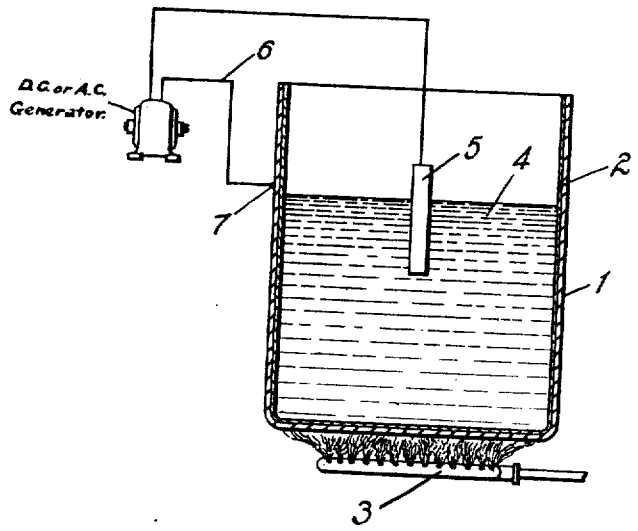
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LIQUID HEATING METHOD AND APPARATUS.

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1,308,040.

Patented July 1, 1919.



WITNESSES:

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LIQUID-HEATING METHOD AND APPARATUS.

1,308,040. Specification of Letters Patent. Patented July 1, 1919.

Application filed June 30, 1915. Serial No. 37,317.

To all whom it may concern:

Be it known that I, LEWIS W. CHUBB, a citizen of the United States, and a resident of Edgewood Park, in the county of Allegheny and State of Pennsylvania, have invented a new and useful Improvement in Liquid-Heating Methods and Apparatus, of which the following is a specification.

My invention relates to liquid heating devices such as steam boilers and water heaters, and it has for its object to increase the amount of available energy per unit area of heating surface in such devices.

The single figure of the accompanying drawing is a view, partially diagrammatic and partially in section, showing a simple form of apparatus embodying my invention.

When liquids are heated in containers, such as steam boilers and the like, the amount of energy transmitted to the water increases, up to a certain point, in proportion to the heat gradient from the heating medium to the liquid being heated. When this point is reached, additional heat will not be transmitted to the liquid on account of the formation of a film of vapor upon the heat-transmitting surfaces, which has the effect of heat-insulating the liquid just as the cushion of vapor between a drop of water and a hot plate insulates and supports the drop in spheroidal form.

I have discovered that the above described heat-insulating effect may be reduced or entirely prevented by establishing a difference of electric potential between the liquid and its container. So marked is the increase in heat transmission under these circumstances that I have been able to evaporate more than three times as much water per unit area of heating surface than is possible by the direct application of heat.

The theoretical reasons for this phenomenon are somewhat obscure. It may be that the electric current passing between the container and the liquid acts catalytically to transfer heat to the liquid; or the electrically charged particles existing in the liquid may act to promote vaporization after the manner of sharp pointed solid bodies. The phenomenon may also be caused by electrostatic attraction between the liquid being heated and the metal container. According to this theory, if a film of vapor has formed upon the liquid engaging wall of the container and if the film is thinner in one spot than on adjacent parts of the surface, the electrostatic attraction, acting inversely as the distance between the liquid and the container, will operate to squeeze out the spheroidal layer of vapor which will escape in bubbles. Whether or not either of the foregoing theoretical explanations is correct, it is a fact that the maintenance of potential or the passage of electric current between a liquid and its container greatly increases the maximum heat transference through such liquid.

In practising my invention, either direct or alternating current may be employed, and the increase in maximum heat transference is a function of the difference of potential established. In one experiment in which a potential of 300 volts was established between a steam boiler and the water contained therein, about 75 pounds of water per square foot per hour were evaporated, while, under the same circumstances but without the assistance of electric energy, only 22 pounds per square foot per hour could be evaporated.

When alternating current is employed for my present purpose, the liquid-engaging surfaces of the container and the auxiliary electrode should both be provided with an asymmetric conducting film, which may conveniently be produced by coating such surfaces with a film-forming metal, such as aluminum, and adding to the liquid a small amount of a film-forming electrolyte. An excellent electrolyte for this purpose, containing boric acid and borax, is described and claimed in my copending application Serial No. 864,666, filed Oct. 2, 1914, and assigned to the Westinghouse Electric and Manufacturing Company.

