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(54) Title: A COOLING DEVICE

(57) Abstract: The present invention relates to a cooling device (1) comprising a body (2) that is composed of a plurality of layers defining an inner volume to be refrigerated; a door (3) that is composed of a plurality of layers and that separates the inner volume of the body (2) from the outer environment; an insulation layer (4) with thermal insulation properties, placed into the door (3) and the body (2) forming an almost continuous layer; a plastic layer (5) that is arranged on the surfaces of the door (3) and the body (2) that face the inner volume to be refrigerated and that completely covers the insulation layer (4), and a panel (6) that is placed on the surfaces of the door (3) and the body (2) that face the outer environment and that surround and completely covers the insulation layer (4).

A COOLING DEVICE

The present invention relates to a cooling device that is used for cooling foodstuffs. The present invention in particular relates to a domestic cooling device.

Odors generated during the preparation of food at the residences of the users spread across the residence of the user. In order to eliminate said odors, embodiments comprising catalytic filters such as active carbon or zeolite and integrated to the exhaust hood have been developed. However, the exhaust hoods generate disturbing levels of noise and increase the energy consumption due to the need for high-power air suction. Furthermore, the exhaust hoods do not have the required capacity, and problems arise in completely removing such odors from the environment or neutralizing the same. In cases when technologies such as exhaust hoods, etc. do not provide an adequate solution, materials that absorb and neutralize the airborne odor molecules can be added into the paint on the outer surface of the cooling device, but since said materials do not activate in the absence of light, the desired effect cannot be provided.

In the state of the art Japanese Patent Document No. JP2005003365, a cooling device is disclosed.

The aim of the present invention is to neutralize the odor molecules during the food preparation and to prevent the formation of unpleasant odors in the residence of the user by means of the paint layer used on the surface coating of the cooling devices.

The cooling device realized in order to attain the aim of the present invention, explicated in the first claim and the respective claims thereof, comprises a body and a door that separates the inner volume of the body from the outer environment. Said door and body consist of a plurality of layers. Said layers are the photocatalytic paint layer, the panel, the insulation layer and the plastic layer in the order from the outer environment towards the body inner volume. The photocatalytic paint layer that covers the surfaces facing the outer environment of the body and the door breaks down the airborne odor molecules that are formed during the preparation of the food in the residence of the user, and creates carbon dioxide and water as by-products. The photocatalytic paint layer is activated by means of the electromagnetic radiation in the environment. Thus, the unpleasant odor molecules in the residence of the user can be eliminated without the need for using an additional device and cost advantage is provided for the user.

In said embodiment of the present invention, the cooling device comprises the photocatalytic paint layer that is obtained by combining one or more than one of semiconductor materials such as metal oxides and metal ions. The photocatalytic paint layer reacts in air or water after being

activated by means of light and forms hydroxyl radicals. The hydroxyl radicals generated play an active role in chemical degradation reactions. Therefore, the humidity generated during the preparation of the food increases the amount of radicals formed by the photocatalytic material, and provides an advantage in eliminating unpleasant odors. The semiconductor metal oxides absorb the ambient light and create free electrons and electron-hole pairs on the surface. Said free electrons and electron holes move freely on the surface. Said free electrons and electron holes react with the O2 and H2O in the air and form free hydroxyl radicals (OH•). Said radicals play role in the degradation of organic chemicals and microorganisms causing the unpleasant odors. By means of the photocatalytic paint layer covering the outer surface of the cooling device, the airborne odor molecules in the residence of the user are removed and thus, the unpleasant odors created during the preparation of food are eliminated, enabling the breaking down of the microorganisms. Thus, the residence of the user is cleaned of unpleasant odors, and the microorganisms are prevented from growing and posing risk to human health.

In said embodiment of the present invention, the photocatalytic paint layer comprises as metal oxides TiO_2 and/or ZnO and/or SnO_2 and/or CeO_2 and/or Fe_2O_3 and/or WO_3 and/or Nb_2O_5. By using said semiconductor metal oxides, the chemicals creating the unpleasant odor in the environment are enabled to be degraded via reduction and oxidation reactions and broken into smaller, harmless components. Moreover, said metal oxides can give antibacterial property to the photocatalytic paint layer and thus, prevents the growth of bacteria that may pose threat to the user health.

