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(54) **Laundry treating machine**

(57) The invention relates to a laundry treating machine (10; 110), in particular a dryer or a washing machine having dryer function, comprising a casing (11; 111), a power supply (25; 125) to power the laundry treating machine (10; 110), a first component (14, 22; 114, 122) to be put in an electrically safe condition, housed in the casing (11; 111), and a second component (15, 32; 115, 132) operable to access the first component (14, 22; 114, 122)

through the casing (11; 111). The machine further comprises a switching device (40; 140) operable by actuation of the second component (15, 32; 115, 132) to disconnect the laundry treating machine (10; 110) from a power supply or to connect the first component (14, 22; 114, 122) of the laundry treating machine (10; 110) to ground. The invention also relates to a method to put in an electrically safe condition a laundry treating machine (10; 110).

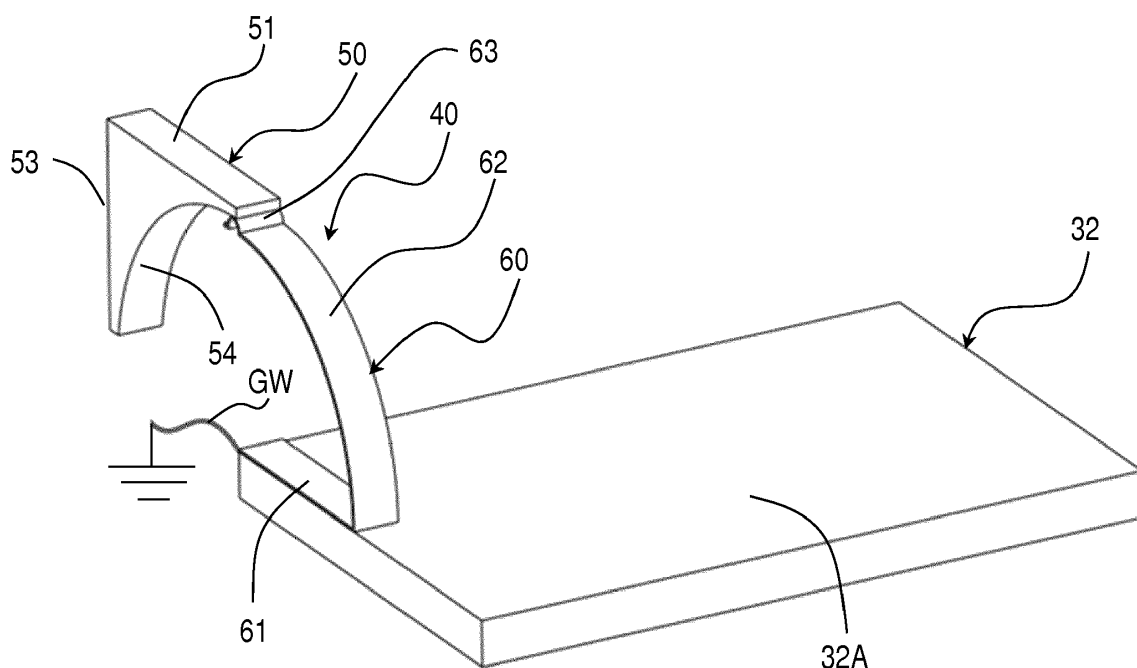


FIG. 5

Description

[0001] The invention relates, in general, to the field of laundry treating machines. In particular, the invention relates to a laundry treating machine having a switching device configured to put the laundry treating machine in an electrically safe condition and to a method to put the laundry treating machine in an electrically safe condition.

[0002] The laundry treating machine can be a laundry washing machine, a laundry dryer, or a laundry washing-drying machine, i.e. a washing machine having a drying function.

[0003] As is known, a laundry treating machine usually comprises a substantially parallelepiped-shaped casing, configured to rest on the floor and to house different components of the machine. A substantially cylindrical drum, which is configured to house the laundry to be treated, i.e. washed, dried or both, is fixed inside the casing to rotate about a rotational axis. The drum directly faces a laundry loading/unloading opening formed in a front or upper wall of the casing itself, and a porthole is hinged to the front or upper wall of the casing to rotate from an open position to a closed position, in which the porthole rests against the front or upper wall to close the laundry loading/unloading opening and tightly seal the drum. The laundry treating machine further comprises an electric motor for driving the drum into rotation about the afore-said rotational axis.

[0004] With reference in particular to a laundry dryer, it is also provided with an open-circuit or closed-circuit hot-air generator, which is housed within the casing and preferably supported by a support base, and with one or more electronic control units which control both the electric motor and the hot-air generator during the performing of user-selectable drying cycles stored in the central electronic control unit.

[0005] The open-circuit or closed-circuit hot-air generator is structured to circulate, in use, inside the drum a stream of hot air having a low moisture content, to dry the laundry placed inside the drum itself.

[0006] In today's laundry dryers, the hot-air generator is usually a closed-circuit, heat-pump type hot-air generator comprising: an air circulating conduit having its two ends connected to respective opposite sides of the drum; an electric fan located along the air circulating conduit to produce inside the latter an airflow which flows through the drum; a heat-pump assembly, having its two heat exchangers located one downstream of the other, along the air circulating conduit; and finally a manually-removable filtering element, which is fixed at an inlet of the air circulating conduit located upstream of the two heat exchangers, and which is configured to retain lint or fluff carried by the drying air flow upstream of the two heat exchangers and of the electric fan.

[0007] Due to the market demand for laundry treating machines which are more and more efficient and with reduced energy consumption, such machines are provided with one or more inverters configured to control the

operation of a respective electrical motor, e.g. the electrical motor which rotates the drum housing the laundry to be washed and/or dried, an electrical motor which operates the centrifugal fan for circulating the airflow within the drum, and/or an electrical motor which operates a compressor of the heat-pump hot-air generator.

[0008] More specifically, an inverter is an electronic device or circuitry that changes direct current (DC) to alternating current (AC). The input voltage, output voltage and frequency, and overall power handling depend on the design of the specific device or circuitry. The inverter does not produce any power; the power is provided by the DC source. Inverter circuits designed to produce a variable output voltage range are often used within motor speed controllers. The DC power for the inverter section can be derived from a normal AC wall outlet or some other source. Control and feedback circuitry is used to adjust the final output of the inverter section which will ultimately determine the speed of the motor operating under its mechanical load.

[0009] When electrical motors are driven, inverters emit electromagnetic radiations that can perturb other circuits of the machine or interfere with the environment where the machine is installed. To reduce these electromagnetic radiations, the laundry treating machine is typically provided with suitable devices, for example electric or electronic filters.

[0010] In order to meet electrical safety requirements, a laundry treating machine requires grounding, which is carried out by electrically connecting to the ground connection of the household power supply each and every electrically conductive (e.g. metallic) component of the machine which may be touched and/or actuated by a user or that can come into contact with live parts of the machine in case of some hardware failure.

[0011] According to the International Standard IEC 60335-1: "Household and similar electrical appliances-Safety", the term "live part" indicates a conductor or conductive part intended to be energized in normal use, including a neutral conductor but, by convention, not a PEN conductor, where a PEN conductor is a protective earthed neutral conductor combining the functions of both a protective conductor and a neutral conductor.

[0012] The permanent grounding of the laundry treating machine often gives worse results in terms of electromagnetic emissions, because the latter diffuse through the grounding connections. In order to avoid such undesired diffusion of electromagnetic emissions through the grounding connections, further electric or electronic filters and/or ferrites configured to eliminate or reduce such emissions are required.

[0013] In addition, due to the provision of said further electromagnetic emissions filters, the laundry treating machine assembling process results more complicated and often some modifications of existing components, such as the support base, wiring supports and so on, are necessary to provide a holding device for receiving electric or electronic filters and/or ferrites. Indeed, to work

properly, the electric or electronic filter and/or ferrites have to be placed close to the noise source, i.e. the inverters. This causes further complications and constraints when designing the arrangements of the internal machine components.

[0014] The main object of the present invention is to improve safety and reliability of a laundry treating machine while keeping low electromagnetic emissions.

[0015] A further object of the present invention is to provide a laundry treating machine provided with a ground connection device, which results reliable for the user, meanwhile avoiding the electromagnetic emissions to increase and further more complex electric or electronic filters and/or ferrites to be installed in the laundry treating machine in order to reduce such increased electromagnetic emissions.

[0016] Another object of the present invention is to provide a laundry treating machine provided with a ground connection device which is simple to be manufactured and installed and can be manufactured at competitive costs.

[0017] A further object of the invention is to provide a laundry treating machine providing for suspension of power supply when user may reach parts of the machine arranged within the casing.

