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(54) **DRYER WITH A MOISTURE SENSOR SYSTEM**

(57) The present invention relates to a dryer (10) comprising:

- a rotatable drum (14) defining an inner volume to contain laundry;
- a moisture sensor system (100) comprising a support (24) for receiving a first and a second electrode (30) in a first and second seat (32), respectively, which are spaced apart one another, each of said first and second electrode (30) defining a first and a second electrode end (148, 150) and first and second opposite surface (152, 154), wherein the first surface (152) faces the inner volume of said laundry drum (14) so as to be contacted by the laundry loaded therein when the drum (14) rotates, and the second surface (154) faces said support (24), said first and second electrode (30) being electrically connected

to a moisture detection circuit;

- each of the first and second seat (32) including a first and a second aperture (48, 50) in which the first and second electrode (30) end are, respectively, at least partially inserted;
- wherein the first end (148) of the first and/or second electrode (30) comprises a first appendix (149) inserted into the first aperture (48) of the first and/or second seat (32), the first appendix (149) comprising a first and a second plate-like element (149a, 149b) which extend in a first and a second plane, respectively, the first and the second plate-like element (149a, 149b) forming an angle between each other, and wherein the first and the second plane are both substantially perpendicular to the second surface (154) of the first and/or the second electrode (30).

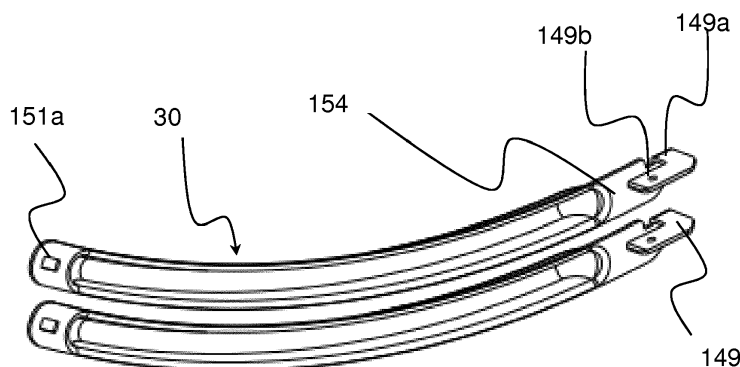


Fig. 8

Description

FIELD OF THE INVENTION

[0001] The present invention relates to a dryer with a moisture sensor system.

[0002] With the term "dryer" or "laundry dryer" or "tumble dryer" both an appliance having drying function only, or a combined washer-dryer appliance, which is capable of performing both washing and drying cycles, are meant.

BACKGROUND ART

[0003] Tumble dryers and other domestic appliances, e.g. spinner-washers, generally include a moisture sensor in order to obtain information about the actual moisture of the laundry in the drum or of the air exiting the latter. This information is used for controlling the tumble dryer, e.g. for stopping the drying cycle when the detected moisture of the laundry is below a prefixed value.

[0004] The moisture sensor may comprise one or more electrodes which are located in a position which allows contact with the laundry, so that the humidity of the laundry can be detected. For example, the electrodes are located facing the drum so that the contact with the laundry is possible. Further, the electrodes are connected to suitable wirings so that electrical signals can be sent from the electrodes to a control unit of the laundry where the information regarding the humidity of the laundry can be derived from the electrical signals themselves. However, the necessary wirings above described are preferably not in contact with the laundry, due to the water presence. This in turn means that there is an aperture in the moisture sensor fluidly connecting a drum inner volume where the laundry is located and a separated volume where the wirings are positioned, so that the electrodes can be connected to the wirings in a safe manner.

[0005] EP2458275 in the name of the same Applicant discloses a tumble dryer comprising: a laundry drum for loading/unloading the laundry; a humidity sensor system comprising at least one support for two or more electrodes, electrically insulated one another and positioned in such a way that the electrodes are placed into or face the internal of the laundry drum, so as to contact the laundry loaded into the latter, the electrodes being electrically connected or connectable to a detection circuit and/or a control unit of the tumble dryer. Advantageously, the support comprises at least two seat or channels for receiving the electrodes; each seat or channel comprises at least one retaining element adapted for retaining a respective electrode into the seat or channel.

SUMMARY OF THE INVENTION

[0006] It is an object of the present invention to provide a dryer with a moisture sensor system, which improves the moisture sensor systems of the prior art, in particular simplifying the assembly of the same, while maintaining

high standards in safety and performances. It is desirable to have a moisture sensor system including electrodes which is easy to mount, easily positioned in the correct location and also easily connectable to wirings needed to send data (i.e. electrical signals) to a control unit in order to detect and evaluate humidity of the laundry. Further, it is desirable that an aperture - realized for example in a bulkhead of the dryer - which is created to allow the electrodes to connect to the wirings, is as small as possible, so that fluff, lint and humidity which may come into contact with the wirings is minimized.

[0007] According to an aspect, the invention relates to a dryer comprising:

- a rotatable drum defining an inner volume to contain laundry;
- a moisture sensor system comprising a support for receiving a first and a second electrode in a first and second seat, respectively, which are spaced apart one another, each of said first and second electrode defining a first and a second electrode end and first and second opposite surface, wherein the first surface faces the inner volume of said laundry drum so as to be contacted by the laundry loaded therein when the drum rotates, and the second surface faces said support, said first and second electrode being electrically connected to a moisture detection circuit;
- each of the first and second seat including a first and a second aperture in which the first and second electrode end are, respectively, at least partially inserted;
- wherein the first end of the first and/or second electrode comprises a first appendix inserted into the first aperture of the first and/or second seat, the first appendix comprising a first and a second plate-like element which extend in a first and a second plane, respectively, the first and the second plate-like elements forming an angle between each other, and wherein the first and the second plane are both substantially perpendicular to the second surface of the first and/or the second electrode.

[0008] The dryer of the invention can be either a "single" drying machine or a "combined" washer-dryer machine, therefore including any appliance having laundry drying function.

[0009] Further, it may be a front-loading dryer, which means that a laundry chamber in which the laundry is located has an axis which is positioned in a horizontal manner or slightly tilted with respect to the horizontal plane, or a top laundry dryer, where the axis of the laundry chamber is substantially vertical.

[0010] In a preferred embodiment, the laundry dryer is a front loading laundry dryer.

[0011] Preferably, the dryer includes a drum where laundry is located or removed. The drum is apt to rotate

around its axis. The drum for example may have the shape of a cylinder, having at least an open end.

[0012] The drum is part of a process air circuit, in particular a closed-loop circuit in case of a condensed dryer or an open circuit in case of a vented dryer, which in both cases includes a process air conduit for channeling a stream of air to dry the load. The process air circuit is connected with its two opposite ends to the drum. More specifically, hot dry air is fed into the drying chamber, flowing over the laundry, and the resulting humid (and to a lower temperature cooled down) air exits the same. In case of a closed-loop drying air circuit, the humid air stream, rich in water vapor, is then fed into a humidity removal element, such as a heat exchanger. In a preferred embodiment of the invention, the humid air is fed to an evaporator of a heat pump system, where the moist process air is further cooled down and the humidity present therein condenses. The resulting cool dry air is then heated up before re-entering again in the drying chamber by means of a hot drying air generator, which can be for example a condenser of the heat pump system, and the whole loop is repeated till the end of the drying cycle. Alternatively or in addition, to remove humidity from humid air stream exiting the drum, an air-air type heat exchanger may be used. Such heat exchanger receives ambient air as cooling fluid to cool down and remove humidity from humid air stream passing there-through. Furthermore, the hot drying air generator may comprise an electrical or gas powered heating device. In a vented dryer, ambient air is taken into the dryer via an inlet duct, such air is heated up by a hot drying air generator, such as condenser of the heat pump system and/or an electrical or gas powered heating device, before entering the drum. Heated air flowing through and on humid laundry contained in the drum, removes humidity from laundry. Humid air stream exiting the drum may be optionally dehumidified by an evaporator of a heat pump system, or an air-air type heat exchanger as explained above, before being exhausted outside the dryer.

[0013] Thus, the process air conduit to channel the flow of drying air preferably includes an air passage that brings such drying air from the hot drying air generator to the inside of the drum from its rear end, i.e. through its back wall. In other possible solutions of laundry dryer, air is fed from the front of the drum and flows in direction of the rear of the drum.

[0014] The dryer furthermore preferably includes a casing comprising preferably a basement, a front wall and a rear wall. The front or top wall is advantageously provided with a through opening, at which a door is mounted to access the drum in order to locate or remove the laundry.

