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(54) **WASHING MACHINE COMPRISING A SUPPORTING ELEMENT FOR A WATER HEATER**

(57) The present invention relates to a washing machine (1) comprising:

- a treatment container (3) including a boundary wall (5) and a sump section (9), said sump section (9) having a bottom wall (31) and a lateral wall (32),
- a heater (14) passing through the lateral wall (32) of the sump section (9), so that the heater (14) is divided by the lateral wall (32) in a heater sump part (14a) housed within the treatment container (3) and in a heater external part (14b) placed outside the treatment container (3), wherein:
 - a. the heater sump part (14a) is adapted to heat water inside the sump section (9) and it is cantilever-mounted,

so that the heater sump part (14a) is supported only at the lateral wall (32) without touching directly or indirectly the bottom wall (31) of the sump section (9);

b. the heater external part (14b) comprises a first and a second electrical pin (51, 52) and it is supported at the lateral wall (32) and at a second location;

- a supporting element (60, 70, 80, 90) located outside the treatment container (3), connected to the boundary wall (5) of the treatment container (3) and to the second location of the heater external part (14b), to support the heater (14).

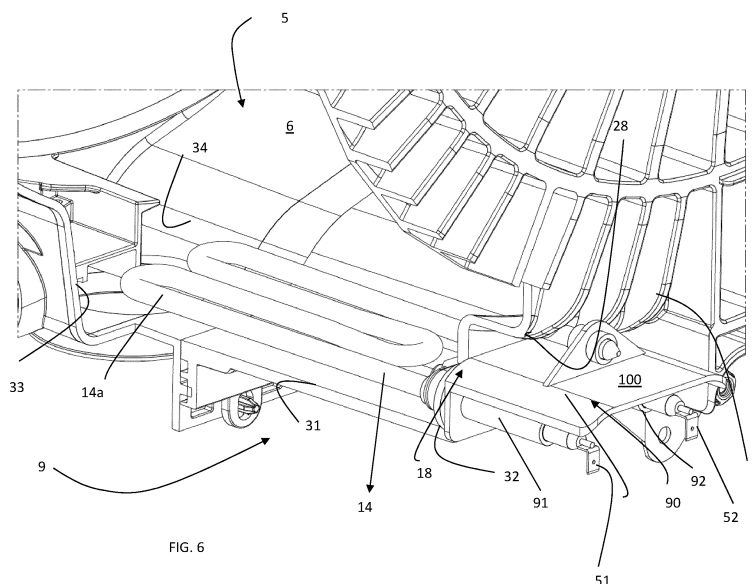


FIG. 6

Description

[0001] The present invention relates to a washing machine having a sump section.

[0002] Washing machines usually comprise washing tubs in which a rotatable drum is housed for receiving goods to be washed, usually laundry. Washing liquid is introduced into the washing tub, which washing liquid consists mainly of water and detergents or washing or cleaning agents added to or dissolved in the water for improving the washing quality.

[0003] Usually at the bottom of the washing tub a sump is arranged for draining the washing liquid from the tub into a draining circuit in order to either feed the washing liquid back from the sump into the washing tub again, in a closed circuit or circulation mode, or to drain the washing liquid out of the washing machine into a sewage conduit, in an open circuit, when it is not needed any more.

[0004] Generally, a heater is placed within the sump in order to heat the washing liquid.

[0005] It is preferred that the heater does not touch the walls of the sump. Indeed, the heater, when heated, reaches a relatively high temperatures and therefore - in particular when the tub is made in plastic material - a contact between the heater and the walls of the tub may damage the latter. In order to avoid this contact and at the same time correctly place the heater inside the sump, a support located inside the sump to support the heater has been developed. An example of such supporting element is given for example in EP 2 604 166 in the name of the same Applicant.

[0006] However, although a correct support and positioning of the heater is achieved using the above mentioned support internal to the sump, it creates several drawbacks.

[0007] First of all, an extra element, the support, needs to be manufactured and mounted inside the sump. In case the heater needs to be removed or changed, for example for maintenance purposes, the removal may be difficult due to limestone and/or fluff accumulated during the washing machine operation between the support and the heater. In addition, accumulation of limestone and/or fluff may cause the heater to stick to the support thereby causing damages to the support or even its accidental removal from the tub when the heater is disassembled from the tub. If this happens, to remount the support to the tub it is required to disassemble the tub, but this is not always possible, especially in the more recent washing machines having a tub formed by two parts that are permanently welded one to the other. In any case, fixing an accidentally removed support to the tub is either a very laborious work or even impossible.

[0008] In addition, because the sump is filled with water coming from the drum where laundry is located, the water may transport some fluff and foreign objects from the laundry into the sump. These fluff and foreign object could entangle with the support and the sump could get clogged. Further, the continuous contact between the

trapped fluff and other objects could damage the heater and require its substitution.

[0009] There is therefore a need for a washing machine in which at least one of the above problems is minimized.

[0010] The present invention relates to a washing machine comprising:

- a treatment container including a boundary wall and a sump section, said sump section having a bottom wall and a lateral wall,
- a heater passing through the lateral wall of the sump section, so that the heater is divided by the lateral wall in a heater sump part housed within the treatment container and in a heater external part placed outside the treatment container, wherein:
 - the heater sump part is adapted to heat water inside the sump section and it is cantilever-mounted, so that the heater sump part is supported only at the lateral wall without touching directly or indirectly the bottom wall of the sump section;
 - the heater external part comprises a first and a second electrical pin and it is supported at the lateral wall and at a second location;
- a supporting element located outside the treatment container, connected to the boundary wall of the treatment container and to the second location of the heater external part, to support the heater.

[0011] The wording "washing machine" in the following refers to washing machine or combined washer-dryers as long as a washing function is present.

[0012] In the following, further, with "vertical" and "horizontal" a frame of reference where the washing machine is located on a horizontal plane (i.e. the floor of a room) is considered. Therefore vertical and horizontal, as well as "above" and "below", have their standard usual meaning. It is to be understood that the washing machine could be placed in a tilted floor and the frame of reference is simply adjusted.

[0013] The washing machine is used to wash (and eventually dry) items, such as laundry.

[0014] The washing machine may comprise an external casing or cabinet on which a door is hinged. The cabinet includes a front wall, a back wall and lateral walls, as well as a top wall. The washing machine further includes a treatment container, that is, a washing tub. In the following, treatment container and tub are used interchangeably. The washing tub itself is provided with a washing drum where the laundry to be treated can be loaded, for example via the mentioned door.

[0015] The tub and the drum both preferably have a substantially cylindrical shape, or a shape that it resembles the one of a cylinder for most of their volume. Any other shape, in particular for the tub, is possible.

[0016] The tub defines therefore a boundary wall, de-

limiting its inner volume, having an inner surface for example facing the drum, and an external surface. The external surface may be facing the casing. The boundary wall may be formed in one piece construction, or it can be made in several pieces. The boundary wall may include a single wall, or many separated walls that are combined together. The boundary wall may comprise an open tubular lateral wall, for example substantially cylindrical, and a back wall closing an open end of the tubular lateral wall. The drum may also comprise a tubular lateral wall, closed by a back wall at one end.

[0017] Between the tub and the drum a gap is defined. This gap allows the drum to rotate inside the tub. The rotation axis of the drum can be horizontal, vertical or slightly tilted from horizontal. The door, depending on the axis of rotation of the drum, is therefore preferably located on the front wall of the casing (for horizontal-axis or slightly-tilted from horizontal washing machines), or on the top wall (vertical-axis washing machines).

[0018] The tub is preferably suspended in a floating manner inside the cabinet, for example advantageously by means of a number of coil springs and shock-absorbers. Any suspension is encompassed by the present invention.

[0019] The drum may be rotated by an electric motor which preferably transmits the rotating motion to the shaft of the drum, for example by means of a belt/pulley system. In a different embodiment of the invention, the motor can be directly associated with the shaft of the drum. In order to have fluid communication between the drum and the tub, preferably the drum is advantageously provided with holes which allow the liquid flowing therethrough. Said holes are typically and preferably homogeneously distributed on the lateral wall of the drum. In any case, any drum known in the art may be used in the present invention.

[0020] The tub is preferably connected to the cabinet by means of an elastic bellows, or gasket.

[0021] The tub may be realized in plastic material or in metal. It can be realized in a single piece or in many pieces that are then assembled together. Preferably, the tub comprises two complementary hemi-shells structured for being reciprocally coupled to form the tub.

[0022] The washing machine may comprise a control unit connected to the various parts of the washing machine in order to ensure its operation. The washing machine preferably also comprises an interface unit, for example in the form of a control panel, connected to the control unit, accessible to the user and by means of which the user may select and set the washing parameters, like for example a desired washing program. Usually, other parameters can optionally be inserted by the user, for example the washing temperature, the spinning speed, etc..

[0023] The tub defines a bottom region, which comprises a sump section. The sump section is adapted to receive liquid. The sump section is preferably an integral part of the tub and thus its walls are a part of the boundary

wall of the tub. Alternatively, the sump section may be built separately, e.g. separately moulded, from the tub and then attached to the tub afterwards. The sump section may protrude downwards from the tub. Advantageously, the sump section is a sort of bulge or "basing-shaped" region provided in the bottom section of the tub, which preferably protrudes externally from the tubular lateral surface of the tub. The sump section inner volume is delimited - among others - by a bottom wall and a lateral wall. The bottom wall of the sump section may be part of the tubular lateral wall of the tub. Further, the lateral wall section of the sump may be a portion of the back wall of the tub. In this embodiment where the sump section is formed by parts of the tub walls, the lateral tubular wall of the tub forms the bottom wall and two opposite first and second lateral walls of the sump section, while the back wall of the tub forms a further, third, lateral wall of the sump section. A fourth lateral wall is present as well, opposite to the third. The top of the sump section is preferably open.

[0024] The sump section is in fluid connection, for example via a conduit, to a drain pump and thereby in fluid connection to a drainage. The connection is made in a known manner in the art. Water can be therefore be removed from the sump section.

[0025] The sump section has a size suitable for receiving a heater, or heating device, and an amount of water to be heated by the heater. The heater, in order to heat the water, has a first portion located inside the sump section, preferably, the majority of the heater is located inside the sump section, defining a sump part of the heater. The heater needs, in order to be activated and heat the water, to be connected to a power generator, such as an electrical cable connected to the mains, and thus it defines a second portion that it is external from the sump section and in turn outside of the tub. This second portion is called external part of the heater, where "external" means external to the tub. The external part of the heater includes a first and a second electrical pins, adapted to be connected to suitable cable(s) in a manner known in the art in order to power the heater and heat the water, as mentioned above.

