

High-Efficiency Energy-Saving Steaming Cabinet

Background of Invention

The present invention relates to steaming cabinets, in particular, an energy-saving steaming cabinet with high efficiency

Prior art food steaming cabinets normally comprise a housing, at the bottom of which there is provided a water feeder, a heater, and an evaporator located above the said heater, wherein water in the said evaporator is heated by the said heater and turned into steam; and the steam is further fed to shelves carrying food located in the upper part of the said cabinet, to heat the food.

Prior art steaming cabinets have the disadvantages that the steam utilization ratio is very low; much heat energy is wasted; and environment is polluted.

Objects of Invention

The primary object of the present invention is to provide a an energy-saving steaming cabinet working at a high efficiency, so as to increase thermal efficiency, save energy, and protect the environment.

Brief Description of Drawings

These and other objects as well as advantages of the present invention will become clear by the following description of a preferred embodiment of the present invention with reference to the accompanying drawings, wherein:

Fig. 1 is an illustration of a three-door food steaming cabinet according to the present invention;

Fig. 2 is an illustration of a full hinge door food steaming cabinet according to the present invention;

Fig. 3 is an illustration showing the structure of a steam-heating device according to the present invention;

Fig. 4 is an illustration showing the structure of a steam convection device according to the present invention;

Fig. 5 is an illustration showing the structure of a heat energy regeneration device according to the present invention;

Fig. 6 is an illustration of a three-door steaming cabinet using the said steam-heating device according to the present invention;

Fig. 7 is an illustration of a full hinge door steaming cabinet using the said steam-heating device according to the present invention;

Fig. 8 is an illustration of a food rack type steamer using the steam-heating device according to the present invention;

Fig. 9 is an illustration of a Cantonese type rice roll steamer using the steam-heating device according to the present invention; and

Fig. 10 is an illustration showing an operation scheme of a water feeding device for the steaming cabinet according to the present invention.

Description of Invention

According to the present invention, there is provided a high-efficiency energy-saving food steaming cabinet, comprising a housing containing at the bottom a water feeder, a heater, an evaporator arranged above the said heater and connecting to the said water feeder, and a steaming box to carry food located above the said evaporator, wherein there is provided between the said evaporator and steaming box a steam-heating device which is connected to the said evaporator and said steaming box, said steam-heating device having a casing in which there are provided an inlet hole and an exit hole; and an electric heater is provided within said casing, said electric heater being provided with radiating flanges. Moreover, there is provided, within the said steaming box, a steam convection device, comprising steaming shelves within the

said steaming box, for steam to pass in between the said shelves, and at one side from the said steaming shelves, there is provided an electric fan.

At the top of the said steaming box, there may also be provided a heat regeneration device connecting to the said steaming box; said heat regeneration device having a casing with an inlet hole and an exit hole in it, and within the said casing there is provided a coil tubing for heat exchange which has a water inlet at one end and an water outlet at the other end. A guide plate may be provided in the middle part within the said heat energy regeneration device.

The main advantages of the high-efficiency energy-saving cabinet according to the present invention are described below:

1. The evaporator is connected to a steam heating device located above it, said steam heating device being also connected to the steaming box. By means of the said steam heating device, 100°C steam can be heated up to 100-150°C, thus increasing the kinetic energy of the steam, increasing the temperature difference between food and steam and extending the process of steam being turned into condensed water with heat absorption; in this way, the heat absorption rate of food is much increased. Introduction of such super-heated steam into a steaming box containing food not only increases the rate of food absorbing heat but also improves the quality of food. The conventional steaming equipment in the prior art all has a common feature that water is heated only at normal atmosphere, thus producing only 100°C steam (with the exception of pressure vessels and pressure steaming equipment). That is also the common deficiency of prior art equipment. Because 100°C is at the same time a critical temperature of steam being condensed into water, so steam at this temperature, when absorbed, is apt to turn into condensed water sticking to the surface of food and even penetrating into it; Or else, the steam before being absorbed may also turn into condensed water drops and flow away. All this not only affects the quality of food, but also results in a waste of heat energy. Now, if the present invention is applied to the above-said conventional steaming equipment, the above-mentioned deficiency can be completely overcome, and revolutionary change upon the concept of food steaming will be introduced.
2. The steam convection device provided within the steaming box functions to set the steam therein in a high speed motion causing a forced steam convection and cycling, thus increasing the duration and area in which food gets into contact with steam, and hence also the degree of food being heated, as well as its heat absorption rate.
3. In addition to the above, there is provided above the said steaming box a heat energy regeneration device to make use of the steam overflowing from the said

steaming box. The waste heat is thus re-used to further increase the heat utilization ratio. Hot water can thus be generated for use by the steaming cabinet itself, or for use by other equipment.

