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S. LIVINGSTONE

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VAPORIZABLE LIQUID ELECTRODE BOILER

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Fig. 2.

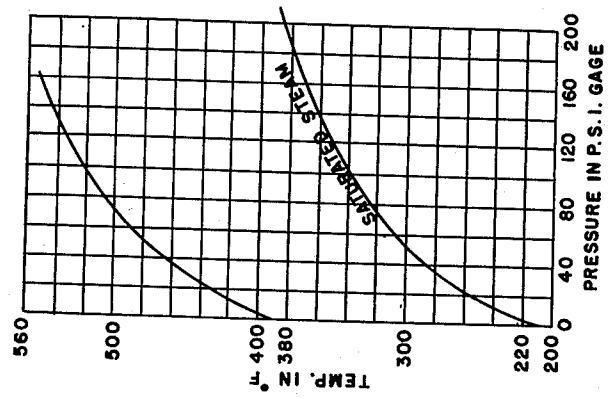
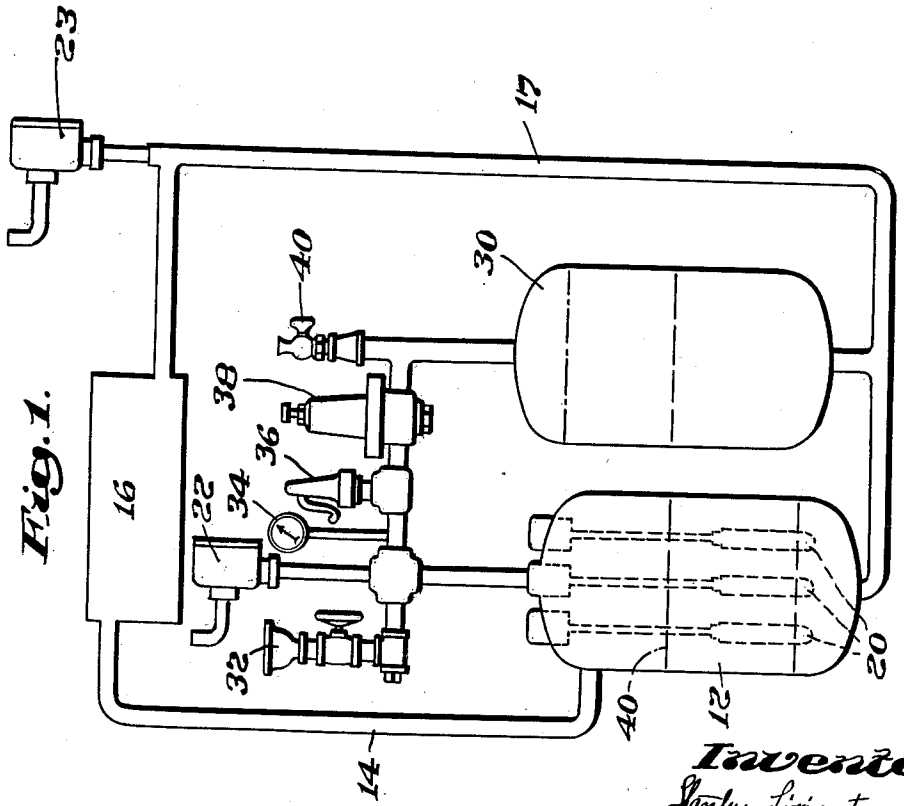


Fig. 1.



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VAPORIZABLE LIQUID ELECTRODE BOILER

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8 Claims. (Cl. 219—40)

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This invention relates to electric boilers and more particularly to a boiler of the type which contains one or more electrodes which contact the liquid from which vapor is generated by electric current passing through the liquid.

In commercial forms of such boilers, water is used as the liquid and saturated steam generated by the electric current from the water is used as a source of heat for a load such as a mold or other heat exchanger. Boilers of this type are shown and described in Vickery Patent No. 2,447,294. Another type utilizes a pressure switch to control the operation of the boiler by regulating the electric power input to the electrodes. The switch is pre-set for the desired pressure and when that boiler pressure is reached the switch shuts off the power. Pressure switches usually include an adjustable pressure differential device so that when the boiler pressure drops to a pre-set level, the switch turns on the power. Still another type of electrode boiler employs a thermostatic switch control. Since the temperature of the steam or vapor is a function of the pressure, a thermostatic switch with an adjustable on and off differential can be used in the same manner as a pressure switch. Where boilers which will develop high temperatures are desired, the design of the boilers becomes expensive because, as temperature demands go up, increased steam pressure must be developed in order to attain the desired temperature. For example, at 40 pounds per square inch gauge pressure saturated steam has a temperature of 286° F. In order to develop steam temperature of 550° F., the pressure must go up above 1,000 pounds per square inch with the result that the boiler, piping, couplings, joints and the pressure seals must be capable of withstanding these exceedingly high pressures.

