(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
31 March 2022 (31.03.2022)

WIPO | PCT

(10) International Publication Number
WO 2022/065608 A1

(51) International Patent Classification:
A47J 36/02 (2006.01) *H05B 6/64* (2006.01)
A47J 36/04 (2006.01) *H05B 11/00* (2006.01)

(21) International Application Number:
PCT/KR2021/000708

(22) International Filing Date:
19 January 2021 (19.01.2021)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
10-2020-0122564 22 September 2020 (22.09.2020) KR

(71) Applicants: **LG ELECTRONICS INC.** [KR/KR]; 128, Yeoui-daero, Yeongdeungpo-gu, Seoul 07336 (KR). **MOKPO NATIONAL UNIVERSITY INDUSTRY-ACADEMIC COOPERATION FOUNDATION** [KR/KR]; 1666, Yeongsan-ro, Cheonggye-myeon, Muan-gun, Jeollanam-do 58554 (KR).

(72) Inventors: **SHIN, Jaeyoung**; IP Center, LG Electronics Inc., 51, Gasan digital 1-ro, Geumcheon-gu, Seoul 08592 (KR). **SIM, Sunghun**; IP Center, LG Electronics Inc., 51, Gasan digital 1-ro, Geumcheon-gu, Seoul 08592 (KR). **HA, Junghyeong**; IP Center, LG Electronics Inc., 51, Gasan digital 1-ro, Geumcheon-gu, Seoul 08592 (KR). **LEE, Yongsoo**; IP Center, LG Electronics Inc., 51, Gasan digital 1-ro, Geumcheon-gu, Seoul 08592 (KR). **KIM, Taeho**; IP Center, LG Electronics Inc., 51, Gasan digital 1-ro, Geumcheon-gu, Seoul 08592 (KR). **KIM, Taehee**; IP Center, LG Electronics Inc., 51, Gasan digital 1-ro, Geumcheon-gu, Seoul 08592 (KR). **SON, Seokkyun**; 106-102, 69, Yeonsanbaengnyeon-ro 1beon-gil, Mokpo-si, Jeollanam-do 58763 (KR). **KIM, Dohun**; A-202, 13-1, Singu-ro 42beon-gil, Giheung-gu, Yongin-si, Gyeonggi-do 16971 (KR).

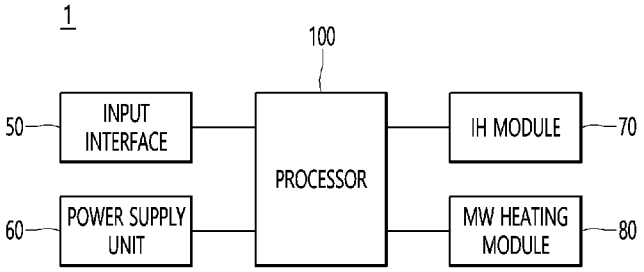
(74) Agent: **HAW, Yong Noke**; 6th Fl., HyunJuk Bldg., 114, Yeoksam-ro, Gangnam-gu, Seoul 06252 (KR).

(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DJ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, IT, JO, JP, KE, KG, KH, KN, KP, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, WS, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Published:
— *with international search report (Art. 21(3))*

(54) Title: COOKING APPLIANCE



(57) Abstract: The present disclosure comprises a housing that defines a cavity therein, a door connected to the housing and configured to open and close the cavity, a microwave (MW) heating module configured to emit microwaves into the cavity, and an induction heating (IH) module configured to emit a magnetic field toward the cavity, the IH module comprises a shielding member through which the magnetic field generated by a working coil of the IH module passes and which blocks microwaves emitted from the MW heating module, and the shielding member comprises any one of carbon paper or carbon fabric woven with carbon fiber.

WO 2022/065608 A1

Description

Title of Invention: COOKING APPLIANCE

Technical Field

[1] The present disclosure relates to a cooking appliance.

Background Art

[2] Various types of cooking appliances are used to heat food at home or in a restaurant. For example, various cooking appliances such as microwave ovens, induction heating type electric stoves, and grill heaters are used.

[3] The microwave oven is a high-frequency heating type cooking appliance, uses a principle that molecules in the high-frequency electric field vibrate violently and thus generates heat, and can heat food evenly in a short time.

[4] The induction heating type electric stove is a cooking appliance that heats an object to be heated using electromagnetic induction. Specifically, the induction heating type electric stove generates an eddy current in the object to be heated made of metal by using a magnetic field generated around the coil when a predetermined amount of high-frequency power is applied to the coil and thus can heat the object to be heated itself.

[5] The grill heater is a cooking appliance that heats food by causing infrared heat to be radiated or convected, and since infrared heat penetrates the food, food can be cooked evenly throughout.

[6] As described above, as cooking appliances using various types of heat sources have been released, the number and types of cooking appliances provided to users have increased, and thus there is a problem that these cooking appliances occupy a large volume in a living space. Accordingly, demands from users for a complex cooking appliance including a plurality of heating modules are increasing. In addition, there is a need to develop a cooking appliance using a plurality of heating methods simultaneously so that food in an object to be heated is cooked more uniformly and quickly.

[7] Republic of Korea Patent Publication No. 10-2018-0115981 (published on October 24, 2018) describes a cooking appliance that provides a microwave and an induction heating heat source in one appliance. However, the conventional cooking appliance is configured to cover the induction heating coil through a shielding cover when a microwave heat source is used, so that the two heat sources are not used simultaneously.

[8] In addition, conventional cooking appliances have the inconvenience of rotating the shielding cover every time a microwave heat source is used, and there are limits that the structure thereof is complicated and the manufacturing cost thereof increases

because a rotary motor for rotating the shielding cover or the like must be separately provided.

Disclosure of Invention

Technical Problem

[9] An object of the present disclosure is to provide a complex cooking appliance having a plurality of heat sources.

[10] An object of the present disclosure is to provide a cooking appliance including a microwave (MW) heating module and an induction heating (IH) module. More specifically, an object of the present disclosure is to provide a cooking appliance in which the MW heating module and the IH module can simultaneously heat an object to be heated.

[11] An object of the present disclosure is to provide a cooking appliance capable of maximizing the efficiency of the IH module when the MW heating module and the IH module simultaneously heat an object to be heated.

Solution to Problem

[12] A cooking appliance according to an embodiment of the present disclosure may comprise an MW heating module configured to emit microwaves into the cavity and an IH module configured to emit a magnetic field toward the cavity, the IH module may comprise a working coil and a shielding member, and the shielding member may comprise any one of carbon paper or carbon fabric woven with carbon fibers.

[13] In addition, the thickness of the shielding member of the cooking appliance according to the embodiment of the present disclosure may be thicker than a skin depth caused by electromagnetic waves emitted from the MW heating module, and thinner than a skin depth caused by the electromagnetic waves emitted from the IH module so that the shielding member may block microwaves and pass an induced magnetic field.

Advantageous Effects of Invention

[14] According to the present disclosure, since the shielding member of the cooking appliance passes an induced magnetic field generated from a working coil and simultaneously blocks microwaves, there is an advantage that the MW heating module and the IH module can be simultaneously driven.

[15] In addition, since the shielding member is composed of any one of carbon fabric or carbon paper, heating by the IH module is minimized, thereby minimizing a decrease in heating efficiency of the IH module.

[16] In addition, since the shielding member is composed of any one of carbon fabric or carbon paper, it is possible to simplify the structure of a cooking appliance that can use the IH module and the MW heating module at the same time, and the manufacturing process thereof is simplified.

[17] In addition to the above-described effects, specific effects of the present disclosure will be described together while describing specific details.

Brief Description of Drawings

[18] Fig. 1 is a perspective view illustrating a cooking appliance according to an embodiment of the present disclosure.

[19] Fig. 2 is a control block diagram illustrating a cooking appliance according to an embodiment of the present disclosure.

[20] Fig. 3 is an exemplary view illustrating a shielding member provided in the cooking appliance of the present disclosure, viewed from the side.

[21] Figs. 4 and 5 are views illustrating the surface of the shielding member when the shielding member of the present disclosure is made of carbon fabric as a single material.

[22] Fig. 6 is a view illustrating the surface of the shielding member when the shielding member of the present disclosure is made of carbon fabric whose surface has been processed.

[23] Fig. 7 is a view illustrating the surface of the shielding member when the shielding member of the present disclosure is made of carbon paper.

[24] Fig. 8 is a perspective view illustrating a shielding member and a working coil provided in the cooking appliance of the present disclosure.

[25] Fig. 9 is a cross-sectional view illustrating the cooking appliance according to a first embodiment of the present disclosure.

[26] Fig. 10 is a cross-sectional view illustrating a cooking appliance according to a second embodiment of the present disclosure.

[27] Fig. 11 is an exploded perspective view illustrating an IH module according to a third embodiment of the present disclosure.

[28] Fig. 12 is a cross-sectional view illustrating a cooking appliance according to a third embodiment of the present disclosure.

