

DESCRIPTION

HUMIDITY-CONTROLLED-AIR SUPPLY DEVICE FOR
VENTILATION-TYPE KOJI PRODUCTION APPARATUS

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Technical Field

[0001] The present invention relates to humidity-controlled-air supply devices for supplying humidity-controlled air to ventilation-type koji (yeast) production apparatus which are applied to brewery industries for producing
10 koji or yeast by distributing humidity-controlled air through a koji making chamber.

Background Art

[0002] Heretofore, the ventilation-type koji production method has been in practical use in brewery industries, which performs a koji making process by
15 causing humidity-controlled air to flow through a koji making chamber, divided by koji-containing material layers, in a bottom-up direction through the material layers.

[0003] In brewery industries of soy sauce, soybean paste, refined sake, etc., or ferment production industries, it has been conventional to make koji by: first
20 soaking in water or adding water to grain, such as soybean, defatted soybean, rice, wheat, barley or corn, or by-product of processed grain, such as bran, to adjust water content in the grain or by-product; then steaming the water-content-controlled grain or by-product to obtain a koji making material; inoculating the koji making material with koji mold; depositing the koji-mold-
25 inoculated material on a metallic mesh or porous plate up to a thickness of 20 – 40 cm; and then blowing air through the koji making material in a bottom-up direction to keep the material at appropriate koji-mold growing temperature.

[0004] In the koji making process, it is important to keep the layers of the koji-mold-inoculated material in a high-humidity atmosphere and under appropriate temperature condition. However, as the koji mold grows proli-
ferously, it generates a great amount of heat to raise the temperature of the
5 koji-mold-inoculated material layers. Although a moderate temperature rise of the material layers is preferable, an excessive temperature rise, e.g. up to a temperature above 40 °C, could destroy the koji mold. Therefore, it has been conventional to supply high-humidity air (e.g., at a humidity of 95 – 100 %) of a predetermined temperature, via a humidity- controlled-air supply device, to the
10 koji making chamber accommodating the koji making material layers, to thereby compulsorily cool the material layers through ventilation of the air. As an example of a koji production apparatus employing such a humidity-controlled-air supply device, a ventilation-type koji production apparatus has been known from, for example, Japanese Patent Publication No. B-2-6510, in
15 which humidity-controlled air is supplied to the koji making chamber through a horizontal air distributing duct.

[0005] Fig. 10 hereof illustrates the humidity-controlled-air distributing duct employed in the conventional koji production apparatus disclosed in the B-2-6510 publication. The duct 101 extends horizontally and has a horizontal
20 passage 102. In the passage 102, there are vertically disposed a plurality of stand pipes 103 for supplying water to spray nozzles in axially spaced-apart relation from one another. A plurality of the spray nozzles 104 are provided on, and vertically spaced from one another along, a portion of each of the stand pipes 103 which is located within the passage 102, and each of these spray
25 nozzles 104 is constructed to spray atomized humidifying water toward an upstream region A. The stand pipes 103 are each connected to a spray pump 105.

[0006] In a downstream end region B of the duct 101, an eliminator 106 for eliminating water droplets 107 is vertically disposed in such a manner as to block the passage 102. Bottom surface of the duct 101 has a water discharging inclination 101 having its lowest level beneath the lower end of the eliminator 106, and a water discharging drain portion 108 is provided on a bottom portion of the duct 101 under the lower end of the eliminator 106. The upstream end region A of the duct 101 is connected to an air blower, while the downstream region B is connected to the koji making chamber. Humidity-controlled air, flowing through the passage 102 and containing atomized humidifying water, flows, in a bottom-to-top direction, through the koji making material layers supported on porous plates in the koji making chamber, so that the koji making material layers are exposed to the humidity-controlled air for a koji making process.