[0026] The heater may include for example a serpentine, at the ends of which the first and second electrical pins are located. The serpentine defining the heater may be cylindrical in shape. It may include a cylindrical element which is crooked and forms a plurality of meanders, starting with and ending up in the first and second pins. Preferably, the meanders formed by the cylindrical element are substantially coplanar. Preferably, the cylindrical serpentine element defines a plurality of straight portions connected by bends. Preferably, the straight portions are parallel to each other. Preferably, the heater defines a longitudinal axis, the longitudinal axis being preferably parallel to the heater straight portions. Preferably, the first and second pins point towards the same direction of the longitudinal axis.

[0027] In order to have a first portion in the sump sec-

tion and a second portion outside the sump section, the heater passes through the lateral wall of the sump section.

[0028] The sump part of the heater is in contact to the inner surface of the boundary wall of the tub only at the lateral wall of the sump section. For example, if the lateral wall of the sump section is a portion of the back wall of the tub, then the only point of direct or indirect contact between the inner surface of the tub and the sump part of the heater is at a portion of the inner surface of the tub at its back wall.

[0029] The lateral wall of the sump section thus defines a support location for the heater, keeping the heater in its position.

[0030] The heater is cantilever-mounted inside the sump section, so that, inside the sump section, the heater does not touch the inner surface of the tub, neither directly nor indirectly (i.e., for example, by means of additional supports), with the exception of the lateral wall of the sump section, where a contact between inner surface of the tub and sump part of the heater is present because the heater passes through the lateral wall of the sump section.

[0031] Thus the sump part of the heater is free-standing, the only contact area with the tub being at the lateral wall.

[0032] In particular, the washing machine comprises a supporting element for the external part of the heater

[0033] Preferably, the supporting element is connected both to the external part of the heater and to the external surface of the back wall of the tub.

[0034] The supporting element is connected to the external surface of the back wall in a single location or in a plurality of locations.

[0035] In this way, rotations and movements of the heater are prevented, and in turn contacts between the sump part of the heater and the inner surface of the tub are prevented as well, because two supporting locations for the heater are present, one at the lateral wall and one outside the tub, the second location, provided by the supporting element.

[0036] The supporting element is completely located outside the tub. Therefore, there is no additional element "difficult to retrieve" positioned inside the tub, such as in the sump section.

[0037] The supporting element is for example fastened to the external surface of the boundary wall of the tub. A screw fastening may be envisaged. Welding can be used as well.

[0038] Further, the supporting element defines a second supporting location for the heater, in addition to the supporting location defined by the lateral wall of the sump section. The second supporting location and the first supporting location (that is, the location of the lateral wall) may define a given distance among each other. However, the supporting element may be in contact with the lateral wall, as long as it extends enough that a support "far" from the lateral wall is present as well.

[0039] Preferably, the supporting element is in direct contact to the external part of the heater at the second support location.

[0040] Preferably, the supporting element is in direct contact to the external surface of the boundary wall of the tub.

[0041] The fact that the supporting element works as a support for the heater minimizes the chance that the heater tilts with respect to its longitudinal axis and comes into contact with a surface of the tub. This tilting could take place if a single support location, such as the single support location at the lateral wall, would be present. Two support locations allow to minimize the chance of undesired movements of the heater. The same advantages of a support inside the sump section are achieved, but the disadvantages of such an inner support are minimized.

[0042] The fact that the heater is cantilever-mounted in the sump section avoids or minimizes the possibility that fluff or foreign objects get entangled in additional elements supporting the heater in the sump section.

[0043] Further, there is no additional element that needs to be mounted inside the sump section connected to the heater, so that a repair or a removal of the heater is much easier.

[0044] Moreover, the size of the sump section itself can be decreased with respect to the size of a sump section containing a heater support. In the latter case, the sump section inner volume needs to be big enough to contain the support and the water to be heated. Removing the support inside the sump section may allow to reduce the overall volume of the sump section itself.

[0045] Preferably, said heater external part includes a first and a second arm terminating in the first and the second electrical pin, respectively, and the second location is positioned in one of said first or said second arm.

[0046] The heater is preferably a serpentine, and the first and second electrical pin define the ends of a first and second arm of the serpentine. Preferably, the first and second arms are substantially cylindrical. Preferably, the first and second arms are parallel to each other. Preferably, in one of these arms, the second support location for the external part of the heater is defined, that is, the supporting element connected to the external surface of the boundary wall of the tub supports the external part of the heater at one of its arms.

[0047] More preferably, said heater external part includes a first and a second arm terminating in the first and the second electrical pin, respectively, and the heater external part is supported at the lateral wall and at a third location, the third location is positioned in the other of said first or said second arm.

[0048] Preferably, the first and second arm are substantially horizontal or slightly tilted with respect to a horizontal plane. Preferably, the supporting element supports the external part of the heater at both the first and second arm. Thus, a second supporting location and a third supporting location are defined. In this way, the sup-

porting element functions also as an "antirotational" element, avoiding rotations of the heater around its longitudinal axis, not only preventing rotations of the heater in a direction perpendicular to the longitudinal axis. Further, the supporting element provides for two support locations, the second and the third support locations, one per arm of the external part of the heater.

[0049] Preferably, said lateral wall of the sump section includes an aperture sealed by a sealing element, said sealing element comprises one or more openings so that said heater is inserted therein. More preferably, the sealing element includes a seal and a mounting element, the mounting element being mounted internally to the seal to compress the seal against the aperture in the lateral wall, said one or more opening being formed in the mounting element.

[0050] In the sump section, during the normal functioning of the washing machine, water is present. The sump section is thus preferably water-tight in order to avoid leakage of water outside the tub. The fact that the heater has a part inside and a part outside the sump section passing through a lateral wall of the sump section might be a potential risk for leakage. In order to avoid leakage, the lateral wall of the sump section includes preferably an aperture which is closed by a sealing element. The sealing element has in addition the opening(s) necessary to let the heater passing through it. For example, in case the heater has a first and a second arms, the sealing element has two openings, for example two holes, to let the heater arms pass, one per opening. Preferably, the sealing element includes a seal, for example adapted to circumferentially seal the whole boundary of the aperture in the lateral wall of the sump section, and a mounting element which compresses the seal against the aperture, keeping the seal in place. In this mounting element, the opening(s) for the heater is(are) preferably made.

[0051] Preferably, a distance is present between said lateral wall of the sump section and said second location, the distance being comprised between 2 centimetres and 15 centimetres.

[0052] More preferably, the distance is comprised between 5 centimetres and 10 centimetres. The fact that a distance is present between the supporting element and the lateral wall of the sump section does not mean that the supporting element cannot be in contact with the lateral wall of the sump section. The meaning of it is that there is a supporting location provided by the supporting element at a distance comprised between 2 and 15 cm from the lateral wall, regardless of whether the support also starts closer to the lateral wall. There could be a continuous support surface between the supporting element and the arms of the external surface of the heater starting at the lateral wall and extending along a longitudinal axis of the heater, reaching the second location when a distance between the contact surface and the lateral wall is above 5 cm. The distance between the lateral wall and the supporting element is considered as the smallest Euclidean distance between the lateral wall ex-

ternal surface and the second supporting location. This range allows optimal support of the heater to avoid tilting of the heater around an axis located at the lateral wall of the sump section in still a reasonable length, so that the size of the sump section and the heater is still "acceptable".

[0053] Preferably, the supporting element is directly in contact with said external part of said heater.

[0054] The second location is determined by a direct contact between the supporting element and the external part of the heater, such as a direct contact between the supporting element and the first and/or second arm of the heater ending with the first or second electrical pin. No other element is interposed between the supporting element and the external part of the heater. Due to the contact, preferably the supporting element is realized in a material that can withstand hot temperatures. For example, the supporting element is realized in metal, such as steel, or in self-extinguishing plastic.

[0055] Preferably, the supporting element is connected to the boundary wall of the treatment container at a location positioned above said heater.

[0056] More preferably, the supporting element is connected to the external surface of the boundary wall of the tub. The washing machine, when in normal function, defines a vertical axis. The supporting element is connected, for example fastened, to the external surface of the boundary wall of the tub. Preferably, it is connected, e.g. fastened, to the external surface of the back wall of the tub. Preferably, the connection with the tub is located above the heater, that is, the highest point of the heater along the vertical axis is located below the connecting location between the supporting element and the boundary wall of the tub. More preferably, the connecting location between the boundary wall of the tub and the supporting element is located higher than the second supporting location.

[0057] Preferably, the connection between the supporting element and the back wall of the tub is realized by means of a screw. Alternatively, the supporting element is fixed with a nut.

[0058] Preferably, the boundary wall of the treatment container forms an indentation and said heater external part extends at least in part within said indentation.

[0059] The boundary wall of the treatment container, preferably its back wall, may form an inward bend so that the external part of the heater may extend within the bend. For example, in this way, a portion of the back wall of the tub extends - without contact - above the external part of the heater.

[0060] Preferably, said supporting element includes a fire resistant protection plate adapted to shield a portion of the boundary wall of the treatment container from the first and second electrical pins.

[0061] The external part of the heater includes the first and second electrical pins. The presence of electrical pins means that there is a contact with some electrical power supply, and thus, in case of overheating due to

unexpectedly prolonged or irregular powering, plastic protections, provided for covering said pins, may become a source of potential damage to the tub material. Therefore, it is preferable that a protection is included in the washing machine to protect the sensible parts of the washing machine located around the electrical pins. Because the supporting element is already located in proximity of the electrical pins, it is relatively easy to mount a fire resistant protection plate onto the supporting element. The fire resistant protection plate might be integral, i.e. in a single piece, with the supporting element, or it might be fastened to the supporting element at a later stage, such as welded or fastened.

[0062] Preferably, fire resistant protection plate is inserted between said heater external part and said boundary wall of the treatment container.

[0063] The boundary wall of the tub might be in a material which does not resist well to high temperatures or fire, for example it might be formed in plastic material. Therefore, if the external part of the heater is located below a portion of the boundary wall, the fire resistant protection plate is located in between the arms ending in the electrical pins of the external part of the heater and the external surface of the boundary wall of the tub.

