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| Inventor(s) | PARK; Junhyeong et al. |


# ELECTRONIC DEVICE INCLUDING FLOATING ELECTRODE STRUCTURE


## Abstract

An electronic device includes: a housing configured to provide a space capable of receiving an object to be heated; a first electrode and a second electrode for forming an electric field in the space in which the object to be heated is received; and a floating electrode disposed between the first electrode and the second electrode, the floating electrode being positioned inside the object to be heated when the object to be heated is disposed in the space.



**Inventors:** **PARK; Junhyeong (Suwon-si, KR), CHOI; Jinsoo (Suwon-si, KR), RYU; Youngho (Suwon-si, KR), CHOI; Bohwan (Suwon-si, KR)**

**Applicant:** **Samsung Electronics Co., Ltd.** (Suwon-si, KR)



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## Background/Summary

CROSS-REFERENCE TO RELATED APPLICATIONS [0001] This application continuation of International Application No. PCT/KR2023/017278 designating the United States, filed on Nov. 1, 2023, in the Korean Intellectual Property Receiving Office and claiming priority to Korean Patent Application No. 10-2022-0143694, filed on Nov. 1, 2022, in the Korean Intellectual Property Office, the disclosures of each of which are incorporated by reference herein in their entireties.

BACKGROUND

Field

[0002] The disclosure relates to an electronic device including a floating electrode structure.

Description of Related Art

[0003] Since a dielectric heating method enables energy to quickly and effectively permeate into an object and thus to heat the object so as to sterilize same, the dielectric heating method has been used in a sterilization device or a care device for various product groups including beverages, clothes, and shoes. For example, an electronic device usually called a microwave oven can easily heat an object by radiating energy of a microwave wavelength (e.g., the high frequency of 2.4 GHz to 2.5 GHz), and thus have been widely used.

[0004] For example, the dielectric heating method can be applied to electronic devices such as shoe care devices. For example, in a state where two flat plate-type electrodes are positioned on a shelf or in an inner case surrounding a shoe care room of a shoe care device, the shoes accommodated in the shoe care room can be dielectrically heated to dry the shoes and sterilize microorganisms or bacteria inside the shoes. However, in case that shoes to be heated are dielectrically heated in a state of being placed in a shoe care device, due to the low permittivity of shoes and the wide space of a shoe care room designed considering various heights of shoes, the two electrode plates for performing dielectric heating may be formed to be positioned quite far away from each other. Due to this, the electronic devices such as shoe care devices may have low dielectric heating efficiency.

[0005] In addition, for example, shoes accommodated in a shoe care device are placed in a case or on a shelf or are accommodated in a form of being mounted by a support member commonly referred to as a shoe tree, and the support member is formed to be attachable thereto or detachable therefrom. Therefore, it is difficult to perform dielectric heating in case of using the support member.

SUMMARY

[0006] Embodiments of the disclosure may provide an electronic device including a floating electrode structure (hereinafter, it may be referred to as “floating electrode disposing structure”), which can easily provide a dielectric heating environment even in case of an electronic device such as a shoe care device and can also improve heating efficiency even in case of an electronic device including an attachable/detachable support.

[0007] According to an example embodiment of the disclosure, an electronic device may include: a housing configured to provide a space capable of accommodating an object to be heated; a first electrode and a second electrode configured to form an electric field in the space in which the object to be heated is accommodated; and a floating electrode disposed between the first electrode and the second electrode, the floating electrode configured to be positioned inside the object to be heated based on the object to be heated being disposed in the space.

[0008] According to an example embodiment of the disclosure, an electronic device may include: a housing including a case configured to provide a space capable of accommodating an object to be heated, and at least one shelf configured to partition the space to accommodate the object to be heated into at least two spaces; a first electrode disposed on a portion of the case or a portion of the shelf and configured to form an electric field in the space; a second electrode disposed on a portion of the case or a portion of the shelf, opposite to the first electrode; a support configured to support the object to be heated in the space in which the object to be heated is accommodated; and a floating electrode disposed on the support, the floating electrode being disposed between the first electrode and the second electrode and being positioned inside the object to be heated based on the object to be heated being disposed in space.

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## Description

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] The above and other aspects, features and advantages of certain embodiments of the present disclosure will be more apparent from the following detailed description, taken in conjunction with the accompanying drawings, in which:

[0010] FIG. **1** is a diagram illustrating an example electronic device including a floating electrode disposing structure according to an embodiment of the disclosure.

[0011] FIG. **2**A is a perspective view of an electronic device including a floating electrode disposing structure according to an embodiment of the disclosure.

[0012] FIG. **2**B is a diagram illustrating a front view of an electronic device including a floating electrode disposing structure according to an embodiment of the disclosure.

[0013] FIG. **3** is a diagram illustrating a state in which a care function is performed in a state where an object to be heated is mounted to a support member of an electronic device according to an embodiment of the disclosure.

[0014] FIG. **4** is a diagram illustrating a state in which dielectric heating is performed by applying a voltage to two electrodes in a state where an object to be heated is disposed between the two electrodes according to an embodiment;

[0015] FIG. **5** is a perspective view illustrating a state in which a voltage is applied to two electrodes in a state where an object to be heated is disposed between the two electrodes according to an embodiment;

[0016] FIG. **6** is a is a diagram illustrating distribution of an electric field formed when a voltage is applied thereto and induction heating is performed, in a state where an object to be heated is disposed between two electrodes according to an embodiment;

[0017] FIG. **7** is a diagram illustrating distribution of an electric field formed when a voltage is applied thereto and induction heating is performed, in a state where an object to be heated and a floating structure are arranged between two electrodes according to an embodiment;

[0018] FIG. **8** is a diagram illustrating distribution of an electric field formed when a voltage is applied thereto and induction heating is performed, in a state where an object to be heated is disposed between two electrodes according to an embodiment;

[0019] FIG. **9** is a diagram illustrating distribution of an electric field formed when a voltage is applied thereto and induction heating is performed, in a state where two additional electrodes spaced apart from each other are arranged between two electrodes according to an embodiment;

[0020] FIG. **10** is a diagram illustrating distribution of an electric field formed when a voltage is applied thereto and induction heating is performed, in a state where an object to be heated and a floating structure are arranged between two electrodes according to an embodiment of the disclosure.

[0021] FIG. **11** is a diagram illustrating distribution of an electric field formed when a voltage is

applied thereto and induction heating is performed, in a state where an object to be heated and a floating structure are arranged between two electrodes according to an embodiment of the disclosure.

[0022] FIG. **12** is a cross-sectional view illustrating a state in which a support member is attached to a rail structure according to an embodiment of the disclosure.; and

[0023] FIG. **13**A and FIG. **13**B are diagrams illustrating a state in which a support member is detached from a rail structure according to an embodiment of the disclosure.

## DETAILED DESCRIPTION

[0024] Hereinafter, various example embodiments of the disclosure will be described in greater detail with reference to the accompanying drawings.

[0025] In the disclosure, the same reference numerals may be used for the same elements. The disclosure may not describe all elements of embodiments, and general contents in the technical field or contents overlapping between embodiments of the disclosure will be omitted.

[0026] In the disclosure, a reference numeral for each of steps may be used for convenience of explanation, a reference numeral does not describe the order of steps. Each of steps may be performed in a different order from the described order unless the context clearly describes a specific order.

[0027] FIG. **1** is a diagram illustrating an electronic device **10** including a floating electrode disposing structure according to an embodiment of the disclosure. FIG. **1** is a view showing a state in which shoes are mounted to an electronic device **10** by a user, according to an embodiment of the disclosure. FIG. **2**A is a perspective view of an electronic device **10** including a floating electrode disposing structure according to an embodiment of the disclosure. FIG. **2**B is a front view of an electronic device including a floating electrode disposing structure according to an embodiment of the disclosure.