Best Mode for Carrying out the Invention

[29] Hereinafter, embodiments according to the present disclosure will be described in detail with reference to the accompanying drawings. In the drawings, the same reference numerals are used to indicate the same or similar elements.

[30] Hereinafter, a cooking appliance according to an embodiment of the present disclosure will be described.

[31] Fig. 1 is a perspective view illustrating a cooking appliance according to an embodiment of the present disclosure.

[32] The cooking appliance 1 according to the embodiment of the present disclosure may include a housing 2 and a door 3 connected to the housing 2.

[33] The housing 2 may define a cavity 4 therein, and the cavity 4 may be a cooking chamber. The cavity 4 may be a cooking space in which an object to be heated is placed.

[34] An input interface 50 may be formed on the outer surface of the housing 2. The input interface 50 may receive an input for manipulating the cooking appliance from a user.

[35] The cavity 4 can be opened or closed by the door 3. The door 3 may be attached to the front portion of the housing 2 so as to be open and close. The door 3 can open and close the cavity 4. A window 31 may be formed on the door 3. The user can check the inside of the cavity 4 through the window 31 when the cavity 4 is closed. The window 31 will be described in detail in Fig. 9.

[36] The cavity 4 may be formed as a first surface to a fifth surface and may be opened or closed depending on the position of the door 3. The first surface of the cavity 4 may be the bottom surface 41, the second surface may be the ceiling surface 43 (see Fig. 9), the third surface may be the rear surface 45 (see Fig. 9), and the fourth and fifth surfaces may be both side surfaces. Both side surfaces may be in contact with the bottom surface 41, the ceiling surface 43, and the rear surface 45, respectively. One 42 of both side surfaces may be formed close to the door 3 and the other (not illustrated) may be formed close to the input interface 50.

[37] Fig. 2 is a control block diagram illustrating a cooking appliance according to an embodiment of the present disclosure.

[38] The cooking appliance 1 may include an input interface 50, a power supply unit 60, an IH module 70, an MW heating module 80, and a processor 100. Meanwhile, Fig. 2 is merely an example for convenience of description, and the cooking appliance 1 according to the embodiment of the present disclosure further includes other components other than the components illustrated in Fig. 2 or may omit some of the components illustrated in Fig. 2.

[39] The processor 100 may control the overall operation of the cooking appliance 1. The processor 100 may control the input interface 50, the power supply unit 60, the IH module 70, and the MW heating module 80, respectively. The processor 100 may control the IH module 70 and the MW heating module 80 to operate the cooking appliance 1 according to an input received through the input interface 50.

[40] The input interface 50 may receive various inputs capable of operating the cooking appliance 1. For example, the input interface 50 may receive an operation start input or an operation stop input of the cooking appliance 1. As another example, the input interface 50 may receive an input for driving the IH module 70 or an input for driving the MW heating module 80.

[41] The power supply unit 60 may receive power required for the operation of the cooking appliance 1 from the outside. The power supply unit 60 may supply power to

the input interface 50, the IH module 70, the MW heating module 80, the processor 100, or the like.

[42] The IH module 70 may be an induction heating type heat source. The IH module 70 can emit a magnetic field towards the cavity 4. In this specification, the magnetic field emitted from the IH module 70 may mean a magnetic field emitted from the working coil of the IH module 70.

[43] The IH module 70 may generate a magnetic field through a working coil, and when the object to be heated in the cavity 4 is a magnetic material, the IH module 70 may directly heat the object to be heated.

[44] Specifically, the IH module 70 may include at least some or all of a working coil, a plate, a heat insulating material, a shielding member, and a ferrite. In addition, the IH module 70 may further include an inverter capable of driving the working coil, or the like.

[45] The MW heating module 80 may provide microwaves into the cavity 4. The MW heating module 80 can emit microwaves into the cavity 4.

[46] The MW heating module 80 may include a magnetron positioned outside the cavity 4 in the housing 2 to generate microwaves, and a waveguide for guiding microwaves generated from the magnetron to the cavity 4.

[47] Meanwhile, in Fig. 2, the cooking appliance 1 is illustrated as having only the IH module 70 and the MW heating module 80, but according to the embodiment, the cooking appliance 1 may further include a grill heater module (not illustrated).

[48] The grill heater module (not illustrated) may supply radiant heat to heat food contained in the cavity 4. The grill heater module (not illustrated) may include a heating unit (not illustrated) having an infrared heating wire and may cause infrared heat generated from the heating unit (not illustrated) to be radiated or convected to the cavity 4.

[49] In other words, according to an embodiment of the present disclosure, the cooking appliance 1 may include an IH module 70, an MW heating module 80, and a grill heater module (not illustrated), and the IH module 70 emits a magnetic field toward the first surface of the cavity 4, the MW heating module 80 supplies microwaves to the cavity 4 through the second surface of the cavity 4, and a grill heater module (not illustrated) may supply radiant heat to the cavity 4 through the third surface of the cavity 4.

[50] Hereinafter, a case where the cooking appliance 1 includes the IH module 70 and the MW heating module 80 will be described.

[51] Meanwhile, when the IH module 70 and the MW heating module 80 of the cooking appliance 1 are operated at the same time, the working coil 140 of the IH module 70 may be damaged by microwaves generated from the MW heating module 80. In

addition, when the working coil 140 (see Fig. 9) is heated by microwaves, there is a problem that accurate control of the IH module 70 is impossible.

[52] Therefore, the cooking appliance 1 of the present disclosure may be provided with a shielding member 130 in the IH module 70 or between the IH module 70 and the MW heating module 80 to protect the elements inside the IH module 70.

[53] Next, the shape and material configuration of the shielding member 130 provided in the cooking appliance 1 of the present disclosure will be described in more detail, with reference to Figs. 3 to 7.

[54] Fig. 3 is an exemplary view illustrating a shielding member provided in the cooking appliance of the present disclosure, viewed from the side.

[55] In Fig. 3, d denotes the thickness of the shielding member 130, $\delta_{M.W}$ denotes a skin depth by electromagnetic waves emitted from the MW heating module 80, and $\delta_{I.H}$ denotes a skin depth caused by electromagnetic waves emitted from the IH module 70.

[56] The shielding member 130 may be made of a conductor.

[57] When an alternating current flows through a conductor, a skin effect occurs in the conductor. The skin effect means a phenomenon in which the current is concentrated on the surface of the conductor as the frequency of the current flowing through the conductor increases. In this case, the depth from the surface of the conductor to the region through which the current flows may be defined as a skin depth δ

[58] The skin depth becomes thinner as the frequency of the current flowing through the conductor increases and becomes thicker as the frequency of the current decreases. In addition, when the skin depth caused by a specific electromagnetic wave is thinner than the thickness of the conductor, the electromagnetic wave cannot pass through the conductor. Conversely, when the skin depth caused by a specific electromagnetic wave is thicker than the thickness of the conductor, the electromagnetic wave may pass through the conductor.

[59] In general, the frequency of the electromagnetic wave (microwave) emitted from the MW heating module 80 is in GHz (Gigahertz, 10^{9}Hz), and the frequency of the electromagnetic wave emitted from the IH module 70 is in KHz (kilohertz, 10^{3}Hz) unit. For example, the frequency of the microwave may be 2.4 to 2.5 GHz, and the frequency of the electromagnetic wave emitted from the IH module 70 may be 35 to 60 KHz, but this is only an example.

[60] The thickness d of the shielding member 130 according to the embodiment of the present disclosure is thicker than the skin depth $\delta_{M.W}$ by microwave and may be thinner than the skin depth $\delta_{I.H}$ by electromagnetic waves emitted from the IH module 70. The thickness d of the shielding member 130 of the present disclosure may be

thicker than a value obtained by multiplying the skin depth $\delta_{M.W}$ by the microwave by a predetermined constant (for example, 4) to block microwaves more effectively and may be thinner than the skin depth $\delta_{I.H}$ caused by the electromagnetic wave emitted from the IH module 70.

[61] Accordingly, the shielding member 130 of the present disclosure may cause microwaves generated from the MW heating module 80 to be shielded and the induced magnetic field emitted from the IH module 70 to be passed.

[62] Next, the material properties of the shielding member 130 of the present disclosure will be described in detail. The shielding member 130 of the present disclosure may be made of any one of carbon fabric, carbon paper, carbon felt, graphite, and graphene.

[63] When the shielding member 130 is made of any one of carbon fabric, carbon paper, carbon felt, graphite, and graphene, the shielding member 130 may exhibit excellent microwave shielding effectiveness caused by high electrical conductivity. In addition, since the shielding member 130 causes the heating by the IH module 70 to be minimized, the heating performance of the IH module 70 can be maximized.

[64] In addition, when the shielding member 130 is made of any one of carbon fabric, carbon paper, carbon felt, graphite, and graphene, heat heated by microwaves may be easily released due to high thermal conductivity. In addition, since the shielding member 130 of the present disclosure does not have to go through a separate processing process for creating a pattern, there is an advantage of simplifying the manufacturing process.

