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(54) Steam producing apparatus, particularly for humidifying air.

(57) The steam producing apparatus for humidifying air comprises a container (1) for liquid to be vaporized, with an upper steam delivery manifold (2). The container is divided into an upper heating and evaporation chamber (3), in whose walls electric resistors (4) are embedded, and into a lower sediment collection chamber (5).

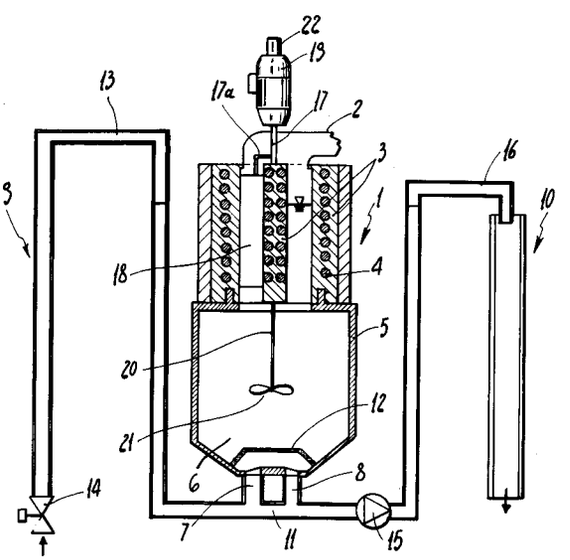

Fig.1

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The present invention relates to a steam producing apparatus, particularly for humidifying air.

Immersed-electrode vaporizers are mainly used to vaporize water suitable for humidifying air in air-conditioning systems or in so-called "fan coils" or "split systems".

Said vaporizers are substantially constituted by a vessel which extends vertically and which contains electrodes which are supplied with mains power.

By using the conductivity of the water contained in the vessel, which is due to the presence of dissolved salts, a current flow is obtained between the electrodes and thereby a relative heating of the water and its vaporization are achieved.

The presence of the electrodes inside the vessel is the source of problems which are mainly due to the calcium which clings thereto, causing deposits and corrosions which deteriorate the operation of the evaporator and limit its operating life.

The operation of these immersed-electrode evaporators in any case depends considerably on the conductivity and on the aggressiveness of the water, which can have different values depending on the location and time of collection and which varies during operation, increasing as the concentration of salts dissolved in the water increases as said water progressively vaporizes.

This causes considerable problems in controlling conductivity, since irregular concentrations of salts can cause problems such as electrical discharges between the surfaces of the electrodes.

The increase in the concentration of salts is not only time-dependent but also spatially dependent, since experimental tests have shown that the concentrations of ions or salts is more significant between the electrodes than in the outer regions.

This imbalance, too, causes problems related to conductivity control.

The aim of the present invention is to provide an apparatus for producing steam for humidifying air which eliminates or at least reduces the problems described above in the prior art.

Within the scope of the above aim, a consequent primary object is to provide an apparatus whose operation for a same type of liquid is substantially independent of the concentration of salts dissolved therein and is thus independent of the conductivity and aggressiveness thereof.

Another important object is to provide a highly efficient apparatus.

Not least object is to provide an apparatus which can be marketed at a price which is at least comparable to that of conventional immersed-electrode evaporators.

A further object of the invention is that of maximizing the life of the apparatus, and thereby limiting maintenance interventions.

This aim, these objects and others which will become apparent hereinafter are achieved by a steam producing apparatus which comprises a container for liquid to be vaporized with an upper steam collection manifold, said container being divided into an upper heating and evaporation chamber, in whose walls electric resistors are embedded, and into a lower sediment collection chamber.

Further characteristics and advantages of the invention will become apparent from the detailed description of a preferred embodiment thereof, illustrated only by way of non-limitative example in the accompanying drawing, wherein:

figure 1 is a schematic longitudinal sectional view of the apparatus according to the invention.

With reference to the above figure, the steam producing apparatus comprises a container, generally designated by the reference numeral 1 which extends vertically and is provided, in an upward position, with a manifold 2 for collecting and directing the produced steam.

Said container 1 is divided, according to the invention, into an upper heating and evaporation chamber 3, in whose walls electric resistors 4 are embedded, and into a lower sediment collection chamber 5 which has a greater capacity than said upper chamber.

In particular, said upper chamber 3 is constituted by an axial annular interspace which is obtained from a vertically extending cylinder.

