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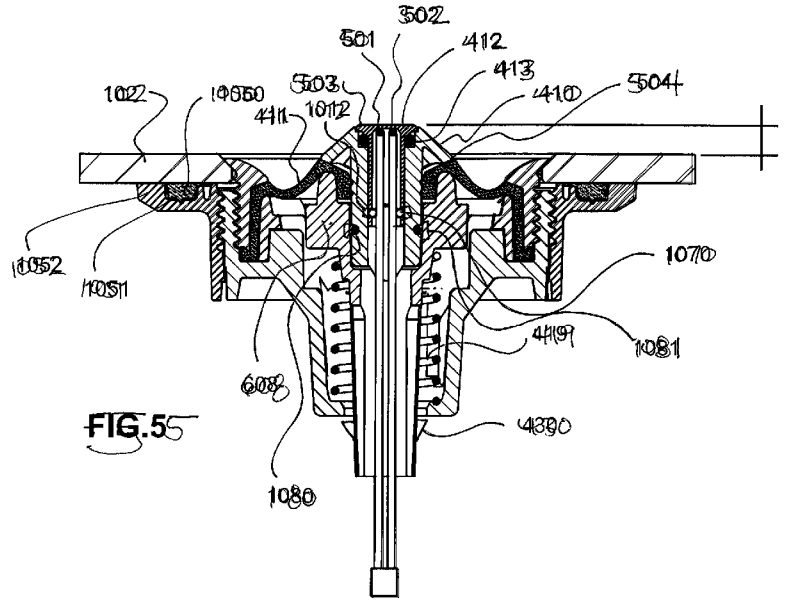

FIG.5

(57) Abstract: An induction cooker has a temperature sensor mount that includes a reciprocating sensor holder and a flexible diaphragm.

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Multi Cooker

Field of the Invention

The invention relates to induction cookers and more particularly to a counter top appliance having induction heating capabilities.

Background of the Invention

Induction cooking heats a cooking vessel for the purpose of heating food within the vessel. Cooking vessels for induction cooktops are usually ferromagnetic metal such as cast iron or particular stainless steels. A coil of copper wire is placed beneath a glass surface that supports the cooking vessel and an alternating electric current flows through the coil. This produces a magnetic field which induces an electric current in the cooking vessel. Current flowing in the vessel produces resistive heating. Heat from the vessel heats the food within the vessel. Radiant heat from the vessel also heats the glass on which the vessel rests and thereby, the components within the induction cooker.

Induction cookers in the prior art have limited capabilities with reference to temperature accuracy, versatility, user programmability, reliability, longevity and maintenance.

The present invention seeks to address, both alone and in combination some of the deficiencies associated with prior art induction cookers.

Induction cooking is known in both kitchen hobs and stand alone counter top appliances. Such hobs and appliances may have one or more induction coils so as to heat one or more vessels simultaneously. Accordingly, the present invention relates to induction hobs, stand alone induction cookers and other appliances incorporating one or more induction coils for cooking.

The contents of the applicant's PCT application PCT/AU2011/000887 (WO/2012/006674) is incorporated herein by reference.

Objects and Summary of the Invention

It is an object of the invention to provide an induction cooker with improved cooking temperature accuracy and functionality.

It is another object of the invention to provide an induction cooker with enhanced reliability and serviceability.

It is a further object of the invention to provide an induction cooker having a replaceable cooking surface.

It is another object of the invention to provide an induction cooker that is programmable.

Brief Description of the Drawing Figures

In order that the invention be better understood, reference is now made to the following drawing figures in which:

Figure 1 is a perspective view of an induction cooker.

Figure 2 is a plan view of the underside of the cooker depicted in Figure 1.

Figure 3 is a schematic diagram of an induction cooker.

Figure 4 is an exploded perspective view of a cooking surface, temperature sensor and insulation layer.

Figure 5 is a cross sectional detail of a temperature sensor and sensor holder.

Figure 6 is a cross sectional detail of a temperature sensor and sensor holder.

Figure 7 is a cross sectional detail of a temperature sensor and sensor holder.

Figure 8 is a cross sectional detail of a temperature sensor and sensor holder.

Figure 9 is a cross sectional detail of a temperature sensor and sensor holder.

Figure 10 is a cross sectional detail of a sensor and sensor holder.

Figure 10A illustrates two styles of temperature sensor carrier.

Figure 10B is a cross sectional view of a temperature sensor mount assembly having a domed upper sensor holder.

Figure 11 is an inverted perspective view of a cooking surface for an induction cooker.

Figure 12 is a schematic cross sectional drawing of a cooking surface attached to a chassis of an induction cooker.

Figure 13 is a schematic cross sectional drawing of a cooking surface attached to a chassis of an induction cooker.

Figure 14 is a perspective view of a fan arrangement for an induction cooker.

Figure 15 is an exploded perspective of a fan and air flow path for an induction cooker.

Figure 16 is a plan view of an air flow path, fan and auxiliary outlet for an induction cooker.

Figure 17 is an exploded perspective view of an induction coil assembly and chassis.

Figure 18 is a cross sectional diagram of an induction coil and its mounting to a chassis.

Figure 19 is a plan view of an induction cooker illustrating sealing membranes.

Figure 20 is a cross sectional view of a sealing membrane and USB connection.

Figure 21 is a cross sectional view of a sealing membrane and jack arrangement.

Figure 22 is a perspective view of a temperature probe.

Figure 23 is a perspective view of an induction cooker and temperature probe.

Figure 24 is a perspective view of a temperature probe holder.

Figure 25 is a cross sectional view of a temperature probe holder.

Figure 26 is a cross sectional view of a temperature probe holder.

Figure 27 is a schematic diagram illustrating uses of a temperature probe holder.

Figure 28 are perspective views of appliances incorporating a temperature probe.

Best Mode and Other Embodiments

As shown in Figures 1 and 2 an induction cooker 100 comprises an exterior body, case or shell 101, above which is mounted a heat resistant and heat stable ceramic glass cooking surface 102. The cooking surface 102 features a central opening 103 into which is mounted a temperature sensing assembly 104 that registers the temperature of a cooking vessel, particularly the underside of the cooking vessel and transmits data regarding same to the device's microprocessor control unit (MCU). In this example, the stand alone counter top appliance 100 has a graphic display 105 and various user inputs 106 for

controlling the operation of the device. The user interface comprising display 105 and inputs 106 communicates with the device's MCU.

As shown more particularly in Figure 2, the underside of the device features and inlet for a first cooling fan 201 that is associated with an induction coil cooling system and a second inlet 202 for a second fan that is associated with a power control cooling system. The intake 201, 202 are elevated above a resting surface by feet 203 that elevate the device 100 from the resting surface. The cooker 100 also features a USB port 204 for receiving and bi-directional communication with a removable USB device 205. A second port 206 is adapted to receive the plug end 207 of a removable, optional temperature probe 208.

As shown in the schematic diagram of Figure 3, an induction cooking device 100 comprises a ceramic glass cooking surface 301 below which is located an induction coil 302. The device's vessel temperature sensor 303, 104, resides in an opening formed in the glass 301 and communicates with the device's MCU 304. Electronic communication between the sensor 303 and the MCU 304 occurs through the central opening 305 of the induction coil 302. The temperature of the cooking surface 301 is monitored by a cooking surface sensor 306 located below the cooking surface 301. It also communicates with the MCU 304 through the central opening 305 on the induction coil 302. A first cooling system incorporates a fan and a flow path 307 whereby air enters the device through a first inlet 308 and is propelled by a fan through the flow path, preferably in which both sides of the coil are located before being exhausted from the device through a first outlet 309. The heat sinks of the power control board 310 are separately cooled by a second flow path 311. The second flow path 311 has a second inlet 312, its own cooling fan and a second outlet 313.

The MCU 304 communicates with the power control board 310, a communications board and sub-system 314. The communications sub-system includes circuitry for two-way communication utilising, for example, WIFI, Bluetooth, NFC or other wireless communication protocols, as appropriate. The MCU 304 also controls the induction coils 302 and receives data from a temperature sensor 314 located in thermal contact with and below the coils 302. As will be explained, the MCU receives signals from the vessel temperature sensor assembly 303 in the form of two distinct signals from two distinct sensors. The MCU also receives data from external devices such as temperature or other sensing devices, through a 3.5mm jack port 315. The MCU also sends and receives data through a USB port 316 and utilises this data for controlling the device and saving data. The device may have a second or further USB port 317 for providing external power to an auxiliary device. As will be explained, the coils 302 may be associated with a second temperature sensor 318 that also provides temperature data to the MCU 304.

The construction and operation of a reciprocating temperature sensor mount assembly is illustrated in Figures 4-10B, shown in Figure 4. A ceramic glass cooking surface 102 has a central chamfered opening 401. The opening 401 receives an exterior threaded and non-conductive clamping ring 402. The clamping ring has an upper, chamfered flange 403 that is received by and cooperates with the chamfer 404 formed around the central opening 401. The ring's interior rim chamfer 403a prevents the ring from passing through the opening 401, but sits completely below the upper surface of the cooking surface 102. A lower generally cylindrical sensor bracket 405 has internal and external threads 406, 407. The internal threads engage the external threads of the clamping ring 402 and draw the ring into a clamping engagement with the

ceramic glass cooking surface 102. The external threads 407 cooperate with internal threads in an upper sensor bracket 408. The upper sensor bracket 408 is attached to the underside of the cooking surface, for example, with a room temperature vulconisation silicone (1050, Figure 10). A sensor lower holder 409 receives an upper sensor holder 410. The upper sensor holder 410 is preferably a non-concoctive material such as polymer and includes a chamfered surround 440 that forms a circumferential ramp of, for example, 45 degrees. The upper holder 410 rests within the lower holder 409 and is guided by it for vertical movement. When joined, the lower and upper sensor holders 409, 410 form a gap that receives the rim of an elastomeric diaphragm 411. The diaphragm 411 may be of the rolling diaphragm type so as to accommodate the vertical movement of the sensor and sensor holders without stretching excessively. The upper sensor holder 410 is adapted to receive a hollow and in this example, cylindrical sensor carrier or cap 412 that is thermally conductive and that protects the sensors. A seal 413 is interposed between the upper and lower sensor holders 409, 410. In this way the lower sensor holder supports the sensors for reciprocating movement. The outer rim 414 of the diaphragm is retained by the lower sensor bracket 405.

An underside of the cooking surface 102 is adhesively bonded to a mounting frame 415, as will be explained. A rigid insulation layer 416 is located below the cooking surface 102 and above the electronic components of the device so as to protect them from heat radiating from above. The insulation 416 has a central opening 417 by which the insulation layer is mechanically supported or alternatively clamped. A clamping ring 418 sits below the insulation 416 for this purpose.

A mechanical bias in the form of, for example, a compression spring 419 urges the lower sensor holder 409 upwardly, being supported from below by a lower portion of the lower sensor bracket 405 that is adapted to contain the spring 419. The lower holder 409 has one or more outward facing teeth 430 that are retained by a ring or other structure 431 located on the lower sensor bracket.

The aforementioned temperature sensor mounting assembly as depicted in Figures 4-10B is considered unique in its manner of assembly and disassembly. In particular, the sensor mounting assembly and the parts in it can be serviced by unthreading the clamping ring 402. Unthreading or removing the clamping ring provides full access to the interior of the sensor mount assembly. However, even after removal of the clamping ring 402 and any service or repair procedures have been carried out, the relative position of the parts is important to maintain. Insuring correct positioning of the parts after repair or service is accomplished during the assembly sequence. The assembly sequence begins by attaching the upper sensor bracket 408 to an underside of the ceramic glass cooking surface using a room temperature vulcanisation silicone 1050. The RTV silicon is located in a circumferential groove 1051 located on an upper surface of the flange 1052 of the upper clamping bracket 408. Even before the vulcanisation or curing of the adhesive 1050, the lower sensor (405 may be engaged with the upper sensor bracket). Once the lower sensor bracket is threadedly engaged with the upper sensor bracket, the remainder of the parts 419, 608, 411, 410 etc are then assembled into position with the clamping ring 402 assembled last to complete the assembly. The clamping ring 402 is threaded into the internal threads of the lower cramping bracket 405 until a specified torque is reached. An exposed

portion of the clamping ring 402, for example, the interior of the upper rim may be provided with openings or protrusions 1060 so that a tool may be affixed to the clamping ring 402 in order that it may be torqued to the specified level. Threading the clamping ring 402 into the lower clamping bracket 405 effectively draws or rotates the lower clamping bracket 405 into the internal threads of the upper clamping bracket 408. As the lower clamping bracket threadedly advances into the upper clamping bracket 408, the torque is monitored until the target torque is reached. During this tightening process, the teeth 432 on the vertical arms 434 carried by the upper clamping bracket 408 engage teeth 432 form circumferentially around an exterior surface of the lower clamping bracket 405. The engagement of the teeth 432, 433 prevent the withdrawal of the lower clamping bracket 405 from the upper clamping bracket 408 by way of counter rotation or un-screwing. Thus, even when the clamping ring 402 is removed the lower clamping bracket 405 will not back away for the upper clamping bracket 408. In this way, the relative position of the parts in maintained even after repeated disassembly and reassembly.

It will be noted that the sensor cap 412 is retained in position within the upper sensor holder 410 by a clevis clip 1070. The clevis clip 1070 occupies a circumferential groove 1071 on an exterior surface of the sensor cap 412 and a groove 1072 located around the inside diameter of the upper sensor holder 410. The clevis clip 1070 is accessed through a radial opening 1073 located through a side wall of the upper sensor holder 412. Similarly, the upper sensor holder 410 is retained in position with respect to the lower sensor holder 409 by a second clevis clip 1080 that is inserted and accessed through a radial opening 1081 in the lower sensor holder 409. The second clevis clip 1080 occupies a first groove

on an outer surface of the upper sensor holder 410 and an internal groove 1081 located about the internal bore of the lower sensor holder 409.

As shown in Figure 5, in a rest position, the upper surface of the sensor cap is elevated above the upper surface of the cooking surface 102 by the action of the spring 419. Note that the upper holder presents a lower rim 504 that is below the upper surface of the cooking surface 102 even when the sensor assembly is in its uppermost position. By presenting a continuously chamfered or tapered outer surface whose rim 504 is below the cooking surface, pots and other cooking vessels will not catch on the upper holder and instead will slide over it so as to depress the moving parts of the sensor assembly to the flush orientation depicted in Figure 6. Because of the spring 419, both sensors (such as NTC sensors) are able to make intimate contact with the underside of a cooking vessel because the cap 412 is conductive, one or more temperature sensors 501, 502 are located directly beneath the flat upper surface 503 of the cap and because the spring 419 is able to be compressed as shown in Figure 6.

With reference to Figure 6, it can be seen that when a cooking vessel is placed onto the cooking surface 102 it urges the cap 412 downwardly until it is flush with the upper surface of the cooking surface 102. Because cooking vessels are often slid into a central position on the cooking surface, the cap 412 together with the external surfaces of the upper sensor holder 410 form a continuous circumferential ramp or truncated cone whenever any part of the cap 412 or holder 410 are above the level of the upper surface 601. Figures 5 and 6 also illustrate how the elastomeric diaphragm 411 seals between the moving and the stationary parts of the sensor assembly 104. In this example, the inner rim of the diaphragm 411 is clamped between the upper holder 410 and the lower sensor holder 409. Thus, in this example, the upper holder 410 has an outward

and downwardly extending rim 602 that makes contact with an upper surface of the diaphragm so that the diaphragm can be clamped between the rim 602 and an upwardly extending blunt ring 603 formed on an upper part of the lower sensor holder 409. The outer rim of the toroidal diaphragm 411 is contained and trapped between and inner surface of the clamping ring 402 and a clamping insert 604 that sits within and cooperates with the lower sensor bracket 405. In this example, the elastomeric sealing diaphragm 411 has a lower rim 605, a circumferential outer wall 606 that is retained between the insert ring 604 and the glass clamping ring, a convoluted central membrane 607 and an inner rim 608 that is retained in a circumferential groove that is radially inward of the lower sensor holder's clamping feature 603. Advancing the clamping ring 402 to the specified torque during assembly clamps the diaphragm's peripheries and creates a seal.

As shown in Figure 7, the sensor assembly's clamping ring 402 has an upper flange 701 having a chamfered underside 702. The clamping ring may feature openings of other features 703 that allow the ring to be unscrewed from the lower bracket 704. In this way, the elastomeric diaphragm 705 as well as the lower holder 409, upper holder 410 and spring 419 can be removed through the top of the cooking surface 102. This allows for the serviceability of at least the removable parts. It should be noted that the upper flange 701 of the clamping ring is larger in diameter than the threaded exterior of the clamping ring but smaller in diameter than the maximum diameter of the edge of the cooperating chamfer 710 formed in the cooking surface 102. As shown in Figure 8, this arrangement allows the upper most surface of the flange 701 to have an installed and usable position that is lower than the upper surface of the cooking surface 102. From Figure 7 and 8 it can also be appreciated that the elastomeric

diaphragm 705 is retained by screwing the clamping ring 402 into the internal threads of the lower bracket, preferably so that a projecting lower rim 720 of the clamping ring enters a circumferential groove 721 formed between the sidewall and the lower rim of the diaphragm. Figure 8 also illustrates that as an alternative, the clamping ring 801 may have an upper flange 802 that terminates above the cooking surface 102. It preferably has a chamfered edge 803 so that cooking vessels can easily slide across the upper surface of the flange 802.