[65] In general, the carbon fabric may mean to include a carbon fabric manufactured by weaving carbon fibers, carbon felt, carbon paper, or the like, but in the present specification, the carbon fabric means only a carbon fabric manufactured by weaving carbon fibers and carbon felt and carbon paper are used in a different sense from the carbon fabric.

[66] The carbon fabric of the present disclosure may mean a carbon fabric manufactured by weaving carbon fibers by a method such as plain, twill, satin, or the like.

[67] First, with reference to Figs. 4 to 6, an advantage will be described when the shielding member 130 of the present disclosure is made of a carbon fabric manufactured by weaving carbon fibers among the above-described configurations.

[68] Figs. 4 and 5 are views illustrating the surface of the shielding member when the shielding member of the present disclosure is made of carbon fabric as a single material.

[69] The shielding member 130 of the present disclosure may be a carbon fabric woven by crossing the carbon fibers in the vertical direction and the horizontal direction as illustrated in Fig. 4.

[70] When the shielding member 130 of the present disclosure is made of a carbon fabric woven by crossing carbon fibers in the vertical direction and the horizontal direction, there is the effect of shielding the horizontal and vertical components of microwaves emitted from the MW heating module 80. For example, carbon fibers arranged in the horizontal direction (0°) may shield microwaves incident in the vertical direction (90°), on the carbon fibers arranged in the horizontal direction, and carbon fibers arranged in the vertical direction (90°) may shield microwaves incident in the horizontal direction (0°), on the carbon fibers arranged in the vertical direction. This shielding effect may be an additional shielding effect acting together with the microwave shielding effect caused by the above-described skin effect.

[71] Therefore, when the shielding member 130 of the present disclosure is made of a carbon fabric woven by crossing carbon fibers, there is an advantage of additionally shielding the vertical component and the horizontal component of the microwave.

[72] Meanwhile, when the shielding member 130 is made of a carbon fabric woven by crossing carbon fibers as a single material, the carbon yarn dropping phenomenon may occur as illustrated in Fig. 5.

[73] The carbon yarn dropping phenomenon means a phenomenon that the ends of the carbon fibers come out during a manufacturing process of manufacturing a carbon fabric by weaving carbon fibers or a process of processing the carbon fabric into the shielding member 130 of the present disclosure. When the material in which the yarn dropping phenomenon occurs is used as the shielding member 130 of the present disclosure, a spark may be generated by microwaves emitted from the MW heating module 80.

[74] Accordingly, the shielding member 130 of the cooking appliance 1 of the present disclosure may be made of a carbon fabric material having a surface processed.

[75] Fig. 6 is a view illustrating the surface of the shielding member when the shielding member of the present disclosure is made of carbon fabric whose surface has been processed.

[76] The shielding member 130 of the present disclosure may be made of a carbon fabric whose surface is processed as illustrated in Fig. 6. A phenolic coating agent having a high heat-resistant temperature may be used in the surface processing of the carbon fabric, and a siloxane-based coating agent as an inorganic coating agent may be used thereto. Since the surface processing method is a known technique, a detailed description thereof will be omitted.

[77] Referring to Fig. 6, it can be seen that the shielding member 130 has been processed smoothly without the yarn coming out of the surface of the shielding member.

[78] When a carbon fabric whose surface has been processed is used as the shielding member 130 of the present disclosure, there is an advantage that the problem of

generating sparks caused by microwaves can be solved as well as the heat resistance of the shielding member 130 which are simultaneously heated by the MW heating module 80 and the IH module 70 can be secured.

[79] Next, an advantage will be described with reference to Fig. 7 when the shielding member 130 of the present disclosure is made of carbon paper among the configurations described above.

[80] Fig. 7 is a view illustrating the surface of the shielding member when the shielding member of the present disclosure is made of carbon paper.

[81] Carbon paper may mean a material made by randomly orienting carbon fibers in a two-dimensional plane. Accordingly, when the shielding member 130 of the present disclosure is made of carbon paper, the surface of the shielding member 130 may be the same as that illustrated in Fig. 7.

[82] When the shielding member 130 is made of carbon paper and has a surface as illustrated in Fig. 7, since carbon fibers are randomly disposed, there is an effect of shielding all components from the horizontal component (0°) to the vertical component (90°) of the microwave emitted from the MW heating module 80.

[83] In addition, carbon paper can obtain the shielding effect of the microwave even with a thin thickness compared to other materials composed of carbon fibers.

[84] Table 1 below shows the performance of the MW heating module 80 and the efficiency of the IH module 70 according to the thickness of the shielding member 130 for each material when the shielding member 130 is made of carbon paper, carbon fabric, and carbon felt.

[85] [Table 1]

	Thickness(mm)	M.W Performance (mW/cm^2)	I.H Performance	
			Rs(45khz)	IH Efficiency(%)
Carbon paper	0.2	Less than 0.45	122	78.3
	0.3	Less than 0.34	166	77.9
Carbon felt	5	Less than 0.28	428.5	73.7
	8	Less than 0.12	499.7	70.5
carbon fabric	3	Less than 0.66	458.5	73.5

[86] In the table above, M.W performance (mw/cm^2) means microwave transmitted per square centimeter, and in general, when M.W performance (mw/cm^2) is 3(mw/cm^2) or less, it is considered to have a microwave shielding effect. In addition, Rs(45khz) means the equivalent resistance of the shielding member 130 when the frequency of

the IH module 70 is 45khz, and the lower the equivalent resistance, the better the IH efficiency.In this way, when carbon paper is used as the shielding member 130, it is possible to achieve high IH efficiency with a thin thickness compared to other materials. In particular, when the shielding member 130 is made of carbon paper, the thickness of the shielding member 130 may be 1 mm or less.

[87] Therefore, when carbon paper is used as the shielding member 130 of the present disclosure, there is an advantage of reducing the volume of the product.

[88] Next, a disposition structure of the shielding member 130, the IH module 70, and the MW heating module 80 in the cooking appliance 1 of the present disclosure will be described.

[89] Fig. 8 is a perspective view illustrating a shielding member and a working coil provided in the cooking appliance of the present disclosure.

[90] Referring to Fig. 8, the shielding member 130 may be disposed to vertically overlap the working coil 140. The size of the shielding member 130 may be greater than or equal to the size of the working coil 140.

[91] In this specification, the shapes of the shielding member 130 and the working coil 140 are illustrated in a circular shape, but each of the shielding member 130 and the working coil 140 may have various shapes, and the scope of the present disclosure is not limited thereto.

[92] The cross-sectional area S1 of the shielding member 130 in the horizontal direction may be equal to the cross-sectional area S2 of the working coil 140 in the horizontal direction or larger than the cross-sectional area S2 of the working coil 140 in the horizontal direction.

[93] If the cross-sectional area S1 of the shielding member 130 in the horizontal direction is equal to the cross-sectional area S2 of the working coil 140 in the horizontal direction or larger than the cross-sectional area S2 of the working coil 140 in the horizontal direction, there is an advantage that the working coil 140 can be effectively shielded from microwaves.

[94] In other words, if the cross-sectional area S1 of the shielding member 130 in the horizontal direction is equal to or larger than the cross-sectional area S2 of the working coil 140 in the horizontal direction, the shielding effect can be obtained, and thus the shielding effect can be obtained even if the shielding member 130 is not placed on the entire upper surface or the entire lower surface of the plate 110.

[95] Fig. 9 is a cross-sectional view illustrating the cooking appliance according to a first embodiment of the present disclosure.

[96] The door 3 can open and close the cavity 4. A window 31 may be formed on the door 3, and the window 31 may include a window unit 32 and a shielding unit 33.

[97] The window unit 32 may be made of a transparent material or a translucent material.

The user can see the inside of the cavity 4 through the window unit 32. The outer surface of the window unit 32 may face the outside of the cooking appliance 1, and the inner surface of the window unit 32 may face the inside of the cooking appliance 1.

[98] The shielding unit 33 may be mounted on the inner surface of the window unit 32. The shielding unit 33 may block microwaves in the cavity 4 from moving to the outside of the cooking appliance 1 through the door 3.

[99] The shielding unit 33 may be an iron net. A plurality of shielding holes 33a may be formed in the shielding unit 33, and the shielding hole 33a may have a size larger than a wavelength of visible light and smaller than a wavelength of a microwave. Accordingly, the user can see the inside of the cavity 4 through the shielding hole 33a, and microwaves cannot pass through the shielding hole 33a.

[100] The housing 2 may be provided with a plate 110 forming a first surface (for example, the bottom surface 41) of the cavity 4.

[101] The IH module 70 may include a plate 110 forming the first surface of the cavity 4, a heat insulating material 120 disposed under the plate 110, a shielding member 130, a working coil generating a magnetic field 140, and ferrite 150. The IH module 70 may emit a magnetic field toward the first surface of the cavity 4.

[102] According to the first embodiment, the shielding member 130 may be disposed on the entire upper surface of the plate 110 or the entire lower surface of the plate 110. The shielding member 130 may be disposed between the heat insulating material 120 and the working coil 140. In Fig. 5, it is assumed that the shielding member 130 is entirely disposed between the heat insulating material 120 and the working coil 140, but this is only an example for convenience of description, and thus the present invention is not limited thereto.