[0064] Preferably, said supporting element comprises a first and a second apertures, said first and second arms being inserted in said first and second apertures, respectively.

[0065] In an embodiment, the supporting element might be plate-like, and can be fastened on the boundary wall of the tub. It may also include a first and a second apertures where the first and second arm of the external part of the heater can be introduced, one arm per aperture. The second supporting location is therefore defined by the location where contact takes place between the supporting element's first or second aperture and the first or second arm of the external part of the heater. As an example, the supporting element could be V-shaped, the vertex of the V being fastened to the external surface of the boundary wall of the tub and the two arms of the V having each an aperture where one arm of the external part of the heater is inserted.

[0066] Preferably, said supporting element comprises a first and a second sleeve, said first and second arms being inserted in said first and second sleeves, respectively.

[0067] The second supporting location is therefore defined by the inner surface of the first or second sleeve in contact with the first or second arm or the external part of the heater, respectively. More preferably, two contact surfaces between both sleeves and both arms are defined, so that a second and third supporting locations are defined. The connection between the supporting element and the boundary wall of the tub in this embodiment is preferably located in a bridging element connecting the first and second sleeves of the supporting element. Preferably, the sleeves define, each, a longitudinal axis, parallel to the longitudinal axis of the heater.

[0068] More preferably, said fire resistant protection plate connects the first and second sleeves.

[0069] The fire resistant protection plate is preferably positioned above the first and second sleeves, connecting the two. Each sleeve defines a longitudinal axis or extension. The fire resistant protection plate may extend longer than the longitudinal extension of the sleeves along the longitudinal axis, so as to cover the ends of the first and second arms of the external part of the heater, where the electrical pins are located.

[0070] Preferably, the boundary wall of the treatment container includes a lateral tubular wall and a back wall closing one side of the lateral tubular wall, the bottom wall of the sump section being part of the lateral tubular wall of the treatment container and the lateral wall of the sump section being part of the back wall of the treatment container.

[0071] Preferably, the external part of the heater is located at the back wall of the tub. It preferably extends outwardly from the back wall of the tub.

[0072] Further advantages of the invention will become clearer in the following description of some preferred embodiments, with non-limiting reference to the appended drawings, where:

- figure 1 shows a perspective view of a washing machine realized according to the invention;
- figure 2 shows a perspective view of the tub of the washing machine of figure 1, where a portion of the boundary wall has been removed to show its sump section;
- figure 3 shows a perspective view in enlarged scale of a detail of figure 2;
- figure 4 shows the same detail of figure 3, with a fire resistant protecting plate added;
- figure 5 is a lateral view in section of the detail of figure 4;
- figure 6 shows the same detail of figure 3 and 4, but of a second embodiment of the supporting element is depicted;
- figures 7a-7b show two lateral views in section, of the supporting element depicted in figure 6;
- figure 8 is a perspective view of the heater disassembled from the washing machine without supporting element;
- figure 9 is a perspective view of the heater disassembled from the washing machine with the supporting element of figures 6 and 7a-7b;
- figure 10 is a perspective view of the heater disassembled from the washing machine with a third embodiment of the supporting element; and
- figures 11a - 11c show respectively a front and two lateral views in section taken along lines A-A and B-B of figure 11a, respectively, of a fourth embodiment of a supporting element; and
- figures 12a - 12d are perspective views of a sequence of mounting steps of the supporting element of figures 11a - 11c on the heating element.

[0073] With initial reference to figure 1, with 1 a washing machine realized according to the present invention is globally indicated.

[0074] Washing machine 1 comprises an outer box or casing 2, preferably but not necessarily parallelepiped-shaped, and a drum (not visible in the appended drawings), for example having the shape of a hollow cylinder, for housing the laundry and in general the clothes and garments to be washed. The drum is preferably rotatably mounted, so that it can rotate around a preferably horizontal axis (not depicted in the drawings; in alternative embodiments, the axis of rotation may be tilted or vertical). Access to the drum in order to load or unload the laundry is achieved for example via a door 4, preferably hinged to cabinet 2, which can open and close an opening (not visible, in figure 1 the door 4 is in a closed position) realized on the cabinet 2 itself.

[0075] The drum is known in the art and not further described below.

[0076] More in detail, casing 2 generally includes a front wall 20, a rear wall 21 and two sidewalls 25. Preferably, on the front wall 20, the door 4 is hinged so as to access the drum. The casing, with its walls, defines the inner volume of the washing machine 1. Front and rear walls, 20, 21 as well as the lateral walls 25 are preferably mounted on a basement 24.

[0077] The washing machine 1, and in particular basement 24, defines an horizontal plane (X,Y) which is substantially the plane of the ground on which the washing machine 1 is situated, thus it is considered to be substantially horizontal, and a vertical direction Z perpendicular to the plane (X,Y). The plane defined by the basement however can be also tilted from the horizontal one.

[0078] The washing machine 1 also preferably comprises an electrical motor assembly (not shown) for rotating, on command, revolving drum along its axis inside a washing tub 3 (visible in figure 2).

[0079] Further, washing machine 1 may include an electronic central control unit 12 (schematically depicted as a rectangle in figure 1) which controls both the electrical motor assembly and other components of the washing machine 1 to perform, on command, one of the user-selectable washing and/or drying cycles preferably stored in the same central control unit. The programs as well other parameters of the washing machine 1, or alarm and warning functions can be set and/or visualized in a control panel 11, preferably realized in a top portion of the washing machine 1, such as above door 4.

[0080] Close to control panel 11, the washing machine 1 includes a drawer 19, fluidly connected to the drum, for the introduction of detergent or other substances inside the drum.

[0081] With reference to Figure 2, the washing tub 3 includes a boundary wall 5 which delimits its volume. The boundary wall may be realized as a single wall, or as many walls assembled together. In particular, boundary wall 5 defines a cavity, used to contain the drum, having an aperture closed by door 4. Further, the boundary wall

is preferably made of plastic. The boundary wall 5 in turns preferably includes a mantle 6, having preferably a substantially tubular body. The mantle 6 is preferably cylindrical-shaped. The mantle 6 defines a first end 3a and a second end 3b and the tub 3 is so arranged that the first end 3a of the mantle 6 is faced to the laundry loading/unloading opening realized on the front wall 20 of the cabinet 2 and the door 4, while the second end 3b faces the rear wall 21.

[0082] Tub 3 further includes a back wall 7 fixedly connected to the mantle 6 and closing the second end 3b.

[0083] The washing tub 3 has a bottom portion 8 which forms a sump section 9. Advantageously the sump section 9 is a sort of bulge or "basing-shaped" region provided in the bottom portion 8 of the washing tub 3, which preferably protrudes externally and downwardly from the substantially tubular mantle 6 of the tub 3.

[0084] The sump section 9 is in fluid connection via a connection conduit 13 to a drain pump (not visible) and thereby in fluid connection to a drainage.

[0085] Fresh water is supplied to the laundry machine 1 via a water supply conduit (not visible) and is preferably guided through the detergent feeding drawer 19 wherein detergent is provided. Thus, fresh water and detergent are mixed up, being now a washing liquid, and guided into the interior of the washing tub 3 by means of a manifold 15.

[0086] Inside the washing tub 3, the washing liquid is collected at least partially in the sump section 9 wherein a heating element 14 is arranged. The heating element 14 can heat up the washing liquid to a desired temperature. Because of a plurality of holes in the shell of the drum, the interior of the drum is in fluid connection with the interior of the washing tub 3.

[0087] Figure 3 shows more detailed views of the sump section 9 of washing machine 1. The sump section 9 is defined by a bottom wall 31, and four lateral walls 32, 33, 34 (the fourth wall not being visible).

[0088] Advantageously, bottom wall 31 and three lateral walls 33, 34 are formed by a portion of the mantle 6, while one of the lateral walls, i.e. the wall 32 is formed by a portion of the back wall 7 of the tub 3.

[0089] More in detail, the heating element 14 passes through one of the lateral walls of the sump section 9, lateral wall 32, and is thus divided in a first part 14a located inside the sump section 9, and in a second part 14b located outside the washing tub 3. Preferably, the wall the heating element 14 passes through is wall 32, part of back wall 7.

[0090] As visible in figure 5, in order to let the heating element 14 pass through lateral wall 32, the lateral wall 32 includes an aperture 35, closed by a seal 36 and a mounting element 37. The seal 36 is located around the perimeter of the mounting element 37 and the seal 36 is kept pressed against a corresponding boundary of aperture 35 to seal the same and make it water-tight. In order to keep the seal 36 tightly pressed against the boundary of the aperture 35, preferably, a threaded screw 39 pro-

truding from a flange 40 passes through the lateral wall 32, and it is tightened by a nut 38, so as to pull the flange 40 towards the mounting element 37 thereby deforming the seal 36 radially and axially against the boundary of the aperture 35. The threaded screw 39, which is visible in figure 7b, represents a configuration applicable to all embodiments.

[0091] The heating element 14 is arranged within the sump section 9 in a configuration that the heating element 14 is not in direct or indirect contact with the bottom wall 31 or three of the lateral walls 32 - 34 of the sump section, but in a connection that it is allowed to heat the washing liquid inside the sump section 9. That is, to say, the heating element 14 does not touch the sump section bottom walls and three of its lateral walls 33-34 neither it is supported by any element in contact with these walls 31, 33 - 34. The only direct or indirect contact between the sump section 9 and the heating element 14 takes place at the lateral wall 32 that the heating element 14 pierces.

[0092] Heating element 14, as better visible in figure 8 in a dismounted configuration from washing machine 1 but still inserted in mounting element 37, preferably includes a serpentine and comprises four straight portions, first, second, third and fourth 41, 42, 43, 44 connected by three bends, first, second and third 45, 46, 47. First bend 45 connects first and second straight portions 41, 42, second bend 46 connects second and third portion 42, 43, and third bend 47 connects third and fourth portion 43, 44. Preferably all portions lie on the same plane. Preferably, straight portions 41 - 44 are parallel to each other and parallel to a longitudinal axis L of the heating element 14. Preferably, the longitudinal axis L is substantially horizontal. The first and fourth portions 41, 44 are preferably longer than the second and third portions 42, 43 and are the side portions among the four. Thus first and fourth straight portions define each a terminal part 53, 54 "sticking out" along the longitudinal axis of the heating element 14.

[0093] Each of the first and fourth straight portions 41, 44 ends with an electrical pin: first straight portion ends with a first electrical pin 51 and fourth straight portion ends with a second electrical pin 52.