[0018] These and other advantages, objects, and features of the invention will be set forth in part in the description and drawings which follow and in part will become apparent to those having ordinary skill in the art upon examination of the following or may be learnt from practice of the invention. The objects and advantages of the invention may be reached and attained as particularly pointed out in the appended claims.

[0019] In a first aspect thereof, the present invention relates to a laundry treating machine comprising a casing, a power supply to power the laundry treating machine, a first component to be put in an electrically safe condition, housed in the casing, and a second component operable to access the first component through the casing.

[0020] The laundry treating machine is characterized in that it further comprises a switching device operable by actuation of the second component to disconnect the laundry treating machine from the power supply or to connect the first component of the laundry treating machine to ground.

[0021] This combination of features advantageously allows the laundry treating machine to be effectively electrically disconnected or a component thereof to be grounded, meanwhile avoiding electromagnetic emissions to increase. Indeed, as the component of the machine to be put in an electrically safe condition is grounded only when it is actually reachable by the user, i.e. when it is actually dangerous for the user, it is possible to avoid a permanent grounding of every component of the laundry treating machine, thus reducing the number of further and more complicated filters and/or ferrites and consequently the cost of the whole laundry treating ma-

chine.

[0022] In the meaning of the present invention, the term "actuation", "actuated", "operation", "operable" and similar used with reference to the second component of the laundry treating machine should be understood as partially or totally open.

[0023] In a preferred embodiment, the switching device consists of a ground connection device comprising a first electrically conductive element associated with the first component of the laundry treating machine and a second electrically conductive element which is grounded and associated with the second component of the laundry treating machine. This advantageously allows the first component of the machine to be grounded only when the second component of the machine is actuated by a user.

[0024] Preferably, the first electrically conductive element of the ground connection device comprises guide means for guiding the second electrically conductive element during the actuation of the second component of the laundry treating machine. This advantageously allows the second component to be easily operated by a user.

[0025] Preferably, the guide means of the first electrically conductive element consists of a front wall connecting an upper wall and a back wall of the first electrically conductive element.

[0026] Preferably, the back wall is configured to be electrically connected to the first component of the laundry treating machine.

[0027] In a preferred embodiment, the upper and back wall are flat and the front wall is curved.

[0028] Preferably, a gap is defined between a portion of the second electrically conductive element and a portion of the first electrically conductive element, said gap being closed during the actuation of said second component of the laundry treating machine. This advantageously allows the second electrically conductive element to be electrically insulated by the first electrically conductive element, when the second component of the laundry treating machine is in its rest or not actuated position, and to be electrically connected to the first portion upon actuation of the second component of the laundry treating machine.

[0029] Preferably, the second electrically conductive element comprises a first portion fixed to the second component of the laundry treating machine and a second portion extending from the first portion towards the first electrically conductive element.

[0030] Preferably, a portion of the second electrically conductive element comprises an end tooth provided for closing a gap defined between a portion of said second electrically conductive element and a portion of said first electrically conductive element.

[0031] Advantageously, the first portion is flat and second portion is curved and extends from the flat first portion towards said first electrically conductive element with its concavity facing the flat first portion.

[0032] Preferably, the curved second portion of the second electrically conductive element has an extension greater than that of said curved front wall of the first electrically conductive element. This advantageously allows the end tooth of the second portion to be electrically disconnected from the first portion when the second component of the laundry treating machine is in its rest or not actuated position.

[0033] Preferably, the first portion and the second portion of the second electrically conductive element are sandwiched between a pair of layers of insulating material.

[0034] Preferably, the second electrically conductive element of the ground connection device is grounded by means of an electrical connection to a ground terminal of the mains or to the casing of the laundry treating machine.

[0035] In a further embodiment, the switching device consists of a first switch and a second switch, both electrically connected between a control unit and the power supply of the laundry treating machine. Preferably, in such embodiment, the laundry treating machine comprises a sensing device configured to sense whether the first component of the laundry treating machine is in a condition allowing a user to touch it and to transmit a signal to the control unit according to the sensed condition. Further preferably, the control unit is configured to provide a signal to open/close the first and second switches, for disconnecting/connecting the laundry treating machine from/to the power supply. This advantageously allows to provide for suspension of power supply when user may reach a part of the machine arranged within the casing which may be a live part of a part which may be in electrical contact with a live part of the machine.

[0036] Preferably, the first switch is electrically connected between the control unit and a line conductor of the powering circuit and the second switch is electrically connected between the control unit and a neutral conductor of the powering circuit, or vice versa.

[0037] Preferably, the sensing device is a proximity sensor selected from a capacitive sensor, Doppler effect sensor, an Eddy current sensor, an inductive sensor, a magnetic sensor, a photocell sensor, an ultrasonic sensor and the like. In other embodiments, said sensing device is realized by a switch whose closed or open status is linked to the a condition allowing the user to touch the first component of the laundry treating machine to be put in an electrically safe condition.

[0038] Preferably, the first component of the laundry treating machine is a drum mounted in a rotating manner inside the casing and the second component of the laundry treating machine is a porthole which is hinged to the casing and operable by a user to access the drum.

[0039] In a preferred embodiment, the laundry treating machine further comprises an air circulating conduit, at least one heat exchanger provided within the casing, and a door arrangement movable to open/close an opening that provides access to the at least one exchanger. The

at least one heat exchanger is provided as a first component of the laundry treating machine to be put in an electrically safe condition and the door arrangement is provided as the second component of the laundry treating machine.

[0040] In a second aspect thereof, the present invention relates to a method to put in an electrically safe condition a first component of a laundry treating machine, which comprises a casing enclosing the first component, a power supply to power the laundry treating machine and a second component operable to access the first component through the casing.

[0041] The method is characterized by comprising:

- operating a switching device of the laundry treating machine upon actuation of the second component; and
- driving the switching device to disconnect the laundry treating machine from the power supply or to connect the first component of the laundry treating machine to ground.

[0042] Preferably, driving the switching device comprises:

- electrically connecting a first electrically conductive element of the switching device with a second electrically conductive element of the switching device to ground the first component of the laundry treating machine (10).

[0043] Alternatively, operating the switching device comprises:

- sensing through a sensing device whether the first component of the laundry treating machine is in a condition allowing a user to touch it;
- according to the condition sensed via the sensing device transmitting a first signal to a control unit of the laundry treating machine;

and driving the switching device comprises:

- transmitting by the control unit a second signal to a first switch and second switch of the switching device to open the first switch and the second switch, thereby electrically disconnecting the laundry treating machine from the power supply, if the first signal indicates that the first component is actually touchable by a user, or to close the first switch and the second switch, thereby electrically connecting the laundry treating machine to the power supply, if the first signal indicates that the first component is prevented from being reach by a user.

[0044] In the following description and in the accom-

panying drawings reference is made to a laundry dryer provided with a closed-circuit, heat-pump type hot-air generator. However, it is understood that the invention applies to a laundry dryer provided with a heater for heating drying process air and optionally with an air-air type heat exchanger for removing moisture from process air, instead of a heat-pump type hot-air generator, as well as to a laundry washing machine and to a laundry washing-drying machine.

[0045] The present invention will now be described with reference to the accompanying drawings that illustrate non-limiting embodiments thereof, wherein:

Figure 1 is a perspective view, with part removed, of a laundry dryer according to the invention, having a door arrangement for allowing access to a drying air circuit;

Figure 2 shows the laundry dryer of Figure 1, wherein an outer door of the door arrangement is open and an inner door of the door arrangement is closed;

Figure 3 is a perspective view, with parts removed, of the inside of the support base of the laundry dryer of Figure 1, with the outer door and the inner door of the door arrangement in the open position;

Figure 4 is a perspective view of the support base of Figure 3, with part removed for showing in detail the closed-circuit, heat-pump type hot-air generator of the laundry dryer;

Figure 5 is a perspective view of a first embodiment of a switching device of the laundry dryer of Figure 1, in the open position of the inner door of the door arrangement;

Figure 6 is a side view of the switching device of Figure 5 in the closed position of the inner door of the door arrangement;

Figure 7 is a view similar to that of Figure 6, where the inner door is shown in its partially open position;

Figure 8 is a view similar to that of Figure 6, where the inner door is shown in its totally open position; and

Figure 9 is a schematic view of a second embodiment of a switching device of the laundry dryer of Figure 1, in the open position of the door arrangement.

Figures 1 to 4 show a laundry treating machine, indicated as a whole with the reference numeral 10, which, in this embodiment, is a heat-pump type laundry dryer. The following description referring to a laundry dryer operating with a heat pump remains however valid even if other known operating tech-

nologies are used, as in the case of a condensing laundry dryer with a condenser consisting of an air-to-air type heat exchanger.