[0007] The foregoing conventional technique has the following inconveniences. Namely, the atomized humidifying water, jetted from the spray nozzles, contains a lot of water droplets. Although the water droplets 107 are eliminated by the eliminator 106 as noted above, the water droplets 107 thus captured by the eliminator 106 flow down the inner and outer wall surfaces of the eliminator 106, and the water droplets resultantly accumulated in the duct's bottom portion 101b are discharged through the drain portion 108. In many cases, the liquid level 107a of the excessive water accumulated in the bottom portion 101a of the duct 101 falls due to the water discharge from the bottom portion 101b. Such water level fall would expose the lower end 106a of the eliminator 106 above the liquid level 107a of the excessive water, which leaves a gap between the liquid level 107a and the lower end 106a of the eliminator 106. As a consequence, a portion of the humidity-controlled air, still containing water droplets, flows toward the downstream end region B, as

indicated by a solid-line arrow. Namely, the humidity-controlled air having water droplets left uneliminated therefrom would short-passes the eliminator 106 (i.e., passes through the gap) and then undesirably flow into the koji making chamber, thereby causing inconveniences to the koji making process.

5 The present invention has been made in view of the foregoing problems of the conventional technique.

Disclosure of the Invention

[0008] It is an object of the present invention to provide a humidity-controlled-air supply device which, in supplying humidity-controlled air to a ventilation-type koji production apparatus, can effectively eliminate unwanted water droplets in the humidity-controlled air and can supply, with an enhanced efficiency, the koji production apparatus with the humidity-controlled air containing only atomized water. It is another object of the present invention to provide a humidity-controlled-air supply device which can increase a time
10 (length) of contact between sprayed atomized water and air to achieve the humidity control with an enhanced efficiency and can also minimize necessary spaces for the humidity-controlled-air supply device and koji production apparatus.
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Problem that the Invention Seeks to Solve

20 [0009] As defined in claim 1, the present invention provides a humidity-controlled-air supply device for a ventilation-type koji production apparatus, the humidity-controlled-air supply device supplying humidity-controlled air to a koji making chamber that is divided into upper and lower chamber sections via a koji material layer disposed in an intermediate region thereof and that
25 has an air outlet port above the koji material layer and a humidity-controlled-air inlet port below the koji material layer. The humidity-controlled-air supply device of the present invention comprises: a vertically-oriented humidity

control tower having an air inlet port formed in an upper portion thereof and a humidity-controlled-air supply opening formed in a lower side portion thereof; a reservoir tank provided in a bottom portion of the humidity control tower; a horizontal humidity-controlled-air distributing duct connecting the humidity-controlled-air supply opening of the humidity control tower and the humidity-controlled-air inlet port of the koji making chamber for fluid communication between the humidity control tower and the koji making chamber; a water-droplet-removing eliminator for blocking the humidity-controlled-air supply opening located in an upstreammost region of the humidity-controlled-air distributing duct, the eliminator being oriented vertically in such a manner that a lower end portion thereof is normally immersed below an overflow level of the reservoir tank in the bottom portion of the humidity control tower; and a plurality of spray nozzles disposed in a plurality of vertically-arranged horizontal tiers within the humidity control tower.

15 [0010] In a preferred form of the invention, as defined in claim 2, the spray nozzles are oriented to spray atomized air upwardly.

[0011] In a further preferred form of the invention, as defined in claim 3, each of the tiers includes a plurality of the spray nozzles, and the spray nozzles in the tiers are arranged to differ in phase as viewed in plan.

20 Advantages of the Invention

[0012] According to the invention defined in claim 1, the air inlet port is formed in an upper portion of the vertically-oriented humidity control tower, the humidity-controlled-air supply opening is formed in a lower side portion of the control tower, and the reservoir tank is provided in a bottom portion of the control tower. The horizontal humidity-controlled-air distributing duct connects the humidity-controlled-air supply opening of the humidity control tower and the humidity-controlled-air inlet port of the koji making chamber for fluid

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communication between the humidity control tower and the koji making chamber. Further, the water-droplet-removing eliminator is mounted to block the humidity-controlled-air supply opening located in the upstreammost region of the air distributing duct, and vertically oriented in such a manner that a lower end portion thereof is normally immersed below an overflow level of the reservoir tank in the bottom portion of the humidity control tower. With such arrangements, the present invention can reliably avoid the so-called short-pass, i.e. prevent humidity-controlled air, containing water droplets, from flowing into the koji making chamber without passing through the eliminator, and thus it can advantageously supply the koji-making material layer within the koji making chamber with appropriate humidity-controlled air containing only atomized water.

