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(54) APPLIANCE COMPRISING ONE OR MORE SENSORS

(57) An appliance **(100)** is proposed. The appliance comprises a control circuitry **(150a)** provided for managing the operation of the appliance **(100),** and at least one operating module **(205)** comprising an electric/electronic/electromechanical component **(220)** provided for performing one or more specific tasks required for the appliance operation, the at least one operating module comprising at least one sensor **(265)** arranged to detect values of one or more physical parameters. Said at least one sensor is arranged to detect values of one or more physical parameters which are not related to the one or more specific tasks performed by the electric/electronic/electromechanical component of the operating module.

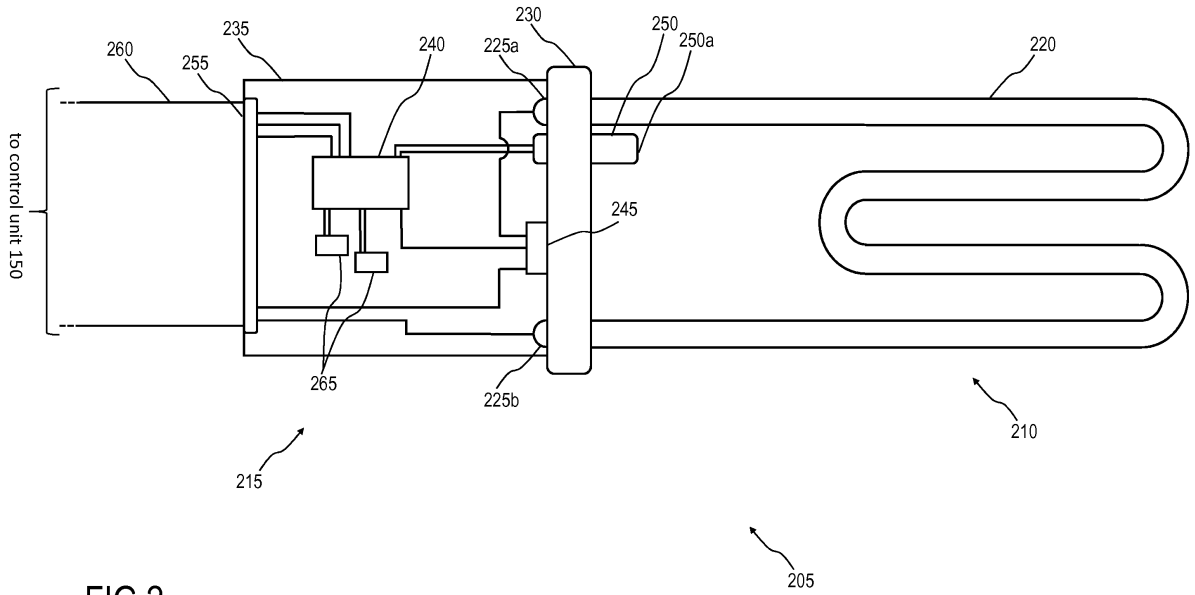

FIG.2

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Description

Field of the invention

[0001] The present invention generally relates to appliances. In detail, the present invention refers to appliances that comprise one or more electrical, electronic and/or electromechanical components and sensor devices implemented for performing operating procedures of the appliance.

Background of the invention

[0002] Appliances, both domestic and professional, of any typology (e.g., dishwashers, laundry machines, refrigerators, ovens, *etc.)* generally comprise a plurality of electrical, electronic and electromechanical components (e.g., sensors, displays, user interfaces, actuators, heaters, motors, relays, *etc.*) for performing their intended operation.

[0003] In addition, appliances features a large number of sensor devices (e.g., measuring temperatures, flow rates, liquid levels, humidity, pressures, positions/oscillations/displacements of moving parts, *etc.)* exploited for achieving an accurate control of the appliance and allowing for an increasingly automated operation thereof.

[0004] Generally, an electronic control board, or control unit, is provided in order to manage the operation of the plurality of electrical/electronic/electromechanical components and sensor devices.

[0005] Each electrical/electronic/electromechanical component or sensor device is operatively coupled with corresponding input/output ports of the electronic control board in order to receive (electric) power from, and/or exchange (i.e., receive and/or transmit) signals with, the electronic control board.

[0006] Therefore, a great number of different connection elements, usually one or more wirings for each electrical/electronic/electromechanical component and sensor device, has to be provided within the body of the appliance running from the electronic control board to the respective electrical/electronic/electromechanical component or sensor device.

[0007] In its turn, the electronic control board has to comprise a corresponding great number of input/output ports in order to being properly connected to each one of the electrical/electronic/electromechanical component or sensor device.

[0008] For example, vibration/displacement sensors, arranged for providing indication of an extent of displacements to which moving parts of an appliance are subjected during operation, requires a careful wiring and placement in their operating position in order to correctly provide such displacement indication even in case of vigorous movements of the moving part to which are mounted.

[0009] An example of a vibration sensor is provided by US 2009/151398 that discloses a washing machine including a housing, a tub disposed in the housing, a laundry drum rotatably mounted in the tub, and an anti-vibration device on the tub.

[0010] Another example is provided by EP 2597187 that discloses a drum-type washing machine adapted to have a mode for selecting a detection axis along which vibration values in a water tank in three-dimensional directions, which have been detected by a vibration detector, indicate a maximum value, and for restarting a spin-drying operation when the vibration value detected along this detection axis exceeds a first threshold value defined for each rotation-speed range of a rotary drum but is less than a second threshold value, in spin-drying processes.

Summary of invention

[0011] The Applicant has observed that, in the known solutions, a wiring harness required for connecting all the sensor devices and the electrical/electronic/electromechanical components to an electronic control board of the appliance is bulky and requires an extensive time and precision during the manufacturing procedure of the appliance.

[0012] In addition, the Applicant has noted that a substantial portion of the workload of the electronic control board is due to generate control signals for efficiently managing the operation of each of electrical/electronic/electromechanical component and acquiring information from the sensor devices comprised in the appliance.

[0013] The Applicant has tackled the problem of devising an improved solution able to overcome, at least partly, the drawbacks of the prior art.

[0014] The Applicant has found that providing a concept of electrical/electronic/electromechanical components comprising one or more sensors designed to detect values and/or values variations of one or more physical parameters which are not related with the operation of the electrical/electronic/electromechanical components, but are exploited by the electronic control board for managing the operation of the appliance, greatly simplifies the design, the manufacturing and the maintenance of the appliance.

[0015] Preferably, electrical/electronic/electromechanical components may be further provided with on-board processing capabilities that allows a simplified and effective managing of the electrical/electronic/electromechanical components within the appliance.

[0016] One or more aspects of the solution according to embodiments of the invention are set out in the independent claims, with advantageous features of the same solution that are indicated in the dependent claims.

[0017] An aspect of the solution according to one or more embodiments of the present invention relates to an appliance. The appliance comprises a control circuitry provided for managing the operation of the appliance, and at least one operating module comprising an electric/electronic/electromechanical component provided for performing one or more specific tasks required for the

appliance operation, the at least one operating module comprising at least one sensor arranged to detect values of one or more physical parameters. Said at least one sensor is arranged to detect values of one or more physical parameters which are not related to the one or more specific tasks performed by the electric/electronic/electromechanical component of the operating module.