[0046] The heat-pump type laundry dryer 10 has a substantially parallelepiped-shaped casing 11 configured to rest on the floor and a power supply 25 to power the machine 10. In particular, the casing 11 comprises a first pair of upright walls 11 A, 11 B arranged at a front and at a rear of the laundry treating machine 10, a second pair of upright walls 11C, 11D arranged at lateral sides of such machine 10, an upper wall 12 and a bottom wall 13.

[0047] A substantially cylindrical laundry treatment chamber or drum 14 configured to house the laundry to be treated is fixed in a rotating manner inside the casing 11, directly facing a laundry loading/unloading through opening formed in the front upright wall 11 A of the casing 11. A porthole 15 is hinged to the front upright wall 11 A of the casing 11 to rotate away from an open position to a closed position in which the porthole door 15 rests completely against the front upright side wall 11 A to close the laundry loading/unloading through opening and substantially tightly seal the drum 14. Alternatively, the laundry loading/unloading through opening and the porthole 15 configured to open/close the laundry loading/unloading through opening can be formed in the upper wall 12 of the casing 11.

[0048] Preferably, the casing 11 further comprises a substantially parallelepiped-shaped lower support base or socle 16, which is structured for resting on the floor. The socle 16 may be provided with a bottom wall 13 facing the floor on which the laundry dryer is placed. The socle 16 houses an electric motor 17 and a closed-circuit hot-air generator 18.

[0049] The electric motor 17 is preferably a variable speed motor controlled by an inverter and is mechanically connected to the drum 14 for driving the drum 14 into rotation about its rotational axis.

[0050] The closed-circuit hot-air generator 18 is configured to circulate air through the drum 14 for drying laundry, cooling down the air arriving from drum 14 in order to extract and retain the surplus moisture in the air itself, heating the dehumidified air to a predetermined temperature, and finally feeding the heated, dehumidified air back into the drum 14, to dry the laundry contained therein.

[0051] A control unit CU is preferably arranged in an upper portion of the front upright wall 11 A of the casing 11 and is configured to control both the electric motor 17 and the closed-circuit hot-air generator 18 while performing the user-selectable drying cycles preferably, but not necessarily, stored in the same central control unit CU. Such control unit CU may be in signal communication with further control units to provide said control of the electric motor 17 and the closed-circuit hot-air generator 18.

[0052] With reference in particular to Figure 4, the

closed-circuit hot-air generator 18 consists of a heat-pump type, hot-air generator comprising; an air circulating conduit 19 in fluid communication with the drum 14; an electric fan 20 which is located along the air circulating conduit 19 to produce, inside the air circulating conduit 19 itself, an airflow f which flows through the drum 14, and through the laundry located inside the drum 14; and a heat-pump assembly 21 which is able to cool the airflow f coming out from the drum 14 for condensing and retaining the surplus moisture in the airflow f itself, and to heat the airflow f returning back to the drum 14, so that the airflow f entering the drum 14 is at a temperature higher than or equal to that of the airflow f coming out of the drum 14.

[0053] In particular, the heat-pump assembly 21 comprises a first heat exchanger 22, a second heat exchanger 23, an electrically-powered refrigerant compressing device 24, and an expansion valve or similar passive or active operated refrigerant expansion device (not shown in Figures), for example a capillary tube, a thermostatic valve or an electrically-controlled expansion valve.

[0054] The first heat exchanger 22, which is conventionally referred to as the "evaporator", is located along the air circulating conduit 19 and is configured to rapidly cool down the airflow f arriving from the drum 14 to condense and retain the surplus moisture in the airflow f itself.

[0055] The second heat exchanger 23, which is conventionally referred to as the "condenser", is located along the air circulating conduit 19, downstream of the first heat exchanger 22 and is configured to rapidly heat the airflow f arriving from the first heat exchanger 22 and directed back to the drum 14, so that the airflow f reentering the drum 14 is at a temperature higher than or equal to that of the airflow exiting the drum 14.

[0056] The electrically-powered refrigerant compressing device 24 is interposed between an outlet of the evaporator 22 and an inlet of the condenser 23 and has the function of compressing the refrigerant provided in a gaseous state from the evaporator 22 so that the refrigerant pressure and temperature are much higher at the inlet of the condenser 23 than at the outlet of the evaporator 22.

[0057] The expansion valve is interposed between the outlet of the condenser 23 and the inlet of the evaporator 22, and is structured so as to cause a rapid expansion of the refrigerant directed towards the evaporator 22, so that the refrigerant pressure and temperature are much higher at the outlet of the condenser 23 than at the inlet of the evaporator 22.

[0058] The closed-circuit, hot-air generator 18 preferably further comprises a lint or fluff filtering assembly (not visible in the drawings), which is located along the air circulating conduit 19, upstream of the evaporator 22 and is configured to retain lint or fluff carried by the airflow from the drum 14 upstream of both the evaporator 22 and the condenser 23, and a rigid, protective grid-like assembly 26 which is firmly and preferably removably fixed inside the air circulating conduit 19, downstream of

the lint or fluff filtering assembly and immediately upstream of the evaporator 22, so as to prevent a generic hard foreign body to bump against the evaporator 22.

[0059] In the example shown, the protective grid-like assembly preferably comprises a flat, rigid, large-meshed grid 26, which is preferably complementary in shape to the air circulating conduit 19 and is preferably made of metal or a plastic material.

[0060] With reference in particular to Figure 3, in a lower portion of the front upright wall 11 A of the casing 11 a door arrangement 30 is provided for closing an opening 31 that provides access to a portion of the air circulating conduit 19 of the heat-pump type, hot-air generator 18. Specifically, the door arrangement 30 comprises an inner door 32 for closing the opening 31 and an outer door 33 for covering the inner door 32.

[0061] The outer door 33 is defined by an upper portion 34 and a lower portion 35 which may be provided with a plurality of stacked horizontal vent fins 35A, said fins 35A being aligned with corresponding vent fins 16A obtained through the front wall of the socle 16, next to the outer door 33.

[0062] The outer door 33 is coupled to the socle 16 by a hinge 36 to rotate around a substantially vertical axis between a closed position (Figure 1), in which the outer door 33 covers the inner door 32, and an open position (Figures 2 to 4), in which the outer door 33 is rotated toward the outside and provides access to the inner door 32 which closes the opening 31. The outer door 33 may be secured in a closed position - shown in Figure 1 - through a locking device 39 accessible once opened the porthole 15.

[0063] The inner door 32 is associated in a removable manner with the socle 16 to rotate about its own longitudinal bottom edge between a closed position (Figure 2), in which the inner door 32 is arranged between the grid-like assembly 26 and the outer door 33 thereby tightly sealing the opening 31, and an open position (Figure 3), in which the inner door 32 is tilted towards the outside and leaves the opening 31 free thereby allowing an operator to easily access the grid-like assembly 26 and the lint or fluff filtering assembly 25 to perform periodically cleaning thereof.

[0064] In order to tightly seal the opening 31 to prevent air leakage from the air circulating conduit 19, the inner door 32 is provided with a gasket 38, which extends along the entire periphery of the inner door 32 and when the inner door 32 is closed, is pressed against a peripheral portion of the opening 31.

[0065] As shown in Figure 2, the inner door 32 can be securely locked in the closed position by a further locking device 37. The locking device 37 is shown in the form of a plate rotatably driven by a wing nut. The locking device 37 may take any form adapted to allow an easy and quick locking/unlocking of the inner door 32 to/from the casing 11.

[0066] With reference back to Figure 3, it is now assumed, for example, that a user desires to clean the grid-

like assembly 26. In fact, the grid-like assembly 26, being invested by the airflow f that exits from the laundry dryer 10, gets dirty after a number of drying processes even if such airflow f is filtered to remove lint or fluff. To this end, the user may open the porthole 15, then she/he opens the outer door 33 by activating the locking device 39 securing the outer door 33 to the casing 11 in a closed position, and by rotating the outer door 33 away from the casing 11, thus making the inner door 32 completely accessible; subsequently she/he opens the inner door 32 by unlocking the locking device 37 and by rotating the inner door 32 about its own longitudinal bottom edge thus finally gaining access to the grid-like assembly 26.

[0067] Alternatively, the user gains access to the grid-like assembly 26 by simply opening the outer door 33 and then the inner door 32 of the door arrangement 30, without having to open the porthole 15 before. Further alternatively, the door arrangement only comprises a single door for closing the opening 31, and in this case, the user opens this single door to access the grid-like assembly 26 to clean it.

