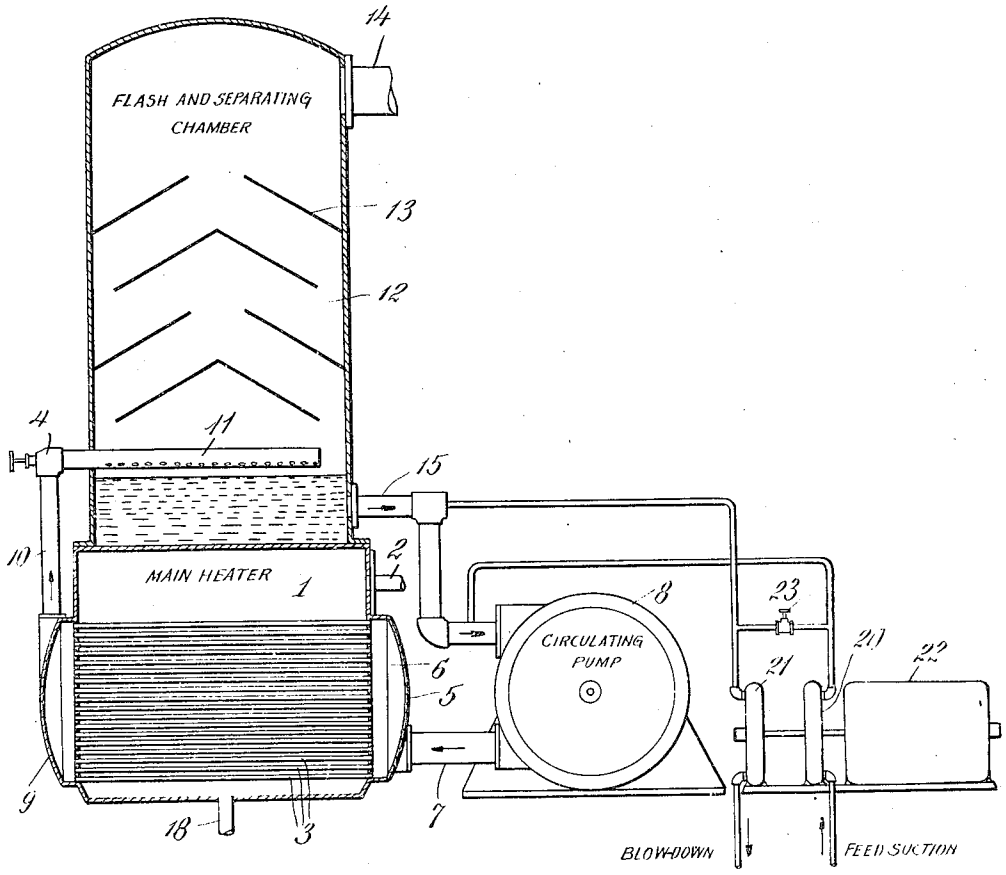
Nov. 18, 1924. 1,516,314

L. E. SEBALD

FLASH EVAPORATOR

Filed Jan. 27. 1921



Leslie E. Sebald

Inventor

By his Attorneys

Pennie, Davis, Marvin & Edmonds

Patented Nov. 18, 1924. 1,516,314

UNITED STATES PATENT OFFICE.

LESLIE EARL SEBALD, OF NEW YORK, N. Y., ASSIGNOR TO THE GRISCOM RUSSELL COMPANY, OF NEW YORK, N. Y., A CORPORATION OF DELAWARE.

FLASH EVAPORATOR.

Application filed January 27, 1921. Serial No. 440,327.

To all whom it may concern:

Be it known that I, LESLIE E. SEBALD, a citizen of the United States, residing at New York, in the county of Bronx, State of New York, have invented certain new and useful Improvements in Flash Evaporators; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

This invention relates to evaporators, particularly to the type employed for producing distilled water from brine or other impure water for boiler feed or similar purposes.

Such evaporators as now constructed consist usually of a shell containing the raw water with heating tubes or coils in the shell and immersed in the raw water, live steam being circulated through the tubes or coils to evaporate the water in the shell. One serious defect in evaporators of this kind is the formation of scale on the heat-transferring surface of the tubes or coils, due to the precipitation, as the water vaporizes, of the scale-forming salts or other impurities in the water on the tube surface, and also due to the fact that the water velocity around the tubes is very low. This scale forming on the tubes lowers the heat-transferring efficiency of the surface and necessitates frequent cleaning of the tube surface to maintain the evaporator operative.