[0015] In a possible embodiment, the front wall includes a front bulkhead which is preferably made of a plastic, i.e. polymeric, material, for example as an integral, i.e. single, unitary piece. A front part of the drum is rotatably coupled to the front bulkhead. In the front bulk-

head the through opening for accessing the drum is preferably provided. The front bulkhead is then preferably covered by a cover which extends around the through opening and defines the external front surface of the front wall of casing. Further, the front wall may comprise a front top control panel to command the functioning of the machine by the user.

[0016] The basement rests on a floor and its vertical distance from the floor may be advantageously adjusted through regulating feet provided on the lower surface of the basement facing the floor.

[0017] The rear wall of the casing may also include a rear bulkhead. The rear bulkhead may form part of the air process circuit that brings process air to (or from) the drum.

[0018] The casing defines the boundary between the internal or inner side of the dryer and the external side of the dryer.

[0019] The laundry further includes a moisture sensor system to detect the moisture or humidity of the laundry located in the drum. Preferably, the dryer also includes a central control unit in signal connection to the moisture sensor system, so that the control unit receives and elaborates the signals sent by the moisture sensor system to determine the moisture value of the laundry. The central control unit therefore has the function of a moisture detection circuit, receiving electric or electronic signals from the moisture sensor system and outputting a moisture value of the laundry.

[0020] The connection between the electrodes and the central control unit is made via suitable wirings and connectors known in the art.

[0021] The moisture sensor system comprises a support defining a first and a second seat and a first and a second electrode housed at least partially in the first and second seat, respectively. The two sensors are spaced apart one another and they are positioned so that the laundry can come into contact with them during the normal functioning of the dryer. For example, the seats and thus the electrodes in the support can be mounted facing the inner volume of the drum so that, during drum rotation, the laundry can come into contact with the electrodes during tumbling.

[0022] The calculation or evaluation of the moisture present in the laundry based on the signals coming from the electrodes can be performed according to any method or algorithm. For example, electrical impedance can be measured between the two electrodes. An impedance can be measured when a circuit formed by the two electrodes which are not in contact to each other is "closed" by a piece of laundry. Variations of this impedance may give a measure of the humidity present in the laundry. Preferably, the calculation is performed by the central control unit.

[0023] Further, from the calculation of the moisture or humidity of the laundry, the dryer can be controlled, for example terminating the drying cycle if the moisture detected is below a given threshold. The performed dryer

control depending on the detected humidity of the laundry can be of any type known in the art.

[0024] Each electrode defines a first and a second end, which are axially opposed one to the other. Further, preferably each electrode has an elongated shape and a longitudinal axis can be defined as a line or axis connecting the first and the second end. The distance between the first and the second end along this longitudinal axis is preferably the major dimension of the electrode. Further, the electrode is preferably curved and it has the shape of a parenthesis. In addition, it is preferably substantially flat, so that its thickness is its minor dimension.

[0025] At the same time, each electrode defines a first and a second opposite surface, separated by a side surface defining the thickness of the electrode, wherein the first surface faces the inner volume of the laundry drum, that is, it is the surface that may come into contact with the laundry, and the second surface faces the support, e.g. the seat where it is inserted.

[0026] In order to position the electrodes in the support and to make the connection with the suitable wirings, each seat includes a first and a second aperture. In these apertures, the first and second ends of the electrode are inserted at least in part, so that the electrode is positioned in the seat for most of its part and remains there due to the mechanical coupling between the seats and the ends of the electrode, while a minor part of the electrode, e.g. a portion of its ends, are located behind the seat. The location behind the seat allows connection with the wirings

[0027] This mechanical coupling seat/electrode is formed by a first appendix realized in at least one of the electrodes, and preferably in both the first and the second electrodes, which couples with a seat wall. The first appendix protrudes from the second surface of the electrode, which is the surface facing the support and the seat where the electrode is positioned. In particular, the first appendix includes a first and a second plate-like element, advantageously connected to each other, which lie on a first and a second plane, respectively. The first and second planes may be parallel to each other, they may be inclined with respect to each other or they may coincide, that is, both first and second plate-like elements lie on the same plane.

[0028] The two first and second plate-like elements form an angle therebetween. That is, each first and second plate-element element has a direction of extension, and these two directions of extension form an angle therebetween. An angle between the two direction of extensions can be defined also when the two elements lie on the same plane, for example the two plate-like elements may form a planar L shape, where each element is an arm of the L. Thus, that the first and second plate-like elements form an angle therebetween means that an angle can be defined between their two different directions of extension, one direction defined for each plate-like element. The direction of extension is defined as an axis along the geometrical extension of the plate-like element

which lies on the same plane defined by the plate-element, that is, the direction of extension of the first plate-like element lies on the first plane and the direction of extension of the second plate-like element lies on the second plane.

[0029] Further, both planes, the first and the second, are perpendicular to the second surface of the electrode. The second surface defines an infinite number of planes perpendicular to itself, thus the orientation of the first and second plane can be arbitrary.

[0030] Preferably, the first plate-like element is attached with a first end to the electrode - for example to the second surface of the same - and extends therefrom along the first direction of extension. The second plate-like element is attached to a second free end of the first plate-like element and extends therefrom along the second direction of extension, forming an angle with the first.

[0031] The first and/or second plate-like element are/is inserted at least for a part into the first aperture formed in the corresponding seat in the support. Being the planes on which the first and second plate-like element lying perpendicular to the second surface of the electrode, which is positioned substantially parallel to a bottom wall of the seat, this allows the realization of a small aperture for the insertion of the electrode's end. As said, the first and second elements are plate-like and therefore they are rather "thin" by definition. The fact that they face the seat with their side, having a small thickness, allows the realization of a "thin" aperture in the seat, so that fluff and lint flowing in the drum which faces the support are hindered in entering it.

[0032] Further, the presence of two angled plate-like elements have the effect of forming a "hook", so that the electrode can grip with this so-formed hook the bottom wall of the seat where the aperture is formed, minimizing the risk of accidental removal of the electrode.

[0033] According to the invention, the dryer may include, alternatively or in combination, one or more of the following features.

[0034] Preferably, the first aperture of the first and/or second seat includes a slit aperture in which the first appendix is at least partially inserted.

[0035] As mentioned, the geometry of the first appendix having a first and a second plate-like elements lying on planes both perpendicular to the second surface of the electrode allows the realization of a "thin" slit-like aperture for the insertion of the first and/or second plate-like element.

[0036] Preferably, each of the first and the second plate-like elements defines a length and width on the first and second plane and a thickness in a direction perpendicular to the first and second plane, respectively, and wherein the slit aperture has a dimension in one direction which is longer than the thickness and shorter than the width and the length of the first and second plate-like element.

[0037] The slit aperture is preferably "thin", in other words it has one dimension which is relatively much

smaller than the others, and in particular it smaller than the length and the width of the plate-like elements. In order to allow entrance of the first and/or second plate-like elements in the slit aperture, the latter has to have a width longer than the thickness of the first and/or second plate-like element.

[0038] Preferably, each of the first and second seats defines a first and a second seat end, the first seat end including the first aperture and the second seat end including the second aperture.

[0039] The geometrical form of the seats preferably is similar to the geometrical form of the electrodes. Thus the ends of the electrodes are positioned at the ends of the seat, where the apertures are formed. Preferably, the seats are thus elongated and slightly curved.

[0040] Preferably, the slit aperture extends in a direction substantially connecting the first to the second seat end.

[0041] Considering a line connecting the seat ends, which may coincide with the position of the seat apertures, the slit aperture preferably extends along this line. The electrode inserted therein therefore may perform position adjustment movements along this line. Further, this direction of extension of the seats preferably substantially coincides with the longitudinal axis of the electrodes.

[0042] Preferably, the first appendix is at least partially inserted in a connector to connect the first and/or second electrode to the moisture detection circuit.

[0043] In order to form a moisture detection circuit that may measure the resistance or impedance between the two electrodes, the latter need to be connected via wirings to an electronic circuit and/or to the central control unit. In order to perform such a connection, suitable connectors known in the art are used. The electrical coupling is created inserting the first appendix for a portion thereof inside the connector so that a mechanical contact is made. Preferably the first appendix is realized in metal.

[0044] Preferably, the second plate-like element of the first appendix is at least partially inserted in the connector.

[0045] A connection which occupies "a small space" is thus obtained. The first plate-like element extends from the electrode in a first direction, which is perpendicular to the second surface. The second direction of extension of the second element is angled with respect to it and thus it cannot be perpendicular to the second surface. This also means that the direction of insertion of the second element into the connector is also angled with respect to the second surface (direction of insertion of the connector and direction of extension of the second plate-like element is this example coincides). The second surface of the electrode faces the support and thus the bottom wall of the seat where the apertures are formed. The direction of insertion into the connector is thus angled with respect to the bottom wall, minimizing the space needed for the connection presence (there is much more space available in a direction parallel to the bottom wall than in the direction perpendicular to it).