[0028] In the detailed description below, the vertical width direction of the electronic device **10** may be defined as the "Y-axis direction", the horizontal width direction thereof may be defined as the "X-axis direction", and/or the height direction (the length direction/the vertical direction) thereof may be defined as the "Z-axis direction". In various embodiments, in connection with the direction in which an element is oriented, in addition to the Cartesian coordinate system illustrated in the drawings, "negative/positive (−/+)" may be mentioned together therewith. In connection with the description of directions, when 'negative/positive (−/+)' is not described, it may be interpreted as including both the + direction and the − direction unless otherwise defined. In other words, it may be interpreted that the "X-axis direction" includes both of the +X direction and the −X direction, and it may be interpreted that the "Y-axis direction" includes both of the +Y direction and the −Y direction. In connection with the description of directions, that something is oriented in one axis-direction among the three axis-directions of Cartesian coordinate system may include that something is oriented in the axis-direction and an axis-direction parallel to the axis-direction. The foregoing is based on the Cartesian coordinate system illustrated in the drawings for the sake of brevity of descriptions, and it should be noted that the descriptions of directions or elements do not limit various embodiments of the disclosure.

[0029] In the example embodiment illustrated in FIG. **1**, FIG. **2**A and FIG. **2**B (which may be referred to as FIG. **1** to FIG. **2**B), the electronic device **10** may be a shoe care device (e.g., a shoe dresser). Referring to FIG. **1** to FIG. **2**B, the electronic device **10** may include a body **100** forming the exterior thereof and a door **200** rotatably coupled to the body **100**. FIG. **1** is a front view showing a state in which a door **200** is opened with respect to a body **100**, in a shoe care device, and FIG. **2**A is a perspective view showing a state in which a door **200** is opened with respect to a body **100**, in a shoe care device, and shows a rear surface **200***b* of the door **200**. FIG. **2**B is a front view showing a state in which a door **200** is closed with respect to a body **100**, in a shoe care device, and shows a front surface **200***a* of the door **200**.

[0030] Referring to FIG. **2**A and FIG. **2**B, the electronic device **10** may include a body **100** and a

door **200** capable of being opened or closed with respect to the body **100**. The body **100** may be provided in a rectangular hexahedron shape having an open front surface. The door **200** may be rotatably coupled to the body **100** and be provided to open or close a space **104** (e.g., a care room) which is formed inside the body **100** and can accommodate an object S to be heated. The door **200** may be coupled to the body **100** through a hinge **202**. The door **200** may include a hanger **201** provided on a surface thereof, which faces the inside of the space **104** when the space **104** is closed. At least one hanger **201** may be provided. A support member (e.g., a support) **120** described in greater detail below may be hung on the hanger **201** and thus be easily stored. The use of the hanger **201** is not limited thereto, and the hanger may also be used in order to store other elements.
[0031] The door **200** may further include an input device **203** provided on a front surface of the electronic device **10**. According to an embodiment, as illustrated in FIG. **2**B, the input device **203** may be disposed on a front surface **200***a* of the door **200**. The electronic device **10** may receive various commands from the user through the input device **203**. In addition, a user may set various care courses (e.g., drying, rapidity, luxury, functionality, and the like) through the input device **203**, based on the type of shoes to be cared. For example, the input device **203** may include buttons **203***b* and **203***c* and a display panel **203***a* enabling a touch input. The display panel **203***a* may enable a touch input and may display a progress state of a care course, state information of an object to be heated (or an object to be accommodated) (e.g., shoes), and the like. A user may select the type of shoes accommodated in the space **104** inside the electronic device **10** using the input device, and set a care course appropriate for the shoes. The display panel **203***a* may display information and/or icons associated with the electronic device **10**. The information and/or icons, which can be displayed on the display panel **203***a*, may include displaying for the selected inner space (e.g., the second space **104***b*), On/Off power icon, and Play/Pause icon. However, there is no limitation on displayable information and/or the type, the shape, the size, and the display position of icons. In addition, the display panel **203***a* may display the state information of scent detected by at least one sensor **106** to be described in greater detail below. The display panel may display replacement notification of a flavor substance to be described in greater detail below. Accordingly, a user may easily identify the state information of the electronic device **10** through the display panel without opening the door **200**.
[0032] Referring to FIG. **2**A, the body **100** may include an outer case **101** forming the exterior thereof and an inner case **102** disposed inside the outer case **101**. The inner case **102** may form the space **104** (e.g., a care room) capable of accommodating the object S to be heated. The space **104** may be provided to accommodate multiple shoes. A machine room **105** may be provided under the space **104** to supply high-temperature dry air to the space **104**. The body **100** may be provided with a pump (e.g., the heat pump **140**) and a fluid channel connected to the pump, the pump and the fluid channel allowing air to circulate through the space **104** and the machine room **105**. At least one electronic component (e.g., the processor **150** including various processing circuitry) may be disposed in the machine room **105** to control the overall operation of the electronic device **10**. For example, a heat pump **140** disposed in the machine room **105** may include a fluid channel, a compressor, a condenser, an expander, an evaporator, other heat exchangers, a blowing fan, and a duct. The operation in which air is circulated by a heat pump system will be apparent to one skilled in the art, and thus the detailed description thereof may not be provided here.
[0033] The body **100** may include at least one shelf **103** for partitioning the space **104** into at least two spaces. The shelf **103** may be provided inside the body **100** in parallel to the ground. For example, the body **100** may include a first shelf **103***a* and a second shelf **103***b*, and the space **104** may be partitioned into a first space **104***a*, a second space **104***b*, and a third space **104***c* by the first shelf **103***a* and the second shelf **103***b*. This is an example embodiment to help understanding and does not limit the number of shelves **103** and spaces **104** of the disclosure. According to the example embodiment illustrated in FIG. **2**A, although it is illustrated that the space **104** includes three spaces (the first space **104***a*, the second space **104***b*, and the third space **104***c*) capable of

individually accommodating the objects S to be heated, it should also be noted that the space may be partitioned into more than 3 spaces or less than 3 spaces. As an example, the shelf **103** provided in the body **100** may be provided to be attachable to or detachable from the body **100**. Accordingly, the space **104** capable of accommodating the objects S to be heated in a state where all shelves **103** are attached to the body **100** may also be partitioned into 3 spaces illustrated in FIG. **2**A. However, according to an embodiment, at least some shelves **103** may be detached from the body **100**, and thus the space **104** capable of accommodating the object S to be heated may also be integrated into two spaces or one space. In case that the space **104** capable of accommodating the object S to be heated is integrated into two spaces or one space in a state where at least some shelves **103** are detached from the body **100**, compared to the example embodiment having three spaces, the example embodiment having two spaces or one space may easily accommodate a long object to be heated (e.g., long boots).

[0034] The support member (e.g., including a support) **120** capable of supporting the object to be heated (e.g., shoes) may be provided inside the space **104**. The support member **120** may be installed on one side surface of the inner case **102** forming the space **104**. Although FIG. **2**A illustrates that the support member **120** is positioned at the left side of the space **104**, the position of the support member **120** is not limited thereto, and the support member may also be positioned at the right side of the space **104** or at the inner rear side of the space **104**. The support member **120** may be provided to be detachable from the body **100**. At least one support member **120** may be provided. The support member **120** may be formed in a shape capable of being inserted inside the shoes.

[0035] For example, the support member **120** may be the support member **120** having a shoe tree shape for maintaining the shape of an object to be heated (e.g., shoes). The support member **120** may include a base **121** and a support part **122** which extends from one side of the base **121** to restrict a movement of an object to be heated (e.g., shoes). In addition, the support member **120** may include a support frame **123** inserted inside an object to be heated (e.g., shoes) to support the object to be heated (e.g., shoes). The support frame **123** may have a shape which extends in one direction from the base **121** to allow an object to be heated to be supported by the support frame when the object to be heated (e.g., shoes) is inserted inside the support frame. As will be described in greater detail below, the support frame **123** may perform a function of spraying air for cleaning to care for an object to be heated (e.g., shoes). According to an embodiment, the support frame **123** may include a pair of support frames **123***a* and **123***b*, and for example, in case that an object to be heated is shoes, a pair of shoes of one set may be inserted into and supported by the pair of support frames **123***a* and **123***b*, respectively.