Preferred Embodiment of the Present Invention

Below is a detailed description of a preferred embodiment according to the present invention.

As shown in Figs. 1 and 2, the high-efficiency energy-saving steaming cabinet according to the present invention is normally one with three doors or with a full hinge door. The steaming cabinet of the present invention comprises a housing 10, which contains a water feeder 17 and a heater 16 at the bottom, and an evaporator 15 arranged above the said heater 16 and connecting to the said water feeder 17. Provided above the said evaporator 15 is a steaming box 14, and a steam heating device 11 is provided between the said evaporator 15 and the steaming box 14. Said steam heating device 11 is further connected to the steaming box 14 located above it.

Now, referring to Fig. 3, the said steam heating device 11 is seen to have a casing 111 with a steam inlet hole 112 and a steam outlet hole 113 in it; within the said casing 111, there is provided an electric heater 114 having on all sides radiating flanges 115. Under normal atmosphere, the 100°C steam generated by boiling water enters through the said inlet hole 112 and gets into uniform contact, within the said casing 111, with the said electric heater 114. As the electric heater 114 is provided with radiating flanges 115 which increase the radiating area, so the steam within the said heater is fully heated; the heated steam has a greatly increased temperature, and is called super-heated steam; it exits from the outlet hole 113. The super-heated steam has an advantage of having a low pressure (normal atmospheric pressure), and a high temperature; it is much easier and safer to control during operation.

Referring to Fig. 4, the steaming box (14) is seen to be provided with a steam convection device, comprising food shelves (141) arranged and spaced within the said steaming box, leaving between said food shelves paths (142) for steam to pass; also comprising an electric fan (143) located on one side from the said food shelves (141).

Now, coming to Fig. 1 or 2, a heat energy regeneration device (13) is seen on top of, and connecting to, the said steaming box (14) (detailed structure of device (13) is shown in Fig. 5), said heat regeneration device (13) possessing a casing (131), said casing (131) having in it a steam inlet hole (132) and an exit hole (133); and within the said casing (131) there is provided a coil tubing (134), which has, at its both ends, a water inlet hole (135) and an outlet hole (136), respectively.

In the middle of the said heat regeneration device (131), there is provided a guide

plate (137).

Now, we will see how the cabinet works. Water in the said evaporator (15) is heated by the said heater (16), so that it boils and is turned into 100°C steam. The 100°C steam enters from the evaporator (15) into the heater (11), where it is heated to be super-heated steam whereby its temperature may rise to 150°C. Such superheated steam is guided through ducts into the steaming box (14), where it keeps moving at a high speed with the help of the said electric fan (143) provided in the said steam convection device; the superheated steam is thus turned into forced convective cycling streams, thus increasing the time and contact area of food with the said superheated steam, as well as its heat absorption rate.

The used steam at the top of the said steaming box (14) is collected by tubing connected to the said steaming box (14) and further guided into the said heat regeneration device (13). Heat exchange occurs between the used steam still having remnant heat and the cold water inside the said coil tubing (134), whereby the cold water in the coil tubing (134) is heated and the steam exits at the exit hole (133). Fed from a water supply tank (17), room temperature water enters through the said inlet hole (135) into the said coil tubing (134) where it is heated and further guided back to the evaporator (15), as shown in Figs. 1 and 2.

With reference to Figs. 1 and 2, we will now explain the working principle of the water supply tank (17). Depending on a simple and efficient mechanism, water is fed from a low level to a high lever into the heat regeneration device (13) to be heated. Fig. 10 shows the operation principle. The said water supply tank (17) comprises a water tank (171), a ball valve (172), a connecting rod (173), and a buoy (174). Said water tank (171) is connected to the evaporator (15) as shown in Figs. 1 and 2, to maintain water at the same level. When the water level is lowered in the evaporator (15) due to evaporation, the buoy (174) will pull on the connecting rod (173), which in turn will open the said ball valve (172), so that water is made to flow upwards through the said ball valve into the said heat energy regeneration device (13) to be heated, and further guided back to the evaporator as replenishment. On the other hand, if evaporation slows down or stops, the water level will rise, and the buoy (174) will push in the reverse direction on the connecting rod (173) to shut the ball valve (172). In this way, a water supply tank is provided which just increases or decreases water feed according to the water level, and water is fed, as required, from a low level to a high level into the said heat energy regeneration device.

As ample of used steam is collected into the said heat energy regeneration device (13), hot water is generated through heat exchange by means of the said coil tubing (134) in large quantities; the hot water thus generated, besides being used by the steaming box, can also be fed to other devices for use, or be stored for future use. If

an additional coil tubing (134) is added in Fig. 5, to feed water whose flow is controlled, hot water of required temperature can be obtained.

