear from the following description taken in connection with the accompanying drawings illustrating diagrammatically and by way of example only certain forms of apparatus that may be used in carrying out the invention.

Fig. 1 is a diagrammatic view of one form of apparatus connected in the circuit with the boiler shell.

Fig. 2 is a side view of this form of apparatus useful for producing the pulsations in the applied current.

Fig. 3 is a plan view of same, and

Fig. 4 is a side view looking in the direction of the arrow in Fig. 2.

Fig. 5 is a diagrammatic view of the system with a make and break device in the circuit, and

Fig. 6 is a diagrammatic view of another device in circuit for producing the pulsating currents by induction.

As the source of current I prefer to use a small thermo pile secured at one end directly to a hot part of the boiler to excite the elements, with the other end exposed for cooling to maintain the desired difference in temperature between the two ends. This pile is shown diagrammatically at 1 in Fig. 1. From the positive pole of this pile a wire leads directly to the device 2 for producing pulsations, and thence to the boiler shell at a point 3. The other pole of the thermo pile is connected by wire 4 directly to a part of the boiler 5 and remote from the first connection.

The pulsation producing device 2 is more fully illustrated in Figs. 2–4, wherein 6 represents a permanently magnetized sheet steel stamping made to vibrate somewhat like a tuning fork when shaken or disturbed. The lower central part of this magnet is threaded into a base plate 7 secured for example to the boiler 8 of a locomotive where it will receive vibrations, or it may be caused to vibrate in any desired manner. On each side of the magnet 6 there is an iron hook 9, 10 and extending up from the base of the magnet midway between its poles 11, 12, there is a soft iron core 13 of I-section as shown in Fig. 2. A coil of wire 14 included in the circuit is so wound upon the hooks 9, 10 and past the side surfaces of the core 13 transverse to the plane of the magnet 6 as to bring about through induction due to vibrations of the magnet 6 with respect to the coil, pulsations in the current of the system.

As shown in Figs. 3 and 4 the wire runs from one binding post 15 around the hook 10 thence along one vertical surface of core 14 to and around hook 9 and back around hook 10 and so on until one side of core 14 is filled, thence back and forth and around the hooks, at the opposite face of the core 14 until a suitable coil is built up as will be readily understood. With this apparatus, as the tuning-fork-like magnet is vibrated, to disturb the magnetic field through which the wires pass, pulsations are set up in the circuit. This or any other suitable device for producing a pulsating applied current may be utilized. The currents used are so small and the pulsations thereof so delicate that it has been found that the necessary vibrations may be set up by securing the base of the device to any support that is subject to continuous vibrations, in some cases to the boiler itself or to a near-by pipe or to the engine run by the boiler, or the device may be mounted upon a plate which is caused to vibrate by the discharge of a little exhaust steam or running water. In short any provision may be utilized that will with certainty effect pulsations in the current or produce a pulsating current.

In Fig. 5 the source 17 may be a thermo pile or very low potential battery of some suitable type and in the circuit may be connected any suitable form of continuously operating make and break device, such as is illustrated diagrammatically at 18, with the vibrating member or tongue 19 mounted on a support 20 which in turn is secured to any part subject to continuous tremors or vibrations. In the drawing it is shown as mounted directly upon a boiler, such for example as a locomotive boiler, and the current flows directly through the tongue and base 20 into the boiler shell. This device may be used as a make and break device to produce interrupted pulsating currents, or it may be so connected as to produce uninterrupted pulsating currents.

In Fig. 6 I have illustrated another form of device for producing pulsations in the current through induction. In this device a relatively long narrow coil of spring wire 21 is suspended centrally from its upper end by a rod 22 mounted on a suitable insulated support 23 and connected in the circuit to wire 24 by a suitable binding post (not shown) while the lower end of the coil is connected to wire 25 running to the boiler. Due to this arrangement of the coil it is quite sensitive to vibrations. About this coil is provided a magnet 26 suitably fixed to the base 23 so that the coil will vibrate or oscillate up and down in front of the different little poles 27 to increase the induc-

tion effect and hence the pulsations of the current in the system. The source of current is shown at 28 as a thermo pile secured to the boiler with the upper end inclosed in wire 29 for purposes of ventilation.

