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

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
16 May 2019 (16.05.2019)

WIPO | PCT

(10) International Publication Number
WO 2019/092653 A1

(51) International Patent Classification:
H05B 6/12 (2006.01)

(21) International Application Number:
PCT/IB2018/058831

(22) International Filing Date:
09 November 2018 (09.11.2018)

(25) Filing Language: Italian

(26) Publication Language: English

(30) Priority Data:
102017000128402 10 November 2017 (10.11.2017) IT

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(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, JO, JP, KE, KG, KH, KN, KP, KR, 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, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, 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).

Declarations under Rule 4.17:
— *of inventorship (Rule 4.17(iv))*

(54) Title: INDUCTION HEATER FOR A COOK TOP

(57) Abstract: An induction heater for a cook top comprising: - a first electrically insulating sheet (1); - a second electrically insulating sheet (2); - one or more inductors (5) arranged on a same plane between the first sheet (1) and the second sheet (2), each inductor (5) comprising a single electrically conductive track defining a flat spiral coil provided with a plurality of turns (15); wherein the thickness (t) of each inductor (5) is comprised between 100 and 500 μm; and wherein the ratio between the distance (g) between the consecutive turns (15) of each inductor (5) and the thickness (t) of each inductor (5) is lower than or equal to 1.5.

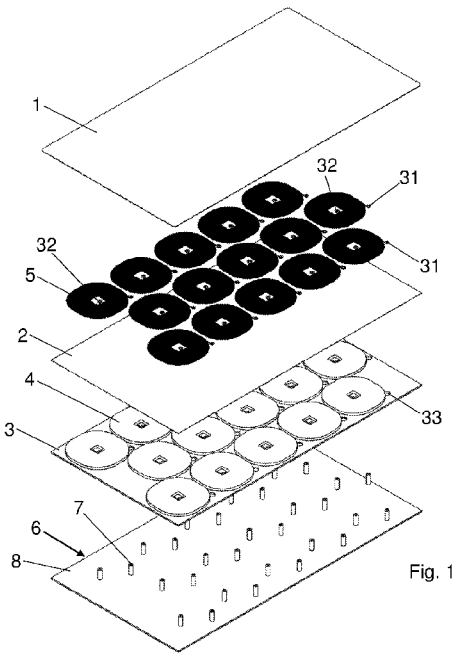

Fig. 1

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Published:

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

— *in black and white; the international application as filed contained color or greyscale and is available for download from PATENTSCOPE*

INDUCTION HEATER FOR A COOK TOP

Field of the invention

The present invention relates to an induction heater for a cook top, e.g. the cook top of a kitchen, and to a cook top comprising such induction heater.

Background art

Induction cook top make it possible to heat saucepans with ferromagnetic bottom and are increasingly more used.

An induction cook top comprises a given number of inductors fixed to a supporting structure.

In a first type of cook top, the arrangement and the number of the inductors is such that each inductor corresponds to a specific position in which a saucepan must be positioned, substantially as on gas stoves. In other words, each saucepan must be positioned above a respective inductor.

Recently, alternative solutions are being developed, in which the saucepan can be positioned freely in any area of the cook top. In this second type, the dimensions of the cook top being the same, the number of inductors is greater and the radial dimension of each inductor is smaller. By means of an appropriate electronic controller, the inductors can be activated independently from one another and automatically as a function of the position of the saucepan.

This second type of cook top opens a scenario which poses new technological challenges to manufacturers. In particular, the optimization of the geometric parameters of the inductors and their arrangement is not simple and is of crucial importance.

In particular, adequate power must be guaranteed for any position of the saucepan. Furthermore, for any position of the saucepan, the modulation of the power applied by the user must be gradual avoiding undesired peaks.

These problems are even more obvious when one attempts to reduce the size of the cook top components.

Indeed, a further drawback of the induction cook tops, of the first and of the second type alike, resides in the large overall dimensions and weight of their components, in particular of the inductors and of the structure to which they are fixed.

In particular, it is desirable to be able to reduce the size of the inductors and of their support structure.

However, in attempting to obtain this result, one must take into account that on one hand, the inductors with reduced thickness must guarantee a high power, while on the other greater overheating problems arise because the heat is concentrated in a smaller thickness. These aspects pose a serious limit to the actual development and use of thin components.

Another drawback of the components for induction cook tops resides in the electrical coupling between the inductors and the power module used to power them. The electrical connections which are used envisage the use of connecting wires. Therefore, during the step of assembly, the intervention of an operator who must manually establish these connections is necessary. Additionally, when attempting to reduce the thickness of the components, the space for making these connections is very small and therefore the operation is particularly difficult.

Summary of the invention

It is an object of the present invention to provide an induction heater for a cook top which is thin and which at the same time can provide adequate power to a saucepan to be heated.

It is another object of the present invention to provide an induction heater for a cook top which is thin and which at the same time makes it possible to obtain an efficient heat dissipation, in particular of the heat developed on the one or more inductors.

It is another object of the present invention to provide an induction heater for a cook top which is thin and which at the same time can be manufactured in automated manner.

The present invention achieves at least one of such objects, and the other objects which will be apparent in light of the present description, by means of an induction heater for a cook top comprising:

- a first electrically insulating sheet;
- a second electrically insulating sheet;
- one or more inductors, e.g. a plurality of inductors, arranged on a same plane between the first sheet and the second sheet, each inductor comprising a single electrically conductive track defining a flat spiral coil provided with a plurality of turns;

wherein each inductor has a thickness comprised between 100 and 500 μm, e.g. between 250 and 390 μm; and wherein the ratio between
the distance between consecutive turns of each inductor and
the thickness of each inductor is lower than or equal to 1.5.

According to an aspect, the invention further comprises a cook top having an upper surface destined to be a supporting surface for at least one saucepan to be heated, comprising at least one heater as defined above.

Advantageously, the geometry of the inductors is carefully designed so as to provide an adequate power although being very thin. Additionally, adequate power is guaranteed even when a saucepan is not perfectly at a single inductor.

Advantageously, according to another aspect, by means of a metal plate, the heat produced by the inductors is dissipated effectively. In particular, it is dissipated the heat which is generated on inductors due to the passage of current by Joule effect.

Also, preferably, there is no need for additional ventilation means, e.g. fans, for dispersing heat or it is possible to reduce the use of such ventilation means.

Advantageously, according to another aspect, an induction heater is provided wherein the electrical connection between the inductors and an electronic power module is made without connecting wires, so that the assembly of the heater is easier and more automated.

Further features and advantages of the present invention will be more apparent in light of the detailed description of preferred, but not exclusive embodiments.

The dependent claims describe particular embodiments of the invention.

Brief description of the figures

The description of the invention refers to the accompanying drawings, which are provided by way of non-limiting example, in which:

Fig. 1 diagrammatically shows an exploded view of a heater according to the invention;

Fig. 2 diagrammatically shows a section of a part of the heater in Fig.1;

Fig. 3 diagrammatically shows a detail of Fig. 2.

Figs. 3A and 3B diagrammatically show two possible variants of the section of the turns of an inductor;

Fig. 4 shows a top plan view of some components of the induction heater in Fig. 1;

Fig. 5 shows a detail of Fig. 4;

Fig. 6 shows a top plan view of a component of the induction heater in Fig. 1, in which the inductors are not shown for the sake of description;

Fig. 7 shows a top plan view of an example of the inductor of the induction heater in Fig. 1;

Fig. 8 shows a diagrammatic top view of the component in Fig. 7;

Fig. 9 shows a top plan view of a part of the induction heater in Fig. 1;

Fig. 10 diagrammatically shows a top plan view of a cook top according to the invention.

