

DEODORIZER USING OZONE AND REFRIGERATOR WITH THE SAME

This invention relates to a deodorizer disposed in a circulation path for cold air in a refrigerator so that air in
5 the refrigerator is deodorized by producing and decomposing ozone and a refrigerator provided with such a deodorizer.

There have conventionally been provided refrigerators with a deodorizer which produces and decomposes ozone so that resultant active oxygen decomposes odor components and bacteria
10 by oxidation. For production of ozone, a high voltage ranging between 4 and 5 kV is induced by a step-up transformer to be applied to a surface discharge electrode so that a corona discharge is caused in order to ionize inert gas in air.

In the above-described conventional deodorizer, however,
15 the step-up transformer is disposed together with the discharge electrode in the refrigerator. Accordingly, the step-up transformer is exposed to cold air circulated in the refrigerator or external air entering the refrigerator when a door thereof is opened. Dew sometimes condenses on the step-up transformer
20 due to a temperature difference between the cold air in the refrigerator and the external air.

Therefore, an object of the present invention is to provide a deodorizer in which dew condensation can be prevented on the step-up transformer and a refrigerator provided with such a
25 deodorizer.

The present invention provides a deodorizer provided in a refrigerator with a circulation path through which cold air is circulated. The deodorizer comprises a first chamber into which



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the cold air circulated in the refrigerator is disallowed to flow, a second chamber into which the cold air circulated in the refrigerator is allowed to flow, a step-up transformer disposed in the first chamber, an ozonizing electrode disposed in the second chamber and electrically connected to a secondary side of the step-up transformer, and an ozone decomposing catalyzer decomposing ozone produced by the ozonizing electrode. The deodorizer is disposed in the circulation path in the refrigerator to deodorize the circulated cold air by use of the ozone produced by the ozonizing electrode.

According to the aforesaid construction, the step-up transformer disposed in the first chamber is shut off from the cold air circulated in the refrigerator, whereas only the ozonizing electrode is exposed to the circulated cold air. Further, the transformer is not directly exposed to external air even when a refrigerator door is opened. Consequently, changes in the temperature around the transformer is reduced such that the dew condensation on the transformer can be prevented.

The ozonizing electrode preferably has a discharge surface on which electric discharge is caused and a non-discharge surface which is a reverse of the discharge surface, and both surfaces of the electrode are preferably located in the second chamber. Electric discharge increases the surface temperature on the discharge surface of the ozonizing electrode. Accordingly, when the discharge and non-discharge surfaces are located in different environments from each other, a temperature gradient between both surfaces is increased, whereupon a thermal stress applied to the ozonizing electrode is increased. However, since

both surfaces of the electrode are located in the second compartment in the aforesaid construction, the temperature gradient between the surfaces is reduced such that the thermal stress applied to the electrode can be reduced.

5 The ozone decomposing catalyzer is preferably disposed below the ozonizing electrode. Since ozone is heavier than air, the ozone moves downward from where it is produced. Accordingly, when the ozone decomposing catalyzer is disposed below the ozonizing electrode, decomposition of ozone and decomposition
10 of odor component by oxidation can be carried out efficiently. Furthermore, the ozonizing electrode is preferably disposed at an inlet side of the deodorizer through which the circulated cold air flows into the deodorizer and the ozone decomposing catalyzer is disposed at an outlet side of the deodorizer through which
15 deodorized cold air exits the deodorizer. Deodorization by generation and decomposition of ozone can be carried out along a flow of circulated cold air efficiently.

The invention also provides a deodorizer comprising a transformer chamber in which a step-up transformer is disposed,
20 an electrode chamber in which an ozonizing electrode electrically connected to a secondary side of the step-up transformer, the electrode chamber being separated from the transformer chamber, a communication hole communicating with the electrode chamber, and a cold-air chamber into which cold air
25 circulated in a refrigerator flows and in which an ozone decomposing catalyzer so as to correspond to the communication hole, the ozone decomposing catalyzer decomposing ozone produced by the ozonizing electrode and supplied through the

communication hole into the cold-air chamber, whereby the cold air circulated in the refrigerator is deodorized by use of the ozone.

The step-up transformer disposed in the transformer
5 compartment is shut off from the cold air circulated in the refrigerator in this construction, too. The circulated cold air is caused to flow into the cold-air chamber. Ozone is supplied from the electrode chamber through the communication hole. Accordingly, the ozonizing electrode is also prevented from
10 direct exposition to the circulated cold air and external air flowing into the refrigerator when the door is opened. Consequently, the temperature change in the ozonizing electrode can be reduced. Further, the ozone generated in the electrode chamber is mixed with air containing odor near the communication
15 hole in the cold-air chamber. Consequently, the odor can be decomposed efficiently when the ozone decomposing catalyzer is disposed so as to correspond to the communication hole.

The invention also provides a refrigerator provided with a deodorizer for deodorizing cold air circulated in the
20 refrigerator, the deodorizer comprising a transformer chamber in which a step-up transformer is disposed, an electrode chamber in which an ozonizing electrode electrically connected to a secondary side of the step-up transformer, the electrode chamber being separated from the transformer chamber, a communication
25 hole communicating with the electrode chamber, and a cold-air chamber into which cold air circulated in a refrigerator and in which an ozone decomposing catalyzer so as to correspond to the communication hole, the ozone decomposing catalyzer decomposing

ozone produced by the ozonizing electrode and supplied through the communication hole into the cold-air chamber, whereby the cold air circulated in the refrigerator is deodorized by use of the ozone. In this construction, too, dew condensation can be prevented on the step-up transformer constituting the deodorizer, and the deodorization effect can be maintained stably.

The deodorizer is disposed at a feedback path side of the circulated cold air. The circulated cold air in the feedback path side is considered to contain a larger quantity of odor component. Consequently, the aforesaid disposition of the deodorizer can render deodorization more efficient.

The refrigerator preferably further comprises a cold storage compartment, a vegetable compartment and an evaporator which is common to both compartments and produces cold air circulated through the compartments. In the refrigerator, the deodorizer is disposed in a boundary through which the cold air flows from the cold storage compartment side to the vegetable compartment side. Consequently, a substantially dead space can be used efficiently and the decrease in the capacity of the refrigerator for cold storage of food can be limited.

The invention yet further provides a refrigerator provided with a deodorizer for deodorizing cold air circulated in the refrigerator, the deodorizer comprising a transformer chamber defined in the deodorizer so as to cut off cold air circulated in the refrigerator, a step-up transformer disposed in the transformer chamber, an ozonizing electrode electrically connected to a secondary side of the step-up transformer and disposed outside the transformer chamber, and an ozone

decomposing catalyzer decomposing the ozone produced by the
ozonizing electrode. In this construction, the circulated cold
air in a cold storage compartment of the refrigerator is caused
to flow through the deodorizer so that the cold air is deodorized
5 and part of the circulated cold air is allowed to flow through
the deodorizer.