[0094] Electrical pins 51, 52 are connected in a known manner to a power supply.

[0095] The mounting element 37 includes a first and a second openings 48, 49, to allow the terminal parts 53, 54, including electrical pins 51, 52, of the first and fourth straight portions 41, 44 to protrude outwardly and exit sump section 9 so as to define a first and second arm 53, 54.

[0096] Therefore, when mounted in the sump section 9, the second and third straight portions 42, 43 and all three bends 45 - 47 of the heating element 14 are completely contained within the sump section 9, as well as a part of the first and fourth straight portions 41, 44 and together define the sump part 14a of the heating element 14. On the other hand, terminal parts 53, 54 of the first and fourth straight portions, that is, first and second arms

53, 54 having pins 51, 52 define the external part 14b of the heating element 14, exiting the sump section 9 from the lateral wall 32.

[0097] The only contact between the sump part 14a of the heater and the sump section' walls is at the lateral wall 32. No other direct or indirect (i.e. via supports) contact is present. More in detail, the only contact present between the sump part 14a of the heating element 14 and the sump section 9 is realized between the first and fourth straight portions 41, 44 when inserted in the first and second openings 48, 49 formed in the mounting element 37, part of the lateral wall 32. This contact between the straight portions 41, 44 and the mounting element 37 at the openings 48, 49 forms a first supporting location for the heating element 14.

[0098] Returning to figure 3, the washing machine 1 also includes a supporting element to create another support for the heating element 14 besides the lateral wall 32, to avoid that the heating elements tilts and touch the bottom wall 31 of the sump section 9.

[0099] In a first embodiment of the supporting element 70 depicted in figures 2 - 5, the supporting element 70 has a plate-like shape and more in detail a V-shape. The supporting element 70 includes two arms 71, 72 of the V-shape which connect in a vertex 73. The vertex 73 is fastened to the back wall 7 of the tub 3 and the arms 71, 72 each include a supporting element aperture 74, 75. In each aperture 74, 75, an arm 53, 54 of the external part 14b of the heating element 14 is inserted. The supporting element 70 is crimped or welded to the external part 14b of the heating element 14. In other words, preferably, the first and second arms 53, 54 of the heating element 14 are inserted in the apertures 74, 75 of the supporting element 70 and the supporting element is crimped or welded at the contact points between the supporting element and the first and second arms. The plate like supporting element 70 is positioned substantially vertical, that is, substantially perpendicular to the longitudinal axis L of the heating element 14. The heating element 14 and supporting element 70 are thus substantially orthogonal one to the other. The vertex 73 is fixed to the back wall 7 by means of a screw, a rivet, a bolt or the like. In the depicted example, the connection of the vertex 73 and the supporting element 70 is realized by means of a protrusion 78 of the back wall 7, which is inserted in a vertex aperture 79 of the supporting element 70. An interference between the protrusion and the vertex aperture 79 may be provided.

[0100] More in detail, the sump section 9 is formed at an indentation 18 of the back wall 7, that is, from its substantially vertical extension, the back wall 7 of the tub 3 forms a recessed part or indentation 18 where the back wall 7 bends twice, so that the lateral wall 32 of the sump section is still substantially vertical, but closer to the door 4 than the rest of the back wall 7.

[0101] Therefore, the electrical pins 51, 52 of the heating element 14 do not extend further along the longitudinal direction L than the furthestmost point of the back wall

7 in the same direction. In other words, taken the longitudinal axis L of the heating element 14, the most remote point of the back wall from the door 4 along the L direction is farthest from the door 4 than the most remote point of the heating element 14 from the door along the same direction.

[0102] Therefore, the external part 14b of the heating element 14 is positioned below an inward bend 28, of substantially 90°, formed on the back wall 7 of the tub 3.

[0103] The connection location between the supporting element 70 and the back wall 7 is thus preferably above the external part 14b of the heating element 14 and it is even more preferably located at the back wall 7 just before the inward bend 28. Bend 29 is followed by a second bend 29, of about 90°, so that lateral wall 32 is also substantially vertical.

[0104] The supporting element 70 thus offers support to the external part 14b of the heating element 14 in a location which corresponds to the contact surface between the first and second arms 53, 54 of the external part 14a of the heating element 14 and the apertures 74, 75 realized in the supporting element 70 where the arms are inserted.

[0105] The second supporting location for the external part 14a of the heating element 14 is defined by supporting element 70 at the contact between the V-shaped plate 70 at apertures 74, 75 and arms 53, 54.

[0106] The second supporting location, defined by the contact above detailed, has a given distance from the mounting element 37. This distance is of about between 5 and 15 cm.

[0107] With now reference to figures 4 and 5, to the supporting element 70 a fire resistant protection plate 100 is added. The fire resistant protecting plate 100 is attached to the plate-like element 70 so that it extends further along the longitudinal axis L direction farther away from door 4. That is, the fire resistant protecting plate 100 extends along the longitudinal axis L direction so as to cover the electrical pins 51, 52. Plate like supporting element 70 and fire resistant protection plate 100 form two planes substantially orthogonal to each other. The location of at least part of the fire resistant protecting plate 100 is above the first and second arms 53, 54 of the external part 14b of the heating element 14.

[0108] The fire resistant protecting plate 100 is thus interposed between the back wall 7 in its portion between bends 28, 29 where it is substantially horizontal and the first and second arms 53, 54.

[0109] As seen in figure 5, the fire resistant protecting plate 100 may extend along the L direction farther than back wall 7, that is, it may protrude from the indentation 18.

[0110] In a further embodiment of the supporting element 90, depicted in figures 6, 7a-7b and 9, the supporting element 90 includes a first and a second sleeve 91, 92. The sleeves preferably extends along the longitudinal axis L of the heating element 14 and thus are preferably substantially horizontal. The first and second sleeve are

preferably inserted in the first and second arm 53, 54, respectively, of the external part 14b of the heating element 14.

[0111] As better visible in figure 7a, there is an extended contact surface between each sleeve 91, 92 and each arm 53, 54. The supporting element 90 further is in contact with the lateral wall 32 of the sump section 9.

[0112] The second supporting location is preferably defined by the whole contact surface between each sleeve and the corresponding arm of the heating element 14 inserted in it. Differently from the first embodiment of the supporting element 70, the second supporting location starts at the lateral wall 32 and there is no distance between the lateral wall and the second supporting location, however the second supporting location is still present after a distance of at least 5 cm from the lateral wall 32 along the longitudinal axis L, due to the length of the sleeves 91, 92.

[0113] Supporting element 90 also comprises fire resistant protection plate 100, which is used to connect the sleeves 91, 92. Fire resistant plate thus connects the sleeve contacting them at their external surface substantially parallel to the axes of the first and second sleeve 91, 92. The fire resistant protection plate defines thus a plane substantially parallel to the longitudinal axis L. Preferably fire resistant plate 100 and sleeves 91, 92 form an integral element.

[0114] The connection between the supporting element 90 and the back wall 7 is made in the same location as in supporting element 70, that is preferably by a back wall 7 protrusion 78 or any other attachment means. In this specific embodiment, on top of the fire resistant protective plate 100 a protruding eyelet 93 for connection with protrusion 78 may be mounted.

[0115] In order to keep the supporting element 90 attached to the heating element 14, avoiding movement of the same, for example due to a sliding of the first and second sleeve 91, 92 on arms 53, 54, the supporting element 90 is attached to the lateral wall 32 by means of the same screw and nut 39, 38 used to tighten the mounting element 37 against seal 36.

[0116] In figure 10, a third embodiment of a supporting element 80 is depicted. Supporting element 80 is formed by a plate like element substantially perpendicular to the external part of the heating element 14 and by fire resistant plate 100. This embodiment is substantially analogue to embodiment depicted in figures 4 and 5, however plate like element and fire resistant plate in this third embodiment are a single piece instead of two separated pieces. The same description of figures 4 and 5 apply to figure 10, with the only difference that in figure 10 supporting element 70 and fire resistant protective plate 100 are a single piece, that is, supporting element 80.

[0117] Figures 11a - 11c show a fourth embodiment of the supporting element 60. Supporting element 60 includes, as supporting element 90, a first and a second sleeve 91, 92. The first and second sleeve are preferably inserted in the first and second arm 53, 54, respectively,

of the external part 14b of the heating element 14. There is an extended contact surface between each sleeve 91, 92 and each arm 53, 54. The supporting element 60 further is in contact with the lateral wall 32 of the sump section 9. Supporting element 60 also comprises fire resistant protection plate 100, which is used to connect the sleeves 91, 92.

[0118] The connection between the supporting element 60 and the back wall 7 is made in the same location as in supporting element 90, that is, the connection is made preferably by a back wall 7 protrusion 78 or any other attachment means. In this specific embodiment, on top of the fire resistant protective plate 100 a protruding eyelet 93 for connection with back wall 7 protrusion 78 may be mounted.

[0119] Further, in order to keep the supporting element 60 attached to the heating element 14, avoiding movement of the same, the supporting element 60 is attached to the lateral wall 32 by means of the same screw and nut 39, 38 used to tighten the mounting element 37 against seal 36.

[0120] However, differently from supporting element 90, supporting element 60 of this fourth embodiment includes an additional fastening element 61. Fastening element 61 is adapted to be coupled to supporting element 60 as shown in figure 11a - 11c where fastening element 61 is mounted on supporting element 60.

[0121] For this purpose, fire resistant protection plate 100 includes an aperture 101. Aperture 101 has a size suitable to house a corresponding tooth 102 formed on the fastening element 61. Fastening element 61 (better seen in the disassembled configuration of figures 12a - 12c) includes a first U shaped portion 103 from which two legs 103, 104 protrude. Legs 103, 104 protrude from the same side of the U shaped portion, perpendicularly to a plane defined by the U-shaped portion itself. Tooth 102 is formed on a surface of the U shaped portion, opposite to the side from which the legs 103, 104 extend.

[0122] In figures 12a - 12d, the mounting of supporting element 61 on the heating element 14 is shown. In Fig. 12a the disassembled configuration of the heating element 14 and supporting element 60 is depicted.