The same elements, or elements which have the same function, have the same reference number.

Description of example embodiments of the invention

According to an embodiment, the induction heater, or induction heating element, for a cook top comprises:

- a first electrically insulating sheet 1;
- a second electrically insulating sheet 2;
- a plurality of inductors 5 arranged on a same plane between the first sheet 1 and the second sheet 2, each inductor 5 comprising, preferably being formed by, a single electrically conductive track defining a flat spiral coil provided with a plurality of turns 15;

wherein each inductor 5 has a thickness comprised between 100 and 500 µm, e.g. between 250 and 390 µm; and wherein the ratio between

the distance g between the consecutive turns 15, i.e. between each turn and the immediately next one, of each inductor 5 and the thickness t of each inductor 5 is lower than or equal to 1.5.

Optionally, a metal plate or foil 3 is provided arranged under the sheet 2, in particular between the sheet 2 and the electronic board 8 of the electronic power module 6.

The sheet 1, the sheet 2, the inductors 5 and the metal plate 3 (the latter, when provided) are much thinner than they are wide and long.

Preferably, the induction heater further comprises at least one magnetic flux concentrator 4 arranged on a plane under the second sheet 2.

Preferably, the total thickness H1 (Fig. 9) of the first sheet 1, of an inductor 5, of the second sheet 2, of the at least one magnetic flux concentrator 4 and of the metal plate 3 is comprised between 4 and 12 mm, e.g. either less than or equal to 9.5 mm.

The inductors 5 are substantially incorporated between the sheet 1 and the sheet 2, so as to form a sandwich structure. The inductors 5 have an upper side which adheres to the sheet 1 and a lower side which adheres to the sheet 2. Such adhesion can be implemented, for example, by means of a bi-adhesive layer or by means of glue.

Preferably, the sheet 1 and the sheet 2 are flexible so that, at least in some areas, the sheet 1 and the sheet 2 also adhere to each other. In particular, it is preferable for the sheet 1 and the sheet 2 to adhere at least partially to each other in the gaps which are present between the inductors 5. Furthermore, preferably, the peripheral edges of the sheet 1 and sheet 2 adhere to one another.

Preferably, the sheet 1 is made of mica. Preferably, the sheet 1 is less than 1000 µm thick. In a particularly preferable manner, the thickness of the sheet 1 is less than 500 µm, more preferably is comprised between 100 and 400 µm.

Preferably, the sheet 2 is made of polymeric material. For example, the sheet 2 can be made of an elastomeric material, such as a type of silicone, or polyamide (PI), in particular Kapton®, or a material containing aramid fibers, in particular Nomex®.

Preferably, the sheet 2 is less than 1000 µm thick. In a particularly preferable manner, the thickness of the sheet 2 is less than 500 µm, more preferably is comprised between 25 and 100 µm.

The sheet 1 and the sheet 2 may also be made of the same material and, in this case, may optionally have the same thickness. For example, the sheet 1 and the sheet 2 may be both made of mica, and preferably have a thickness of less than 500 µm, more preferably comprised between 100 and 400 µm; alternatively, the sheet 1 and the sheet 2 may both be made of polymeric material, e.g. one of the materials mentioned above, and preferably have a thickness of less than 500 µm, more preferably between 25 and 100 µm.

Optionally, the sheet 1 and/or the sheet 2 have a compact, i.e. non-porous structure or microstructure.

Each inductor 5 is typically made of a metal material, e.g. copper or aluminum, preferably copper, or may be made by means of conductive ink or conductive paste. Preferably, each inductor 5 is made by etching, in particular by chemical etching, of a metal element, e.g. a sheet or foil, preferably of copper or aluminum.

Preferably, each inductor 5 has a thickness comprised between 100 and 500 µm, or between 200 and 400 µm, or between 250 and 400 µm, or between 250 and 450 µm, or between 250 and 390 µm, or between 250 and 350 µm, or between 280 and 350 µm. In Fig. 3, the thickness of each inductor 5, in particular of each of its turns 15 or equivalently of the conductive track, is indicated by reference "t" (Fig. 3).

Each inductor 5 defines a respective X axis about which the turns 15 are wound. In particular, such an axis X passes through the barycenter C of each inductor 5. The thickness t of each inductor 5 is a length which develops parallel to the axis X. The turns 15 form a single electrically conductive track, different from a Litz wire. The track is preferably formed by a single layer. Preferably, such track is structurally homogeneous, in particular along its thickness, i.e. is seamless.

Preferably, the distance "g" (Fig. 3), in particular the minimum distance, between each turn 15 and the next, i.e. the consecutive turn, is comprised between 150 and 1500 µm; more preferably between 250 and 500 µm; even more preferably between 300 and 400 µm. Such distance g is either perpendicular or substantially perpendicular to the thickness t.

Preferably, the distance g between the consecutive turns, e.g. between two consecutive turns, is equal or substantially equal for all the turns 15, i.e. remains constant or substantially constant.

Preferably, the ratio g/t is comprised between 0.5 and 3, or between 0.5 and 1.5, or between 0.5 and 1, or between 1 and 1.5, the extreme values being preferably included. In a particularly preferred way, the ratio g/t is either less than or equal to 1.5, more preferably is comprised between 0.5 and 1.5. For example, the ratio g/t may be equal to or approximately equal to 0.5; or to 0,6; or to 0,7; or to 0,8; or to 0,9; or to 1 or 1.1; or 1,2; or 1,3; or 1,4; or 1.5.

For example, each inductor 5 may have a thickness comprised between 100 and 500 µm, or between 200 and 400 µm, or between 250 and 400 µm, or between 250 and 450 µm, or between 250 and 390 µm, or between 250 and 350 µm, or between

280 and 350 μm; and the ratio g/t may be lower than or equal to 1.5, e.g. comprised between 0.5 and 1.5, or between 0.5 and 1, or between 1 and 1.5.

In a particular example, the thickness of each inductor 5 is comprised between 250 and 390 μm and the ratio g/t is lower than or equal to 1.5.

Preferably, the width w of each turn 15 is comprised between 100 and 1000 μm, more preferably between 200 and 700 μm, even more preferably 400 and 600 μm. Preferably, the width w is equal for all the turns 15, i.e. remains constant. This width w is considered perpendicularly to the thickness t.

Preferably, the pitch of the turns, i.e. the distance between corresponding points of one turn and the consecutive one, i.e. the immediately subsequent one, is comprised between 250 and 2500 μm, preferably between 600 and 1000 μm.

The number of turns 15 of each inductor 5 is preferably comprised between twenty-five and seventy-five, more preferably between thirty and seventy, even more preferably between thirty five and fifty.

The turns 15 preferably have a rectangular or substantially rectangular section, as shown in Fig. 3. However, in particular when the inductors 5 are made by means of chemical etching, due to process inaccuracies, the section of the turns may not be perfectly rectangular. In particular, the section of the turns may be trapezoidal with sides inclined with respect to the bases. The sides may have the same or mutually different inclination, as diagrammatically shown in Fig. 3A and 3B, which show two possible cross sections of the turns 15', 15".

Preferably, the possible trapezoidal shape of the section of the turns, does not substantially alter the distance g between the turns and the width w of the turns, which are two quantities which remain substantially constant.

Preferably, each inductor 5 is configured to provide a maximum power of between 300 and 1000 W. Preferably, such maximum power is the power which is supplied to the cook top, in particular at its upper surface.

