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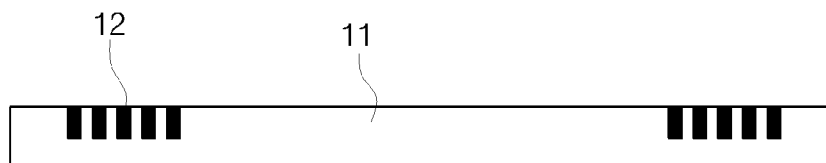
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(54) Title: MAGNETIC SHEET HAVING WIRELESS CHARGING RADIATOR FUNCTION, METHOD OF MANUFACTURING THE SAME, AND WIRELESS CHARGING DEVICE USING THE SAME

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(57) Abstract: Since the magnetic sheet (10) of the present invention has a much thinner thickness compared to a corresponding conventional magnetic layer and radiator coil material assembly and has no adhesive layer or air layer between the magnetic layer and the radiator, permeability required at the time of charging can be improved, a loss rate can be reduced and high charging efficiency can be obtained. Furthermore, since a band width and a gain rate can be improved, the magnetic sheet can be very usefully applied to wireless charging products which pursue slimming in design.

Description

Title of Invention: MAGNETIC SHEET HAVING WIRELESS CHARGING RADIATOR FUNCTION, METHOD OF MANUFACTURING THE SAME, AND WIRELESS CHARGING DEVICE USING THE SAME

Technical Field

- [1] The present invention relates to a magnetic sheet having a wireless charging radiator function, which is applied to a wireless charging device, and a manufacturing method and use thereof.

Background Art

- [2] In general, since arithmetic operation devices and portable information communication such as a cellular phone, personal digital assistants (PDA), a palm-top computer, an internet phone and the like use a charging battery as an energy source, a battery charger is necessarily required.
- [3] A desktop or portable charger which has been currently commercialized adopts a contact-type charging method for bringing a battery into contact electrically with a charger. The contact-type charger has various problems which should be solved.
- [4] For example, the problems such as a charge failure problem and a battery lifetime shortening problem caused by contact failure should be solved. A problem which is that when a charger or a communication device is exposed to moisture or dust, system performance is deteriorated, should be solved. Also, a problem which is that since the malfunction of a communication device is generated due to static electricity generated when a charging metal terminal exposed to the outside comes into contact with the user's clothing, the reliability of a product is reduced, should be solved.
- [5] To solve these problems, researches for adopting a wireless charging method for charging a battery using a magnetic combination without an electrical contact have been carried out.
- [6] In a current wireless charging technology, to satisfy the values of permeability and a loss rate resulting from corresponding frequency (i.e. a magnetic resonance type of 100 to 200 kHz, a magnetic induction type of 200 to 300 kHz, 6.78 Mhz), the thickness of a magnetic material, the thickness and winding number of a metal coil material and the like become main factors for a magnetic material part (i.e. a magnetic material/metal coil material assembly).
- [7] As exemplified in FIG. 1, a conventional wireless charging magnetic material part is formed in a structure in which a magnetic material layer composed of a ferrite sintered

material, a ferrite composite, a sendust sintered material, a composite and the like, an adhesive layer formed on the magnetic material layer, and a metal coil material formed on the adhesive layer to perform a radiator function are laminated.

- [8] In such a conventional magnetic material part having the radiator function for wireless charging, the adhesive layer or an air layer located between the magnetic material layer and the metal coil material causes an obstacle in permeability improvement, an obstacle in loss rate reduction, an obstacle in increase of charging efficiency and an obstacle in slimming design of a wireless charging device due to the lamination structure.

Disclosure of Invention

Technical Problem

- [9] An aspect of the present invention provides a wireless charging magnetic material part which can improve permeability (μ) required at the time of charging and which can reduce a loss rate and obtain high charging efficiency (Q).
- [10] Another aspect of the present invention provides a wireless charging magnetic material part which enables a wireless charging device to be designed to be slim.