As shown in Figure 9, the aforementioned sensor assembly and method of mounting it with respect to the cooking surface, allow for the provision of a liquid flow path 901 that extends from above the cooking surface 102 to a location below a discharge opening or vent 902 located on an underside 903 of the case or body 101. This is provided for in the event that the elastomeric diaphragm 411 is inadvertently penetrated or if it fails. As illustrated in Figure 9, the flow path 901 (below the diaphragm 411) passes through a gap located between the reciprocating lower sensor holder 904 and the lower bracket 905. The uninterrupted vertical flow path continues through the interior 906 of the lower bracket and through a second gap 908 located between and opening in the lower part of the lower bracket 905 and a cylindrical body portion 909 of the lower sensor holder that passes through the opening 908 in the lower bracket 905. In this example, the flow path also extends through a cylindrical channel 910 formed in an intermediate chassis component 911 within the case that discharges into a cylindrical collector 912 associated with the case's lower surface 913. The flow path contains no area where liquid can accumulate. In this example, the discharge opening in the case 101 has a protective, perforated cover 914 that can be removed so as to access the interior of the case. Note that

the flow path 901 allows fluids to flow from above the cooking surface 102 to a discharge below the device, utilising only gravity to promote the flow of liquids through the device in a way that does not interfere with the induction coil, the cooling airflow or any of the internal electrical components associated with the device.

The same arrangement creates an airflow path that effectively cools the sensor assembly 915 the internal space within the case particularly around the induction coil heating element 916. An internal channel or chassis component 911 has an elevated wall or moat 917 around the fluid flow path and interior wall 910 of the channel. The raised rim or wall 917 permits air to flow in close proximity to and even through the sensor assembly 915 while avoiding water ingress into the compartment 920 below the plenum 911 by way of the open airflow path 921. This same arrangement also prevents fluids inadvertently entering past the diaphragm 411 from being entrained in the airflow 921. Note the nesting and concentricity between the sensor assembly 915, the channel 910 and the protective shroud 912. This allows for the creation of separate air and fluid flow paths that potentially intersect with one another but do not interfere with one another.

As shown in Figure 10, the lower holder 1000 moves vertically relative to the lower bracket 1001. It may be guided by the flat cylindrical surfaces of the brackets or by optional interdigitating ribs or fins 1006, 1007. This vertical motion, biased upwardly by the spring 1002 is important for maintaining the pair of sensors 1003, 1004 intimate thermal communication within a vessel that is in contact with the cap 1005. However, rotational movement between the lower holder and the lower bracket is preferably avoided. To prevent or limit the rotation between the two parts, the lower holder 1000 may be provided with

vertical fins 1006 on an exterior surface. These vertical fins cooperate with inward facing vertical fins 1007 formed on an inner surface of the lower bracket. Pairs or inner and outer cooperating fins may be provided in any number, as required to maintain low friction vertical sliding between the parts. Figure 10 also illustrates two different methods for retaining an insulation layer 1008 between the induction coil heating element 1009 and the electronic and other components that may be located in the interior 1010 of the cooker. In this example, a mica sheet or another stable insulator is provided in a shape that corresponds approximately to the outer perimeter of the cooking surface and that has an internal opening 1011 for accommodating the radially outward most parts of the temperature sensing assembly, for example, the outer diameter of the upper bracket 1012. In this example, an insulation inner rim retaining shelf 1013 is located within the compartment 1010. In this example, the shelf 1013 is carried by the upper bracket 1012 or alternately affixed to it or spaced from it in a predicable way. In the example provided in Figure 10, the shelf 1013 provides a mechanical support to the inner rim 1014 of the insulation 1008 without being affixed to it or adhered to it. By resting on the shelf 1013, the insulating sheet or layer 1008 can move relative to the shelf 1013, without creating unnecessary stresses in the insulation. If required, the spacing between the shelf 1013 and the underside 1015 of the cooking surface can be large enough so as to create an air gap or spacing 1016 between the underside of the cooking surface 1015 and the induction coil 1009. This air gap can form part of the induction coil's cooling air flow path as shown in Figure 3.

Figure 10 also illustrates that the upper sensor holder 410 forms a bumper in the form of a truncated cone. The cone shape allows a cooking vessel to slide over the sensor holders 410, 412 and depress them.

As shown in Figure 10A, the upper sensor holder 412 has an enlarged head 1030. To facilitate the movement of cooking vessels into engagement with the head 1030 the outer rim of the head 1030 may be optionally chamfered 1031, or radiused (or curved) 1032.

As shown in Figure 10B, the lower sensor holder 410 may comprise a truncated cone as shown in Figure 10 or comprise a dome, bulge or mound with sides curved in a vertical plane 1033.

As shown in Figure 11 a fixing bracket assembly 1100 is adhered to an underside 1101 of the ceramic glass cooktop surface 1102. The bracket assembly allows for the provision of, for example, eight internally threaded screw (or other fastener) fixing positions 1103 inward or the outer rim 1104 or the surface 1102. The screw fixing positions 1103 receive fasteners that can be removed for the purpose of better servicing, replacing or maintaining of the surface 1102 or component that may be below it. In this example, the bracket assembly comprises four individual, straight aluminium brackets 1105. Aluminium is used because it is rigid, stable and not ferromagnetic. Each of the aluminium brackets 1105 is in the shape of a C-shaped channel. The channel may be perforated 1107 for better cooling and airflow. Each bracket has axial limbs or extensions 1108 that may be affixed to one another so as to form a continuous frame when adjacent tab or legs 1108 are affixed to one another.

The threaded openings 1103 associated with the cooker surface 1102 are used to retain the cooktop surface 1102 to an upper margin of the shell or case 1201 as shown in Figures 12 and 13. As previously mentioned an adhesive 1202 may be used to adhere the brackets or bracket assembly 1105, 1100 to the top 1102. In this example, an underside of the bracket is provided with a longitudinal channel 1203 that allows the edges of the bracket to either side of

the channel to make direct contact with the underside of the surface 1102. Openings through the underside of the bracket allow the adhesive 1202 to have more surface area contact with the bracket or bracket assembly. The bracket is depicted as having an interior lip 1204 that is generally parallel with the underside of the surface 1102 and that defines a gap below the underside of the top 1102. This gap contains the outer rim of the insulation layer 1205 located below the induction coil. The inner rim of the insulation layer is supported in the manner suggested by Figure 10. Thus, the insulation layer is maintained in registry with the induction coil but is free to expand and contract without binding or requiring fasteners or adhesives to mount it.

Figures 12 and 13 also illustrate how the top 1102 is affixed to the device's chassis 1301. As illustrated, a threaded fastener 1302 in registry with opening in the bracket passes through an optional guide, support, opening, slot or washer that is retained by the chassis 1301. Tightening the threaded fastener 1302 draws the top 1102 toward the chassis 1301.

In preferred embodiments a liquid and air impermeable seal 1304 is maintained between the chassis 1301 or the chassis' shell or case 1201 and the top 1102. In the examples depicted in Figures 12 and 13, this circumferential seal below the top 1102 comprises two upper sealing lips 1305, 1306, a longer lip 1305 being located radially outward of a smaller lip 1306. The outer lip 1305 has an outer rim 1307. As the fastener 1302 is rotated, the outer sealing lip 1305 is compressed to form a primary seal between the shell 1201 and the top 1102. A second sealing engagement is formed between the inner lip 1306 and the underside of the top 1102. Other sealing arrangements are contemplated.

The shelf 1204 may be formed by bending a tab into a horizontal orientation as shown in Figure 12. In this way, the insulation can be installed and then the tab 1204 bent over to form the shelf 1204.

As shown in Figure 14, the base or underside chassis component of an induction cooker has grill covered vent openings 201, 202 (as shown in Figure 2) an enclosed fan 1402 draws air through one of the openings 202. The enclosed fan discharges air into an enclosed channel 1403. The channel 1403 comprises a lower component 1404 and a cover 1405. The lower component 1404 is preferably an aluminium heat sink with spaced apart fins onto which is mounted heat sensitive circuit components such as IGBT semi-conductors 1406 and a grid component semi-conductor 1407. The semi-conductors 1406, 1407 may be mounted on an underside of the lower component 1404. The upper surface of the lower component comprises longitudinal and generally parallel fins 1501 (see Figure 15) that extend in the direction of air flow. The upper component 1405 forms a cap that together with a lower component 1404 forms an airflow channel or path that leads from the discharge of the fan 1408 to an exit or air discharge opening 1409 adjacent to but preferably interior of an end wall 1410 in which are formed discharge vent openings 1411.

As shown in Figure 15, the fan's discharge opening 1408 is coupled to the airflow path created by the upper and lower components 1404, 1405 by a polymeric boot or adaptor 1502 that mechanically couples the discharge opening 1408 with the flow path. In this way, a cooling airflow path associated with the induction coil does not co-mingle or share an air path with the cooling airflow path associated with the semi-conductors 1406, 1407. The adaptor 1502 is preferably elastomeric so as to seal efficiently against both the fan 1402 and the assembly that includes the upper and lower components 1403, 1404.

As shown in Figure 16, the cooling airflow path 1601 defined by the heat sink and its cover 1404, 1403 may include an auxiliary air outlet port 1602. In this example, the auxiliary outlet port 1602 is formed at an angle 1603 relative to the channel and generally linear flow path 1601. The auxiliary outlet 1602 may be used to collect cooling air for other purpose or to moderate the airflow occurring in the main cooling path 1601.

As shown in Figures 17 and 18 the induction coil assembly 1701 is mounted to the chassis or an intermediate chassis component 1702 so as to minimise the effect of the thermal expansion and contraction of the induction coil assembly 1701. In this example, the induction coil assembly 1701 comprises (for example) a generally circular substrate 1703 in which is formed cooling openings 1704 and a spiral track 1705 for receiving and supporting the twisted copper wire induction element. As shown in Figures 17 and 18, the outer rim or periphery of the substrate 1703 features through openings 1706 for receiving fasteners 1707 that go through the openings 1706 and are received by fixing points or posts 1708 on the chassis component 1702. As shown more clearly in Figure 18, the through openings 1706 are elongated, or longer at least in a radial direction than either the fastener 1707 or their fixing points 1708, creating a radial clearance so that the substrate 1703 is free to expand in a radial direction without stressing the chassis 1702 or the fixing point or post 1708. So as to engage with the lateral sides of the opening or slot 1706, the fastener may have a flange or washer 1709 under the head 1710. Because the degree of thermal expansion of the substrate 1703 is less about the inner periphery, the inner circumference, being a portion of the substrate that surrounds its central opening 1801, may be affixed by providing the substrate with downward facing bosses that are internally threaded to receive fasteners 1803. The fasteners

1803 may pass through openings 1804 with merely a sliding fit so that there is little or no relative movement between the boss 1802 and the chassis or chassis sub-component 1702. This arrangement essentially fixes the inner rim 1805 of the substrate while allowing the outer rim to expand and contract relative to the fixing points 1708.

As shown in Figure 19, a kitchen appliance or other appliance such as an induction cooker may be provided with externally accessible ports adapted for the insertion of the male portion of a USB cable or other electrical connection such as a 3.5mm jack. In this example, the appliance 1901 is provided with a recessed port 1902 for receiving a male USB connector. The port has a water resistant cover being a flexible elastomeric membrane 1903. So that the membrane can allow the USB connector to pass through it, the membrane is through penetrated with one or more incisions-or slots. The slot or slots do not form a permanent opening, but flex so as to allow the connector to pass through, preferably maintaining a water resistant seal around the connector, particularly when the connector is engaged with the cooperating connector behind the membrane 1903. The slot may be a straight or linear slot 1904, a "U" shaped slot 1904 having linear upright and transverse portions, and "H" shaped slot 1905 or a straight slot, terminated at each end with "V" shaped portions 1906. As shown in Figure 20, the protective membrane 1903 flexes as the USB connector 2001 is inserted. The parts of the membrane that are adjacent to the slot or arrangement of slots flexes so that flexed leg or flap 2002 is formed. The flap 2002 makes surface contact with an exterior portion of the connector 2001 so as to create a seal. In this example, the flap is trapped between and internal face of the device's chassis 2003 and a mounting bracket 2004. Thus, the connector 2001 passes through an opening 2005 in the chassis before

penetrating the flexible membrane 1903, finally making contact with the cooperating female style USB connector 2006.

Similarly, and as shown in Figures 19 and 21, a receptacle or female jack for a pin like electrical connector such as a 3.5mm plug comprises a preferably recessed port opening 1907 that is protectively and sealingly covered by a flexible membrane 1908. The membrane 1908 may have a single point-like, but flexible opening 1909 for admitting the tip of the plug. In the alternative, it may have a network of intersecting linear slots 1910, a network comprising a "Y" shaped slot 1911 or a single slot 1912. As shown in Figure 21, the point or slot-like perforations of the membrane bend, flex 2101 or accommodate the body 2102 of the plug, thereby allowing the tip 2103 to make electrical contact with a cooperating socket or electrical connection 2104. The flexing of the membrane creates a return, leg or flap 2105 that fold inwardly so as to make surface contact with the body of the plug 2102 and create a seal around it.

As shown in Figure 22, an electrical plug of the kinds shown in Figure 21 may be incorporated into a temperature probe 2202. The probe comprises a temperature sensor 2202 forming a part, such as the tip, of a stem 2203 having a pointed tip 2204 that is adapted to penetrate common food stuffs. The stem 2203 is carried by a probe handle 2205. The handle 2205 comprises a body portion 2206 and a ring or ring-like end 2207. The handle is preferably formed from a polymer. An electrical cable 2208 extends from the probe's handle to the probe's plug assembly 2208. The plug assembly 2208 has a body 2209 from which extends an electrically conductive tip or plug 2210 such as a 3.5mm, multiple conductor plug. The plug body 2209 terminates in a ring 2211. The centre of the ring 2211 is in axial alignment with the tip 2210. Similarly, the probe's ring 2207 is in axial alignment with the probe's pointed tip 2204. When

plugged into its socket or receptacle 1907, the probe communicates temperature data to the device's microprocessor. This real time temperature data can be utilised in a number of ways in the preparation or cooking of foods by the device.

As shown in Figure 23, the temperature probe 2301 is connectable by its cord or cable 2302 to a port 2303 carried by or associated with the induction cooking appliance, or another appliance 2304. The body 2305 of the probe's handle has a projecting limb 2306. The gap or corner between the limb 2306 and the main part of the body 2305 forms a saddle 2307. The saddle 2307 is adapted to fit over a rim 2308 of a cooking vessel 2309 so that the probe handle can rest on or engage the cooking vessel 2309 or rest on it without human intervention. In this example, both the probe's main body 2310 and limb 2306 are generally cylindrical or tapered cylinders.

As shown in Figure 24, the temperature probe 2401 may also be carried or supported by a probe holder 2402. The probe holder of this example is a split elastomeric ring having a circumferential groove 2403 for snugly receiving the stem of the probe 2401. In this example, the holder is in the form of a disc with a central opening 2404. The cap or split 2405 in the holder allows the holder to flex so as to accommodate the rim or sidewall of a cooking vessel 2406.

As shown in Figure 25, the depth of the circumferential groove 2403 is preferably deeper than the thickness of the probe stem 2203. The holder may have embedded within it a resilient clip 2501 that maintains the shape of the holder and allows it to return to its rest position when withdrawn from a pot. The clip also improves the resiliency and clamping force of the holder when it is installed on a pot or vessel. In this example, the central opening 2404 is approximately one third of the overall diameter of the holder. The adjacent

clamping edges of the clip 2502, 2503 may be rounded so as to accommodate a wide variety of pot shapes and thicknesses. As shown in Figure 26, the groove 2403 is preferably located on the centre line between the opposite edges 2601, 2602 of the holder. As shown in Figure 27, the stem 2701 may be releasably clamped within the holder's groove in a variety of orientations. Illustrated are examples of an upright orientation 2702, and inclined orientation 2703 and a generally horizontal orientation 2704. The holder retains the stem by interference or friction, the width of the groove being narrower than the diameter of stem 2701. This stem can be inserted, repositioned and removed easily.

As shown in Figure 28 a variety of cooking tools may either incorporate or be adapted to incorporate a temperature probe of the type suggested by Figure 22. For example, a cooking spoon 2801, a spatula 2302 or a whisk 2803 may have a handle 2804 in which is formed a longitudinal through bore 2805. The bore 2805 is adapted to receive the stem 2806 of a temperature probe 2807, either permanently or removably. In these examples, the working part of the spoon, spatula or whisk is provided with an exit opening 2808 that allows the end of the stem and particularly the tip 2809 to protrude into a location adjacent to the respective working part of the spoon, spatula or whisk. In the example of the whisk 2803, the probe tip 2809 terminates within the cage or array of wire 2810 forming the working part of the whisk. In these examples, the probe's handle 2811 comes to rest, when installed, adjacent to a terminal end of the handle 2804. The handle's ring 2812 allows for the easy installation of the stem through the central bore 2805. The handle's saddle 2812 remains functional for the purpose of supporting the cooking tool and its temperature probe on the rim of a cooking vessel, when in use.

Although the invention has been described with reference to specific examples, it will be appreciated by those skilled in the art that the invention may be embodied in many other forms.

As used herein, unless otherwise specified the use of the ordinal adjectives "first", "second", "third", etc., to describe a common object, merely indicate that different instances of like objects are being referred to, and are not intended to imply that the objects so described must be in a given sequence, either temporally, spatially, in ranking, or in any other manner.

Reference throughout this specification to “one embodiment” or “an embodiment” or “example” means that a particular feature, structure or characteristic described in connection with the embodiment is included in at least one embodiment of the present invention. Thus, appearances of the phrases “in one embodiment” or “in an example” in various places throughout this specification are not necessarily all referring to the same embodiment or example, but may. Furthermore, the particular features, structures or characteristics may be combined in any suitable manner, as would be apparent to one of ordinary skill in the art from this disclosure, in one or more embodiments.