[103] In this case, the plate 110 may be formed of a non-magnetic material so that the magnetic field passes. The plate 110 may be made of a glass material (for example, ceramic glass). In other words, according to the first embodiment, the plate 110 may form the first surface 41 of the cavity 4 and cover the heat insulating material 120 and the shielding member 130 at the same time.

[104] In addition, the size of the cross-sectional area of the shielding member 130 in the horizontal direction may be the same as the size of the cross-sectional area of the plate 110 in the horizontal direction. Accordingly, the movement of microwaves through the first surface of the cavity 4 may be blocked by the shielding member 130.

[105] The ferrite 150 may be disposed under the working coil 140. The ferrite 150 may be mounted under the working coil 140 to block a magnetic field generated downward when the working coil 140 is driven.

[106] The working coil 140 generates a magnetic field when driven, and when an object to be heated made of a magnetic material is placed in the cavity 4, the magnetic field

passes through the shielding member 130 to induce an eddy current in the object to be heated so that the object to be heated can be heated.

[107] In summary, the IH module 70 of the cooking appliance 1 according to the embodiment of the present disclosure may heat a magnetic material and may heat a corresponding object to be heated regardless of the position to place the object to be heated. Accordingly, the user may place the object to be heated on an arbitrary heating region on the cavity 4, so that the convenience of use may be improved.

[108] Meanwhile, in the cooking appliance 1 according to the embodiment of the present disclosure, the MW heating module 80 as well as the IH module 70 may heat the object to be heated placed on the cavity 4.

[109] The MW heating module 80 may be installed close to any one of the second to fifth surfaces of the cavity 4. For example, the MW heating module 80 may supply microwaves to the cavity 4 through the second surface of the cavity 4, and in this case, the second surface may be the ceiling surface 43, but this is only an example. In other words, the second surface may be at least one of the remaining surfaces other than the surface from which the magnetic field is emitted by the IH module 70. Hereinafter, it is assumed that the second surface is the ceiling surface 43.

[110] The MW heating module 80 includes a magnetron 81, a waveguide 83, and a cooling fan 90, and the waveguide 83 has one side connected to the magnetron 81 and the other side connected to the cavity 4. At least one slot 83a through which microwaves pass may be formed on the ceiling surface 43 of the cavity 4. The cooling fan 90 may be installed around the magnetron 81 so that the magnetron 81 is cooled.

[111] The object to be heated and food placed in the cavity 4 may be heated by the IH module 70 and the MW heating module 80.

[112] In particular, according to the present disclosure, there is an advantage in that the heating time can be shortened because food can be simultaneously heated by the IH module 70 and the MW heating module 80 regardless of the position of the object to be heated.

[113] Fig. 10 is a cross-sectional view illustrating a cooking appliance according to a second embodiment of the present disclosure.

[114] Since the features of the door 3, the shielding member 130, the MW heating module 80, and the like, excluding the structure, shape, or the like of the first surface 41 of the cavity 4 and the IH module 70 are the same as those described through the first embodiment, a duplicate description will be omitted. In other words, since the method for heating the object to be heated by the magnetic field generated from the working coil 140 is the same as that described in the first embodiment, a duplicate description will be omitted.

[115] Referring to Fig. 10, a first surface (for example, a bottom surface 41) of the cavity 4

is formed in the housing 2, and at least a portion of the plate 110 may overlap the shielding member 130 in the vertical direction.

[116] The plate 110 may be formed of a first plate 113 made of glass material and a second plate 115 made of iron material overlapping the shielding member 130 in the vertical direction. The working coil 140 of the IH module 70 may emit a magnetic field toward the first surface 41 of the cavity 4.

[117] The first plate 113 may be disposed inside the second plate 115. The region A1 in which the first plate 113 is formed may be a heating region, and the region A2 in which the second plate 115 is formed may be a non-heating region.

[118] The size of the cross-sectional area of the shielding member 130 in the horizontal direction may be less than or equal to the size of the cross-sectional area of the first plate 113 in the horizontal direction.

[119] The size of the cross-sectional area of the shielding member 130 in the horizontal direction may be greater than or equal to the size of the cross-sectional area of the working coil 140 in the horizontal direction.

[120] The first plate 113 may be made of components of the non-magnetic material so that the magnetic field passes. The first plate 113 may be made of the glass material (for example, ceramic glass). The first plate 113 may be made of a component having heat resistance to heat of an object to be heated, the heat of the shielding member 130, and the like. The first plate 113 may dissipate the heat of the shielding member 130.

[121] The second plate 115 may be made of the components of the magnetic material. The second plate 115 may be made of iron material. The second plate 115 made of the components of the magnetic material may block microwaves from reaching the working coil 140.

[122] According to the second embodiment, the cooking appliance 1 of the present disclosure does not entirely dispose the shielding member 130 on the first surface (for example, the bottom surface 41) of the cavity 4, but by disposing only under the first plate 113 which is the non-magnetic material, it is possible to minimize the damage problem of the IH module 70 caused by microwaves using a minimum amount of material.

[123] Next, a configuration of a cooking appliance according to a third embodiment of the present disclosure will be described with reference to Figs. 11 and 12.

[124] Fig. 11 is an exploded perspective view illustrating an IH module according to a third embodiment of the present disclosure.

[125] Fig. 12 is a cross-sectional view illustrating a cooking appliance according to a third embodiment of the present disclosure.

[126] According to the third embodiment, the IH module 70 of the present disclosure may further include connection members 160a and 160b for fixing the shielding member

130 or the like.

[127] The IH module 70 may include a working coil 140, a heat insulating material 120, a first plate 113 made of glass material, and a second plate 115 made of iron material. According to the third embodiment, as illustrated in Fig. 11, the IH module 70 of the present disclosure may further include connection members 160a and 160b for fixing the shielding member 130 in the IH module 70. The connection members 160a and 160b may be holders or brackets, but this is only an example.

[128] A heat insulating material 120 may be disposed under the first plate 113, and a shielding member 130 may be disposed under the heat insulating material 120. Unlike illustrated in the drawing, the shielding member 130 may be disposed under the first plate 113, and the heat insulating material 120 may be disposed under the shielding member 130.

[129] The first connection member 160a is disposed above the first plate 113 and the second plate 115, the second connection member 160b is disposed under the first plate 113 and the second plate 115, and the first plate 113, the second plate 115, the heat insulating material 120, and the shielding member 130 may be disposed between the first connection member 160a and the second connection member 160b.

[130] Therefore, the first connection member 160a and the second connection member 160b can serve to fix the first plate 113, the second plate 115, the heat insulating material 120, and the shielding member 130. In addition, the first connection member 160a and the second connection member 160b may serve to partition the heating region and the non-heating region.

[131] Referring to the cross-sectional view of Fig. 12, the first connection member 160a may be disposed on the plate 110, and the second connection member 160b may be disposed under the plate 110, as a shape of surrounding the heat insulating material 120 and the shielding member 130. Therefore, when the shielding member 130 is disposed on the upper surface or the lower surface of the plate 110 since a separate bonding process or coating process is not required and only the end of the shielding member 130 can be fixed to obtain a fixing effect, there is an advantage that the manufacturing process thereof can be simplified. In addition, the heating region by the IH module 70 can be clearly displayed to the user by partitioning the heating region and the non-heating region caused by the protrusion of the first connection member 160a into the cavity 4.

[132] The above description is merely to describe the technical idea of the present disclosure by way of example, and a person skill in the art to which the present disclosure pertains will be able to make various modifications and variations without departing from the essential characteristics of the present disclosure.

[133] Accordingly, the embodiments disclosed in the present disclosure are not intended to

limit the technical idea of the present disclosure, but to explain the technical idea, and the scope of the technical idea of the present disclosure is not limited by these embodiments.

[134] The scope of protection of the present disclosure should be interpreted by the following claims, and all technical ideas within the scope equivalent thereto should be construed as being included in the scope of the present disclosure.

Claims

[Claim 1] A cooking appliance comprising:
a housing that defines a cavity therein;
a door connected to the housing and configured to open and close the cavity;
a microwave (MW) heating module configured to emit microwaves into the cavity; and
an induction heating (IH) module configured to emit a magnetic field toward the cavity,
the IH module comprising;
a shielding member through which the magnetic field generated by a working coil of the IH module passes and which blocks microwaves emitted from the MW heating module,
the shielding member comprising;
any one of carbon paper or carbon fabric woven with carbon fiber.

[Claim 2] The cooking appliance of claim 1,
wherein the carbon fabric woven with the carbon fiber is a fabric woven by crossing carbon fibers in a vertical direction and a horizontal direction.

[Claim 3] The cooking appliance of claim 1,
wherein the thickness of the carbon paper is 1mm or less.

[Claim 4] The cooking appliance of claim 1,
wherein the thickness of the shielding member is thicker than a skin depth caused by electromagnetic waves emitted from the MW heating module, and thinner than a skin depth caused by electromagnetic waves emitted from the working coil of the IH module.