Solution to Problem

- [11] According to an aspect of the present invention, there is provided a magnetic sheet having a radiator function for wireless charging, including: a magnetic layer having a thin-film shape and composed of a magnetic layer composition containing a magnetic material power and a binder resin; and a thin-film coil for radiator use which is directly inlaid on a surface of the magnetic layer.
- [12] Preferably, according to the present invention, the magnetic sheet having the radiator function for wireless charging is characterized in that the magnetic material power is one element or an alloy of a combination of two or more elements selected from the group consisting of Fe, Ni, Co, Mn, Al, Zn, Cu, Ba, Ti, Sn, Sr, P, B, N, C, W, Cr, Bi, Li, Y and Cd, or ferrite power.
- [13] Preferably, according to the present invention, the magnetic sheet having the radiator function for wireless charging is characterized in that a particle size of the magnetic material power ranges from 3 μm to 50 μm .
- [14] Preferably, according to the present invention, the magnetic sheet having the radiator function for wireless charging is characterized in that the binder resin is one resin or a mixture of two or more resins selected from the group consisting of a polyvinyl alcohol-based resin, a silicon-based resin, an epoxy-based resin, an acrylate-based resin, an urethane-based resin, a polyamide-based resin, and a polyimide-based resin.
- [15] Preferably, according to the present invention, the magnetic sheet having the radiator function for wireless charging is characterized in that a mix proportion of the magnetic

material power to the binder in the magnetic layer composition is 10 to 90 ~ 95 to 5 in a weight ratio.

- [16] Preferably, according to the present invention, the magnetic sheet having the radiator function for wireless charging is characterized in that the magnetic layer composition contains a general additive agent, which is generally mixed in the bind resin, in an amount of less than 2 wt.% with respect to a total weight of the composition
- [17] Preferably, according to the present invention, the magnetic sheet having the radiator function for wireless charging is characterized in that the metal thin-film coil is composed of one element or an alloy of a combination of two or more elements selected from the group consisting of Ag, Au, Cu and Al.
- [18] Preferably, according to the present invention, the magnetic sheet having the radiator function for wireless charging is characterized in that a thickness of the metal thin-film coil ranges from 5 μm to 1 mm.
- [19] According to the present invention, the wireless charging magnetic sheet having a radiator function for wireless charging is characterized in that a pitch of the metal thin-film coil ranges from 5 to 500 μm .
- [20] According to another aspect of the present invention, there is provided a method of manufacturing the magnetic sheet having the radiator function for wireless charging, the method including: molding a magnetic layer having the thin-film shape with a magnetic layer composition containing a magnetic material power and a binder resin; and forming a thin-film coil by directly inlaying it on a surface of the magnetic layer.
- [21] In the method, the metal thin-film coil may be formed by an inlaying method.
- [22] Examples of the inlaying method are a method of forming a partial intaglio on a surface of a magnetic layer using a laser and filling it with a metal, a method of masking a surface of a magnetic layer, and thereafter forming an intaglio thereon using drying and etching processes, and filling it with a metal, and a method of forming an intaglio on a magnetic layer using a method of forming a step fully (i.e. a method of forming an intaglio by providing a press difference between corresponding area and non-corresponding area), and filling it with a metal.
- [23] Also, According to an aspect of the present invention, there is provided a wireless charging device with a magnetic sheet having a radiator function for wireless charging.

Advantageous Effects of Invention

- [24] According to the present invention, since the magnetic sheet 10 of the present invention corresponding to the conventional magnetic layer and radiator coil material assembly has a much thinner thickness compared to the conventional assembly and has no adhesive layer or air layer between the magnetic layer and the radiator, permeability required at the time of charging can be improved, a loss rate can be reduced and high

charging efficiency can be obtained, Furthermore, since a band width and a gain rate can be improved, the magnetic sheet can be very usefully applied to wireless charging products which pursue slimming in design.

Brief Description of Drawings

- [25] The accompanying drawings are included to provide a further understanding of the present invention, and are incorporated in and constitute a part of this specification. The drawings illustrate exemplary embodiments of the present invention and, together with the description, serve to explain principles of the present invention. In the drawings:
- [26] FIG. 1 is a photo showing a planar structure of a conventional magnetic layer/radiator coil assembly;
- [27] FIG. 2 is a cross-sectional view schematically showing a laminated structure of the assembly shown in FIG. 1;
- [28] FIG. 3 is a plane view showing a planar structure of a magnetic sheet having a radiator function for wireless charging according to one exemplary embodiment; and
- [29] FIG. 4 is a cross-sectional view schematically showing a laminated structure of the magnetic sheet shown in FIG. 3.

