

SPECIFICATION

COOKING DEVICE

Technical Field

[0001] The present invention relates to an oven cooking device that heats foodstuffs within a heating chamber.

Background Art

[0002] Oven cooking devices that heat foodstuffs within a heating chamber by high-frequency waves, electrical heat, hot air, steam or the like are indispensable in our daily lives. Some cooking devices of this type have a mechanism for forcibly discharging oil smoke or steam produced from foodstuffs when they are heated or steam used for heating foodstuffs. An example thereof is disclosed in patent document 1.

[0003] Air discharged from the heating chamber has a high temperature and contains a large amount of steam or oil smoke. Hence, when a wall, furniture, an electrical appliance or the like is located immediately above or to the side of a discharge port, they may become wet or dirty by oil smoke. To overcome this problem, the cooking device disclosed in patent document 1 dilutes the discharged air by mixing it with outside air to decrease its temperature and reduce factors giving moisture and dirt, and then discharges the air.

Related Art Document

Patent Document

[0004] Patent document 1: JP-A-2008-116094

Disclosure of the Invention

Problems to be Solved by the Invention

[0005] A discharge/dilution device of the cooking device disclosed in patent document 1 has a complicated configuration including a dumper in a discharge system. An object of the present invention is to relatively simply configure the discharge/dilution device of a cooking device without use of a dumper such that the discharge/dilution device is easily incorporated into an existing design. Another object of the present invention is to provide a discharge/dilution device that can continuously perform discharge even if an outlet is accidentally blocked.

Means for Solving the Problem

[0006] To achieve the above objects, according to the present invention, there is provided a cooking device including: a heating chamber that heats a foodstuff, in which the heating chamber has a discharge port, a discharge/dilution device is provided to the discharge port and the discharge/dilution device includes: an outlet duct that discharges, through a first ejector via an outlet, air outside the heating chamber fed by a dilution fan; a dilution duct whose one end is connected to a suction port provided in the outlet duct at a position where the first ejector produces a suction

effect and whose other end is an air intake port; and a discharge duct whose one end is connected to the discharge port provided in a side wall of the heating chamber and whose other end is connected through a second ejector to a position between the suction port and the air intake port in the dilution duct.

[0007] With this configuration, it is possible to provide a system that sucks in air to be discharged from the heating chamber, dilutes it with outside air and discharges it without using a dumper. Since basic elements are only the dilution fan, the ducts and the ejectors provided within the ducts, the discharge/dilution device is simply configured and easily produced such that it can easily be incorporated into an existing design.

[0008] Preferably, in the cooking device configured as described above, a nozzle portion of the second ejector includes a suction-port-side baffle and an air-intake-port-side baffle that are spaced and that project substantially in parallel from the discharge duct into the dilution duct, and the suction-port-side baffle projects into the dilution duct deeper than the air-intake-port-side baffle.

[0009] In this configuration, if the outlet of the outlet duct is accidentally blocked, an air current from the dilution fan flows into the dilution duct through the air intake port and flows out through the air intake port. Thus, within the dilution duct, an air current flowing from the suction port to the air intake port in a direction opposite to the normal direction is produced, but the air current is prevented, by the suction-port-side baffle, from entering the discharge duct through the second ejector. By contrast, a static pressure is reduced by the air current, and thus gas is sucked from the discharge duct. Therefore, the air is continuously discharged from the discharge duct.

[0010] Preferably, in the cooking device configured as described above, the nozzle portion of the second ejector slants toward the suction port from a portion communicating with the discharge duct.

[0011] In this configuration, air discharged from the discharge duct through the second ejector flows to the suction port, smoothly mixes with the current of outside air within the dilution duct and flows into the outlet duct.

Advantages of the Invention

[0012] With the present invention, the discharge/dilution device of a cooking device is simply configured and easily produced such that the discharge/dilution device can easily be incorporated into an existing design.

Brief Description of Drawings

[0013] [Fig. 1] A schematic cross-sectional side view of a cooking device according to an embodiment of the present invention;

[Fig. 2] A schematic cross-sectional side view similar to Fig. 1 taken in a different plane;

[Fig. 3] A schematic cross-sectional front view of the cooking device;

[Fig. 4] A schematic cross-sectional front view similar to Fig. 3 taken in a different plane;

[Fig. 5] A schematic cross-sectional top view of the cooking device;

[Fig. 6] An enlarged cross-sectional view of a steam generator;

[Fig. 7] An enlarged cross-sectional view of a dilution duct and a discharge duct;

[Fig. 8] An enlarged cross-sectional view of the dilution duct and the discharge duct showing an operational state different from that of Fig. 7; and

[Fig. 9] A block diagram showing the configuration of the cooking device.