Similarly it should be appreciated that in the above description of exemplary embodiments of the invention, various features of the invention are sometimes grouped together in a single embodiment, figure, or description thereof for the purpose of streamlining the disclosure and aiding in the understanding of one or more of the various inventive aspects. This method of disclosure, however, is not to be interpreted as reflecting an intention that the claimed invention requires more features than are expressly recited in each claim. Rather, as the following claims reflect, inventive aspects lie in less than

all features of a single foregoing disclosed embodiment. Any claims following the Detailed Description are hereby expressly incorporated into this Detailed Description, with each claim standing on its own as a separate embodiment of this invention.

Unless specifically stated otherwise, as apparent from the following discussions, it is appreciated that throughout the specification discussions utilizing terms such as "processing," "computing," "calculating," “determining” or the like, refer to the action and/or processes of a microprocessor, controller or computing system, or similar electronic computing or signal processing device, that manipulates and/or transforms data.

Furthermore, while some embodiments described herein include some but not other features included in other embodiments, combinations of features of different embodiments are meant to be within the scope of the invention, and form different embodiments, as would be understood by those in the art. For example, in the following claims, any of the claimed embodiments can be used in any combination.

Thus, while there has been described what are believed to be the preferred embodiments of the invention, those skilled in the art will recognize that other and further modifications may be made thereto without departing from the spirit of the invention, and it is intended to claim all such changes and modifications as fall within the scope of the invention.

While the present invention has been disclosed with reference to particular details of construction, these should be understood as having been provided by way of example and not as limitations to the scope or spirit of the invention.

What is claimed is:

1. A temperature sensor mount assembly device for an induction cooker, comprising:

a thermal sensor;

the sensor carried by an upper sensor holder; and

the upper sensor holder reciprocating with respect to, and restrained for vertical motion by, a lower sensor holder.

2. The device of claim 1, wherein:

a flexible diaphragm extends between the upper sensor holder and an interior of an opening that receives the upper and lower sensor holders.

3. The device of either of claims 1 or 2, wherein:

the upper sensor holder is not conductive.

4. The device of any one of claims 1 to 4, wherein:

the upper sensor holder further comprises a chamfered surround that forms a circumferential ramp.

5. An assembly of an induction cooktop surface and temperature sensor mount, comprising:

a cooktop surface in which is formed a through opening;

an upper clamping bracket adhered to an underside of the cooktop surface, the clamping ring having first threads and one or more arms, each arm having a ratchet tooth;

a lower clamping bracket having second threads that engage the first threads, an array of circumferential teeth that cooperates with the one or more ratchet teeth;

a clamping ring mounted within the opening in the cooktop surface and limited in a downward direction; and

the clamping ring having third threads that engage fourth threads formed on the lower damping bracket.

6. The assembly of claim 5, wherein:

the opening is chamfered and the clamping ring has a chamfered flange that engages the opening and is restrained by it in a downward direction.

7. A combination of induction cooking surface and temperature sensing assembly, wherein:

the opening having a chamfer;

a clamping ring is located in the opening;

the cooking surface having an upper surface; and

the clamping ring having a chamfered flange that when fully installed is received by the chamfer and fully located below the upper surface.

8. An induction cooking device comprising:

a body with an underside having a discharge opening;

a cooking surface in which is formed a through opening for a temperature sensor mount that is located above the discharge opening;

the through opening supporting the temperature sensor mount;

the temperature sensor mount having a flexible diaphragm through which protrudes a sensor cap; and

the temperature sensor, below the diaphragm, defining an uninterrupted vertical flow path that extends to the discharge opening.

9. The device of claim 8, wherein:

the flow path passes through an induction coil within the body.

10. An induction cooking device comprising:

a cooktop having an underside to which is adhered a bracket assembly, the assembly having a plurality of fastener fixing positions; and

a case that supports the cooktop, the case having an upper margin in which is formed a plurality of through opening through which extend fasteners that attach the bracket to the case.

11. The device of claim 10, wherein:

the bracket retains an outer rim of an insulation layer located below an induction coil.

12. The device of either of claims 10 or 11, wherein:

a circumferential seal is clamped between the cooktop and the case by the action of the fasteners.

13. An induction cooker comprising:

a chassis in which is formed vent opening;

a cooling fan that draws through the opening;

the cooling fan discharging into an enclosed channel having a component and a cover;

the component being a heat sink into which is mounted one or more semi-conductor components; and

the enclosed channel leading from the fan to a discharge vent.

14. The cooker of claim 13, wherein:

the heat sink has spaced apart fins that extends in the direction of an air flow in the enclosed channel.

15. An induction cooking device, comprising:

an induction coil assembly mounted to a chassis component;

the induction coil assembly comprising a substrate that supports an induction element, the substrate having through openings through which extend fasteners that attach the substrate to the chassis component; and

the opening being elongated in a radial direction to allow the substrate to expand in a radial direction.

16. The device of claim 15, wherein:

the opening are formed on an outer rim of the substrate.

17. The device of either of claims 15 or 16, wherein:

the substrate has a central opening.

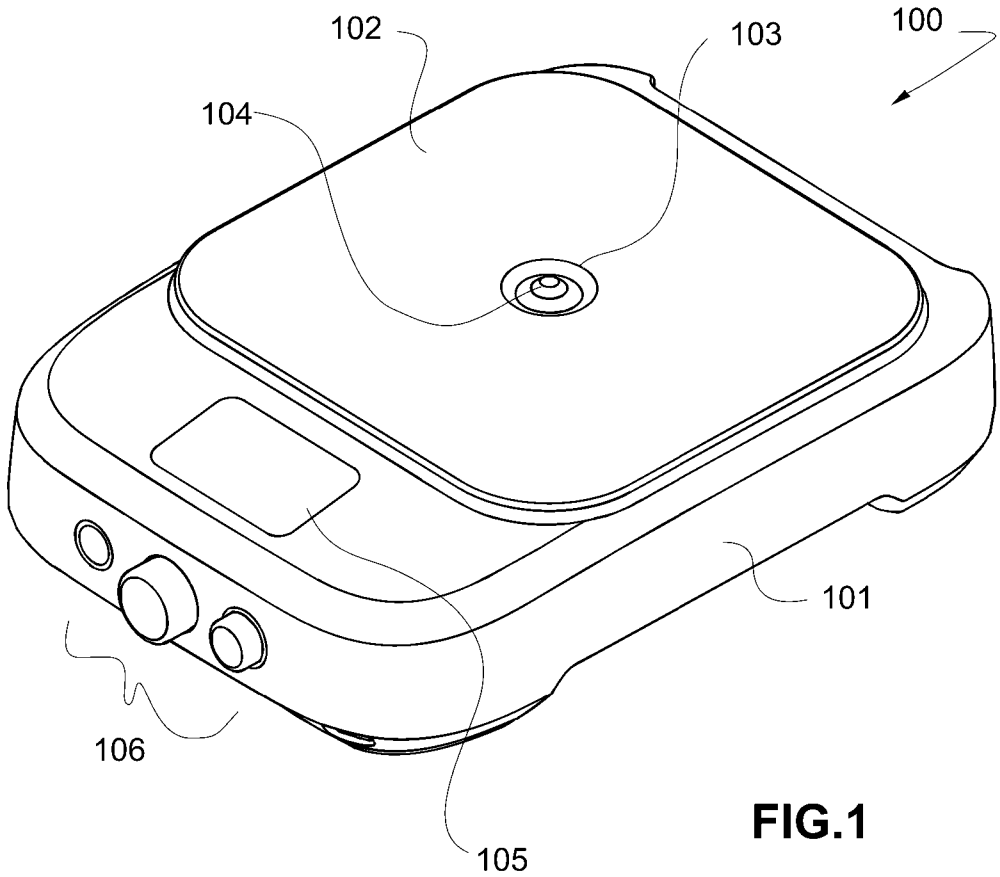


FIG.1

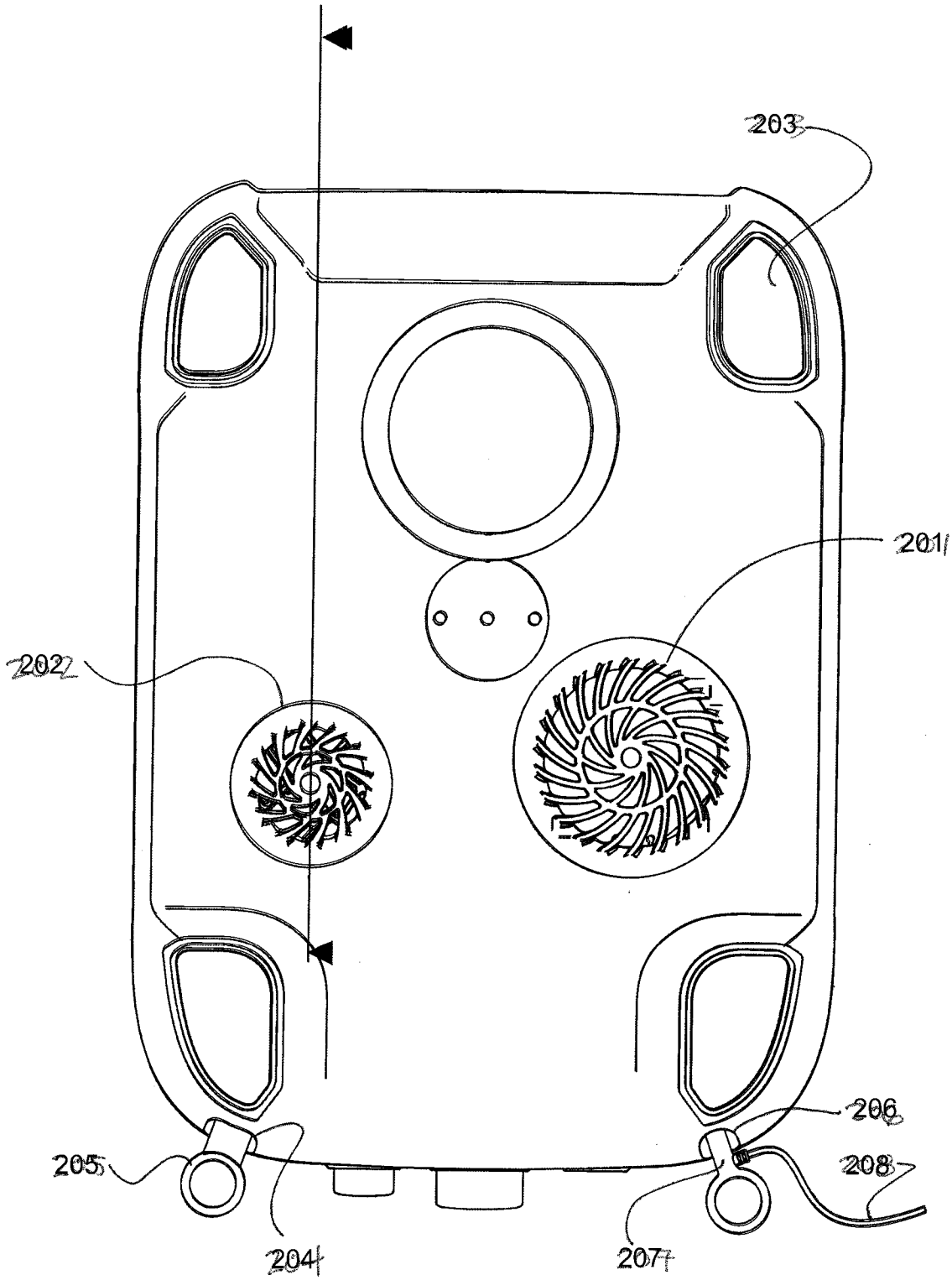


FIG.2

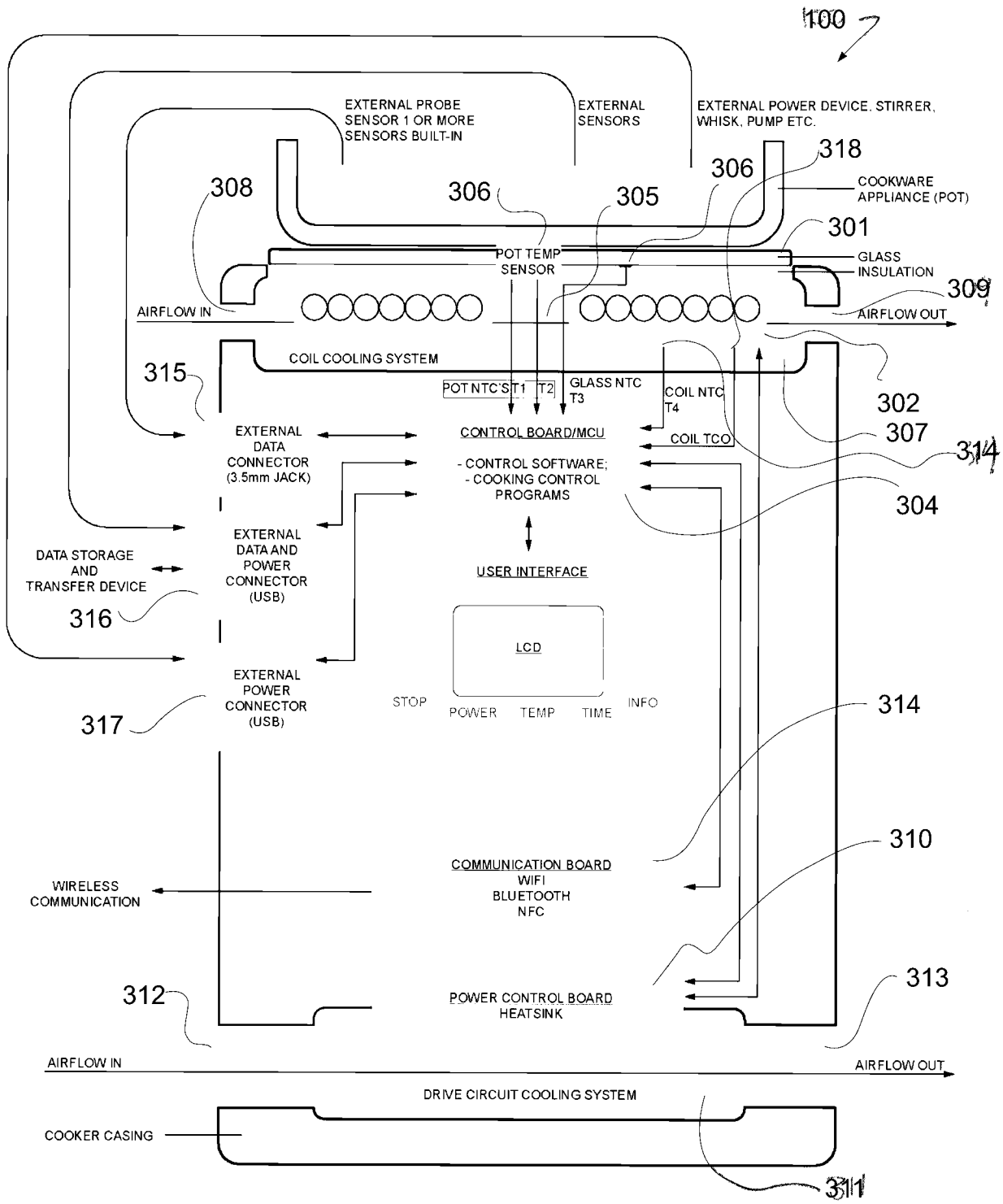
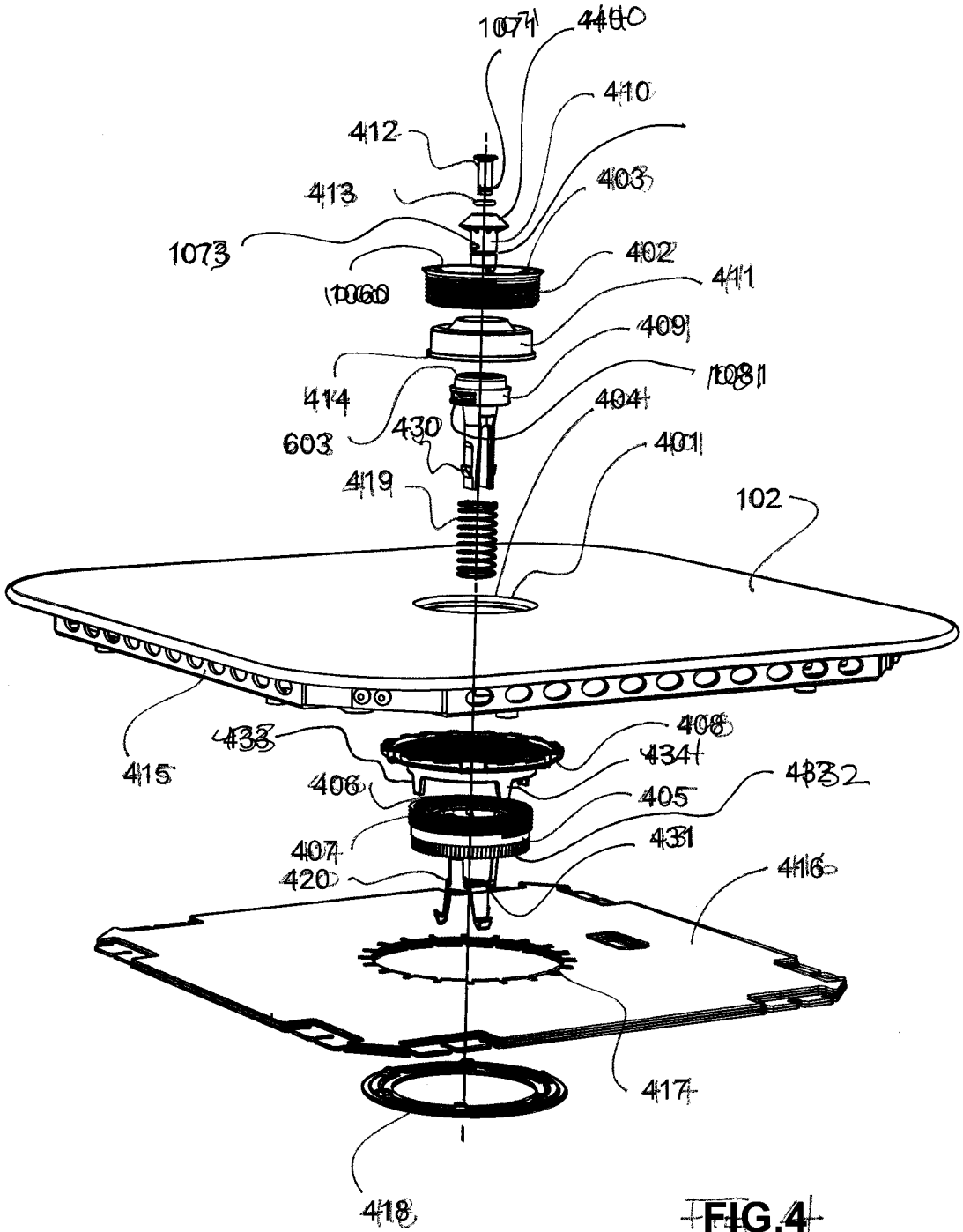