Mode for the Invention

- [30] First, the present inventor has found the following matters through a research and has suggested the present invention. When a thin-film coil having a radiator function is directly inlaid on a magnetic layer having a film shape and composed of a magnetic material powder and a binder resin, an adhesive layer or an air layer was not present between the magnetic layer and the radiator. Therefore, permeability (μ) required at the time of charging could be improved, a loss rate could be reduced, and high charging efficiency (Q) could be obtained. Furthermore, since a thickness could be largely reduced, it could be very usefully applied to a slimming design of wireless charging devices, and material and process costs could be reduced.
- [31] The term “inlaying” used in the present invention means engraving a pattern on a surface and filling it with a metal of the same pattern.
- [32] Hereinafter, the present invention will be specifically explained with reference to the accompanying drawings showing one exemplary embodiment of the present invention.
- [33] A magnetic sheet according to the present invention, which is intended to replace a conventional magnetic layer/metal coil assembly, is a magnetic sheet having a radiator function for wireless charging.
- [34] As illustrated in FIG. 3 and FIG. 4, a magnetic sheet 10 of the present invention may include: a magnetic layer 11 having a thin-film shape; and a thin-film coil for radiator use 12 which is directly inlaid on a surface of the magnetic layer.

- [35] The magnetic sheet 10 of the present invention is configured such that the magnetic layer 11 having the thin-film shape is composed of a magnetic layer composition, and the magnetic composition contains a magnetic material power and a binder resin.
- [36] The example of the magnetic material power, which can be used in a magnetic layer composition, is one element or an alloy of a combination of two or more elements selected from the group consisting of Fe, Ni, Co, Mn, Al, Zn, Cu, Ba, Ti, Sn, Sr, P, B, N, C, W, Cr, Bi, Li, Y and Cd, or ferrite powder.
- [37] In the magnetic layer composition of the present invention, the binder resin may be uniformly mixed with the magnetic material power. If a binder has a property which enables thin-film molding of the magnetic material composition to be performed, the binder is not specifically limited. The examples of the binder resin are a polyvinyl alcohol-based resin, a silicon-based resin, an epoxy-based resin, an acrylate-based resin, an urethane-based resin, a polyamide-based resin, and a polyimide-based resin and the like. The resin may be used alone or in a mixture of two or more resins.
- [38] Preferably, a particle size of the magnetic material power ranges from 3 nm to 50 μ m. If the particle size of the magnetic material power fails to meet the lowest limit of the range, it would be difficult to uniformly mix it with the resin, thereby causing non-uniform distribution of the magnetic material power on the magnetic layer. Furthermore, if the particle size exceeds the upper limit of the range, it would be difficult to make the magnetic layer thin. Thus, it is preferable that the particle size of the magnetic material power is selected within the range.
- [39] In the magnetic layer composition of the present invention, it is preferable that a mix proportion of the magnetic material power to the binder resin is 10 to 90 ~ 95 to 5 in a weight ratio. If the mix proportion of the magnetic material power in the magnetic layer composition is high, a physical property of the film is rather insufficient. If the mix proportion of the magnetic material power is too low, a wireless charging performance can be deteriorated. Thus, it is preferable that the magnetic material power and the binder resin are mixed in the proportion of the above range.
- [40] Also, a general additive agent, which is generally mixed in the binder resin, may be mixed in the magnetic layer composition of the present invention. In a case where this additive agent is mixed therein, it would be preferable that a content thereof is less than 2 wt.% with respect to a total weight of the composition. The examples of the additive agent are a silane coupling agent, a defoaming agent, a cross-linking agent and the like.
- [41] In the magnetic sheet 10 of the present invention, the metal thin-film coil 12 laminated directly on the magnetic layer 11 having the thin-film shape performs a radiator function. The examples of the material metal are Ag, Au, Cu and Al and the like. The metal may be used alone or in an alloy of a combination of two or more elements.