The number of inductors 5 is variable, preferably from two to twenty-five or from four to sixteen. Preferably, the number of inductors 5 is: at least two, or at least three or at least four, or at least five, or at least six, or at least seven or eight. Alternatively, only one inductor 5 may also be provided.

Preferably, the inductors 5 are all identical or substantially identical to one another.

Fig. 7 shows a top plan view of an example of inductor 5; In Fig. 8, the outermost turn and the innermost turn of the inductor 5 are diagrammatically shown for the sake of description.

Preferably, each inductor 5 has a maximum dimension comprised between 30 and 240 mm, more preferably between 65 and 130 mm, even more preferably between 80 and 120 mm, e.g. about 80 mm or about 120 mm. In particular, the aforesaid maximum dimension corresponds to the length of the diameter of the circumscribed circumference of the outermost turn 15, this diameter being indicated by reference "A" in Fig. 8.

Preferably, the length of the diameter of the circumscribed circumference of the innermost turn is comprised between 10 and 50 mm, more preferably between 15 and 30 mm, e.g. about 18 mm, such diameter being indicated by reference "B" in Figure 8.

Preferably, the inductors 5 are shaped so that each turn 15 has four straight stretches 21, 22, 23, 24 mutually parallel in pairs, and four curved stretches 25, 26, 27, 28. Two mutually successive rectilinear stretches are joined by a respective curved stretch. Optionally, only the innermost turn and the outermost turn have one or more fewer rectilinear stretches and/or one or more fewer curvilinear stretches than the other turns.

Preferably, the radius of curvature of the curved stretches 25, 26, 27, 28 gradually increases, preferably linearly, from the innermost turn to the outermost turn. Preferably, between one turn and the next, the radius of curvature increases by a value equal to the distance g+w (Fig. 3), i.e. a value equal to the pitch between the turns. Preferably, the curved stretches of each turn have a radius of curvature either equal or substantially equal to each other. Preferably, the radius of curvature of the curved stretches of the innermost turn is comprised between 0.5 and 5 mm, and the radius of curvature of the curved stretch of the outermost turn is comprised between 20 and 60 mm.

Alternatively, it is however possible to provide one or more inductors in which the radius of curvature of the curved stretches is substantially the same for all turns, e.g. with a value selected in the range from 5 to 10 mm.

It has been experimentally observed that if the radius of curvature increases gradually from the inside outwards, the efficiency of the inductor is greater than the case in which the radius of curvature remains constant for all turns. In particular, a reduction in the power dissipated on the inducers of 20-25% has been observed.

In another alternative, each turn is substantially circular.

Each inductor 5 has two terminals 31, 32, (Fig. 7) or pads, which are used for their electrical power supply. In particular, a terminal 31 extends from the outermost turn towards the outside of the inductor 5, and the other terminal 32 extends from the innermost turn towards the inside of the inductor 5. Preferably, the terminals 31, 32 have substantially the shape of an eyelet or ring.

Alternatively, it can be provided that the inductors are be connected to one another and only two terminals are provided in common for all the inductors or each inductor has only one terminal which is provided in common for all the inductors. In these two cases, by way of example only, the inductors may be made by means of a single conductive track, shaped so as to have portions spirally wound to form inductors, and connecting portions between the inductors.

Preferably, the minimum distance between two adjacent, i.e. consecutive, inductors 5 is comprised between 4 mm and 20 mm, more preferably between 5 and 10 mm, e.g. about 5 mm.

Preferably, the inductors 5 are distributed so that the saucepan to be heated (not shown) can be positioned substantially freely on the cook top. In other words, the bottom of the saucepan can be arranged above a portion of multiple inductors, e.g. above only a respective portion of four inductors.

Preferably, the inductors 5 are arranged according to a grid, more preferably according to a honeycomb grid. In particular, the barycenters C of the inductors 5 of a first row are offset with respect to the barycenters C of the inductors 5 of a second row, immediately successive (i.e. consecutive) to the first row, and aligned with the barycenters of the inductors 5 of a third row, consecutive to the second row. Preferably, three rows of inductors 5 are provided.

Preferably, the induction heater comprises at least one magnetic flux concentrator 4 arranged between the sheet 2 and the metal plate 3, for each inductor 5. In particular, each magnetic flux concentrator 4 is preferably coaxial to the respective

inductor 5. In particular, the barycenter of each magnetic flux concentrator 4 is preferably aligned along the axis X with the barycenter of a respective inductor 5. Preferably, the magnetic flux concentrators 4 are identical or substantially identical to each other.

Each magnetic flux concentrator 4 is preferably made of ferrite and preferably has a plan geometry and dimensions substantially similar to those of the respective inductor 5. In particular, each magnetic flux concentrator 4 has an outer contour having four straight stretches mutually parallel in pairs, and four curved stretches. Two mutually rectilinear stretches are joined by a respective curved stretch. Furthermore, each magnetic flux concentrator 4 preferably has a central hole delimited by a wall having the same shape but smaller size with respect to the aforesaid outer contour.

Alternatively, a single magnetic flux concentrator may be provided, made as a single layer, preferably either made of ferrite or containing ferrite, e.g. silicone containing ferrite particles. In a further alternative, it is possible to use a plurality of magnetic flux concentrators, e.g. shaped as ferrite bars, substantially parallelepiped-shaped. In any case, preferably, the at least one magnetic flux concentrator 4 has a thickness comprised between 2 and 4 mm, e.g. about 3 mm.

Preferably, a heat sink metal plate 3 is provided below the magnetic flux concentrators 4. Preferably, the metal plate 3 has a thermal conductivity greater than 100 $W \cdot m^{-1} \cdot K^{-1}$. Preferably, the metal plate 3 is made of aluminum or an alloy containing aluminum.

The metal plate 3 has a width and a length substantially equal to that of the sheet 1 and sheet 2. The thickness of the metal sheet 3 is preferably comprised between 0.5 mm and 3 mm, even more preferably from 1 to 2 mm.

Preferably, the magnetic flux concentrators 4 rest on the metal plate 3. Preferably, the magnetic flux concentrators 4 each have an upper face adjacent to the sheet 2 and a lower face adjacent to the metal plate 3.

The induction heater further comprises an electronic power module 6, shown for example in Fig. 1 and 9. Preferably, the electronic power module 6 comprises a plurality of columns 7, or connectors, which are used to electrically supply the

inductors 5. The columns 7 are made of electrically conductive material, preferably metal, e.g. brass.

The columns 7 rise vertically, in particular parallel to the axes X, from an electronic board 8, which substantially acts as a base plate, of the electronic power module 6.

One column is provided for each terminal. In particular, when each inductor has two terminals 31, 32, two columns 7 are provided for each inductor 5. Each column 7 is connected to a respective terminal 31, 32 of each inductor 5 by means of electrical connection and fixing means 37, i.e. which have the dual function of forming an electrical connection and fixing at the same time.

Preferably, such electrical connection and fixing means either are or comprise screws 37. The screws 37 are made of electrically conductive material, preferably metal, e.g. stainless steel or brass.

In particular, the columns 7 pass through the metal plate 3 (when provided) and have an upper edge in contact, preferably in direct contact, with the lower surface of the sheet 2 and/or with the lower surface of the terminal 31, 32 according to the dimensions of the holes of the sheet 2. The metal plate 3 is provided with a plurality of holes 33 (Fig. 1 and 9), wherein each hole 33 is coaxial with a respective column 7. Each column 7 is internally provided with a threaded housing 17 for a respective screw 37.