According to the aforesaid construction, the step-up
transformer disposed in the transformer chamber is shut off from
the cold air circulated in the refrigerator, whereas only the
10 ozonizing electrode is exposed to the circulated cold air outside
the transformer chamber. Further, the transformer is not
directly exposed to external air even when the refrigerator door
is opened. Consequently, changes in the temperature around the
transformer is reduced such that the dew condensation on the
15 transformer can be prevented.

The circulated cold air flowed into the deodorizer passes
the ozone decomposing catalyzer together with the ozone produced
by the ozonizing electrode. Accordingly, when all the
circulated cold air is caused to flow into the deodorizer, the
20 resistance caused when the cold air passes the catalyzer
decreases the circulating speed, thereby reducing the cooling
performance. In view of this problem, part of the circulated
cold air needs to be caused to flow into the deodorizer so that
the cold air is deodorized without reduction of the cooling
25 performance.

Further, too much circulated cold air passing through the
deodorizer can exceed the limit of a decomposing speed of the
ozone in the catalyzer. If the amount of cold air should exceed

the limit decomposing speed of the ozone, the latter could not decompose all the cold air. As a result, the deodorizing efficiency would be reduced and an excessive amount of ozone would flow out into the interior of the refrigerator. In the
5 above-described construction, however, part of the circulated cold air is caused to flow into the deodorizer such that the deodorizing efficiency can be maintained at a proper value.

A volume of the circulated cold air flowing through the deodorizer is preferably variable. Even when an amount of food
10 etc. stored in the refrigerator changes, an amount of cold air flowing into the deodorizer is changed according to the amount of food, whereupon the deodorizing efficiency can be maintained at a proper value.

A ratio of the volume of the cold air flowing through the
15 deodorizer to a volume of the cold air flowing through another portion is preferably variable. More specifically, even when an amount of circulated cold air flowing in the refrigerator is constant, the ratio of the amount of cold air flowing through the deodorizer and the amount of cold air flowing through the
20 other portion is varied such that an amount of circulated cold air flowing into the deodorizer can be changed.

The invention will be described, merely by way of example, with reference to the accompanying drawings, in which:

FIG. 1 is a schematic perspective view of a deodorizer of
25 a first embodiment in accordance with the present invention;

FIG. 2 is a longitudinal side section of a refrigerator provided with the deodorizer;

FIG. 3 is a view similar to FIG. 2, showing a second

embodiment of the invention;

FIG. 4 is a front view of the deodorizer;

FIG. 5 is a schematic perspective view of the deodorizer of a third embodiment of the invention;

5 FIG. 6 is a schematic perspective view of a covering structure and a restricting structure in the deodorizer of a fourth embodiment in accordance with the invention;

FIG. 7 is a schematic perspective view of a diffusion plate with the covering structure and the restricting structure in the
10 deodorizer of a fifth embodiment in accordance with the invention;

FIG. 8 is a view similar to FIG. 2, showing a sixth embodiment in accordance with the invention;

FIG. 9 is a view similar to FIG. 1, showing the sixth
15 embodiment;

FIG. 10 is a plan view of the deodorizer;

FIG. 11 is a partially enlarged longitudinal section of the deodorizer;

FIG. 12 is a view similar to FIG. 9, showing a seventh
20 embodiment in accordance with the invention;

FIG. 13 is an exploded perspective view of the deodorizer of an eighth embodiment in accordance with the invention;

FIG. 14A is a partial longitudinal side section of the refrigerator, and FIG. 14B is a partially enlarged view showing
25 a part of the refrigerator as shown in FIG. 14A;

FIG. 15A is a longitudinal side section of an ozonizing electrode, FIG. 15B is a plan view of the electrode, and FIG. 15C is an enlarged view of a discharge electrode;

FIG. 16 is a graph showing the experimental results of deodorization with ammonia serving as marker gas when an amount of cold air passing through the deodorizer is changed;

FIG. 17 is also a graph showing the experimental results
5 of sensory analysis when the amount of cold air passing through the deodorizer is changed;

FIG. 18 is a view similar to FIG. 14B, showing a ninth embodiment in accordance with the invention;

FIGS. 19A and 19B are front views of a louver in a closed
10 state and in an open state in a tenth embodiment in accordance with the invention respectively;

FIGS. 20A and 20B are plan views of the deodorizer mounted on a partition plate in an eleventh embodiment in accordance with the invention in both cases where flow ports are closed and open,
15 respectively; and

FIG. 21 shows an operating pattern when the deodorizer is intermittently operated in a twelfth embodiment.

Several embodiments of the present invention will be described with reference to the accompanying drawings. FIGS.
20 1 and 2 illustrate a first embodiment in accordance with the invention. Referring first to FIG. 2, a refrigerator is shown including a body 1 formed into the shape of a generally rectangular box with a front opening. The refrigerator body 1 includes an outer casing 2, an inner casing 3 provided in the
25 outer casing 2 and a heat insulator 4, such as urethane foam, filling a space defined between the outer and inner casings 2 and 3. A horizontal partition plate 5 (a bottom plate of a cold storage compartment) made from a synthetic resin is fixed to an

inner face of the inner casing 3. The partition plate 5 defines a cold storage compartment 6 in an upper interior of the body 1. A door 7 is rotatably mounted on a front end of the cold storage compartment 6.

5 The partition plate 5 has a plurality of protrusions (not shown) formed on an upper side thereof. A chilling case 8 is placed on the protrusions of the partition plate 5. The chilling case 8 is formed into the shape of a container and has an open top and an open front. A cold air path 9 is defined between the
10 underside of the chilling case 8 and the upper face of the partition plate 5. A lid 10 closes and opens the front of the chilling case 8. The partition plate 5 has an opening into which a deodorizer 11 is fitted, thereby supporting the latter. Another cold air path 101 is defined between the partition plate
15 5 and a support plate 100.

 A heat-insulated partition plate 12 is fixed in the inner casing 3 to be located below the partition plate 5. The partition plate 12 includes a casing made from a synthetic resin and filled with styrene foam. A vegetable compartment 13 is defined between
20 the partition plates 12 and 5. The vegetable compartment 13 communicates via the deodorizer 11 disposed on the partition plate 5 with the cold storage compartment 6. That is, the vegetable compartment 13 thus serves as a part of the cold storage compartment 6. A door 14 is attached to a front end of the
25 vegetable compartment 13 so as to be slidable forward and rearward.