Said upper chamber 3 is sealingly connected, in its lower part, to the chamber 5.

The liquid, which is constituted by water which is designated by the reference numeral 6, completely fills the lower chamber 5 and skims the inner surface of the upper chamber 3.

The lower chamber 5 for collecting sediments of crystallized salts, which also has a substantially cylindrical extension, is made of a material which withstands the temperature of 100 degrees Celsius and, as already mentioned earlier, is sealingly connected to the upper chamber 3.

A water feed pipe 7 and a water discharge pipe 8 are connected in a downward position to said chamber 5; said pipes are respectively part of a respective feed circuit 9 and of a discharge circuit 10.

The two pipes 7 and 8 are in any case mutually connected by a union 11 and exit below a filter 12 which protects the inside of the chamber 5.

The water feed circuit 9 is constituted by a pipe which defines a siphon 13 by rising higher than the heating chamber 3, and by an electric feed valve 14 with a built-in flow regulator.

The water discharge circuit 10 is instead constituted by an electric pump 15 with a pipe which defines a siphon 16 which is lower than the maximum height of the heating chamber 3 and is open.

A level sensor, not illustrated in the figure, is arranged inside the heating chamber 3 and has two steps: a normal operation step and an overflow alarm step.

A sensor which detects the operating temperature of the heating chamber 3 is also mounted inside said chamber and is not visible in the figure.

An axial shaft 17 is also present inside the heating chamber 3 and radially supports, by means of an arm 17a, a scraper element 18 which scrapes the inner and outer surfaces of said chamber.

Said shaft 17 is rigidly associated with the shaft of a motor 19 which rotates it, consequently rotating the element 18, which removes any calcareous deposits present on the surface of the chamber 3.

The shaft of the motor 19, the shaft 17 and the chamber 3 are axially hollow, and another shaft 20 is arranged inside them, extends downward to the inside of the lower chamber 5 and is provided, at its end, with a propeller 21.

Said shaft 20 is rotated by another motor 22 which consequently rotates the propeller 21 at a low rpm rate.

Said propeller 21 acts as sensor suitable for detecting the amount of deposited salts.

Said propeller is in fact braked by high salt concentrations.

The current absorbed by the motor 22 can thus constitute an alarm signal.

As regards the operation of the apparatus according to the invention, the flow of current through the electric resistors 4 heats the cylinder which constitutes the chamber 3 and thus heats the water inside it, with the consequent evaporation of said water.

With respect to known types, this steam production system has an undeniable advantage, which arises from the fact that its heating element (the resistor) is not in direct contact with the water and that it therefore avoids deposits and corrosion.

In any case, the mechanical deposit removal system, which is operated periodically, eliminates the salts which crystallize on the inner surface of the chamber 3, keeping heat exchange with the water optimum.

Another evident advantage is the possibility of working with any kind of water, regardless of its conductivity and thus of its aggressiveness.

The fact that the sediment collection chamber 5, and thus the heating chamber 3, are fed with water from their lower part provides and maintains a vertical thermal gradient in the various layers of the liquid, preventing the mixing of water masses at different temperatures and allowing to preheat said water as it approaches the heating chamber, due to the heat transmitted by the chamber.

The water discharge circuit is used to completely empty the water of the heating chamber 3 and of the sediment collection chamber 5 both for automatic periodic maintenance (time-controlled discharge) and for chamber replacement.

The discharge circuit also acts as overflow circuit, with the purpose of eliminating the water which might completely fill the heating chamber 3.

The siphon 16, which is present in said circuit and is lower than the maximum height of the heating chamber 3, and the electric pump 15, which is free to rotate when it is inactive, discharge the water which is present in the chamber when it exceeds the height of the siphon.

The overflow circuit has a second safety function if a narrowing occurs in the steam delivery pipe.

In this case, the discharge circuit is structured so as to avoid explosions, since the overpressure would push the water, making it flow out through the open siphon, until the heating chamber 3 reached atmospheric pressure.

As regards the water level sensor, the first signal step is used to warn the control unit of the apparatus, which supervises its operation and the alarms, so that water loading is performed.

The second step is used to indicate an overflow alarm which makes the control unit discharge water.

The temperature sensing performed by the related sensor checks that said temperature does not exceed a limit threshold, in which case the control unit of the apparatus reduces the power of the resistors by a certain percentage, so as to reduce the temperature of the heating chamber 3 and thus reduce the production of steam.