[Claim 5] The cooking appliance of claim 4,
The thickness of the shielding member is thicker than a value obtained by multiplying a predetermined constant by a skin depth caused by electromagnetic waves emitted from the MW heating module and thinner than a skin depth caused by electromagnetic waves emitted from the IH module.

[Claim 6] The cooking appliance of claim 1,
wherein the IH module comprising;
a plate forming a first surface of the cavity,
a heat insulating material disposed under the plate, and
the working coil generating the magnetic field,

wherein the shielding member is disposed between the heat insulating material and the working coil.

[Claim 7] The cooking appliance of claim 6,
wherein the size of the cross-sectional area of the shielding member in the horizontal direction is greater than or equal to the size of the cross-sectional area of the working coil in the horizontal direction.

[Claim 8] The cooking appliance of claim 6,
wherein the shielding member overlaps at least a portion of the working coil in the vertical direction.

[Claim 9] The cooking appliance of claim 6,
wherein the housing is provided with the plate that forms a first surface of the cavity and overlaps at least a portion of the working coil in the vertical direction.

[Claim 10] The cooking appliance of claim 9,
wherein the plate is formed of a first plate made of glass and a second plate made of iron.

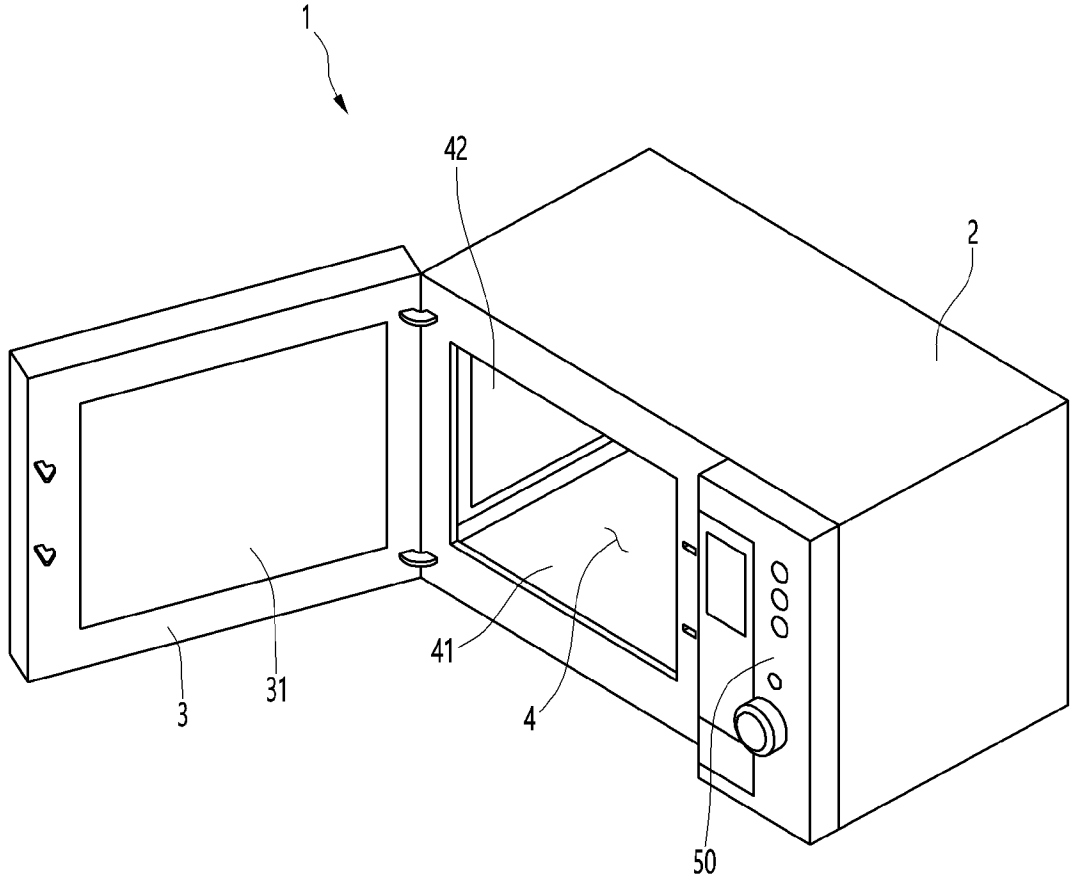
[Claim 11] The cooking appliance of claim 10,
wherein the first plate is disposed inside the second plate.

[Claim 12] The cooking appliance of claim 11,
wherein the working coil overlaps at least a portion of the first plate in the vertical direction.

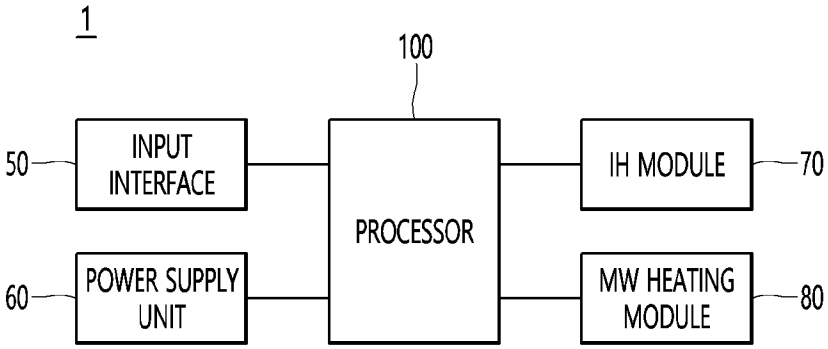
[Claim 13] The cooking appliance of claim 1,
wherein the IH module emits the magnetic field toward the first surface of the cavity, and
wherein the MW heating module supplies the microwaves to the cavity through a second surface of the cavity.

[Claim 14] The cooking appliance of claim 13,
wherein the first surface of the cavity is a bottom surface of the cavity, and
wherein the second surface of the cavity is at least one of other surfaces other than the bottom surface of the cavity.

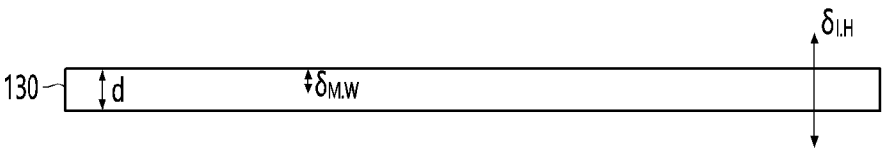
[Fig. 1]



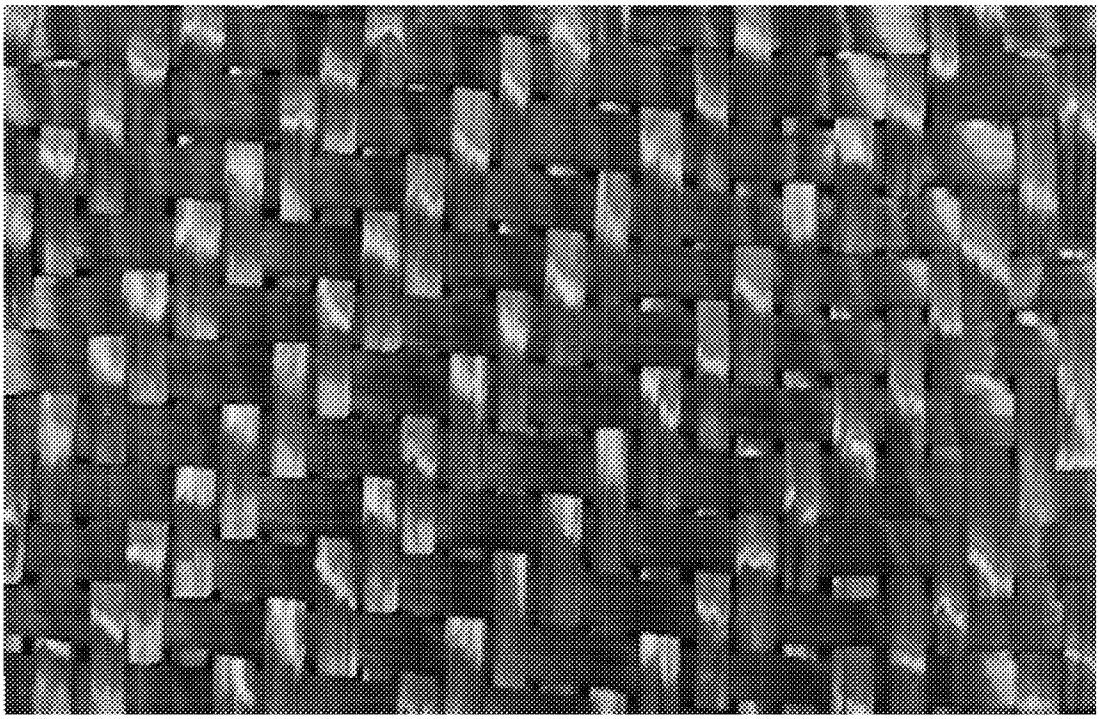
[Fig. 2]