 A lower case 15 is accommodated in the vegetable compartment 13. The lower case 15 is formed into the shape of a container

with an open top. An upper case 16 is mounted on the lower case 15 so as to close the top of the lower case 15 except a front end. The upper case 16 is formed into the shape of a container with an open top. A lid 17 is attached to the top of the upper
5 case 16 so as to be opened and closed. A cold air path 18 is formed between the lid 17 and the partition plate 5. A freezing compartment 19 is defined below the partition plate 12. The freezing compartment 19 is thermally isolated from the upper vegetable compartment 13 and cold storage compartment 6. An
10 upper door 20 and the lower door 21 are mounted on a front end of the freezing compartment 19 so as to be slidable forward and rearward. An upper freezing case 22 and a lower freezing case 23 are accommodated in the freezing compartment 19.

A machine compartment 24 is defined at a lower end of the
15 refrigerator body 1. A compressor 25 for the refrigeration cycle is provided in the machine compartment 24. The compressor 25 includes a compressor motor 26 serving as a driving source and of the reciprocation type. The compressor motor 26 is electrically connected via a drive circuit to a main control
20 device although neither of them is shown. The main control device mainly comprises a microcomputer and is disposed in the body 1. A refrigeration cold air generating compartment 36 is defined in the rear of the vegetable compartment 13. A refrigeration evaporator 33 is enclosed in the cold air
25 generating compartment 36. The cold air generating compartment 36 includes a cylindrical cold air discharge opening 37 and a louver-shaped cold air suction opening 38. The cold air discharge opening 37 is inserted into the upper case 16.

A generally L-shaped duct cover 39 is fixed in the cold storage compartment 6. The duct cover 39 is made from a synthetic resin and has a plurality of cold air discharge holes 40 open to the cold storage compartment 6. The duct cover 39 constitutes
5 a generally L-shaped cold air duct 41 together with a rear plate of the inner casing 3. The cold air duct 41 has an upper end open to the cold storage compartment 6 and a lower end communicating with the cold air generating compartment 36. A refrigeration fan motor 42 is enclosed in the cold air generating
10 compartment 36 and electrically connected via a drive circuit (not shown) to the main control device. The fan motor 42 includes a rotational shaft to which a fan 43 is connected. When the fan 43 is rotated, the cold air is circulated through the following route. A refrigeration fan 44 comprises a refrigeration fan
15 motor 42 and a refrigeration fan blade 43. The fan 44 and the evaporator 33 constitute a refrigeration cooling unit 45.
Cold air circulation route in the cold storage and vegetable compartments 6 and 13:

Part of air in the refrigeration cold air generating
20 compartment 36 is discharged through the discharge opening 37 into the upper case 16. The air is further discharged into the cold air path 18 through a cold air flow hole 46 formed in the front end of the lid 17. The air further flows downward along the front face of the lower case 15 and then further flows rearward
25 along the underside of the lower case 15, being returned through the cold air suction opening 38. The air is cooled by the refrigeration evaporator 33, thereby cooling the atmosphere in the vegetable compartment 13.

The remainder of air in the compartment 36 is discharged through the discharge holes 40 of the duct 41 and the upper end thereof into cold storage compartment 6. The air further flows into a cold air path 101 provided below the chilling case 8. The
5 air then flows into the vegetable compartment 13, passing through the deodorizer 11 fitted in the hole of the partition plate 5 and the cold air path 101. The air then flows forward along the path 18. Thereafter, the air flows downward along the front face of the lower case 15, further flowing rearward along the underside
10 of the lower case 15. The air is then returned through the suction opening 38 into the refrigeration cold air generating compartment 36. In this case, the air is cooled by the refrigeration evaporator 33 thereby to be supplied into the cold storage and vegetable compartments 6 and 13. That is, the
15 deodorizer 11 is disposed at the feedback path side of the circulated cold air.

A freezing cold air generating compartment 47 is defined in the rear of the freezing compartment 19. The compartment 47 has a cold air discharge opening 48 and a cold air suction opening
20 49 formed in an upper end and a lower end thereof respectively. A freezing evaporator 34 and a fan motor 50 are provided in the compartment 47. The fan motor 50 is electrically connected via a drive circuit to the main control device. A freezing fan blade 51
is connected to a rotational shaft of the fan motor 50. When
25 the fan blade 51 is rotated, the cold air is circulated through the following route. A freezing fan unit 52 thus comprises the fan motor 50 and the fan blade 51. The fan unit 52 constitutes a freezing cooling unit 53 together with the freezing evaporator

52.

Circulation route of cold air in freezing compartment 19:

Air in the freezing cold air generating compartment 47 is discharged through the cold air discharge opening 48 into the freezing compartment 19. The air is returned through a cold air suction opening 49 into the compartment 47. In this case, the air is cooled by the freezing refrigerator 34, thereby cooling the atmosphere in the freezing compartment 19.

FIG. 1 shows the construction of the deodorizer 11. The deodorizer 11 includes a generally rectangular box-shaped case 54 made from a resin. The case 54 has an open lower end as viewed in FIG. 1. The resin used for the case 54 may be transparent or non-transparent. In the embodiment, the resin used for the case 54 is transparent. In the case 54, part of the interior of the case 54 corresponding to an upper right corner as viewed in FIG. 1 is partitioned by partition walls 55 and 56 such that a transformer chamber (first chamber) 57 is defined. A small-sized step-up transformer 58 is provided in the transformer chamber 57. Power is supplied to a primary terminal (not shown) of the step-up transformer 57. The step-up transformer 58 includes secondary terminals 58a and 58b extending through the partition wall 56 and exposed to the outside of the transformer compartment 57. The other interior of the case 54 constitutes an electrode chamber 59 (a second chamber).

The surface discharge type ozone generating electrode 60 is connected to secondary terminals 58a and 58b and comprises a generally rectangular thin ceramic plate 60a and two metal electrodes (not shown) connected to the secondary terminals 58a

and 58b respectively. One of the metal electrodes is disposed on the surface of the ceramic plate 60a so as to be exposed thereon (discharge electrode). The other metal electrode is embedded in the ceramic plate 60a by means of molding (inductive electrode).
5 Further, a ceramic coating is applied to the surface of the discharge electrode in order to reduce deterioration with age. When about 4.5 kV AC stepped up by the transformer 58 is applied to the metal electrodes, these electrodes discharge via the ceramic plate 60a.

10 The left side wall of the case 54 is formed with a generally rectangular through inlet 54a through which air containing odor in the refrigerator is taken in, as viewed in FIG. 1. The case 54 further has an outlet 54b formed in the underside thereof. A catalyzer (ozone decomposing catalyzer) 61 is disposed in the
15 outlet 54b so as to close the latter. The catalyzer 61 includes a core member made by forming a ceramic honeycomb with a base of manganese oxide or a metal honeycomb into a generally rectangular plate shape. The catalyzer 61 further includes a catalytic component fixed to the core member. The catalyzer 61
20 is thus honeycombed such that a contact area thereof with ozone and odor is increased, whereupon the decomposing efficiency is increased. Air from which odor has been removed by the catalyzer 61 is caused to flow downward as viewed in FIG. 1. The honeycombed catalyzer 61 is shown as a diamond construction for
25 the sake of simplicity in FIG. 1. The deodorizer 11 thus constructed is fitted in the opening of the partition plate 5 so that the inlet 54a is directed upward or toward the cold storage compartment 6.