Best Mode for Carrying Out the Invention

[0014] An embodiment of the present invention will be described below with reference to the accompanying drawings. A cooking device 1 includes a cabinet 10 that is formed in the shape of a rectangular parallelepiped. A heating chamber 20 that is also formed in the shape of a rectangular parallelepiped is provided within the cabinet 10. The heating chamber 20 has an opening on the front side of the cabinet 10. On the front of the cabinet 10, a door 11 is provided to open or close the opening of the heating chamber 20. The door 11 is pivoted on its lower portion within a vertical plane; when a handle 12 on its upper portion is gripped and the door 11 is pulled frontward, its position can be changed 90 degrees from a fully closed vertical position shown in Fig. 1 to a fully open horizontal position. The door 11 is provided with means to prevent high-frequency wave leakage and a gasket to prevent steam leakage; since those technologies are conventional, description of them are omitted.

[0015] Vapor produced from foodstuffs that are being cooked and steam used for cooking may be condensed on the inner surface of the door 11. A droplet receiver 13 is arranged below the door 11 so as to prevent dripping of the condensed water from causing the location site of the cooking device 1 to become wet.

[0016] As for the heating chamber 20, an air supply duct 21 is provided on the outside of a side wall (hereinafter referred to as a "right side wall") that is on the right side as

viewed from the front. The air supply duct 21 extends in a horizontal direction; an air supply fan 22 that takes in air within the cabinet 10 is arranged at one end of the air supply duct 21. The air supply fan 22 is a propeller fan (axial flow fan). The other end of the air supply duct 21 is connected to an air supply port 23 through which air is fed into the heating chamber 20. The air supply port 23 is composed of a plurality of small holes formed in the right side wall of the heating chamber 20.

[0017] A discharge duct 24 is provided on the right side wall of the heating chamber 20. One end of the discharge duct 24 is connected to a discharge port 25 through which air is discharged from the inside of the heating chamber 20. The discharge duct 24 forms a part of a discharge/dilution device, which will be described later. The discharge port 25 is composed of a plurality of small holes formed in the right side wall of the heating chamber 20.

[0018] The discharge duct 24 extends vertically from a location where the discharge duct 24 is connected to the discharge port 25. Within the discharge duct 24, a humidity sensor 26 is arranged in a position where air from the discharge port 25 is received. On the other hand, on the ceiling of the heating chamber 20, a temperature sensor 27 consisting of a thermistor is arranged.

[0019] A grill 30 having legs on its perimeter and a tray 31 on which the grill 30 is placed support the foodstuff F within the heating chamber 20. Within the heating chamber 20, tray holders that support the inserted tray 31 at predetermined heights are provided. In the present embodiment, on both side walls of the heating chamber 20, the tray holders are formed that engage with the left side and the right side of the tray 31 to support it horizontally.

[0020] As shown in Fig. 3, the tray holders are provided in two tiers, that is, upper and lower tiers. An upper tray holder 32 and a lower tray holder 33 are composed of ridge-shaped projections that project from the side walls of the heating chamber 20.

[0021] The cooking device 1 can perform heating by high-frequency waves, hot air, steam or mixing of those. The configurations of the heating means will now be described.

[0022] In a space between the bottom of the heating chamber 20 and the bottom of the cabinet 10, there are arranged a magnetron 40 and a waveguide 41 that supplies high-frequency waves generated by the magnetron 40 to the heating chamber 20. The waveguide 41 is connected to an antenna pit 42 that extends below the bottom of the heating chamber 20. The antenna pit 42 is separated from the heating chamber 20 by a division plate 43 formed of dielectric material such as glass or ceramic. The division plate 43 serves as a bottom plate of the heating chamber 20 and also serves as a ceiling plate of the antenna pit 42.