[0018] In an advantageous embodiment of the invention, the at least one operating module further comprises a managing element being in communication relationship with the control circuitry, the managing element being configured for controlling the execution of the one or more specific tasks of the at least one electric/electronic/electromechanical component.

[0019] In an advantageous embodiment of the invention, the managing element is configured for controlling the execution of the one or more specific tasks of the at least one electric/electronic/electromechanical component based on electric signals received from the control unit.

[0020] In an advantageous embodiment of the invention, the managing element is electrically coupled with the at least one sensor, and is configured to manage the detected values of one or more physical parameters detected by the at least one sensor.

[0021] In an advantageous embodiment of the invention, the managing element is further configured for receiving and forwarding to the control circuitry the detected values of one or more physical parameters detected by the at least one sensor.

[0022] In an advantageous embodiment of the invention, the detected values of one or more physical parameters is transmitted from the at least one sensor to the control circuitry as electric signals. Preferably, the managing element is further configured for pre-processing said electric signals provided by the at least one sensor.

[0023] In an advantageous embodiment of the invention, said pre-processing comprises filtering, amplifying and/or digitalizing the electric signals provided by the at least one sensor.

[0024] In an advantageous embodiment of the invention, the managing element comprises a microprocessor, microcontroller or an application-specific integrated circuit.

[0025] In an advantageous embodiment of the invention, the at least one operating module is mounted to a portion of the appliance capable of moving during the operation of the appliance. Preferably, the at least one sensor is arranged for detecting parameters associated with a movement of the at least one operating module corresponding to a movement of the portion of the appliance to which the at least one operating module is mounted.

[0026] In an advantageous embodiment of the invention, the at least one sensor comprises an accelerometer for determining an acceleration along three-dimensional axes to which the at least one operating module is subjected.

[0027] In an advantageous embodiment of the invention, the at least one sensor comprises a gyroscope for determining a radial velocity to which the at least one operating module is subjected.

[0028] In an advantageous embodiment of the invention, the at least one sensor comprises a magnetometer for detecting an orientation of the at least one operating module based on measurements of Earth's magnetic field along three-dimensional axes.

[0029] In an advantageous embodiment of the invention, the at least one operating module comprises at least one further sensor, the at least one further sensor being arranged to detect values of one or more physical parameters which are related to the one or more specific tasks performed by electric/electronic/electromechanical component of the operating module.

[0030] In an advantageous embodiment of the invention, the appliance is a laundry washing machine or a laundry washing/drying machine comprising a washing tub enclosing a rotatable drum for containing items to be washed and/or dried. Preferably, the at least one operating module is a heating module mounted to the washing tub, and the electric/electronic/electromechanical component is a heater arranged for heating a fluid with which, in operation, the heater is at least partly in thermal contact.

[0031] In an advantageous embodiment of the invention, the heating module comprises a heating portion comprising the heater, an electronic portion comprising an electronic switch, the electronic switch being arranged for selectively actuating the heater in order to achieve and maintain a desired temperature, or set of temperatures, of the fluid with which, in operation, the heater is at least partly in thermal contact, and a sealing member arranged for maintaining separated the electronic portion from the heater, once the heating module is mounted to the tub. Preferably, at least one part of the electronic switch is provided in thermal contact with the sealing member in order to disperse heat generated during operation.

[0032] In an advantageous embodiment of the invention, the electronic switch is arranged for electrically insulating the managing element and the heater.

[0033] In an advantageous embodiment of the invention, the appliance is a laundry washing machine or a laundry washing/drying machine comprising a washing tub enclosing a rotatable drum for containing items to be washed and/or dried. Preferably, the electric/electronic/electromechanical component is a drum motor arranged for rotating the rotatable drum during the operation of the appliance.

Brief description of the annexed drawings

[0034] These and other features and advantages of the present invention will be made apparent by the following description of some exemplary and non-limitative embodiments thereof. For its better intelligibility, the fol-

lowing description should be read making reference to the attached drawings, wherein:

Figure 1A is a schematic perspective view of a laundry machine in which the present invention can be applied;
Figure 1B is a schematic perspective front view of the laundry machine of Figure 1A with removed parts;
Figure 1C is a schematic perspective rear view of the laundry machine of Figure 1A with removed parts, and
Figure 2 is a schematic top view of a heating module according to an embodiment of the invention.

Detailed description of preferred embodiments of the invention

[0035] Referring now to the drawings, **Figures 1A** to **1C,** are a schematic perspective view and perspective views with removed parts of an appliance, particularly a (domestic) laundry machine **100** in which an embodiment according to the present invention may be applied.

[0036] It is stressed that the laundry machine **100** should be considered only as a non-limiting example of an appliance in which an embodiment of the present invention may be implemented. Indeed, embodiments of the present invention may be applied to any kind of appliances (both for domestic and professional use) comprising one or more electrical/electronic/electromechanical components, in the following referred to as e-components for short, designed for performing on or more specific tasks required for the appliance operation and an electronic control board, or control unit comprising a suitable control circuitry designed for managing whole operation of the appliance.

[0037] The laundry machine **100** is a machine for treating laundry, such as for example a laundry washing machine or a laundry washing/drying machine, of the front-loading type. Anyway, it should be apparent from the following description that laundry machines of the top-loading type may also benefit from the solution according to the present invention.

[0038] In the example at issue, the laundry machine **100** comprises a casing or cabinet **105** preferably substantially parallelepiped-shaped, which encloses a washing tub, or simply tub, **107** (as shown in **Figures 1B** and **1C)** preferably substantially cylindrically-shaped, wherein the laundry is treated, along with any other component of the laundry machine **100** necessary for its operation (*e.g.,* hydraulic, electronic and electromechanical components).

[0039] The tub **107** houses a rotatable drum **110** preferably substantially cylindrically shaped, which, in operation, rotates about an axis **A** in order to tumble the laundry to be washed.

[0040] Typically, the tub **107** is suspended in the casing **105** in such a way to be substantially free to oscillate during its operation. For example, the tub **107** is connected to the casing **105** in a movable manner by means of suspension elements **111** (e.g., spring elements, for example extension springs) and damping elements **112** (e.g., shock absorbers).

[0041] In addition, the tub **107** comprises, in a backside or backwall **107a** thereof, a shaft opening **107b,** in which a drum rotor shaft **110a** is inserted. The rotor shaft **110a** is attached to the drum **110** and rotatably connected by means of a transmission apparatus **115** to a, preferably electric, drum motor **120** comprised in the laundry machine **100** in order to rotate the drum **110** during operation. The drum motor **120** is preferably, although not limitatively, positioned in a bottom position with respect to the casing **105.** The transmission apparatus **115** may comprise a transmission belt or chain **115a** coupled with a pair of pulleys **115b** and **115c,** of which a first pulley **115b** is mounted to the drum rotor shaft **110a** while a second pulley **115c** is mounted to a motor shaft **120a.**

[0042] In the laundry machine **100** the drum motor **120** is preferably mounted to a lower portion of the tub **107,** thus the drum motor **120** is integral with the tub **107** and they oscillates together during operation. In this way, also the drum motor **120** and the rotor shaft **110a** are substantially integral and any oscillation does not affect a tensioning of the chain **115a** between the pulleys **115b** and **115c.**

[0043] Alternatively, in other embodiments according to the present invention (not shown in the Figures), the rotating movement may be transferred to the drum in any other known manner; for example, a motor may be directly connected to the drum (so called "direct drive"), with the motor shaft coinciding to the drum shaft.