[0036] A rail structure **110** for supporting the support member **120** may be provided in the space **104**. The support member **120** may be detachably coupled to the rail structure **110**. The rail structure **110** may be provided on one side surface of the inner case **102**. The rail structure **110** may have a shape which enables the base **121** of the support member **120** to be fitted and coupled therein.

[0037] According to an embodiment, the rail structure **110** and the support member **120** may also be provided in all spaces **104** capable of accommodating the object S to be heated, but the disclosure is not necessarily limited thereto. That is, the rail structure **110** and the support member **120** may not also be provided in a space (e.g., the third space **104***c*). For example, as illustrated in FIG. **1** and FIG. **2**A, in case that the rail structure **110** and support member **120** are not provided in a space (the third space **104***c*), it may be possible to care for various types of accommodated objects (e.g., shoes such as baby shoes and sandals which are difficult to be fit into the support member).

[0038] The rail structure **110** may be disposed to correspond to an air supply port (not shown) provided in one side surface of the inner case **102**. The rail structure **110** may include an opening (not shown) formed to be connected to the air supply port. Air for cleaning may be supplied

through the opening of the rail structure **110** by a pump (e.g., the heat pump **140**) disposed in the machine room **105** of the body **100**, so as to deodorize and/or dry an object to be heated (e.g., shoes).

[0039] According to an embodiment of the disclosure, the electronic device **10** may include a "floating electrode disposing structure" including a first electrode, a second electrode, and a third electrode (hereinafter, referred to as a "floating electrode") disposed between the first electrode and the second electrode, and thus the electronic device **10** can evenly heat (sterilize) an object regardless of the type or size of the object without expensive components provided therein. In the following example embodiments, for the convenience of explanation, as a type of object, shoes requiring sterilization may be used as an example, but it should be noted that the disclosure is not limited thereto.

[0040] The floating electrode disposing structure of the disclosure may be based on the induction heating or the dielectric heating method, and may be configured such that, when an electric field is formed around an object, the polar molecules of the object rotate or vibrate, and the frictional heat generated at this time is used to heat the object. For example, in case that the floating electrode disposing structure is applied to shoes requiring sterilization, the useful life of shoes is greatly increased. The electronic device **10** including a floating electrode disposing structure of the disclosure may be configured to heat an object using an alternating electric current having a frequency of several MHz to several tens MHz, thereby uniformly heating the outside and the inside of the object.

[0041] Some (a first electrode and a second electrode) of electrodes included in the floating electrode disposing structure may be provided in the inner case **102** or shelf **103** of the electronic device **10** as illustrated in FIG. **1**. According to an embodiment, some (a first electrode and a second electrode) of the electrodes included in the floating electrode disposing structure may be provided in each of partitioned spaces **104**. For example, the electronic device **10** may include a plurality of floating electrode disposing structures. For example, the electronic device **10** in FIG. **1** may include a first floating electrode disposing structure, a second floating electrode disposing structure, and/or an additional floating electrode disposing structure. For example, the electronic device **10** may include a first electrode **130***a* disposed on the upper part inside the inner case **102**, a second electrode **130***b* disposed on the first shelf **103***a*, and a floating electrode (the floating electrode **125** described in greater detail below with reference to FIG. **3**) disposed between the first electrode **130***a* and the second electrode **130***b*, to form one floating electrode disposing structure (e.g., a first floating electrode disposing structure). As another example, the electronic device **10** may include a first electrode **130***b* disposed on a first shelf **103***a*, a second electrode **130***c* disposed on a second shelf **103***b*, and a floating electrode (the floating electrode **125** described in greater detail below with reference to FIG. **3**) disposed between the first electrode **130***b* and the second electrode **130***c*, to form one floating electrode disposing structure (e.g., a second floating electrode disposing structure). According to an embodiment, electrodes (e.g., **130***b*) disposed on one shelf may be used together in floating electrode disposing structures different from each other. Hereinafter, in explaining various embodiments, for the convenience of explanation, the example embodiments will be described focusing on a first floating electrode disposing structure including a first electrode **130***a* disposed on the upper surface of the inner case **102**, a second electrode **130***b* disposed on the first shelf **103***a*, and a floating electrode (the floating electrode **125** described in greater detail below with reference to FIG. **3**) disposed between the first electrode **130***a* and the second electrode **130***b*. It should be noted that this can also be applied to other floating electrode disposing structures.

[0042] FIG. **3** is a diagram illustrating a state in which a care function is performed in a state where an object to be heated is mounted to a support member of an electronic device according to an embodiment of the disclosure.

[0043] Referring to FIG. **3**, the electronic device **10** of the disclosure may have a structure which

allows accommodated objects (e.g., S**1**, S**2**, S**3**) having various types and/or sizes to be easily cared. The electronic device **10** may care for some accommodated objects S**1** and S**2** in a state where the objects are raised from above the floor (e.g., the shelf) of the space **104** using a support member **120**, and may care for other accommodated objects S**3** in a state where the objects are placed on the floor (e.g., a shelf or an inner case) of the space **104** without using a support member **120**. The disclosure may provide the electronic device **10** which allows some accommodated objects S**1** and S**2** to be cared for in a state where the objects are raised from above the floor (e.g., the shelf) of the space **104** using a support member **120**, the accommodated objects being an objects to be heated.

[0044] The support member **120** may provide general care for an object to be heated (e.g., shoes S) through the support frame **123** inserted into the object to be heated (e.g., shoes S). For example, "general care" may refer, for example, to an object to be heated being cared for in a manner of spraying air for cleaning. According to an embodiment, the high-temperature dry air supplied from the heat pump **140** may dry and/or dehumidify an object to be heated. According to an embodiment, the support member **120** may include two support frames **123***a* and **123***b* which can be inserted into a pair of shoes, respectively, and an opening **124** may be formed through each of the support frame **123***a,* **123***b* to discharge air downward and thus dry and/or dehumidify an object to be heated. The electronic device **10** may perform a drying and/or a dehumidifying function, and additionally or alternatively, may also perform a deodorizing and/or a sterilizing function. According to an embodiment, the electronic device **10** may further include a filter (e.g., a UV filter (not shown)), and the filter may also perform a function of removing odor by decomposing odor particles separated from an object to be heated by the air for cleaning.

[0045] The disclosure may provide a floating electrode disposing structure to provide an improved heating function for an object to be heated, in addition to the above-described general care function using the support member **120**.

[0046] As illustrated in FIG. **3**, in a state where the first electrode **130***a* is disposed in the inner case **102** and the second electrode **130***b* is disposed on a shelf (e.g., the first shelf **103***a*), the object S to be heated, which is disposed in the space **104**, may be induction-heated even only by the first electrode **130***a* and the second electrode **130***b*. However, in this case, since the distance d between the first electrode **130***a* and the second electrode **130***b* is far, it may be difficult to sufficiently obtain the effects by induction heating. For example, in case that an object to be heated is the shoes S, the shoes may have various heights according to the type of shoes. Therefore, the space **104**, in which the shoes are accommodated, should be formed to have a large volume. Accordingly, the first electrode **130***a* and the second electrode **130***b*, which are spaced apart from each other in the inner case **102** and/or on the shelf **103**, may be formed to be spaced apart from each other by a distance corresponding to the inner case **102** having a large volume and the shelf **103** and/or the distance between shelves. In addition, since the shoes S are usually formed of fibers such as linen and cotton, or materials such as cork, urethane, polyester, leather, and the like having low permittivity, it may be difficult to obtain the effects by induction heating.