The operation of the deodorizer 11 will now be described. Deodorization performed by the deodorizer 11 will first be described. The deodorizer 11 electrochemically serves as a plasma deodorizer. More specifically, a corona discharge is
5 caused when a high voltage is applied to the ozonizing electrode 60. As a result, an inert gas such as Ar contained in air is ionized such that a plasma state is established:



When an electron resulting from ionization shown by chemical
10 formula (1) collides against an oxygen molecule O_2 , active oxygen O is produced:



When the active oxygen O combines oxygen molecule O_2 , ozone O_3 is produced:



Ozone O_3 produced through the above-described process as shown by the chemical formulas (1) to (3) is mixed with air flowing through the inlet 54a into the deodorizer 11 and containing odor when cold air is circulated in the refrigerator. When ozone O_3
20 and odor component are adsorbed onto the surface of the catalyzer 61, the ozone is decomposed such that active oxygen is produced. The odor component is oxidized by the active oxygen to be decomposed. Air thus deodorized is caused to flow out through the outlet 54b.

25 The above-described deodorization is carried out in the circulation path of the cold air in the cold storage compartment 6. More specifically, air containing odor flows through the inlet 54a into the deodorizer 11 together with cold air circulated

through the cold air path 9, and deodorized air is caused to flow out into the cold air path 101 in the vegetable compartment 13. In this case, since the step-up transformer 58 disposed in the transformer compartment 57 is shut off from the cold air
5 circulated in the refrigerator, only the ozonizing electrode 60 producing ozone is disposed in the electrode compartment 59 so as to be exposed to the circulated cold air.

According to the above-described embodiment, the step-up transformer 58 is disposed in the transformer chamber 57.
10 Accordingly, the transformer 58 is prevented from being directly exposed to the cold air circulated in the refrigerator and external air flowing into the refrigerator when the door 7 is opened. Consequently, changes in the temperature around the transformer 58 is reduced such that the dew condensation on the
15 transformer can be prevented. Further, the service life of the transformer 58 can be increased and the reliability thereof can be improved.

Both discharge and non-discharge surfaces of the ozonizing electrode 60 are located in the electrode chamber 59.
20 Accordingly, since the temperature gradient between the surfaces is reduced, thermal stress applied to the electrode 60 can be reduced. This can increase the service life of the electrode 60. Additionally, the electrode 60 is disposed at the cold air entrance side in the deodorizer, whereas the catalyzer 61 is
25 disposed at the cold air exit side in the deodorizer. Consequently, the production of ozone and deodorization by oxidation thereof can efficiently be performed along the flow of circulated cold air.

The cold air produced by the common refrigeration cooling unit 45 is circulated through the cold storage compartment 6 and the vegetable compartment 13. The deodorizer 11 is disposed in the boundary where the circulated cold air flows from the cold storage compartment 6 side to the vegetable compartment 13 side. Accordingly, the dead space can efficiently be used for disposition of the deodorizer 11, and the reduction in the capacity of the refrigerator can be limited. Further, since the deodorizer 11 is located in the circulated cold air feedback path side, the air containing a large amount of odor component as the result of circulation can be deodorized efficiently.

FIGS. 3 and 4 illustrate a second embodiment of the invention. Only the difference between the first and second embodiments will be described. Identical or similar parts in the second embodiment are labeled by the same reference symbols as in the first embodiment. In the second embodiment, only the location of the deodorizer differs from that in the first embodiment. More specifically, the partition plate 5A used for the partition plate 5 has a plurality of cold air flow holes 62. The location of the flow holes 62 corresponds to that of the deodorizer 11 in the first embodiment. Only one of the flow holes 62 is shown in FIG. 3.

The deodorizer 11A is disposed on the wall formed with cold air suction openings 38 of the vegetable compartment 13. As shown in FIG. 4, the deodorizer 11A is disposed between the two suction openings 38 below the cold air discharge opening 37 so that the inlet 54a thereof is directed toward the vegetable compartment 13. The case 54A of the deodorizer 11A has a shape

differing from that of the case 54 of the deodorizer 11 in the first embodiment as shown in FIG. 3. More specifically, the outlet 54b in the first embodiment is closed, and an outlet 54c is formed in the rear of the case 54A so as to communicate with the refrigeration cold air producing compartment 36, instead. A filter is attached to the inlet 54a.

According to the second embodiment, the deodorizer 11A is disposed on the wall formed with the cold air suction openings 38 in the vegetable compartment 13. Thus, the deodorizer 11A is located at a distal end of the feedback path for the circulated cold air. Consequently, the deodorization for air containing a larger amount of odor component than in the first embodiment can be performed efficiently. Further, the catalyzer 61 is disposed below the ozonizing electrode 60. Since ozone is heavier than air, the ozone flows downward. Accordingly, ozone produced near the ozonizing electrode 60 moves toward the catalyzer 61. Consequently, decomposition of ozone and decomposition of odor component can be performed efficiently. Additionally, since the ozonizing electrode 60 is disposed so that the discharge surface thereof is vertical, dust can be prevented from collecting on the electrode 60.

FIG. 5 illustrates a third embodiment of the invention. Only the difference between the second and third embodiments will be described. When the deodorizer 11A is disposed in the second embodiment, the ozonizing electrode 60 disposed in the electrode chamber 59 is covered with a covering structure 63. More specifically, the covering structure 63 is made from a resin and formed into the shape of a generally rectangular box with an open

bottom. The covering structure 63 is disposed so as to cover the electrode 60 from above. The step-up transformer 58 includes secondary side terminals 58a and 58b extending through the top of the covering structure 63.

5 According to the third embodiment, the ozonizing electrode 60 is covered with the covering structure 63. Consequently, the electrode 60 can be prevented from being directly exposed to external air flowing into the refrigerator when the vegetable compartment door 14 is opened. Since this can prevent a sudden
10 increase in the temperature of the electrode 60 due to exposure thereof to the external air, the thermal stress can further be reduced such that the service life of the electrode 60 can be improved.