[0044] In order to allow a user to access the tub **107** and the inside of the drum **110** (for loading/unloading the laundry), a loading/unloading opening is advantageously provided on a front side of the laundry machine **100.** The loading/unloading opening is closable by a door **125** (as shown in **Figure 1A),** which is hinged, preferably, to the casing **105** by means of a hinge (not shown in the figures).

[0045] The tub **107** is provided with a tub opening **107c,** and the drum **110** is provided with a drum opening. The tub opening **107c** is aligned with the loading/unloading opening provided in the casing **105,** and with the drum opening of the drum **110.**

[0046] Preferably, in order to achieve a watertight connection between the loading/unloading opening and the tub opening **107c** (in order to avoid leakages of washing liquid into the casing **105),** a bellows **130,** preferably made of an elastomeric and waterproof material, is mounted in a watertight manner (such as by gluing, by welding, by interference fitting, *etc.)* to a border of the loading/unloading opening and is coupled with a border of the tub opening **107c.**

[0047] The tub **107** is fluidly connected to a hydraulic apparatus (not shown in the drawings) adapted to provide washing liquids (*e.g.,* water mixed with detergents) in the washing tub **107** for treating the laundry therein, and to

exhaust such liquids once used.

[0048] Preferably, the hydraulic apparatus comprises electromechanical valve components (e.g., solenoid valves) that are actuated in order to selectively allow water, detergents, softeners and/or other laundry-treating liquids and/or powders in the tub **107.**

[0049] Moreover, a heating module (not shown, but described in the following with reference **Figure 2** wherein the heating element is indicated as a whole by numerical reference **205)** is provided coupled with the tub **107** in order to selectively heat water/washing liquids therein contained.

[0050] Preferably, a receiving aperture **107d** is provided in a lower portion of the tub **107** and sized in order to receive the heating module and allowing a heating portion thereof (not shown, but described in the following with reference **Figure 2** wherein the heating portion is indicated as a whole by numerical reference **210)** to protrude within the tub **107** in its working position. Advantageously, a rim of the receiving aperture **107d** may be provided with fasteners (e.g. snap-fitting or bayonet mounting fastening arrangements and/or fastening arrangements designed to cooperate with additional fasteners, such as for example threaded or unthreaded bores for receiving screws, bolts and nuts, rivets, *etc.)* in order to fix the heating element to the tub **107.**

[0051] The laundry machine **100** may possibly comprise also a drying air apparatus (not shown) fluidly connected with the tub **107** adapted to heat up and blow drying air into the tub and draw therefrom moisturized cool air.

[0052] In addition, a user interface **140** is advantageously provided, preferably, although not limitatively, on a top portion **105t** of the casing **105.** Preferably, the user interface **140** may comprise a control panel **140a** for selecting laundry treatment cycles (*e.g.,* a set of operations and parameters designed for treating peculiar fabrics, such as wool items) to be carried out by the laundry machine **100,** and a drawer **140b** for loading laundry-treating products (e.g., detergents, softeners, bleachers, *etc.).*

[0053] The laundry machine **100** is advantageously provided with a (main) control unit **150** (schematically denoted as a dashed rectangle in **Figure 1A),** e.g. comprising an electronic board on which at least one (central) control circuitry **150a** is provided. The control circuitry **150a** comprises one or more microprocessors/microcontrollers, an application-specific integrated circuit - ASIC - or a similar electronic control component and, possibly, further processing circuitry such as a Digital Signal Processor - DSP -, *etc.*) adapted to control the laundry machine **100** operation, which is preferably, although not necessarily, placed in a top position inside the casing in order to be less prone to contacts with liquids or humidity possibly leaking from the tub **107.**

[0054] In an embodiment of the invention, the control unit **150** is further arranged for supplying power (e.g., at one or more DC and/or AC voltage values) and interacting with the e-components comprised in the laundry machine **100 -** such as for example the drum motor **120,** electromechanical valves, pumps and impellers of the hydraulic apparatus, one or more heating elements for heating water / washing liquids / air, the user interface **140a,** *etc.* - in order to manage an execution of selected laundry-treating operations featured by the laundry machine **100.**

[0055] To this extent, the control unit **150** comprises a power supply circuitry **150b,** along with control circuitry **150a** mentioned above. The power supply circuitry **150b** of the control unit **150** is arranged for receiving the AC mains to which the control unit **150** is connected - e.g., by means of a power cord (such connection is omitted in the figures for the sake of simplicity and since well-known in the art) - and converts the AC voltage received in one or more DC voltages adapted to power electronic components (e.g., such as a 5 VDC).

[0056] In addition, the power supply circuitry **150b** of the control unit **150** may be also designed for providing a power supply at high voltage - e.g., a voltage ranging from 100V to 275 V, such as for example 110V or 220V, preferably but not limitatively an AC high voltage.

[0057] The power supply at high voltage is provided to e-components which requires high voltages for their operation (e.g., heaters and the drum motor **120).**

[0058] In alternative embodiment of the present invention (not shown), a stand-alone power unit may be provided instead of having the power supply circuitry **150b** integrated in the control unit **150.**

[0059] Advantageously, the laundry machine **100** is further provided with one or more load sensing devices, i.e. sensors, arranged for providing a (electric) signal indicative of physical parameters associated with the laundry machine **100** operation that are exploited for an accurate and effective provision of the laundry-treating operations.

[0060] For example, the laundry machine **100** may comprise one or more temperature sensors for monitoring a water and/or air temperature inside the tub **107,** weight sensors for estimating a weight of laundry items loaded in the drum **110,** humidity sensor estimating a humidity of laundry items loaded in the drum **110,** oscillation and/or vibration sensors for estimating an extent of displacements of the tub **107** during operation, flowmeters for assessing an amount of water and/or washing liquids/powders introduced in the tub **107,** *etc.*

[0061] An operating module comprising an e-component for heating a fluid, i.e. water/washing liquid, contained in the tub **107** according to an embodiment of the present invention is now described by making reference to **Figure 2,** which is a schematic perspective view of a heating module **205** according to an embodiment of the present invention.

[0062] Generally, the heating module **205** is at least partly in thermal contact with the fluid contained in the tub **107** during the laundry machine operation **100.**

[0063] The heating module **205** comprises a heating

portion **210** and an electronic portion **215.**

[0064] The heating element portion **205** comprises a heater **220.** For example, the heater **220** comprises a substantially cylindrical body with a predetermined diameter and length and including a core heating wire embedded in a stainless metal alloy that, in its turn, is possibly coated with a protective layer.