[0123] First, the supporting element 60 is mounted on the heating element 14. Sleeves 91, 92 of supporting element 60 are inserted in arms 53, 54, so that pins 51, 52 protrude from the sleeves 91, 92. Supporting element 60 is then hooked to mounting element 37 by means of a hooking member 55 provided on the supporting element 60 in a position that is opposite to the fire resistant protection plate 100. The supporting element 60 is further fastened to the mounting element 37 using screw 39 and bolt 38. This configuration is shown in figure 12c. Further, fastening element 61 is slid between the fire resistant protective plate 100 and the external portion 14b of heating element 14, so that the U-shaped portion 103 is located substantially under protective plate 100 and above arms 53, 54. Protective plate 100 and U shaped portion form, at least partially, two parallel planes. Each leg 103,

104 is inserted in a sleeve 91, 92. The fastening element 61 slides under protective plate 100 till the tooth 102 is inserted in aperture 101. The engagement of tooth 102 in aperture 101 avoids that the fastening element may detach from supporting element 60. The assembled configuration is shown in figure 12d.

Claims

1. A washing machine (1) comprising:

- a treatment container (3) including a boundary wall (5) and a sump section (9), said sump section having a bottom wall (31) and a lateral wall (32);
- a heater (14) passing through the lateral wall (32) of the sump section (9), so that the heater (14) is divided by the lateral wall in a heater sump part (14a) housed within the treatment container (3) and in a heater external part (14b) placed outside the treatment container (3), wherein:

- a. the heater sump part (14a) is adapted to heat water inside the sump section (9) and it is cantilever-mounted, so that the heater sump part (14a) is supported only at the lateral wall (32) without touching directly or indirectly the bottom wall (31) of the sump section (9);
- b. the heater external part (14b) comprises a first and a second electrical pin (51, 52) and it is supported at the lateral wall (32) and at a second location;

- a supporting element (60, 70, 80, 90) located outside the treatment container (3), connected to the boundary wall (5) of the treatment container and to the second location of the heater external part (14b), to support the heater (14).

2. Washing machine (1) according to claim 1, wherein said heater external part (14b) includes a first and a second arm (53, 54) terminating in the first and the second electrical pin (51, 52), respectively, and the second location is positioned in one of said first or said second arm (53, 54).

3. Washing machine (1) according to claim 2, wherein said heater external part (14b) includes a first and a second arm (53, 54) terminating in the first and the second electrical pin (51, 52), respectively, and the heater external part (14b) is supported at the lateral wall (32) and at a third location, the third location is positioned in the other of said first or said second arm.

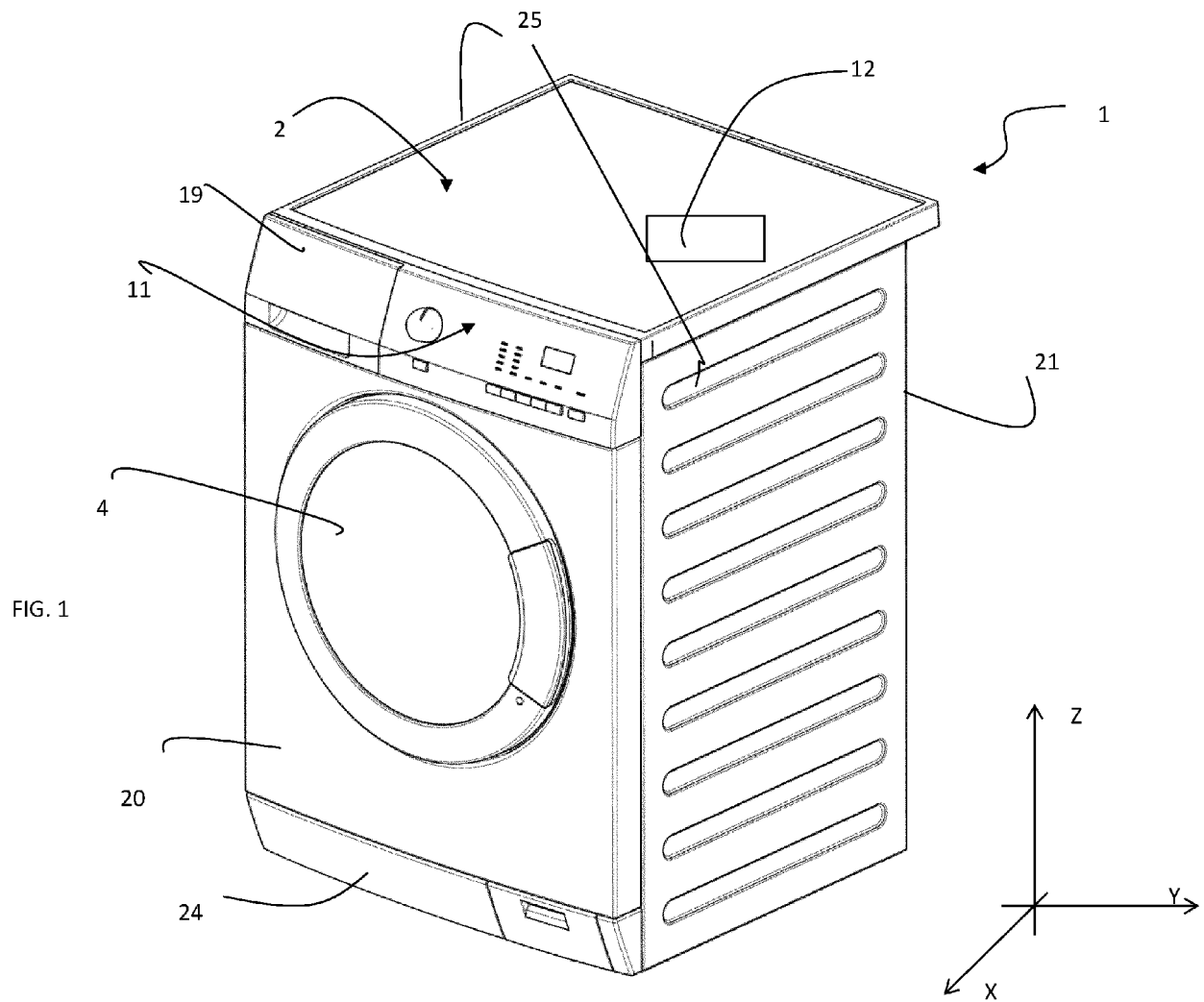
4. Washing machine (1) according to one or more of

the preceding claims, wherein said lateral wall (32) of the sump section (9) includes an aperture (35) sealed by a sealing element, said sealing element comprises one or more openings (48, 49) so that said heater is inserted therein.

5. Washing machine according to claim 4, wherein the sealing element includes a seal (36) and a mounting element (37), the mounting element being mounted internally to the seal to compress the seal against the aperture (35) in the lateral wall (32) of the sump section, said one or more openings (48, 49) being formed in the mounting element (37).
6. Washing machine (1) according to one or more of the preceding claims, wherein a distance is present between said lateral wall (32) and said second location, the distance being comprised between 2 centimetres and 15 centimetres.
7. Washing machine (1) according to one or more of the preceding claims, wherein said supporting element (60, 70, 80, 90) is directly in contact with said external part (14b) of said heater (14).
8. Washing machine (1) according to one or more of the preceding claims, wherein said supporting element (60, 70, 80, 90) is connected to the boundary wall (5) of the treatment container (3) at a location positioned above said heater (14).
9. Washing machine (1) according to one or more of the preceding claims, wherein the boundary wall (5) of the treatment container (3) forms an indentation (18) and said heater external part (14b) extends at least in part within said indentation (18).
10. Washing machine (1) according to one or more of the preceding claims, wherein said supporting element (60, 70, 80, 90) includes a fire resistant protection plate (100) adapted to shield a portion of the boundary wall (5) of the treatment container (3) from the first and second electrical pins (51, 52).
11. Washing machine (1) according to claim 10, wherein said fire resistant protection plate (100) is inserted between said heater external part (14b) and said boundary wall (5) of the treatment container (3).
12. Washing machine (1) according to one or more of the preceding claims when depending on claim 2, wherein said supporting element (70, 80) comprises a first and a second aperture (74, 75), said first and second arms (53, 54) being inserted in said first and second apertures, respectively.
13. Washing machine (1) according to one or more of claims 2 - 11, wherein said supporting element (60,

90) comprises a first and a second sleeve (91, 92), said first and second arms (53, 54) being inserted in said first and second sleeves (91, 92), respectively.

14. Washing machine (1) according to claim 10 and 13, wherein said fire resistant protection plate (100) connects the first and second sleeves (91, 92).
15. Washing machine (1) according to one or more of the preceding claims, wherein the boundary wall (5) of the treatment container (3) includes a lateral tubular wall (6) and a back wall (7) closing one side of the lateral tubular wall (6), the bottom wall (31) of the sump section (9) being part of the lateral tubular wall of the treatment container (3) and the lateral wall (32) of the sump section (9) being part of the back wall (7) of the treatment container.