[0047] The electronic device **10** including a floating electrode disposing structure of the disclosure may perform a heat function using a floating electrode disposed between an electrode and an electrode, to significantly improve the heating effect of an object to be heated, especially the internal heating effect of an object to be heated.

[0048] Hereinafter, the internal heating effect by the floating electrode disposing structure provided in the disclosure will be described in greater detail with reference to FIGS. **4**, **5**, **6**, **7**, **8**, **9**, **10** and **11** (which may be referred to as FIGS. **4** to **11**).

[0049] FIG. **4** is a diagram illustrating a state in which dielectric heating is performed by applying a voltage to two electrodes in a state where an object to be heated is disposed between the two electrodes according to an embodiment. FIG. **5** is a perspective view illustrating a state in which a voltage is applied to two electrodes in a state where an object to be heated is disposed between the

two electrodes according to an embodiment.
[0050] The electronic device **10** may include a first electrode **130***a* and a second electrode **130***b* which are spaced apart from each other in the inner case **102** and/or on the shelf **103**. The first electrode **130***a* and the second electrode **130***b* may be arranged at positions corresponding to each other in the inner case **102** and/or on the shelf **103**. The first electrode **130***a* and the second electrode **130***b* may be flat plate-type electrodes and may have a width and a length of several tens mm. According to an embodiment, the first electrode **130***a* and the second electrode **130***b* may have substantially the same width and length. For example, the width L**1** of the first electrode **130***a* and the width L**2** of the second electrode **130***b* may be substantially the same. The electronic device **10** may perform dielectric heating using the first electrode **130***a* and the second electrode **130***b*. In case that an object to be heated is positioned in a high frequency electric field formed by the first electrode **130***a* and the second electrode **130***b*, dielectric heating may be implemented based on the principle that frictional heat loss occurs in the molecules of the object to be heated and thus the object to be heated is heated.
[0051] As mentioned above, in case that an object to be heated is the shoes S, the distance d between the first electrode **130***a* and the second electrode **130***b* may be significantly far. The first electrode **130***a* and the second electrode **130***b* may be formed to be spaced apart from each other by several hundred mm, for example, approximately 120 mm. In case that the distance between the first electrode **130***a* and the second electrode **130***b* is far, it may be difficult to effectively perform dielectric heating, and also since the permittivity of an object to be heated is low, it may be difficult to achieve a high dielectric heating effect. In the disclosure, in order to address the problems, a floating electrode **125** may be provided on the support member **120** included in the electronic device **10** to improve the dielectric heating effect.
[0052] The support member **120** may be spaced apart from the inner case **102** and/or a shelf (e.g., the first shelf **103***a*), and may be positioned approximately at the center of a space (e.g., the first space **104***a*) between the inner case **102** and/or the shelf (e.g., the first shelf **103***a*). One end (e.g., the base **121**) of the support member **120** may be fixed to the rail structure **110**, and in case that the one end (e.g., the base **121**) of the support member **120** is fixed, the other end (e.g., the support frame **123**) thereof may be disposed to protrude to a space (e.g., the first space **104***a*). According to an embodiment, the support member **120** may include various materials, but may be formed as a rigid body as a whole to stably support an object to be heated (e.g., the shoes S). Therefore, even in case that an object to be heated (e.g., the shoes S) is mounted to the support member, the support member **120** may stably support the object to be heated (e.g., the shoes S) while preventing and/or reducing the object to be heated (e.g., the shoes S) from sagging by the weight. In case that a heated object mounted to the support member **120** is the shoes S, the tongue portion or the toe cap portion of the shoes S may be positioned adjacent to the support frame **123** by inserting the shoes S into the support frame **123** of the support member **120**. The sole (e.g., including the insole, outsole, and midsole) of the shoes S may also be positioned adjacent to the support frame **123**.
[0053] According to an embodiment, a floating electrode **125** may be provided on the support member **120** of an electronic device **10**. For example, the floating electrode **125** may be disposed on the support frame **123** of the support member **120**. For another example, in case that a heated object mounted to the support member **120** is the shoes S, the floating electrode **125** on the support frame **123** of the support member **120** may be positioned at a position which at least partially overlaps a position adjacent to the tongue portion, the toe cap portion, and/or the sole portion of the shoes S. Accordingly, in case that an object to be heated (e.g., the shoes S) is mounted to the support member **120**, the floating electrode **125** may be substantially surrounded by the object to be heated (e.g., the shoes S).
[0054] The floating electrode **125** may be configured to be electrically insulated from the first electrode **130***a* and the second electrode **130***b*. In addition, the floating electrode **125** may be configured to be disposed on the support frame **123** of the support member **120** in a state of being

electrically insulated from other components. In addition, the support frame **123** may be formed of a high insulation material such as polycarbonate or an elastic material (e.g., urethane), and be insulated from the floating electrode **125**. The floating electrode **125** may be a passive element other than an active element which implements a function by itself upon receiving a command from the processor **150** or upon satisfying a set condition. Therefore, in a state of being electrically insulated from other elements, without an applied electrical input or signal, the floating electrode **125** may cause the effect of the dielectric heating function to be improved in conjunction with operations of other elements (e.g., the first electrode **130***a* and the second electrode **130***b*).

[0055] When the floating electrode **125** is viewed from above or below, the floating electrode **125** can be formed at a position overlapping the first electrode **130***a* and the second electrode **130***b*. The floating electrode **125** may be positioned between the first electrode **130***a* and the second electrode **130***b* and be positioned at a position at least partially overlapping the first electrode **130***a* and the second electrode **130***b*, and thus the floating electrode may be positioned in an electric field E**1** formed by the first electrode **130***a* and the second electrode **130***b*. According to an embodiment, by the electric field E**1** formed by the first electrode **130***a* and the second electrode **130***b*, the floating electrode **125** disposed between the first electrode **130***a* and the second electrode **130***b* may be induced. Referring to FIG. **4**, in case that an object to be heated (e.g., the shoes S) is positioned between the first electrode **130***a* and the second electrode **130***b* in a state where a voltage is applied to the first electrode **130***a* and the second electrode **130***b* and thus the electric field E**1** is formed, the electric field E**1** may be at least partially blocked by the object to be heated (e.g., the shoes S). At this time, the electric field E**1** between the first electrode **130***a* and the second electrode **130***b* may be distorted by the object to be heated (e.g., the shoes S) having a predetermined permittivity. In viewpoint of an object to be heated (e.g., the shoes S), since an electric field (hereinafter, referred to as "external electric field E**1**" with reference to an object to be heated) is formed therearound, vibration of molecules by dielectric heating may occur on the surface of an object to be heated (e.g., the shoes S). In a state where an object to be heated (e.g., the shoes S) is mounted to the support member **120** and the floating electrode **125** is substantially surrounded by the object to be heated (e.g., the shoes S), a charge may be induced in the floating electrode **125** by the external electric field E**1** formed by the first electrode **130***a* and the second electrode **130***b*. For example, the floating electrode **25** may be a conductive body formed of a metal material such as copper; in case that the floating electrode is affected by the external electric field E**1**, one side of the floating electrode is induced to have a positive (+) charge and the other side thereof is induced to have a negative (−) charge; and in case that the external electric field E**1** causing the influence thereof disappears, the floating electrode **25** may be returned to the original state thereof. The charges induced on the floating electrode **125** may form an internal electric field E**2** in the space between an object to be heated (e.g., the shoes S) and the floating electrode **125**. The dielectric heating effect for an object to be heated (e.g., the shoes S) may be significantly improved by the internal electric field E**2**. According to the disclosure, a conductive body (a floating electrode) may be disposed between two flat plate-type electrodes (the first electrode **130***a* and the second electrode **130***b*) which are physically and/or electrically spaced apart from each other, a voltage may be applied to the two flat plate-type electrodes (the first electrode **130***a* and second electrode **130***b*) to induce charge in the conductive body (a floating electrode), and thus the distance (hereinafter, referred to as "effective distance") between electrodes to dielectrically heat the two flat plate-type electrodes (the first electrode **130***a* and the second electrode **130***b*) can be reduced.