FIG. 6 illustrates a fourth embodiment of the invention.
15 Only the difference between the third and fourth embodiments will be described. In the fourth embodiment, a restricting structure 64 formed into the shape of a rectangular plate is provided so as to correspond to the open bottom of the covering structure 63 in the third embodiment. The restricting structure 64 has,
20 for example, three circular openings 64a so that air containing ozone produced near the electrode 60 is caused to flow through the openings 64a to the catalyzer 61 located below the restricting structure. More specifically, a discharge starting voltage of the ozonizing electrode 60 is generally increased due to
25 deterioration with age. In view of this characteristic, it is desirable that voltage applied to the electrode 60 should previously be set at a larger value in expectation of the increase in the discharge starting voltage. However, at an initial stage

of the use of the deodorizer, the concentration of ozone in the refrigerator is expected to be relatively high.

In the fourth embodiment, however, air containing ozone gradually flows outward through the openings 64a. As a result,
5 since air containing a high concentration of ozone is prevented from direct contact with the catalyzer 61, deterioration of the catalyzer 61 can be restrained.

FIG. 7 illustrates a fifth embodiment of the invention. Only the difference between the fourth and fifth embodiments will
10 be described. In the fifth embodiment, a diffusion plate 65 is disposed horizontally between the covering structure 63 provided with the restricting structure 64 and the catalyzer 61. Air containing ozone and flowed out of the openings 64a of the restricting structure 64 is blocked by the diffusion plate 65
15 thereby to be diffused peripherally with respect to the diffusion plate. Thereafter, the air flows downward to the catalyzer 61. Thus, since the diffusion plate 65 prevents air containing high concentration of ozone from direct contact with the catalyzer 61, the deterioration of the catalyzer can further be prevented.

20 FIGS. 8 to 11 illustrate a sixth embodiment of the invention. Only the difference between the first and sixth embodiments will be described. In the sixth embodiment, the deodorizer 66 includes a case 67 having a different structure from the case 54 of the deodorizer 11 in the first embodiment. The deodorizer
25 66 is disposed in the boundary between the cold storage compartment 6 and the vegetable compartment 13 in the same manner as in the first embodiment.

The construction of the deodorizer 66 will first be

described with reference to FIGS. 9 to 11. A generally rectangular box-shaped case 67 is divided by a horizontally disposed partition wall 68 into upper and lower interiors 67D and 67U. The lower interior 67D (catalyzer chamber) has a suction hole 67Da open to the front of the cold storage compartment 6. Vertical partition walls 69 and 70 define a transformer chamber 71 in an upper right-hand corner in the upper interior 67U as viewed in FIG. 10. The other part of the upper interior 67U than the transformer chamber 71 serves as an electrode chamber 72. The step-up transformer 58 is disposed in the transformer chamber 71. The transformer 58 includes secondary side terminals 58a and 58b extending through the partition wall 69 to be exposed to the electrode chamber 72. The ozonizing electrode 60A is connected to the secondary side terminals 58a and 58b. The ozonizing electrode 60A is disposed so that the discharge surface thereof is vertical.

The partition wall 70 extends leftward so as to narrow the path of the ozone produced near the ozonizing electrode 60A and flowing toward the lower interior 67D, as viewed in FIG. 10. Further, the partition wall 68 has a communication hole 68a which is formed in the lower right-hand portion thereof so as to communicate with the lower interior 67D, as viewed in FIG. 10. The deodorizer 66 has a small suction hole 67Ua formed through a top thereof as shown in FIG. 9. Air is sucked through the suction hole 67Ua so that air in the upper interior 67U is caused to flow.

Referring to FIG. 11, a lower right-hand portion of the bottom of the deodorizer slightly projects downward and is open.

The catalyzer 73 having substantially the same construction as the catalyzer 61 in the first embodiment is disposed in the projecting portion so as to close the latter. Thus, the catalyzer 73 is disposed beneath the communication hole 68a.

5 The primary side terminals 58c of the transformer 58 are disposed on the right-hand end of the case of the transformer so as to be directed downward, as viewed in FIG. 11. Only one of the terminals 58c is shown in FIG. 11. A power supply line 74 extending from outside the deodorizer 66 is connected to the
10 primary side terminals 58c. The deodorizer 66 thus constructed is disposed on the partition plate 75 serving as the boundary between the cold storage compartment 6 and the vegetable compartment 13 as shown in FIGS. 8 and 11. A partition plate 75 employed instead of the partition plate 5 in the first
15 embodiment has an inclined portion 75a in the middle thereof. The partition plate 75 is further formed with a depression 75b extending from the inclined portion 75a just before the suction hole 67Da. A fitting hole into which the deodorizer 66 is fitted is formed in an inward portion relative to the depression 75b.
20 The projecting portion 67Db of the lower interior 67D of the deodorizer is fitted in the fitting hole.

 The cold air is circulated in the cold storage compartment 6 and the vegetable compartment 13 in the same manners as those in the first embodiment. The deodorizer 66 serves
25 electrochemically in the same manner as the deodorizer 11 in the first embodiment. More specifically, cold air circulated through the cold air path 9 in the cold storage compartment 6 is introduced into the suction hole 67Da. The cold air then flows

through the lower interior 67D, further flowing through the catalyzer 73 and the outlet 67Db into the vegetable compartment 13. Ozone is produced near the ozonizing electrode 60A in the electrode chamber 72 in the upper interior 67U of the deodorizer

5 66. When the cold air flows through the lower interior 67D as described above, a slight amount of interior air flows through the suction hole 67Ua into the electrode chamber 72. The produced ozone then flows inward, passing the partition wall 70. The cold air further flows through the communication hole 68a

10 into the lower interior 67D. The ozone is mixed with the interior air containing odor near the communication hole 68a, so that the ozone is decomposed and the odor component is decomposed by means of oxidation by the catalyzer 73. The deodorized air is caused to flow through the outlet 67Db into the vegetable compartment

15 13.

According to the sixth embodiment, the step-up transformer 58 is disposed in the transformer chamber 71 defined in the upper interior 67U of the case 67. The ozonizing electrode 60A is disposed in the electrode chamber 72. Ozone produced in the

20 electrode chamber 72 is supplied through the communication hole 68a into the lower interior 67D, being mixed with the air containing odor near the communication hole. The ozone and odor component are decomposed by the catalyzer 73. Consequently, the changes in the temperature of the transformer 58 are restrained

25 as in the first embodiment. Further, the ozonizing electrode 60A is prevented from exposure to the circulated cold air and external air flowing into the refrigerator interior when the door 7 is opened. Consequently, the temperature changes are further

restrained as in the first embodiment. Additionally, since the catalyzer 73 is disposed below the communication hole 68a through which ozone is supplied, decomposition of the ozone and odor component can be carried out efficiently.

5 Further, since the primary side terminals 58c of the step-up transformer 58 are directed downward, water can be prevented from penetrating into the primary side via the power supply line 74 etc. Additionally, the depression 75b is formed in the front half 75a of the partition plate 75 so as to be located in front
10 of the suction hole 67Da through which cold air flows into the deodorizer 66. Water flowing along the partition plate 75 toward the suction hole 67Da is caught by the depression 75b such that penetration of water into the deodorizer can be prevented.