[0068] Therefore when the outer door 33 and the inner door 32 are in the open position shown in Figure 4, as the grid-like assembly 26 is fixed immediately upstream of the evaporator 22, the evaporator 22 is accessible, or may become accessible to the user. More particularly, as the grid-like assembly 26 has meshes that can be passed through by a user finger, especially in case of accidental breaking of one or more of said meshes, if a user finger passes through the grid-like assembly 26, it can reach the evaporator 22. It follows that, during the cleaning phase of the grid-like assembly 26, the evaporator 22 must be in electrically safe conditions to avoid any risk of electric shock for the user.

[0069] Moreover, it may happen that the user closes the porthole 15 and switch on the laundry dryer 10, leaving open the inner door 32 providing access to the evaporator. This condition is even more dangerous for the user, who can reach the evaporator 22 during an operative state of the laundry machine 10.

[0070] Similarly, if a user desires to load/unload the laundry into/from the drum 14, she/he opens the porthole 15 by rotating it from a closed position, in which the porthole 15 rests against the front upright wall 11 A or the upper wall 12 of the casing 11, thereby closing the laundry loading/unloading through opening and tightly sealing the drum 14, to an open position, in which the laundry loading/unloading through opening is clear, thus allowing the user to access the drum 14. It follows that, during the laundry loading/unloading into/from the drum 14, the drum 14 must also be in an electrically safe condition to avoid any risk of electric shock for the user.

[0071] In order to put the evaporator 22 and/or the drum 14 in an electrically safe condition, the laundry dryer 10 is provided with at least one switching device, which, in a first embodiment of the invention is configured as a ground connection device, designated in general with the reference number 40 and shown in detail in Figures 5 to 8.

[0072] In the following description, the ground connection device 40 for grounding the evaporator 22 will be dealt with in detail. It is however understood that a similar ground connection device can be used to ground the drum 14 and, more in general, any other component of a laundry machine which needs to be put in an electrically safe condition when the user can actually reach it.

[0073] As shown in Figures 5 to 8, the ground connection device 40 comprises a first electrically conductive element 50 and a second electrically conductive element 60.

[0074] The first electrically conductive element 50 comprises an upper wall 51, a back wall 53 and a front wall 54 connecting the upper 51 and back 53 walls. Preferably, the upper 51 and back 52 walls are flat and the front wall 54 is curved. The back wall 53 is electrically associated with the evaporator 22, which is the component of the laundry treating machine 10 to be put in electrically safe condition, while the wall 54 acts as a guide means for the second electrically conductive element 60, as it will be discussed in more detail in the following.

[0075] The second electrically conductive element 60 preferably comprises a first portion 61 and a second portion 62, extending from the first portion 61 towards the first electrically conductive element 50. The first portion 61 is fixed to an inner surface 32A of the inner door 32, preferably at a transversal edge thereof. The second portion 62 terminates with a tooth 63, acting as a sliding electrical contact of the ground connection device 40 during the operation of the ground connection device 40, as it will become clear in the follow.

[0076] In the embodiment illustrated in Figures 5 to 8, the second electrically conductive element 60 is band-shaped, and the first portion 61 is flat and the second portion 62 is curved and extends from the flat portion 61 towards the first electrically conductive element 50, with its concavity generally facing the flat portion 61. A gap G is thus defined between the curved second portion 62 and the curved front wall 54 of the first electrically conductive element 50, which, during the operation of the ground connection device 40, is closed by the tooth 63, which slides in contact with the wall portion 54. Therefore, the tooth 63 has a height h corresponding to the size of the gap G. The presence of the gap G between the first electrically conductive element 50 and the second electrically conductive element 60 guarantees the second electrically conductive element 60 to be electrically insulated from the first electrically conductive element 50 when the inner door 32 is in its closed position.

[0077] More in particular, the curved second portion 62 has an extension greater than that of the front wall 54 of the first electrically conductive element 50. As a consequence, in the closed position of the inner door 32 shown in Figure 6, the tooth 63 is placed in a lower position with respect to the front wall 54.

[0078] The first portion 61 is suitable for being fixed to an inner surface 32A of the inner door 32, which is the component of the machine 10 which a user operates to

access the evaporator 22. Moreover, the flat portion 61 is grounded, for example by electrical connection to a ground terminal of the mains, e.g. by means of a ground wire GW, or to the casing 11 of the laundry machine 10. As a consequence, the second electrically conductive element 60 is permanently grounded.

[0079] Preferably, the first portion 61 and the second portion 62 of the second electrically conductive element 60 are closed by a housing thereby avoiding a user to touch them during operation of the inner door 32. In a preferred embodiment, the first 61 and second portion 62 are sandwiched between two layers of an insulating material.

[0080] Again with reference to Figures 5 to 8, the operation of the ground connection device 40 in the case in which a user desires to clean the grid-like assembly 26 is now described.

[0081] As shown in Figure 6, when the inner door 32 is in its closed position, the electrically conductive element 60, specifically its end tooth 63, of the ground connection device 40 is placed below, and thus not in contact with the curved wall 54 of the first electrically conductive element 50. Therefore, the first and second electrically conductive elements 50, 60 are not electrically connected. As a result, the second electrically conductive element 60 is grounded, whereas the first electrically conductive element 50 and the evaporator 22, are not grounded.

[0082] While the user opens the inner door 32 to access the grid-like assembly 26 to clean it, the tooth 63 comes into abutment against the curved wall 54 and during the whole opening movement of the inner door 32 the tooth 63 slides along the curved wall 54 in contact with it. Thanks to the contact between the tooth 63 and the curved wall 54, the first and second electrically conductive elements 50, 60 are now electrically connected. As a result, the second electrically conductive element 60 is still grounded and the first electrically conductive element 50, and the evaporator 22 which is electrically connected to the first conductive element 50, are also grounded through the second electrically conductive element 60.

[0083] On the contrary, while a user closes the inner door 32, the tooth 63 initially slides along the curved wall 54 in a direction opposite to that of the opening of the inner door 32 remaining in contact with the curved wall 54. During this operation the first and second electrically conductive elements 50, 60 are electrically connected and the evaporator 22 is grounded. When the inner door 32 fully closes, the tooth 63 disconnects from the curved wall 54 and the first and second electrically conductive elements 50, 60 are not more electrically connected and the evaporator 22 is not more grounded.

[0084] Therefore, when a user grasps the inner door 32 and starts movement to open the inner door 32, the evaporator 22 gets grounded by the ground connection device 40 when it may be actually touchable/reachable by a user, so no risks of electrical shock for the user are

present.

[0085] Conversely, when inner door 32 is completely closed, i.e. in the condition in which no risk exists for the user, the evaporator 22 is not grounded and no complex filters or ferrules are to be installed in the laundry dryer 10 to reduce or eliminate electromagnetic emissions generated by a permanent grounding of the laundry dryer 10.

[0086] Moreover, as the evaporator 22 is grounded by the ground connection device 40 when the inner door 32 is in its, even partially, open position, no risk of electrical shock exists for the user if she/he closes the porthole 15 and switches on the laundry dryer 10 leaving open, or partly opened the inner door 32.

[0087] With reference now to Figure 9, a laundry treating machine according to a second embodiment of the present invention is shown.

[0088] The laundry treating machine, which is indicated in general with the reference number 110, comprises a casing 111, configured to rest on the floor, a drum 114 mounted in rotating manner inside the casing 111 and facing a laundry loading/unloading opening formed in the casing 111, and a power supply 125 to power the machine 110.

[0089] In particular, the casing 111 comprises a first pair of upright walls 111 A, 111 B arranged at a front and at a rear of the laundry treating machine 110, a second pair of upright walls 111 C, 111 D arranged at lateral sides of the machine 110, an upper wall 112 and a bottom wall 113. A porthole 115 is hinged to the front upright wall 111 A or upper wall 112 of the casing to rotate from an open position to a closed position, in which the porthole closes the laundry loading/unloading opening and tightly seals the drum 114.

[0090] A control unit CU, preferably in signal communication with further control units (not shown), is preferably arranged in an upper portion of the casing 111 and is configured to control the machine 110 while performing the user-selectable washing and/or drying cycles. The control unit CU is also in signal communication with the power supply 125 of the laundry treating machine, as will be described in more detail below. A door arrangement 130 is provided in a lower portion of the front upright wall 111 A of the casing 111, configured to close an opening 131 that provides access to a component of the machine 110 to be put in electrically safe conditions, for example an evaporator 122 of an heat-pump type, hot-air generator. The door arrangement 130 is similar to the door arrangement 30 described above with reference to the embodiment of Figures 1 to 8 and therefore it will not be described in further detail below.