The screws 37 pass through the sheet 1 and the sheet 2. Indeed, both the sheet 1 and the sheet 2 have a plurality of holes, of which each hole is coaxial with a respective hole 33, and therefore with a respective column 7. Each screw 37 is fastened into a respective column 7. Each screw 37 is in contact with a respective terminal 31, 32 of each inductor 5. Preferably, the head of each screw 37 is in contact, preferably in direct contact, with a respective terminal 31, 32, in particular with its upper surface, which is the surface distal from the electronic board 8. In such manner, the electronic power module 6 may supply the inductors 5. Indeed, the electrical current passes through the columns 7 and the screws 37 to reach the terminals 31, 32. Alternatively, it can be provided that the upper edge of each column is in contact with a respective terminal 31, 32, while the head of the screw is in contact with the sheet 1; and/or that the upper edge of each column 7 and the head

of each screw 37 are both in direct contact, or more in general in electrical contact with the respective terminal 31, 32.

Alternatively to the screws 37, rivets or pins (not shown) may be provided. In this case, the walls of the housings of the columns are substantially smooth, i.e. not threaded. Furthermore, each rivet or each pin passes vertically through the whole respective column and the electronic board 8. When rivets are provided, the head of each rivet preferably abuts with the lower surface of the electronic board 8, while the counterhead preferably abuts with the sheet 1 and/or with a respective terminal 31, 32, or vice versa. In particular, in this case, the lower surface of the electronic board 8 is appropriately electrically isolated from the head of the rivet, e.g. by means (not shown) made of electrically insulating material arranged between the head of the rivet and the lower surface of the electronic board 8.

When pins are provided instead, brazing is used for fixing to the sheet 1 and to the electronic board 8.

Advantageously, when the electrical connection and fixing means 37 and columns 7 are provided, the electrical connection between the inductors 5 and the electronic power module 6 is made without the use of supply wires. However, it is worth noting that as an alternative it is also possible to provide connections between the inductors and electronic power module which envisage wires.

The columns 7, which are all mutually equal, have a height preferably comprised between 10 and 20 mm, more preferably between 12 and 18 mm.

The metal plate 3 and the electronic board 8 of the electronic power module 6 are spaced apart from each other. In particular, the lower surface of the metal plate 3 is spaced from the upper surface of the electronic board 8. Preferably, between the lower surface of the metal plate 3 and the upper surface of the electronic board 8 an empty gap is provided.

Advantageously, the total thickness H2 (Fig. 9) of the induction heater, comprising the electronic power module 6, is comprised between 14 and 26, more preferably between 16 and 22, e.g. about 20 mm. In particular, such overall thickness H2 is the thickness of the structure formed by sheet 1, sheet 2, inductors 5, magnetic flux concentrators 4, metal plate 3 and electronic power module 6. In more detail, this total thickness H2 is the distance between the upper surface of the sheet 1 and the

lower surface of the electronic power module 6, in particular of the lower surface of the electronic board 8 of the electronic power module 6.

Preferably, the metal plate 3 is fixed to a plurality of pedestals 9, or spacers, which rise vertically from the electronic board 8. Preferably, such pedestals 9 are distinct or different from the columns 7. The fixing can be achieved, e.g. by means of screws, in similar manner to the fixing between the columns 7 and the screws 37.

Preferably, the distance between the metal plate 3 and the inductors 5 is either less than or equal to 5 mm, and preferably is between 2.5 and 4.5 mm. In particular, such distance is the distance, parallel to the axis X, between the upper surface of the metal plate 3 and the barycenter C of an inductor 5 or between the upper surface of the metal plate 3 and the lower surface of an inductor 5. Preferably, such distance is either equal or substantially equal for all the inductors 5.

Preferably, the induction heater also comprises a plurality of temperature sensors 35 (Fig. 6), preferably a temperature sensor 35 for each inductor 5. The temperature sensors 35 are arranged in respective holes of the sheet 1, of the sheet 2 and of the metal plate 3. In particular, each temperature sensor 35 is arranged in the zone of each inductor 5, which is surrounded by the innermost turn 15. Advantageously, the temperature sensors 35 are sensitive to the temperature of the cook top, in particular of its upper surface.

The invention further comprises a method for making an induction heater comprising at least the steps of:

- preparing a sandwich structure formed by the first sheet 1, by the second sheet 2 and by the inductors 5 arranged between the first sheet 1 and the second sheet 2;
- arranging the sandwich structure so as to align each column 7 of the electronic power module 6 with a respective terminal 31, 32 of the plurality of inductors 5;
- electrically connecting each column 7 to a respective terminal 31, 32 and fixing said sandwich structure to said electronic power module 6 by means of the electrical connection and fixing means 37.

The invention further comprises a cook top, e.g. a cook top 100 of a kitchen (Fig. 10).

The cook top 100 has an upper surface 101 destined to be a supporting plane for one or more saucepans to be heated. Preferably, the cook top further comprises a lower surface opposite to the upper surface.

The cook top 100 comprises one or more induction heaters, e.g. an induction heater, or two or three induction heaters. When there are more than one induction heaters, the induction heaters are mutually side-by-side and each one is substantially an independent heating module.

Preferably, each module has a width comprised between 23 and 30 cm, such as about 27 cm. Preferably, the length of each module is comprised between 35 and 50 cm, e.g. is equal to or approximately equal to 40 cm or equal to or approximately equal to 44 cm.

The induction heater or the induction heaters are arranged under the upper surface 101 of the cook top 100. In particular, each induction heater is arranged so that the sheet 1 and the sheet 2 are respectively in a proximal and distal position with respect to the surface 101.

Advantageously, the distance between the barycenter C of each inductor 5 and the lower surface is preferably less than 3 mm. More preferably, such distance is comprised between about 0.025 and 2 mm.

Advantageously, the barycenters C of the inductors can be positioned very close to the upper surface 101, in particular by virtue of the reduced thickness of the heater according to the invention. In particular, the use of very thin inductors, formed by a single track defining a flat spiral coil, is advantageous.

Since the barycenter C of the inductors is very close to the upper surface 101, the modulation of power of each inductor, operated by a user, can occur gradually, avoiding undesired peaks.

Advantageously, moreover, the heater of the invention is adapted to be mounted in a cook top the upper surface of which is made of glass or in a cook top the upper surface of which is made of a different material from the glass, e.g. in ceramics or wood. In particular, the heater of the invention can be integrated in a housing of a structure the upper surface of which is intended not only to be used as a cook top but also as a work top for other operations, different from cooking, which are

performed in a kitchen. In other words, the same area that can be used to place the saucepans for cooking can also be used as work top.

CLAIMS

1. An induction heater for a cook top comprising:

- a first electrically insulating sheet (1);
- a second electrically insulating sheet (2);
- one or more inductors (5) arranged on a same plane between the first sheet (1) and the second sheet (2), each inductor (5) comprising a single electrically conductive track defining a flat spiral coil provided with a plurality of turns (15);

wherein the thickness (t) of each inductor (5) is comprised between 100 and 500 µm; and wherein the ratio of the distance (g) between the consecutive turns (15) of each inductor (5) and the thickness (t) of each inductor (5) is either smaller than or equal to 1.5.

2. An induction heater according to claim 1, wherein the thickness (t) is comprised between 200 and 400 µm or between 250 and 400 µm, or between 250 and 390 µm, or between 250 and 350 µm, or between 280 and 350 µm.

3. An induction heater according to claim 1 or 2, wherein said distance (g) between the consecutive turns (15) of each inductor (5) is comprised between 250 and 500 µm, preferably between 300 and 400 µm.

4. An induction heater according to any one of the preceding claims, wherein the width (w) of each inductor (15) is comprised between 400 and 600 µm.