[0056] In case that the floating electrode **125** is physically spaced apart from the first electrode **130***a* and the second electrode **130***b*, the floating electrode may have various specific shapes and positions according to various embodiments. As will be described in greater detail below with reference to FIG. **7** and below, the floating electrode **125** of the disclosure may include a portion at least partially facing the first electrode **130***a* (e.g., the first portion **125***a* in FIG. **7**) and a portion facing the second electrode **130***b* (e.g., the second portion **125***b* in FIG. **7**), and the portion facing

the first electrode **130***a* (e.g., the first portion **125***a* in FIG. **7**) and the portion facing the second electrode **130***b* (e.g., the second portion **125***b* in FIG. **7**) may be formed to be electrically connected to each other. The floating electrode **125** may have a shape corresponding to the shape of the support frame **123**. For example, as illustrated in FIG. **3**, in case that the support frame **123** has an elongated rod shape having a flat elliptical cross section, the floating electrode **125** may have a cylindrical shape having a flat elliptical cross section. For another example, the floating electrode **125** may also be formed in a ring cross section shape or a loop cross section shape. For another example, the floating electrode **125** may also have a column shape having a quadrilateral cross section as illustrated in FIG. **5**. In addition, the floating electrode **125** may have various cross section shapes such as a circle, a triangle, a polygon other than a square, and the like. For another example, the floating electrode **125** may also have various polyhedral shapes including a hexahedral shape as well as a shape having a through-type opening as illustrated in drawings. For another example, the floating electrode **125** may also have a shape in which a conductive body is rolled.

[0057] In the example embodiment of FIG. **3** and FIG. **4**, although it is illustrated that the floating electrode **125** is formed along the circumference of the support frame **123**, the disclosure is not limited thereto. For example, the floating electrode **125** may also have an elongated shape extending the direction in which the support frame **123** extends. In addition, in the example embodiments of FIG. **3** and FIG. **4**, although it is illustrated that the floating electrode **125** is formed on the surface of the support frame **123** to be exposed to the outside, it should also be noted that the floating electrode **125** is formed inside the surface of the support frame **123** so as not to be exposed to the outside.

[0058] The floating electrode **125** may also be implemented as a single floating electrode or multiple floating electrodes. For example, the floating electrode **125** disposed between the first electrode **130***a* and the second electrode **130***b* may also be provided as a single floating electrode **125** or a pair of floating electrodes **125** respectively arranged on the pair of support frames **123** as illustrated in FIG. **3**, and a greater number of floating electrodes, which are not illustrated in the drawings, may be provided. FIG. **6** is a diagram illustrating distribution of an electric field formed when a voltage is applied thereto and induction heating is performed, in a state where an object to be heated is disposed between two electrodes. In the example embodiments of FIG. **6** described in greater detail below, the cross sections of an object to be heated (e.g., the shoes S), the support frame **123**, and/or the floating electrode **125** may be simply represented as a Z-axis direction component, an X-axis direction component, and a direction component parallel thereto, but it should be noted that this is for convenience of explanation.

[0059] FIG. **6** is a diagram illustrating a simulation result of an electric field formed around an object to be heated (e.g., the shoes S) and the support frame **123** in a state where the support frame **123** of the support member **120** is inserted inside an object to be heated (e.g., the shoes S). In the example of FIG. **6**, in case that the distance between the first electrode **130***a* and the second electrode **130***b* is set to 120 mm and an object to be heated (e.g., the shoes S) has a cross section of 80 mm in the Z-axis direction and 50 mm in the X-axis direction, the simulation result where a voltage is applied to the first electrode **130***a* and the second electrode **130***b* is illustrated.

[0060] FIG. **6** shows the support frame **123** not provided with the floating electrode **125**. The support frame **123** may be formed of an insulation material. Referring to FIG. **6**, in an embodiment where the floating electrode **125** is not provided, in case that a predetermined (e.g., specified) voltage is applied to the first electrode **130***a* and the second electrode **130***b*, it is shown that an electric field having a high density (approximately 20 V/m) is formed outside the surface of an object to be heated (e.g., the shoes S), with reference to the object to be heated (e.g., the shoes S). On the other hand, it is shown that an electric field having a significantly lower density is formed inside the surface of the object to be heated (e.g., the shoes S), for example, in the spaces a**1** and a**2** between the object to be heated (e.g., the shoes S) and the support frame **123**, compared to the outer

surface.

[0061] FIG. **7** is a diagram illustrating distribution of an electric field formed when a voltage is applied thereto and induction heating is performed, in a state where an object to be heated and a floating structure are arranged between two electrodes according to an embodiment. FIG. **7** is a diagram illustrating a simulation result of an electric field formed when a voltage is applied to the first electrode **130***a* and the second electrode **130***b*, when all conditions are the same except that the floating electrode **125** is additionally disposed inside the object to be heated (e.g., the shoes S) compared to FIG. **6**. In FIG. **7**, a support frame (e.g., the support frame **123** in FIG. **6**) is omitted. In the example embodiment of FIG. **7**, the first electrode **130***a* and the second electrode **130***b* may be flat plate-type electrodes as the example embodiment illustrated in FIG. **6**. Even in the example of FIG. **7**, in case that the distance between the first electrode **130***a* and the second electrode **130***b* is set to 120 mm and an object to be heated (e.g., the shoes S) has a cross section of 80 mm in the Z-axis direction and 50 mm in the X-axis direction, the simulation result where a voltage is applied to the first electrode **130***a* and the second electrode **130***b* is illustrated. In the example of FIG. **7**, as a floating electrode **125**, a floating electrode **125** having a quadrilateral cross section is additionally illustrated. The floating electrode may have a cross section of 60 mm in the Z-axis direction and 30 mm in the X-axis direction.

[0062] Referring to the example illustrated in FIG. **7**, in case that a predetermined voltage is applied to the first electrode **130***a* and the second electrode **130***b*, it is shown that an electric field having a high density (e.g., approximately 20 V/m) is formed outside the surface of an object to be heated (e.g., the shoes S), with reference to the object to be heated (e.g., the shoes S). In addition, it is shown that an electric field having a relatively high density compared to FIG. **6** is formed inside the surface of the object to be heated (e.g., the shoes S), for example, in the spaces a**1** and a**2** between the object to be heated (e.g., the shoes S) and the support frame **123**.

[0063] According to an embodiment, as illustrated in FIG. **7**, the floating electrode **125** may include a first portion **125***a* at least partially facing the first electrode **130***a* and a second portion **125***b* facing the second electrode **130***b*. In addition, the first portion **125***a* facing the first electrode **130***a* and the second portion **125***b* facing the second electrode **130***b* may be formed to be electrically connected to each other. For example, the floating electrode **125** may include a third portion **125***c* and/or a fourth portion **125***d* for connecting the first portion **125***a* and the second portion **125***b*. Although FIG. **7** shows a floating electrode **125** having a quadrilateral cross section as an example, the shape of the floating electrode **125** is not limited thereto. Accordingly, the floating electrode **125** may also further include a fifth portion which is different from the first portion **125***a* to the fourth portion **125***d*. In addition, differently from that illustrated in FIG. **7**, each of the first portion **125***a* to the fourth portion **125***d* may also include at least a part formed in a curved surface.