FIG. 12 illustrates a seventh embodiment of the invention.
15 Only the sixth and seventh embodiments will be described. In the seventh embodiment, a louver 76 is provided on the deodorizer 66 for preventing foreign matter from entering the deodorizer. Since food or the like is prevented from entering the deodorizer 66, a reduction in the deodorizing efficiency can be prevented.

20 FIGS. 13 to 17 illustrate an eighth embodiment of the invention. In the eighth embodiment, the deodorizer 77 is disposed in the path through which cold air is circulated between the cold storage and vegetable compartments 6 and 13 as in the first embodiment. A partition plate 78 employed instead of the
25 partition plate 5 constitutes a part of the deodorizer 77 as shown in FIGS. 13 and 14. The case 79 of the deodorizer 77 has only the transformer chamber 80 and the electrode chamber 81. A space defined between the case 79 and the partition plate 78 when the

former is assembled to the latter constitutes the cold air chamber 82.

The direction of the transformer 58 disposed in the transformer chamber 80 differs by 90 degrees from that of the transformer in the sixth embodiment. The ozonizing electrode 84 is connected to the secondary side terminals 58a and 58b extending through the partition wall 83 of the transformer chamber 80. A portion of the case 79 located below the ozonizing electrode 84 has an inclined portion 79a slightly inclined in the direction of the depth of the electrode chamber 81 as shown in FIG. 14B. Ozone produced near the ozonizing electrode 84 is introduced by the inclined portion 79a toward the rear of the electrode chamber 81. A portion of the case 79 in the rear of the electrode chamber 81 has a plurality of ozone outlets 79b through which the ozone is caused to flow downward into the cold air chamber 82. An upper lid 85 is attached to an upper portion of the case 79 so as to cover the transformer and electrode chambers 80 and 81. A louver 86 is formed on the front of the case 79 so as to extend downward. When the case 79 is assembled to the partition plate 78, the louver 86 prevents foreign matter from entering the cold air chamber 82.

The construction at the partition plate 78 side will now be described. A mounting recess 87 is formed in a portion of the partition plate 78 to which the case 79 is assembled, as shown in FIG. 13. The partition plate 78 has two sets of inlets 88 formed at both sides of the recess 87 respectively. The cold air circulated in the refrigerator is caused to directly flow from the cold storage compartment 6 into the vegetable

compartment 13 through the inlets 88 without passing through the deodorizer 77. The partition plate 78 further has drain holes 89 formed therein so as to be located in front of the louver 86 of the case 79. When water drops are inadvertently caused to
5 fall in the refrigerator, the drain holes 89 prevent the water from entering the deodorizer 77.

An inclined portion 90 is provided in the rear of the louver 86 in the recess 87 so as to be inclined forwardly downward. The inclined portion 90 also prevents foreign matter or water from
10 entering the deodorizer 77. The catalyzer 73 is disposed in the rearmost of the recess 87 so that the cold air flows vertically through the catalyzer 73 as in the sixth embodiment. A soft tape (or sponge) is wound on the outer periphery of the catalyzer 73, and in this state, the catalyzer 73 is force-fitted into the case
15 79. A grid-like protection fence 91 is provided in the recess 87 so as to be covered with the catalyzer 73. Since a core of the catalyzer 73 is fragile, there is a possibility that the core may be broken when the worker inadvertently touches the catalyzer 73 at the underside of the case 79. In view of this problem,
20 the protection fence 91 is disposed below the case 79 in order to prevent the catalyzer 73 from being broken. Further, a rib 92 is formed along the rear peripheral edge of the recess 87 so as to surround the rear and portions of opposite sides of the case 79 mounted in the recess. The rib 92 is also provided for
25 preventing water from entering the deodorizer 77. The ozonizing electrode 84 is eliminated in FIG. 14B.

The ozonizing electrode 84 connected to the secondary side terminals 58a and 58b of the transformer 58 will now be described

with reference to FIGS. 15A to 15C. The ozonizing electrode 84 is of the surface discharge type as the electrode 60 in the first embodiment and includes an inductive electrode 94 embedded in a ceramic substrate 93 and a discharge electrode 95 disposed on the surface (discharge surface) of the ceramic substrate. The discharge electrode 95 has a plurality of protrusions 95a protruding vertically therefrom as viewed in FIG. 15C. An electric field is concentrated onto the protrusions 95a such that the discharge starting voltage of the ozonizing electrode 84 is reduced.

When cold air is circulated through the cold storage and vegetable compartments 6 and 13, most of the cold air (about 95%) directly flows from the cold storage compartment 6 into the vegetable compartment 13 through the inlets 88 and drain holes 89 of the partition plate 78. About 5% of the circulated cold air is caused to flow through the deodorizer 77. More specifically, when a total volume of cold air circulated through the cold storage and vegetable compartments 6 and 13 is 40 m³/H, about 2 m³/H of cold air flows into the deodorizer 77. When a total capacity of the cold storage and vegetable compartments 6 and 13 is 350 lit., cold air whose volume becomes about six times larger than the total capacity per hour flows through the deodorizer 77.

The transformer 58 is energized so that ozone is produced near the ozonizing electrode 84. Since the ozone produced near the electrode 84 is heavier than air, the ozone flows rearward along the inclined portion 79a of the electrode chamber 81 by the self-weight thereof, further flowing downward through the

ozone outlets 79b into the lower cold air chamber 82. When flowing through the louver 86 into the cold air chamber 82, the circulated cold air is mixed with the ozone, further flowing toward the catalyzer 73. The odor component contained in the
5 circulated cold air is decomposed by the active oxygen resulting from decomposition of ozone.

FIG. 16 shows the results of a deodorization test with ammonia serving as an index gas in the case where a gas volume of circulated cold air passing through the deodorizer 77 is
10 changed. As obvious from FIG. 16, a residual rate of ammonia becomes equal to or less than 10% within 60 minutes when a gas volume of cold air passing through the deodorizer 77 per hour becomes equal to or larger than quadrupled total capacity of the cold storage and vegetable compartments 6 and 13. FIG. 17 shows
15 the results of a sensory test also in the case where a gas volume of circulated cold air passing through the deodorizer 77 is changed. In the test, 200 gram of retort pouch curry was kept in the refrigerator in its open state for 24 hours. The retort pouch was taken out of the refrigerator and thereafter, upon
20 expiration of 5 hours, odor in the refrigerator was evaluated in three levels, that is, at odor level 1, residual odor of food is not almost perceived, at odor level 2, residual odor of food is slightly perceived, and at odor level 3, residual odor of food is clearly perceived. As obvious from FIG. 17, too, a definite
25 effect of deodorization can be achieved when a gas volume of cold air passing through the deodorizer 77 per hour becomes equal to or larger than quadrupled total capacity of the cold storage and vegetable compartments 6 and 13.