5. An induction heater according to any one of the preceding claims, wherein each turn (15) of a plurality of turns of each inductor (5) is shaped so as to have four rectilinear stretches (21, 22, 23, 24) parallel in pairs, and four curved stretches (25, 26, 27, 28), wherein two mutually successive rectilinear stretches (21, 22, 23, 24) are joined by a respective curved stretch (25, 26, 27, 28).

6. An induction heater according to any one of the preceding claims, wherein the curvature radius of the curved stretches (25, 26, 27, 28) gradually increases, preferably linearly, from the innermost turn to the outermost turn.

7. An induction heater according to any one of the preceding claims, wherein each inductor (5) has a maximum dimension comprised between 30 and 240 mm, said maximum dimension being preferably the diameter (A) of the circumference circumscribed to the outermost turn of the inductor (5).

8. An induction heater according to any one of the preceding claims, wherein for each inductor (5), the diameter (A) of the circumference circumscribed by the outermost turn is comprised between 65 and 130 mm or between 80 and 120 mm; and preferably wherein the diameter (B) of the circumference circumscribed to the innermost turn is comprised between 15 and 30 mm.

9. An induction heater according to any one of the preceding claims from 1 to 4 and from 7 to 8, where each turn is substantially circular.

10. An induction heater according to any one of the preceding claims, wherein each inductor (5) has a number of turns comprised between 25 and 75, or between 30 and 70, or between 35 and 50.

11. An induction heater according to any one of the preceding claims, wherein each inductor (5) is configured to provide a maximum power comprised between 300 and 1000 W.

12. An induction heater according to any one of the preceding claims, wherein the thickness of the first sheet (1) is less than 1000 μm; and the thickness of the second sheet (2) is less than 1000 μm.

13. An induction heater according to any one of the preceding claims, further comprising:

- at least one magnetic flux concentrator (4) arranged on a plane under the second sheet (2);
- a metallic heat sink plate (3) arranged under the at least one magnetic flux concentrator (4), adapted to dissipate the heat produced by the one or more inductors (5).

14. An induction heater according to any one of the preceding claims, wherein the one or more inductors (5) are provided with at least two terminals (31, 32);

wherein the induction heater comprises an electronic power module (6) provided with a plurality of electrically conductive columns (7), and electrical connection and fixing means (37) inserted preferably coaxially in a respective column (7);

wherein each column (7) is electrically connected to the respective terminal (31, 32) by means of electrical connection and fixing means (37), and preferably wherein said electrical connection and fixing means (37) are screws or rivets or pins.

15. A cook top (100) comprising at least one induction heater according to any one of the preceding claims.

16. A cook top (100) according to claim 15, having an upper surface (101) destined to be a resting surface for at least one saucepan to be heated, and a lower surface opposite to the upper surface, wherein the distance between the barycenter (C) of each inductor (5) and said lower surface is less than 3 mm.