[0064] In the examples of FIG. **6** and FIG. **7**, in case that the distance between the first electrode **130***a* and the second electrode **130***b* is set to 120 mm and an object to be heated has a cross section of 80 mm in the Z-axis direction and 50 mm in the X-axis direction, the simulation result where a voltage is applied to the first electrode **130***a* and the second electrode **130***b* is illustrated. In the example embodiment of FIG. **6**, an electric field of about 8 volt/meter (V/m) or less may be formed in the spaces a**1** and a**2** between an object to be heated (e.g., the shoes S) and the support frame **123**. In the example embodiment of FIG. **7**, an electric field exceeding 12 volt/meter (V/m) may be formed in the space a**1** between an object to be heated (e.g., the shoes S) and the first portion **125***a* of the floating electrode **125**, and in the space a**2** between the object to be heated (e.g., the shoes S) and the second portion **125***b* of the floating electrode **125**. According to an embodiment, compared to the example embodiment of FIG. **6**, the example embodiment of FIG. **7** can obtain the effect in which the electric field is strengthened by more than three times in the inner space of the surface of an object to be heated (e.g., the shoes S). By adding the floating electrode **125**, it is identified that an electric field is strengthened inside the object S to be heated by the charge induced in the

floating electrode **125**.

[0065] In the disclosure, in case that an object to be heated (e.g., the shoes S) is disposed in the space **104**, the floating electrode **125** positioned inside the object S to be heated is included therein, and thus the internal heating effect of the object S to be heated can be significantly increased using the effect in which the effective distance forming an electric field between electrodes (the first electrode **130***a* and the second electrode **130***b*) is reduced.

[0066] Hereinafter, the floating electrode disposing structure will be described in greater detail with reference to FIGS. **8**, **9**, **10** and **11** (which may be referred to as FIG. **8** to FIG. **11**). As previously described, FIG. **8** to FIG. **11** illustrate simulation results of electric field distribution in the space **104** of a shoe care device, in which an object to be heated is accommodated.

[0067] FIG. **8** is a diagram illustrating an electric field formed when a voltage is applied thereto and induction heating is performed, in a state where an object to be heated is disposed between two electrodes according to an embodiment.

[0068] FIG. **8** illustrates a simulation result of electric field distribution formed in the space **104** between the object S to be heated and the first electrode **130***a* and between the object to be heated and the second electrode **130***b*. At this time, the first electrode **130***a* and the second electrode **130***b* may be flat plate-type electrodes.

[0069] FIG. **8** illustrates a state in which an electric field is formed around an object to be heated, in an embodiment not provided with a floating electrode. Referring to FIG. **8**, the first electrode **130***a* may be a negative (−) electrode and the second electrode **130***b* may be a positive (+) electrode. Differently from that illustrated in FIG. **8**, it is also possible that the first electrode **130***a* is formed as a positive electrode and the second electrode **130***b* is formed as a negative electrode.

[0070] The example embodiment of FIG. **8** may not have a separate support frame **123** inside an object to be heated (e.g., the shoes S). In addition, FIG. **8** shows an electric field generated when an object to be heated (e.g., the shoes S), which has permittivity different from that of the object to be heated (e.g., the shoes S) of the example embodiment of FIG. **6**, is disposed between the first electrode **130***a* and the second electrode **130***b*.

[0071] Referring to FIG. **8**, in an embodiment not provided with the floating electrode **125**, in case that a predetermined voltage is applied to the first electrode **130***a* and the second electrode **130***b*, it is identified that the electric field formed between the first electrode **130***a* and the second electrode **130***b* has a value of approximately 4 to 12 volt/meter (V/m). In the example embodiment of FIG. **8**, it is identified that the influence of an object to be heated (e.g., the shoes S) on the electric field is insignificant.

[0072] FIG. **9** is a diagram illustrating an electric field formed when a voltage is applied thereto and induction heating is performed, in a state where two additional electrodes spaced apart from each other are arranged between two electrodes according to an embodiment.

[0073] In addition, FIG. **9** illustrates a simulation result of an electric field formed in the space **104** between the object S to be heated and the first electrode **130***a* and between the object to be heated and the second electrode **130***b*. The first electrode **130***a* and the second electrode **130***b* may be flat plate-type electrodes, a flat plate-type floating electrode **125**′ as a floating electrode may be disposed between the first electrode **130***a* and the second electrode **130***b*. Two flat plate-type floating electrodes **125**′ may be arranged inside the object S to be heated, one thereof may be disposed close to the first electrode **130***a* and thus disposed to face the first electrode **130***a*, and the other thereof may be disposed close to the second electrode **130***b* and thus disposed to face the second electrode **130***b*.

[0074] In the example embodiment of FIG. **7**, in which the floating electrode **125** includes a portion (e.g., the first portion **125***a*) facing the first electrode **130***a* and a portion (e.g., the second portion **125***b*) facing the second electrode **130***b*, and the portion (e.g., the first portion **125***a*) facing the first electrode **130***a* and the portion (e.g., the second portion **125***b*) facing the second electrode **130***b* are electrically connected to each other. In the example embodiment of FIG. **9**, provided is an

embodiment in which a portion (e.g., the floating electrode **125**′) facing the first electrode **130***a* and a portion (e.g., the floating electrode **125**) facing the second electrode **130***b* are not electrically connected to each other. Referring to FIG. **9**, the first electrode **130***a* may be a negative (−) electrode and the second electrode **130***b* may be a positive (+) electrode. It is also possible that the first electrode **130***a* is formed as a positive electrode and the second electrode **130***b* is formed as a negative electrode. In this state, it is identified that an electric field of approximately 6 to 12 volt/meter (V/m) is formed between the first electrode **130***a* and the second electrode **130***b*.
Referring to FIG. **9**, in case that the floating electrodes **125**′ facing the first electrode **130***a* and the second electrode **130***b* are not electrically connected to each other even in the case that the floating electrodes **125**′ facing the first electrode **130***a* and the second electrode **130***b* are arranged inside an object to be heated (e.g., the shoes S), it is identified that the same simulation result as the example embodiment in which the floating electrodes are not arranged is obtained. Even though a voltage is applied to the first electrode **130***a* and the second electrode **130***b*, no charge is induced between the floating electrodes **125**′ facing the first electrode **130***a* and the second electrode **130***b*. Therefore, according to the example embodiment illustrated in FIG. **9**, even though a floating electrode is provided, the effect, in which the distance between the electrodes becomes substantially closer, may not be realized.
[0075] FIG. **10** is a is a diagram illustrating an electric field formed when a voltage is applied thereto and induction heating is performed, in a state where an object to be heated and a floating structure are arranged between two electrodes according to an embodiment of the disclosure.
[0076] FIG. **10** illustrates a simulation result of an electric field formed in the space **104**, in which the object S to be heated and the support frame **123** are arranged between the first electrode **130***a* and the second electrode **130***b*, in a state where the support frame **123** of the support member **120** is accommodated inside the object S to be heated. The first electrode **130***a* and the second electrode **130***b* may be flat plate-type electrodes, and a separate space (e.g., the spaces a**1** and a**2** in FIG. **7**) may not be formed between an object to be heated (e.g., the shoes s) and the floating electrode **125**. According to an embodiment, the floating electrode **125** may be configured as an electrode having a hollow part **126** formed therein. For example, the floating electrode **125** may be formed to have a cross section having a long rectangular shape, and may have one portion (e.g., the first portion **125***a* in FIG. **7**) facing the first electrode **130***a* and the other portion (e.g., the second portion **125***b* in FIG. **7**) facing the second electrode **130***b*. In addition, the other surface of the floating electrode may form an electrical movement path for charges.
[0077] Referring to FIG. **10**, the first electrode **130***a* may be a negative (−) electrode and the second electrode **130***b* may be a positive (+) electrode. It is also possible that the first electrode **130***a* is formed as a positive electrode and the second electrode **130***b* is formed as a negative electrode. In this state, it is identified that an electric field exceeding approximately 20 volt/meter (V/m) is formed around an object to be heated (e.g., the shoes S). Referring to FIG. **10**, in case that the floating electrode **125** is disposed inside an object to be heated (e.g., the shoes S), it is identified that a simulation result, in which an electric field having a significantly high density is formed, is obtained, in case that a portion (e.g., the first portion **125***a*) facing the first electrode **130***a* and a portion (e.g., the second portion **125***b*) facing the second electrode **130***b* are electrically connected to each other. According to the example embodiment illustrated in FIG. **10**, the floating electrode **125** may be provided, and thus the effect, in which the distance between two electrodes **130***a* and **130***b* is substantially shortened, can be realized.
[0078] FIG. **11** is a diagram illustrating an electric field formed when a voltage is applied thereto and induction heating is performed, in a state where an object to be heated and a floating structure are arranged between two electrodes according to an embodiment of the disclosure.
[0079] FIG. **11** illustrates a simulation result of an electric field formed in the space **104**, in which the object to be heated (e.g., the shoes S) and the support frame **123** are arranged between the first electrode **130***a* and the second electrode **130***b*, in a state where the support frame **123** of the support