Fig 1: Induction Cooker Schematic

FIG.3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1081
414
404
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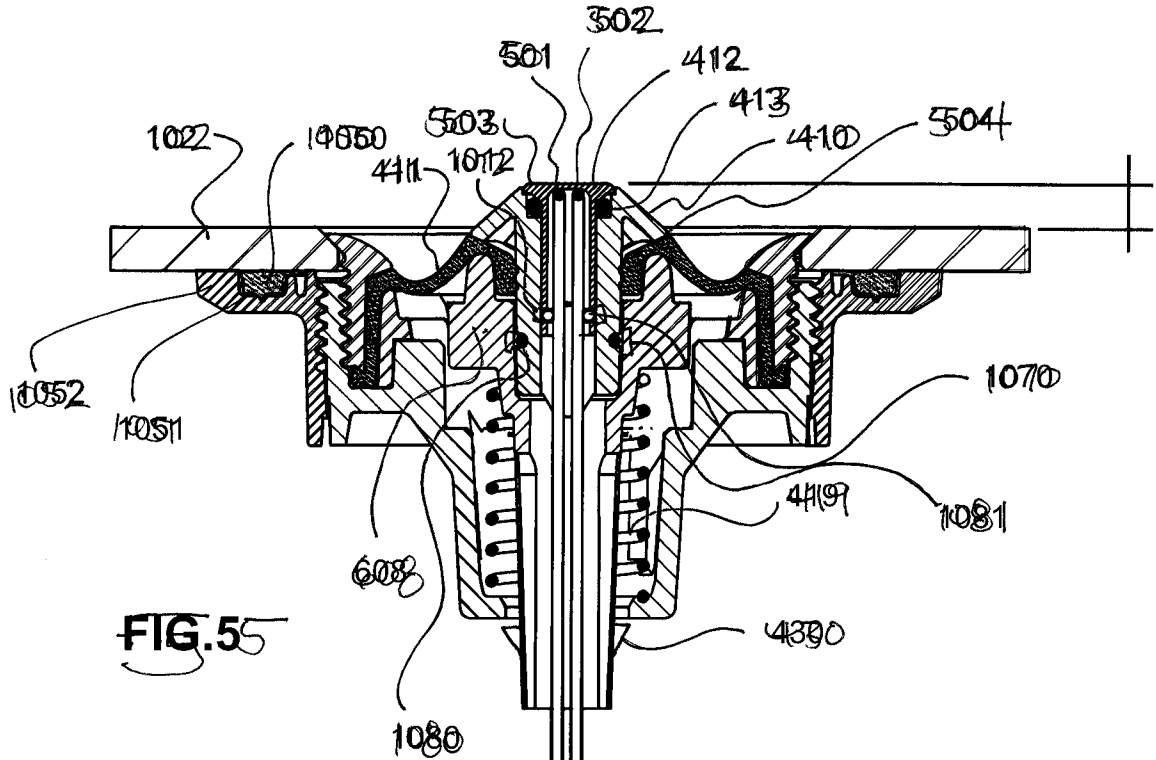
4116
417
418

FIG.4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4390
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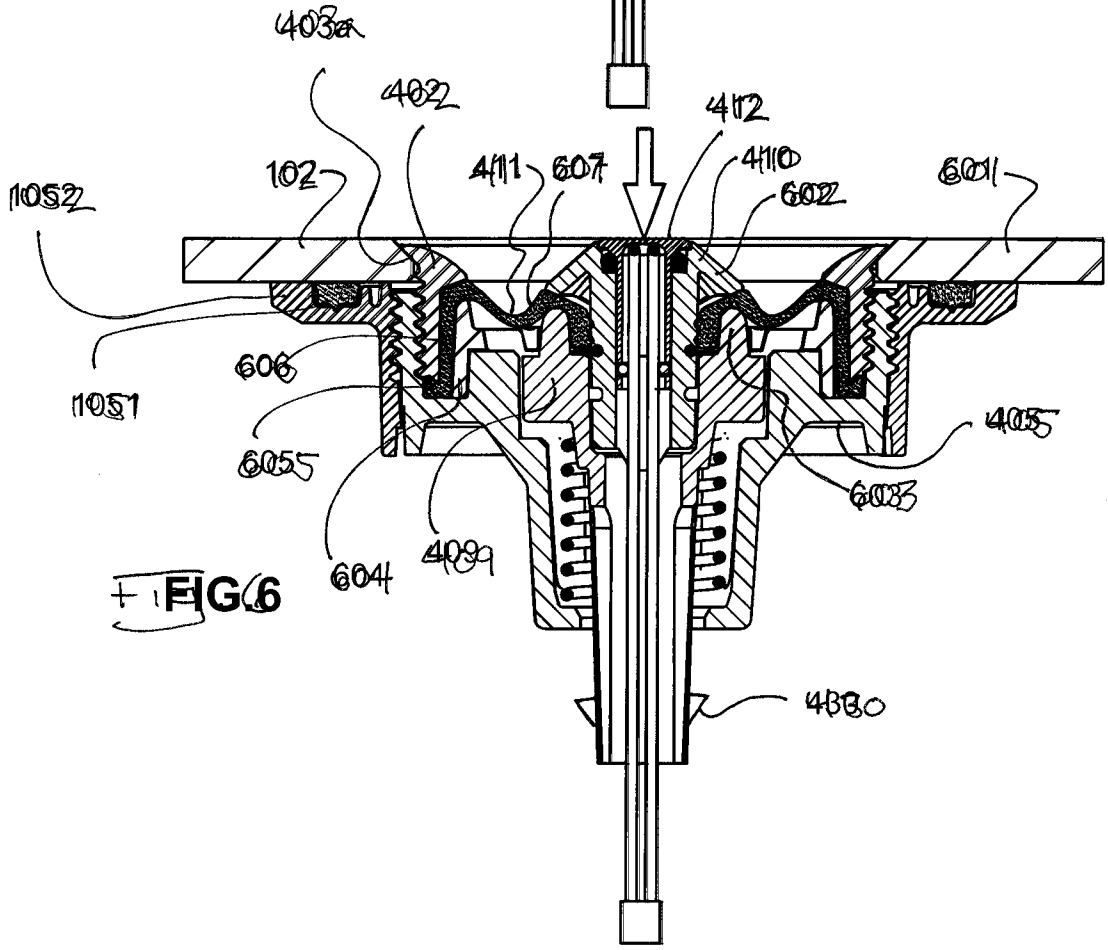
FIG.5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402
412
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1052
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1051
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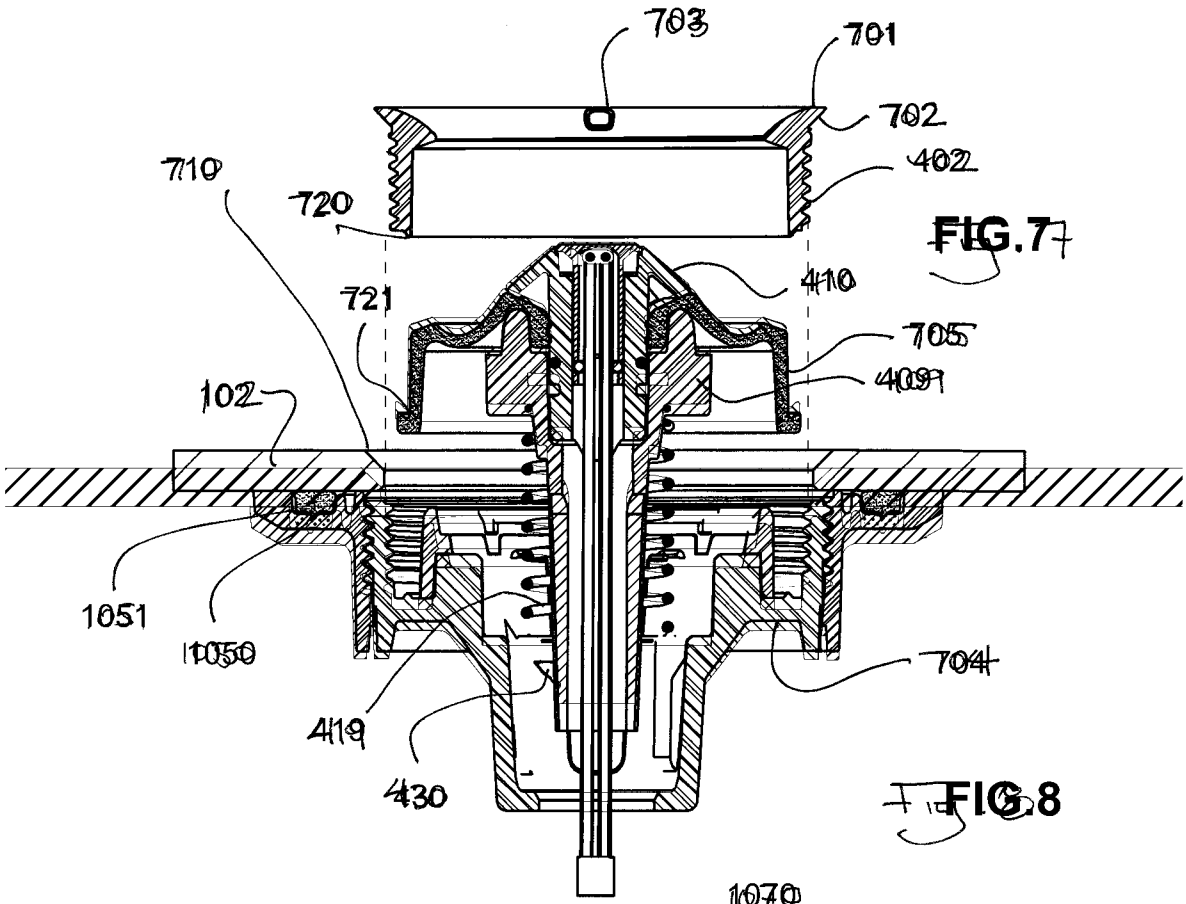
6083
6044
4099
4030

FIG.6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702
710
720
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410
721
705
4099
102
1051
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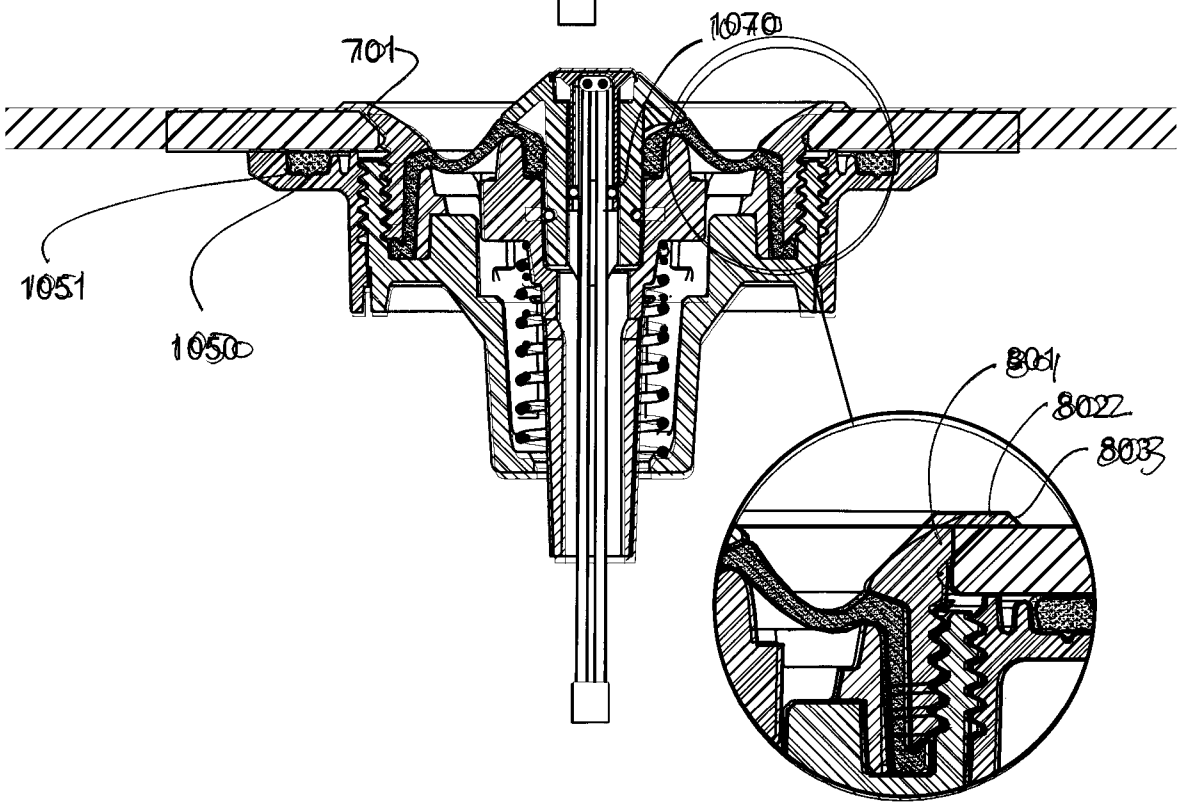
704
419
430

FIG.7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1050
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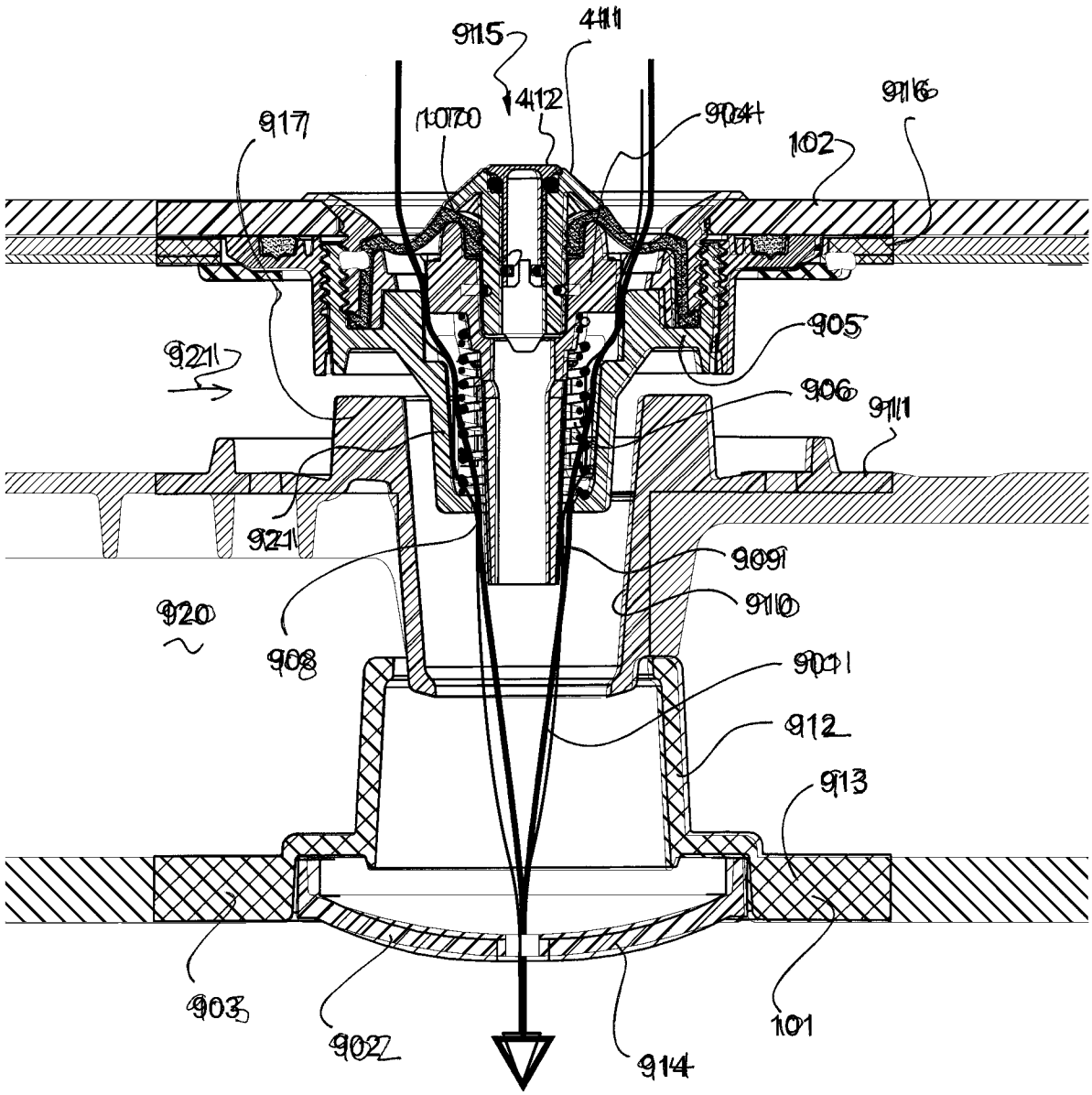
8022
803