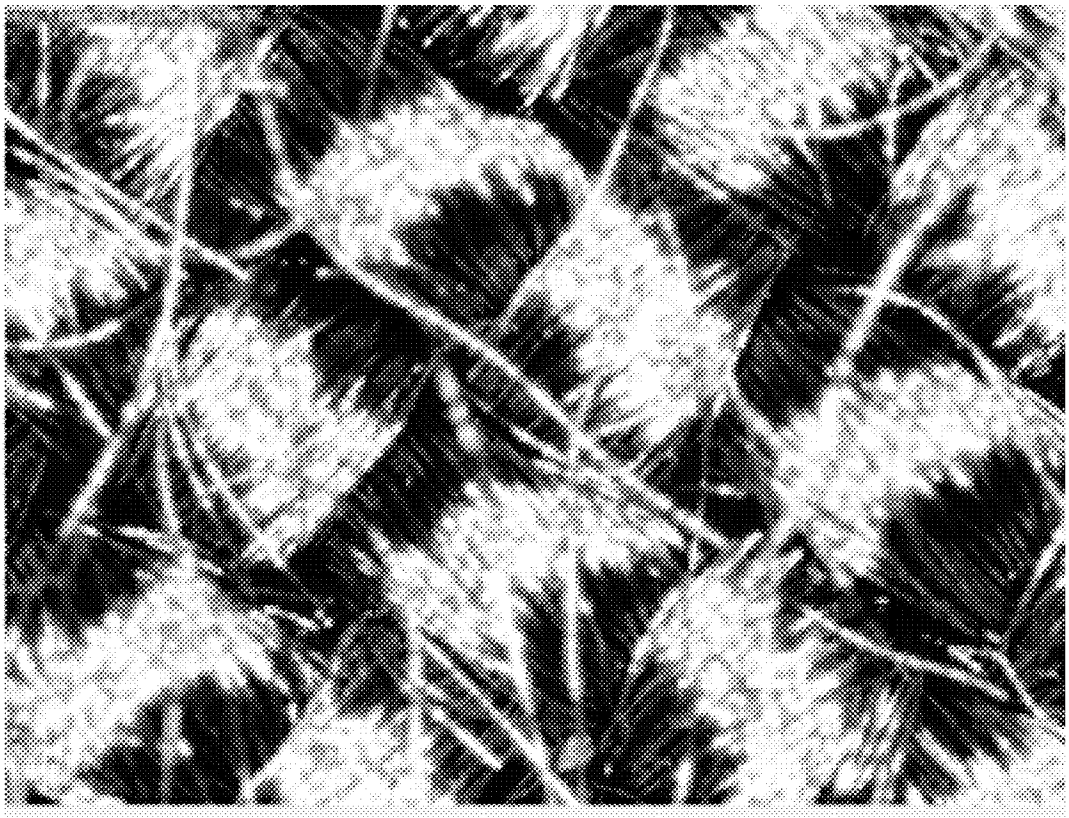
[Fig. 3]



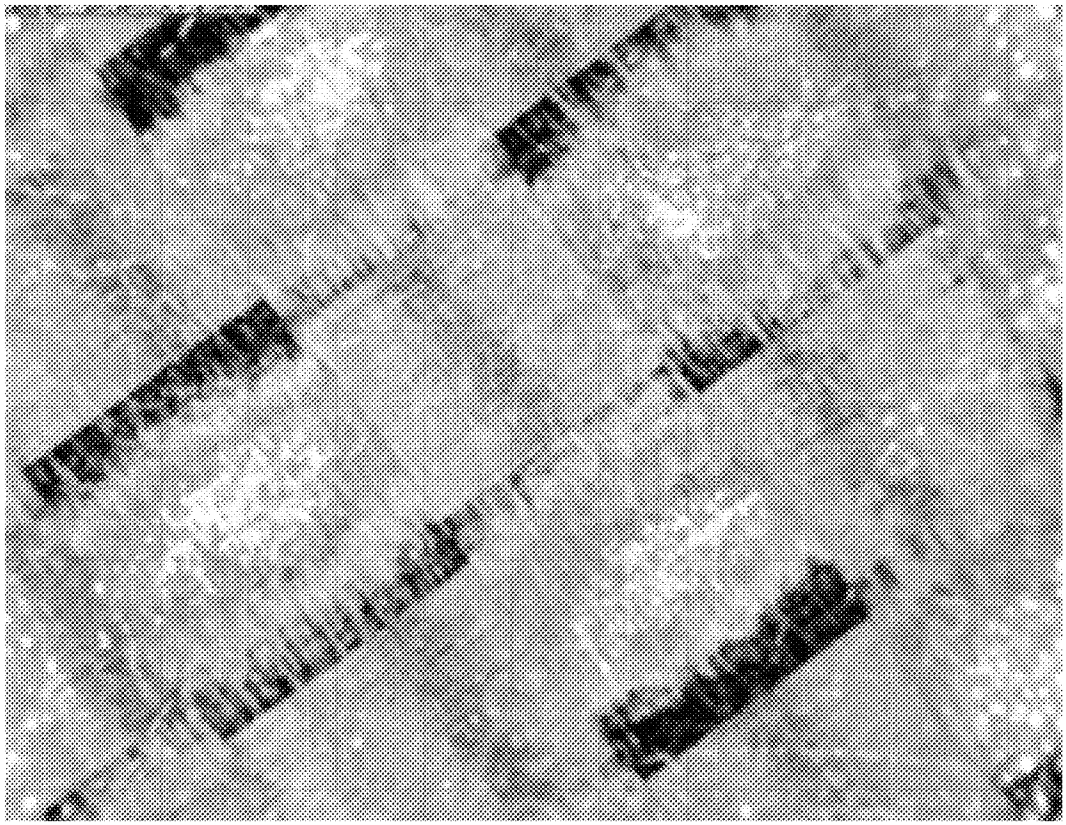
[Fig. 4]



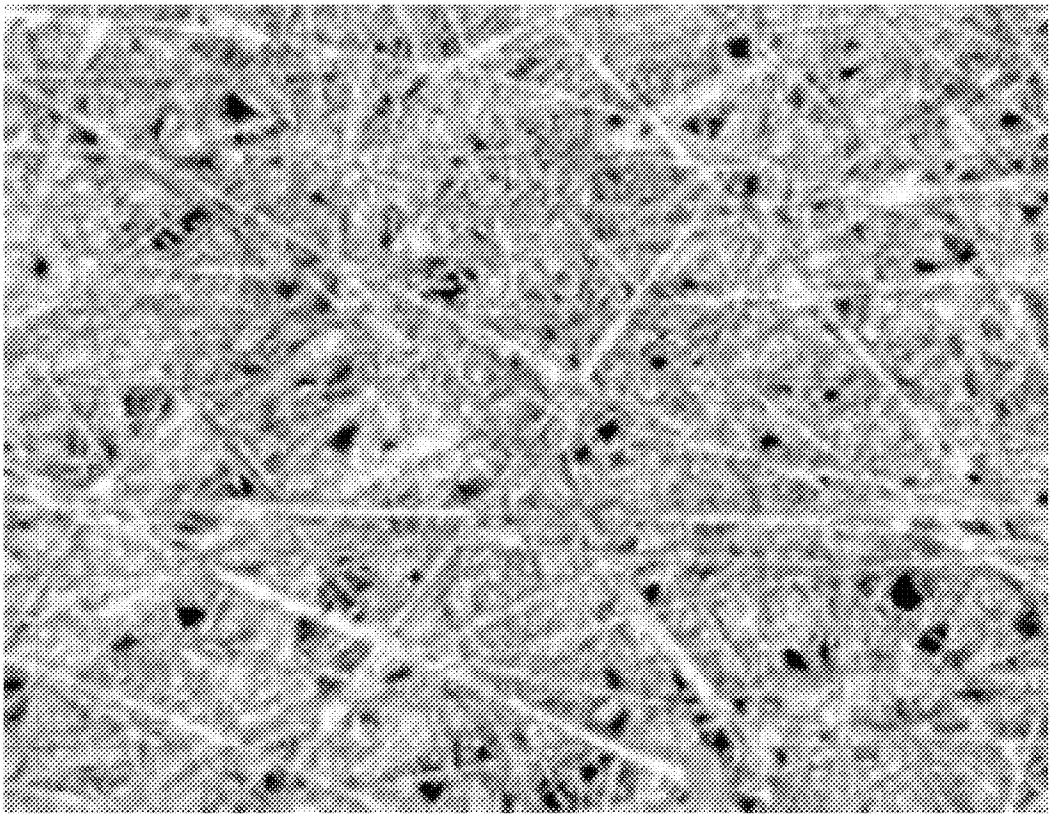
[Fig. 5]