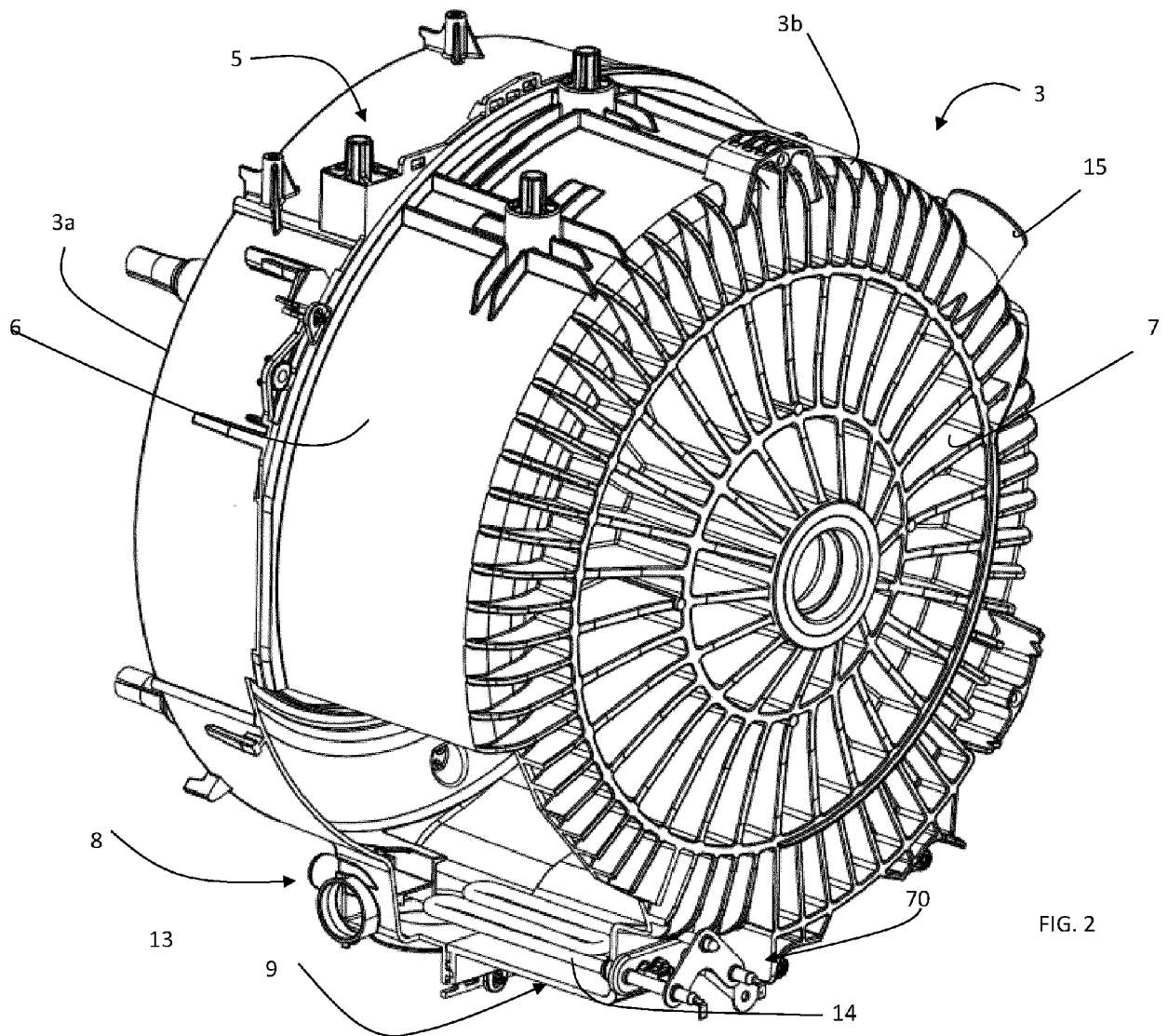
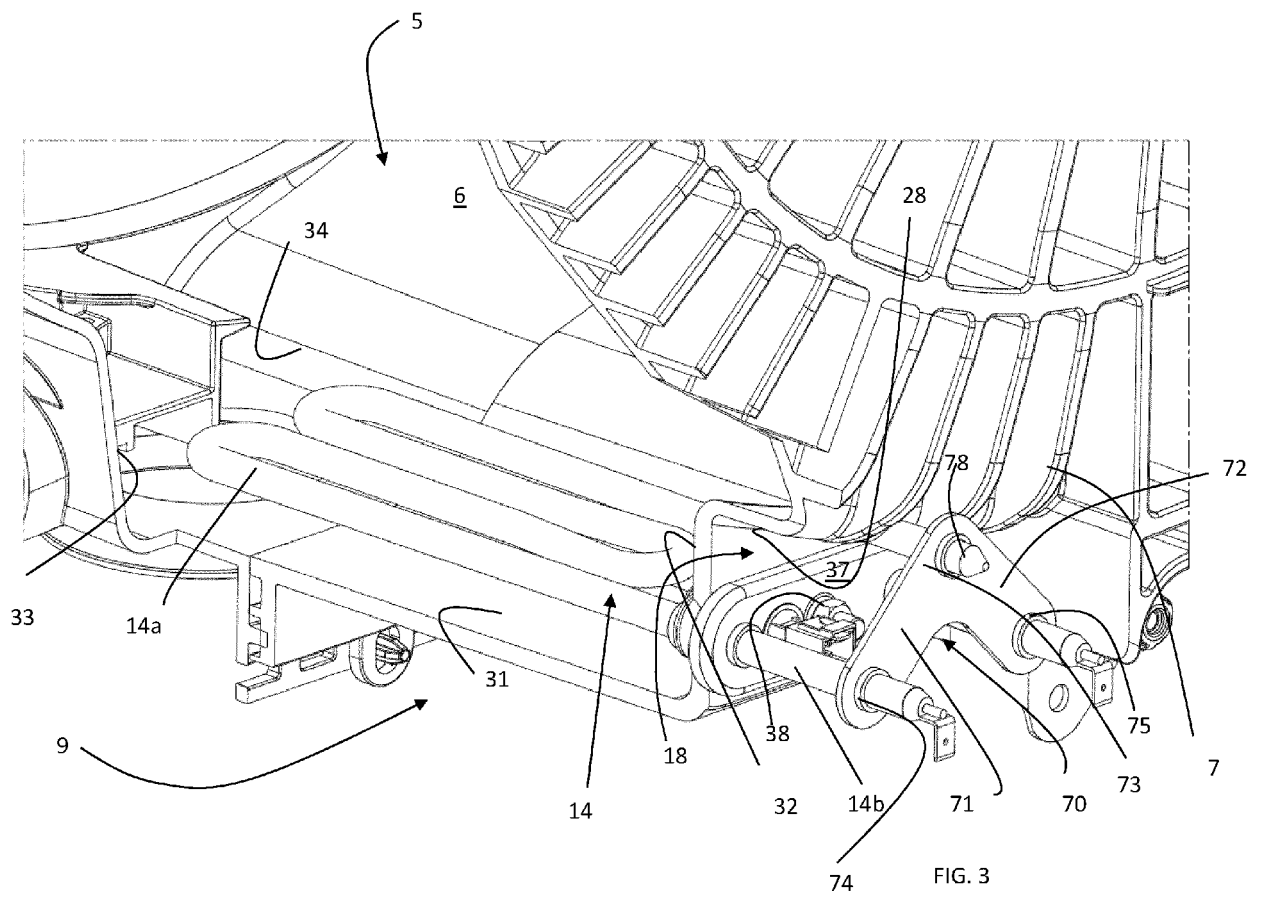
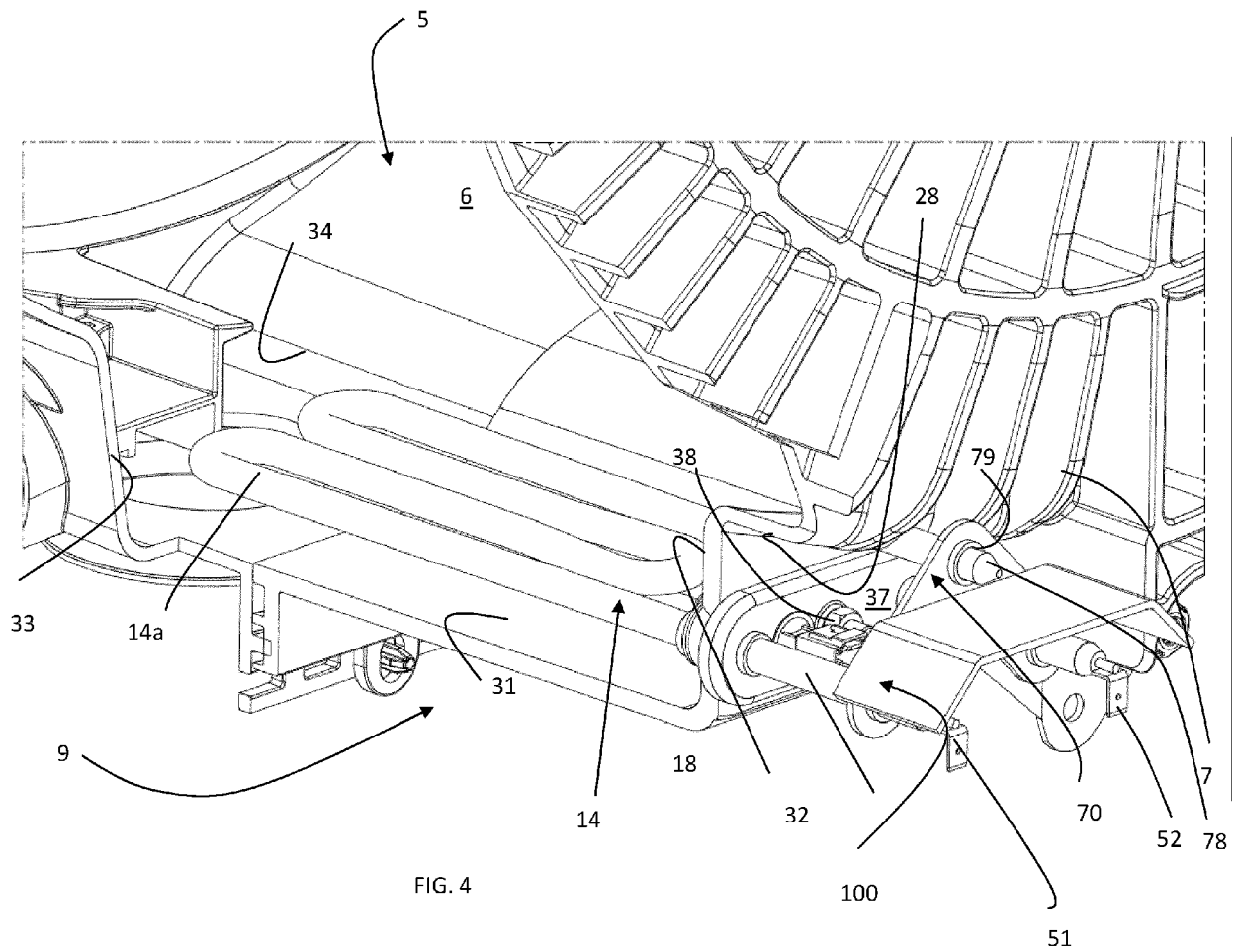