Nevertheless, particularly in molding, it is desirable to have efficient units which can develop temperatures in the range of 400–550° F.

According to this invention, an electrode boiler is provided which can develop such high temperatures of the order of 550° F. without exceeding pressure capacities that would produce, in the case of a steam boiler, temperatures not exceeding about 365° F. Furthermore, an electrode boiler is provided which develops temperatures in the neighborhood of 410° F. without exceeding pressures of five to ten pounds per square inch. This is an extremely important characteristic of this electrode boiler because it permits heating ordinary jacketed kettles, sterilizers, autoclaves and other forms of heat exchangers to temperatures far above those attainable with steam be-

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cause of the limited pressure capacity of such heat exchangers.

Boilers of this invention may be used in a closed or open system. In the closed system, the boiler is provided with an external fluid circuit leading from its upper or vapor portion to its lower or liquid portion and having interposed in the fluid circuit a mold or other heat exchanger constituting the load and wherein vapor produced in the generating chamber passes through the circuit to the load where it condenses and returns as condensate into the lower portion of the boiler.

When boilers of this invention are used in an open system, the condensate leaving the mold, jacketed kettle or other form of heat exchanger load, is piped to a trap of the ordinary bucket or float type and discharged through an after-cooler into a receiver. From the receiver, the liquid is pumped into the boiler. The after-cooler is a heat exchanger, either air or water cooled. Its purpose is to dissipate heat and lower the temperature of the liquid to avoid loss through evaporation or flashing. The primary purpose of condensate return systems used with steam boilers is to conserve heat but in boilers of this invention, the primary objective is to conserve and recover the liquid.

Boilers of this invention should have thermostatic traps or equivalent devices for continuously venting air or gases that may be in the boiler at starting or generated during operation. One such trap can be mounted on the piping connected to the top of the regulating or surge tank of boilers of the type described in Vickery Patent No. 2,447,294. Pressure or thermostatic switch controller boilers can have the venting device mounted at the vapor outlet from the boiler to the load. In a closed system, another such trap should be located on the condensate return line from the heat exchanger load and close to the heat exchanger.

The invention is predicated upon the use of a novel liquid vapor system in the boiler, which system I have discovered to have all the requirements for such use. It is of such nature that it does not detrimentally break down chemically at temperatures of 400–550° F.; it is conductive and vaporizes in the same manner as water but at a higher temperature and condenses as it gives up its latent heat. It has no adverse effect upon the materials of which ordinary boilers, piping and heat exchangers are made and has the admirable characteristic of having vapor temperatures of from 400–550° F. at pressures not exceeding about 150 pounds per square inch. In

fact, the first vapor of the preferred form of liquid at atmospheric pressure has a temperature of 386° F. in contrast to the 212° top temperature of saturated steam.

The liquids which I use are the glycols, the preferred glycol being ethylene glycol, the glycols being rendered conductive by the addition thereto of an electrolyte. Other glycols which may be used instead of ethylene glycol are diethylene glycol, triethylene glycol, propylene glycol and dipropylene glycol. The preferred electrolyte is soda ash which I found will dissolve in ethylene glycol, a preferred percentage being in the order of 5 to 12% by weight added to the ethylene glycol when hot. Any other salt soluble in the glycol to a greater or lesser degree, may, however, be substituted for the sodium carbonate, for example, sodium chloride or trisodium phosphate, and other alkali metal carbonates, bicarbonates, phosphates and halides, in amount sufficient to render the composition conductive.

In Fig. 1 of the drawing, I have diagrammatically shown a closed boiler system of the invention with a self-regulating pressure valve; and

In Fig. 2, I have illustrated the comparative vapor heat curves of ethylene glycol and saturated steam at increasing pressures.