A further increase beyond an alarm temperature value causes the control unit to switch the apparatus off completely and to issue an alarm signal.

The temperature sensor constitutes a further safety element, since it avoids overheatings and excessive temperatures.

The control unit of the apparatus also supervises, by means of the temperature sensor, the preheating of the water when the set relative humidity has been reached, so as to have an immediate production of steam when required.

Finally, the sensor constituted by the propeller 21 is suitable for issuing an alarm signal if the salts deposited in the chamber 5 have filled said chamber.

In practice it has thus been observed that the apparatus according to the present invention has achieved the intended aim and objects.

In practice, the materials employed, so long as they are compatible with the contingent use, as well as the dimensions, may be any according to the requirements.

Where technical features mentioned in any claim are followed by reference signs, those reference signs have been included for the sole purpose of increasing the intelligibility of the claims and accordingly such reference signs do not have any limiting effect on the scope of each element identified by way of example by such reference signs.

Claims

1. Steam producing apparatus, comprising a container (1) for liquid to be vaporized, with an upper steam delivery manifold (2), characterized in that said container is divided into an upper heating and evaporation chamber (3), in whose walls electric resistors (4) are embedded, and into a lower sediment collection chamber (5).

2. Apparatus according to claim 1, characterized in that said upper chamber (3) is considerably smaller than said lower chamber (5).

3. Apparatus according to claim 1, characterized in that said upper heating and evaporation chamber (3) is constituted by an axial annular interspace obtained from a vertically extending cylinder.

4. Apparatus according to one or more of the preceding claims, characterized in that said upper chamber (3) is associated with the lower chamber (5) with a liquid-tight seal.

5. Apparatus according to one or more of the preceding claims, characterized in that said lower chamber (5) is provided, in a downward position, with a water feed pipe (7).

6. Apparatus according to one or more of the preceding claims, characterized in that said sediment collection chamber (5) is connected to a water feed circuit (9) in a downward position.

7. Apparatus according to one or more of the preceding claims, characterized in that said water loading circuit comprises a pipe (7), which defines a siphon (13) which is higher than the heating chamber (3), and an electric feed valve (14) with a built-in flow regulator.

8. Apparatus according to one or more of the preceding claims, characterized in that said sediment collection chamber is connected to a water discharge circuit (10).

9. Apparatus according to one or more of the preceding claims, characterized in that said water discharge circuit is constituted by an electric pump (15) with a discharge pipe which defines a siphon (16) which is lower than the maximum height of said heating chamber and is open.

10. Apparatus according to one or more of the preceding claims, characterized in that said water feed circuit (9) and said water discharge circuit (10) are connected by means of a union (11).

11. Apparatus according to one or more of the preceding claims, characterized in that said water feed and discharge circuits lead into said sediment collection chamber at a protective filter (12).

12. Apparatus according to one or more of the preceding claims, characterized in that a level sensor is arranged inside said heating chamber (3) and has two steps, one for normal operation and one for overflow alarm.

13. Apparatus according to one or more of the preceding claims, characterized in that a temperature sensor is mounted inside said heating chamber (3).

14. Apparatus according to one or more of the preceding claims, characterized in that it has, inside said heating chamber, a mechanical deposit removing unit which is constituted by an axial shaft (17) which supports a radial scraper element (18), or other mechanical means, which scrapes the inner and outer walls, said shaft being connected to an electric actuation motor (19).

15. Apparatus according to one or more of the preceding claims, characterized in that a device (21) is arranged inside said sediment collection chamber and acts as sensor in order to issue an alarm signal if the deposited salts exceed a certain concentration or is otherwise suitable for measuring the torque of an electric motor (22) in order to determine the load and thus the increase in sediments.

16. Apparatus according to one or more of the preceding claims, characterized in that said alarm device for the deposited salts is constituted by a propeller (21) which rotates at low speed and is actuated by an electric motor (22).