According to the eighth embodiment, ozone produced in the electrode chamber 81 of the deodorizer 77 is caused to flow downward into the cold air chamber 82 by the self-weight thereof. As a result, ozone can readily be supplied into the cold air chamber 82. Further, the ozonizing electrode 80 is disposed to be parallel with the direction in which the ozone flows into the cold air chamber 82. Consequently, the ozone can smoothly be supplied into the cold air chamber 82 without being blocked by the electrode 80. Additionally, part of the circulated cold air is caused to flow through the deodorizer 77. Consequently, deodorization can be carried out without excessive obstruction of circulation of cold air and with prevention of reduction in the cooling performance of the refrigerator. Further, the cold air whose volume exceeds the speed at which the catalyzer 73 decomposes the ozone can be prevented from flowing into the deodorizer 73, and accordingly, the deodorizing efficiency can be maintained at a proper value.

A volume of cold air flowing into the deodorizer 77 is set to be equal to or larger than quadrupled or sextupled total capacity of the cold storage and vegetable compartments 6 and 13. Consequently, the volume of cold air flowing into the deodorizer 77 is set at a suitable value according to the total capacity of the cold storage and vegetable compartments 6 and 13, and accordingly, a desired deodorizing efficiency can be achieved. Further, repeated discharge of the ozonizing electrode 84 results in deposition of nitrogen oxide on the surface of the discharge electrode 95. Even when this prevents discharge, provision of the protrusions 95a causes the discharge

starting voltage substantially to drop. Consequently, the discharge function can be maintained for a long time.

FIG. 18 illustrates a ninth embodiment of the invention. Only the difference between the eighth and ninth embodiments will be described. In the ninth embodiment, a fan 96 dedicated to the deodorizer 77 is disposed at the outlet side of the deodorizer or more specifically, below the protection fence 91 of the case 79. The fan 96 is operated independent of the fan 43 for circulating the cold air. For example, when the door 7 is provided with a switch, the fan 96 can be turned on and off by the user and a volume of air produced by the fan 96 can be increased or decreased by the user.

As the result of provision of the fan 96 dedicated to the deodorizer 77, the volume of cold air flowing into the deodorizer can be adjusted irrespective of the condition in the cold storage compartment 6. For example, the fan 96 is stopped when an amount of food is small in the refrigerator and the user does not consider that deodorization needs to be performed. On the other hand, when an amount of food is increased in the refrigerator and the user considers that deodorization needs to be performed, the fan 96 and the deodorizer 77 are operated. Further, since a volume of air flowing into the deodorizer 77 can be increased and decreased by the fan 96, the deodorizing efficiency can be adjusted when the user operates the deodorizer 77. Additionally, the fan 96 may be stopped and the transformer 58 may be deenergized when deodorization is unnecessary. As a result, electric power consumption can be reduced and the service life of the catalyzer 73 can be improved.

FIGS. 19A and 19B illustrate a tenth embodiment of the invention. Only the difference between the eighth and tenth embodiments will be described. In the tenth embodiment, a shutter 97 is rotatably mounted on the louver 86 in the deodorizer 77A. The shutter 97 is rotated by an operating member (not shown) such as a lever provided in front of the deodorizer 77 so that the user can operate the operating member. The louver 86 is closed when the shutter 97 is rotated so as to be substantially perpendicular to the direction in which the circulated cold air flows, as shown in FIG. 19A. On the other hand, the louver 86 is opened when the shutter 97 is rotated so as to be substantially parallel to the direction in which the circulated cold air flows, as shown in FIG. 19B.

Even when a volume of cold air circulated in the refrigerator is constant, rotation of the shutter 97 can change a ratio of a volume of cold air flowing into the deodorizer 77 to a volume of cold air caused to flow through the inlets 88 directly into the vegetable compartment 13. Consequently, the deodorizing efficiency can be adjusted.

FIGS. 20A and 20B illustrate an eleventh embodiment of the invention. Only the difference between the eighth and eleventh embodiments will be described. In the eleventh embodiment, shutters 98 each of which is similar to the shutter 97 in the tenth embodiment are mounted to the inlets 88 respectively. The inlets 88 are closed when the respective shutters 98 are rotated so as to be substantially perpendicular to the direction in which the circulated cold air flows, as shown in FIG. 20A. On the other hand, the inlets 88 are opened when the respective shutters 98

are rotated so as to be substantially parallel to the direction in which the circulated cold air flows, as shown in FIG. 20B. In the above-described construction, too, even when a volume of cold air circulated in the refrigerator is constant, rotation
5 of the shutters 98 can change a ratio of a volume of cold air flowing into the deodorizer 77 to a volume of cold air caused to flow through the inlets 88 directly into the vegetable compartment 13, as in the tenth embodiment. Consequently, the deodorizing efficiency can be adjusted.

10 FIG. 21 illustrates a twelfth embodiment of the invention. Various types of refrigerators have different storage capacities. Accordingly, when the same deodorizer 77 is applied to the refrigerators with different storage capacities, an ozonic concentration becomes high in a refrigerator with a small storage
15 capacity. For example, even if the catalyzer 73 is out of order such that ozone cannot normally be decomposed, the ozonic concentration needs to be at or below 0.1 ppm for extra safety.

In view of the above-described problem, the deodorizer 77 is intermittently operated according to the storage capacity of
20 each refrigerator so that the deodorizing efficiency is adjusted. For example, as shown in FIG. 21, the deodorizer 77 is operated for 36 seconds and stopped for subsequent 24 seconds (operation factor is 60%). This operation pattern is repeated. Thus, the deodorizer 77 is intermittently operated such that the
25 deodorizing efficiency can be adjusted so as to be suitable relative to the storage capacity of the refrigerator. Consequently, the deodorizer 77 can be applied to various types of refrigerators with different storage capacities.

In the first embodiment, the ozonizing electrode 60 may be disposed so that the discharge surface thereof is vertical. Consequently, dust can be prevented from collecting on the electrode 60 as in the second embodiment.

5 The deodorizer of the third embodiment may be provided with the diffusion plate 65 employed in the deodorizer of the fifth embodiment. Further, ozone diffusing means should not be limited to the diffusion plate 65. Any means for diffusing ozone may be employed.

10 The depression 75b may or may not be provided in the fifth embodiment. Further, the catalyzer 73 may or may not be disposed so as to correspond to the communication hole 68a. Additionally, the primary side terminals 58c may or may not be disposed so as to be directed downward. The location of the deodorizer should
15 not be limited to those shown in the drawings. The location of the deodorizer may be changed.