[0023] In the antenna pit 42, an antenna 44 having a receiving antenna portion and a radiation antenna portion is arranged. The antenna 44 is attached to the upper end of the shaft of an antenna motor 45; the antenna motor 45 is controlled its rotation such that the antenna 44 is continuously rotated or swung (periodical reversal of rotation), thereby the distribution of high-frequency waves within the heating chamber 20 is controlled.

[0024] In the space between the bottom of the heating chamber 20 and the bottom of the cabinet 10, there is provided an electrical component housing 46; a power supply for high-frequency 47 (see Fig. 9) is fitted to a control board within the electrical

component housing 46. Since the power supply for high-frequency 47 and the magnetron 40 are components that produce heat during high-frequency heating, that is, components that give off heat during high-frequency oscillation, a cooling fan 48 that forcibly cools these components is arranged on the bottom of the cabinet 10. The cooling fan 48 is composed of a fan casing 48a, a vertical-axis cooling fan motor 48b and a sirocco fan 48c fixed on the top end of the shaft of the cooling fan motor 48b. When the cooling fan motor 48b is driven to rotate the sirocco fan 48c, outside air is sucked through an air intake port 49 (which is also composed of a plurality of small holes) formed in the bottom of the cabinet 10, and the air is strongly discharged through a discharge port of the fan casing 48a in a horizontal direction, thereby the air cools the components that produce heat during high-frequency heating.

[0025] The heating by hot air is achieved by a convection heater unit 50 that is provided on the outside of the back wall of the heating chamber 20. The convection heater unit 50 is composed of: a dish-shaped heat insulating fan casing 51 that is fixed to the outside surface of the back wall of the heating chamber 20; a convection fan 52 that is arranged in a space enclosed by the heat insulating fan casing 51 and the back wall of the heating chamber 20; a convection motor 53 that rotates the convection fan 52; and a ring-shaped convection heater 54 that surrounds the outer circumference of the convection fan 52.

[0026] The convection fan 52 is a centrifugal fan. The convection fan 52 sucks air within the heating chamber 20 through an air intake port 55 formed in the middle of the back wall of the heating chamber 20, discharges it in an outer circumferential direction and jets it into the heating chamber 20 through jet ports 56 that are so formed

in a total of six locations of the back wall of the heating chamber 20 as to surround the air intake port 55. When the convection heater 54 is energized, the air to be discharged from the convection fan 52 is heated, and the hot air is jetted through the jet ports 56. The air intake port 55 and the jet ports 56 are also composed of a plurality of small holes.

[0027] The heating by steam is achieved by a steam generator 60 that is placed on the outside of the right side wall of the heating chamber 20. The steam generator 60 can generate saturated steam or superheated steam; its configuration will be described below, mainly with reference to Fig. 6.

[0028] The steam generator 60 has a housing 61 that is flattened in a lateral direction as viewed from the front; within the housing 61, a steam generation heater 62 is provided at its lower portion, and a steam heater 63 is provided at its upper portion. Each of the steam generation heater 62 and the steam heater 63 is formed with a sheathed heater; when viewed from the right side, that is, when viewed as in Figs. 1 and 2, the steam generation heater 62 is formed in the shape of a horseshoe, and the steam heater 63 is formed in the shape of an oval loop. The oval loop of the steam heater 63 is a continuous double loop in which one loop overlaps the other in a depth direction with respect to the plane of Fig. 1.

[0029] A body 61a and a lid 61b that are die-cast components are attached to each other to form the housing 61; the steam generation heater 62 is molded in the body 61a. A portion of the wall surface of the body 61a into which the steam generation heater 62 is molded is recessed toward the lid 61b, and thus a space is formed between the portion and the right side wall of the heating chamber 20. Hence, heat generated by

the steam generation heater 62 is unlikely to travel to the right side wall of the heating chamber 20 and is therefore utilized effectively for generation of vapor, which is the original purpose.

[0030] Within the housing 61, the steam heater 63 is surrounded by a box-shaped partition 64 having an open top. The partition 64 is formed of a metal or ceramic having a higher heat resistance than that of the housing 61. The inner surface of the partition 64 is coated with a black heat-resistant paint. The purpose of the paint is that heat radiated from the steam heater 63 is absorbed as much as possible by the partition 64 and thus the temperature rise of the housing 61 is reduced.