A simple arrangement illustrative of the principles of my invention is shown in the accompanying drawing, in which a container 1, provided with an internal coating 2 of aluminum or other suitable film-forming material, is supplied with heat by means of a gas burner 3 and is adapted to contain a body of liquid 4. An electrode 5 is immersed in the liquid 4 and is connected to one terminal of a generator 6, the other terminal of which is connected, as at 7, to the wall of the container 1.

My invention may be applied to steam boilers of any ordinary type and also to water-heating systems where the heat is not

carried sufficiently far to evaporate the water. Similar economies are effected in both cases, since the transmission of heat to the water or other liquid is facilitated whether the liquid is evaporated or not.

In the device shown in the drawing and in any liquid heating device in which the use of an asymmetric conducting coating is necessary, such coating must cover the entire wetted surface of the container and, with alternating potential, the electrode also. It is to be particularly noted that, if boric acid and borax constitute the electrolyte, the entire surface of an iron container should be coated with the film-forming metal, preferably aluminum, because the electrolyte acts upon iron to form an iron borate, which, in a tubular boiler, would accumulate as an insoluble precipitate upon the boiler tubes and thus heat-insulate them.

My invention may obviously be modified in many particulars without departing from its spirit and scope, and it is therefore to be understood that no limitations are to be imposed thereon unless indicated in the appended claims.

I claim as my invention:

1. The method of increasing the energy developed in liquid-heating devices that comprises establishing a difference of electric potential between the said liquid and its container while the latter is being heated.

2. The method of increasing the energy developed in liquid-heating devices that comprises adding an electrolyte to the said liquid and passing an electric current through the said liquid and its container while the latter is being heated.

3. The method of increasing the energy developed in liquid-heating devices that comprises placing the liquid to be heated in a container, the liquid-engaging surface of which is provided with an asymmetric conducting film, and passing an electric current through the said liquid and the said container.

4. The method of developing energy in liquid-heating devices that comprises placing the liquid to be heated in a container, the liquid-engaging surface of which is provided with an asymmetric conducting film, heating said container, and maintaining an electric potential between said liquid and said container while said container is being heated.

5. The method of increasing the energy developed in liquid-heating devices that comprises placing the liquid, together with a film-forming electrolyte, in a container the liquid-engaging surface of which is coated with a film-forming metal, and passing electric current through the said liquid and the said container.

6. The method of developing energy in liquid-heating devices that comprises placing the liquid to be heated, together with a film-forming electrolyte, in a container the liquid-engaging surface of which is coated with aluminum, heating the container, and passing an electric current through the said container while the same is being heated.

7. A liquid-heating device comprising a container for the liquid to be heated having its liquid-engaging surface provided with an asymmetric conducting film, an electrode adapted to be immersed in the said liquid, and an electric circuit including the said electrode and the said container.

8. In a liquid-heating apparatus, the combination with a liquid container having a liquid-engaging surface comprising a film-forming substance, of means for heating said container, and other means for establishing a difference of electric potential between said container and the liquid therein during the operation of said heating means, whereby the transfer of heat from said heating means to said liquid is increased.

9. In a liquid-heating apparatus, the combination with a liquid container having its liquid-engaging surface coated with aluminum, of means for heating said container, and other means for establishing a difference of electric potential between said container and the liquid therein during the operation of said heating means, whereby the transfer of heat from said container to said liquid is increased.

10. A liquid-heating device comprising a non-film-forming metal container having its liquid-engaging surface coated with a film-forming metal, an electrode adapted to be immersed in the said liquid and an electric circuit including the said electrode and the said container.

11. A liquid-heating apparatus having a liquid-engaging surface comprising a film-forming substance, means whereby said surface is heated, and means for establishing a difference of electric potential between said surface and the liquid while said surface is being heated.

12. The method of developing energy in liquid-heating devices that comprises placing the liquid to be heated in engagement with a member, the liquid-engaging surface of which comprises a film-forming substance, heating said member and surface, and establishing an electric potential between said liquid and surface during the heating operation, whereby the transfer of heat from said member and surface to said liquid is increased.

In testimony whereof I have hereunto subscribed my name this 26th day of June, 1915.

LEWIS W. CHUBB.

Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents, Washington, D. C."