[0013] Further, when humidity-controlled air is generated via the spray nozzles disposed in a plurality of vertically-arranged horizontal tiers within the vertical humidity control tower, the present invention allows the sprayed atomized water to contact the air while dropping within the humidity control tower; thus, the present invention permits an increased time of contact between the sprayed water and the air, thereby achieving the humidity control with an enhanced efficiency. Furthermore, with the vertically-oriented humidity control tower, the present invention can significantly reduce the necessary overall floor area for the equipment, as compared to the conventional apparatus employing a horizontally-oriented humidity-controlled-air supplying duct. Also, the present invention is advantageous over the conventional technique in terms of the space layout.

[0014] The present invention, as defined in claim 2, is also characterized in that the spray nozzles are oriented to spray atomized air upwardly. Thus, when humidity-controlled air is generated via the spray nozzles disposed in the

plurality of vertically arranged horizontal tiers within the vertical humidity control tower, the atomized water, sprayed upwardly from the spray nozzles, can contact the air for an increased time because it drops an increased distance within the vertical humidity control tower; namely, the present invention
5 permits an increased time of contact between the sprayed water and the air, thereby achieving the humidity control with an enhanced efficiency.

[0015] The present invention, as defined in claim 3, is also characterized in that each of the tiers includes a plurality of the spray nozzles, and the spray nozzles in the tiers are arranged to differ in phase as viewed in plan. As a
10 result, the present invention can spray atomized water uniformly across transverse cross-sectional planes within the humidity control tower, thereby achieving uniform humidity control of the air.

Best Mode for Carrying Out the Invention

[0016] Fig. 1 is a schematic sectional view of a koji (yeast) production
15 apparatus having annexed thereto a humidity-controlled-air supply device of the present invention. In the figure, reference numeral 1 represents a koji making chamber which is surrounded and defined by a floor 1a, ceiling 1b and peripheral walls; of the peripheral walls, only the left and right walls 1c and 1d are shown. The left wall 1c has a humidity-controlled-air outlet port 2 formed
20 in an upper end portion thereof, and the right wall 1d has a humidity-controlled-air inlet port 3 formed in a lower end portion thereof.

[0017] Within the koji making chamber 1, a horizontal porous plate 4 is disposed across a substantial vertically-intermediate region of the chamber 4 to divide the chamber interior into upper and lower chamber section 6 and 7.
25 Koji making material layers 5 including a koji layer are placed on the porous plate 4. Humidity-controlled air generated by the humidity-controlled-air supply device 10 is introduced via the air inlet port 3 into the lower chamber

section 7 of the koji making chamber 1, flows upward, through the holes of the porous plate 4 and material layers 5, into the upper chamber section 6 and is then discharged through the outlet port 2. The humidity-controlled-air supply device 10 is disposed adjacent to the koji making chamber 1.

5 [0018] Fig. 2 is a vertical sectional view of the humidity-controlled-air supply device 10. The body of the humidity-controlled-air supply device 10 comprises a vertically-oriented humidity control tower 11, which, in the illustrated example, has a rectangular cross-section as shown in Figs. 3 -5. Alternatively, the humidity control tower 11 may be of a cylindrical shape.

10 The humidity control tower 11 has an air inlet port 12 formed in an upper end portion thereof and opening toward the adjoining koji making chamber 1. Flange 12a is provided around an opening end of the air inlet port 12, and the air inlet port 12 communicates with a humidity control chamber 14 in the control tower 11.