[0031] In the lid 61b of the housing 61, a water supply port 65 is formed at a level slightly higher than the steam generation heater 62. A water delivery pipe 66a from a water supply pump 66 (see Figs. 3 and 5) is connected to the water supply port 65. A water intake pipe 66b to the water supply pump 66 is connected to the bottom of a water supply tank 67. The water supply pump 66 and the water supply tank 67 are arranged in a space between the right side wall of the cabinet 10 and the right side wall of the heating chamber 20; the water supply tank 67 is removable from the front side of the cabinet 10.

[0032] In the side wall of the body 61a of the housing 61, a horizontal steam jet port 68 that projects inward and outward of the housing 61 is formed at a position slightly higher than the water supply port 65. One end of the steam jet port 68 extends through a through hole formed in the partition 64 such that its head penetrates into the partition 64; the other end of the steam jet port 68 extends through a through hole formed in the right side wall of the heating chamber 20 such that its head penetrates

into the heating chamber 20. When the partition 64 is formed of metal, the black heat-resistant paint described previously serves to prevent electrical corrosion resulting from the partition 64 and the housing 61 of different metals making contact with each other. A total of four steam jet ports 68 are formed such that they are arranged in a tier from the front side to the back side of the cabinet 10; saturated steam or superheated steam is jetted into a gap between the grill 30 and the tray 31.

[0033] The discharge/dilution device 70 is arranged on the outside of the right side wall of the heating chamber. The main components of the discharge/dilution device 70 are the discharge duct 24, a dilution fan 71, an outlet duct 72, a dilution duct 73, a first ejector 74 that is formed within the outlet duct 72 and a second ejector 75 that is formed between the discharge duct 24 and the dilution duct 73.

[0034] The dilution fan 71 is composed of a casing 71a, a sirocco fan 71b that is arranged within the casing 71a and a dilution fan motor 71c that rotates the sirocco fan 71b (see Fig. 9). An air delivery duct 71d extends horizontally from the casing 71a, and enters the outlet duct 72. An end of the air delivery duct 71d is bent upward and perpendicularly, and forms a nozzle portion 74a of the first ejector 74.

[0035] The upper end of the outlet duct 72 projects upward from the top surface of the cabinet 10. In this portion, an outlet 72a is formed that faces obliquely upwardly with respect to the front of the cooking device 1. In the outlet 72a, a louver 72b is provided that directs an air current in a selected direction. A portion of the outlet duct 72 is constricted; the constricted portion is a throat portion 74b that forms the first ejector 74 together with the nozzle portion 74a.

[0036] In the outlet duct 72, a suction port 72c is formed in a portion lower than the

first ejector 74. The first ejector 74 produces a suction effect here. The suction port 72c communicates with the dilution duct 73.

[0037] A drain tube 72d is connected to the bottom of the outlet duct 72. Steam contained in discharged air is condensed on the inner surface of the outlet duct 72. Water may enter the outlet duct 72 through the outlet 72a. The drain tube 72d serves to pass the water to an unillustrated drain path or drain tank.

[0038] In Fig. 1, the dilution duct 73 is present behind the outlet duct 72 and extends horizontally, and one end thereof is closed and the other end is open. The closed end is connected to the suction port 72c of the outlet duct 72. The open end is exposed to the outside of the cabinet 10; its opening serves as an air intake port 73a.

[0039] The discharge duct 24 is connected to the bottom surface of the dilution duct 73. The second ejector 75 is formed in a boundary wall between the discharge duct 24 and the dilution duct 73. The second ejector 75 is formed between the suction port 72c and the air intake port 73a in the dilution duct 73.

[0040] As shown in Fig. 7, a nozzle portion 75a of the second ejector 75 includes a suction-port-side baffle 75b and an air-intake-port-side baffle 74c that are spaced and project substantially in parallel from the discharge duct 24 into the dilution duct 73. The suction-port-side baffle 75b projects into the dilution duct 73 more than the air-intake-port-side baffle 75c by a distance h. The nozzle portion 75a slants toward the suction port 72c from a portion communicating with the discharge duct 24.