FIG.8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1070
412
904
916
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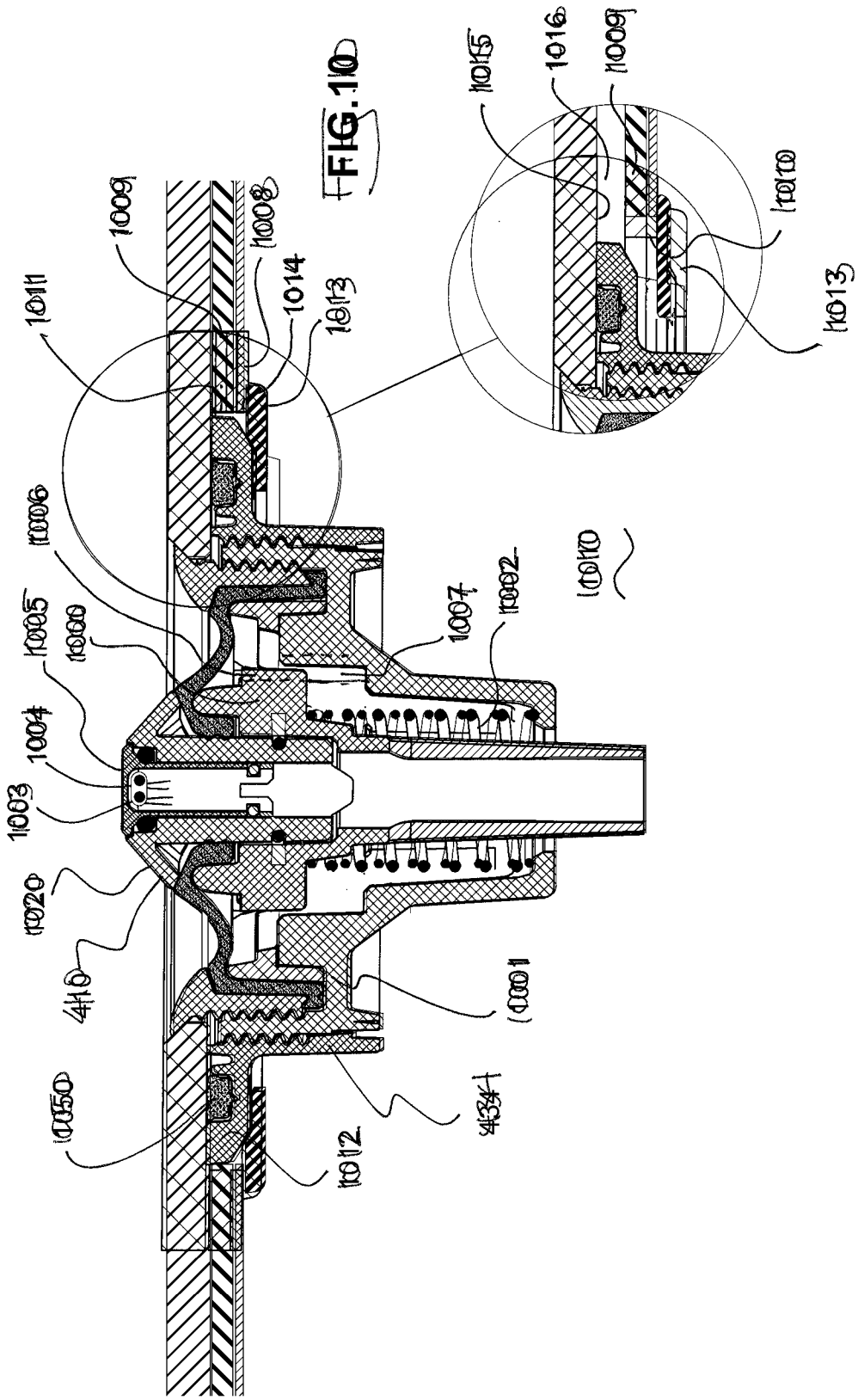
920
910
908
901
912
913
903
902
914
101

FIG.9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1008
1014
1013
1011
1006
1005
1000
1004
1003
1020
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10001
1007
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10010
1015
1016
1009
10100
1013

FIG. 10

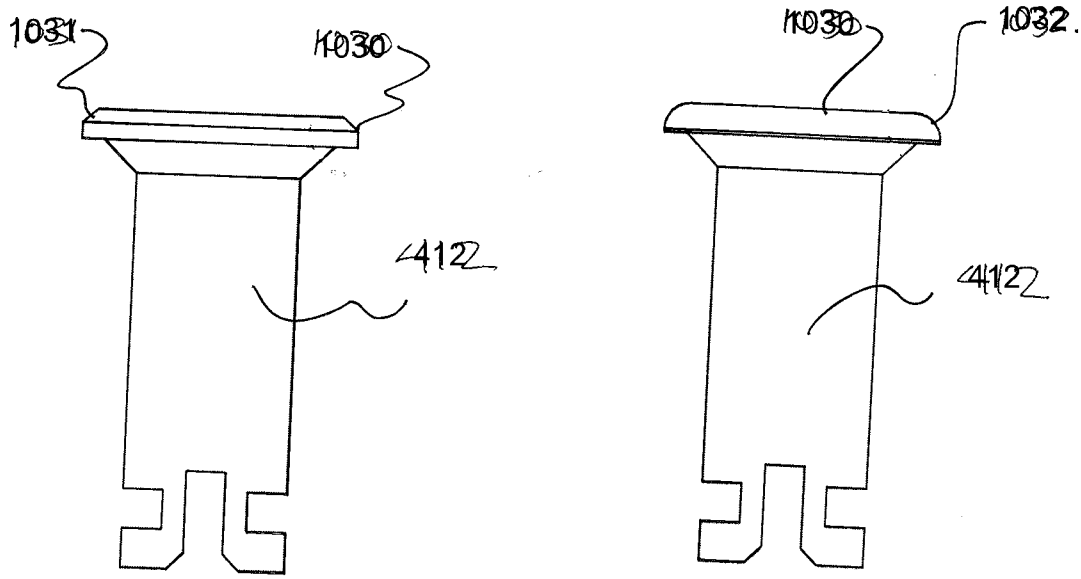


FIG.10A

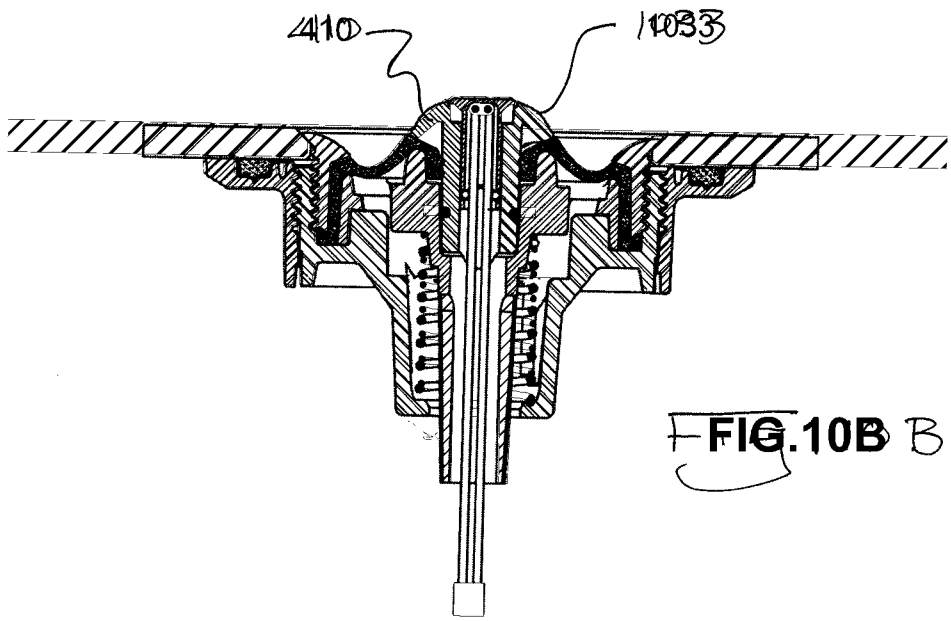


FIG.10B

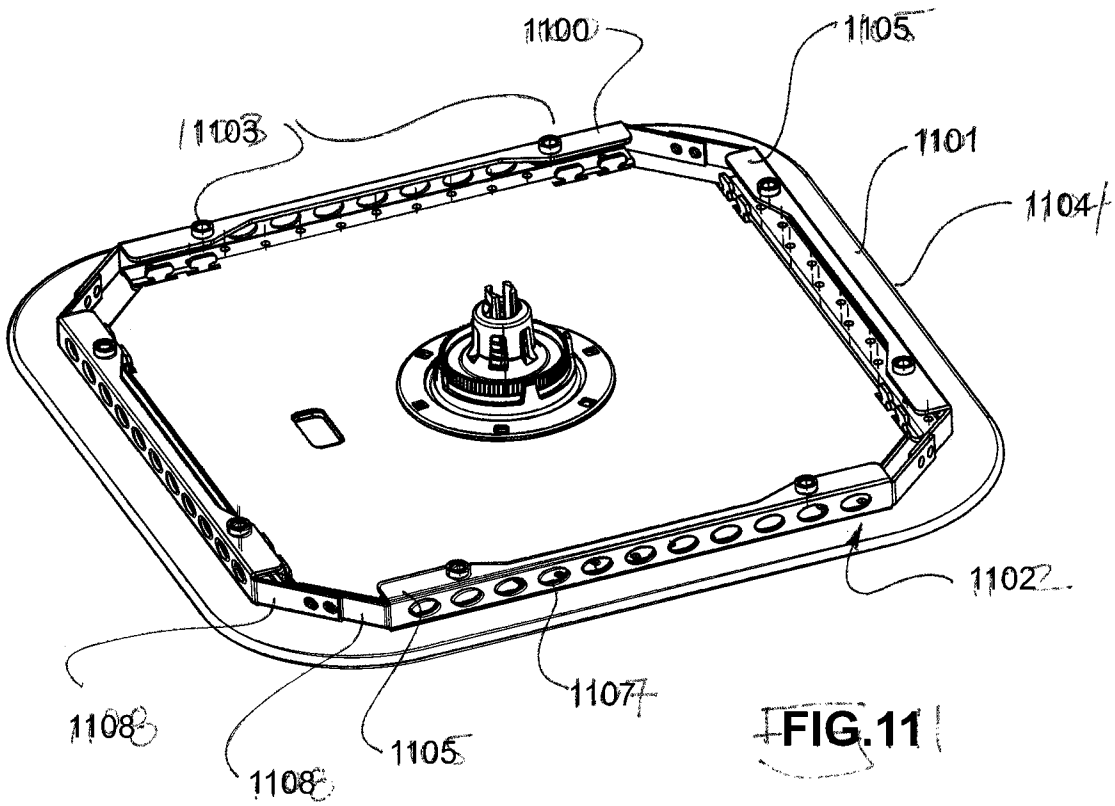
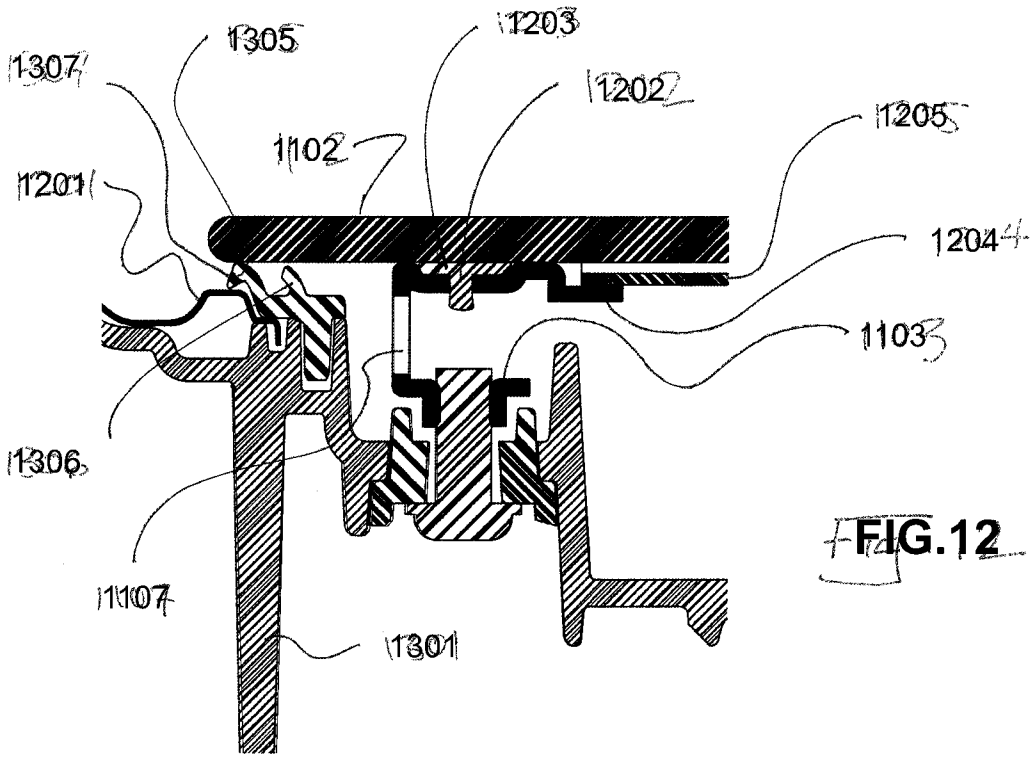


FIG.11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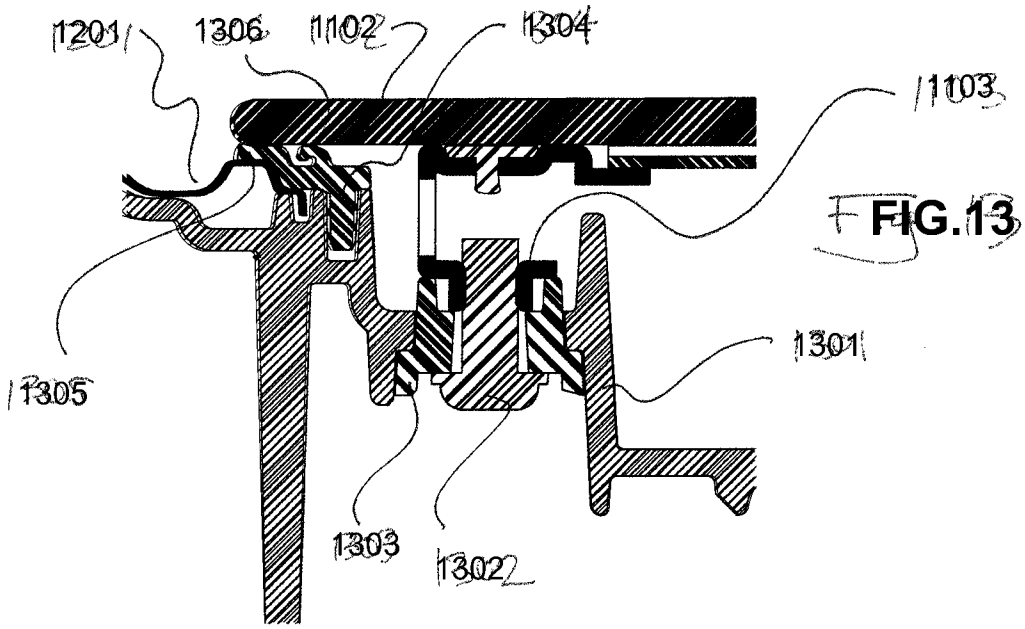
1306
1107
1301