In the ninth embodiment, the fan 96 may be disposed in front of the louver 86. A switch for increasing a volume of circulated cold air may be provided on the door 7. Accordingly, when
20 powerful deodorization is desired, the switch is operated so that a larger volume of circulated cold air is caused to flow into the deodorizer 77, whereupon the deodorizing efficiency is increased. Further, an operating time of the deodorizer 77 may be changed according to a volume of circulated cold air flowing
25 into the deodorizer. For example, when the volume of circulated cold air flowing into the deodorizer is increased, the operating time of the deodorizer is increased accordingly, whereupon the deodorizing efficiency can be improved. On the other hand, when

the volume of circulated cold air flowing into the deodorizer is decreased, the operating time of the deodorizer is decreased accordingly, whereupon ozone can be prevented from staying in the deodorizer.

5 The foregoing description and drawings are merely illustrative of the principles of the present invention and are not to be construed in a limiting sense. Various changes and modifications will become apparent to those of ordinary skill in the art. All such changes and modifications are seen to fall
10 within the scope of the invention as defined by the appended claims.

WE CLAIM:

1. A deodorizer provided in a refrigerator with a circulation path through which cold air is circulated,
5 comprising:

a first chamber into which the cold air circulated in the refrigerator is disallowed to flow;

a second chamber into which the cold air circulated in the refrigerator is allowed to flow;

10 a step-up transformer disposed in the first chamber;

an ozonizing electrode disposed in the second chamber and electrically connected to a secondary side of the step-up transformer; and

an ozone decomposing catalyzer decomposing ozone produced
15 by the ozonizing electrode,

wherein the deodorizer is disposed in the circulation path in the refrigerator to deodorize the circulated cold air by use of the ozone produced by the ozonizing electrode.

20 2. A deodorizer according to claim 1, wherein the ozonizing electrode has a discharge surface on which electric discharge is caused and a non-discharge surface which is a reverse of the discharge surface, and both surfaces of the electrode are located in the second chamber.

25

3. A deodorizer according to claim 1 or 2, wherein the ozone decomposing catalyzer is disposed below the ozonizing electrode.

4. A deodorizer according to claim 1 or 2, wherein the
ozonizing electrode is disposed at an inlet side of the deodorizer
through which the circulated cold air flows into the deodorizer
and the ozone decomposing catalyzer is disposed at an outlet side
5 of the deodorizer through which deodorized cold air exits the
deodorizer.

5. A deodorizer comprising:

a transformer chamber in which a step-up transformer is
10 disposed,

an electrode chamber in which an ozonizing electrode
electrically connected to a secondary side of the step-up
transformer, the electrode chamber being separated from the
transformer chamber;

15 a communication hole communicating with the electrode
chamber; and

a cold-air chamber into which cold air circulated in a
refrigerator flows and in which an ozone decomposing catalyzer
so as to correspond to the communication hole, the ozone
20 decomposing catalyzer decomposing ozone produced by the
ozonizing electrode and supplied through the communication hole
into the cold-air chamber, whereby the cold air circulated in
the refrigerator is deodorized by use of the ozone.

25 6. A deodorizer according to claim 5, wherein the ozonizing
electrode has a discharge surface on which electric discharge
is caused and a non-discharge surface which is a reverse of the
discharge surface, and both surfaces of the electrode are located

in the electrode chamber.

7. A deodorizer according to claim 5 or 6, wherein the ozone produced in the electrode chamber is caused to flow downward to the cold-air chamber by a self-weight thereof.

5

8. A deodorizer according to claim 7, wherein the ozonizing electrode is disposed so as to be horizontal relative to a direction in which the ozone flows downward toward the cold air chamber.

10

9. A deodorizer according to claim 5, wherein the ozonizing electrode has a discharge surface and is disposed so that the discharge surface is vertical.

15

10. A deodorizer according to claim 5, wherein the step-up transformer has a primary terminal disposed so as to be directed downward.

20

11. A deodorizer according to claim 5, further comprising an inlet through which the cold air is caused to flow into the deodorizer and a louver provided in the inlet for preventing invasion of a foreign matter into the deodorizer.

25

12. A refrigerator provided with a deodorizer for deodorizing cold air circulated in the refrigerator, the deodorizer comprising:

a transformer chamber in which a step-up transformer is disposed;

an electrode chamber in which an ozonizing electrode electrically connected to a secondary side of the step-up transformer, the electrode chamber being separated from the transformer chamber;

5 a communication hole communicating with the electrode chamber; and

 a cold-air chamber into which cold air circulated in a refrigerator and in which an ozone decomposing catalyzer so as to correspond to the communication hole, the ozone decomposing
10 catalyzer decomposing ozone produced by the ozonizing electrode and supplied through the communication hole into the cold-air chamber, whereby the cold air circulated in the refrigerator is deodorized by use of the ozone.

15 13. A refrigerator according to claim 12, wherein the deodorizer is disposed at a feedback path side of the circulated cold air.

 14. A refrigerator according to claim 13, further comprising
20 a cold storage compartment, a vegetable compartment and an evaporator which is common to both compartments and produces cold air circulated through the compartments, wherein the deodorizer is disposed in a boundary through which the cold air flows from the cold storage compartment side to the vegetable compartment
25 side.

 15. A refrigerator according to claim 14, wherein the cold storage compartment includes a bottom plate including a portion

formed with a recess for preventing invasion of water into the deodorizer, and the deodorizer includes an inlet through which the circulated cold air flows into the deodorizer, the inlet being located in front of the recess.

5

16. A refrigerator provided with a deodorizer for deodorizing cold air circulated in the refrigerator, the deodorizer comprising:

a transformer chamber defined in the deodorizer so as to
10 cut off cold air circulated in the refrigerator;

a step-up transformer disposed in the transformer chamber;

an ozonizing electrode electrically connected to a secondary side of the step-up transformer and disposed outside the transformer chamber;

15 an ozone decomposing catalyzer decomposing the ozone produced by the ozonizing electrode,

wherein the circulated cold air in a cold storage compartment of the refrigerator is caused to flow through the deodorizer so that the cold air is deodorized and part of the
20 circulated cold air is allowed to flow through the deodorizer.

17. A refrigerator according to claim 16, wherein a volume of the circulated cold air flowing through the deodorizer is variable.

25

18. A refrigerator according to claim 17, wherein a ratio of the volume of the cold air flowing through the deodorizer and a volume of the cold air flowing through another portion is

variable.

19. A refrigerator according to any one of claims 16 to 18, wherein the deodorizer is operated intermittently so that a deodorizing efficiency is adjustable.

5

20. A deodorizer substantially as herein described with reference to the accompanying drawings.

21. A refrigerator substantially as herein described with
10 reference to the accompanying drawings.