15 [0019] As illustrated in Fig. 1, a blower 8 is mounted on the ceiling 1b of the koji making chamber 1, and the blower 8 is connected in fluid communication to the air inlet port 12 via a connecting pipe 9 with a flange 9a of the pipe 9 and the flange 12a of the air inlet port 12 joined with each other in end-to-end abutted relation. Thus, the interior of the humidity control chamber

20 14 within the humidity control tower 11 communicates with the outside air. Filter (not shown) is inserted in an outside-air introducing pipe 8a of the blower 8, so as to purify the outside air that is to be supplied into the humidity control tower 11.

[0020] Upper end portion of the peripheral wall 11b of the humidity

25 control tower 11, which opposes the air inlet port 12, has an upper inclined surface 11c that is inclined outwardly downwardly from an end of a duct portion 13, so that the outside air introduced through the air inlet port 12 as

indicated by a white arrow is directed, along the inclined surface 11c, to flow in an axially downward direction of the humidity control tower 11. Flow adjusting plates 15 are provided in an upper end portion of the humidity control chamber 14 along and in substantial parallel relation to the upper inclined surface 11c, and the flow adjusting plates 15 adjust the air, introduced via the air inlet port 12, in such a manner that the air is directed vertically downward in an upper portion of the chamber 14 and diffuses across the chamber 14.

[0021] The humidity control tower 11 has a V-shaped bottom 11d to provide an excessive water reservoir tank 16, and an overflow pipe 17 of a substantially S shape is connected to a lower end portion of the peripheral wall 11b. The overflow pipe 17 has a regulation section 17a for regulating a liquid level a of the excessive water reservoir tank 16 to be at a predetermined level, and the liquid level a of the reservoir tank 16 formed in the bottom 11d is shown in the figure as being at an overflow level. Reference numeral 11e in the figure represents a drain hole.

[0022] In a lower portion of the humidity control tower 11, located adjacent and opposing the koji making chamber 1, there is formed a humidity-controlled-air outlet port 18 that serves as a humidity-controlled-air supply opening. The humidity-controlled-air outlet port 18 and the humidity-controlled-air inlet port 3 of the koji making chamber 1 is connected in fluid communication with each other via a horizontal humidity-controlled-air distributing duct 19. The humidity-controlled-air outlet port 18, forming the upstreammost end of the humidity-controlled-air distributing duct 19, is constructed in the following manner.

[0023] Engaging stepped portion 18a is formed in an inner peripheral surface portion of the humidity-controlled-air outlet port 18, a stepped portion 19a is formed in the inner surface of the air outlet port 18 adjacent to and at a

level one step higher than a lower downstream region 18b of the engaging stepped portion 18a, and the lower downstream region 18b of the engaging stepped portion 18a and stepped portion 19a are set to be lower than the liquid level of the tank 16. Namely, the stepped portion 19a and lower downstream
5 region 18b of the engaging stepped portion 18a are normally located below the liquid level a and immersed in the reservoir water.

[0024] In the humidity-controlled-air outlet port 18, an eliminator 20 for eliminating water droplets is installed in a vertical orientation, which comprises a stainless-steel corrugated panel, meshed panel, etc. vertically
10 disposed in the port 18 or spiral spring, coil, etc. arranged so as to block the flow of the humidity-controlled air. The eliminator 20 has an outer peripheral edge engaged by the engaging stepped portion 18a, so as to close the air outlet port 18. Although the eliminator 20 entirely closes the humidity-controlled-air outlet port 18, a lower portion 20a of the eliminator 20 is immersed below the
15 liquid level a, and normally located below the overflow level; thus, the lower portion 20a is never exposed above the liquid level a.