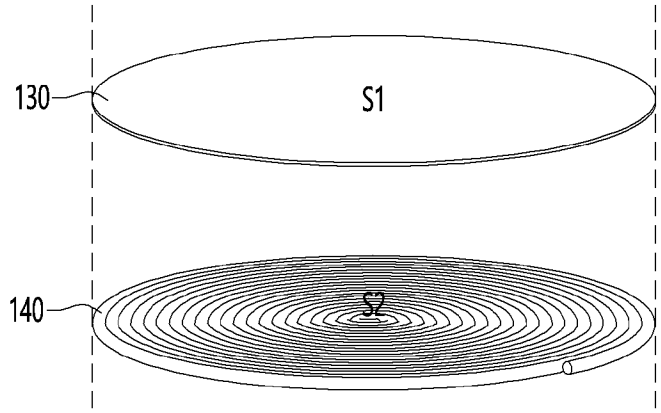
[Fig. 6]



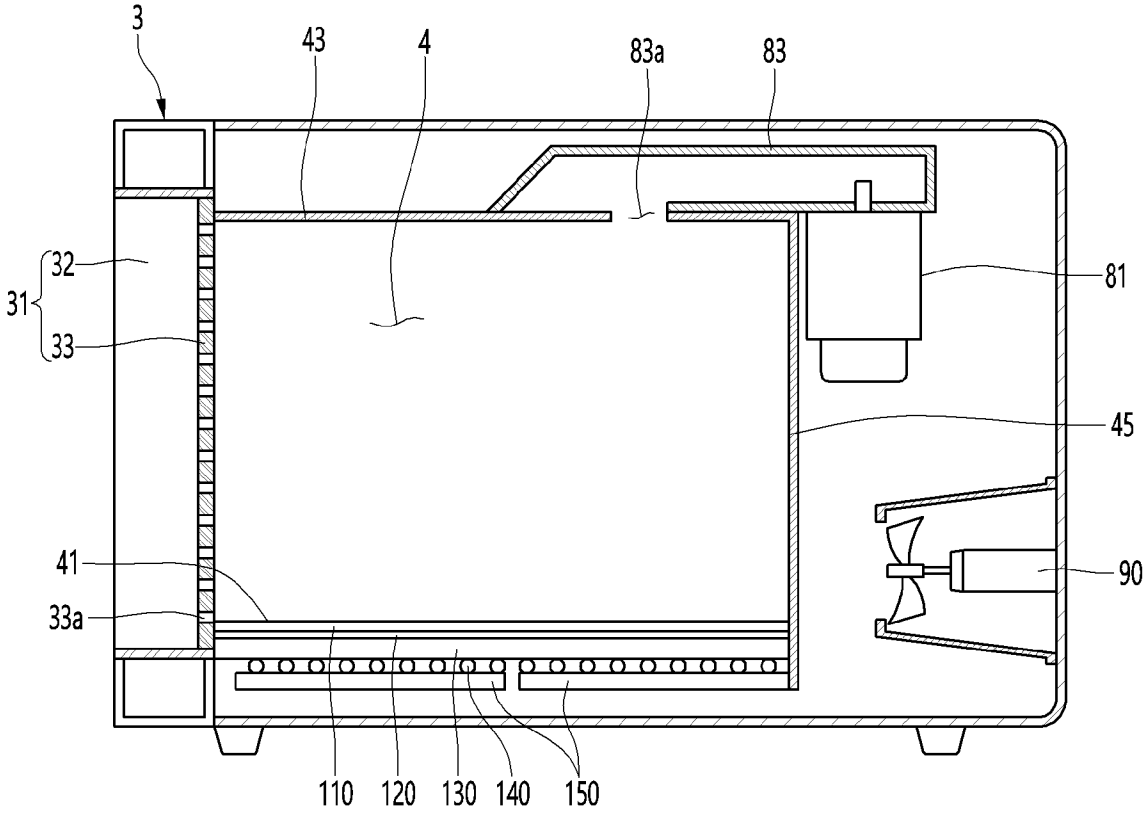
[Fig. 7]



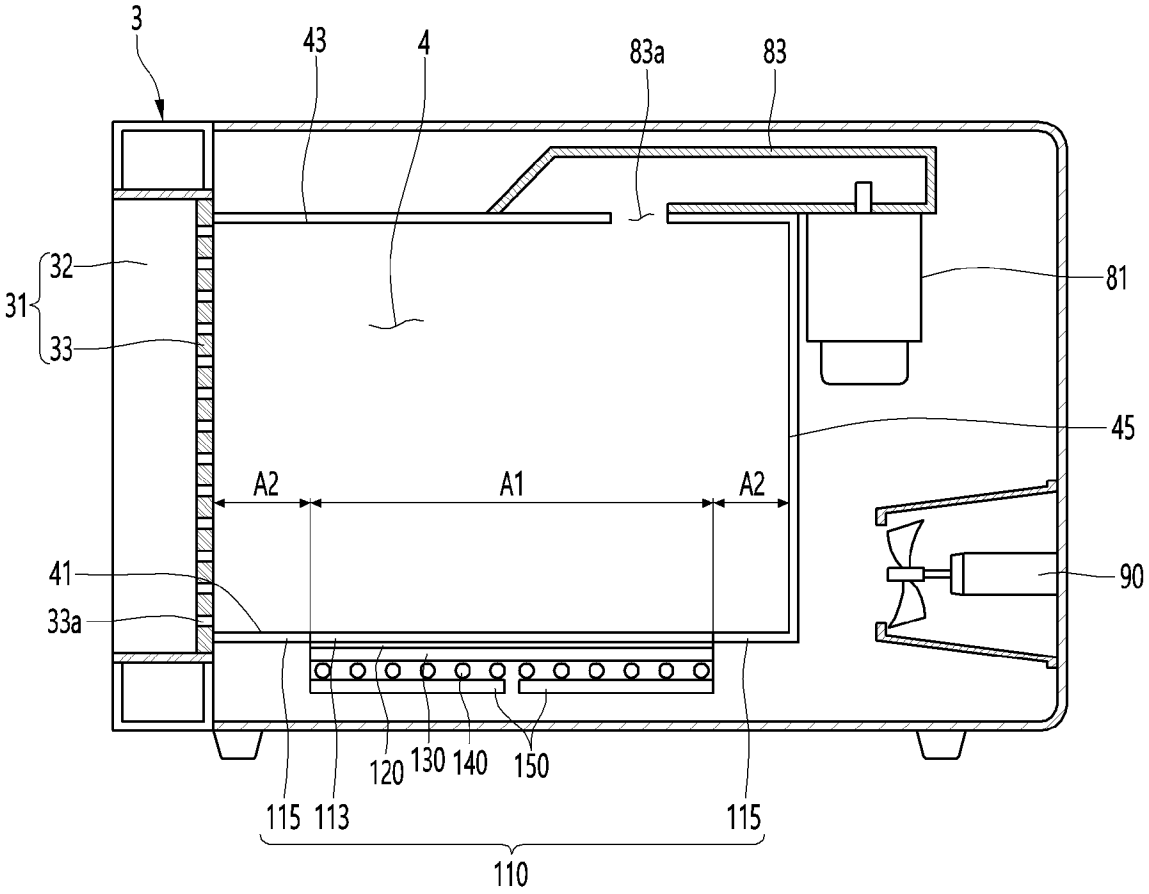
[Fig. 8]


130
S1
140
S2

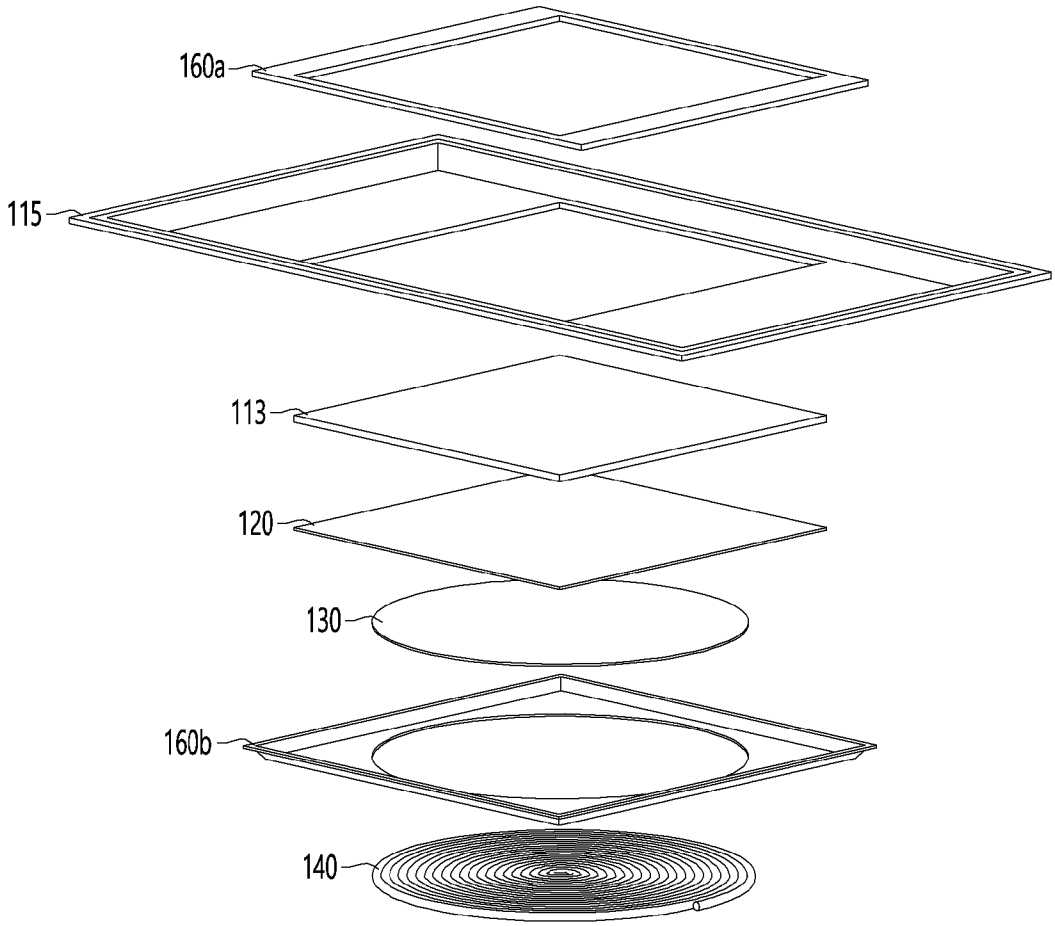
[Fig. 9]