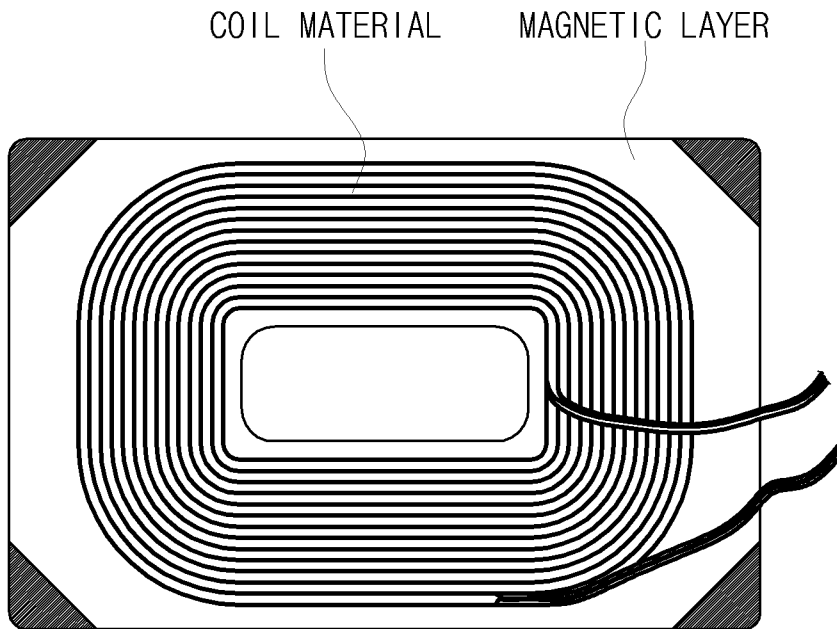
- [42] Preferably, the metal thin-film coil 12 has a thickness of $5\mu\text{m}$ to 1mm , and a pitch of 5 to $500\mu\text{m}$. The metal thin-film coil 12 having this shape may be formed by a method in which the magnetic layer 11 having the thin-film shape is directly inlaid with a metal.
- [43] Hereinafter, a manufacturing method of the magnetic sheet 10 having the radiator function for wireless charging according to the present invention will be explained based on preferred exemplary embodiments.
- [44] For example, the magnetic sheet 10 of the present invention may be manufactured by molding the magnetic material layer 11 having the thin-film shape with the magnetic layer composition containing the magnetic material powder and binder resin, and thereafter, forming the metal thin-film coil 12 by inlaying directly it on a surface of the magnetic layer 11.
- [45] The molding of the magnetic layer 11 having the thin-film shape may be performed using a process of forming a thin film directly on a substrate, which has been well-known in the relevant field, a process of molding the thin film and the like.
- [46] As the example of the process of forming the thin film directly on the substrate, there is a process of forming the thin film by depositing the magnetic layer composition on the substrate using laser vapor deposition (LVD), physical vapor deposition (PVD), chemical vapor deposition (CVD) and the like.
- [47] The example of the thin-film molding process using molding is a thin-film molding process using the injecting, pressing, casting and blow-molding of a magnetic layer composition.
- [48] Examples of the inlaying method used in the formation of the metal thin-film coil 12 are a method of forming a partial intaglio on a surface of a magnetic layer using a laser and filling it with a metal, a method of masking a surface of a magnetic layer, and thereafter forming an intaglio thereon using drying and etching processes, and filling it with a metal, and a method of forming an intaglio on a magnetic layer using a method of forming a step fully, and filling it with a metal.
- [49] The magnetic sheet 10 having the radiator function for wireless charging may be applied to various wireless charging products. Since magnetic sheet 10 of the present invention has a much thinner thickness compared to the conventional magnetic layer/radiator coil assembly, and there is no adhesive layer or air layer between the magnetic layer and the radiator, permeability required at the time of charging can be improved, a loss rate can be reduced, and high charging efficiency can be obtained. Furthermore, since a band width and a gain rate can be improved, the magnetic sheet 10 can be very usefully applied to wireless charging products which pursue a slimming design.
- [50] As previously described, in the detailed description of the invention, having described the detailed exemplary embodiments of the invention, it should be apparent

that modifications and variations can be made by persons skilled without deviating from the spirit or scope of the invention. Therefore, it is to be understood that the foregoing is illustrative of the present invention and is not to be construed as limited to the specific embodiments disclosed, and that modifications to the disclosed embodiments, as well as other embodiments, are intended to be included within the scope of the appended claims and their equivalents.

