Oct. 19, 1948. G. W. WATSON 2,451,594

ELECTRONIC STEAM GENERATOR

Filed Dec. 17, 1947

Fig. 1

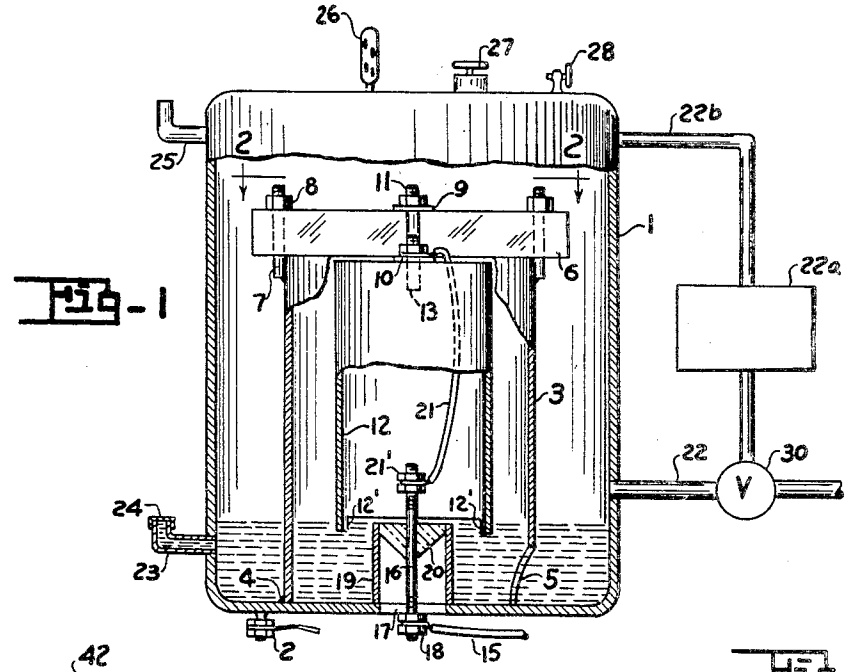


Fig. 4

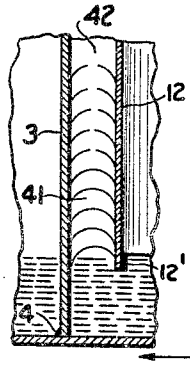
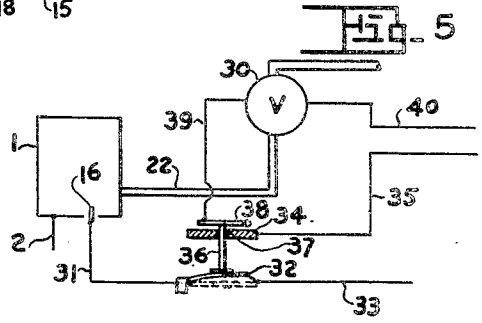


Fig. 5



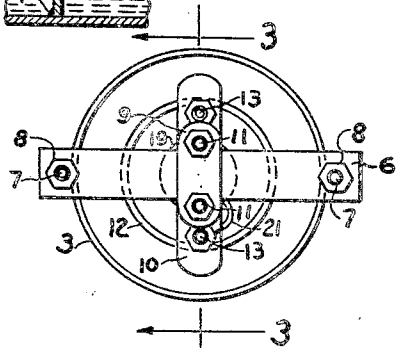


Fig. 3

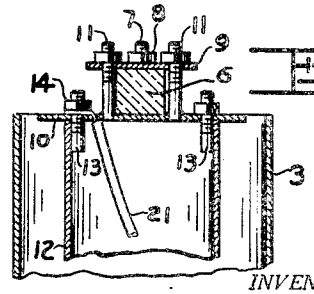


Fig. 2

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ELECTRONIC STEAM GENERATOR

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5 Claims. (Cl. 219—40)

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This application is a continuation-in-part of my co-pending application Serial No. 544,254, filed July 10, 1944, now abandoned.

The present invention pertains to a novel method of vaporizing a liquid by electrical action. The invention resides in producing a supply of liquid film and vaporizing the film. The supply of film is obtained by placing oppositely charged electrodes in surface contact with a body of liquid, as will be described in detail hereinafter. A characteristic of the method is that the spacing of the oppositely charged electrodes is greater than capillary action spacing for the particular liquid to be vaporized. The distance between electrodes is identified as the limit of the bridging of the particular liquid, that is, a distance greater than that of capillary action spacing and not exceeding the distance across which a film of the particular liquid can be supported.