FIG.12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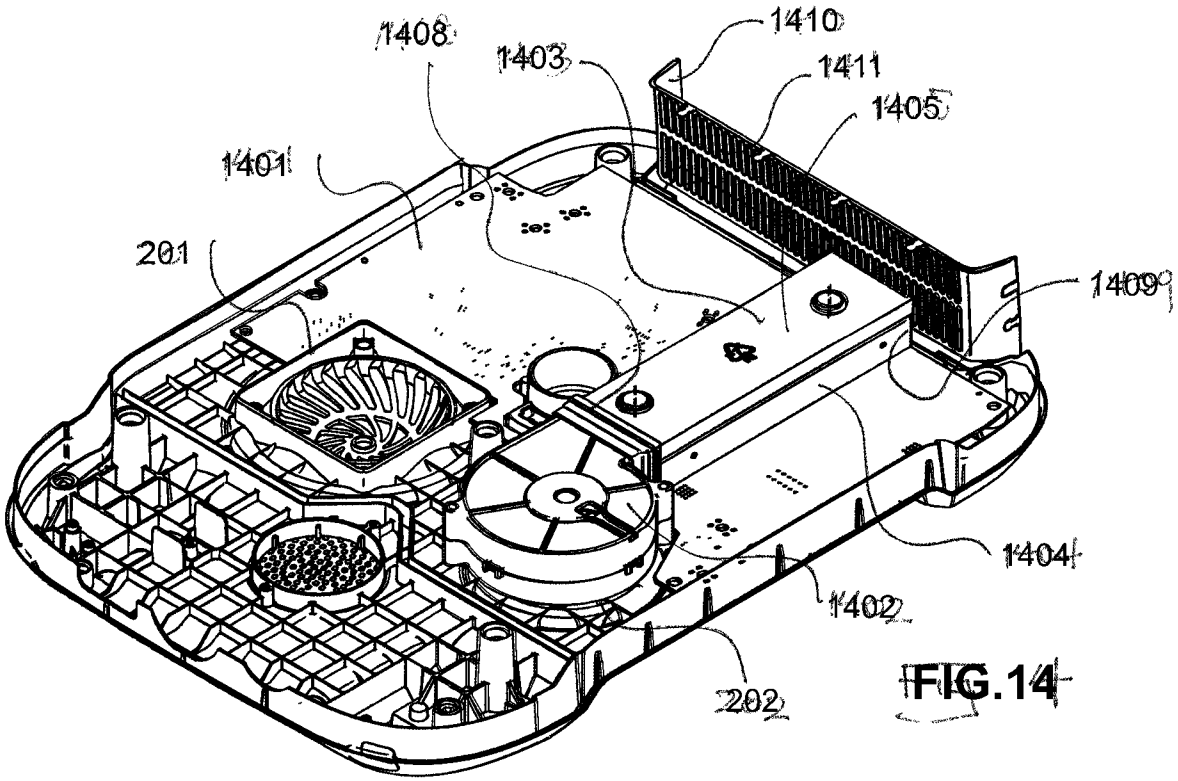
1302

FIG.13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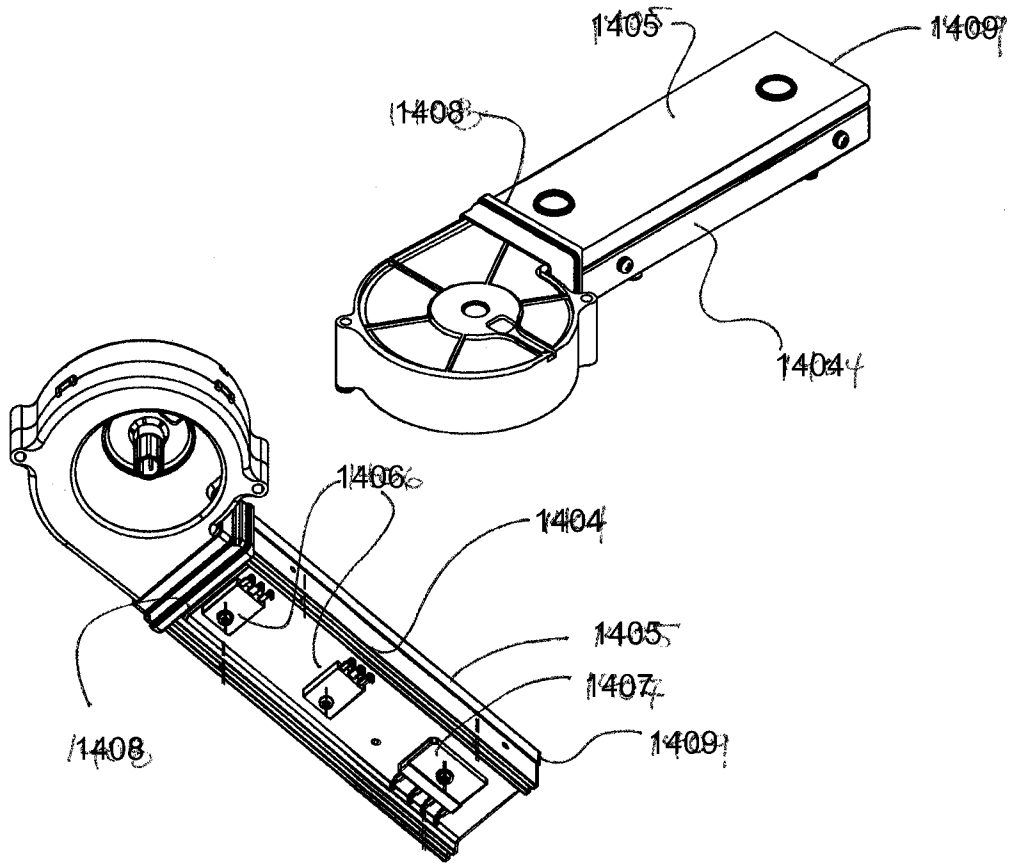
1404
1402
202

FIG.14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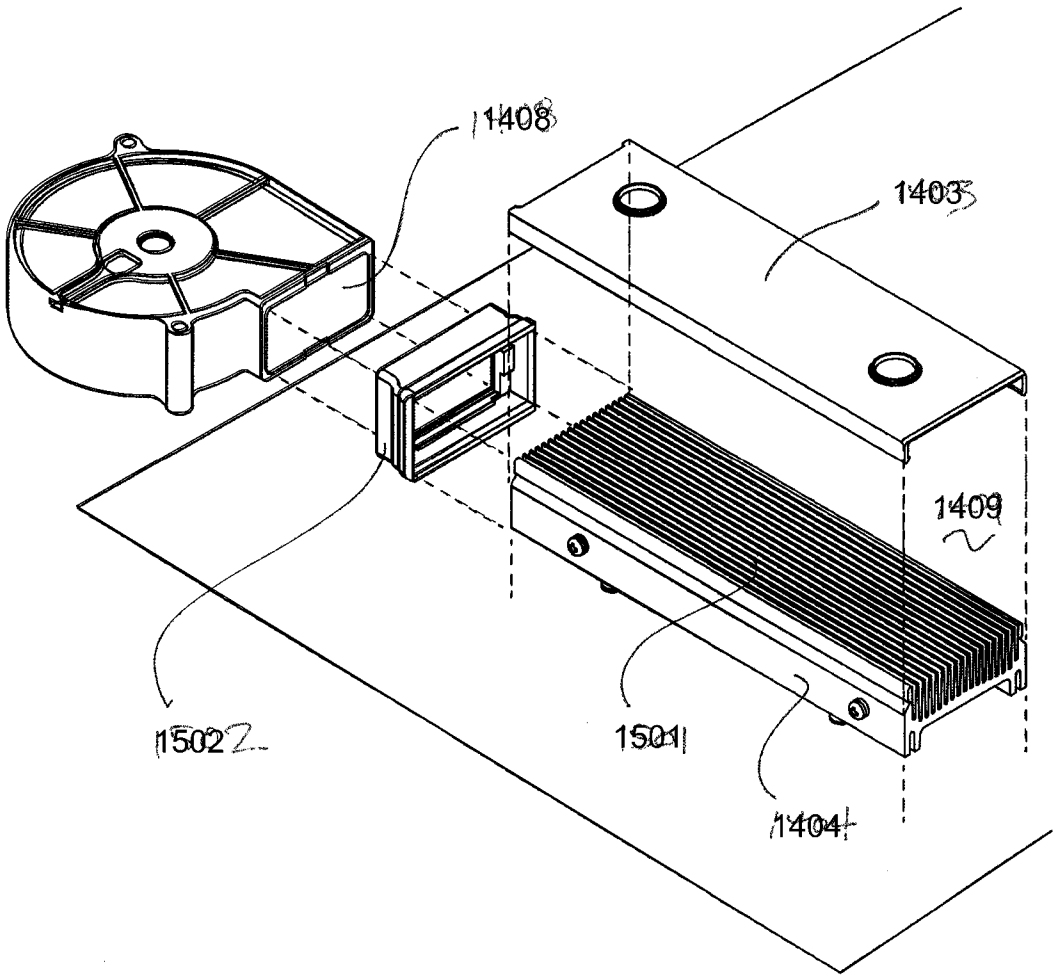

FIG.15

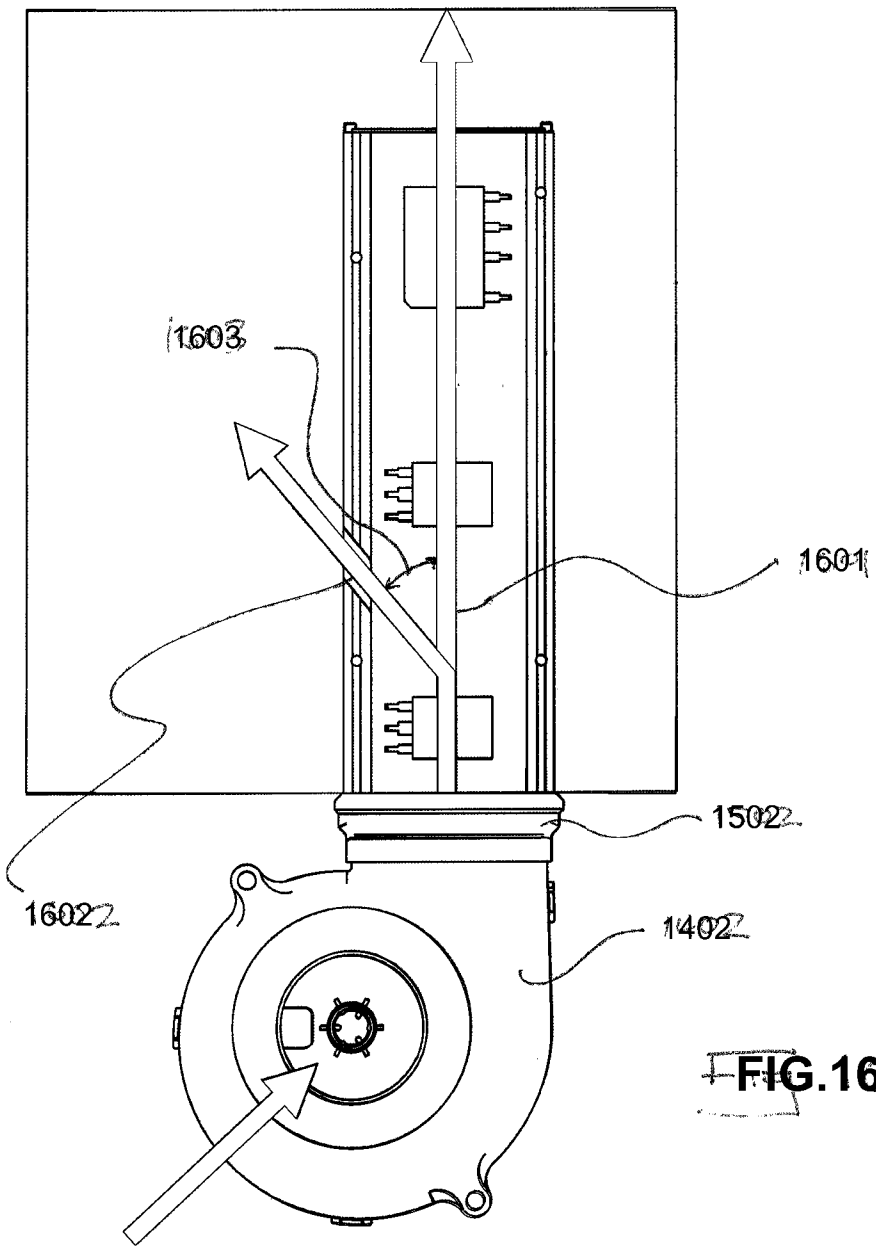

FIG.16

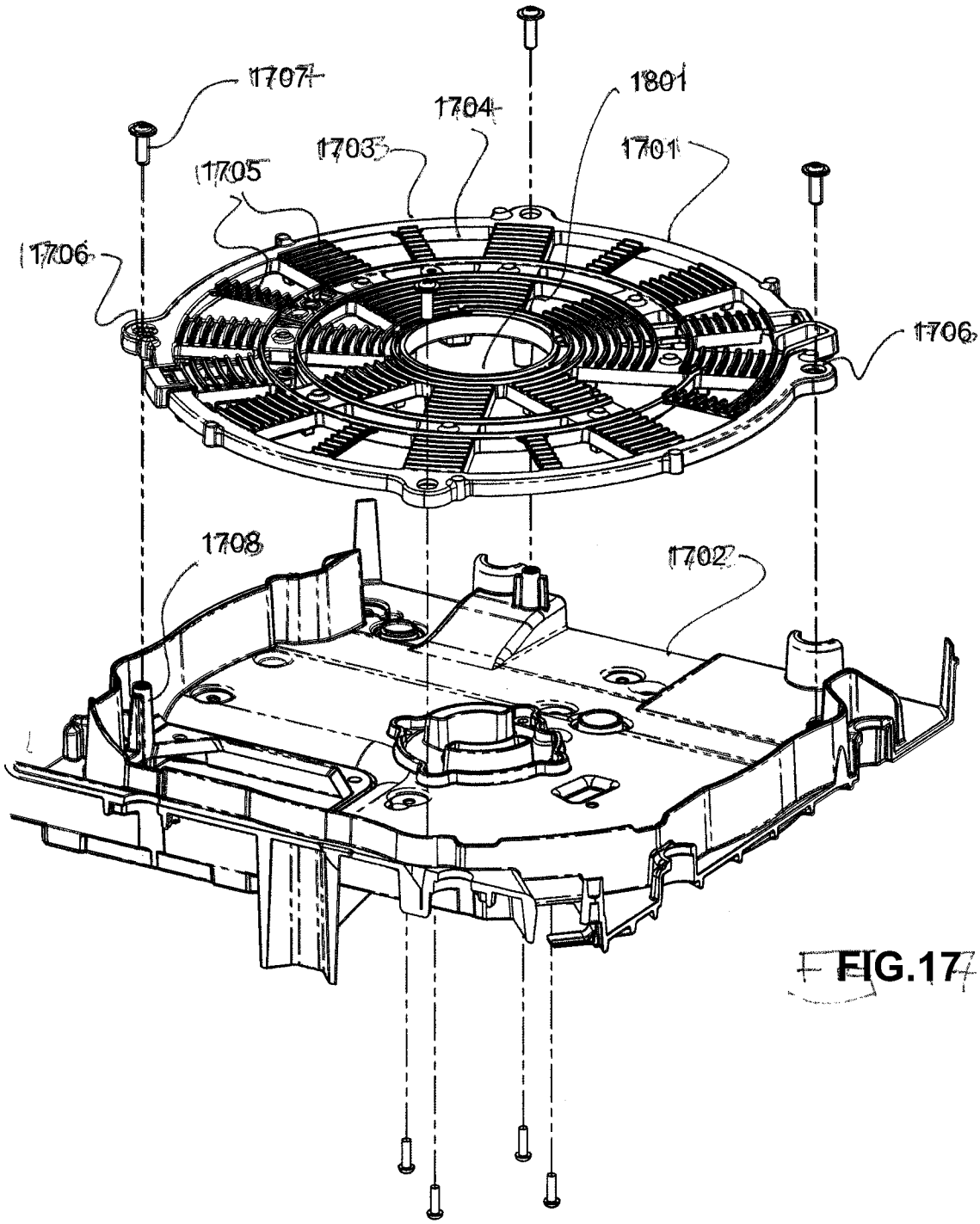

FIG.17

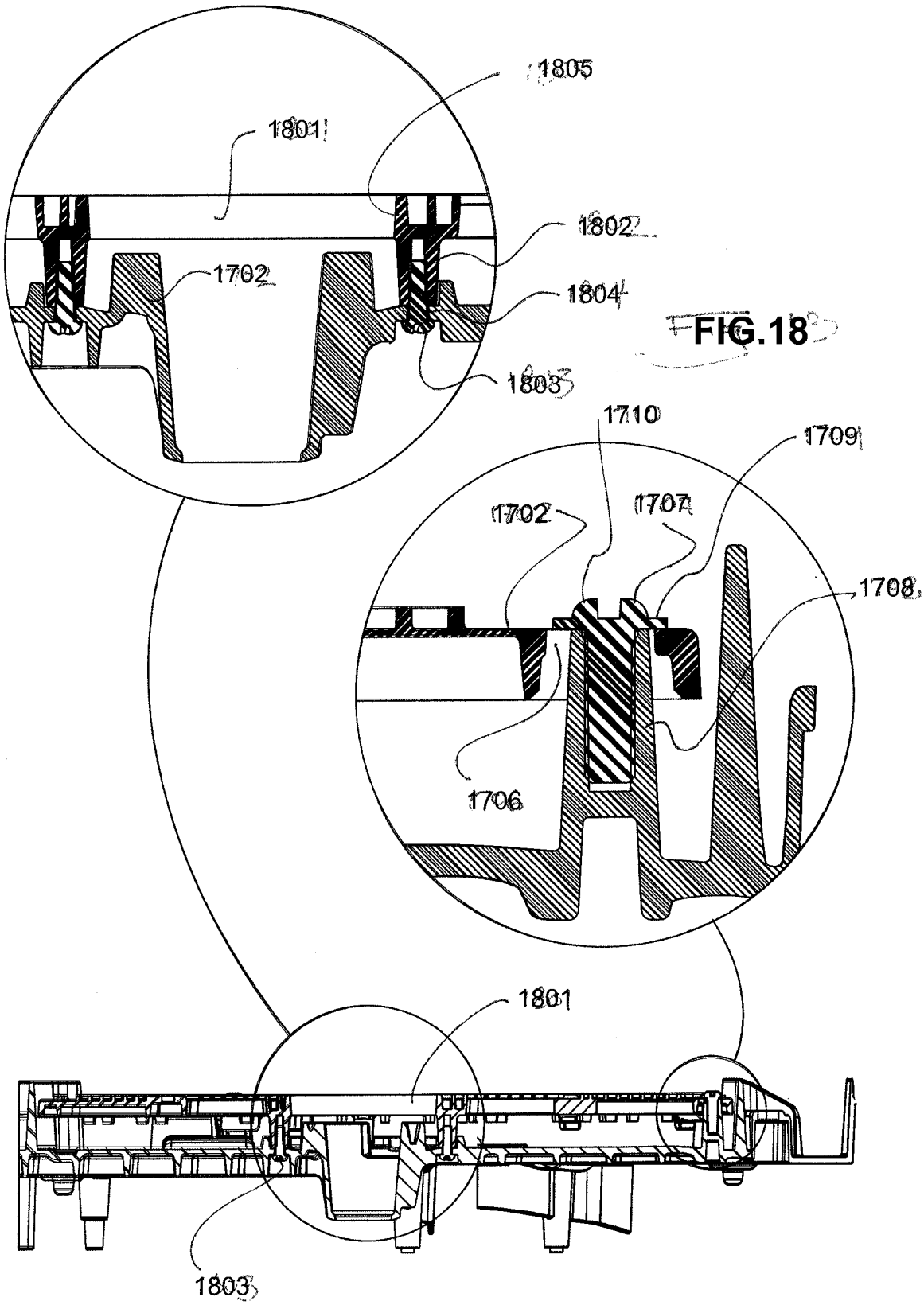
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FIG.18