member **120** is accommodated inside the object to be heated (e.g., the shoes S). The first electrode **130***a* and the second electrode **130***b* may be flat plate-type electrodes, and a separate space (e.g., the spaces a**1** and a**2** in FIG. **7**) may not be formed between an object to be heated (e.g., the shoes s) and the floating electrode **127**. According to an embodiment, the floating electrode **127** may be configured as an electrode having a hexahedral shape. In addition, the floating electrode **127** may be configured as an electrode in which the inner space thereof is filled. For example, the floating electrode **127** may be formed in a shape having a quadrilateral cross section and no hollow part, and may have one surface facing the first electrode **130***a* and the other surface facing the second electrode **130***b*.

[0080] Referring to FIG. **11**, the first electrode **130***a* may be a negative (−) electrode and the second electrode **130***b* may be a positive (+) electrode. It is also possible that the first electrode **130***a* is formed as a positive electrode and the second electrode **130***b* is formed as a negative electrode. In this state, it is identified that an electric field exceeding approximately 20 volt/meter (V/m) is formed around an object to be heated (e.g., the shoes S). Referring to FIG. **11**, it is identified that a simulation result, in which an electric field having a significantly high density is formed, is obtained even in case that the floating electrode **127** having a hexahedral shape and a filled inner part is disposed inside an object to be heated (e.g., the shoes S). That is, as the embodiment illustrated in FIG. **11**, the floating electrode **127** may be provided, and thus the effect, in which the distance between electrodes is substantially shortened, can be realized.

[0081] To summarize the above description, in the electronic device **10** including two flat plate-type electrodes, in case that the floating electrode disposing structure **125** or **127** is provided in the space between the two flat plate-type electrodes **130***a* and **130***b*, the electric field between the two flat plate-type electrodes can be strengthened. On the other hand, a floating electrode disposing structure may be provided in the space between the two flat plate-type electrodes **130***a* and **130***b*, and thus the electrical distance between the flat plate-type electrodes **130***a* and **130***b* can also be substantially shortened. However, in this case, the floating electrode disposing structure **125** or **127** may be configured to face each of the first electrode **130***a* and the second electrode **130***b*, but if two flat plate-type electrodes (the flat plate-type electrodes **125**′ in FIG. **9**), which are not electrically connected to each other, are configured to face the first electrode **130***a* and the second electrode **130***b*, respectively, the expected effect cannot be obtained. Therefore. at least two surfaces (or electrodes) should be oriented toward the first electrode **130***a* and the second electrode **130***b* and the at least two surfaces (or electrodes) should be electrically connected to each other.

[0082] Referring again to FIG. **1** to FIG. **4**, according to an embodiment of the disclosure, the electronic device **10** may include the processor **150**, and the processor **150** may be configured to adjust intensity of voltages applied to the first electrode **130***a* and the second electrode **130***b*, based on the permittivity of an object to be heated (e.g., the shoes S). According to an embodiment, the electronic device **10** may detect the permittivity of an object to be heated (e.g., the shoes S) through at least one sensor. For example, shoes having wet soles may have permittivity higher than that of dry shoes. In this case, the processor **150** may determine that an object S to be heated needs to be heated to a higher temperature, to apply a higher voltage to the first electrode **130***a* and the second electrode **130***b*. For example, this may correspond to an operation implemented by the rapidity, luxury, or functionality button **203***c* in FIG. **2**B pressed by a user.

[0083] The voltage applied to the electrode by the processor **150** may be in the form of an alternating current. For example, an alternating electric current having a frequency range of several MHz to several tens of MHz may be applied to the first electrode **130***a* and the second electrode **130***b*.

[0084] FIG. **12** is a cross-sectional view illustrating a state in which a support member **120** is attached to a rail structure **110** according to an embodiment of the disclosure. FIG. **13**A and FIG. **13**B are perspective views illustrating a state in which a support member **120** is detached from a rail structure **110** according to an embodiment of the disclosure.

[0085] According to an embodiment t of the disclosure, an electrostatic prevention/reduction structure may be provided using the configuration that the support member **120** is attached to or detached from the body **100**.
[0086] According to an embodiment, the support member **120** may include a conductive path **128** connected to the floating electrode **125**. The support member **120** may include the conductive path **128** extending from the floating electrode **125** formed on a support frame **123** toward the base **121**, and a terminal **128***a* of the conductive path may be formed at an end of the base **121**.
[0087] Referring to FIG. **12**, FIG. **13**A and FIG. **13**B together, the support member **120** may be attached to and detached from the rail structure **110** in a sliding manner, may be detached from a ground terminal **111** formed in the rail structure **110** in the process of being detached from the rail structure, and may be in contact with the ground terminal **111** formed in the rail structure **110** in the process of being attached to the rail structure, thereby forming a discharging path.
[0088] A separate space may be required in case that an electrostatic prevention/reduction structure is provided by wire. However, as illustrated in FIG. **12**, FIG. **13**A and FIG. **13**B, the electronic device of the disclosure may provide an electrostatic prevention/reduction structure using the structure in which the support member **120** is attached or detached, to effectively remove and/or prevent/reduce static electricity without separate space.
[0089] The electronic device according to an embodiment of the disclosure may be one of various types of devices. For example, the electronic device may include a shoe care device, a clothing care device, a medical appliance, as well as various home appliances, or the like. The electronic device according to embodiments of the disclosure is not limited to those described above.
[0090] It should be appreciated that the various example embodiments and the terms used therein are not intended to limit the technological features set forth herein to particular embodiments and the disclosure includes various changes, equivalents, and/or alternatives for a corresponding embodiment. With regard to the description of the drawings, similar reference numerals may be used to designate similar or relevant elements. A singular form of a noun corresponding to an item may include one or more of the items, unless the relevant context clearly indicates otherwise. As used herein, each of such phrases as “A or B,” “at least one of A and B,” “at least one of A or B,” “A, B, or C,” “at least one of A, B, and C,” and “at least one of A, B, or C,” may include any one or all possible combinations of the items enumerated together in a corresponding one of the phrases. Such terms as “a first,” “a second,” “the first,” and “the second” may be used to simply distinguish a corresponding element from another, and does not limit the elements in other aspect (e.g., importance or order). If an element (e.g., a first element) is referred to, with or without the term “operatively” or “communicatively”, as “coupled with/to” or “connected with/to” another element (e.g., a second element), the element may be coupled/connected with/to the other element directly (e.g., wiredly), wirelessly, or via a third element.
[0091] As used in an embodiment of the disclosure, the term “module” may include a unit implemented in hardware, software, or firmware, or any combination thereof, and may be interchangeably used with other terms, for example, “logic,” “logic block,” “component,” or “circuit”. The “module” may be a single integrated component, or a minimum unit or part thereof, adapted to perform one or more functions. For example, according to an embodiment, the “module” may be implemented in the form of an application-specific integrated circuit (ASIC).
[0092] According to various embodiments, each element (e.g., a module or a program) of the above-described elements may include a single entity or multiple entities, and some of the multiple entities may also be separately disposed in another element. According to an embodiment, one or more of the above-described elements may be omitted, or one or more other elements may be added. Alternatively or additionally, a plurality of elements (e.g., modules or programs) may be integrated into a single element. In such a case, according to various embodiments, the integrated element may still perform one or more functions of each of the plurality of elements in the same or similar manner as they are performed by a corresponding one of the plurality of elements before the

integration. According to various embodiments, operations performed by the module, the program, or another element may be carried out sequentially, in parallel, repeatedly, or heuristically, or one or more of the operations may be executed in a different order or omitted, or one or more other operations may be added.