A further distinctive feature of the present invention, when involving direct contact of a portion of the electrodes with the liquid supply, is a double and simultaneous electrolytic action. This dual action is automatic and spontaneous. It involves a combination of the electrolytic pool or water rheostat principle and the generation of vapor from a film. At the immersed parts of the electrodes current flows through the mass of solid liquid as in a water rheostat. Approximately two percent of the consumed current is thus employed. Liquid constantly rises between the electrodes in the form of rapidly succeeding liquid inverted film hammocks. Above the surface of the liquid, current flows through the films and eventually vaporizes them. The major portion of the current is consumed in this manner over myriads of thin bridges, even to the extent of purposely precluding any substantial electrical heating of the electrodes, as described more fully below.

In the vaporization of water by this method, the steam emerging from the space between the electrodes has a moisture content of about six percent. It is well known that steam initially emerging from the surface of a body of water has a moisture content of ten to twelve percent. Consequently the steam generated between the electrodes has lost approximately half of its initial moisture content before the current has completed its travel between the electrodes. Since the electrodes are relatively cool, the only available energy for the removal of moisture is in the flow of current between the electrodes. The current traversing the areas of the electrodes, where the films have practically disappeared, flows for

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the most part through a gas or vapor. The action here is therefore electronic, characterized by the flow of current through a gas, namely that which is under the 12% moisture content. Consequently it may be said that at least a portion of the final steam is generated by an electronic method.

The invention is fully disclosed by way of example in the following description and in the accompanying drawings in which:

Figure 1 is a vertical section of an apparatus employing the method of the invention;

Figure 2 is an interior plan view on the line 2—2 of Figure 1;

Figure 3 is a section on the line 3—3 of Figure 2;

Figure 4 is a detail vertical section illustrating diagrammatically the film action, and

Figure 5 is a wiring diagram of an automatic liquid level maintenance apparatus.

Reference to these views will now be made by use of like characters which are employed to designate corresponding parts throughout.

In Figure 1 is shown a suitable casing or receptacle 1 consisting of an electrically conductive material and grounded through a terminal 2. Within the receptacle is mounted a cylindrical electrode 3, preferably co-axially, and brought into contact with the receptacle as by a means of fastening 4 at the bottom. The lower end of the electrode 3 is formed with one or more openings 5 to admit liquid to the interior thereof from the receptacle.

The opposite electrode is suspended within the electrode 3 by suitable means such as that which will now be described. An insulating block 6 is slipped over a pair of vertical bolts 7 which are welded or otherwise secured to the upper end of the electrode 3. The block 6 is clamped in position by means of nuts 8 on the upper ends of the bolts. A strap 9 is laid across the center of the block 6 and supports a transverse conducting strap 10 below the block by means of bolts 11 straddling the block. A smaller cylindrical electrode 12 is positioned concentrically within the electrode 3. Bolts 13 extending from the upper end of the electrode 12 (Figure 3) pass through the strap 10 and are secured thereto by nuts 14.

The opposite side 15 of the circuit is fastened to a conducting rod 16 passed through the center of the bottom of the case 1 and insulated therefrom by an opening 17. Nuts 18 fasten the conductor 15 to the rod 16. A tubular shield 19 secured on the bottom of the case surrounds the rod 16 and has its upper portion sealed to the rod by insulating material such as a mass of

porcelain 20. The lower portion of the shield 19 is preferably void. A conductor 21, fastened to the upper end of the rod 16 by nuts 21', is connected to one of the bolts 13 by being secured under the nut 14 thereof. The bare upper end of the conductor 21 is thus connected to the electrode 12.

The liquid to be vaporized is admitted to receptacle 1 through an intake pipe 22 from a water supply container 22a connected to the case 1 by a pressure equalizer tube 22b. A predetermined level is established in the receptacle by means of an open overflow tube or elbow 23 which is subsequently closed by a cap 24. The upper end of the case 1 is fitted with a vapor outlet pipe 25, an air vent 26, a safety valve 27 and a manual pet cock 28, all of these being of conventional construction.

Figure 5 illustrates diagrammatically a device for automatically maintaining the predetermined level in the receptacle 1 as the liquid is consumed. In the supply line 22 is mounted an electromagnetic valve 30 that remains closed when no current flows in its coil. A conductor 31 extends from the rod 16 through a bimetal strip 32 which in turn is joined by a conductor 33 to the power supply. It may be assumed that the case 1 and electrode 3 are negative and the electrode 12 positive. As long as the liquid is in contact with the electrode 12, current will flow through the strip 32, and the strip will be arched upward as shown.

Over the strip 32 is a fixed insulated contact 34 connected by a conductor 35 to one side of an auxiliary circuit for the valve 30. Upon the strip 32 is secured an insulating pin 36 passing through the contact 34 and insulated therefrom at 37. Over the contact 34 the pin 36 carries a contact 38 permanently connected by a conductor 39 to the valve coil which is connected by a conductor 40 to the other side of the auxiliary circuit.

When the liquid level in receptacle 1 lowers slightly, current to electrode 12 decreases in flow to the strip 32, the latter becomes flatter and brings the contact 38 into engagement with the fixed contact 34, thereby opening the normally closed valve. The flow of current in the valve coil opens the valve and is interrupted to close the valve when the higher level of liquid increases the current flow through bimetal 32.