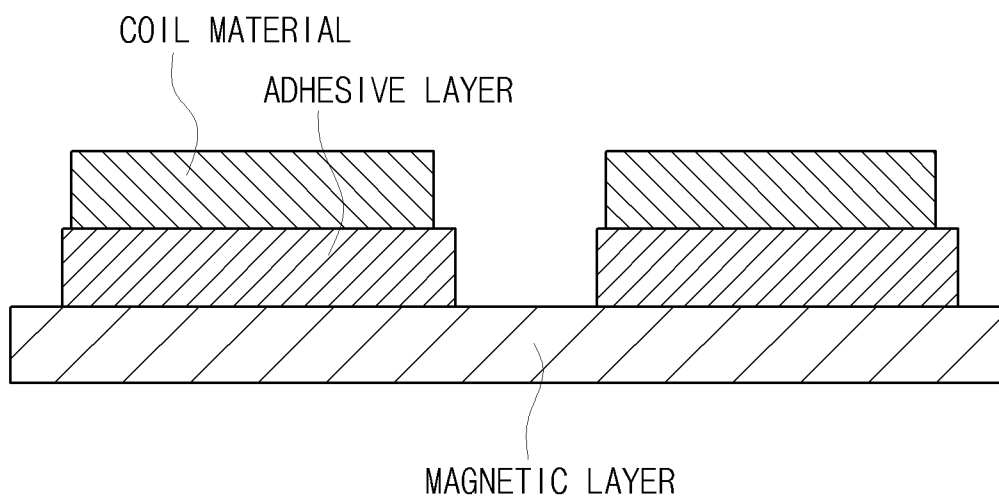
Claims

- [Claim 1] A magnetic sheet having a radiator function for wireless charging, the magnetic sheet comprising:
a magnetic layer having a thin-film shape and composed of a magnetic layer composition containing a magnetic material powder and a binder resin; and
a thin-film coil for radiator use which is directly inlaid on a surface of the magnetic layer.
- [Claim 2] The magnetic sheet of claim 1, wherein the magnetic material power is one element or an alloy of a combination of two or more elements selected from the group consisting of Fe, Ni, Co, Mn, Al, Zn, Cu, Ba, Ti, Sn, Sr, P, B, N, C, W, Cr, Bi, Li, Y and Cd, or ferrite power.
- [Claim 3] The magnetic sheet of claim 1, wherein a particle size of the magnetic material power ranges from 3 mm to 50 μ m.
- [Claim 4] The magnetic sheet of claim 1, wherein the binder resin is one resin or a mixture of two or more resins selected from the group consisting of a polyvinyl alcohol-based resin, a silicon-based resin, an epoxy-based resin, an acrylate-based resin, an urethane-based resin, a polyamide-based resin and a polyimide-based resin.
- [Claim 5] The magnetic sheet of claim 1, wherein a mix proportion of the magnetic material power to the binder in the magnetic layer composition is 10 to 90 ~ 95 to 5 in a weight ratio.
- [Claim 6] The magnetic sheet of claim 1, wherein the magnetic layer composition contains a general additive agent, which is generally mixed in the binder resin, in an amount of less than 2 wt.% with respect to a total weight of the composition.
- [Claim 7] The magnetic sheet of claim 1, wherein the metal thin-film coil is composed of one element or an alloy of a combination of two or more elements selected from the group consisting of Ag, Au, Cu and Al.
- [Claim 8] The magnetic sheet of claim 1, wherein a thickness of the metal thin-film coil ranges from 5 μ m to 1mm.
- [Claim 9] The magnetic sheet of claim 1, wherein a pitch of the metal thin-film coil ranges from 5 to 500 μ m.
- [Claim 10] A wireless charging device with a magnetic sheet having a radiator function for wireless charging as defined in any one of Claims 1 to 9.