Fig. 1 shows a generating tank 12 having an outlet 14 running to a heat exchanger 16 as, for example, the platens of a mold press and connected to a return condensate line 17. Electrodes 20 are disposed within the generating tank 12 and supplied with suitable electrical connections not shown. Thermostatic traps 22 and 23 are provided, as previously described.

The generator also includes a pressure-regulating system which includes a surge tank 30 connected in a suitable line extending from the top of the generating tank 12 into the return condensate line 17. This latter circuit is provided with a fluid inlet 32, a gauge 34, a safety valve 36, a pressure-regulating valve 38 and a pet cock 40. The pressure-regulating valve is adjustable and acts to close the regulating circuit when the pressure in the generating chamber 12 builds up to a predetermined pressure, thus causing any conductive liquid in the tank 12 to back up into the surge tank 30 and reduce the current until the pressure in the top of the generating tank 12 drops below the predetermined pressure whereupon the regulating valve 38 opens to permit liquid from the surge tank 30 to re-enter at the bottom of the tank 12. The operation of such a regulating circuit is well known. However, in the instances of its commercial use and description, the conductive liquid is water with the result that the temperatures attained in the heat exchanger 16 cannot exceed the temperature of saturated steam at the pressure for which the regulating valve 38 is set.

In accordance with my invention, the tank 12 is filled to the level 40 with a glycol containing an electrolyte which acts in the same manner as steam to the extent that it vaporizes as a result of passage of electric current therethrough between the electrodes 20. However, if the pressure regulator has the same setting as in the case of the steam generator, the temperature developed in the heat exchanger with the use of my conductive liquid, will be very much greater and supply heat, in the case of ethylene glycol, at substantially the temperatures indicated in Fig. 2 for any given setting of the pressure regulator valve 38.

It will be understood that the form of system and regulating control shown in the drawings is merely an example of one application of the invention and that, as previously described, the invention is equally applicable to closed systems having different forms of regulating controls or to open systems. However, since the invention is concerned not with the particular type of systems, but with the nature of the vaporizable liquid used, only a typical system has been shown in the drawings.

I claim:

1. An electric boiler having a tank adapted to contain liquid to be boiled, electrodes in said tank, a liquid in said tank contacting said electrodes, said liquid comprising a mixture of a glycol and an electrolyte, said glycol being adapted to be vaporized by the passage of electric current through said liquid between said electrodes, and means for regulating the current input to said electrodes to boil said liquid and create vapor in said system at a pressure corresponding to a temperature at least as great as the boiling point of said glycol mixture and for reducing said current input when said pressure has reached a predetermined maximum.

2. An electric boiler as claimed in claim 1, wherein the glycol is ethylene glycol.

3. An electric boiler as claimed in claim 1, wherein the glycol is diethylene glycol.

4. An electric boiler as claimed in claim 1, wherein the glycol is triethylene glycol.

5. An electric boiler as claimed in claim 1, wherein the glycol is propylene glycol.

6. An electric boiler as claimed in claim 1, wherein the glycol is dipropylene glycol.

7. An electric boiler as claimed in claim 1, wherein the glycol is ethylene glycol and the electrolyte is soda ash in an amount of about 5%–12% by weight of the liquid.

8. An electrode boiler having a liquid-vapor system in which a liquid in contact with the electrodes of said boiler comprises a vaporizable glycol containing a non-vaporizable electrolyte, and the vapor comprises said glycol free of said electrolyte.

STANLEY LIVINGSTONE.

References Cited in the file of this patent

UNITED STATES PATENTS

Number	Name	Date
1,546,061	Drefahl	July 14, 1925
1,672,899	Miller	June 12, 1928
1,709,427	Bush	Apr. 16, 1929
1,845,852	Slisz	Feb. 16, 1932
1,868,710	McCullough	July 26, 1932
1,919,204	Decker	July 25, 1933
1,941,855	Eggleston	Jan. 2, 1934
2,162,397	Gray	June 13, 1939
2,196,057	Clark	Apr. 2, 1940
2,253,506	Clark	Aug. 26, 1941
2,375,892	Bouyoucos	May 15, 1945
2,447,294	Vickery	Aug. 17, 1948
2,510,235	Kögel	June 6, 1950
2,543,363	Glendinning et al.	Feb. 27, 1951