[0046] Preferably, the second electrode end of the first

and/or second electrode includes a second appendix extending substantially parallel to the second surface of the first and/or second electrode, the second appendix being at least partially inserted in the second aperture.

[0047] Both ends of the electrodes are inserted in respective apertures. The second end includes a second appendix, preferably also plate-like, which can be inserted in the second aperture.

[0048] Preferably, the first appendix has an L-shape having a first and a second arm, wherein the first and the second plate-like elements correspond to the first and second arms.

[0049] An L shape does not mean that the first and second planes are parallel or they coincide. Indeed two L arms can be angled in more than one direction.

[0050] Preferably, the first and the second planes are parallel to each other. More preferably, the first and second planes are the same plane.

[0051] Preferably, the first and/or second seat includes a bottom wall having a first side and a second side opposite to the first side, the first side facing the second surface of the first and/or second electrode, and wherein the first appendix partially faces the second side of the wall.

[0052] In this embodiment therefore there is a portion of the first appending that is "shielded" by the bottom wall and it is not in contact with the laundry. This portion is preferably used to perform the electrical connection with the wirings.

[0053] Preferably, the second plate-like element is positioned at least partially facing the second side of the wall.

[0054] The portion inserted in the aperture preferably includes the second plate-like element which is then inserted in the connector.

[0055] Preferably, the first and/or the second seat includes a retaining member to retain the first and/or second electrode into the first and/or second seat, respectively.

[0056] This retaining member may be positioned on an edge of the seat. It may include a small flap or a snap-in element. It is used to maintain the electrode within the seat in addition to the presence of the mechanical coupling given by the insertion of the ends of the electrodes in the apertures of the seats. More than one retaining member may be present as well.

[0057] Preferably, said first and second electrode and said respective first and second seat have an elongated shape defining a longitudinal axis.

[0058] The longitudinal axis may be defined as the line connecting the first and the second end of the electrode. In the same way, each seat has a longitudinal axis defined as the line connecting its first and second end (or the first and the second aperture). In a preferred embodiment, when the electrode is inserted in the respective seat, the longitudinal axis of the electrode coincides with the longitudinal axis of the seat.

[0059] Preferably, the first and/or the second plane

forms an angle comprised between 0° and 25° with the longitudinal axis of the electrode.

[0060] The longitudinal axis of the electrode lies on its second surface. Preferably, the first and the second planes are perpendicular to the second surface and form each an angle comprised between 0° and 25° with this axis. The angle formed by the first plane may be equal or different than the angle formed by the second plane.

[0061] Preferably, each of the first and/or second electrode is moveable within its respective first and/or second seat about a predetermined length. More preferably, the movement is along a longitudinal axis of the first and/or second electrode.

[0062] The dimensions of the first and second ends of the electrode and of the first and second apertures are preferably such that the insertion is relatively easy and relatively small movements are possible to properly position the electrodes.

BRIEF DESCRIPTION OF THE DRAWINGS

[0063] Further features and advantages of the present invention shall become clearer from the following detailed description of a preferred embodiment thereof, made with reference to the attached drawings and given as an indication and not for limiting purposes.

[0064] In particular, the attached drawings are included to provide a further understanding of the invention and are incorporated in and constitute a part of this specification. The drawings together with the description serve to explain the principles of the invention. In the drawings, corresponding characteristics and/or components are identified by the same reference numbers. In such drawings:

- Fig. 1 is a sectional side view of a dryer with a moisture sensor system according to the present invention;
- Fig. 2 is a sectional side view of the moisture sensor system according to the present invention;
- Fig. 3 is an exploded prospective view of a part of the dryer of Fig. 1;
- Fig. 4 is a prospective view of the part of the dryer of Fig. 3, viewed from a different view point;
- Fig. 5 is a prospective view of a component (support for receiving electrodes) of the dryer of Fig. 3;
- Fig. 6 is a prospective view of the component of Fig. 5, viewed from an opposed view point;
- Fig. 7 is an enlarged prospective view of other components (electrodes) of the dryer of Fig. 3;
- Fig. 8 is a prospective view of the other components

of Fig. 7, viewed from an opposed view point;

- Fig. 9 is a prospective view of the components of Fig. 7 associated with the component of Fig. 5;
- Fig. 10 is a prospective view of the components of Fig. 9, viewed from an opposed view point;
- Fig. 11 is an enlarged prospective view of the circled detail of Fig. 10;
- Fig. 12 is a prospective view of the circled detail of Fig. 11, in another operating condition; and
- Fig. 13 is the same prospective view of figure 12 in a further operating condition.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS OF THE INVENTION

[0065] Fig. 1 illustrates a sectional side view of a dryer 10 including a moisture sensor system 100 according to the present invention.

[0066] The dryer 10 advantageously comprises a casing 12 having a front wall 26 with a loading/unloading opening 17. The opening 17 could be positioned in another part of the casing as well. This opening 17 is closable by a door 16. A laundry drum 14 is rotatably arranged inside the casing 12. The rotatable drum 14 defines an inner volume to contain laundry. The drum 14 defines an open front side facing the door 16 which is advantageously sealed by a gasket 28 fixed preferably to the front wall 26. Alternatively, the gasket may be fixed to a flange or bulkhead which is associated to the casing 12. Preferably the gasket 28 encloses the loading/unloading opening of the dryer 10; advantageously the frontal edge of the laundry drum 14 is in contact to and slides on the gasket 28, so as to guarantee a rotatable airtight connection between the laundry drum 14 and the gasket 28.

[0067] It should be observed that, in the present description and in the attached claims, when relative terms such as "front", "back", "rear", "lateral", "top", "bottom", etc. are used, they refer to the normal operational position of the dryer 10 when in use, e.g. located on a floor which usually is (substantially) horizontal. The location of the door 16 of the dryer 10, generally coupled to the front side of the casing 12 in order to access the drum 14, defines the "front" of the dryer 10 itself in this embodiment. Given the horizontal plane on which the dryer 10 is located, "top" and "bottom" - as their normal common meaning - refer to the position of an object along a vertical axis.

[0068] The dryer 10 is arranged in such a way that an air stream 18 may circulate between the laundry drum 14 and an air stream channel 20, which are connected to each other. The air stream channel 20 extends preferably below and behind the laundry drum 14; advantageously the front wall 26 is comprised in the air stream

channel 20, for example defining an inlet for the air stream channel.

[0069] A heat exchanger or a heat pump including a condenser and an evaporator (all indicated with 22) is preferably arranged within the air stream channel 20, for example below the laundry drum 14.

[0070] During operation of the dryer 10, the air stream 18, advantageously heated before entering the laundry drum 14, circulates through the laundry drum 14 and the air stream channel 20, so as to remove the moisture from the laundry loaded into the laundry drum 14. A heat exchanger or the evaporator of the heat pump 22 may cool down the air stream 18 exiting from the laundry drum 14 and removes moisture from the air stream 18. After passing the condenser 22, the air stream 18 is heated up again within the air stream channel 20, for example by an electric heater or the condenser of the heat pump system. Then, the air stream 18 is introduced into the laundry drum 14 again. Thus, the air stream 18 circulates within a closed loop.

[0071] Alternatively, the present invention may be applied to a vented dryer, wherein the hot and humid air stream 18 exiting the laundry drum 14 is blown to the environment without recirculation.

[0072] The dryer 10 further comprises a moisture sensor system 100. The system 100 includes a support 24 for two or more electrodes 30, electrically insulated one another, which is positioned in such a way that the electrodes 30 are placed into or faces the inner volume of the laundry drum 14, so as to contact the laundry loaded into the latter. Preferably, the electrodes 30 are identical to each other.

[0073] Preferably the support 24 is attached at a lower portion of the front wall 26. In this case the support 24 is arranged internally or in proximity to laundry drum 14, preferably but not necessarily in correspondence to the inlet of the air stream channel 20. Advantageously, the support 24 may be obtained in a single piece construction with the front wall 26 (i.e. it may be part of the front wall 26, for example part of the bulkhead); alternatively, the support 24 and the front wall 26 may be advantageously obtained as completely separate components, and they may be associated one another after their manufacture.

[0074] Fig. 2 illustrates a very schematic sectional side view of the moisture sensor system 100 according to the present invention. The support 24 may be advantageously attached at the lower portion of the front wall 26.

[0075] It is clear that in a further embodiment, not illustrated, the support 24 may be also defined as the part of the front wall 26 to which the electrodes 30 are associated, and therefore they are not proper distinguished components as in the enclosed figures.

[0076] As mentioned above, the moisture sensor system 100 also includes two (or more) electrodes 30 which are advantageously attached at the support 24

[0077] The support 24 is preferably made of an electrically insulating material, so that the two electrodes 30 are electrically insulated from each other. For example,

support 24 is made of plastic material.