In said aforementioned embodiment of the present invention, the photocatalytic paint layer comprises the metal ions Ag^{+} and/or Cu^{2+} and/or Ni^{2+} and/or Co^{2+} and/or Mg^{2+} and/or Al^{3+} and/or Fe^{3+}. By using said ions, the photocatalytic paint layer is enabled to be activated with light sources emitting electromagnetic radiation at visible wavelengths (390-700nm). Thus, the need for using a light source that emits light outside the visible spectrum to activate the photocatalytic paint layer is eliminated, the photocatalytic paint layer can be activated by means of the illumination systems used in daily life and thus, cost advantage is provided.

In said embodiment of the present invention, the need for cleaning the outer surfaces of the body and the door of the cooling device is substantially eliminated. The self-cleaning property of the photocatalytic paint layer provides ease of use and improves the quality perception of the product.

In said embodiment of the present invention, the cooling device comprises an odor sensor provided on the body and/or the door so as to be positioned on the same surface as the

photocatalytic paint layer. In said embodiment of the present invention, the odor sensor detects the molecules that create the odor in the residence of the user.

In said embodiment of the present invention, the cooling device comprises a light sensor provided on the body and/or the door so as to be positioned on the same surface as the photocatalytic paint layer. By means of said light sensor, the light intensity in the residence of the user is detected.

In said embodiment of the present invention the cooling device comprises the first light source provided on the body so as to be positioned on the same surface as the photocatalytic paint layer. Said first light source improves the activation of the photocatalytic paint layer by emitting light onto the body at visible wavelengths. Thus, the photocatalytic paint layer is enabled to be activated even when the user turns off the lights that illuminate the residence and leaves the residence after the preparation of food.

In said embodiment of the present invention the cooling device comprises the second light source provided on the door so as to be positioned on the same surface as the photocatalytic paint layer. Said second light source improves the activation of the photocatalytic paint layer by emitting light onto the door at visible wavelengths. Thus, the photocatalytic paint layer is enabled to be activated even when the user turns off the lights that illuminate the residence and leaves the residence after the preparation of food.

In said embodiment of the present invention, the cooling device comprises a liquid spraying means provided on the door. Said liquid spraying means sprays liquid, preferably water, onto the photocatalytic paint layer. The activation of the photocatalytic paint layer is facilitated in the humid environment. Thus, the efficiency of the unit area of the photocatalytic paint layer is maximized and an increased amount of odor molecules is neutralized by the photocatalytic paint layer and thus, the user satisfaction is improved.

In said embodiment of the present invention, the cooling device comprises a control unit. Said control unit compares the values measured by the light sensor and the odor sensor with the values predetermined by the producer and, based on the results, detects the odor molecules and the light intensity of the environment. When the density of the odor molecules is below the threshold value predetermined by the producer, the control unit deactivates the first light source and the second light source. When the density of the odor molecules is above the threshold value predetermined by the producer, the control unit evaluates the data provided by the light sensor. When the light intensity value obtained from the light sensor is below the value

predetermined by the producer, the control unit decides that the intensity of the light that illuminates the photocatalytic paint layer is lower than the value required for the activation. In this case, the control unit activates the first and second light source and enables the photocatalytic paint layer to be activated. When the density of the odor molecules is above an upper limit predetermined by the producer, the control unit enables a liquid, preferably water to be sprayed onto the photocatalytic paint layer by means of the liquid spraying means in order to expedite the neutralization of the odor molecules by means of the photocatalytic paint layer. Thus, the activation of the photocatalytic paint layer is facilitated.

The present invention is advantageous in that the odors created during the food preparation process are absorbed and eliminated by means of the photocatalytic paint layer.

A cooling device realized in order to attain the aim the object of the present invention is illustrated in the attached figures, where:

Figure 1 – is the perspective view of the cooling device.

Figure 2 – is the side view of the cross-section taken along the line A-A shown in Figure 1.

Figure 3 – is the enlarged view of the area B in Figure 2.