[0091] The laundry treating machine 110 further comprises a switching device 140, which in the present embodiment of the invention comprises a first switch 141 and a second switch 142. More specifically, the first switch 141 is electrically connected between the control unit CU and a line conductor 125 L of the power supply 125 of the machine 110 and the second switch 142 is electrically connected between the control unit CU and

a neutral conductor 125N of the power supply 125 of the machine 110, or vice versa.

[0092] The switching device 140 further comprises a sensing device 143, for example a proximity sensor, which is placed close to the door arrangement 130 of the laundry treating machine 110 and is configured to detect the opening/closing e.g. of the door arrangement, for example the opening/closing of an inner door 132 of the door arrangement 130 gaining access to a live part of the machine 110. The proximity sensor is preferably selected from a capacitive sensor, Doppler effect sensor, a Eddy current sensor, an inductive sensor, a magnetic sensor, a photocell sensor, an ultrasonic sensor and the like.

[0093] In the following, the operation of the switching device 140 is described when a user opens the inner door 132 of the door arrangement 130, e.g. for cleaning a grid-like assembly (not shown) protecting the evaporator 122 of the laundry treating machine 110. It is however understood that the same applies when a user opens the porthole 115 to access the drum 114, or any other component operable to access a further component of the machine which may be a live part or may be in electrical contact with a live part.

[0094] When the inner door 132 is in its closed position, both the first and second switches 141, 142 are closed and the laundry treating machine 110 is electrically connected to the power supply 125.

[0095] While the user opens the inner door 132 to access the grid-like assembly to clean it, the sensing device 143 detects the opening of the inner door 132 and transmits a signal s_{open} to the control unit CU, informing the control unit CU that the inner door 132 is no longer in its closed position. The control unit CU transmits signals s_{1open} and s_{2open} to the first switch 141 and the second switch 142, respectively, which open thereby electrically disconnecting the laundry treating machine 110 from the power supply 125. In this way, it is avoided that the evaporator 122 may be in an electrical conductive condition when it is actually touchable by a user. With such arrangement, safety of the laundry treating machine is definitely improved.

[0096] Conversely, while a user closes the inner door 132, the sensing device 143 detects the closing and transmits a signal s_{close} to the control unit CU, informing the control unit CU that the inner door 132 is no longer in its open position. The control unit CU transmits signals s_{1close} and s_{2close} to the first switch 141 and the second switch 142, respectively, to close the switches 141 and 142, thereby electrically connecting the laundry treating machine 110 to the power supply 125. Since the evaporator 122, which may be in an electrical conductive condition, is not touchable by a user because the door 132 is closed, the machine can be powered without risks for a user.

[0097] Therefore, when a user grasps the inner door 132 and starts movement to open the inner door 132 making the evaporator 122 actually touchable by a user,

the machine power supply is electrically disconnected by the first and second switches 141 and 142 of the switching device 140. Therefore no risks of electrical shock for the user are present.

[0098] Moreover, as the whole laundry treating machine is electrically disconnected by the switching device 140 when the inner door 132 is in its, even partially, open position, no risk of shock exists for the user.

[0099] Conclusively, it can be stated that the present invention allows providing a ground connection device for a laundry treating machine which results reliable for the user, meanwhile avoiding the electromagnetic emissions to increase and further more complex filters and/or ferrites to be installed in the laundry treating machine in order to reduce such increased electromagnetic emissions.

[0100] Although a preferred embodiment has been shown and described, it would be appreciated by those skilled in the art that changes can be made in this embodiment without departing from the invention, the scope of which is defined in the appended claims. For example, although a first preferred embodiment has been described and illustrated, which provides a single ground connection device 40 placed at a transversal edge of the inner panel 32, a pair of ground connection devices 40 can be similarly provided, which are placed at opposite transversal edges of the inner panel 32. Similarly, although the second curved portion 62 of the second electrically conductive element 60 can be replaced by a flexible tongue provided with a terminal tooth.

Claims

1. A laundry treating machine (10; 110) comprising a casing (11; 111), a power supply (25; 125) to power the laundry treating machine (10; 110), a first component (14, 22; 114, 122) to be put in an electrically safe condition, housed in the casing (11; 111), and a second component (15, 32; 132) operable to access the first component (14, 22; 114, 122) through said casing (11; 111),
characterized by comprising a switching device (40; 140) operable by actuation of said second component (15, 32; 132) to disconnect said laundry treating machine (10; 110) from the power supply or to connect said first component (14, 22; 114, 122) of the laundry treating machine (10; 110) to ground.
2. The laundry treating machine (10) according to claim 1, wherein said switching device (40) consists of a ground connection device (40) comprising:
 - a first electrically conductive element (50) associated with said first component (14; 22) of the laundry treating machine (10); and
 - a second electrically conductive element (60) which is grounded and associated with said sec-

- ond component (15; 32) of the laundry treating machine (10);
 wherein said first electrically conductive element (50) and said second electrically conductive element (60) cooperate with each other to ground said first component (14; 22) only when said second component (15; 32) is actuated by the user.
3. The laundry treating machine (10) according to claim 2, wherein said first electrically conductive element (50) of the ground connection device (40) comprises guide means (54) for guiding the second electrically conductive element (60) during the actuation of the second component (15; 32) of the laundry treating machine (10).
 4. The laundry treating machine (10) according to any previous claim, wherein a gap (G) is defined between a portion (62) of said second electrically conductive element (60) and a portion (54) of said first electrically conductive element (50), said gap (G) being closed during the actuation of said second component (15; 32) of the laundry treating machine (10).
 5. The laundry treating machine (10) according to any previous claim, wherein said second electrically conductive element (60) comprises a first portion (61) fixed to said second component (15; 32) of the laundry treating machine (10) and a second portion (62) extending from said first portion (61) towards said first electrically conductive element (50).
 6. The laundry treating machine (10) according to claim 4 or 5, wherein said portion (62) of said second electrically conductive element (60) comprises an end tooth (63) provided for closing a gap (G) defined between a portion (62) of said second electrically conductive element (60) and a portion (54) of said first electrically conductive element (50).
 7. The laundry treating machine (110) according to claim 1, wherein said switching device (140) consists of a first switch (141) and a second switch (142), electrically connected between a control unit (CU) and said power supply (125) of the laundry treating machine (110).
 8. The laundry treating machine (110) according to claim 7, wherein it further comprises a sensing device (143) configured to sense whether the first component (114; 122) of the laundry treating machine (110) is in a condition allowing a user to touch it and to transmit a signal (s_{open} , s_{close}) to the control unit (CU) according to the sensed condition.
 9. The laundry treating machine (110) according to claim 7 or 8 wherein the control unit (CU) is configured to provide a signal (s_{1open} , s_{2open} , s_{1close} , s_{2close}) to open/close said first switch (141) and second switch (142) for disconnecting/connecting said laundry treating machine (110) from/to the power supply (125).
 10. The laundry treating machine (110) according to any claim 7 to 9, wherein said first switch is electrically connected between the control unit (CU) and a line conductor (125L) of the power supply (125) and the second switch (142) is electrically connected between the control unit (CU) and a neutral conductor (125N) of the power supply (125), or vice versa.
 11. The laundry treating machine (10; 110) according to any previous claim, wherein said first component (14, 114; 22, 122) is a drum (14; 114) mounted in a rotating manner inside said casing (11; 111) and said second component (15, 115; 32, 132) is a porthole (15; 115) which is hinged to the casing (11; 111) and operable by the user to access the drum (14; 114).
 12. The laundry treating machine (10) according to any previous claim, further comprising an air circulating conduit (19), at least one heat exchanger (22; 122) provided within the casing (11; 111), and a door arrangement (30) movable to open/close an opening (31; 131) that provides access to said at least one heat exchanger (22, 122);
 wherein said at least one heat exchanger (22) is provided as said first component of the laundry treating machine (10; 110) and the door arrangement (30) is provided as said second component of the laundry treating machine.
 13. A method to put in an electrically safe condition a first component (14, 114; 22, 122) of a laundry treating machine (10; 110), which comprises a casing (11; 111) enclosing said first component (14, 114; 22, 122), a power supply (25; 125) to power the laundry treating machine (10; 110) and a second component (15, 32; 132) operable to access said first component (14, 114; 22, 122) through the casing (11; 111);
 wherein the method is **characterized by** comprising:
 - operating a switching device (40; 140) of the laundry treating machine (10; 110) upon actuation of said second component (15, 32; 132); and
 - driving said switching device (40; 140) to disconnect the laundry treating machine (10; 110) from the power supply (25; 125) or to connect the first component (14, 114; 22, 122) of the laundry treating machine (10; 110) to ground.
 14. The method according to claim 13, wherein driving the switching device (40; 140) comprises:
 - electrically connecting a first electrically con-

ductive element (50) of the switching device (40) with a second electrically conductive element (60) of the switching device (40) to ground the first component (14, 114; 22, 122) of the laundry treating machine (10).