It will be seen from the foregoing that the use of these insignificant currents and voltages enables the use of extremely simple and inexpensive apparatus, and that any injurious action of the current on the boiler is excluded in the event that the system should be misapplied or get out of order. No precautionary measures need be taken to safeguard the boiler from the currents in the event that the system should get out of order. In fact in my system the polarity can be reversed without affecting the operation and with equally good results.

I have found from actual experiment that not only will the use of the infinitesimal pulsating currents keep a boiler entirely free of incrustation and corrosion but that if the system be applied to a boiler already heavily incrusted, the scale or fur will be loosened or dissolved so that the boiler is made clean.

It will be apparent that if, as is the case, a total current of only a few milliampères is utilized in this system, then the current density per square decimeter of boiler surface is practically negligible. For example in one system where a boiler of approximately 150 H. P. with about 120 square metres of heating surface was equipped with this system, the total current applied to the boiler is about 20 milliampères, and the system works with entire success. The resistance of this size boiler being about .005 ohm, the drop of potential across the boiler at the connected points is about .1 millivolt. Even if this current was increased 5 times to say 100 milliampères, there would be only a current density per square decimeter of about .008 milliampère. This is about 1/90 of the lower limit of currents that are considered as already injurious. As a further example,—assume a larger boiler of say 500 H. P. with approximately 400 square meters of heating surface, the voltage measured across the terminals of the thermo pile before connecting same to the boiler may be about 100 millivolts. With the thermo pile connected to the boiler the total current flowing through the boiler can be made such as to pulsate—if a true pulsating current is utilized—between the values of 80 milliampères and 160 milliampères. In some cases it might be found desirable on large boilers to use even twice or three times as much current as this. But even if the maximum current were say 500 milliampères, the current density would be such as to amount to only about .012 milliampère per square decimeter of boiler surface, or far below that which is harmful.

Because of the low circuit density used in my system no measurable consumption of the boiler can take place and both poles of the source can therefore be connected as shown in a closed circuit to the boiler shell, without any fear of consuming any portion of the boiler within its otherwise operative or useful life. It would appear from the foregoing that this system does not work on the principle of electrolysis.

Where in the claims I use the term "pulsating currents" or "pulsations" I wish to be understood as using the term broadly, and as including various currents whose line or form characteristic is periodically varied with respect to the zero line whether by interruptions of current flow or by increases and decreases with respect to the zero line without interruptions.

While I have described my invention with particularity in connection with certain preferred embodiments thereof, it will be apparent to those skilled in the art, after understanding my invention, that various modifications and changes may be made therein without departing from the spirit or scope of the invention and I aim in the appended claims to cover all such modifications and changes as are within the scope of my invention.

Having thus described my invention what I claim is:

1. Method of protecting from incrustations metal surfaces in contact with liquids, which comprises connecting both poles of a source of current to the metal of the metallic object to be protected or to connected metallic parts, at spaced points to get a distributed flow of current through the metal of said object and causing a "pulsating" electric current to flow through said object of a magnitude insufficient to produce a drop of potential across said connected points high enough to decompose water.

2. Method of protecting from incrustations metal surfaces in contact with liquids, which comprises connecting both poles of a source of current to the metal of the metallic object to be protected or to connected metallic parts, at spaced points of said object to get a distributed flow of current through the metal of said object and causing a "pulsating" electric current to flow through said object having an applied voltage at said spaced points of the object, of but a small fraction of a volt.

3. Method of protecting from incrustations metal surfaces in contact with liquids, which comprises connecting both poles of a source of current to the metal of the metallic object to be protected or to connected metallic parts, at spaced points of said object to get a distributed flow of current through the metal of said object and causing a "pulsating" electric current to flow through said object having an applied volt-

age at said spaced points of the object, of not more than a few millivolts.

4. Method of protecting from incrustations metal surfaces in contact with liquids, which comprises connecting both poles of a thermo electric source of current to the metal of the metallic object to be protected or to connected metallic parts, at spaced points of said object to get a distributed flow of current through the metal of said object and causing a "pulsating" electric current to flow through said object having an applied voltage at said spaced points of the object, far below that necessary to decompose water.