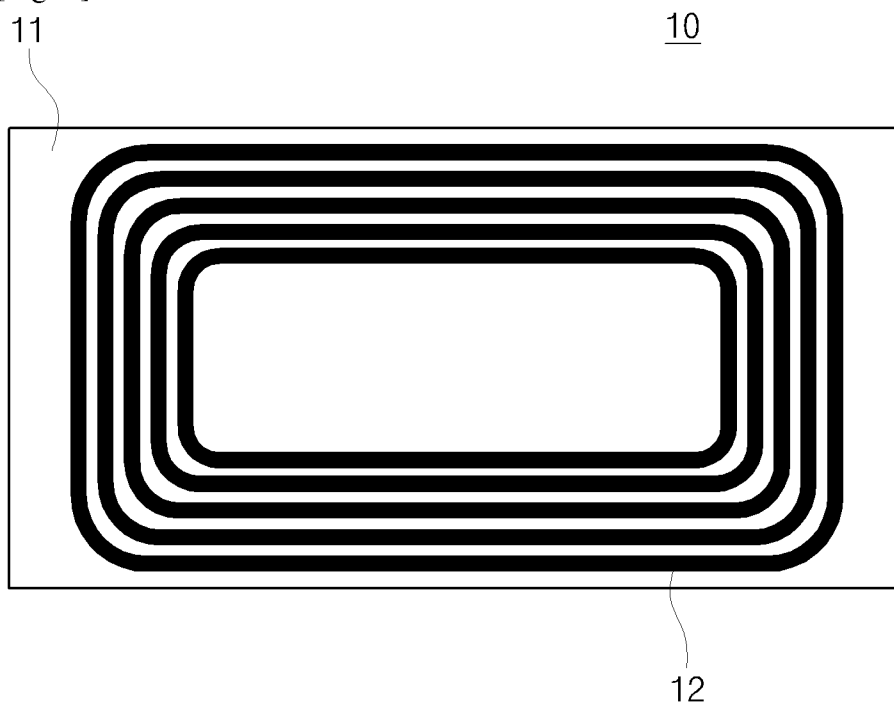
[Fig. 1]



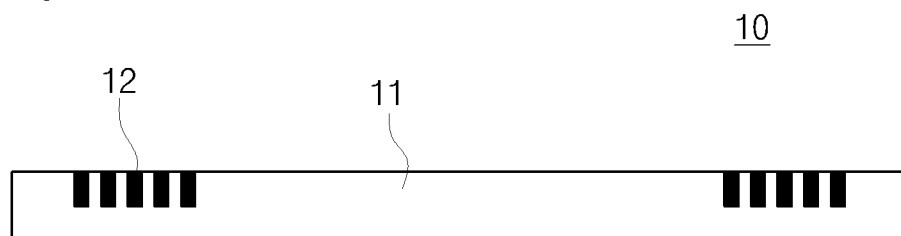
[Fig. 2]



[Fig. 3]



[Fig. 4]



INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR2013/003753**A. CLASSIFICATION OF SUBJECT MATTER****H01F 1/18(2006.01)i, H01F 38/14(2006.01)i, H01F 41/02(2006.01)i, H02J 17/00(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)

H01F 1/18; G11B 5/842; H01Q 1/38; G11B 5/702; H01F 27/32; H01F 41/12; H02J 17/00; H02J 7/00; H01Q 7/08; H01F 38/14; H01F 41/02

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: magnetic, sheet, thin-film, resin, powder, radiator, coil, wireless charging and inlaid

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	KR 10-1079679 B1 (DONGYANG MIRAE UNIVERSITY UNIVERSITY-INDUSTRY COOPERATION FOUNDATION) 04 November 2011 See paragraphs [0031]-[0036]; claim 1; and figure 2.	1-10
Y	KR 10-2010-0111409 A (AMOTECH CO., LTD.) 15 October 2010 See abstract; paragraphs [0011],[0049],[0082],[0084]; claims 1,6,8,10; and figure 5.	1-10
Y	JP 04-141818 A (MATSUSHITA ELECTRIC IND CO., LTD) 15 May 1992 See page 2, line 36 - page 3, line 17 and claim 1.	6
A	JP 2009-170488 A (FUKUI, YOSHIKUMI) 30 July 2009 See abstract; paragraphs [0012],[0017]; and claims 1,4.	1-10
A	US 2011-0210696 A1 (INOUE, TETSUO) 01 September 2011 See abstract; paragraphs [0074]-[0076]; and figure 1.	1-10



Further documents are listed in the continuation of Box C.



See patent family annex.

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/KR2013/003753

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