[0065] Generally (as shown in **Figure 2),** the heater **220** is configured (e.g., bent) to have a serpentine or zigzag shape.

[0066] The heater **220** further comprises a couple of (electric) terminals **225a** and **225b** at its free ends for receiving an electric power supply (as described in the following).

[0067] According to an embodiment of the present invention, the terminals **225a** and **225b** selectively receive a power supply at an (AC) high voltage (as described in the following).

[0068] A sealing member **230** is coupled with the heater **220.** The sealing member **230** is arranged in order to maintain the terminals **225a** and **225b** spaced apart by a predetermined distance (e.g., a distance adapted to prevent arc discharges between terminals due to voltage differences therebetween). Moreover, the sealing member **230** is disposed in order to maintain separated, preferably in a watertight manner, the terminals **225a** and **225b** from the rest of the heater **220,** once the latter is disposed in the tub **107** of the laundry machine **100** and, in operation, is in direct contact with water and/or washing liquid in order to heat it.

[0069] For example, the sealing member **230** is substantially parallelepiped-shaped and comprises a couple of through holes, each of which designed to receive a portion of the heater **220** and to be sealed in a watertight manner. Particularly, the heater **220** is coupled with the sealing member **230** in such a way that the terminals **225a** and **225b** protrude from a first (dry) face of the sealing member **230** (on the left of the sealing member **230** in the example of **Figure 2)** opposite to a second (wet) face of the sealing member **230** from which the rest of the heater **220** protrudes (on the right of the sealing member **230** in the example of **Figure 2).**

[0070] Preferably, the sealing member **230** is designed to fit in a watertight manner a corresponding the receiving aperture **107d** provided in the tub **107** of the laundry machine **100** in such a way that the heater **220** protrudes inside the tub **107** while the electronic portion **215** remains outside the tub **107,** once the heating module **205** is mounted to the tub **107.**

[0071] In other words, the sealing member **230** is disposed in order to maintain separated, preferably in a watertight manner, the whole the electronic portion **215** from the heater **220** of the heating module **205,** once the latter is mounted to the tub **107.**

[0072] Even more preferably, the electronic portion **215** is mechanically coupled with the sealing element **230** in such a way the heating module **205** forms an integral unit.

[0073] The electronic portion **215** of the heating module **205** comprises an electronic board **235** (or any other similar support medium adapted to support electronic components and provide/support interconnections among such electronic components) on which an electronic circuit designed for operating (as described in the following) the heating module **205** may be advantageously provided.

[0074] In order to mechanically couple the electronic portion **215** with the sealing element **230,** the electronic board **235** may be fastened to the sealing element **230.** To this extent, the electronic board **235** and the sealing element **230** may be provided with matching fasteners, e.g. matching snap-fitting or bayonet mounting matching fastening arrangements and/or fastening arrangements cooperating with additional fasteners such as for example threaded or unthreaded bores for receiving screws, bolts and nuts, rivets, *etc.*

[0075] The electronic circuit may comprise a local control circuitry, or managing element **240** (comprising for example a microprocessor, microcontroller, an application-specific integrated circuit - ASIC - or a similar electronic control component), and an electronic switch, such as for example a triac **245.**

[0076] The managing element **240** is configured for managing the operation of the heating module **205,** and particularly of the triac **245.** Preferably, although not limitatively, the managing element **240** is configured for operating in a manner substantially independent from the control circuitry **150a** of the control unit **150** of the laundry machine **100** (as described in the following).

[0077] According to an embodiment of the invention, the electronic circuit comprises one or more sensors that are adapted to detect values of physical parameter(s) affected by the operation of the heating module **205.**

[0078] Preferably, although not limitatively, such one or more sensors comprised in the electronic circuit are connected to the managing element **240** that may advantageously exploit the values of the physical parameter(s) detected by such one or more sensors for managing the heating module **205** operation (as further described in the following).

[0079] For example, the electronic circuit comprises a temperature sensor **250.** Possibly, the temperature sensor **250** may comprise a probing end **250a** provided in proximity of the heater **220** beyond the sealing member **230** (in order to sense water/washing liquid temperature provided in the tub **107),** but in electric connection with the electronic board **235.**

[0080] The electronic circuit further comprises a connector terminal **255** in order to couple the latter with the control unit **150,** e.g. by means of electric wirings **260.**

[0081] In an embodiment of the invention, the electric wirings **260** supply power (e.g., at a DC voltage such as for example 5 V) to the managing element **240.**

[0082] Preferably, the electric wirings **260** further deliver power supply at (AC) high voltage for operating the heater **220.**

[0083] In an alternative embodiment of the present invention (not shown), the electronic portion **215** may comprise a power adapter arrangement designed to adapt the high voltage, provided to the heating element **205** by means of the electric wirings **260,** for supplying power to the managing element **240.** In this case, only the power supply at (AC) high voltage is fed to the heating module **205.**

[0084] The terminals **225a** and **225b** of the heater **220** are selectively fed with the high voltage delivered by the electric wirings **260** to the connector terminal **255** of the heating module **205.**

[0085] Preferably, the provision of the high voltage at the terminals **225a** and **225b** of the heater **220** is controlled by activating/deactivating the triac **245.** Even more preferably, the triac **245** is managed by the managing element **240.**

[0086] For example, the first terminal **225a** of the heater **220** is connected to a first main terminal of the triac **245** while a first output, of the connector terminal **255** is connected to a second main terminal of the triac **245.** A control terminal of the triac **245** is connected to the managing element **240.** Finally, the second terminal **225b** of the heater **220** is connected to a second output of the connector terminal **255.**

[0087] In an embodiment of the invention, an electric insulation is implemented between the managing element **240** (and other electronic members of the electronic circuit) that generally operates at a DC voltage and the heater **220** receiving the high voltage.

[0088] For example the triac **245** may comprise an opto-triac (known in the art and not herein described for the sake of brevity). It should be noted that different electronic switches may be used for controlling the heater **220** in alternative embodiments of the heating module **205** according to the present invention and, at the same time, for ensuring insulation between DC and AC voltages, such as for example opto-thyristors or solid state relays.

[0089] In other words, the electronic switch, implemented in the heating module **205** according to the present invention, is arranged for electrically insulating the managing element **240** and the heater **220.**

[0090] Such arrangement of the electronic circuit allows the managing element **240** selectively powering the heater **220** by controlling the operation of the triac **245** (as further described in the following).

[0091] In an embodiment of the invention, at least one part of the triac **245** is provided in thermal contact with the sealing member **230** in order to disperse heat generated during operation.

[0092] Indeed, the sealing member **230** is preferably made of a heat conductive material such as for example a metal (e.g., stainless steel).