[0025] Further, in intermediate-upper and intermediate-lower sections of the above-mentioned humidity control tower 11, spray nozzle units 30, 40 and 50 are provided in vertically spaced-apart relation to one another. Details of the
20 spray nozzle units 30, 40 and 50 are illustratively shown in Figs. 3 - 5, which are sectional views taken along the 3-3 line, 4-4 line and 5-5 line, respectively, of Fig. 2. Fig. 3, which is a sectional view taken along the 3-3 line of Fig. 2, which particularly shows the first-stage (or first-tier), i.e. uppermost-stage, spray nozzle unit 30.

25 [0026] Referring to Figs. 2 and 3, the spray nozzle unit 30 includes: a main pipe 31 introduced from outside the humidity control tower 11 and extending parallel to a peripheral wall 11f; three parallel branch pipes 32 connected at

respective one ends in fluid communication with the main pipe 31 and extending at right angles to the main pipe 31 (i.e., in a direction parallel to the peripheral walls 11b and 11a); and a support rod 34 extending parallel to the main pipe 31 and supporting the respective distal ends of the branch pipes 32.

5 [0027] The branch pipes 32 are disposed parallel spaced apart from one another at predetermined intervals, and each of the branch pipes 32 has spray nozzles 33 provided thereon and spaced apart from one another along the length of the branch pipe 32; each of the spray nozzles 33 is constructed to spray atomized water upward. The number of the spray nozzles 33 provided
10 is different among the branch pipes 32. In the illustrated example, the left and right branch pipes 32 each have four such spray nozzles 33, while the middle branch pipe 32 has five spray nozzles 33. More specifically, for each of the left and right branch pipes 32, the two spray nozzles 33 near the longitudinally-opposite ends of the pipe 32 are each disposed to the left of the
15 pipe 32, while the other two spray nozzles 33 on a longitudinally-intermediate portion of the pipe 32 are disposed to the right of the pipe 32. Further, for the middle branch pipe 32, the two spray nozzles 33 near the longitudinally-opposite ends of the pipe 32 are disposed to the left of the pipe 32, two of the three spray nozzles 33 on a longitudinally-intermediate portion of the pipe 32
20 are disposed to the right of the pipe 32, and the other spray nozzle 33 on the intermediate portion of the pipe 32 is disposed to the left of the pipe 32 in a similar manner to the spray nozzles 33 near the longitudinally-opposite ends. Reference numeral 35 represents an air-bleeding section provided at the distal end of each of the branch pipes 32.

25 [0028] Dotted-line circles b depicted about the respective spray nozzles 33 represent spraying patterns of the spray nozzles 33, and the spraying patterns of the spray nozzles 33 on the first-stage (i.e., first-tier) spray nozzle unit 30

and similar spraying patterns of the spray nozzles 33 on the second- and third-stage spray nozzle units 40 and 50 are arranged in such a manner that a combination of the spraying patterns of all the spray nozzles 33 can spray atomized water uniformly across transverse cross-sectional planes within the humidity control chamber 14.

[0029] Fig. 4 is a sectional view taken along the 4-4 line of Fig. 2, which particularly shows the second-stage (tier), i.e. middle-stage, spray nozzle unit 40. In the figure, reference numeral 41 represents a main pipe, 42 three branch pipes, and 43 spray nozzles; four spray nozzles 43 are provided at predetermined intervals on each of the left and right branch pipes 42, five spray nozzles 43 are provided at predetermined intervals on the middle branch pipe 42, and these spray nozzles 43 are oriented to spray atomized water upward. Reference numeral 44 represents a support rod for supporting the respective distal ends of the branch pipes 42, and 45 an air-bleeding section. The spray nozzles 43 of the second-stage spray nozzle unit 40 are positioned in different phases from the spray nozzles 33 of the first-stage or uppermost-stage spray nozzle unit 30, and spraying patterns c of these spray nozzles 43 are set to not overlap the spraying patterns b of the first-stage or uppermost-stage spray nozzle unit 30.