My invention has for its principal object to provide an evaporator in which there is no vaporization of the water at the heating surface whereby there will be no scale-formation and the heat-transferring capacity of the surface will be constant and higher than the capacity of the surface of the ordinary evaporator heating coil.

A further object of the invention is to provide an evaporator in which the raw water may be concentrated to a greater degree of salinity than heretofore practical, thereby lessening the heat loss due to the discharge or blow-down of the concentrated brine at comparatively high temperature.

A further object of the invention is to provide an evaporator in which variations in the water level and steam pressure have little effect on the operation of the evaporator whereby the plant requires little attention and with a suitable automatic feed pump will be virtually self-regulating.

In the drawing, which is largely diagrammatic, I have illustrated my improved evaporator in vertical section with the auxiliary apparatus shown in side elevation.

In said drawing, 1 indicates the heating chamber of the evaporator into which live steam is fed through the line 2, the steam condensing on the tubes 3 which extend across the chamber 1 and fill the lower cylindrical portion of the chamber, with the ends of the tubes supported in suitable tube sheets forming the end walls of the chamber 1.

The shell 1 of the main heater has a discharge line 18 and will be provided with the usual trap, not shown, for preventing the discharge of steam from the main heater but allowing the water of condensation to pass into the fresh water line.

The tube sheet at one end is enclosed by a drum 5 forming a chamber 6 into which the raw water is fed through a line 7 connected to the discharge side of a circulating pump 8. The tube sheet at the other end is similarly enclosed by a drum 9 having its discharge pipe 10 extending upwardly and communicating with a horizontal branch 11 leading into what may be termed the "flash" and separating chamber 12 which, as shown, consists of a suitable shell supported on the upper wall of the main heater but entirely disconnected from the heating chamber. The horizontal branch 11 of the discharge pipe is perforated on its under side throughout its length in the manner shown and extends just above the surface of the water in the flash chamber, the level of which will be maintained by any suitable feed at about that shown in the drawing. Above the pipe 11 the chamber 12 is provided with a series of staggered baffles 13 arranged in the manner shown in the drawing or in some other equivalent manner, to provide a circuitous passage for the vapor to separate from the vapor any entrained liquid which would otherwise carry impurities into the vapor line 14.

The other side of the circulating pump is connected to the flash chamber through a line 15 leading from the chamber below the water level, whereby the pump will maintain a constant circulation of the water through the tubes of the heater, thence through the perforated discharge pipe 10 into the flash chamber, and thence back through the circulating pump. The discharge pipe 10 is preferably

provided with a regulating valve 4 whereby the discharge of water from the pipe 10 may be regulated and the load imposed on the pump increased or decreased to maintain the pressure on the liquid just above the pressure corresponding to the temperature to which the water is raised in the heating chamber.

The water circuit may be provided with any desired arrangement of feed and blow-down connections for maintaining the water level at the desired point and discharging the concentrated liquor at the desired degree of concentration. I have shown for the purpose a suction feed pump 20 and a blow-down pump 21 connected to the same shaft of a pump motor 22 for operation in unison. The feed pipe may conveniently be connected to the suction side of the circulating pump, while the blow-down pump may conveniently be connected to the line 15 in the manner shown, although the point of connection of neither the feed pump nor the blow-down pump is material.

The blow-down and feed pumps have their capacities of a proper ratio to determine the degree of concentration to be produced in the evaporator, for instance, if the feed pump has a capacity of three times that of the blow-down pump the raw water will be concentrated to three times its normal salinity and the volume of blow-down will be but half the volume of distillate produced from the vapor. For varying the ratio between the feed and the blow-down a bypass 23 containing an ordinary regulating valve may be employed, whereby more or less water, as desired, may be short-circuited directly from the delivery side of the feed pump to the suction side of the blow-down pump, thereby decreasing the amount of blow-down in greater proportion than the amount of feed with a correspondingly greater concentration of the brine. Also this injection of cold water will prevent flash in the blow-pump suction.