[0093] According to an embodiment of the disclosure, provided may be an electronic device **10** including: a housing **101** configured to provide a space **104** capable of accommodating an object S to be heated; a first electrode **130***a* and a second electrode **130***b* forming an electric field in the space **104** in which the object S to be heated is accommodated; and a floating electrode **125** disposed between the first electrode **130***a* and the second electrode **130***b*, the floating electrode **125** configured to be positioned inside the object S to be heated based on the object S to be heated being disposed in the space **104**.

[0094] According to an embodiment, the electronic device **10** may be a shoe care device configured to accommodate, in the space, shoes as an object to be heated.

[0095] According to an embodiment, a support member **120**, which is configured to support the object S to be heated in the space **104** in which the object S to be heated is accommodated, may be further included therein.

[0096] According to an embodiment, based on the electronic device being a shoe care device, the support member may be a shoe tree.

[0097] According to an embodiment, the floating electrode may be formed in a form of being exposed from the support member to the outside or be formed in a form of not being exposed to the outside in a state of being disposed inside the support member.

[0098] According to an embodiment, the electronic device may include an attachable/detachable rail to allow the support member to be attached or detached.

[0099] According to an embodiment, in case that the support member is attached, the floating electrode may be electrically connected to a ground electrode provided in the attachable/detachable rail.

[0100] According to an embodiment, a case, which forms the space **104** capable of accommodating the object S to be heated, may be included therein.

[0101] According to an embodiment, at least one shelf, which is configured to partition the space **104** capable of accommodating the object S to be heated into at least two spaces, may be included therein.

[0102] According to an embodiment, the first electrode **130***a* and the second electrode **130***b* may be flat plate-type electrodes embedded in the case or the shelf.

[0103] According to an embodiment, the floating electrode **125** may be formed in a loop shape surrounding a hollow part thereof.

[0104] According to an embodiment, the floating electrode **125** may be formed in a hexahedral shape.

[0105] According to an embodiment, the floating electrode **125** may include at least two surfaces facing the first electrode and the second electrode.

[0106] According to an embodiment, a processor may be further included therein, and the electronic device may be configured to adjust intensity of voltages applied to the first electrode and the second electrode by the processor, based on the permittivity of the object to be heated.

[0107] According to an embodiment, an alternating electric current having a frequency range of several MHz to several tens of MHz may be configured to be applied to the first electrode and the second electrode.

[0108] According to an embodiment of the disclosure, provided may be an electronic device **10** including: a housing **101** including a case **102** configured to provide a space **104** capable of accommodating an object S to be heated, and at least one shelf **103** configured to partition the space **104** capable of accommodating the object S to be heated into at least two spaces; a first electrode **130***a* formed on a portion of the case or a portion of the shelf to form an electric field in

the space **104**; a second electrode **130***b* formed on a portion of the case or a portion of the shelf, which is opposite to the first electrode **130***a;* a support member **123** configured to support the object S to be heated in the space **104** in which the object S to be heated is accommodated; and a floating electrode **125** formed on the support member, the floating electrode **125** being disposed between the first electrode **130***a* and the second electrode **130***b* and being positioned inside the object S to be heated in case that the object S to be heated is disposed in space **104**.

[0109] In the above descriptions, although specific embodiments are described in the detailed description of an embodiment of the disclosure, it will be apparent to one skilled in the art that various changes are possible within the range without departing from the gist of the disclosure. For example, the electronic device of the disclosure is not limited to a shoe care device which cares about footwear (e.g., the shoes S) as an object to be heated, and may be applied to care about devices for various other products, including a clothing care device.

[0110] While the disclosure has been illustrated and described with reference to various example embodiments, it will be understood that the various example embodiments are intended to be illustrative, not limiting. It will be further understood by those skilled in the art that various modifications, alternatives and/or variations of the various example embodiments may be made without departing from the true technical spirit and full technical scope of the disclosure, including the appended claims and their equivalents. It will also be understood that any of the embodiment(s) described herein may be used in conjunction with any other embodiment(s) described herein.

## Claims

**1**. An electronic device comprising: a body including a space configured to accommodate an object to be heated; a first electrode and a second electrode configured to form an electric field in the space in which the object to be heated is accommodated; and a floating electrode disposed between the first electrode and the second electrode, the floating electrode configured to be positioned inside the object to be heated based on the object to be heated being positioned in the space.

**2**. The electronic device of claim 1, wherein the electronic device comprises a shoe care device configured to accommodate, in the space, shoes as the object to be heated.

**3**. The electronic device of claim 1, further comprising a support member comprising a support configured to support the object to be heated in the space in which the object to be heated is accommodated.

**4**. The electronic device of claim 3, wherein based on the electronic device being a shoe care device, the support member comprises a shoe tree.

**5**. The electronic device of claim 3, wherein the floating electrode is exposed from the support member to the outside or not exposed to the outside in a state of being disposed inside the support member.

**6**. The electronic device of claim 1, wherein the electronic device comprises a rail structure including a rail configured to allow the support member to be attached or detached.

**7**. The electronic device of claim 6, wherein based on the support member being attached, the floating electrode is electrically connected to a ground electrode provided in the rail structure.

**8**. The electronic device of claim 1, further comprising a case forming the space capable of accommodating the object to be heated.

**9**. The electronic device of claim 8, further comprising at least one shelf configured to partition the space and configured to accommodate the object to be heated into at least two spaces.

**10**. The electronic device of claim 9, wherein the first electrode and the second electrode comprise flat plate-type electrodes embedded in the case or the shelf.

**11**. The electronic device of claim 1, wherein the floating electrode has a loop shape surrounding a hollow part thereof.

**12**. The electronic device of claim 1, wherein the floating electrode has a hexahedral shape.

**13**. The electronic device of claim 1, wherein the floating electrode comprises at least two portions facing the first electrode and the second electrode respectively, and the at least two portions are electrically connected to each other.

**14**. The electronic device of claim 1, further comprising at least one processor, comprising processing circuitry, wherein the electronic device is configured to adjust intensity of voltages applied to the first electrode and the second electrode by at least one processor, individually and/or collectively, based on the permittivity of the object to be heated.

**15**. The electronic device of claim 1, wherein an alternating electric current having a frequency range of several MHz to several tens of MHz is configured to be applied to the first electrode and the second electrode.

**16**. An electronic device comprising: a housing including a case configured to provide a space capable of accommodating an object to be heated, and at least one shelf configured to partition the space capable of accommodating the object to be heated into at least two spaces; a first electrode formed on a portion of the case or a portion of the shelf to form an electric field in the space; a second electrode formed on a portion of the case or a portion of the shelf, which is opposite to the first electrode; a support member configured to support the object to be heated in the space **104** in which the object to be heated is accommodated; and a floating electrode formed on the support member, the floating electrode being disposed between the first electrode and the second electrode and being positioned inside the object S to be heated in case that the object S to be heated is disposed in space.

**17**. The electronic device of claim 16, wherein the first electrode and the second electrode comprise flat plate-type electrodes embedded in the case or the shelf.

**18**. The electronic device of claim 16, wherein the floating electrode has a loop shape surrounding a hollow part thereof.

**19**. The electronic device of claim 16, further comprising at least one processor, comprising processing circuitry, wherein the electronic device is configured to adjust intensity of voltages applied to the first electrode and the second electrode by at least one processor, individually and/or collectively, based on the permittivity of the object to be heated.

**20**. The electronic device of claim 16, wherein the first electrode and the second electrode are configured such that an alternating electric current having a frequency range of several MHz to several tens of MHz is applied to the first electrode and the second electrode.