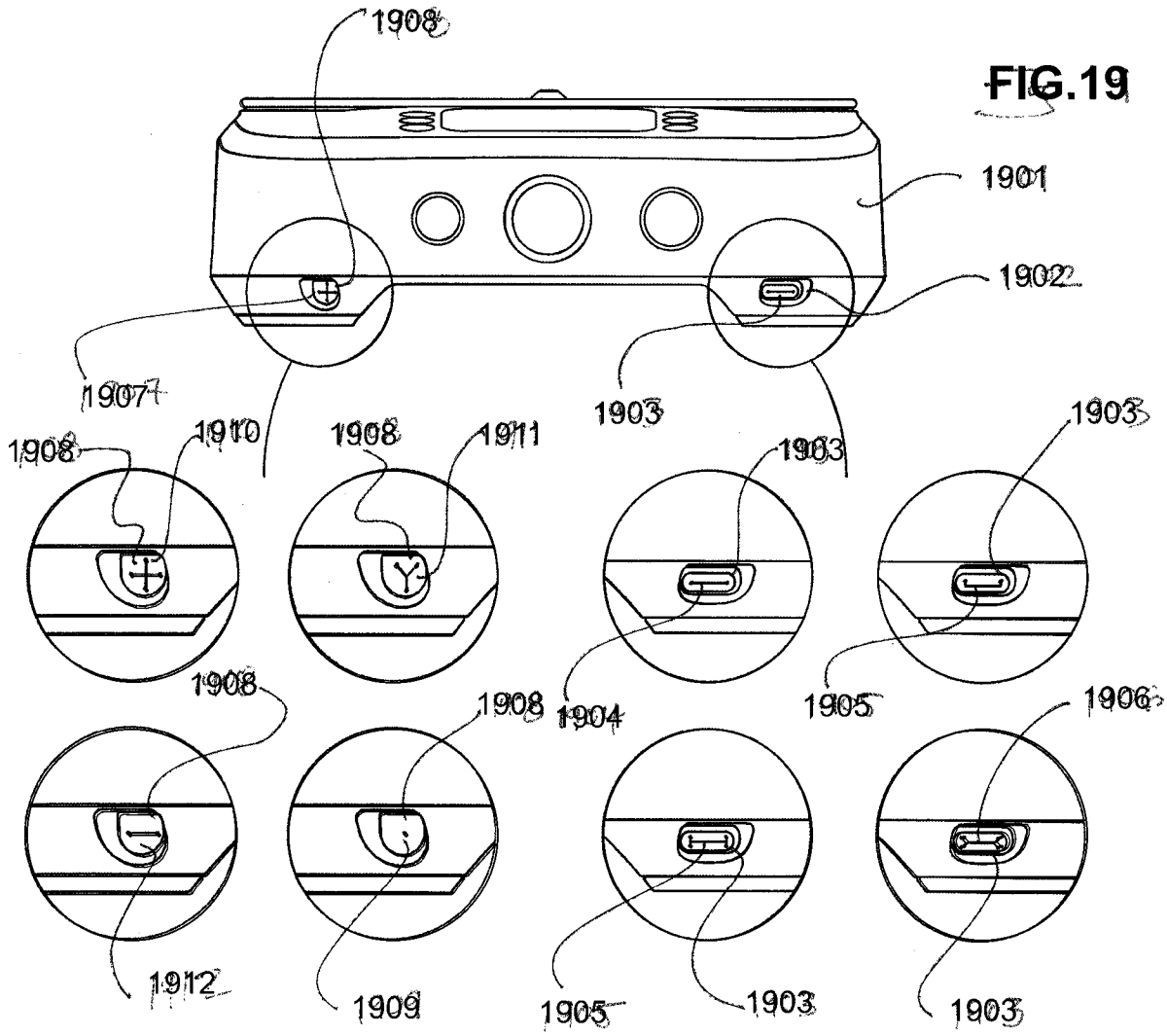
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FIG.19

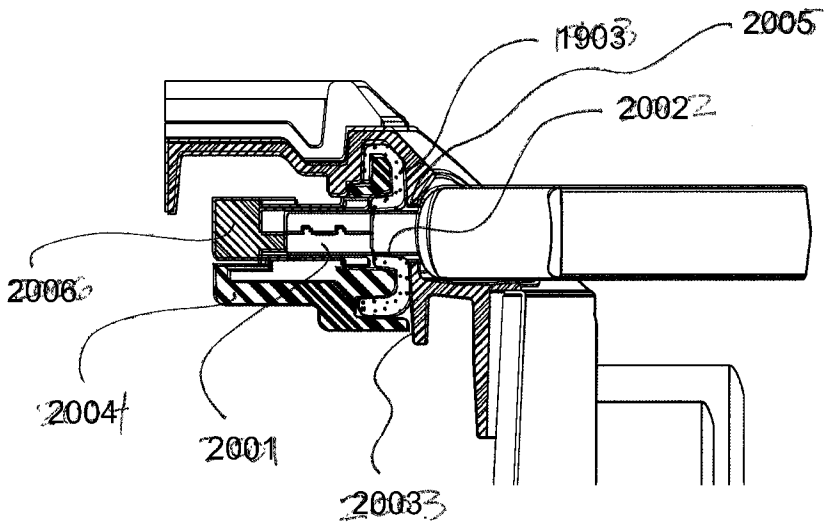


FIG.20

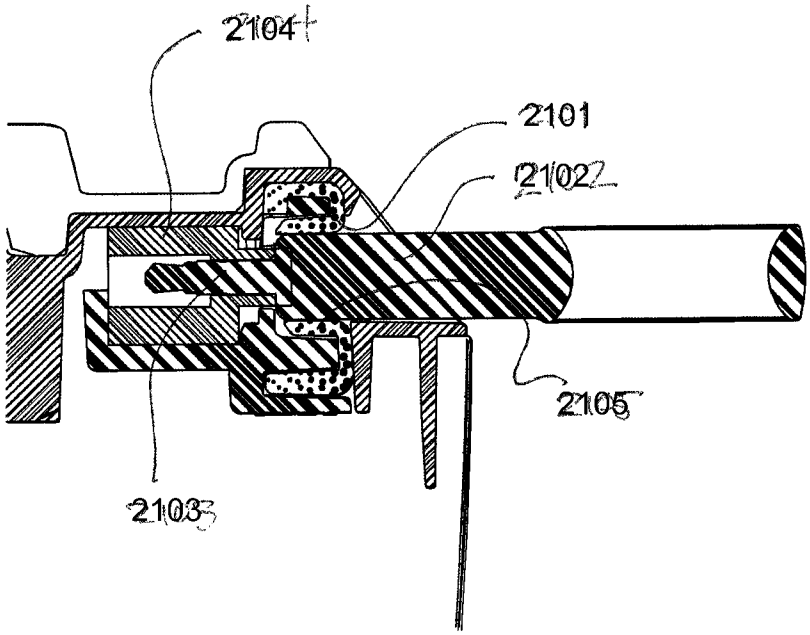


FIG.21

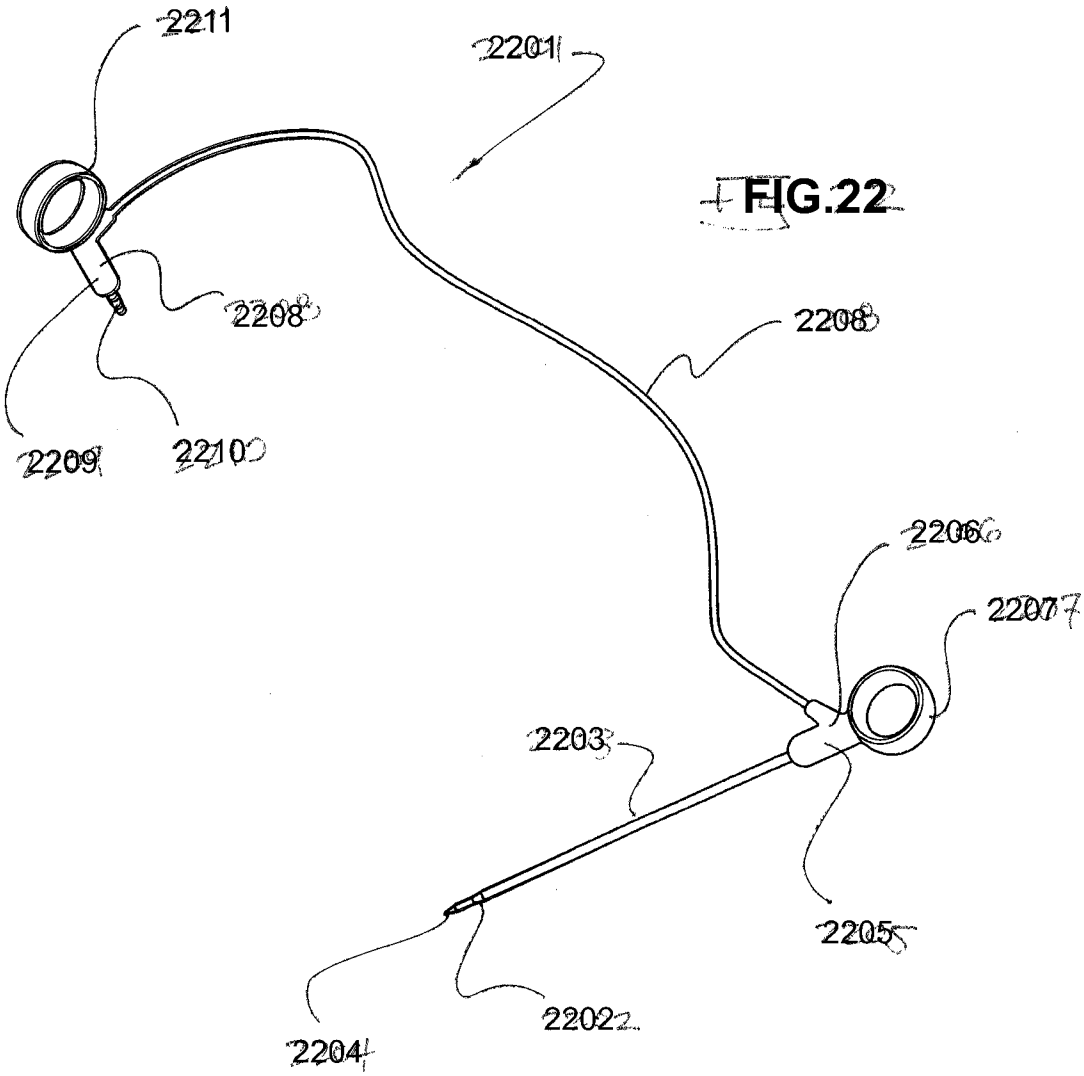
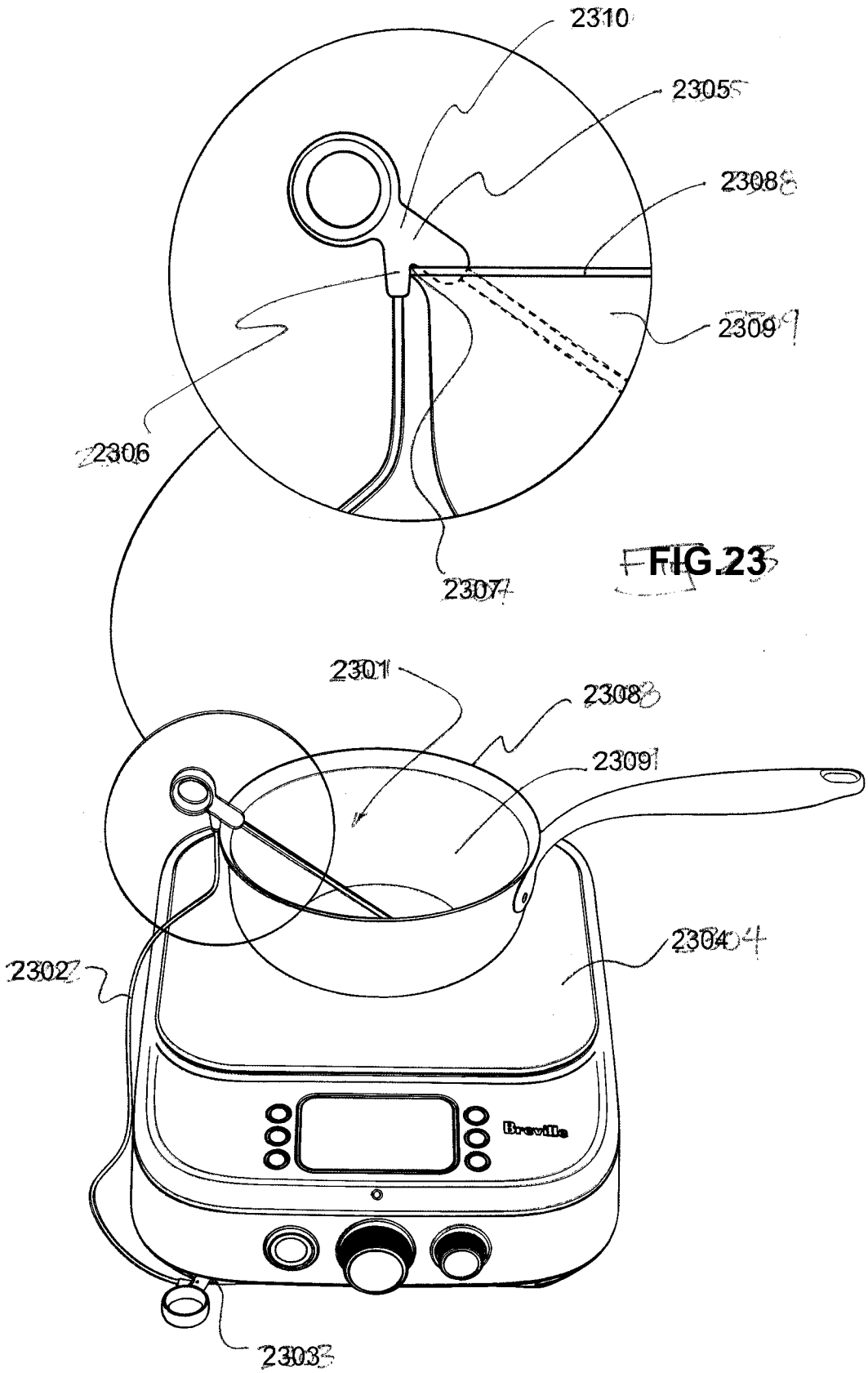