In operating my improved evaporator the circulating pump will be maintained at a speed such as to impress on the water at the delivery side of the pump a pressure greater than the vaporizing pressure of the water to the temperature to which the water is heated in the heating chamber, so that there will be no vapor formed in the tubes of the heater, but instead, the heat will be absorbed by the liquid under pressure. When the liquid is discharged from the pipe 11 it will be at a temperature in excess of the pressure maintained in the flash chamber, which may be a sub-atmospheric pressure, and the excess heat will be instantaneously converted or "flashed" into vapor which will rise through the baffles in the separating chamber to be discharged into the vapor line. The water from the flash chamber with its temperature thus reduced by the flash will be drawn into the suction side of the pump and again passed through the tubes to absorb further heat, the process being continuous with the quantities of water flashed into vapor and discharged by the blow-down pump maintained in the proportion determined by the capacity of the feed and blow-down pumps and the adjustable by-pass 23.

My improved evaporator is particularly advantageous for operating at low temperatures. In an ordinary evaporator the tendency to foam and prime is so increased by lowering the pressure in the vapor space as to make it difficult of operation except at comparatively high pressures in the vapor space and hence at small temperature differences. In my improved evaporator the tendency to prime will be decreased. No scale will be formed on the tubes at any temperature and the vapor space may be kept at a sub-atmospheric pressure with a correspondingly high efficiency of the heat-transferring surface. The tubes may be arranged in a more compact and condensed space than in an ordinary evaporator in which the vapor is formed at the tube surface, as will be obvious. Also, as the pressure is substantially the same on both sides of the tube, that is, the high pressure of the pump on one side and the vapor pressure on the steam on the other, the tubes may be made of light material without danger of destruction.

Instead of the above described arrangement of feed and blow-down pumps I may employ a separate float feed controlled suction pump and blow-down regulator such as is ordinarily employed for evaporators. Also, if desired, I may employ an automatic regulator for the feed and blow-down pump motor, such for instance, as a float controlled rheostat, but if the steam supply is fairly uniform no automatic control will be necessary for the heat transferring surface of the tubes remains clean and at its maximum efficiency at all times and the vapor output will be constant.

The term "pump circuit" as employed in the appended claims is intended to include the entire circuit of the apparatus, including the separating chamber and the heating chamber as well as the pumps and pipes, and it is to be understood that the raw water will be introduced anywhere in the pump circuit and not necessarily at the location shown.

In the foregoing description the liquid to be evaporated has been described as brine or other impure water, and the heating fluid as steam, but it will of course be understood that the apparatus may be used for vaporizing any liquid and that other heating fluids may be employed, for instance, flue gases.

It will be understood that the structure

and arrangement of the parts shown in the drawing is by way of example only and various changes may be made therein, within the scope of the appended claims.

I claim:

1. In a flash evaporator the combination of a heating chamber having spaces for the heating medium, passages through said chamber for the circulation of the liquid to be evaporated, said passages being separated from said spaces by heat transferring surfaces, a vaporizing chamber separate from said heating chamber, connections between said passages and said vaporizing chamber, a pump for circulating the liquid through said passages and discharging it into said vaporizing chamber, a return connection from said vaporizing chamber to said pump whereby said pump maintains the liquid to be evaporated in continuous circulation, means for adding to the liquid being evaporated a controlled amount of raw feed water to replenish the liquid being vaporized and regulating means cooperating therewith for discharging concentrated liquid from the apparatus to maintain a substantially constant liquid density therein.

2. In a flash evaporator, the combination of a heating chamber to receive the heating fluid, heating tubes extending across said chamber, a separate vaporizing chamber, connections for the passage of liquid from said tubes to said chamber, a pump for forcing the liquid to be evaporated through said tubes and into said vaporizing chamber, a return connection from said vaporizing chamber to the suction side of the said pump, and means for automatically pumping into said circuit a definite quantity of liquid to be evaporated and pumping out of said circuit a smaller quantity of liquid, the quantity of discharge being definitely proportioned to the feed to determine the desired concentration of the evaporated liquid.

3. In a flash evaporator, the combination of a heating chamber to receive the heating fluid, heating tubes extending across said chamber, a separate vaporizing chamber, connections for the passage of liquid from said tubes to said chamber, a pump for forcing the liquid to be evaporated through said tubes and into said vaporizing chamber, a return connection from said vaporizing chamber to the suction side of said pump, a feed pump for pumping into said circuit the raw liquid to be evaporated, a separate blowdown pump having its suction side connected to said circuit, and means for regulating the relative capacities of said pumps to maintain the blowdown capacity at a definite fraction of the feed capacity.

In testimony whereof I affix my signature.

LESLIE EARL SEBALD.