The elements illustrated in the figures are numbered as follows:

1. Cooling device
2. Body
3. Door
4. Insulation layer
5. Plastic layer
6. Panel
7. Photocatalytic paint layer
8. Odor sensor
9. Light sensor
10. First light source
11. Second light source

12. Liquid spraying means

13. Control unit

The cooling device (1) of the present invention comprises a body (2) that is composed of a plurality of layers defining an inner volume to be refrigerated; a door (3) that is composed of a plurality of layers and that separates the inner volume of the body (2) from the outer environment; an insulation layer (4) with thermal insulation properties, placed into the door (3) and the body (2) forming an almost continuous layer; a plastic layer (5) that is arranged on the surfaces of the door (3) and the body (2) that face the inner volume to be refrigerated and that completely covers the insulation layer (4), and a panel (6) that is placed on the surfaces of the door (3) and the body (2) that face the outer environment and that surround and completely covers the insulation layer (4).

The cooling device (1) of the present invention comprises a photocatalytic paint layer (7) that completely covers the outer surface of the panel (6) and that is enriched with molecules that can be activated by means of electromagnetic radiation. The electromagnetic radiation that reaches the photocatalytic paint layer (7) is absorbed by said layer, and by means of the absorbed electromagnetic radiation, the airborne organic impurities (aromatics, aldehydes, fatty acids, etc.) in the air in the residence of the user are broken down by the photocatalytic paint layer (7), eliminating the unpleasant odors. Thus, the air in the kitchen is cleaned and the quality perception of the user is improved.

The cooling device (1) of the present invention comprises the photocatalytic paint layer (7) that contains TiO_2 and/or ZnO and/or SnO_2 and/or CeO_2 and/or Fe_2O_3 and/or WO_3 and/or Nb_2O_5. The activation of the photocatalytic paint layer (7) is improved by the metal oxides therein. Furthermore, the use of metal oxides provides cost advantage and thus, decreases the cost of the cooling device (1).

The cooling device (1) of the present invention comprises the photocatalytic paint layer (7) that contains the metal ions Ag^{+} and/or Cu^{2+} and/or Ni^{2+} and/or Co^{2+} and/or Mg^{2+} and/or Al^{3+} and/or Fe^{3+}. Since the photocatalytic paint layer (7) contains metal oxides (TiO_2 and/or ZnO and/or SnO_2 and/or CeO_2 and/or Fe_2O_3 and/or WO_3 and/or Nb_2O_5) and metal ions, said photocatalytic paint layer (7) can be activated by means of light at visible wavelengths. Thus, the photocatalytic paint layer (7) can be activated by means of light sources that are present in the residence of the user such as lamps, etc. that emit light at visible wavelengths and ease of use is provided.

The cooling device (1) of the present invention comprises an odor sensor (8) positioned on the photocatalytic paint layer (7). The odor sensor (8) positioned on the photocatalytic paint layer (7) covering the outer surface of the cooling device (1) detects the dissolved organic and inorganic molecules in the air in the residence of the user.

The cooling device (1) of the present invention comprises a light sensor (9) positioned on the photocatalytic paint layer (7). The light sensor (9) positioned on the photocatalytic paint layer (7) covering the outer surface of the cooling device (1) enables the light intensity in the residence of the user to be detected. Thus, the data is collected to determine whether there is sufficient light in the residence of the user to activate the photocatalytic paint layer (7).

The cooling device (1) of the present invention comprises a first light source (10) that is arranged on the body (2) and that emits light onto the photocatalytic paint layer (7) at visible wavelengths. The first light source (10) emits light onto the outer surface of the cooling device (1). Thus, the photocatalytic paint layer (7) can be activated and the molecules causing the odor in the environment are enabled to be broken down and neutralized, and thus, the quality perception of the product is improved.

The cooling device (1) of the present invention comprises a second light source (11) that is arranged on the body (3) and that emits light onto the photocatalytic paint layer (7) at visible wavelengths. The second light source (11) emits light onto the outer surface of the cooling device (1), especially onto the door (3). Thus, the photocatalytic paint layer (7) can be activated and the molecules causing the odor in the environment are enabled to be broken down and neutralized, and thus, the quality perception of the product is improved.