[0093] Therefore, a surface of the triac **245 -** preferably a heat sink surface implemented in electronic power members known in the art, such as in case of triacs - may be attached (e.g. by means of an electrically insulating but thermally conductive resin, e.g. a resin comprising mica) to the first face of the sealing member **230** facing the electronic board **235.**

[0094] In this way, the heat generated during the triac **245** operation is effectively dispersed by the sealing member **230** without requiring an *ad hoc* heat sink to be provided attached to the triac **245.** In other words, by thermally coupling the triac **245** sealing member **230** allows the triac **245** operating at a temperature comprised within an optimal working temperatures range without the need for further heat sinking elements (thus reducing the overall cost and weight of the heating module **205).**

[0095] Moreover, the heat transmitted from the triac **245** to the sealing member **230** is then transmitted to the water/washing liquid in contact with the second face of the sealing member **230** facing the inside of the tub **107** (when the heating module **205** is coupled with the latter).

[0096] Therefore, thanks to the reciprocal arrangement of the triac **245** and of the sealing member **230** just described, the heat generated by the triac **245** operation is not merely dispersed in the environment, but it is transmitted to the water/washing liquid and concurs to warming the water/washing liquid together with the heat provided by the heater **220.**

[0097] In an embodiment of the present invention, the heating module **205** may further comprise one or more additional sensors designed to detect values and/or values variations of one or more physical parameters which are not related with the operation of the heating module **205.**

[0098] Preferably, although not limitatively, such one or more additional sensors designed to detect values and/or values variations of one or more physical parameters (which are not related with the operation of the heating module **205)** may be comprised in the electronic circuit of the electronic portion **215.**

[0099] Even more preferably, the additional sensors may be operatively connected to the managing element **240** of the electronic circuit.

[0100] In an embodiment of the invention, the heating module **205** comprises one or more displacement sensors, i.e. sensors designed to detect a movement, such as oscillations or rotations/rotary movements of the heating module **205** preferably, although not limitatively, during laundry treating procedures implemented by the laundry machine **100.**

[0101] For example, the electronic circuit comprises one or more displacement sensors, generally denoted with the reference **265** in **Figure 2,** designed to detect a movement, such as oscillations or rotations/rotary movements of the heating module **205** during the laundry machine **100** operation (as described in the following).

[0102] According to embodiments of the present invention, the displacement sensors **265** provided in the electronic circuit may comprise an accelerometer for determining an acceleration (e.g., measured in m/s^2) along at least one among three-dimensional axes, but preferably along all three three-dimensional axes (preferably centered on the accelerometer) and/or a gyroscope for de-

termining a radial velocity (e.g., measured in rad/s) to which the heating module **205** is subjected.

[0103] In a further embodiment of the present invention, the displacement sensors **265** may also comprise (as an addition or an alternative to the accelerometer and/or the gyroscope) a magnetometer for detecting an orientation of the heating module **205** based on measurements of Earth's magnetic field along three-dimensional axes (preferably centered on the magnetometer).

[0104] In other embodiments of the invention, other displacement sensors **265** may be provided as an addition or as an alternative to the displacement sensors of above without departing from the scope of the present invention.

[0105] The displacement sensors **265** are advantageously exploited for assessing an intensity of vibration, oscillations and/or rotary/eccentric movements of the tub **107** (which is arranged for moving during the laundry machine **110** operation as known) to which the heating module **205** is attached.

[0106] Optionally, the heating module **205** may further comprise a casing (not shown) arranged for enclosing at least the electronic portion **215** of the heating module **205,** i.e. the electronic board **235** and all the electric and electronic components mounted thereon, particularly the managing element **240**, the triac **245,** the terminals **225a** and **225b** yet allowing the connector terminal **255** to couple with the electric wirings **260.**

[0107] Preferably, the casing is a substantially watertight enclosure that protects the electronic portion **215** from foreign matters (e.g., dirt) and water and/or moisture.

[0108] In case the casing is provided, the casing may be shaped and/or provided with coupling appendages and/or recesses in order to allow a simple mounting of the heating module **205** in its position within the laundry machine **100** (e.g., protrusions and/or receptacles suitable for snap-fitting or bayonet mounting, and/or bored tabs or hooks for fastening means such as screws) instead or in addition to the fasteners provided on the electronic board **235** as described above.

[0109] Having described the structure of the heating module **205** according to embodiments of the present invention, an operation thereof is described in hereinbelow.

[0110] Preferably, the control circuitry **150a** of the control unit **150** of the laundry machine provides to the heating module **205** an indication of a desired temperature, or set of temperatures, for the water/washing liquid in the tub **107,** for example based on a laundry-treating procedure selected by a user through the user interface **140a.** Such indication is preferably transmitted from the control circuitry **150a** of the control unit **150** to the heating module **205** as an electric, preferably digital, signal over the electric wirings **260.**

[0111] In an embodiment of the invention, the indication of a desired temperature or set of temperatures is received, and preferably stored, by the managing element **240;** e.g., such temperature(s) indication is stored in a memory portion, not detailed in the figures, comprised in the managing element **240** or in a separate memory element (not shown in the figures) of the electronic portion **215** of the heating module **205.**

[0112] Afterwards, the managing element **240** selectively actuates the triac **245** and, accordingly, the heater **220** in order to achieve and maintain the desired temperature, or set of temperatures, of the water/washing liquid in the tub **107.**

[0113] It should be noted that, once the desired temperature, or set of temperatures, is provided to the managing element **240** of the heating module **205** the operation of the heater **220** may be performed in a manner completely independent from the control circuitry **150a** of the control unit **150.**

[0114] Preferably, the managing element **240** exploits the temperature sensor **250** in order to monitor temperature values and trends during the advancement of the laundry-treating procedure and to adjust the heat generated by the heater **220** by leveraging the actuation of the triac **245** in order to control the water/washing liquid in the tub **107.**

[0115] At the same time, the displacement sensors **265** acquires information regarding the displacement of the tub **107** with respect to the casing **105** (generally caused by oscillations and vibration of the tub **107** generated the laundry machine **100** operation).

[0116] In an embodiment of the invention, such displacement information, gathered by the displacement sensors **265,** is transmitted from the displacement sensors **265** to the electronic managing element **240,** generally in the form of electric signals.

[0117] Preferably, the managing element **240** is configured for pre-processing electric signals provided by the displacement sensors **265.**

[0118] For example, the managing element **240** is configured for filtering, amplifying and/or digitalizing the electric signals provided by the displacement sensors **265** accordingly generating corresponding pre-processed electric signals.

[0119] Afterwards, the displacement information may be forwarded to the control circuitry **150a** of the control unit **150** by the managing element **240,** in the form of the pre-processed electric signal.

[0120] Alternatively, the displacement information may be stored in the memory portion of the managing element **240** and may be forwarded to the control circuitry **150a** of the control unit **150** upon request from the latter and/or at predetermined time instants.

[0121] It should be noted that the provision of displacement sensors **265** within the heating module **205** is not required for the operation of the latter.

[0122] Nevertheless, the displacement sensors **265** provided on the heating module **205** allow avoiding design and producing a further sensor module for monitoring the displacement of the tub **107.** Accordingly, this avoids the need for providing a dedicated housing for

such sensor module, reduces the wiring complexity within the laundry machine **100** and simplifies an assembling of the laundry machine **100.**

[0123] It should be noted that various alternative embodiments (not shown) of the heating module **205** according to the present invention may be devised.

[0124] For example, in alternative embodiments (not shown) the heating module may comprise displacement sensors directly connected to the control board by means of independent wirings, i.e. bypassing the managing element of the heating module.