[0078] Advantageously the electrodes 30 are provided for detecting the moisture of the laundry loaded into the laundry drum 14; when a piece of laundry touches both the electrodes, the electrical impedance between the electrodes changes, and can be detected by a suitable detection circuit to which the electrodes are electrically connected, as detailed below. Advantageously the detection circuit detects the moisture of the laundry as a function of the electrical impedance (or of a quantity related to the impedance) between the electrodes 30.

[0079] The electrodes 30 advantageously have a predetermined distance from each other.

[0080] Figs. 3 and 4 illustrate perspective rear views of the front wall 26, in this case of a bulkhead 26a is part of the front wall 26, of the dryer 10 including the moisture sensor system 100 according to the present invention. As shown, the support 24 of the electrodes 30 is fitted in a rear surface of the bulkhead 26a, for example in a seat 37 of the same.

[0081] The support 24 is preferably attached at a lower portion of the bulkhead 26a, close to opening 17, for example by screws (not depicted in the drawings). In view of that, the support 24 preferably comprises corresponding screw holes 36.

[0082] Further, a light source 34 may preferably be arranged at an upper portion of the front wall 26 (see figure 4). The light source 34 is provided for illuminating the inner volume of the laundry drum 14.

[0083] The support 24 comprises two seat or channels 32, having preferably an elongated shape, for receiving the respective two electrodes 30. In case of more than two electrodes, the number of seats is preferably equal to the number of electrodes. Each channel 32 is substantially complementary in shape to at least part of the respective electrode 30. Preferably, the seat or channel 32 - as the electrodes - are identical to each other and are positioned one on top of the other. The electrodes 30 as well as the channels 32 are preferably curved, having the shape of a parenthesis. Further, the electrodes 30, as well as the seat or channel 32, are elongated, having a predominant dimension, being better detailed below. Further, each electrode 30 defines a thickness, which is relatively "thin" compared to the other dimensions of the electrode.

[0084] Figs. 5 and 6 illustrate perspective views of the support 24 of the moisture sensor system 100 according to the present invention; in the mentioned figures, the electrodes 30 are not shown to better display the details of the support 24 itself. Figure 5 shows the support as visible from the inner volume of the drum, while figure 6 shows an inner surface of the support 24 which is normally not visible because it is attached to the bulkhead 24a.

[0085] The seats 32 are visible in figure 5 and they are spaced apart one another and extend substantially parallel to one another, one on top of the other.

[0086] Each channel or seat 32 includes a first and a

second end 32a, 32b and it advantageously comprises a first opening or aperture 48 at its first end 32a and a second opening or aperture 50 at its second end 32b. For clarity, the reference numbers are positioned only in correspondence of one of the two seats 32, such as the first seat, being the numbering identical in the second one.

[0087] Further, each channel or seat 32 defines a bottom wall 32c, one side of which faces the electrode 30 when the latter is inserted in the seat. The apertures 48, 50 are formed in the bottom wall 32c of each seat.

[0088] Each bottom wall 32c has a first side 33a and a second side 33b opposite to the first side. The first side 33a of the wall 32c faces the second surface 154 of the respective electrode 30. The second surface 33b faces the remaining of the bulkhead 26a, or seat 37. Between the support 24 and the bulkhead 26a a free volume may be defined, to connect the electrodes to suitable wirings, as detailed below.

[0089] As shown in figure 6, the second sides 33b of the bottom walls 32c of the two channels or seats 32 merge in a single surface of the support 24. In other words, in the side of the support opposite to the side where the seats 32 are formed, the two bottom walls of the two seats are geometrically one the continuation of the other (second surfaces 33b of the walls 32c are a single flat surface).

[0090] As shown in Fig. 5, each seat or channel 32 preferably further comprises a retaining element 62 adapted for retaining the respective electrode 30 into the seat or channel 32. Advantageously the retaining element 62 may be placed at a longitudinal side or edge of the channel 32, preferably, but not necessarily, at a lower longitudinal side. The retaining element 62 preferably projects towards the internal part of the channel 32.

[0091] With now reference to figures 7 and 8, a detailed view of the electrodes 30 is given.

[0092] Each of the two electrodes 30 defines a first and a second electrode end 148, 150 axially opposite one to the other, and a first and a second opposite surface 152, 154. The first surface 152 (better visible in figure 7) faces the inner volume of the laundry drum 14 to be contacted by the laundry loaded therein when the drum 14 rotates. The second surface 154 (better visible in figure 8) faces the support 24, in particular first side 33a of bottom wall 32c.

[0093] Each electrode 30 defines a longitudinal axis X which is defined as an axis connecting the first and the second end 148, 150, as visible in figure 7. The electrodes have their major dimension - or length - along the longitudinal axis X.

[0094] The first and second electrode ends 148, 150 are, respectively, at least partially inserted into the first and second openings or apertures 48, 50, respectively, of each channel or seat 32.

[0095] Fig. 9 and 10 show the electrodes 30 inserted into the seats 32 of the support 24 and the ends 148, 150 of each electrode 30 partially inserted in the respective

apertures 48, 50 formed in the bottom wall 32c. Figures 9 and 10 are substantially equivalent to figures 5 and 6, where the support 24 is shown without the electrodes 30.

[0096] The two electrodes 30 are electrically connected to the moisture detection circuit (mentioned above) to form the moisture sensor system 100.

[0097] In particular, the first end 148 of the electrode 30 comprises a first appendix 149 at least partially inserted into the first aperture 48 of the respective seat 30. Advantageously the first end 148 of the electrode 30 is adapted to be coupled to suitable electric connectors for electrically connecting the electrode 30 to the moisture detection circuit. The moisture detection unit may include a control unit 200 of the dryer 10, schematically depicted in figure 1 as a rectangle.

[0098] The first appendix 149 comprises a first and a second plate-like element 149a, 149b which lie in a first P1 and a second plane P2, respectively. The first and the second planes P1, P2 are both substantially perpendicular to the second surface 154 of the electrode 30.

[0099] The first appendix 149 is better visible in figures 11 and 12 which represent enlarged views of the encircled detail of figure 10 in two different mounting conditions. The first plate-like element 149a is preferably substantially rectangular, and it extends along a first direction of extension L1 perpendicular to the second surface 154 of the electrode 30. It is connected with a first end 161a to the electrode 30 and with a second end 161b to the second plate-like element 149b. The second plate-like element 149b, which is also preferably substantially rectangular, extends along a second direction L2 starting from a first end 162a connected to the second end 161b of the first plate-like element 149a and terminating with a second free end 162b. The extension of the second plate-like element is directed from the second end 161b of the first plate-like element 149a towards the second end 150 of the electrode 30.

[0100] The first and second directions of extension L1 and L2 of the first and the second plate-like elements 149a, 149b form an angle between each other. This angle in the present embodiment is of about 90°. Further, in the shown embodiment (in particular see Figs. 11 and 12), the first and second planes P1 and P2 are the same plane. Further, this common plane is also substantially parallel to the longitudinal axis X. In this way, the second direction of extension L2 is substantially parallel to the longitudinal axis X of the electrode 30, so that second plate-like element 149b and electrode 30 run substantially parallel for a given interval.

[0101] In an alternative embodiment (not shown), the first and the second planes are incident to each other. In this embodiment, the first and/or the second plane forms an angle comprised between 0° and 25° with the longitudinal axis X.

[0102] In the shown embodiment (in particular see Figs. 7, 8, 11, 12), the first appendix 149 has an L-shape having a first and a second arm, wherein the first and the second plate-like element 149a, 149b correspond to the

first and second arm.

[0103] The first aperture 48 of the seats 30 includes a slit aperture 49 in which the first appendix 149 is at least partially inserted. The dimension of the slit aperture 49 is such that introduction of at least a portion of the first and second plate-like element is advantageously possible, that is, it is preferably at least as long as the combined lengths of the first and second plate-like elements 149a, 149b along the longitudinal axis X and its width is preferably at least equal to the thickness of the first and second plate-like elements. In the present embodiment, the width of the slit aperture 49 is in a direction substantially perpendicular to the longitudinal axis X. The first and second plate-like elements thus are inserted in the slit 49 in order to attach the electrode 30 to the corresponding seat 32.

[0104] After the insertion of the first appendix in the slit aperture, the L-shape of it determines that the first appendix partially "embraces" the bottom wall 32c of the seat 32. A portion of the first appendix 149 partially faces the second side 33b of the wall 32c (see Figs. 11-12). In particular, the second plate-like element 149b is positioned at least partially facing the second side 33b of the bottom wall 32c and also parallel to the same.