The cooling device (1) of the present invention comprises a liquid spraying means (12) that is arranged on the door (3) and that sprays liquid onto the photocatalytic paint layer (7). The liquid spraying means (12) sprays a liquid, preferably water onto the photocatalytic paint layer (7). The activation of the photocatalytic paint layer (7) is facilitated by using water and the airborne organic and inorganic molecules causing the odor in the environment are enabled to be neutralized more quickly.

The cooling device (1) of the present invention comprises a control unit (13) that evaluates the data received from the odor sensor (8) and the light sensor (9) and activates or deactivates the first light source (10) and/or the second light source (11) and/or the fluid spraying means (12) based on the data received. The control unit (13) detects whether an odor is present in the residence of the user or not based on the data received from the odor sensor (8). If the control

unit (13) decides that there are odor molecules in the environment based on the data received from the odor sensor (8), the control unit (13) evaluates the data received from the light sensor (9). The control unit (13) activates the first light source (10) and/or the second light source (11) upon deciding that the light intensity in the residence of the user is below the light intensity predetermined by the producer that is required for the activation of the photocatalytic paint layer (7) and enables the intensity of the light that is emitted onto the photocatalytic paint layer (7) to be increased. Likewise, the control unit (13) decides that the user is away from the cooling device (1) if the light intensity value received from the light sensor (9) is below the predetermined light intensity and activates the liquid spraying means (12) and enables the liquid, preferably water, to be sprayed onto the photocatalytic paint layer (7). Thus, the ambient conditions such as humidity and light intensity are enabled to be kept in the desired range to provide the efficient functioning of the photocatalytic paint layer (7) and the quality perception of the product is improved.

By means of the present invention, by using the photocatalytic paint, the odors created during the food preparation process in the residence of the user are enabled to be neutralized by the photocatalytic paint layer (7) even when the light intensity is not sufficient.

CLAIMS

1. A cooling device (1) comprising

- a body (2) that is composed of a plurality of layers defining an inner volume to be refrigerated;
- a door (3) that is composed of a plurality of layers and that separates the inner volume of the body (2) from the outer environment;
- an insulation layer (4) with thermal insulation properties, placed into the door (3) and the body (2) forming an almost continuous layer;
- a plastic layer (5) that is arranged on the surfaces of the door (3) and the body (2) that face the inner volume to be refrigerated and that completely covers the insulation layer (4), and
- a panel (6) that is placed on the surfaces of the door (3) and the body (2) that face the outer environment and that surround and completely covers the insulation layer (4),
- **characterized by** a photocatalytic paint layer (7) that completely covers the outer surface of the panel (6) and that is enriched with molecules that can be activated by means of electromagnetic radiation.

2. A cooling device (1) as in Claim 1, **characterized by** the photocatalytic paint layer (7) comprising TiO_2 and/or ZnO and/or SnO_2 and/or CeO_2 and/or Fe_2O_3 and/or WO_3 and/or Nb_2O_5.

3. A cooling device (1) as in any one of the above claims, **characterized by** the photocatalytic paint layer (7) comprising the metal ions Ag^+ and/or Cu^{2+} and/or Ni^{2+} and/or Co^{2+} and/or Mg^{2+} and/or Al^{3+} and/or Fe^{3+}.

4. A cooling device (1) as in any one of the above claims, **characterized by** an odor sensor (8) that is positioned on the photocatalytic paint layer (7).

5. A cooling device (1) as in any one of the above claims, **characterized by** a light sensor (9) that is positioned on the photocatalytic paint layer (7).

6. A cooling device (1) as in any one of the above claims, **characterized by** a first light source (10) that is arranged on the body (2) and that emits light onto the photocatalytic paint layer (7) at visible wavelengths.

7. A cooling device (1) as in any one of the above claims, **characterized by** a second light source (11) that is arranged on the body (3) and that emits light onto the photocatalytic paint layer (7) at visible wavelengths.

8. A cooling device (1) as in any one of the above claims, **characterized by** a liquid spraying means (12) that is arranged on the door (3) and that sprays liquid onto the photocatalytic paint layer (7).