5. Method of protecting from incrustations metal surfaces in contact with liquids, which comprises connecting both poles of a source of current to the metal of the metallic object to be protected or to connected metallic parts, at spaced points of said object to get a distributed flow of current through the metal of said object and causing a "pulsating" electric current to flow through said object, which total current is but a fraction of an ampere.

6. Method of protecting from incrustations surfaces of boilers, which comprises applying directly to the metal of the boiler or connected metallic parts and at spaced portions of said boiler, a "pulsating" current having an impressed voltage at the connections to said boiler insufficient to produce a "pulsating" current of a volume equivalent to an intensity of about .75 milliampère per square decimeter of said boiler surface, and causing such "pulsating" current to flow through the metal of said boiler.

7. In a system of the character described, the combination of a metallic object to be protected from incrustations, a source of "pulsating" current connected at spaced points of said metallic object and in closed circuit with said object and delivering to said object "pulsating" currents with an impressed voltage at said connecting points of the source to said object, below that necessary to decompose water.

8. In a system of the character described, the combination of a metallic object to be protected from incrustation, means producing "pulsating" current and connections connecting same to the metal of said object or metallic connecting points, at spaced points of said object and delivering to the object "pulsating" currents with an impressed voltage at said connecting points of the source to said object far below that necessary to decompose water.

9. In a system of the character described, the combination of a metallic object to be protected from incrustations, electrical apparatus connected at spaced points of said metallic object, and in closed circuit with said object and delivering to said object "pulsating" currents with an impressed voltage at said connecting points of the source to said object, of but a small fraction of a volt.

10. In a system of the character described, the combination of a metallic object to be protected from incrustations, a source of "pulsating" current connected at spaced points of said metallic object and in closed circuit with said object and delivering to said object "pulsating" currents with an impressed voltage at said connecting points with said object, of not more than a few millivolts.

11. In a system of the character described, the combination of a metallic object to be protected from incrustations, a thermo pile connected in a closed circuit with said object, the connections from said thermo pile to the object being at spaced parts of the object to provide distributed flow of current through said object with an impressed voltage at said connecting points to said object, below that necessary to decompose water, and means in said circuit for producing "pulsations" in said current.

12. In a system of the character described, the combination of a metallic object to be protected from incrustations, a thermo pile connected in a closed circuit with said object, the connections from said thermo pile to the object being at spaced parts of the object to provide a distributed flow of current through said object, which total current is but a fraction of an ampere, and means in said circuit for producing "pulsations" in said current.

13. In a system of the character described, the combination of a metallic object to be protected from incrustations, a thremo pile with the poles connected to the metal of said object or to the metallic connected parts, at spaced parts of the object to provide a distributed flow of current through said object, with an impressed voltage at said connecting points to said object of but a small fraction of a volt, and means operatively related to said thermo pile for producing "pulsations" in said current.

14. In a system of the character described, the combination of a metallic object to be protected from incrustations, a thermo pile with the poles connected to the metal of said object or to metallic connecting parts, at spaced parts of the object, to provide a distributed flow of current through said object, with an impressed voltage at said connecting points to said object of not more than a few millivolts, and means operatively related to said thermo pile for producing "pulsations" in said current.

15. In a system of the character described, the combination of a boiler to be protected from incrustations and electrical apparatus connected in closed circuit to the boiler

metal at spaced parts of the boiler and delivering to the boiler "pulsating" currents of an amount equivalent to less than about .75 milliampère per square decimeter of boiler surface.

16. In a system of the character described, the combination of a boiler, a thermo pile connected in closed circuit to the metal of the boiler, the connections to the boiler metal being at remotely spaced parts of the boiler, the applied voltage at the boiler being of the order of magnitude of millivolts, and a vibrator in the circuit for producing "pulsations" in said current.

17. The method of protecting boilers against incrustations, which comprises connecting a source of current in a closed circuit with the boiler metal, the connections being at remotely spaced parts of the boiler to get a distributed flow of current through the boiler metal and causing a "pulsating" electric current to flow through said boiler metal having an applied voltage at the connected points to the boiler of the order of magnitude of millivolts.

In testimony whereof I affix my signature.

WALTER THALHOFER.