[0030] Fig. 5 is a sectional view taken along the 5-5 line of Fig. 2, which particularly shows the third-stage (tier), i.e. lowermost-stage, spray nozzle unit 50. In the figure, reference numeral 51 represents a main pipe, 52 three branch pipes, and 53 spray nozzles; four spray nozzles 53 are provided at predetermined intervals on each of the left and right branch pipes 52, five spray nozzles 53 are provided at predetermined intervals on the middle branch pipe 52, and these spray nozzles 53 all have an upward spraying direction. Reference numeral 54 represents a support rod for supporting the respective

distal ends of the branch pipes 52, and 55 an air-bleeding section. The spray nozzles 53 of the third-stage spray nozzle unit 50 are positioned in different phases from the spray nozzles 33 and 43 of the first-stage and second-stage (or uppermost and middle-stage) spray nozzle units 30 and 40, and the spraying patterns d of these spray nozzles 53 are set to not overlap the spraying patterns b and c of the uppermost-stage and middle-stage spray nozzle units. However, as viewed in plan, these spraying patterns b, c and d are set to overlap with one another in their peripheral regions so that the spraying patterns b, c and d, as a whole, can cover the entire transverse cross-sectional planes of the humidity control chamber 14.

[0031] The main pipes 31, 41 and 51 of the spray nozzle units 30, 40 and 50 have their respective upstream end portions extending out of the peripheral wall 11b and collectively connected to a humidity-controlling water supply pipe 60. Heater 61 is inserted in the humidity-controlling water supply pipe 6, and temperature-controlled pressure water is supplied, via a pump 62 and heater 61, to the respective upstream end portions of the main pipes 31, 41 and 51 through the supply pipe 60.

[0032] Fig. 6 is a view explanatory of how atomized water sprayed by the spray nozzles effects is placed in liquid-gas contact in the humidity control device of the present invention, and Fig. 7 is a view explanatory of how water atomized sprayed by the spray nozzles is placed in liquid-gas contact in the conventional apparatus as a comparative example. In the present invention, the three-tiered spray nozzle units 30, 40 and 50 are provided, in the humidity control tower 11 having a relatively great vertical dimension, in such an orientation as to spray atomized water in the upward direction. Thus, the atomized water sprayed by the spray nozzles 33, 43 and 53, even that sprayed by the sprays 53 of the lowermost spray nozzle unit 50, can travel a great

distance before reaching the humidity-controlled-air outlet port 18 that supplies humidity-controlled air to the koji making chamber 1. As a result, the present invention permits a further increased time of contact between the sprayed water and the air, thereby achieving the humidity control with an enhanced efficiency.

[0033] In the example of Fig. 7, on the other hand, the stand pipe 103 is provided, in a vertical orientation in the horizontal passage 102 of the duct 101, for supplying atomized water to the spray nozzle, and the spray nozzle 104 is provided on a portion of the stand pipe 103 in such a manner that the spray nozzle 104 can spray atomized water upstream. Thus, in this comparative example, the water emitted from the spray nozzle 104 against an airflow indicated by a white arrow is caused to flow downward; however, because the spray nozzle 104 is located within the duct 101, the sprayed water can not travel a long distance in the vertical direction. As a consequence, the time of contact between the sprayed water and the air tends to be unavoidably short, which would make it difficult to effect the required humidity control with a high efficiency. For this reason, it should be appreciated that the present invention is advantageous over the conventional technique also in that it can effect the humidity control with an increased efficiency.

[0034] Fig. 8 is a plan view explanatory of the humidity-controlled-air supply device of the present invention. In the humidity-controlled-air supply device 10 of the invention, the humidity control tower 11, which has a rectangular shape as viewed in plan, is installed adjacent the koji making chamber 1 and connected in fluid communication with the chamber 1. Because the humidity control device is in the form of a tower, the humidity control device can have a small floor area and the distance L between the koji making chamber 1 constituting the koji making device and the humidity

control tower 11 constituting the humidity control device 10 can be made shorter, so that the humidity-controlled-air supply device can have a smaller floor area.