[0105] Further, the moisture detection circuit includes one or more connectors 180 to connect the electrode to the central unit 200. As shown in figure 13, the second plate-like element 149b is inserted at least partially in one of the connectors 180. Preferably, the insertion of the second plate-like element 149b into the connector 180 takes place along the second extension direction L2.

[0106] Each of the two electrodes 30 is moveable within its respective seat 32 about a predetermined length (in Figs. 11 and 12 are shown two different positions of the electrode 30) along the longitudinal axis X. The movement is possible due to the fact that the length of the aperture 48 or slit 49 is a bit longer than the combined length along the longitudinal axis of the first and second plate-like elements 149a, 149b.

[0107] Coming back to figures 7 and 8, the second electrode end 150 of the electrode 30 includes a second appendix 151. The second appendix 151 is also plate-like and it lies on a plane substantially parallel to the second surface 154 of the electrode 30. The second appendix 151 is at least partially inserted in the second aperture 50. Movement of the electrode 30 along the longitudinal axis X implies a bigger or smaller insertion of the second appendix 151 in the aperture 50.

[0108] The second end 150 may advantageously comprise a hole 151a which is provided for receiving a pin 39 (see Fig. 6) formed on the support, in particular on its inner surface, to hold the second end 150.

[0109] Figs. 9-12 illustrate perspective views of the support 24 and the electrode 30 of the moisture sensor system according to the present invention in different stages of mounting. In a first step (not visible), the second end 150 of the electrode 30 is inserted into the second opening 50 of the channel 32 of the support 24, at least

partially. Figs. 9-11 show a second step of insertion the electrode 30 into the seat 32, wherein the first appendix 149 of the first end 148 of the electrode 30 is inserted into the first opening 48 of the channel 32. Then, the electrode 30 can adjust its position along the longitudinal axis X, shifting along the longitudinal axis (see the difference between figures 11 and 12 in the position of the first appendix 149 along the longitudinal axis X) and thus engaging the second plate-like element 149b with the bottom wall 32c.

[0110] Fig. 12 illustrates that the first plate-like element 149a of the appendix 149 faces a portion of the second side 33b of the wall 32c, so that the electrode 30 is in its final mounting condition, wherein the first end 148 of the electrode 30 is inserted in the first opening 48 of the channel 32 and at the same time the second end 150 of the electrode 30 is inserted in the second opening 50 of the channel 32.

[0111] In the final mounting condition of Fig. 13, the retaining elements 62 effect the fixation of the electrodes 30 within the channels 32.

[0112] Further, in the second step above described where the second end 150 is inserted in the second opening 50, the second plate-like element 149b is inserted in connector 180 in the same movement, so as to obtain an electrical connection.

[0113] In this configuration, electrical signals produced in the electrodes 30 are transmitted via the connectors 180 and suitable wirings 181 to the control unit 200 forming the moisture detection circuit, and the moisture of the laundry is evaluated according to algorithms known in the art.

[0114] Although the present invention relates to a dryer, the moisture sensor system may be also applied to other domestic appliances like washer-drier or a spinner-washer.

Claims

1. A dryer (10) comprising:

- a rotatable drum (14) defining an inner volume to contain laundry;
- a moisture sensor system (100) comprising a support (24) for receiving a first and a second electrode (30) in a first and second seat (32), respectively, which are spaced apart one another, each of said first and second electrode (30) defining a first and a second electrode end (148, 150) and first and second opposite surface (152, 154), wherein the first surface (152) faces the inner volume of said laundry drum (14) so as to be contacted by the laundry loaded therein when the drum (14) rotates, and the second surface (154) faces said support (24), said first and second electrode (30) being electrically connected to a moisture detection circuit (200);

- each of the first and second seat (32) including a first and a second aperture (48, 50) in which the first and second electrode end (148, 150) are, respectively, at least partially inserted;
 - wherein the first end (148) of the first and/or second electrode (30) comprises a first appendix (149) inserted into the first aperture (48) of the first and/or second seat (32), the first appendix (149) comprising a first (149a) and a second plate-like element (149b) which extend in a first (P1) and a second plane (P2), respectively, the first (149a) and the second plate-like element (149b) forming an angle between each other, and wherein the first and the second plane (P1, P2) are both substantially perpendicular to the second surface (154) of the first and/or the second electrode (30).
2. The dryer (10) according to claim 1, wherein the first aperture (48) of the first and/or second seat (32) includes a slit aperture (49) in which the first appendix (149) is at least partially inserted.
 3. The dryer (10) according to claim 2, wherein each of the first (149a) and the second plate-like element (149b) defines a length and width on the first and second plane and a thickness in a direction perpendicular to the first and second plane, respectively, and wherein the slit aperture (49) has a dimension in one direction which is longer than the thickness and shorter than the width and the length of the second plate-like element (149b).
 4. The dryer (10) according to any of the preceding claims, wherein each of the first and second seat (32) defines a first and a second seat end (32a, 32b), the first seat end (32a) including the first aperture (48) and the second seat end (32b) including the second aperture (50).
 5. The dryer (10) according to claim 4 and 2 or 3, wherein the slit aperture (49) extends in a direction (X) substantially connecting the first to the second seat end (32a, 32b).
 6. The dryer (10) according to any of the preceding claim, wherein the first appendix (149) is at least partially inserted in a connector (180) to connect the first and/or second electrode (30) to the moisture detection circuit (200).
 7. The dryer (10) according to claim 6, wherein the second plate-like element (149b) of the first appendix (149) is at least partially inserted in the connector (180).
 8. The dryer (10) according to any of the preceding claims, wherein the second electrode end (150) of the first and/or second electrode (30) includes a second appendix (151) extending substantially parallel to the second surface (154) of the first and/or second electrode (30), the second appendix (151) being at least partially inserted in the second aperture (50).
 9. The dryer (10) according to any of the preceding claims, wherein the first appendix (149) has an L-shape having a first and a second arm, wherein the first and the second plate-like element (149a, 149b) correspond to the first and second arm.
 10. The dryer (10) according to any of the preceding claims, wherein the first and the second plane (P1, P2) are parallel to each other.
 11. The dryer (10) according to claim 10, wherein the first and second plane are the same plane.
 12. The dryer (10) according to any of the preceding claims, wherein the first and/or second seat (32) includes a wall (33) having a first side (33a) and a second side (33b) opposite to the first side (33a), the first side (33a) facing the second surface (154) of the first and/or second electrode (30), and wherein the first appendix (149) partially faces the second side (33b) of the wall (33).
 13. The dryer (10) according to claim 12, wherein the second plate-like element (149b) is positioned at least partially facing the second side (33b) of the wall (33).
 14. The dryer (10) according to any of the preceding claims, wherein the first and/or the second seat (32) includes a retaining member (62) to retain the first and/or second electrode (30) into the first and/or second seat (32), respectively.
 15. The dryer (10) according one or more of the preceding claims, wherein said first and second electrode (30) and said respective first and second seat (32) have an elongated shape defining a longitudinal axis (X), wherein the first and/or the second plane (P1, P2) forms an angle comprised between 0° and 25° with the longitudinal axis (X).