FIG. 2





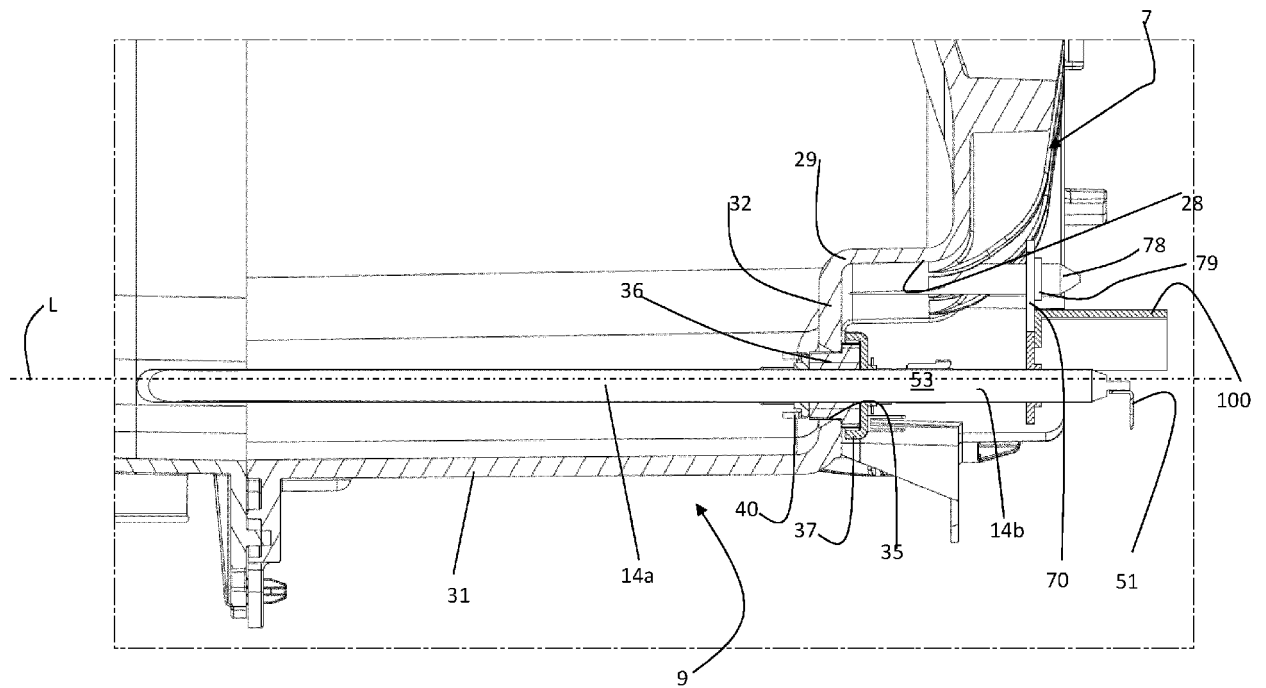
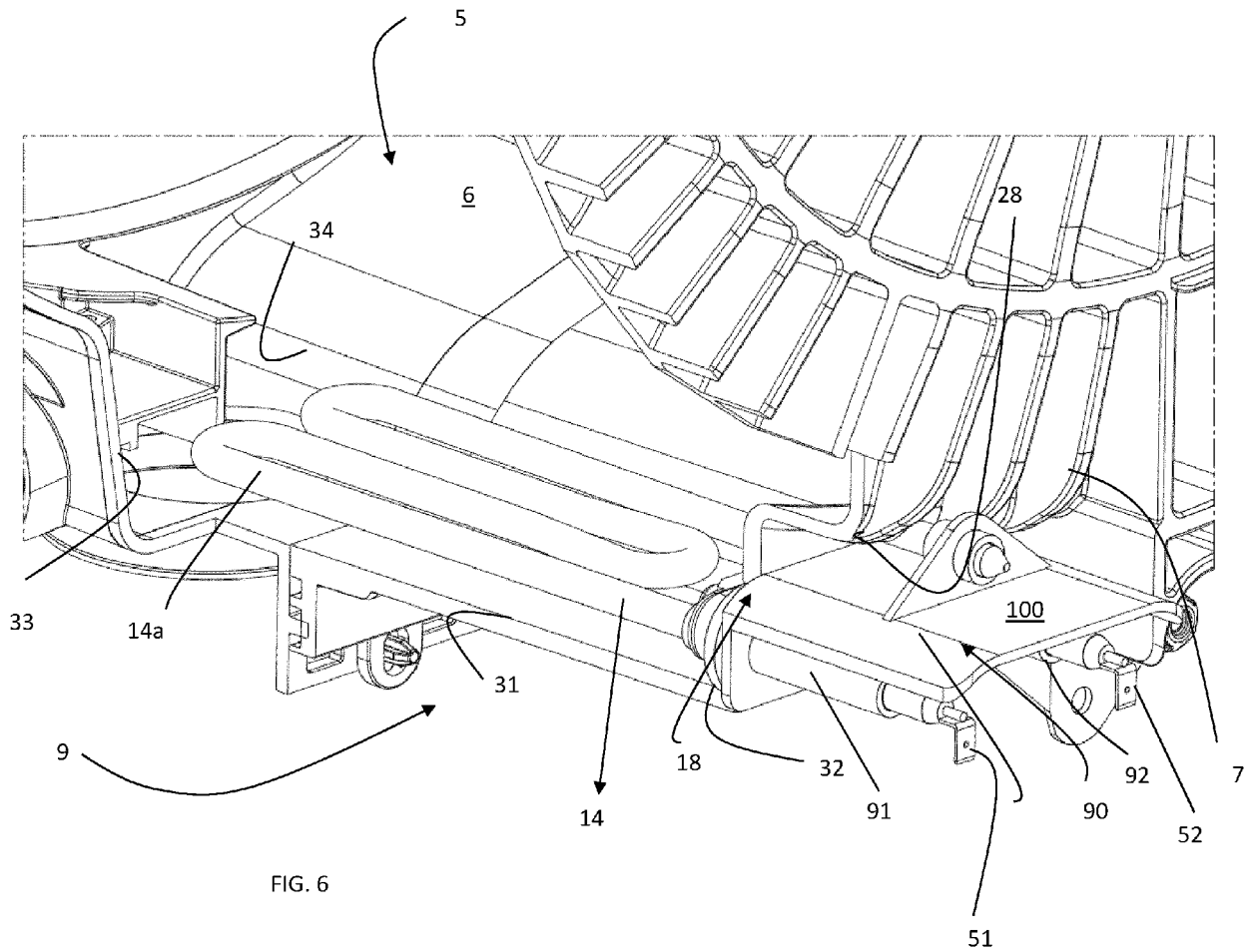
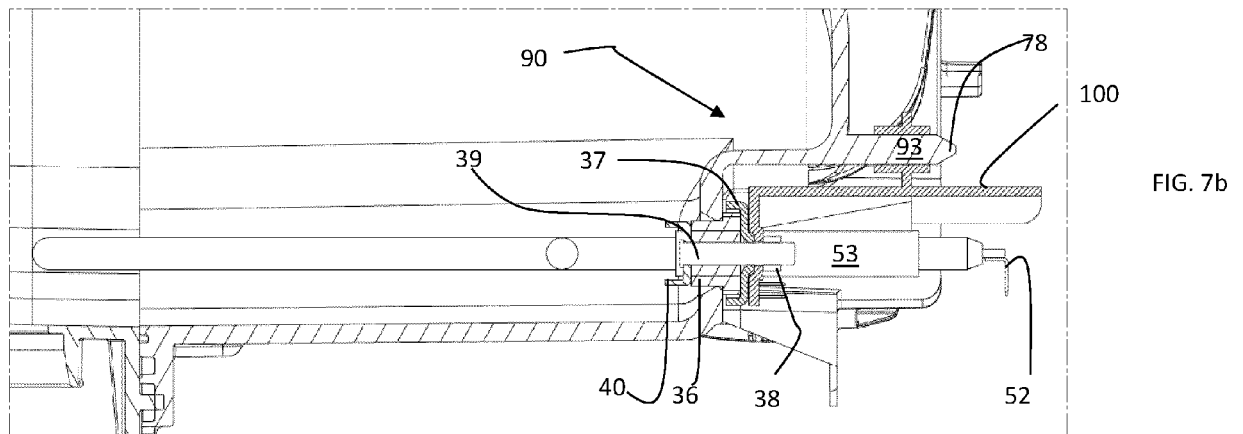
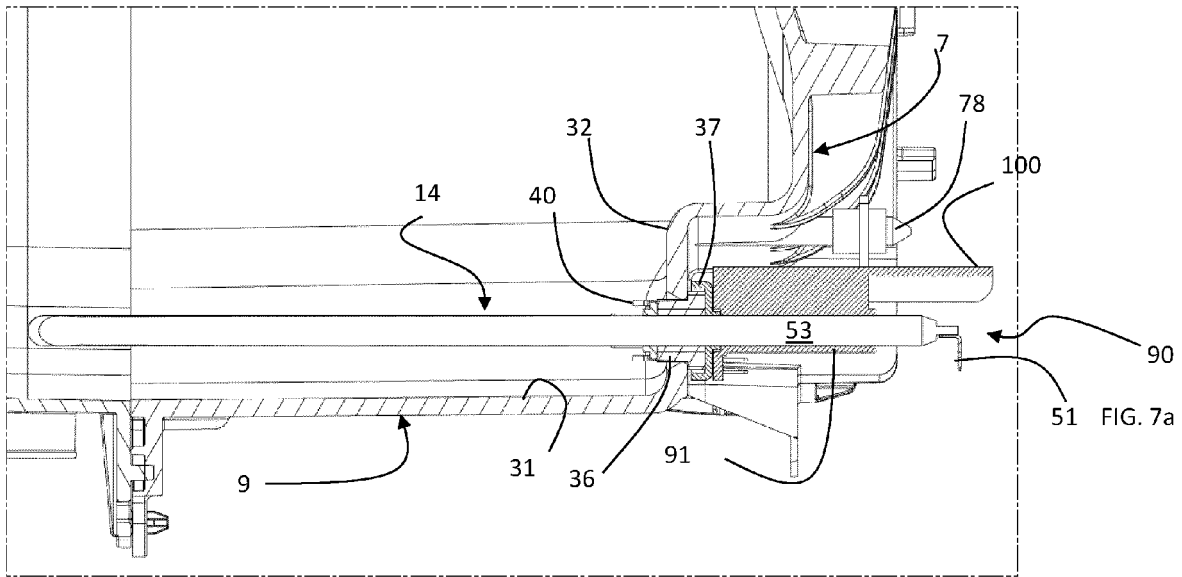
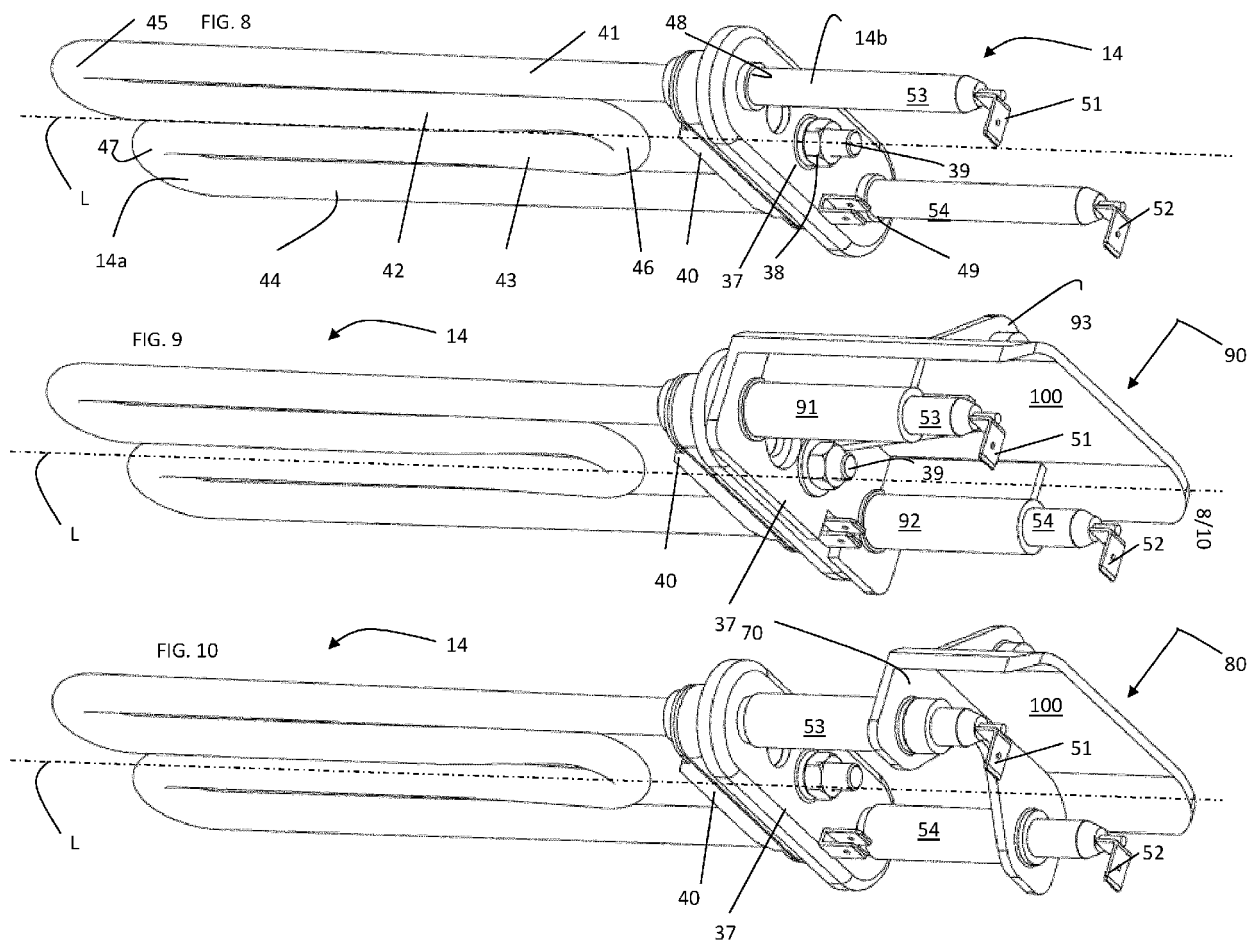