FIG.22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Breville

FIG.23

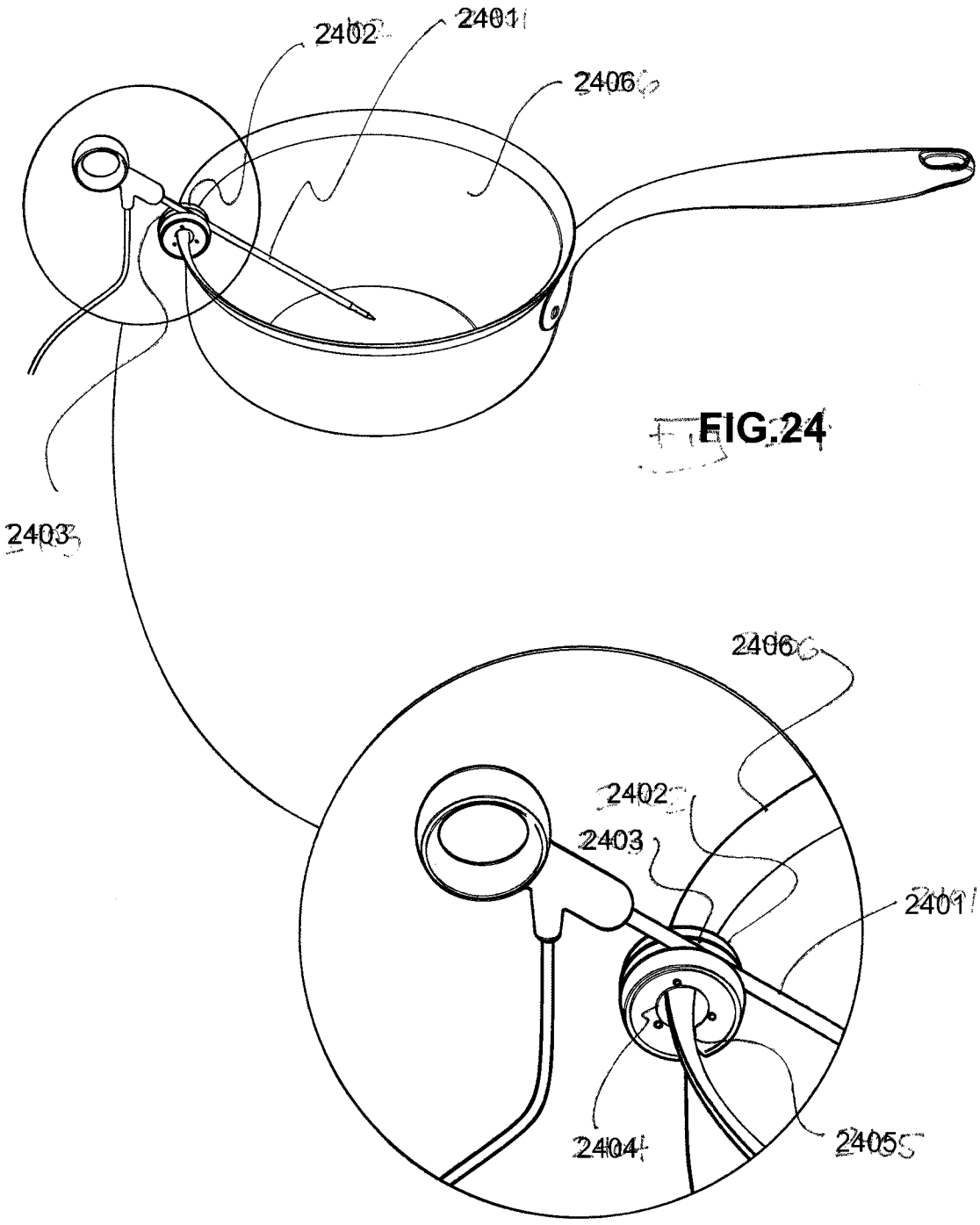

FIG.24

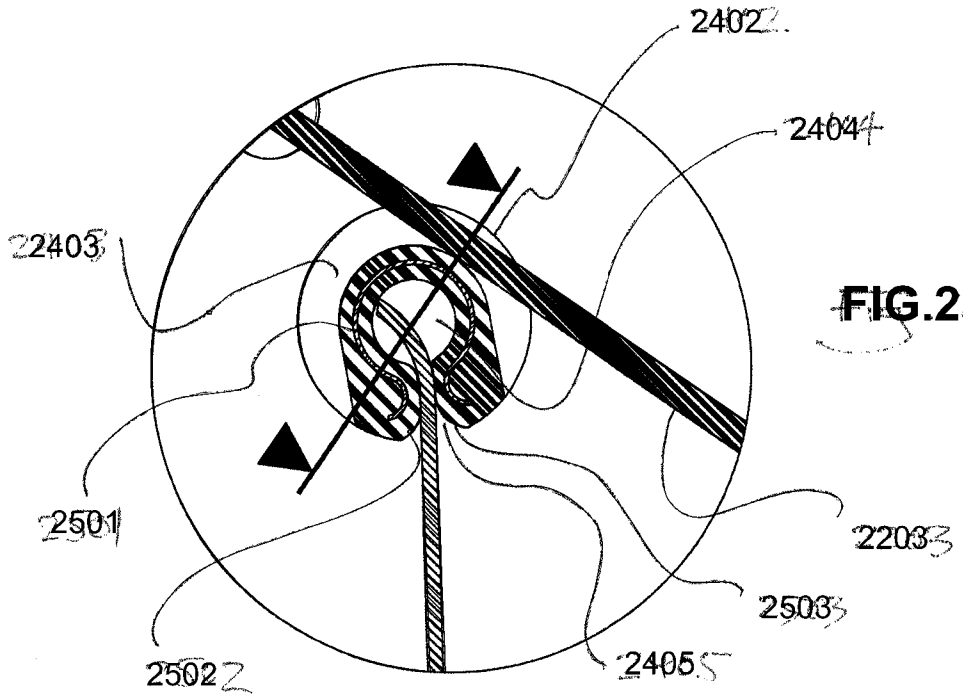
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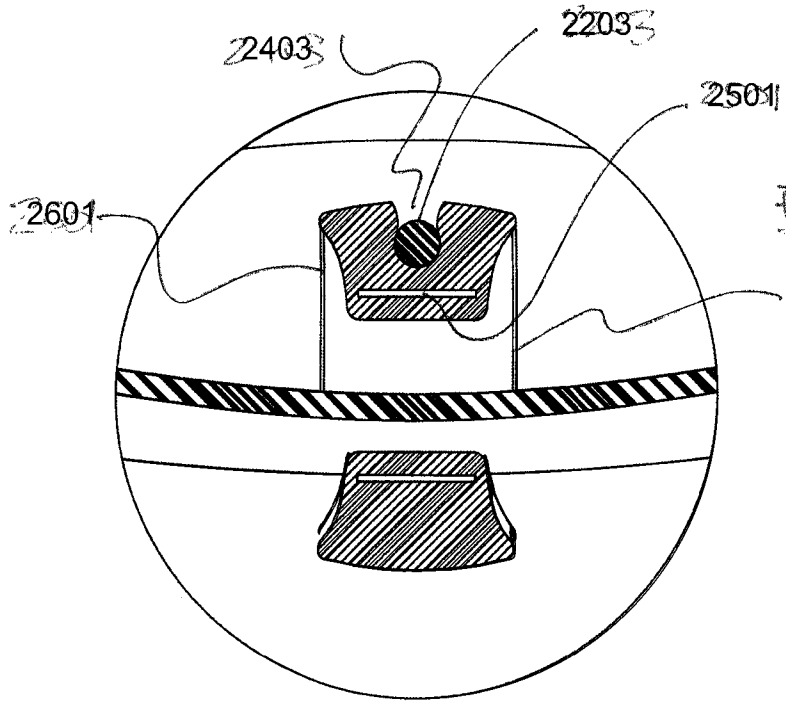
FIG.25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2501
2601
2602

FIG.26

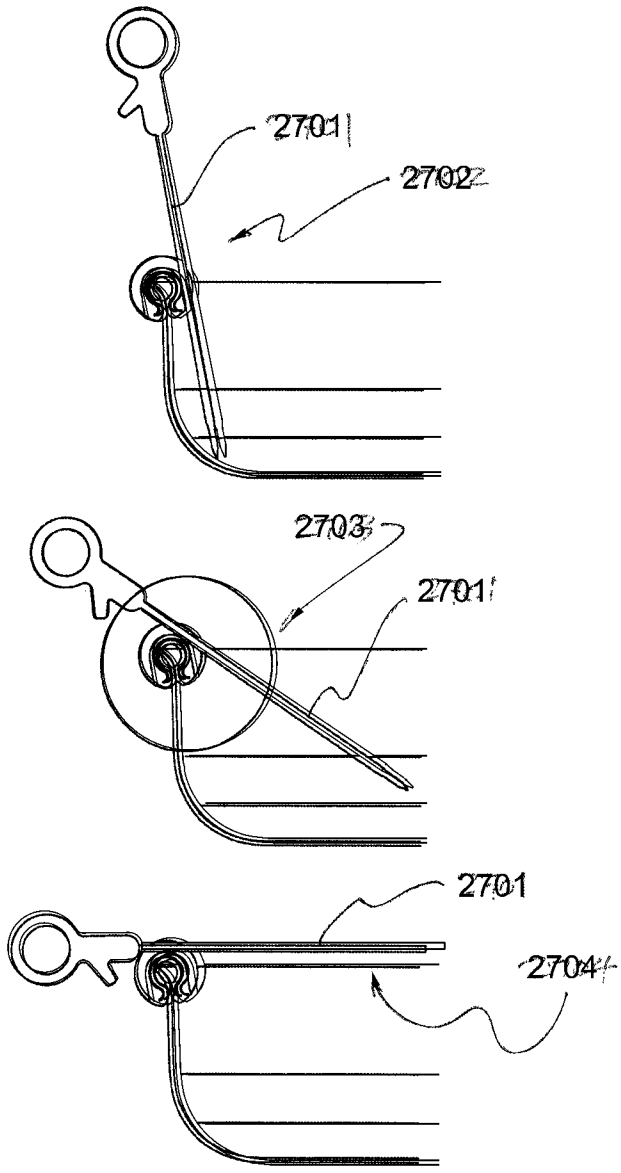

FIG.27

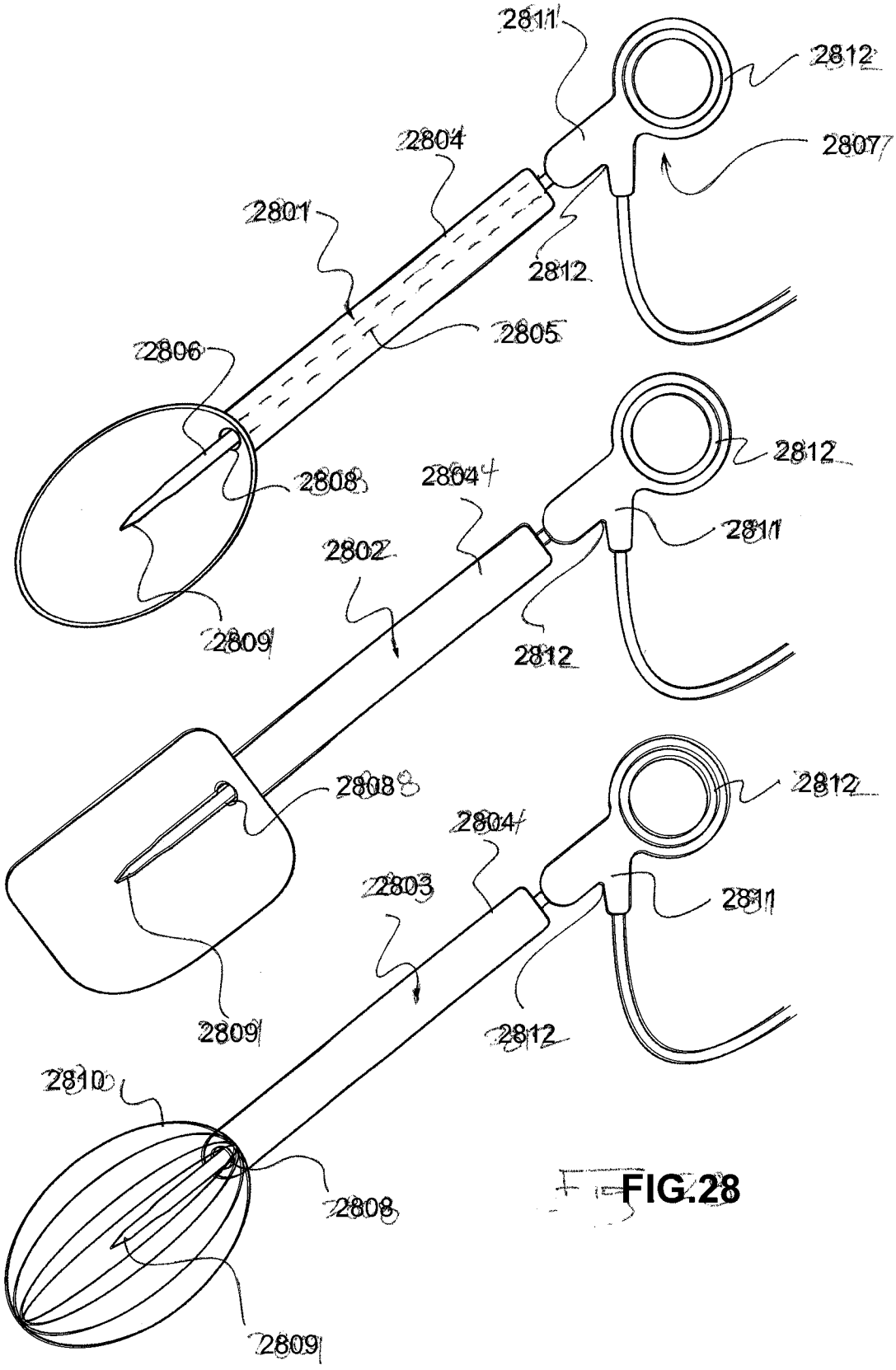
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FIG.28

INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU2015/000364

A. CLASSIFICATION OF SUBJECT MATTER

H05B 6/12 (2006.01)

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)

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)

Databases: WPIAP, EPODOC, INSPEC and keywords:induction, cooker, stove, hot-plate, hob, sensor, detector, monitor, temperature, heat, thermal, diaphragm, flexible, soft, membrane and similar terms.

Applicant(s)/Inventor(s) name search in Espacenet, AusPat, Google Patent, INTESS AND PAMS NOSE:

Applicant name: BREVILLE PTY LIMITED; Inventor name: Hoare, Richard; Davenport, David; Rose, Vyvyan; Foxlee, Brendan, John; Hegedis, Tibor.

keywords: induction, cook, plate, stove, flexible, diaphragm, membrane, holder, support, carrier and similar terms.

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
	Documents are listed in the continuation of Box C	

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

[X] 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

"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
10 November 2015	10 November 2015

Name and mailing address of the ISA/AU

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INTERNATIONAL SEARCH REPORT C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		International application No. **PCT/AU2015/000364**
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	JP H10214680 A (TOSHIBA CORP) 11 August 1998 Figs. 1, 4-5 and paragraphs 0024-0032,	1-4
X	CN 203369799 U (FEI CHUNYANG) 01 January 2014 Fig. 1 and paragraphs 0008, 0022, 0025,	1-4
X	WO 2013/134239 A1 (MEYER INTELLECTUAL PROPERTIES LTD.) 12 September 2013 Fig. 1 and paragraphs 0018-0022	1-4

INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU2015/000364

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:
the subject matter listed in Rule 39 on which, under Article 17(2)(a)(i), an international search is not required to be carried out, including

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claims Nos:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a)

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

See Supplemental Box for Details

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:
1-4

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.

☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.

☐ No protest accompanied the payment of additional search fees.

Supplemental Box

Continuation of: **Box III**
This International Application does not comply with the requirements of unity of invention because it does not relate to one invention or to a group of inventions so linked as to form a single general inventive concept.

This Authority has found that there are different inventions based on the following features that separate the claims into distinct groups:

• Claims 1-4 are directed to a temperature sensor mount assembly device comprising a thermal sensor carried by an upper sensor holder, wherein the upper sensor holder reciprocating with respect to and restrained for vertical motion by a lower sensor holder. The features of a thermal sensor as described above are specific to this group of claims.

• Claims 5-7 are directed to an assembly of an induction cooktop surface and a temperature sensor mount comprising a cooktop surface with an opening having a chamfer; an upper clamping bracket, the clamping ring having first threads and arms with ratchet tooths; a lower clamping bracket having second threads that engage the first threads, an array of circumferential teeth that cooperates with the one or more ratchet teeth; a clamping ring mounted within the opening in the cooktop surface and limited in a downward direction; the clamping ring having third threads that engage fourth threads formed on the lower damping bracket; and the clamping ring having a chamfered flange that when fully installed is received by the chamfer and fully located below an upper surface of the cooktop surface. The features of the assembly of the induction cooktop surface and the temperature sensor mount as described above are specific to this group of claims.

• Claim 8-9 are directed to an induction cooking device comprising a body with an underside having a discharge opening; a cooking surface having a through opening for mounting a temperature sensor; wherein the temperature sensor mount having a flexible diaphragm through which protrudes a sensor cap; and the temperature sensor below the diaphragm, defining an uninterrupted vertical flow path that extends to the discharge opening. The features of the induction cooktop device as described above are specific to this group of claims.

• Claims 10–12 are directed to an induction cooking device comprising a cooktop having an underside to which is adhered a bracket assembly, the assembly having a plurality of fastener fixing positions; and a case that supports the cooktop, wherein the case having an upper margin in which is formed a plurality of through opening through which extend fasteners that attach the bracket to the case. The features of the induction cooking device as described above are specific to this group of claims.

• Claims 13-14 are directed to an induction cooker comprising a chassis in which is formed vent opening; a cooling fan that draws through the opening; the cooling fan discharging into an enclosed channel having a component and a cover; the component being a heat sink into which is mounted one or more semi-conductor components; and the enclosed channel leading from the fan to a discharge vent. The features of the induction cooker are specific to this group of claims.

• Claims 15-17 are directed to in induction cooking device comprising an induction coil assembly mounted to a chassis component; wherein the induction coil assembly comprising a substrate that supports an induction element, the substrate having through openings through which extend fasteners that attach the substrate to the chassis component; and the opening being elongated in a radial direction to allow the substrate to expand in a radial direction. The features of the induction cooking device are specific to this group of claims.

PCT Rule 13.2, first sentence, states that unity of invention is only fulfilled when there is a technical relationship among the claimed inventions involving one or more of the same or corresponding special technical features. PCT Rule 13.2, second sentence, defines a special technical feature as a feature which makes a contribution over the prior art.

When there is no special technical feature common to all the claimed inventions there is no unity of invention.

In the above groups of claims, the identified features may have the potential to make a contribution over the prior art but are not common to all the claimed inventions and therefore cannot provide the required technical relationship. Therefore there is no special technical feature common to all the claimed inventions and the requirements for unity of invention are consequently not satisfied *a priori*.

INTERNATIONAL SEARCH REPORT Information on patent family members	International application No. **PCT/AU2015/000364**

This Annex lists known patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document/s Cited in Search Report		**Patent Family Member/s**	
Publication Number	**Publication Date**	**Publication Number**	**Publication Date**
JP H10214680 A	11 August 1998	JP H10214680 A	11 Aug 1998
		JP 3715398 B2	09 Nov 2005
CN 203369799 U	01 January 2014		
WO 2013/134239 A1	12 September 2013	WO 2013134239 A1	12 Sep 2013

End of Annex

Due to data integration issues this family listing may not include 10 digit Australian applications filed since May 2001.