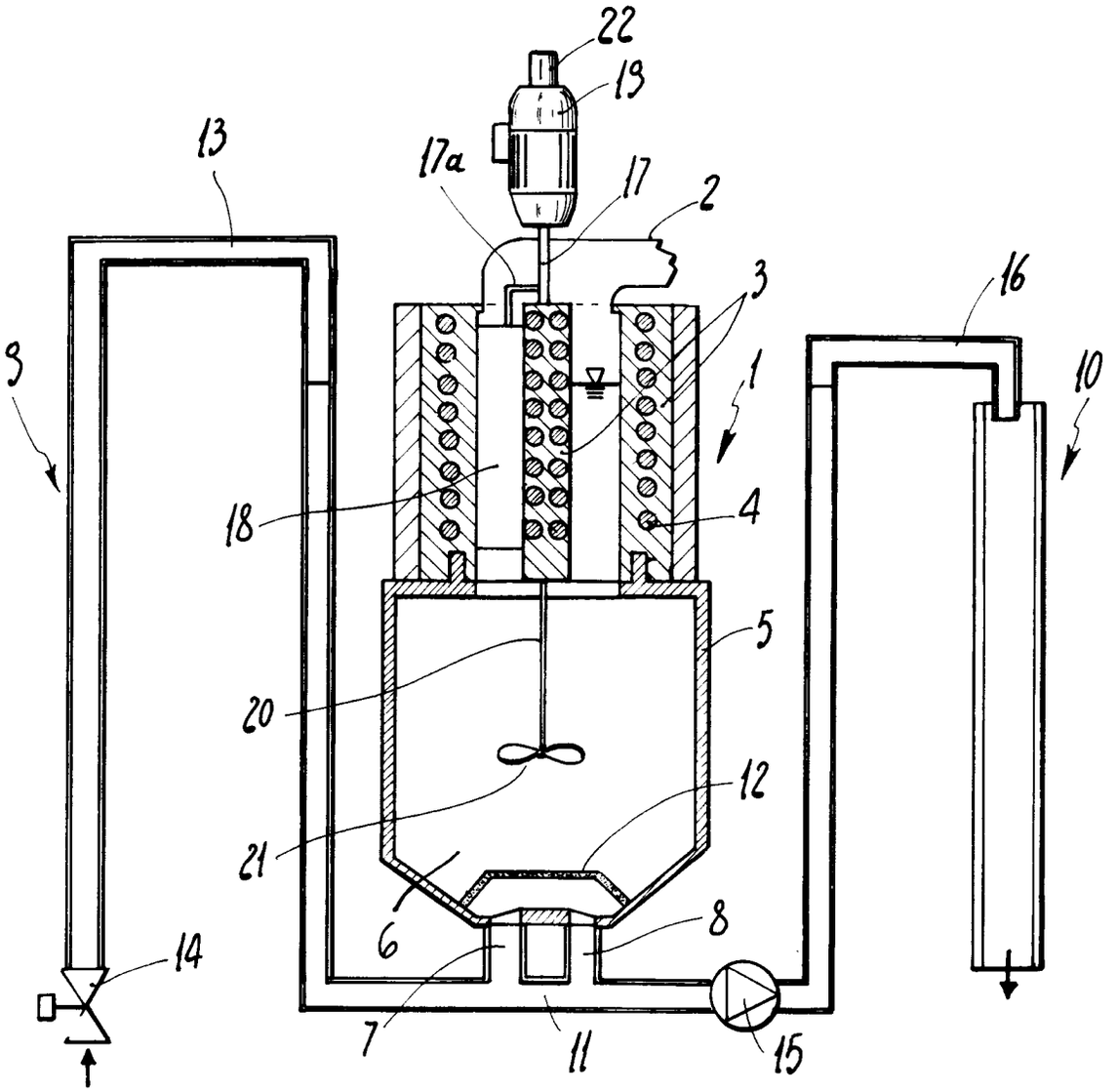

Fig. 1

European Patent Office

EUROPEAN SEARCH REPORT

Application Number

EP 92 10 6030

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
Y	US-A-3 873 806 (SCHOSSOW) * column 6, line 3 - line 66; figure 5 *	1,2,4	F22B1/28 F24F6/00
Y	EP-A-0 323 939 (BOURGEOIS) * column 4, line 60 - column 5, line 50; figures *	1,2,4	
P,X	EP-A-0 451 066 (BOURGEOIS) * column 4, line 23 - column 6, line 25; figures *	1,2,4,8, 9	
A	EP-A-0 383 327 (LECHMETALL) * column 6, line 33 - column 7, line 22; figure 2 * * column 8, line 23 - column 9, line 33; figure 4 *	1,9	
A	DE-A-3 532 261 (RIBA) * column 6, line 6 - column 7, line 52; figures *	1,4,5,6	
A	FR-A-2 645 624 (BLANCO)		TECHNICAL FIELDS SEARCHED (Int. Cl.5) F22B F24F

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	07 JULY 1992	VAN GHEEL J.U.M.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
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