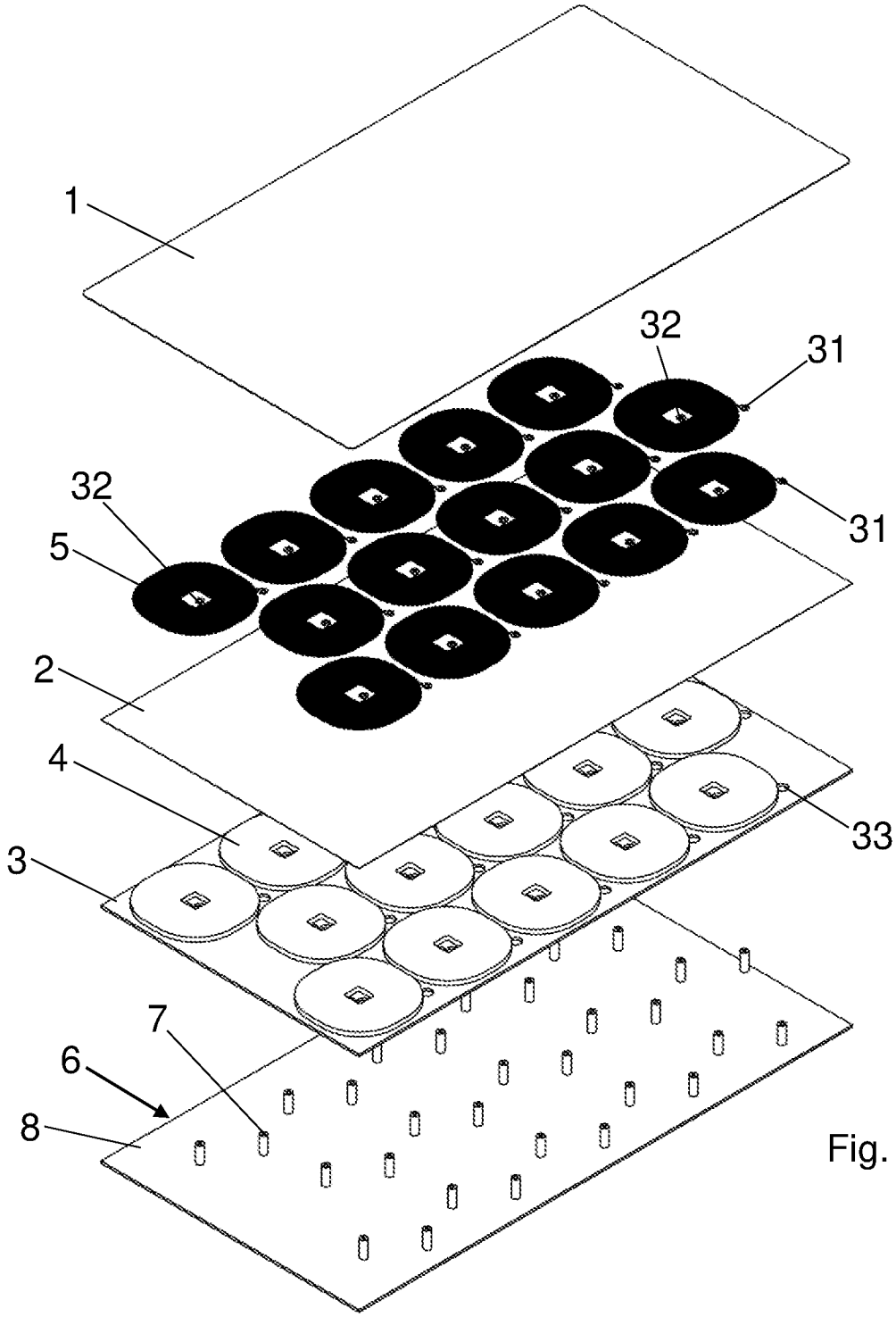

Fig. 1

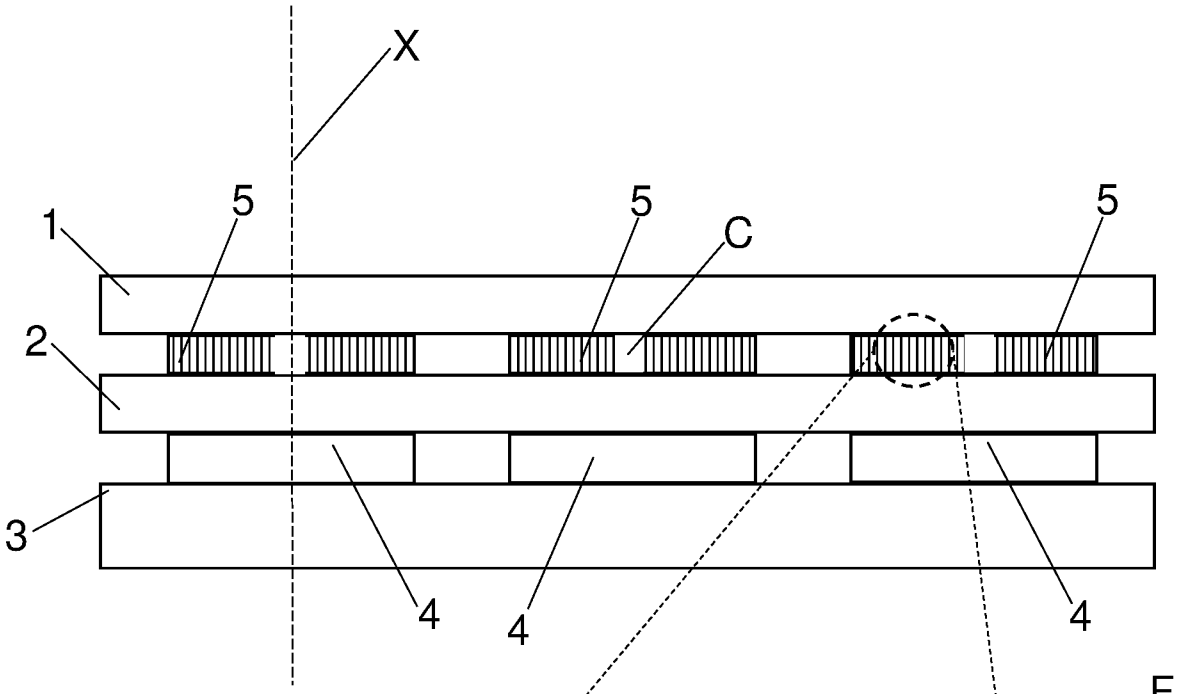

Fig. 2

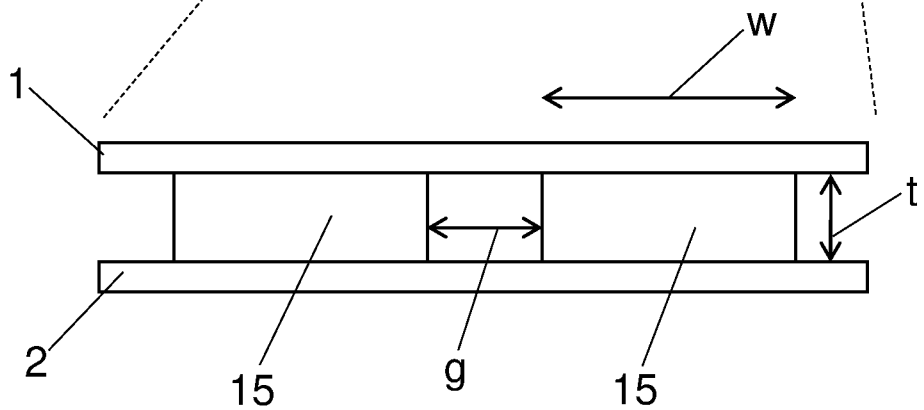

Fig. 3

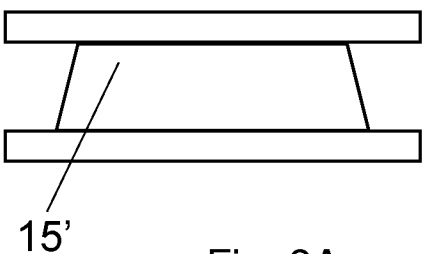

Fig. 3A

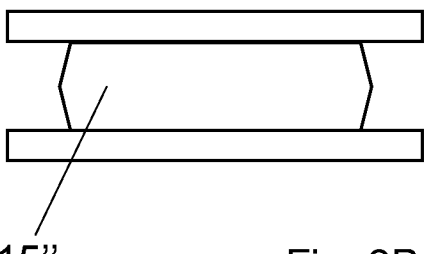

Fig. 3B

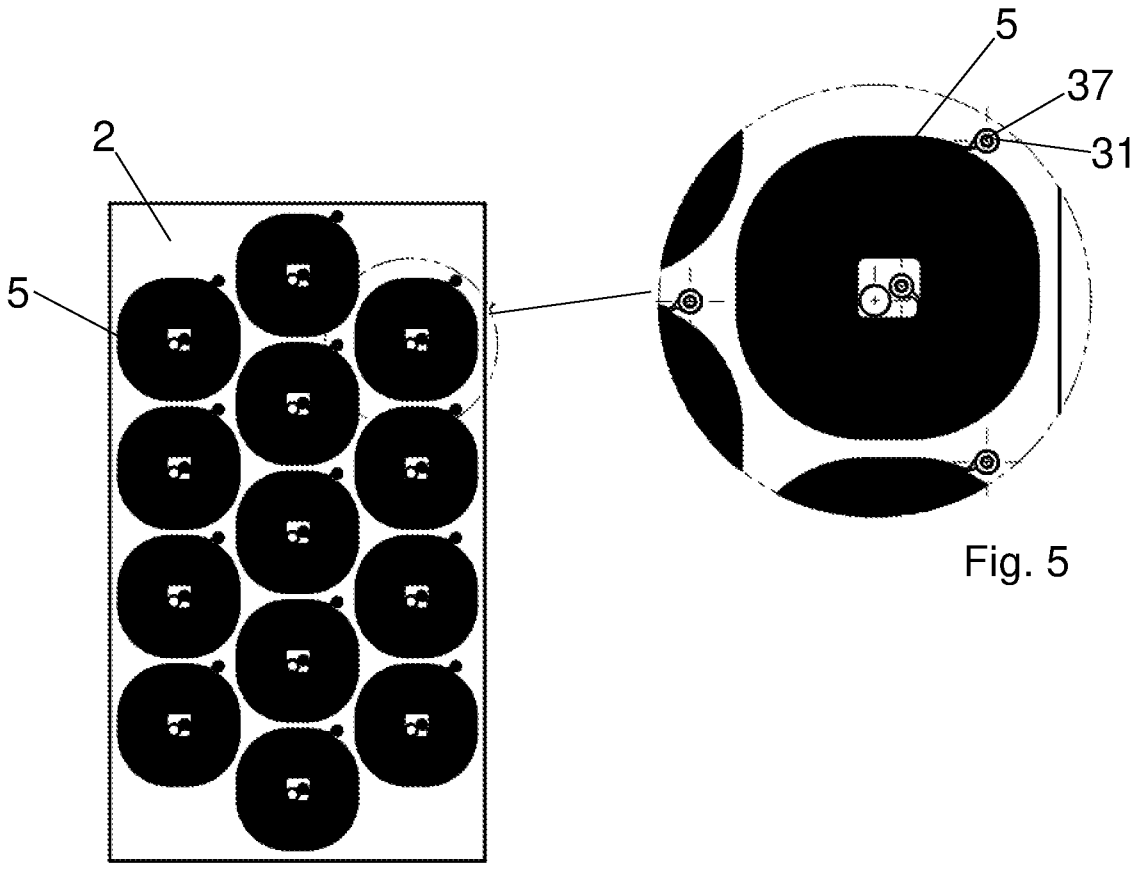

Fig. 5

Fig. 4

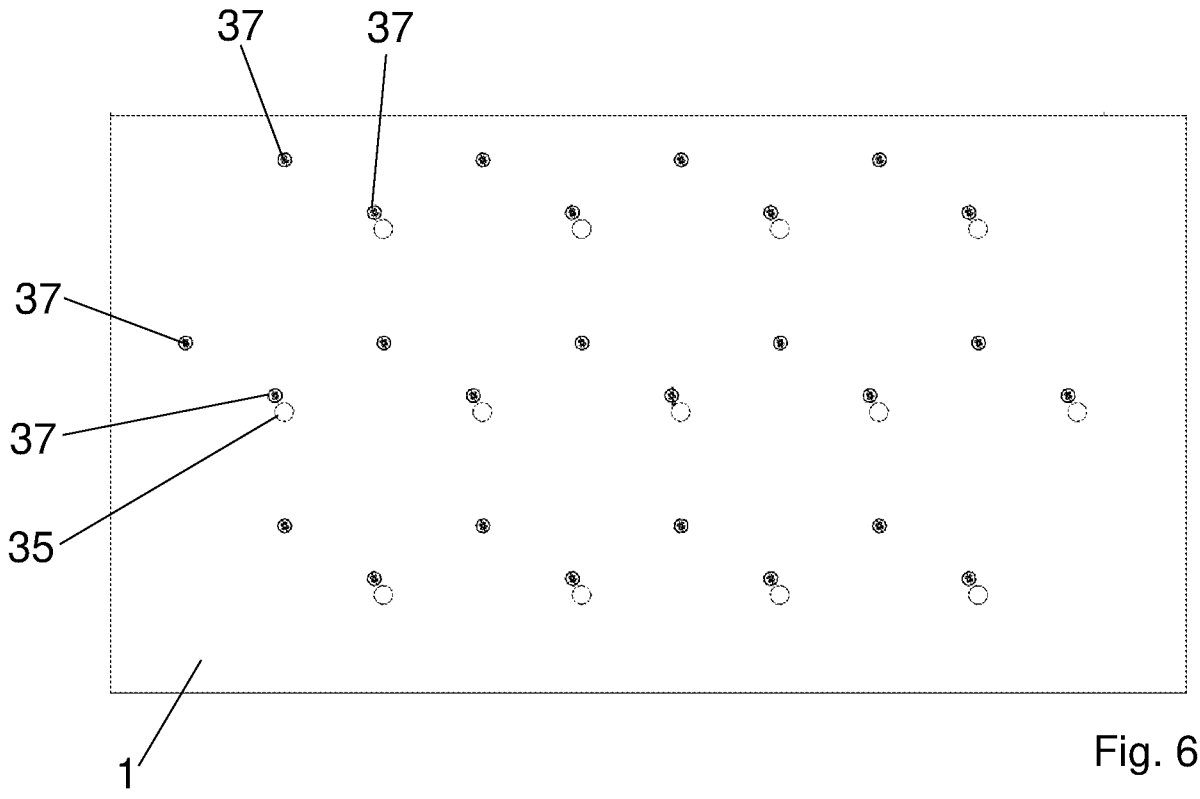

Fig. 6

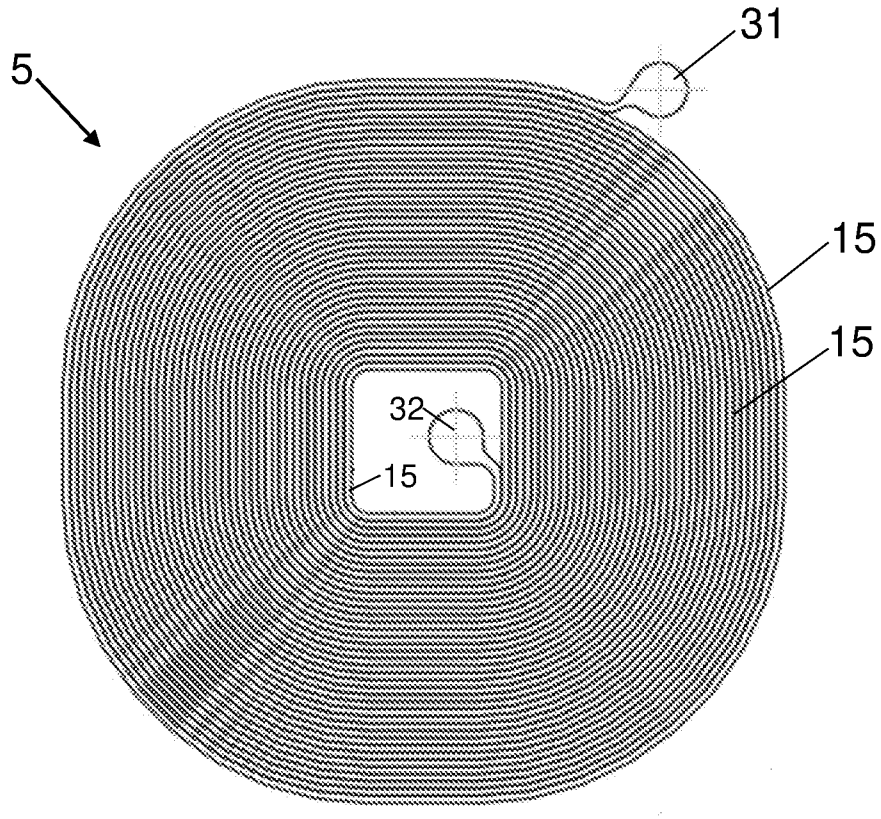

Fig. 7

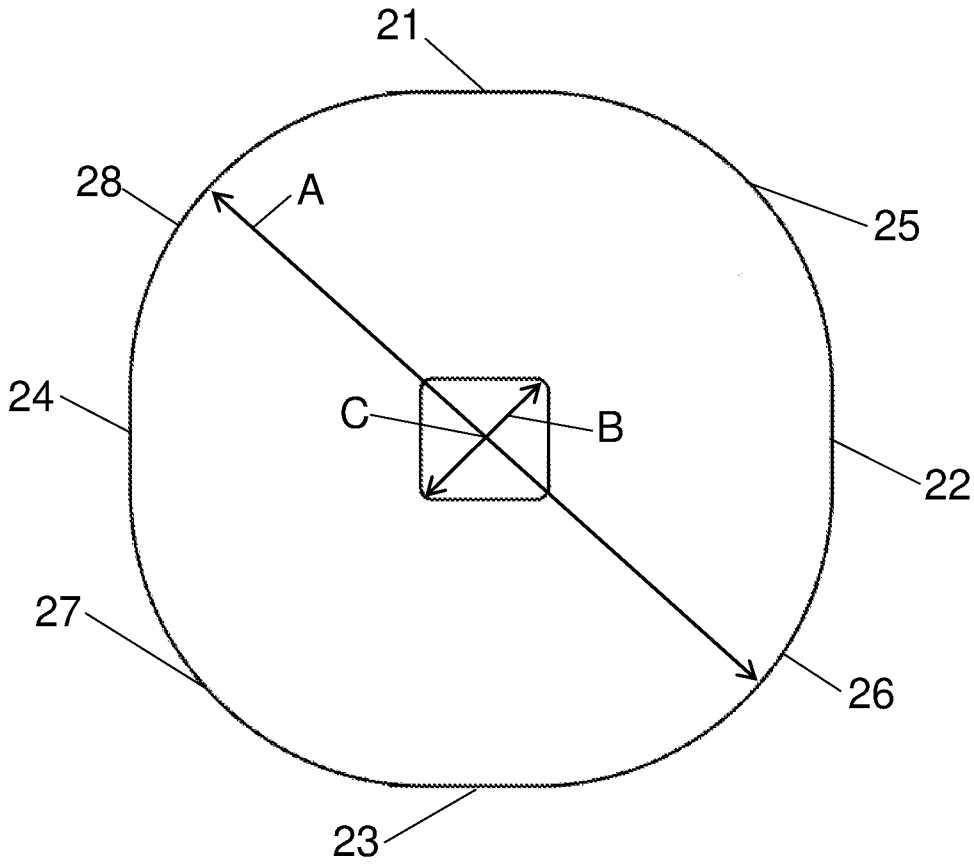

Fig. 8

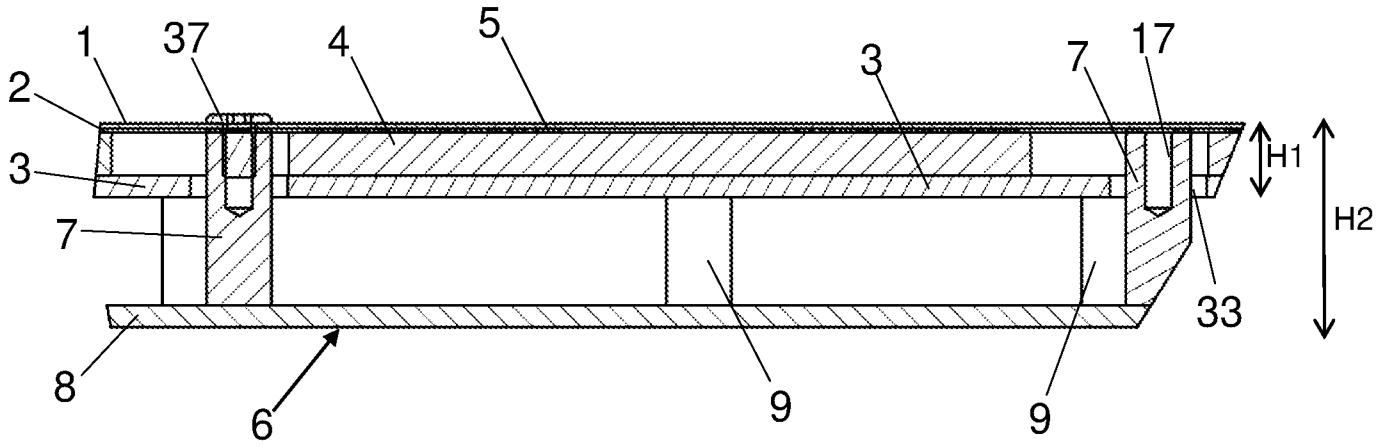

Fig. 9

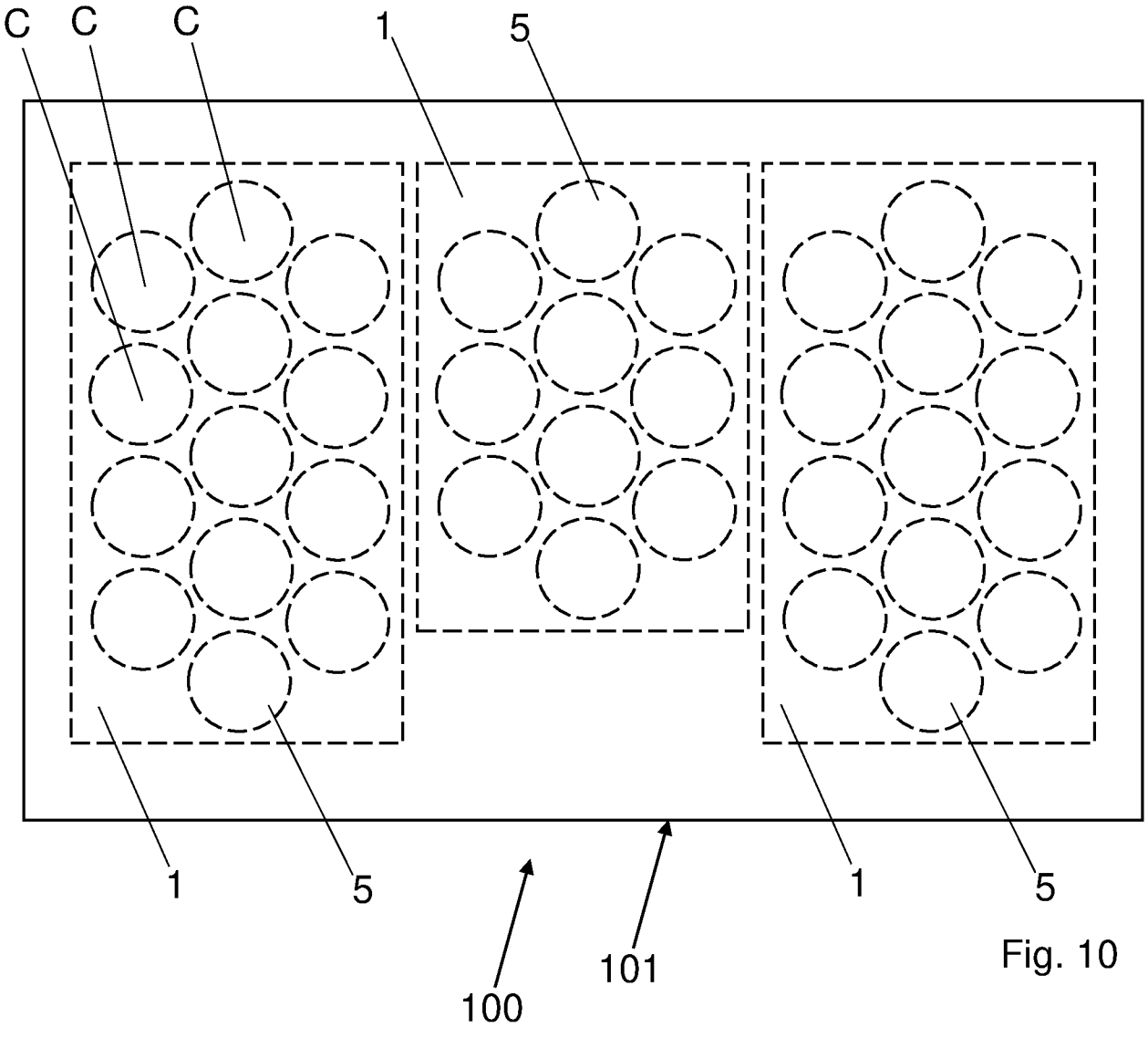

Fig. 10

INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2018/058831

A. CLASSIFICATION OF SUBJECT MATTER
INV. H05B6/12
ADD.

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)
H05B

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

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP 3 139 702 A1 (ELECTROLUX APPLIANCES AB [SE]) 8 March 2017 (2017-03-08) paragraph [0027]; figure 1	1-16
A	CN 206 410 178 U (ZHONGSHAN YOULONG KITCHEN APPLIANCES CO LTD) 15 August 2017 (2017-08-15) figure 1	1-16
A	EP 0 808 080 A1 (EUROP EQUIP MENAGER [FR]) 19 November 1997 (1997-11-19) column 3, line 56 - column 4, line 14	1-16
A	EP 2 533 255 A1 (F & B INTERNAT S R L [IT]) 12 December 2012 (2012-12-12) paragraphs [0036] - [0037]	1-16

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[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

* Special categories of cited documents :

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"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

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
4 February 2019	12/02/2019

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Pierron, Christophe

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Form PCT/ISA/210 (second sheet) (April 2005)

INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2018/058831

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	FR 2 483 727 A2 (ELECTRICITE DE FRANCE [FR]) 4 December 1981 (1981-12-04) page 2, lines 32-36 -----	1-16

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Information on patent family members

International application No
PCT/IB2018/058831

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