As already indicated, the electrode 12 is immersed only slightly in the surface of the liquids. The immersion is only enough to establish a current between the electrodes, since it is desired to maintain the rheostat action at the necessary minimum. In fact the lower end of the electrode 12 is preferably formed with a small number of downwardly extending ears or tops 12' and only these make contact with the solid liquid.

The bridging limit of the liquid, which determines the spacing of the electrodes, is approximately the diameter of the largest bubble that can be blown in the liquid. The bridging limit of water, for example, is approximately three-fourths of an inch. This limit for any liquid can be determined simply by blowing breath through a tube into the liquid and observing the maximum diameter attained by the bubbles before bursting. The distance between the electrodes need not be the maximum bridging limit but is preferably less and in any event is considerably in excess of capillary action spacing.

On passage of current across the surface of the liquid, as described, films of liquid immediately commence to rise in rapid succession in the manner illustrated in Figure 4. The films 41 bridge the space between the electrodes and are arched upward. Current flows through the films until the latter becomes vaporized. Both the electrodes may be active for a distance of about ten inches above the liquid level.

The electrodes are of such low resistance as to be practically unheated by the flow of current through them. This can be demonstrated by touching with the hand the electrodes after the generation of vapor has commenced and the current disconnected. The electrodes have been found to be cool at this time although they eventually become warm by contact with the generated steam. It follows therefore that the action of the electrodes in vaporizing the films is mainly the conducting of current through or over the films rather than the conducting of heat from the electrodes. Also, the body of liquid remains cool, so that the vaporization does not depend on heating any of the mass of liquid, as in the case of the usual water rheostat. In fact the electrodes may be dipped in a body of liquid of unlimited size, even a flowing river, and the formation of films and steam will commence almost immediately.

It is known that steam emerging from the surface of a body of water has a moisture content of ten to twelve percent. The steam emerging from the electrodes has a moisture content of about six percent by commercial laboratory test. Approximately half of the normal moisture content has therefore been vaporized between the electrodes. It has been shown that the heat radiated or conducted from the electrodes is purposely insignificant. The final step in the vaporization process is therefore electronic, consisting of the passage of current through a gas or vapor.

The action is illustrated diagrammatically and somewhat mechanically in Figure 4. As the films rise, they become separated at 42 and the size of the rupture increases until the films disintegrate completely, although the entire action is almost instantaneous after the initial rupture. However, for an instant, the separated film is maintained, and current flows through the vapor that occupies the separation. On disintegration, the unvaporized part of the film collects upon the electrodes. The flow of current through the vapor in the ruptured films reduces the moisture content and is therefore electronic.

The film generation, once started, has been observed to continue even though the solid liquid level has dropped to one-quarter of an inch below the lowest point of the matching portions of the electrodes, drawing the solid liquid to that height above the surface of the supply liquid in case 1.

What I claim is:

1. The method of electrically vaporizing liquid consisting in inserting a pair of spaced electrodes in the surface of the liquid while dipping one of the electrodes only slightly below the surface of the liquid, applying unlike potentials to said electrodes, and adjusting the spacing between said electrodes to a distance greater than the capillary spacing for the liquid and within the distance that can be bridged by a film of the liquid.

2. The method of electrically vaporizing liquid consisting in inserting a pair of spaced low resistance electrodes in the surface of the liquid, while dipping one of the electrodes only slightly below the surface of the liquid, applying unlike potentials to said electrodes, and adjusting the spacing between said electrodes to a distance greater than the capillary spacing for the liquid and within the distance that can be bridged by a film of the liquid.

3. The method of electrically vaporizing water consisting in inserting a pair of spaced electrodes in the surface of the water, while dipping one of the electrodes only slightly below the surface of the water, applying unlike potentials to said electrodes, and adjusting the spacing between said electrodes to a distance greater than the capillary spacing for water and within the distance that can be bridged by a film of water.

4. The method of electrically vaporizing water consisting in inserting a pair of spaced low resistance electrodes in the surface of the water, while dipping one of the electrodes only slightly below the surface of the water, applying unlike potentials to said electrodes, and adjusting the spacing between said electrodes to a distance greater than the capillary spacing for water and within the distance that can be bridged by a film of water.

5. The method of electrically vaporizing liquid consisting in inserting a pair of spaced electrodes in the surface of the liquid while dipping one of the electrodes only slightly below the surface of the liquid, applying unlike potentials to said electrodes, and adjusting the spacing between said electrodes to a distance greater than the capillary spacing for the liquid and within the distance that can be bridged by a film of the liquid, continuing the application of current to said electrodes after the liquid level has dropped below the slightly dipped electrode, whereby liquid is drawn from the surface into contact with the last named electrode and converted into films rising between said electrodes.

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No references cited.