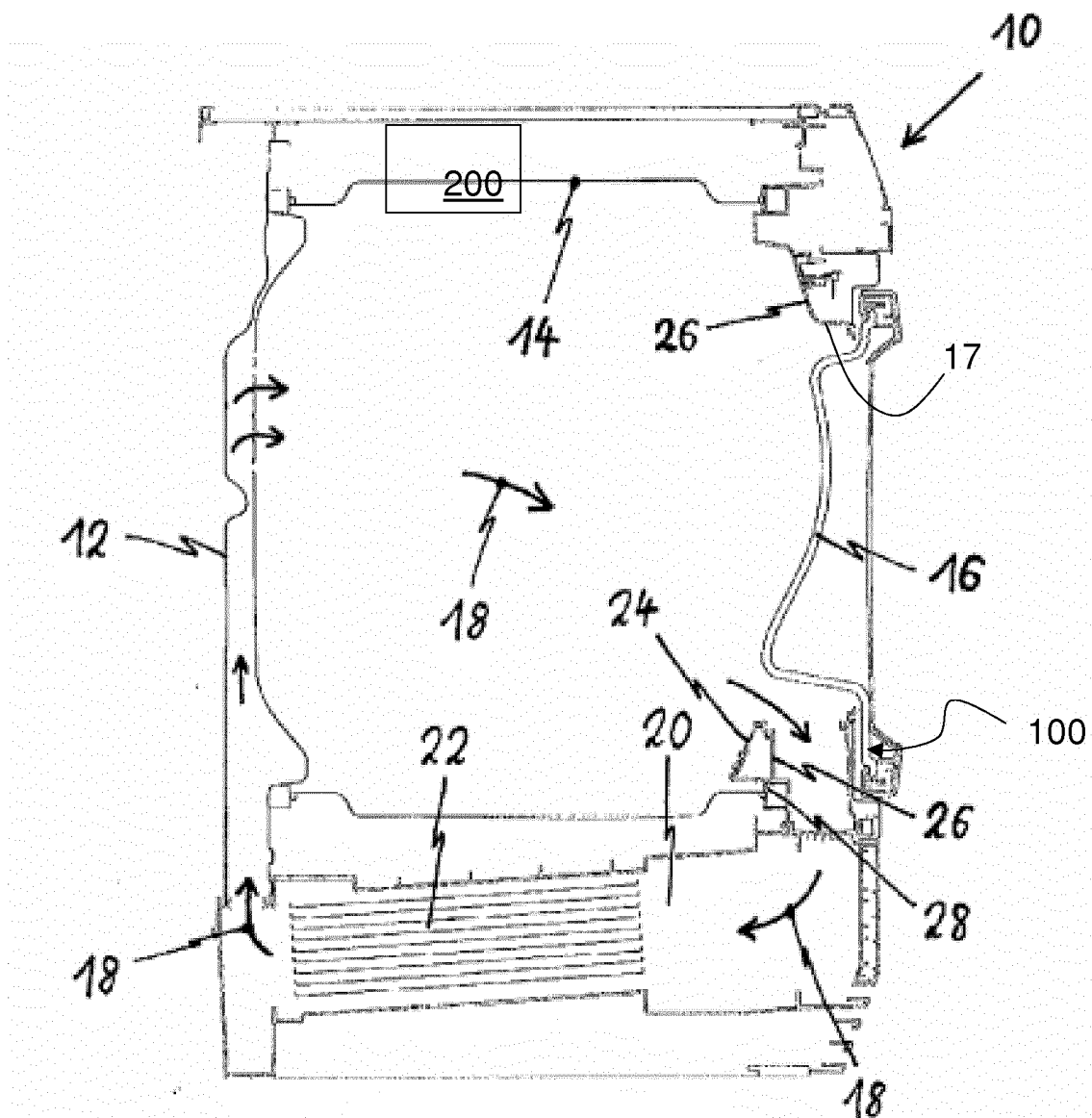


Fig. 1

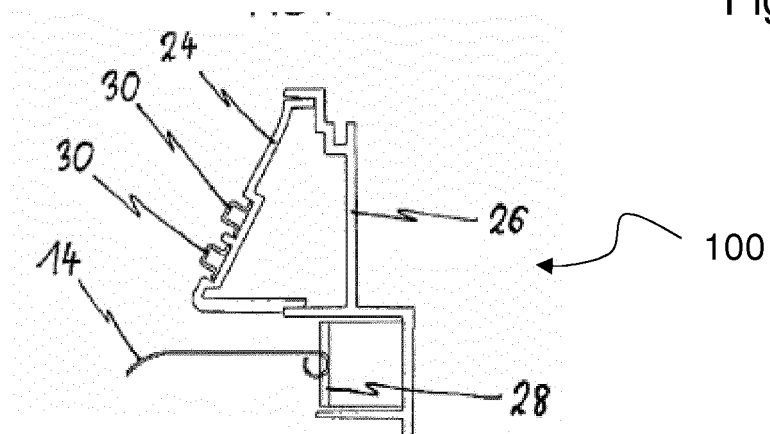


Fig. 2

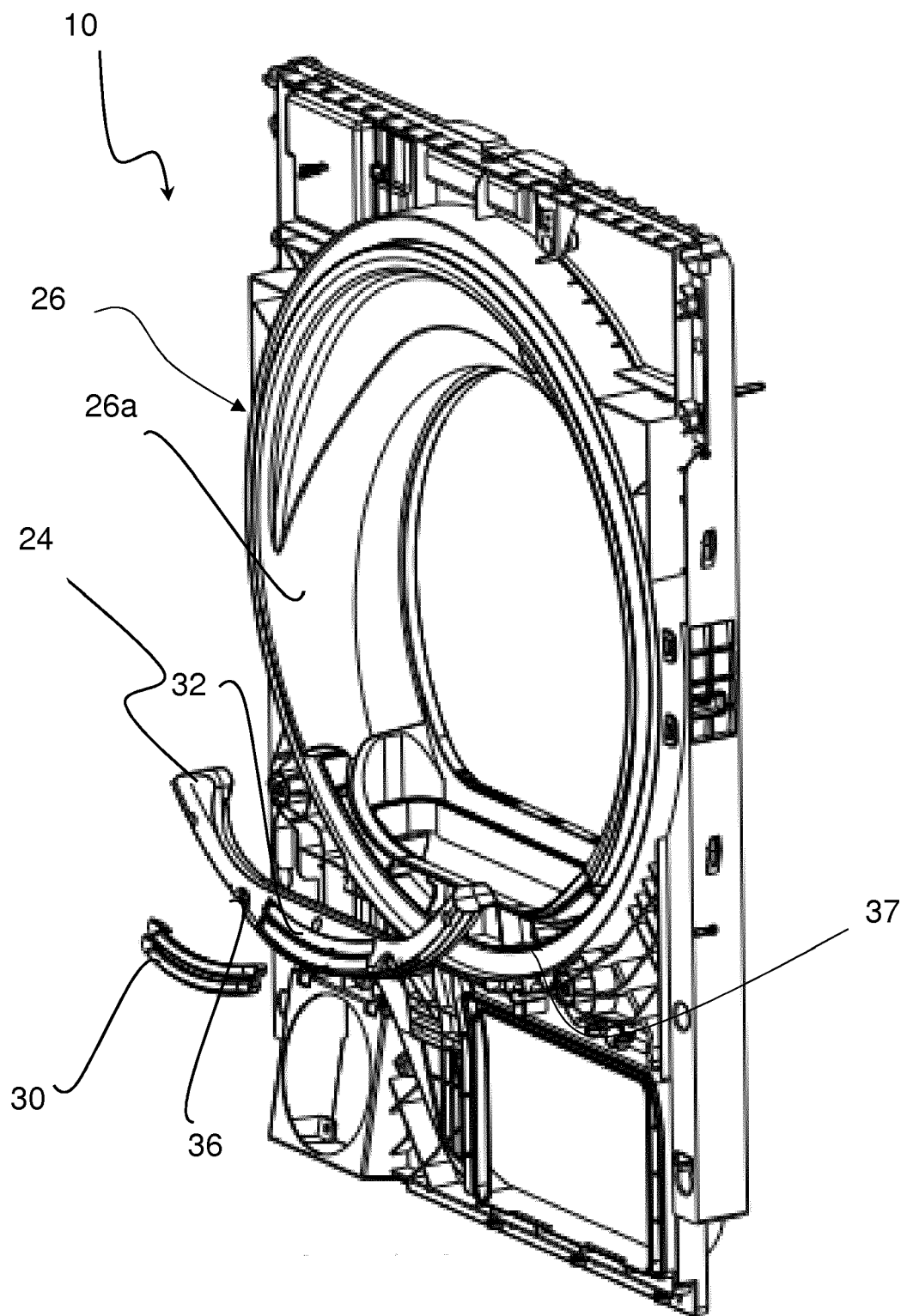