[0125] In a further embodiment (not shown), a simpler heating module may be provided. The simpler heating module is provided only with the temperature sensor (such as the temperature sensor **250)** and with the one or more displacement sensors (such as the displacement sensors **265).** In other words, the simpler heating module does not comprise a managing element (such as the managing element **240).** In this case, the temperature sensor and the one or more displacement sensors are independently wired to the control unit of the laundry machine.

[0126] It should be noted that one or more displacement sensors may be provided (in alternative or in addition to the displacement sensors provided in the heating module) on a different e-component mounted to the washing tub (or a different portion of the laundry machine capable of moving at least during operation).

[0127] For example, in a yet alternative embodiment of the invention, one or more further displacement sensors may be provided in the drum motor **120** in case the latter is mounted to the washing tub **107** (as shown in **Figures 1B** and **1C).**

[0128] It should be apparent to the skilled person that the provision of displacement sensors in the drum motor **120** may be carried out in a similar way as described above with reference to the heating module **205.**

[0129] In general, one or more other operating modules e-components of the laundry machine **100** may further comprise one or more additional sensors designed to detect values and/or values variations of one or more physical parameters which are not directly related or required for managing the operation of such e-component (on which are provided) without departing from the scope of the present invention.

[0130] Additionally, also the stand-alone sensor modules may be provided with one or more typology of sensors. In other words, stand-alone sensor modules may comprise two or more sets of one or more sensor each of which devised for detecting and monitoring values and/or values variations of one or more respective physical parameters.

Claims

1. An appliance **(100)** comprising:

a control circuitry **(150a)** provided for managing the operation of the appliance **(100),** and

at least one operating module **(205)** comprising an electric/electronic/electromechanical component **(220)** provided for performing one or more specific tasks required for the appliance operation, the at least one operating module comprising at least one sensor **(265)** arranged to detect values of one or more physical parameters,

characterized in that

said at least one sensor is arranged to detect values of one or more physical parameters which are not related to the one or more specific tasks performed by the electric/electronic/electromechanical component of the operating module.

2. The appliance **(100)** according to claim 1, wherein the at least one operating module **(205)** further comprises a managing element **(240)** being in communication relationship with the control circuitry **(150a),** the managing element being configured for controlling the execution of the one or more specific tasks of the at least one electric/electronic/electromechanical component **(220).**

3. The appliance **(100)** according to claim 2, wherein the managing element **(240)** is electrically coupled with the at least one sensor **(265),** and is configured to manage the detected values of one or more physical parameters detected by the at least one sensor.

4. The appliance **(100)** according to claim 3, wherein the detected values of one or more physical parameters is transmitted from the at least one sensor **(265)** to the control circuitry **(150a)** as electric signals, and wherein the managing element **(240)** is further configured for pre-processing said electric signals provided by the at least one sensor.

5. The appliance **(100)** according to claim 4, wherein said pre-processing comprises filtering, amplifying and/or digitalizing the electric signals provided by the at least one sensor **(265).**

6. The appliance **(100)** according to any one of the preceding claims 2 to 5, wherein the managing element **(240)** comprises a microprocessor, microcontroller or an application-specific integrated circuit.

7. The appliance **(100)** according to any one of the preceding claims, wherein the at least one operating module **(205)** is mounted to a portion **(107)** of the appliance capable of moving during the operation of the appliance, and

wherein the at least one sensor **(265)** is arranged for detecting physical parameters associated with a

movement of the at least one operating module corresponding to a movement of the portion of the appliance to which the at least one operating module is mounted.

8. The appliance **(100)** according to claim 7, wherein the at least one sensor **(265)** comprises an accelerometer for determining an acceleration along three-dimensional axes to which the at least one operating module **(205)** is subjected.

9. The appliance **(100)** according to claim 7 or 8, wherein the at least one sensor **(265)** comprises a gyroscope for determining a radial velocity to which the at least one operating module **(205)** is subjected.

10. The appliance **(100)** according to claim 7 to 9, wherein the at least one sensor **(265)** comprises a magnetometer for detecting an orientation of the at least one operating module **(205)** based on measurements of Earth's magnetic field along three-dimensional axes.

11. The appliance **(100)** according to any one of the preceding claims, wherein the at least one operating module **(205)** comprises at least one further sensor **(250),** the at least one further sensor being arranged to detect values of one or more physical parameters which are related to the one or more specific tasks performed by electric/electronic/electromechanical component **(220)** of the operating module.

12. The appliance **(100)** according to any one of the preceding claims Ito 11, wherein the appliance is a laundry washing machine or a laundry washing/drying machine comprising:

a washing tub **(107)** enclosing a rotatable drum **(110)** for containing items to be washed and/or dried, and
wherein the at least one operating module is a heating module **(205)** mounted to the washing tub, and the electric/electronic/electromechanical component is a heater **(220)** arranged for heating a fluid with which, in operation, the heater is at least partly in thermal contact.

13. The appliance **(100)** according to claim 12, wherein the heating module **(205)** comprises:

a heating portion **(210)** comprising the heater **(220);**
an electronic portion **(215)** comprising an electronic switch **(245),** the electronic switch being arranged for selectively actuating the heater in order to achieve and maintain a desired temperature, or set of temperatures, of the fluid with which, in operation, the heater is at least partly in thermal contact, and
a sealing member **(230)** arranged for maintaining separated the electronic portion from the heater, once the heating module is mounted to the tub **(107),** and
wherein at least one part of the electronic switch is provided in thermal contact with the sealing member in order to disperse heat generated during operation.

14. The appliance **(100)** according to claim 13, wherein the electronic switch **(245)** is arranged for electrically insulating the managing element **(240)** and the heater **(220).**

15. The appliance **(100)** according to any one of the preceding claims 1 to 10, wherein the appliance is a laundry washing machine or a laundry washing/drying machine comprising:

a washing tub **(107)** enclosing a rotatable drum **(110)** for containing items to be washed and/or dried, and
wherein the electric/electronic/electromechanical component is a drum motor **(120)** arranged for rotating the rotatable drum during the operation of the appliance.