3
43
4
83a
83
32
31
33
81
45
41
33a
90
110
120
130
140
150

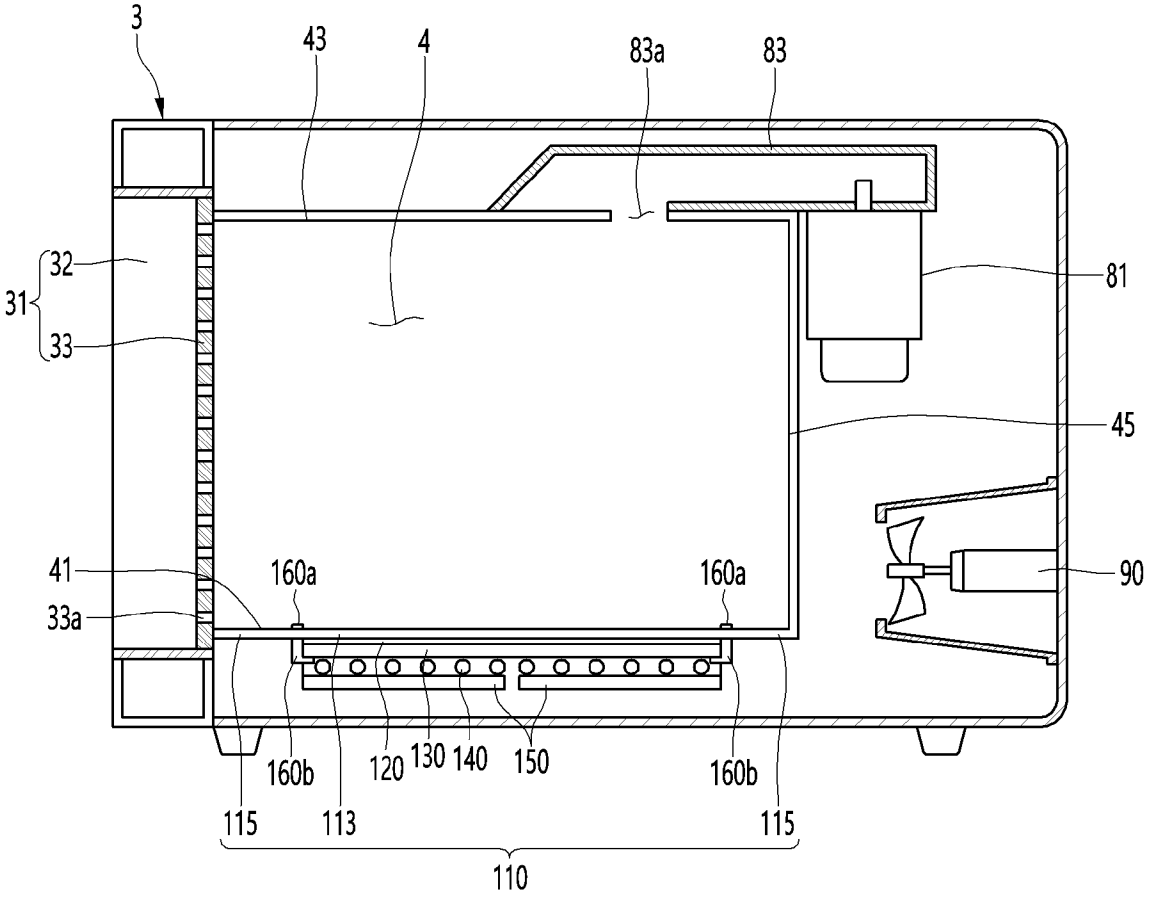
[Fig. 10]


3
43
4
83a
83
32
31
33
81
45
A2
A1
A2
41
33a
90
120
130
140
150
115
113
115
110

[Fig. 11]


160a
115
113
120
130
160b
140

[Fig. 12]


3
43
4
83a
83
32
31
33
81
45
41
160a
160a
33a
90
160b
120
130
140
150
160b
115
113
115
110

INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR2021/000708

A. CLASSIFICATION OF SUBJECT MATTER

A47J 36/02(2006.01)i; **A47J 36/04**(2006.01)i; **H05B 6/64**(2006.01)i; **H05B 11/00**(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

A47J 36/02(2006.01); F24C 1/02(2006.01); F24C 7/02(2006.01); H05B 6/02(2006.01); H05B 6/64(2006.01); H05B 6/76(2006.01); H05B 6/80(2006.01)

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Korean utility models and applications for utility models
Japanese utility models and applications for utility models

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

eKOMPASS(KIPO internal) & keywords: cooking appliance, microwave (MW) heating module, induction heating (IH) module, shielding member, working coil, carbon paper, carbon fabric, carbon fiber

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	KR 10-0176773 B1 (LG ELECTRONICS INC.) 15 May 1999 (1999-05-15) pages 2-3 and figures 4-5d	1-14
A	EP 0199264 B1 (MATSUSHITA ELECTRIC INDUSTRIAL CO., LTD.) 16 September 1992 (1992-09-16) claims 4-5 and figures 1-10	1-14
A	EP 2020827 A1 (WHIRLPOOL CORPORATION) 04 February 2009 (2009-02-04) paragraphs [0012]-[0013] and figures 1-3	1-14
A	US 5177333 A (OGASAWARA, TOSHIO) 05 January 1993 (1993-01-05) column 2, line 61 - column 3, line 58 and figure 1	1-14
A	KR 10-1996-0004901 A (DAEWOO ELECTRON CO., LTD.) 23 February 1996 (1996-02-23) claim 1 and figures 1-3	1-14

☐ Further documents are listed in the continuation of Box C. ☑ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"D" document cited by the applicant in the international application
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
02 June 2021	**08 June 2021**

Name and mailing address of the ISA/KR	Authorized officer
Korean Intellectual Property Office **189 Cheongsa-ro, Seo-gu, Daejeon** **35208, Republic of Korea**	**PARK, Tae Wook**
Facsimile No. **+82-42-481-8578**	Telephone No. **+82-42-481-3405**

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/KR2021/000708

Patent document cited in search report			Publication date (day/month/year)	Patent family member(s)			Publication date (day/month/year)
KR	10-0176773	B1	15 May 1999	CN	1135591	A	13 November 1996
				CN	1135591	C	12 November 1996
				DE	69523141	T2	20 June 2002
				EP	0742413	A2	13 November 1996
				EP	0742413	A3	07 January 1998
				EP	0742413	B1	10 October 2001
				IN	186492	B	15 September 2001
				JP	09-050885	A	18 February 1997
				JP	3045372	B2	29 May 2000
				US	5698125	A	16 December 1997
EP	0199264	B1	16 September 1992	AU	5611386	A	23 October 1986
				AU	579235	B2	17 November 1988
				CA	1253923	A	09 May 1989
				CA	1253923	A1	09 May 1989
				DE	3686735	T2	28 January 1993
				EP	0199264	A2	29 October 1986
				JP	03-025696	B2	08 April 1991
				JP	05-042798	B2	29 June 1993
				JP	61-237921	A	23 October 1986
				JP	61-240591	A	25 October 1986
				JP	62-010516	A	19 January 1987
				US	4745246	A	17 May 1988
EP	2020827	A1	04 February 2009	EP	2020827	B1	23 October 2013
				ES	2436106	T3	27 December 2013
				US	2009-0008386	A1	08 January 2009
				US	8772686	B2	08 July 2014
US	5177333	A	05 January 1993	EP	0464390	A2	08 January 1992
				EP	0464390	B1	02 November 1995
				JP	04-065097	A	02 March 1992
				KR	10-1992-0002995	A	28 February 1992
KR	10-1996-0004901	A	23 February 1996	None			