9. A cooling device (1) as in Claim 8, **characterized by** a control unit (13) that evaluates the data received from the odor sensor (8) and the light sensor (9) and activates or deactivates the first light source (10) and/or the second light source (11) and/or the fluid spraying means (12) based on the data received.

Figure 1

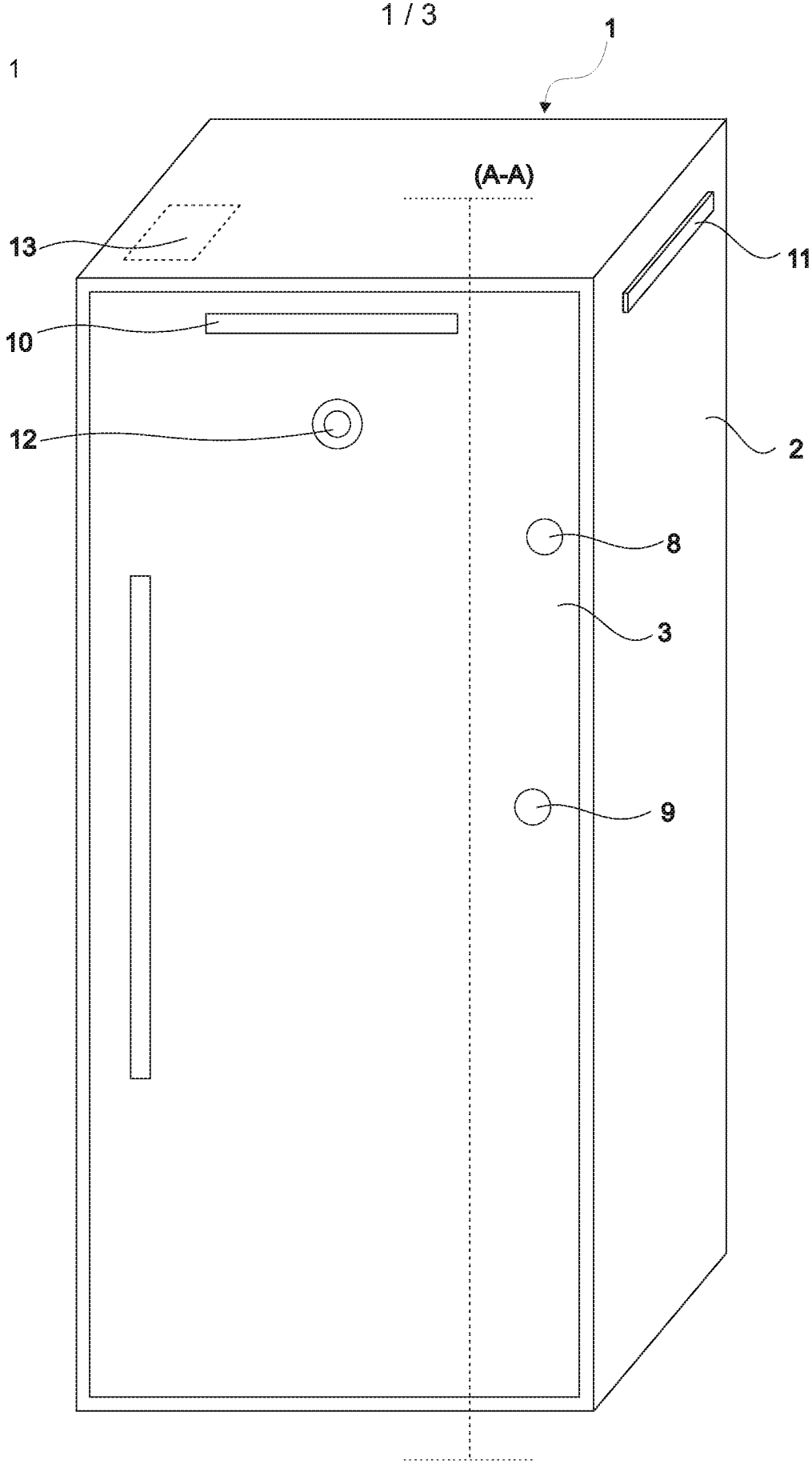

Figure 2

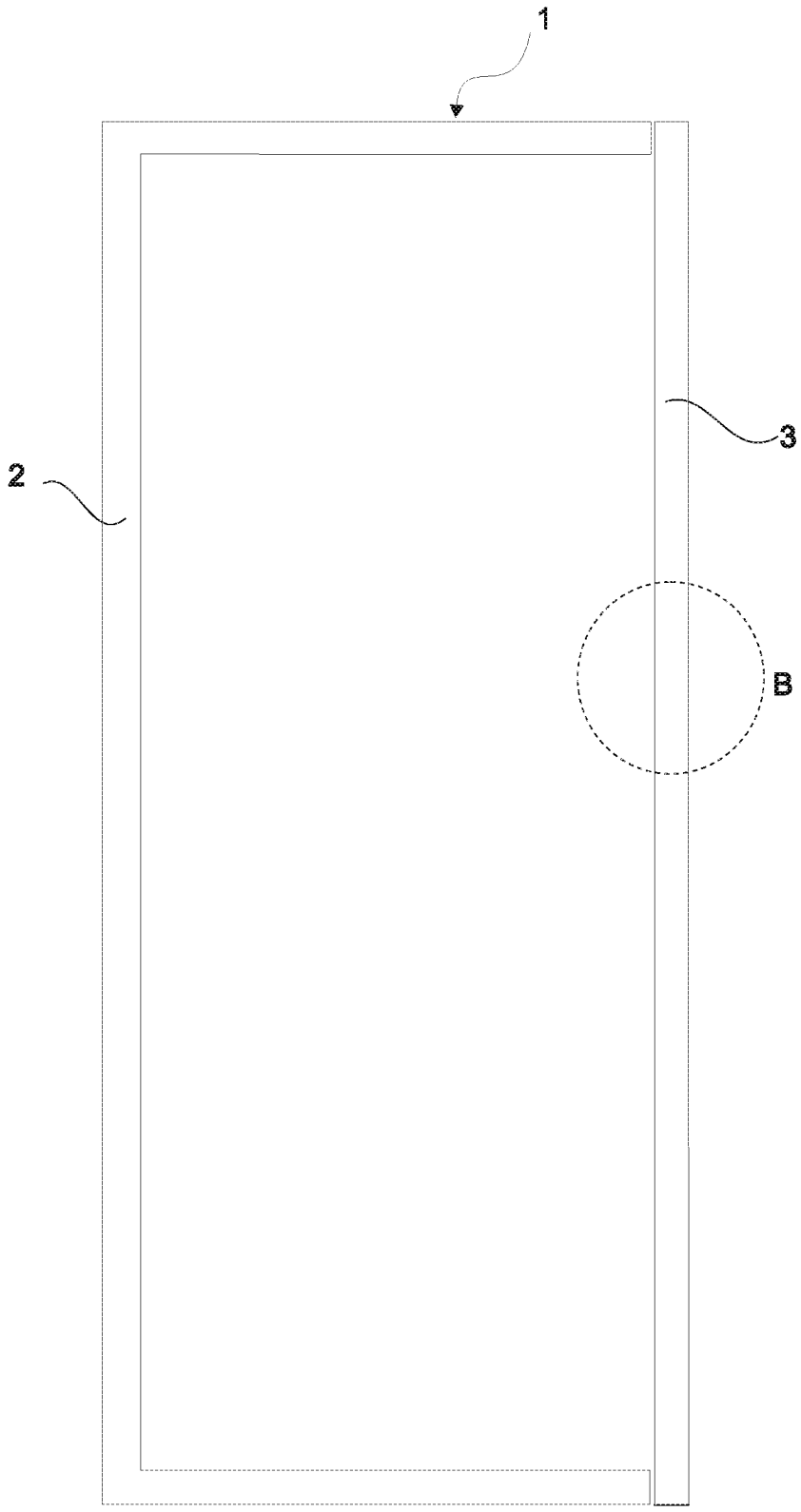

Figure 3