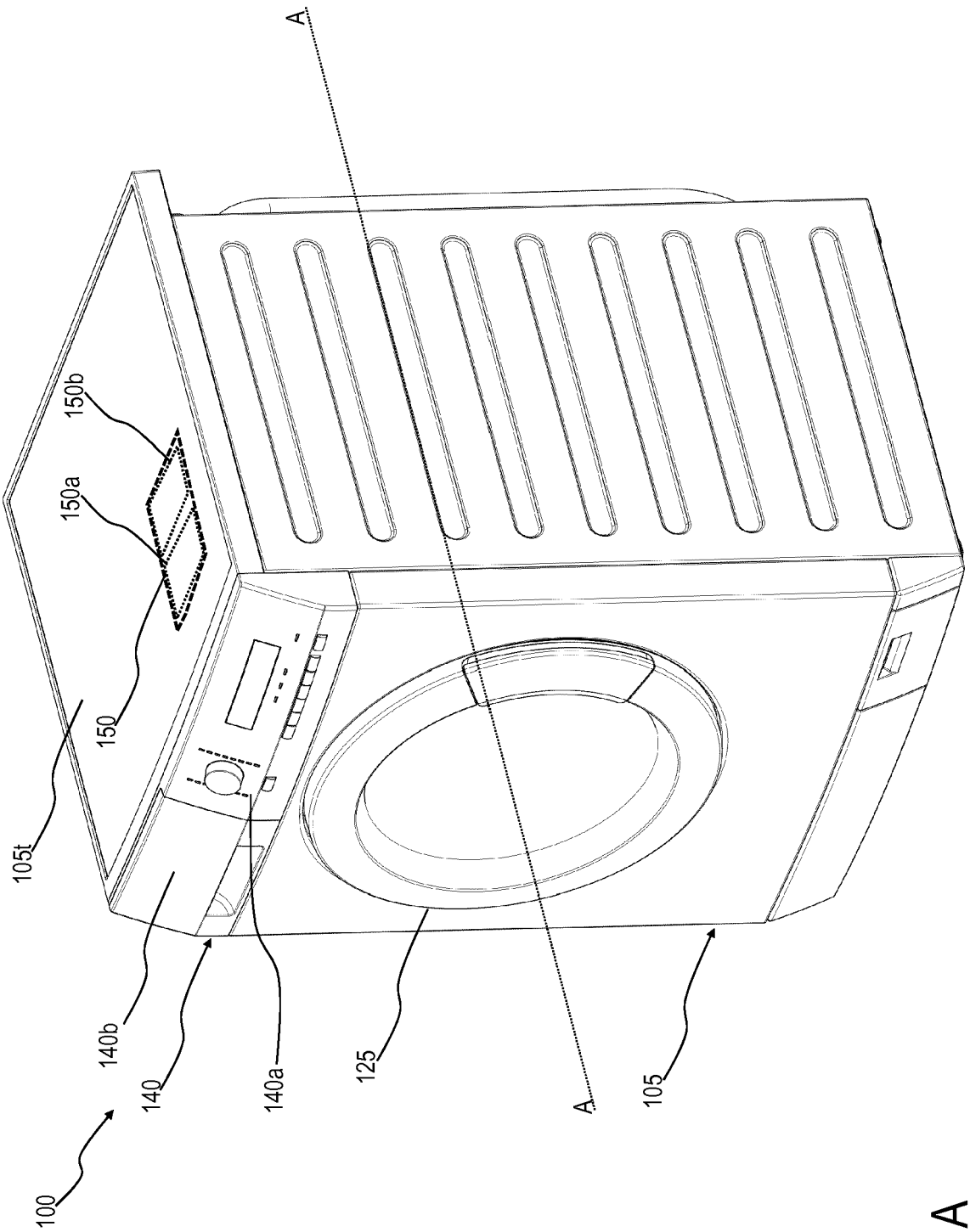

FIG.1A

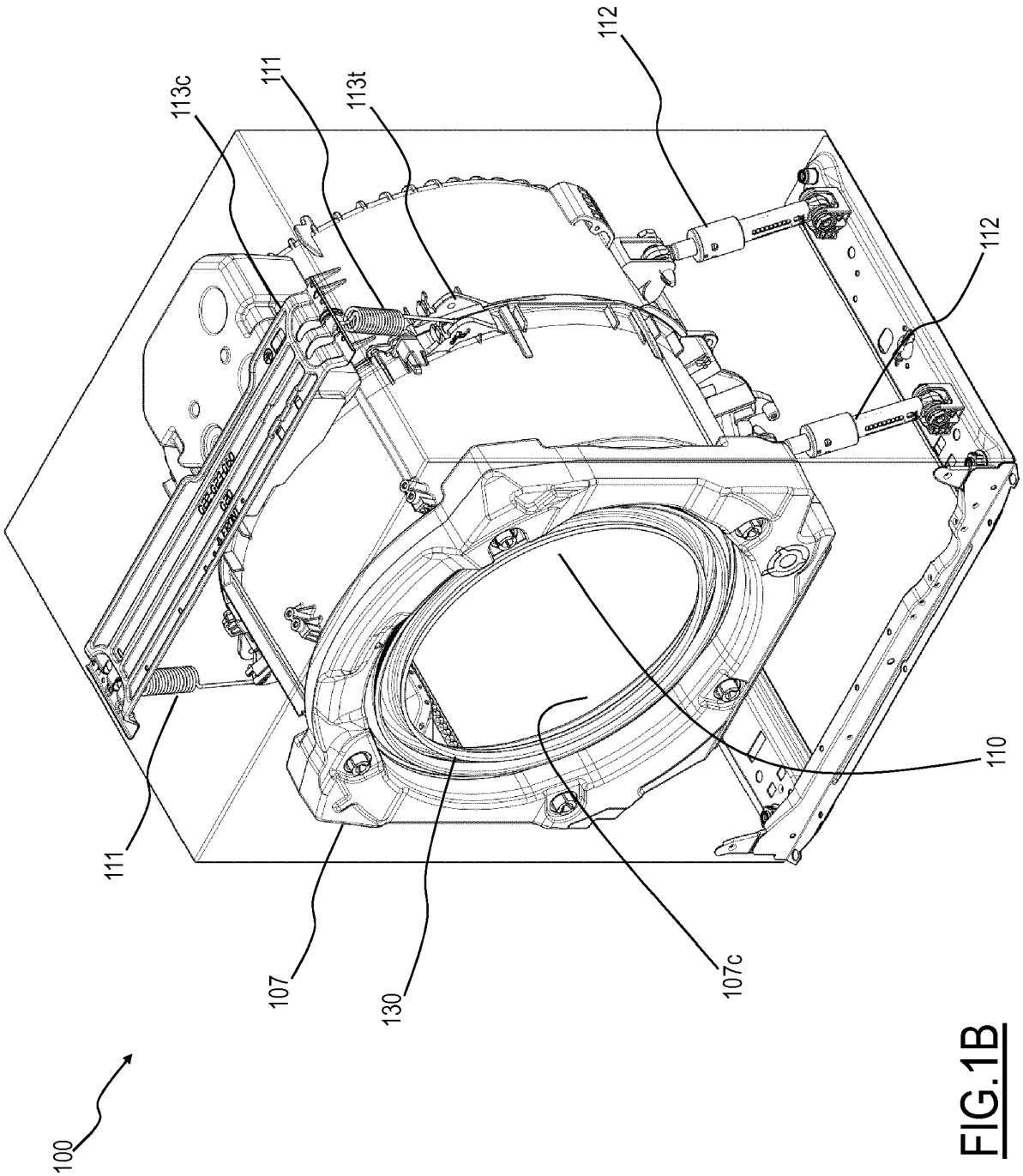

FIG.1B

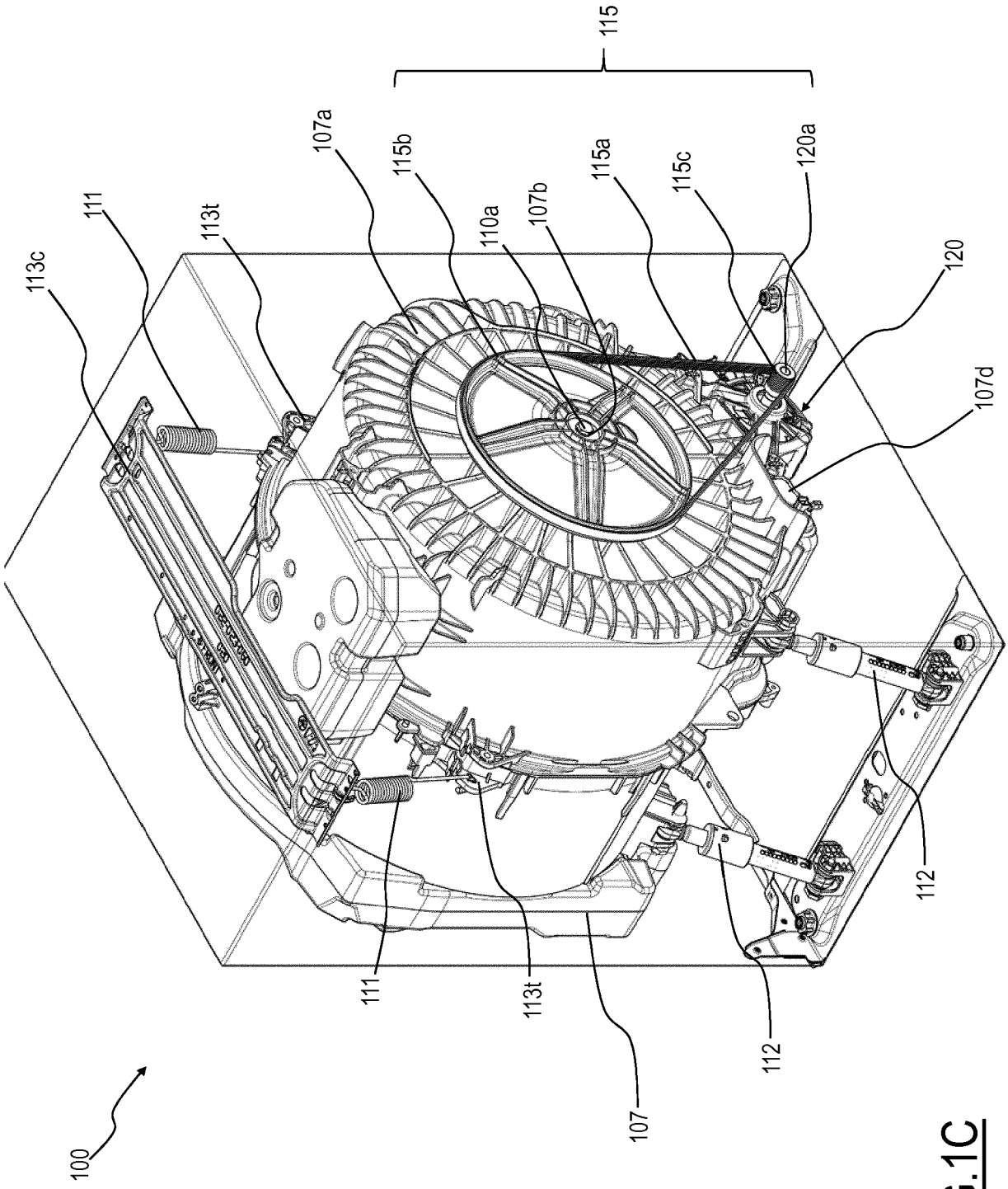
115
107a
115b
115a
115c
120a
111
113t
110a
107b
113c
120
107d
112
111
113t
107
112
100

FIG.1C

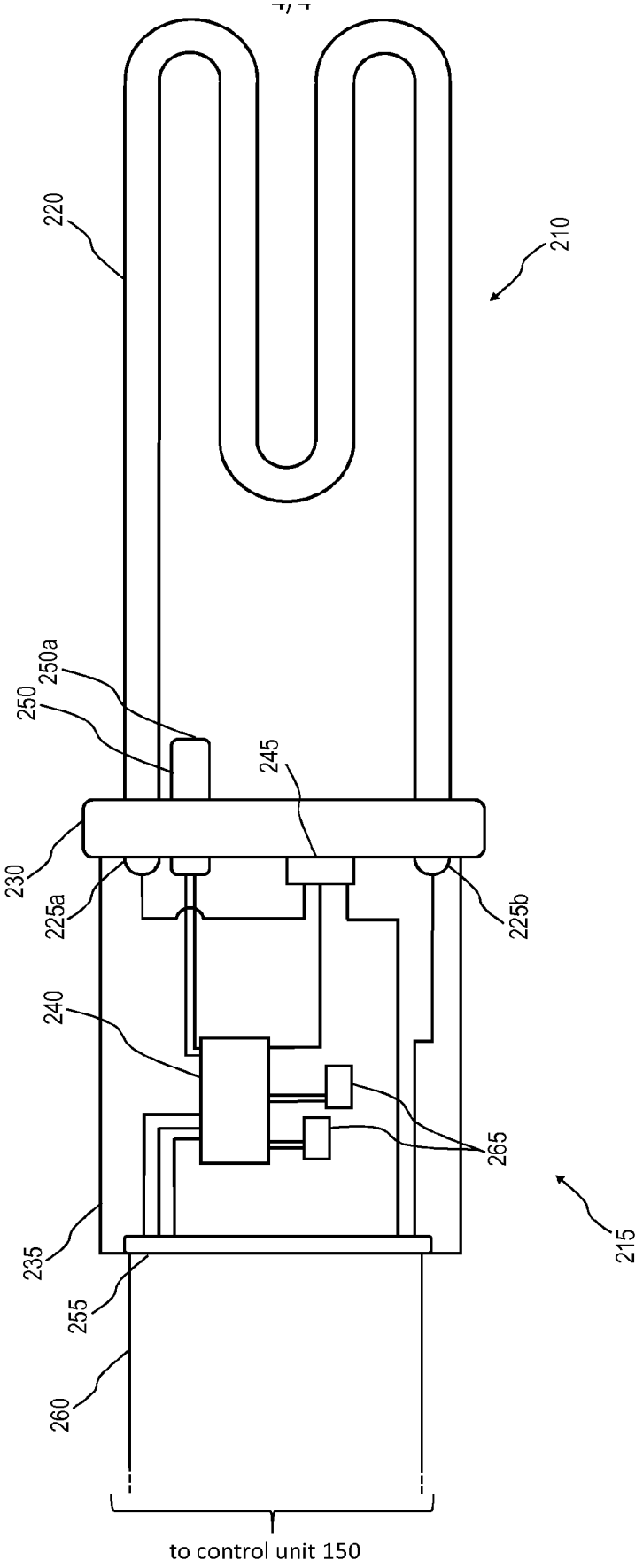
220
210
205
250a
250
245
230
225a
225b
240
265
215
235
255
260
to control unit 150

FIG.2

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EUROPEAN SEARCH REPORT

Application Number
EP 17 15 1124

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