Fig. 3

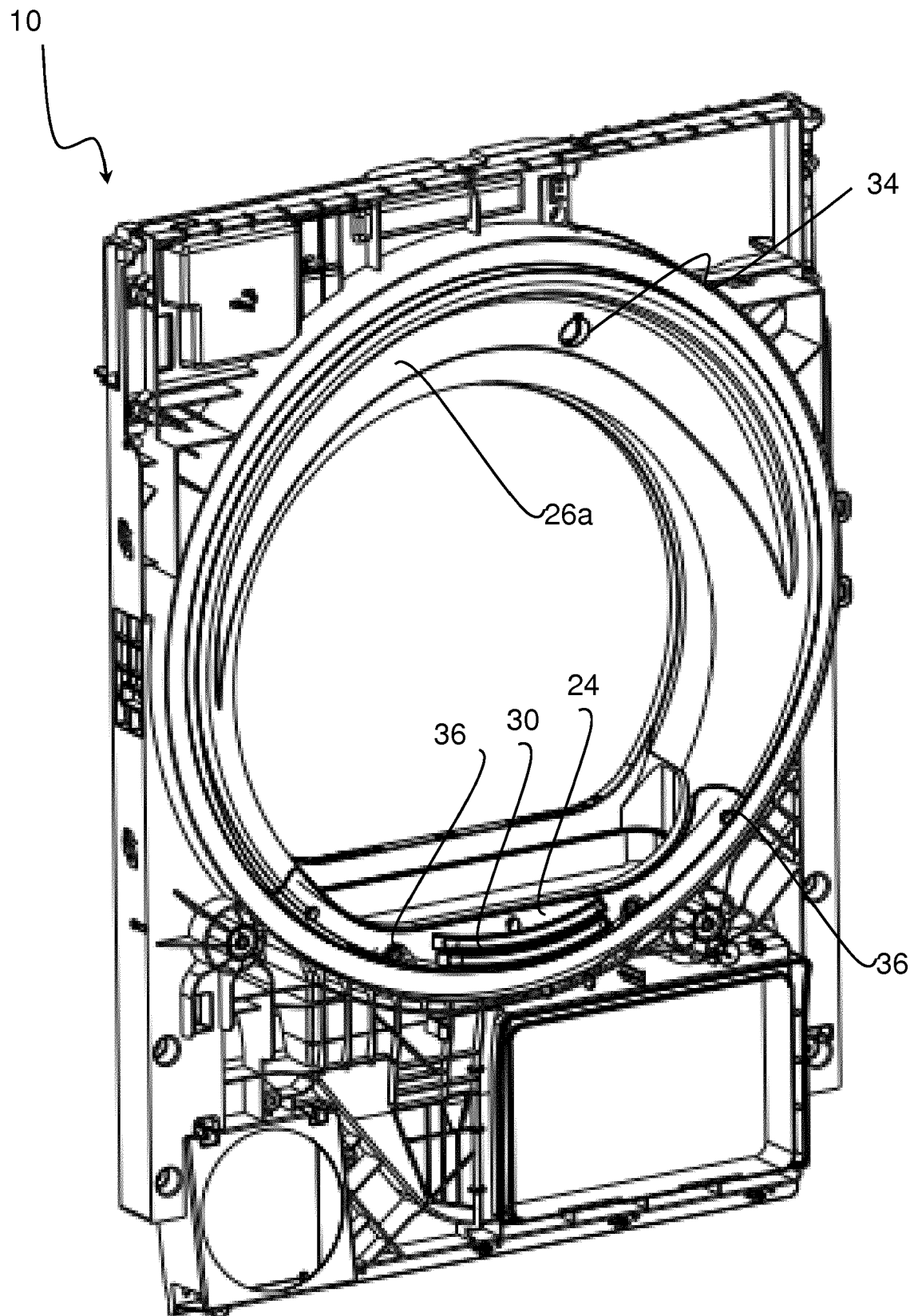
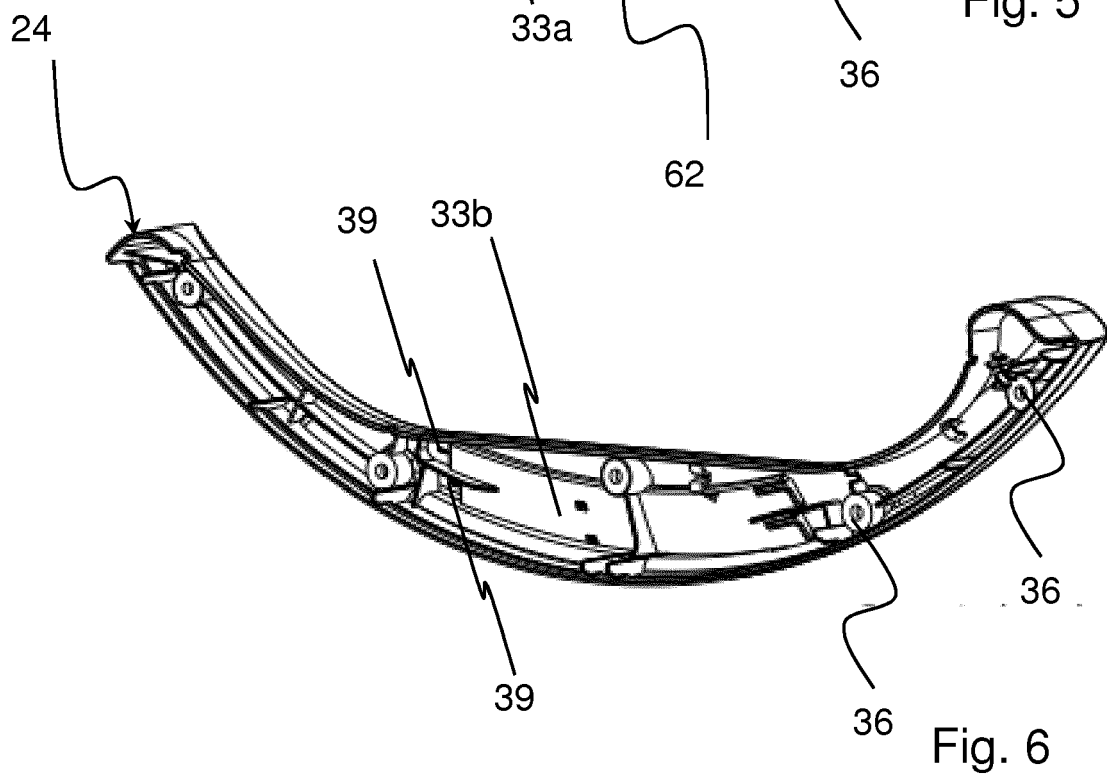
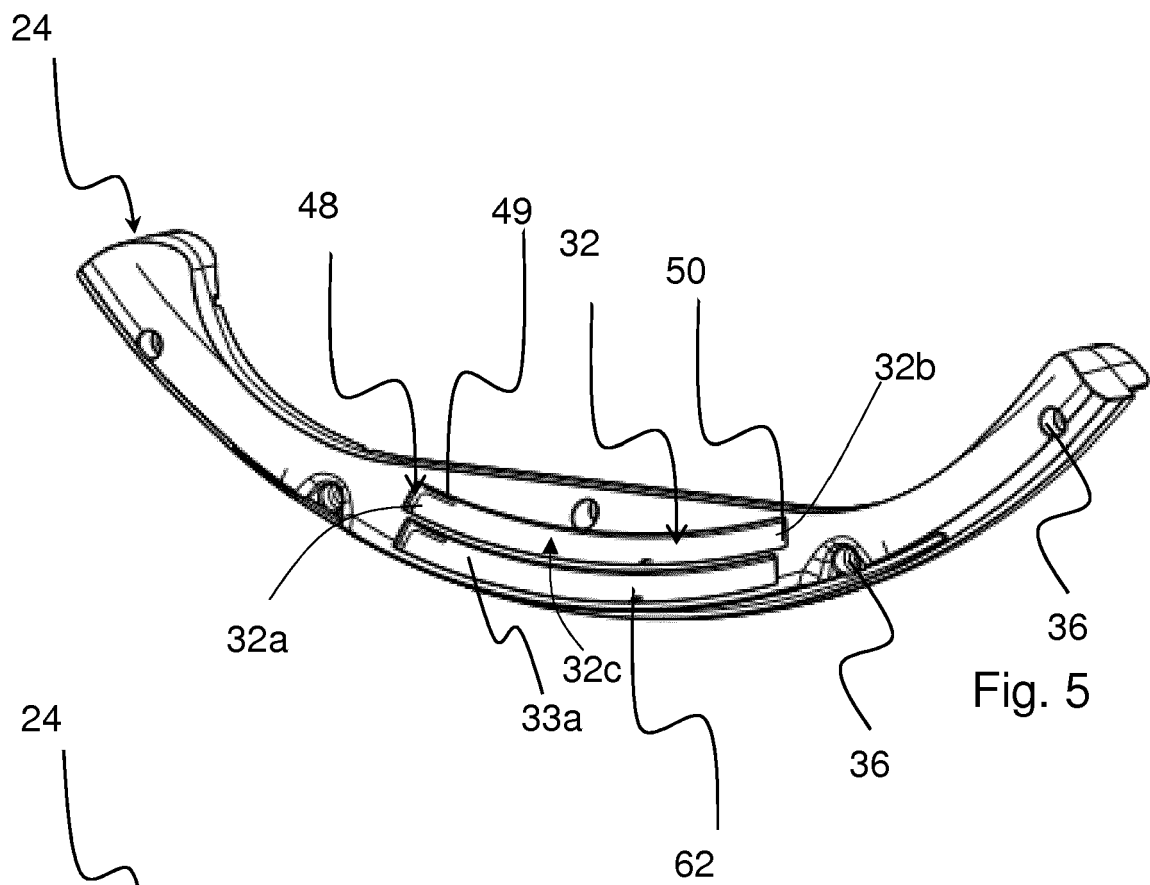