[0041] Control elements of the cooking device 1 are shown in Fig. 9. A control device 80 performs overall control. To the control device 80 are connected the air supply fan 22, the antenna motor 45, the power supply for high-frequency 47, the

cooling fan motor 48b, the convection motor 53, the convection heater 54, the steam generation heater 62, the steam heater 63, the water supply pump 66, the dilution fan motor 71c, the humidity sensor 26, the temperature sensor 27, which are described previously; an operation portion 14, a display portion 15, a water level sensor 60a, a tank water level sensor 67a and a door open/close sensor 11a are also connected to the control device 80. The operation portion 14 is provided in the front surface of the door 11, and includes operation means such as a push button and a dial. The display portion 15 is also provided in the front surface of the door 11, and includes display means such as a liquid crystal display panel. The water level sensor 60a is provided in the steam generator 60 to measure a water level within the steam generator 60; the tank water level sensor 67a is provided in a water supply tank 67 to measure a water level within the water supply tank 67. The door 11 is provided with the door open/close sensor 11a to determine whether the door 11 is open or closed.

[0042] When heating by high-frequency waves is performed, the power supply for high-frequency 47, the air supply fan 22, the cooling fan 48 and the dilution fan 71 are turned on. Then, the magnetron 40 oscillates to generate high-frequency waves, and the generated high-frequency waves enter the antenna pit 42 through the waveguide 41. The high-frequency waves that have entered the antenna pit 42 are received by the receiving antenna portion of the antenna 44, and are thereafter radiated by the radiation antenna portion through the division plate 43 to the heating chamber 20. Then, the high-frequency waves heat the foodstuff F within the heating chamber 20. The air supply fan 22 supplies fresh air to the heating chamber 20, and thus air that contains vapor generated from the foodstuff F and that is present within heating

chamber 20 is forced through the discharge port 25 into the discharge duct 24. The air is diluted by the action of the dilution fan 71, then is sucked into the outlet duct 72 and is discharged through the outlet 72a to the outside of the cooking device.

[0043] When heating by hot air is performed, the convection motor 53 and the convection heater 54 are turned on with the air supply fan 22 in an OFF state and the dilution fan 71 in an ON state. The convection fan 52 rotated by the convection motor 53 sucks air within the heating chamber 20 through the air intake port 55, and discharges it in the outer circumferential direction. The air discharged from the convection fan 52 is heated by the convection heater 54 into hot air, and the hot air is jetted into the heating chamber 20 through the jet ports 56 to heat the foodstuff F within the heating chamber 20. In this case, the dilution fan 71 is also operated, and thus oil smoke, odor, water vapor and the like produced from the foodstuff F are sucked through the discharge port 25 into the discharge duct 24, and are diluted and then discharged through the outlet 72a to the outside of the cooking device.

[0044] When heating by steam is performed, with the air supply fan 22 in an OFF state and the dilution fan 71 in an ON state, water is poured into the housing 61 of the steam generator 60 to a required water level, and the heaters are turned on. When only the steam generation heater 62 is turned on, the generated steam enters the partition 64 through a gap between the inner surface of the housing 61 and the partition 64, and is jetted into the heating chamber 20 through the steam jet port 68. Here, the jetted steam is saturated steam.

[0045] When the steam heater 63 is also turned on, the saturated steam that has entered the partition 64 is heated, and the resulting superheated steam is jetted into the

heating chamber 20.

[0046] When the saturated steam or the superheated steam is jetted into the heating chamber 20, excess steam within the heating chamber 20 is discharged into the discharge duct 24 through the discharge port 25. This steam is diluted by the action of the dilution fan 71, and thus its temperature is decreased, thereby the steam becomes harmless. Furthermore, when its relative humidity is decreased and the steam is turned into a state in which it is unlikely to be condensed on the surrounding walls, the steam is discharged through the outlet 72a to the outside of the cooking device.

[0047] The heating by high-frequency waves, the heating by hot air and the heating by steam can be independently performed. Alternatively, it is possible to simultaneously use two or three of these heating methods. When air within the heating chamber 20 is forcibly replaced during, for example, cooling, both the air supply fan 22 and the dilution fan 71 are operated.

[0048] When the dilution fan 71 is operated, air within the cabinet 10 is sucked by the dilution fan 71, and the air is jetted upward through the nozzle portion 74a and passes through the first ejector 74 at a high speed. Since the high-speed air current reduces a static pressure and the air current flows together with the ambient air to the outlet 72a, a suction effect is produced in an area below the first ejector 74 of the outlet duct 72, thereby air that compensates for the removed air is sucked from the dilution duct 73 through suction port 72c.