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15. The method according to claim 13, wherein operating the switching device comprises:

- sensing through a sensing device (143) whether the first component (114; 122) of the laundry treating machine (10) is in a condition allowing a user to touch it; 10

- according to the condition sensed via the sensing device (143) transmitting a first signal (s_{close} , s_{open}) to a control unit (CU) of the laundry treating machine (110); 15

and wherein driving the switching device comprises:

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- transmitting by the control unit (CU) a second signal (S_{1open} , S_{2open} , S_{1close} , S_{2close}) to a first switch (141) and second switch (142) of the switching device (140) to open the first switch (141) and the second switch (142), thereby electrically disconnecting the laundry treating machine (110) from the power supply (125), if the first signal (s_{open}) indicates that the first component (114; 122) is actually touchable by a user, 25

or to close the first switch (141) and the second switch (142), thereby electrically connecting the laundry treating machine (110) to the power supply (125), if the first signal (s_{close}) indicates that the first component (114; 122) is prevented from being reach by a user. 30

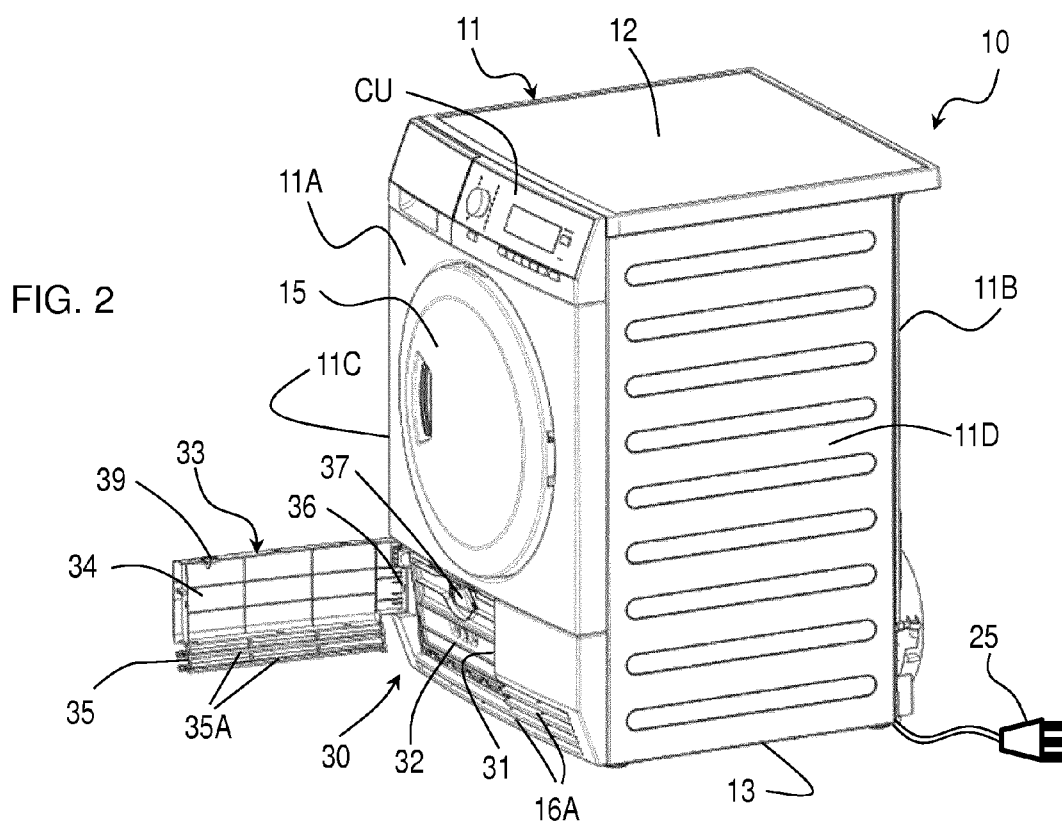
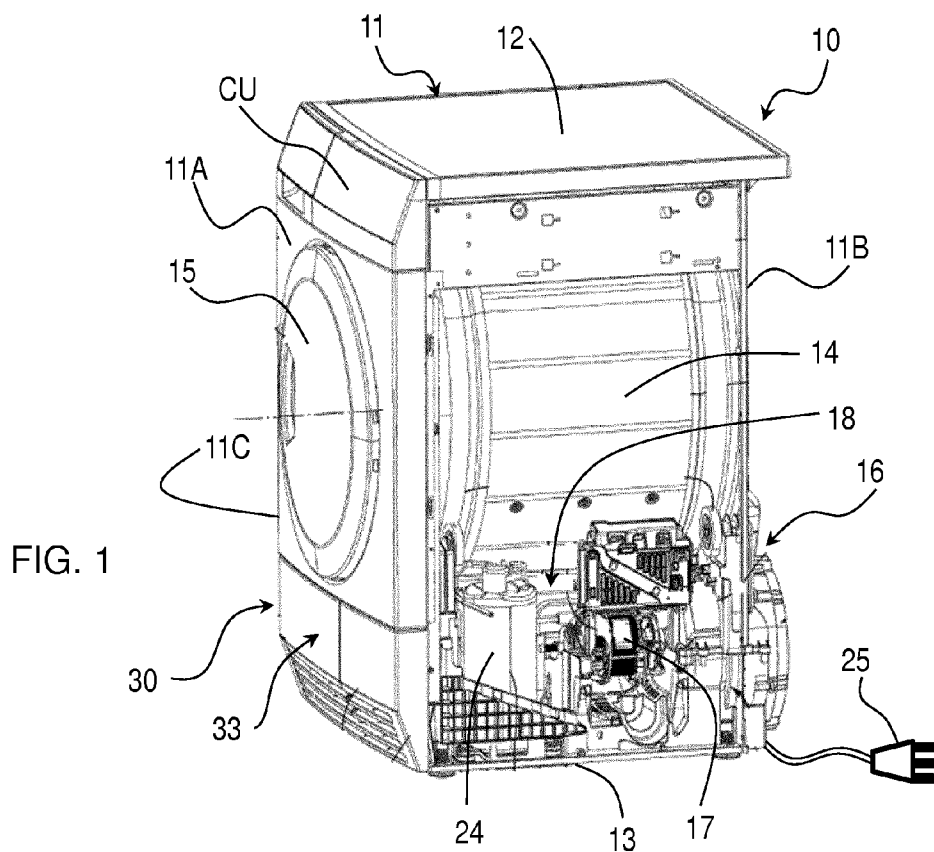
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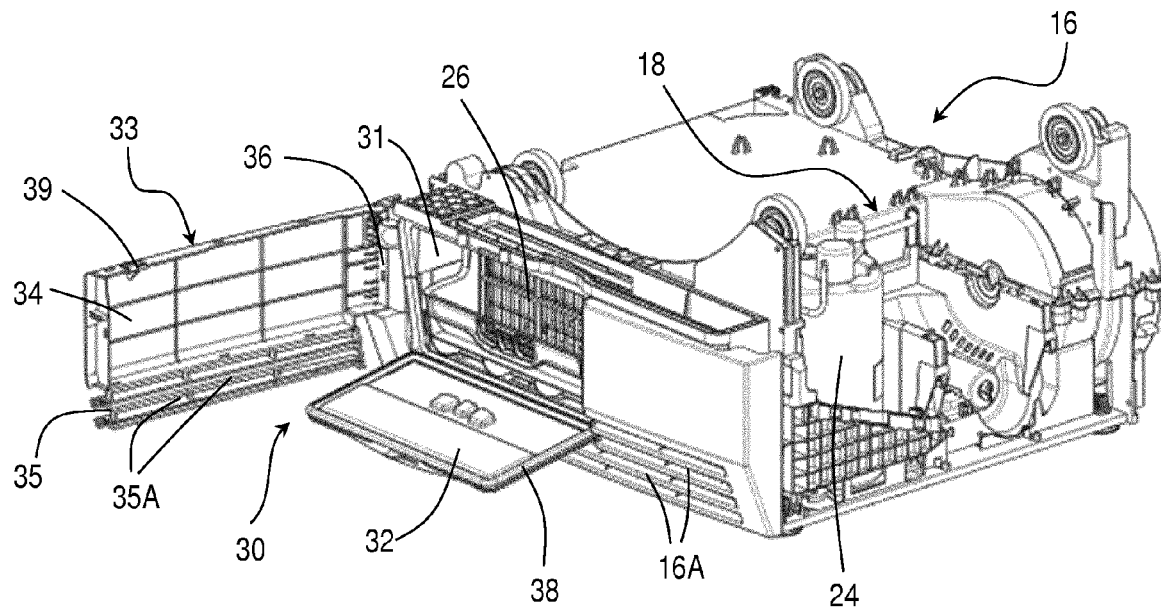