FIG. 5







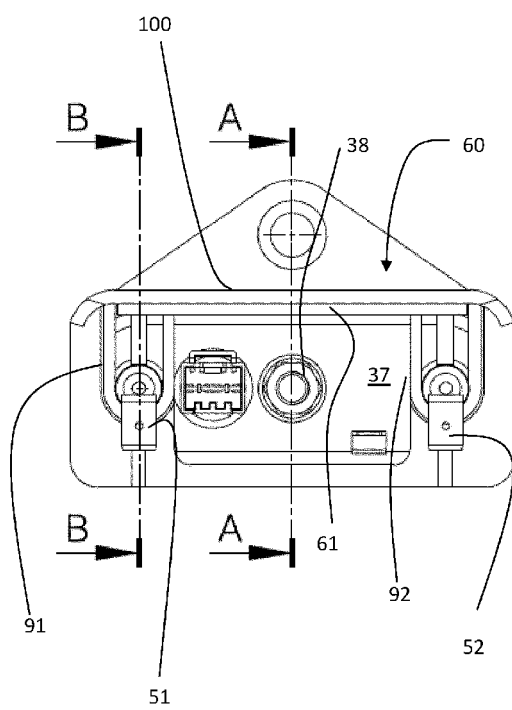


FIG. 11a

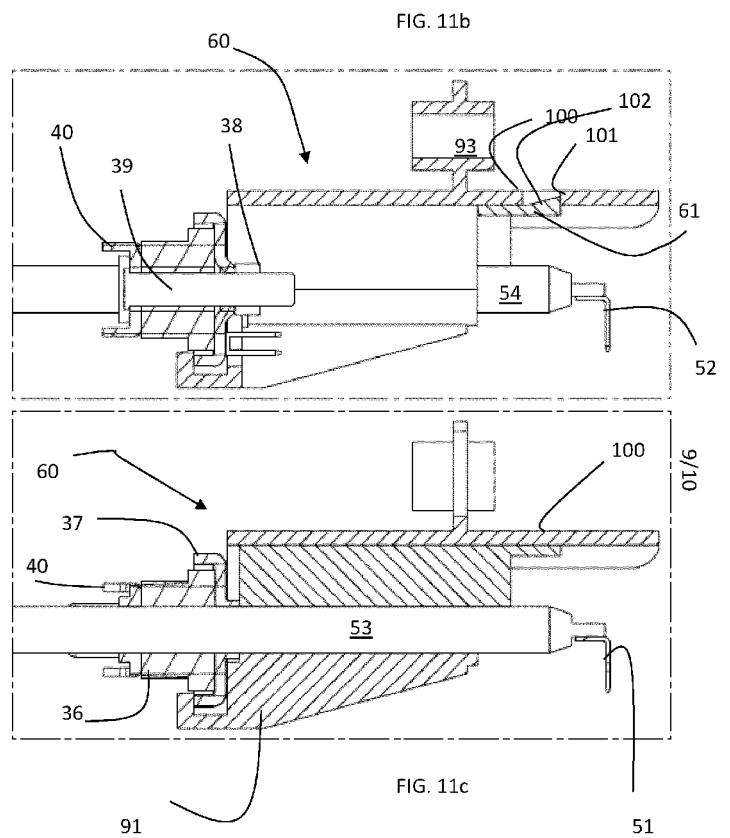
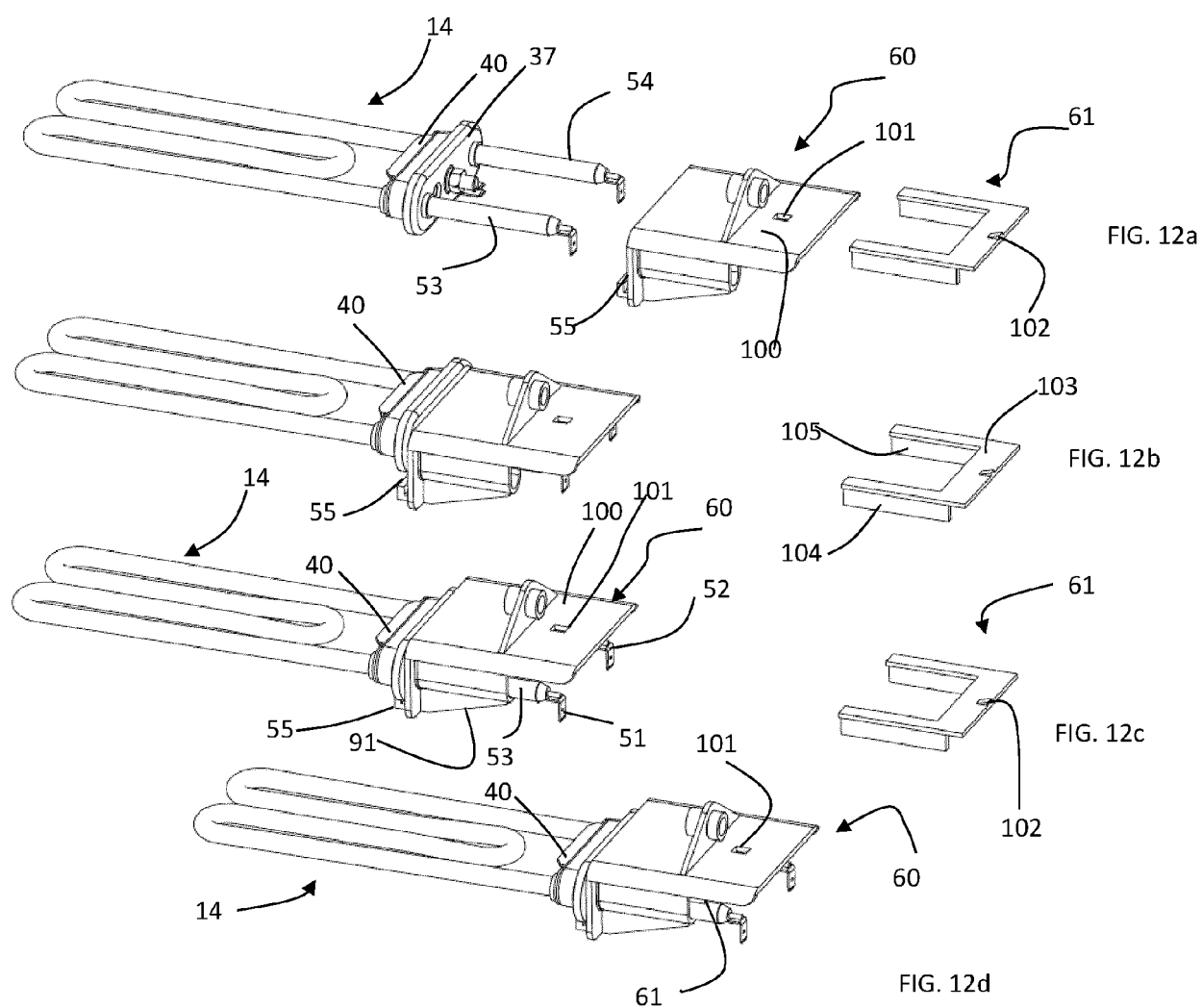


FIG. 11b

FIG. 11c





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