The main feature of the high-efficiency energy-saving steaming cabinet according to the present invention lies in the steam heater. Such a steam heater can not only be applied to a steaming cabinet, but also to other types of steaming and stewing vessels, wherever steam is generated under normal atmosphere. These comprise, for example, food rack type steamer, Cantonese type rice roll steamer. Said steam heater can be arranged between a steam exit and a steaming box, and then, depending on the need of the food to be steamed, the steam temperature is adjusted to a proper range (100°C to 150°C), thus greatly increasing the utilization ratio of heat. Figs. 6 to 9 are embodiments of the steam heater in the present invention in other devices, mainly to make use of the superheated steam it generates. Among those are the common three-door steaming cabinet (Fig. 6), the full hinge door cabinet (Fig. 7), the food rack type steamer (Fig. 8), and the Cantonese type rice roll steamer (Fig. 9).

In Figs. 6 to 9, a heater B1 turns the fuel energy into heat energy, heating the water inside a steam generator B2 to turn it into 100°C steam. The steam is further heated by a steam heater B3 into superheated steam having a temperature of $(100 + \Delta)^{\circ}\text{C}$. According to experiments, when $\Delta = 2\sim 50^{\circ}\text{C}$, the quality of the steamed food can be best. The superheated steam enters into a steaming box B4 to steam the food.

The steam heater in the high-efficiency energy-saving steaming cabinet according to the present invention can be applied to various kinds of equipment with very good results. In addition to the above-mentioned four types of common steaming equipment, the steam heater can also be applied to large types of steaming cabinets, as well as various kinds of sterilizers for household and commercial purposes and medical purposes.

Protection for the present invention is to cover whatever equipment is provided with a steam heater claimed as the characterizing feature in the present invention.

High-Efficiency Energy-Saving Steaming Cabinet

Claims

What is claimed is:

- 1) A kind of high-efficiency energy-saving food steaming cabinet, comprising a housing, a water supply tank and a heater provided at the bottom of the housing, said heater being provided at its top with an evaporator connecting to the said water supply tank, wherein a food steaming box is provided above the said evaporator, and between said evaporator and steaming box, there is provided a steam heater which is connected to the said evaporator as well as the said steaming box.
- 2) A high-efficiency energy-saving food steaming cabinet as claimed in Claim 1, wherein the 100°C steam produced under normal atmosphere is passed through the said steam heater, to be heated to superheated steam having a temperature range of $100 + \Delta^{\circ}\text{C}$.
- 3) A high-efficiency energy-saving food steaming cabinet as claimed in Claim 1, wherein said steam heater is provided with a casing, with a steam inlet hole and an outlet hole in it, and wherein there is further provided an electric heater.
- 4) A high-efficiency energy-saving food steaming cabinet as claimed in Claim 2, wherein the said electric heater is provided with radiating flanges.
- 5) A high-efficiency energy-saving food steaming cabinet as claimed in Claim 1, wherein said steaming box is provided with a steam convection device, said steam convection device comprising food shelves arranged and spaced in said steaming box, whereby steam passages are formed between the shelves; and wherein further an electric fan is provided on one side of the food steaming shelves.
- 6) A high-efficiency energy-saving food steaming cabinet as claimed in Claim 1, wherein above the said steaming box there is provided a heat energy regeneration device connecting to the said steaming box, said heat energy regeneration device having a casing which has steam inlet and outlet holes in it, and within said casing there is provided a heat exchange coil tubing having at both ends, respectively, a water inlet hole and an outlet hole.
- 7) A high-efficiency energy-saving food steaming cabinet as claimed in Claim 6, wherein a simple mechanism is used to feed water from a lower level to a high level into the said heat energy regeneration device.

High-Efficiency Energy-Saving Steaming Cabinet**Abstract**

The present invention relates to a kind of high-efficiency energy-saving steaming cabinet, comprising a housing, a water feeder and a heater arranged at the bottom in the housing, and an evaporator located above the said heater, wherein a steaming box for steaming food is provided above the said evaporator, and between the said evaporator and steaming box there is provided a steam-heating device connecting to the said evaporator, which device is capable of heating atmospheric steam from 100° C to 150° C, or even higher, thus increasing the temperature difference between the steam and the food and extending the process of steam condensation. Provided in the steaming cabinet is also a device for steam convection to make the steam flow at a high speed within the said cabinet and get in full contact with the food. Moreover, in the top part of the said cabinet, there is also provided a heat energy regeneration device, which is used to heat the running water entering into the said cabinet, by means of the remnant heat in the exiting steam.

Figure. 1