[0035] Fig. 9 is a plan view explanatory of the conventional apparatus as a comparative example. In this case, the humidity control device disposed adjacent the koji making chamber 109 is in the form of the horizontal duct 101, so that the humidity control device extends like an elongated passageway along the floor surface. Consequently, as illustrated in Fig. 10, a plurality of the spray nozzles 1014 have to be provided in spaced apart relation to one another along the length of the tunnel-like elongated passageway, and the humidity control device and the distance L1 between the humidity control device and the koji making chamber would increase considerably. Thus, the overall floor area would increase as compared to that of the present invention. For this reason, it should be appreciated that the present invention is advantageous over the conventional technique also in terms of the space layout.

Industrial Applicability

[0036] The humidity-controlled-air supply device of the present invention is suited for use in ventilation-type koji production apparatus which produce koji for brewing purposes.

Brief Description of the Drawings

[0037] Fig. 1 is a schematic sectional view of a koji production apparatus having annexed thereto a humidity-controlled-air supply device of the present invention;

Fig. 2 is a vertical sectional view of the a humidity-controlled-air supply device of the present invention;

Fig. 3 is a sectional view taken along the 3-3 line of Fig. 2;

Fig. 4 is a sectional view taken along the 4-4 line of Fig. 2;

Fig. 5 is a sectional view taken along the 5-5 line of Fig. 2;

Fig. 6 is a view explanatory of how atomized water sprayed by spray nozzles is placed in liquid-gas contact in the humidity control device of the present invention;

5 Fig. 7 is a view explanatory of how atomized water sprayed by spray nozzles is placed in liquid-gas contact in a conventional apparatus as a comparative example;

Fig. 8 is a plan view explanatory of the device of the present invention;

Fig. 9 is a plan view explanatory of the conventional apparatus as a
10 comparative example; and

Fig. 10 is a view showing a humidity-controlled-air distributing duct employed in the conventional apparatus.

Description of Reference Numerals

[0038] 1...kaji making chamber; 2...humidity-controlled-air outlet port;
15 3...humidity-controlled-air outlet port; 5...kaji making material layer;
10...humidity-controlled-air supply device; 11...humidity control tower; 12...air inlet port; 16...reservoir tank; 18...humidity-controlled-air outlet port;
19...humidity-controlled-air distributing duct; 20...eliminator; a...liquid level;
33, 43, 53...spray nozzles

CLAIMS

1. A humidity-controlled-air supply device for a ventilation-type koji production apparatus, said humidity-controlled-air supply device supplying
5 humidity-controlled air to a koji making chamber that is divided into upper and lower chamber sections via a koji material layer disposed in an intermediate region thereof and that has an air outlet port above the koji material layer and a humidity-controlled-air inlet port below the koji material layer, said humidity-controlled-air supply device comprising:

10 a vertically-oriented humidity control tower having an air inlet port formed in an upper portion thereof and a humidity-controlled-air supply opening formed in a lower side portion thereof;

a reservoir tank provided in a bottom portion of said humidity control tower;

15 a horizontal humidity-controlled-air distributing duct connecting the humidity-controlled-air supply opening of said humidity control tower and the humidity-controlled-air inlet port of the koji making chamber for fluid communication between said humidity control tower and the koji making chamber;

20 a water-droplet-removing eliminator vertically for blocking the humidity-controlled-air supply opening located in an upstreammost region of said humidity-controlled-air distributing duct, said eliminator being oriented vertically in such a manner that a lower end portion thereof is normally immersed below an overflow level of said reservoir tank in the bottom portion
25 of said humidity control tower; and

a plurality of spray nozzles disposed in a plurality of vertically-arranged horizontal tiers within said humidity control tower.

2. A humidity-controlled-air supply device as defined in claim 1 wherein said spray nozzles are oriented to spray atomized air upwardly.
3. A humidity-controlled-air supply device as defined in claim 1 or 2 wherein
5 each of the tiers includes a plurality of said spray nozzles, and said spray nozzles in the tiers are arranged to differ in phase as viewed in plan.