FIG. 3

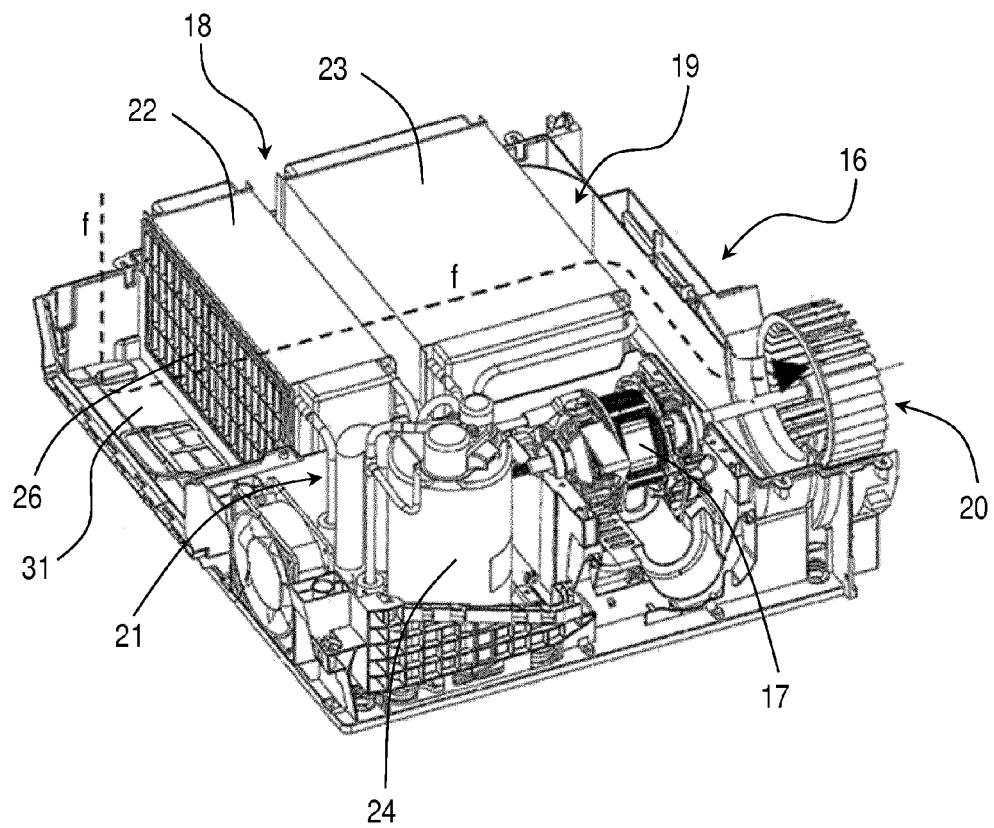


FIG. 4

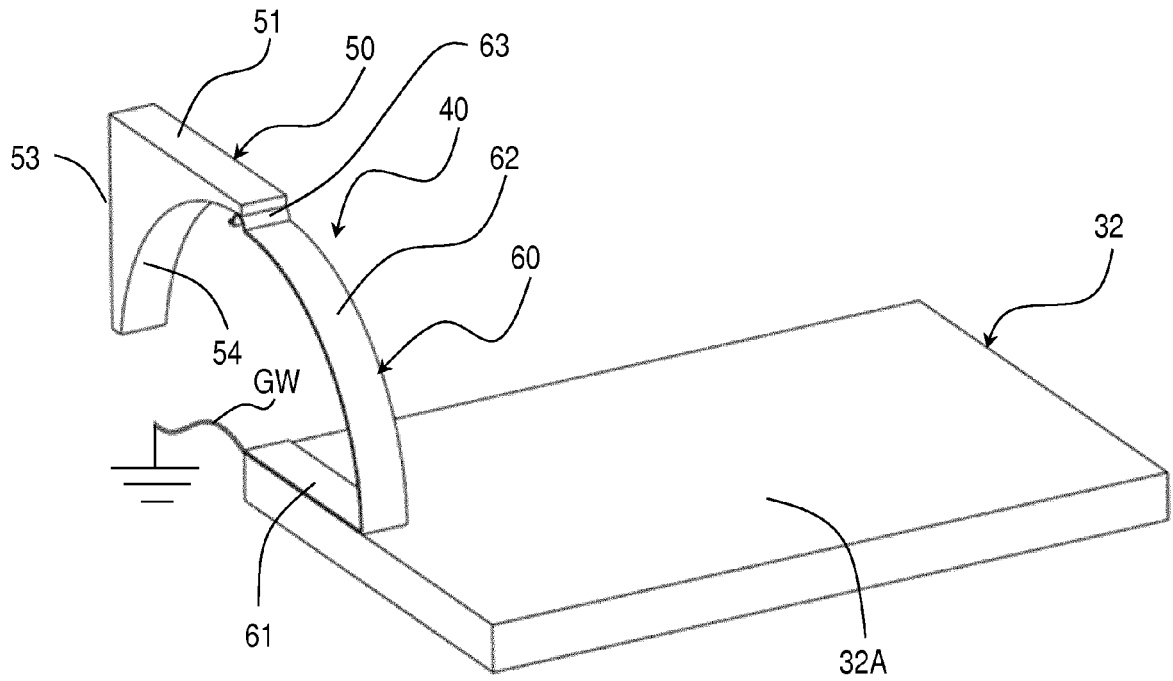


FIG. 5

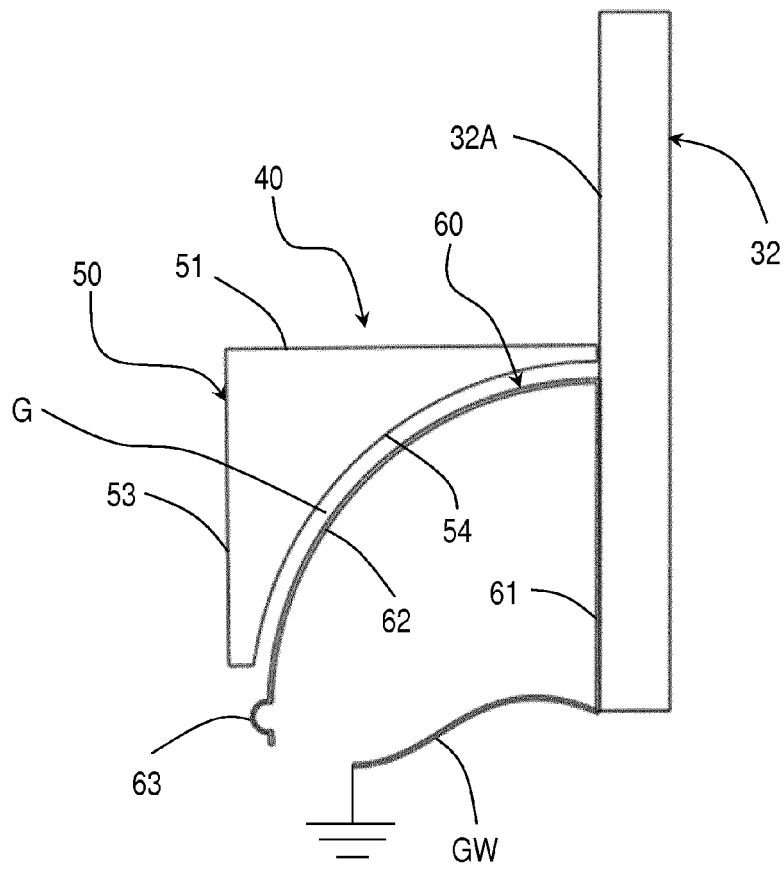


FIG. 6

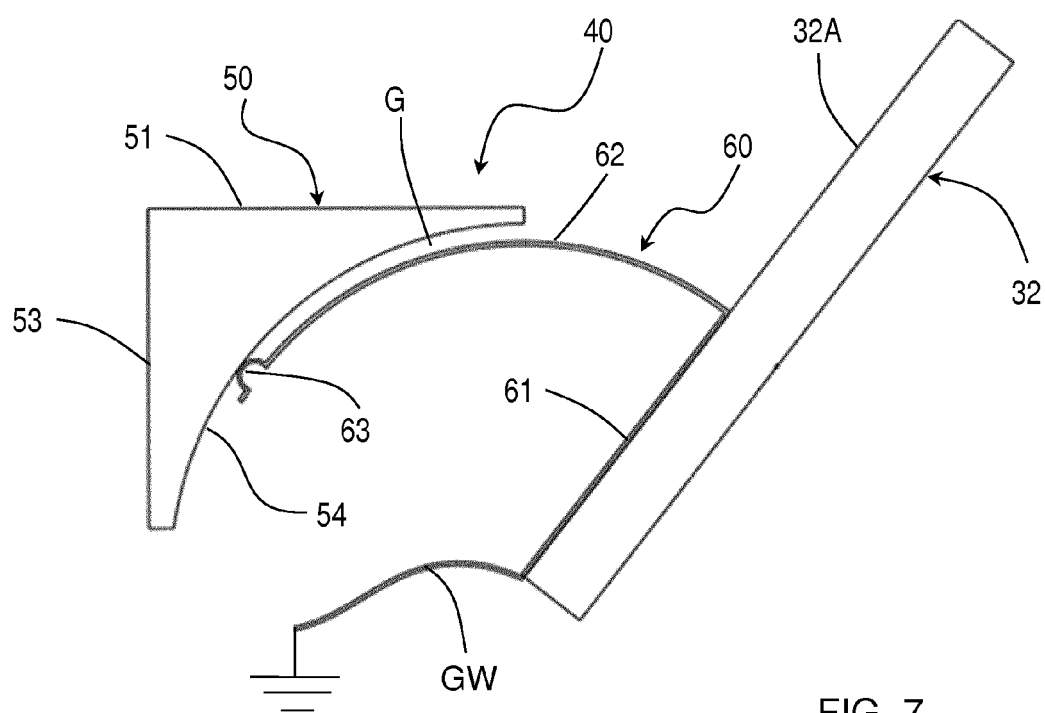


FIG. 7

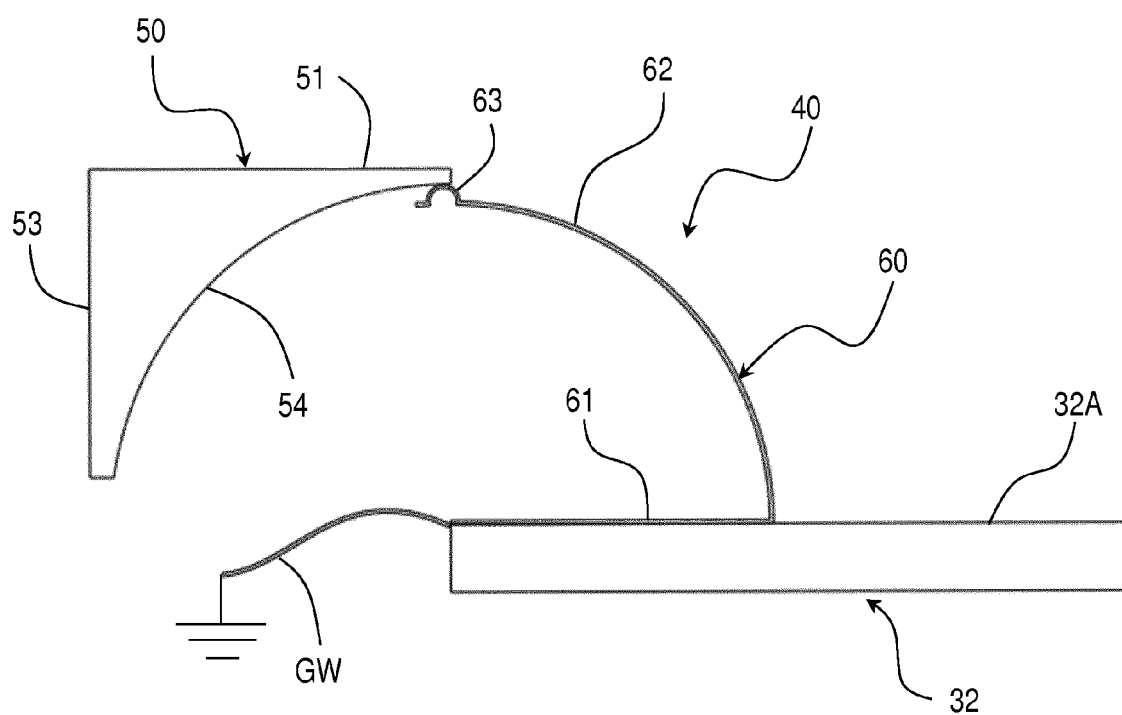


FIG. 8

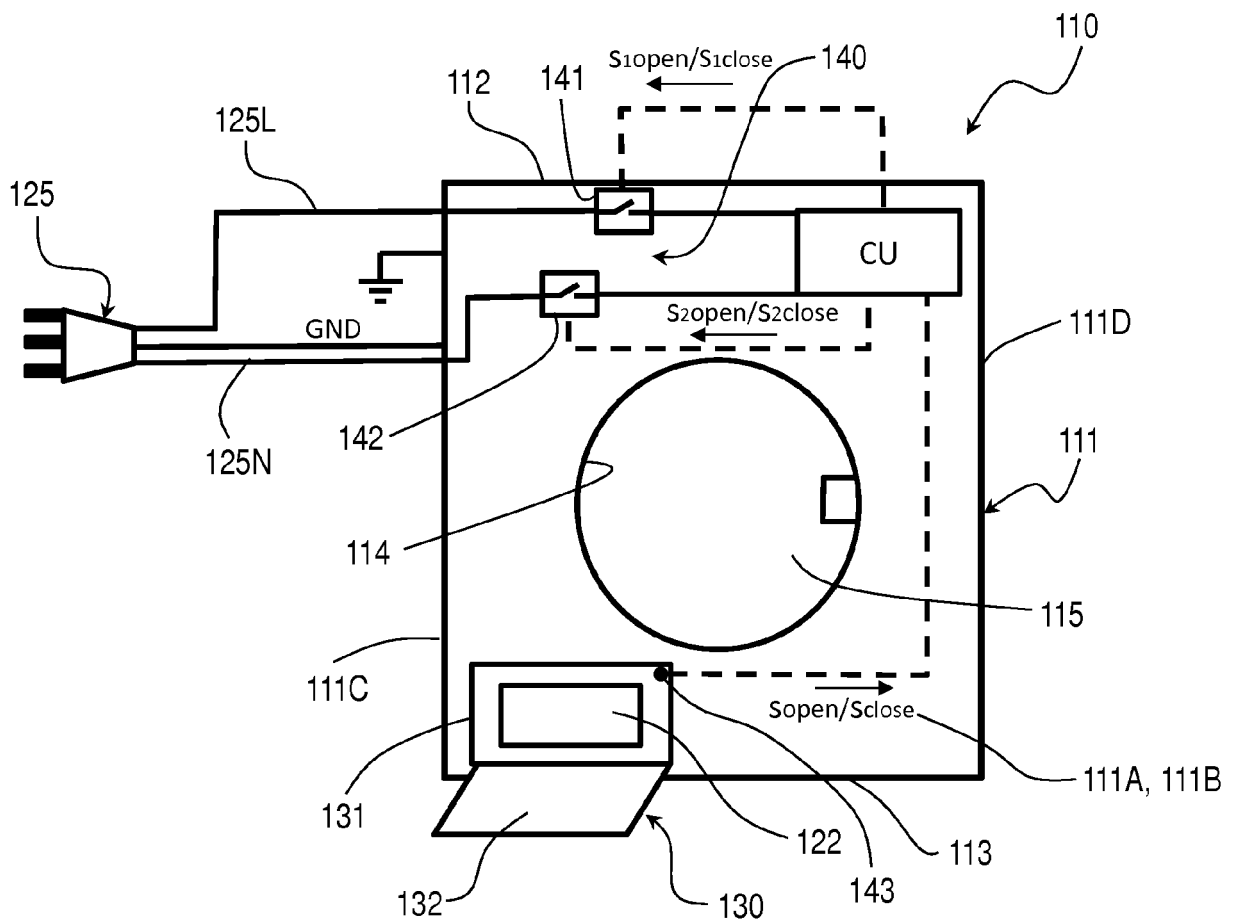


FIG. 9



EUROPEAN SEARCH REPORT

Application Number
EP 14 19 3412

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			D06F
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 28 May 2015	Examiner Westermayer, Wilhelm
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

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5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
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28-05-2015

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