[0049] A large amount of outside air is sucked, by a suction force produced in the suction port 72c, into the dilution duct 73 through the air intake port 73a.

Furthermore, as shown in Fig. 7, gas within the discharge duct 24 is sucked, by part of the suction force produced in the suction port 72c, into the dilution duct 73 through the second ejector 75. The gas is diluted by being mixed with outside air sucked through the air intake port 73a. Hence, even when the gas within the discharge duct 24 has a high temperature and contains a large amount of steam or oil smoke, the steam or oil smoke is diluted by the outside air, thereby the steam or oil smoke is discharged through the outlet 72a to the outside of the cooking device after factors giving moisture and dirt to the surrounding has been reduced.

[0050] Since the nozzle portion 75a of the second ejector 75 slants toward the suction port 72c from the portion communicating with the discharge duct 24, when the air supply fan 22 is ON, air discharged from the discharge duct 24 through the second ejector 75 flows to the suction port 72c, smoothly mixes with the current of the outside air within the dilution duct 73 and flows into the outlet duct 72.

[0051] If the outlet 72a is accidentally blocked, air to be jetted by the dilution fan 71 through the nozzle portion 74a is jetted not through the nozzle portion 74a but through the suction port 72c into the dilution duct 73. Hence, as shown in Fig. 8, within the dilution duct 73, an air current flowing from the suction port 72c to the air intake port 73a in a direction opposite to the normal direction is produced, and the air current is discharged through the air intake port 73a.

[0052] Since the suction-port-side baffle 75b projects into the dilution duct 73, the air current flowing from the suction port 72c to the air intake port 73a does not enter the second ejector 75. Since the air-intake-port-side baffle 75c projects less than the suction-port-side baffle 75b by the distance h, a static pressure is reduced by the air

current flowing from the suction port 72c to the air intake port 73a and thus a suction effect is produced in the second ejector 75, thereby the gas within the discharge duct 24 is sucked out. In this way, since air is continuously discharged from the discharge duct 24, air blown by the dilution fan 71 does not reversely flow through the discharge port 25 into the heating chamber 20. Therefore, there is no possibility that steam or oil smoke within the heating chamber 20 leaks through the air supply port 23, a junction of sheet metals or the like into the space within the cabinet 10 where the electrical component housing 46 and the magnetron 40 are present.

[0053] The embodiment of the present invention is described above; the scope of the present invention is not limited by the embodiment, and many modifications are possible without departing from the spirit of the present invention.

Industrial Applicability

[0054] The present invention can be widely applied to an oven cooking device that heats foodstuffs within a heating chamber.

List of Reference Symbols

[0055]	1	cooking device
	10	cabinet
	20	heating chamber
	24	discharge duct
	25	discharge port
	30	grill

31	tray
F	foodstuff
40	magnetron
47	power supply for high-frequenecy
48	cooling fan
50	convection heater unit
60	steam generator
70	discharge/dilution device
71	dilution fan
72	outlet duct
72a	outlet
72c	suction port
73	dilution duct
73a	air intake port
74	first ejector
75	second ejector
75a	nozzle portion
75b	suction-port-side baffle
74c	air-intake-port-side baffle
80	control device

CLAIMS

- [1] A cooking device comprising:
- a heating chamber that heats a foodstuff,
- wherein the heating chamber has a discharge port, a discharge/dilution device is provided to the discharge port and
- the discharge/dilution device includes:
- an outlet duct that discharges, through a first ejector via an outlet, air outside the heating chamber fed by a dilution fan;
- a dilution duct whose one end is connected to a suction port provided in the outlet duct at a position where the first ejector produces a suction effect and whose other end is an air intake port; and
- a discharge duct whose one end is connected to the discharge port provided in a side wall of the heating chamber and whose other end is connected through a second ejector to a position between the suction port and the air intake port in the dilution duct.
- [2] The cooking device of claim 1,
- wherein a nozzle portion of the second ejector includes a suction-port-side baffle and an air-intake-port-side baffle that are spaced and that project substantially in parallel from the discharge duct into the dilution duct, and the suction-port-side baffle projects into the dilution duct deeper than the air-intake-port-side baffle.

- [3] The cooking device of claim 2,
 wherein the nozzle portion of the second ejector slants toward the suction port
 from a portion communicating with the discharge duct.