Fig. 4



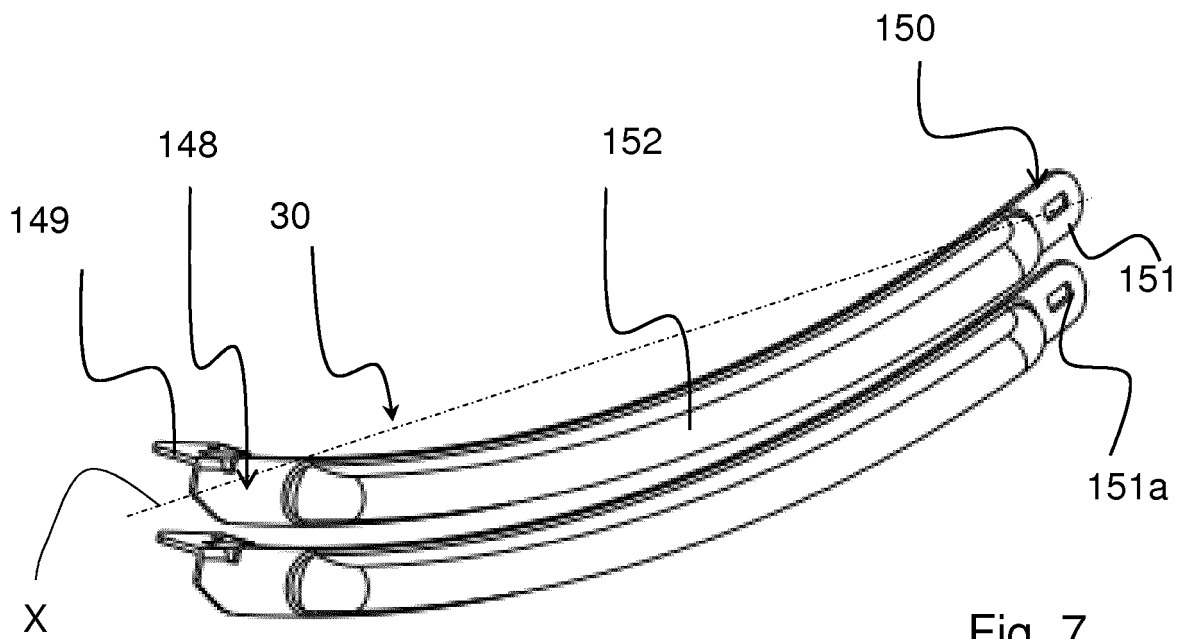


Fig. 7

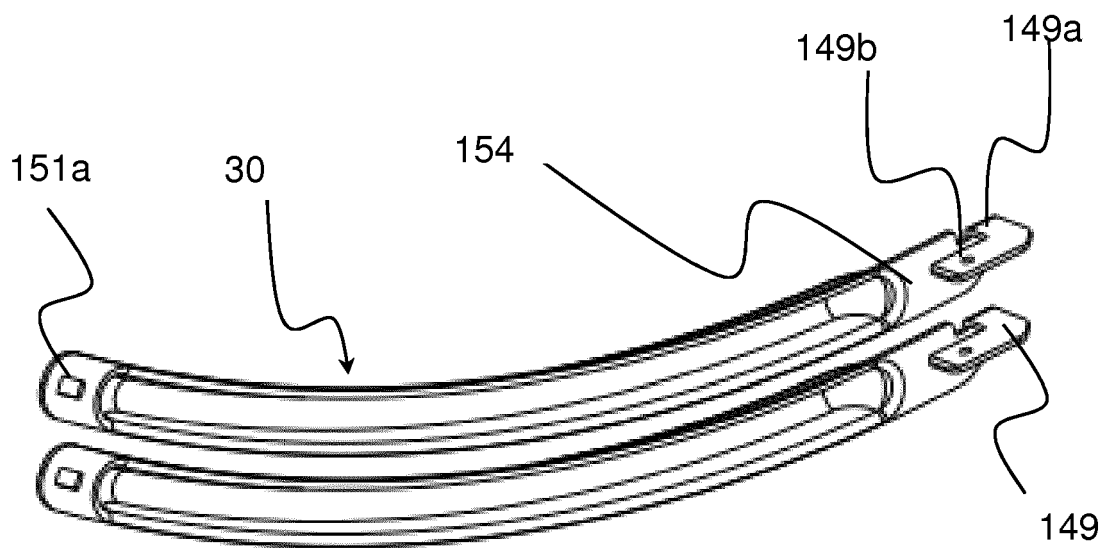
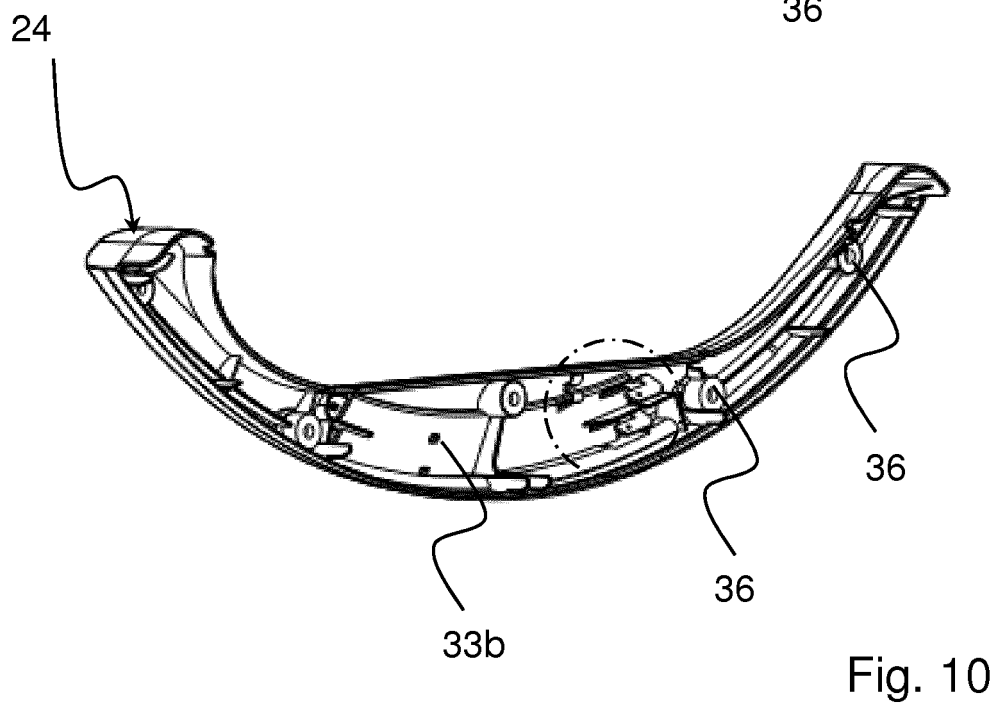
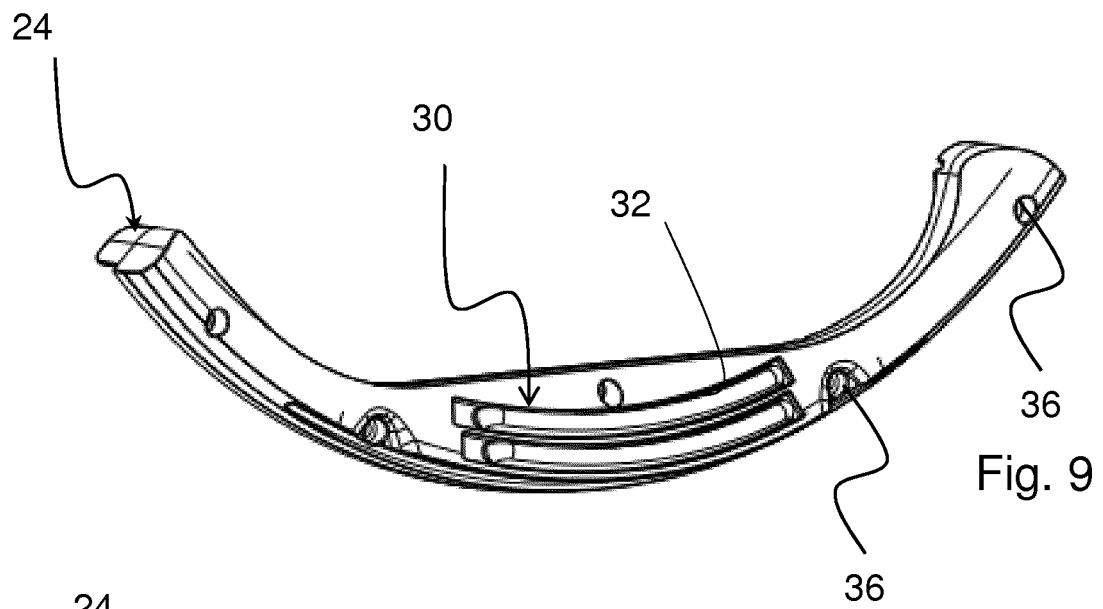
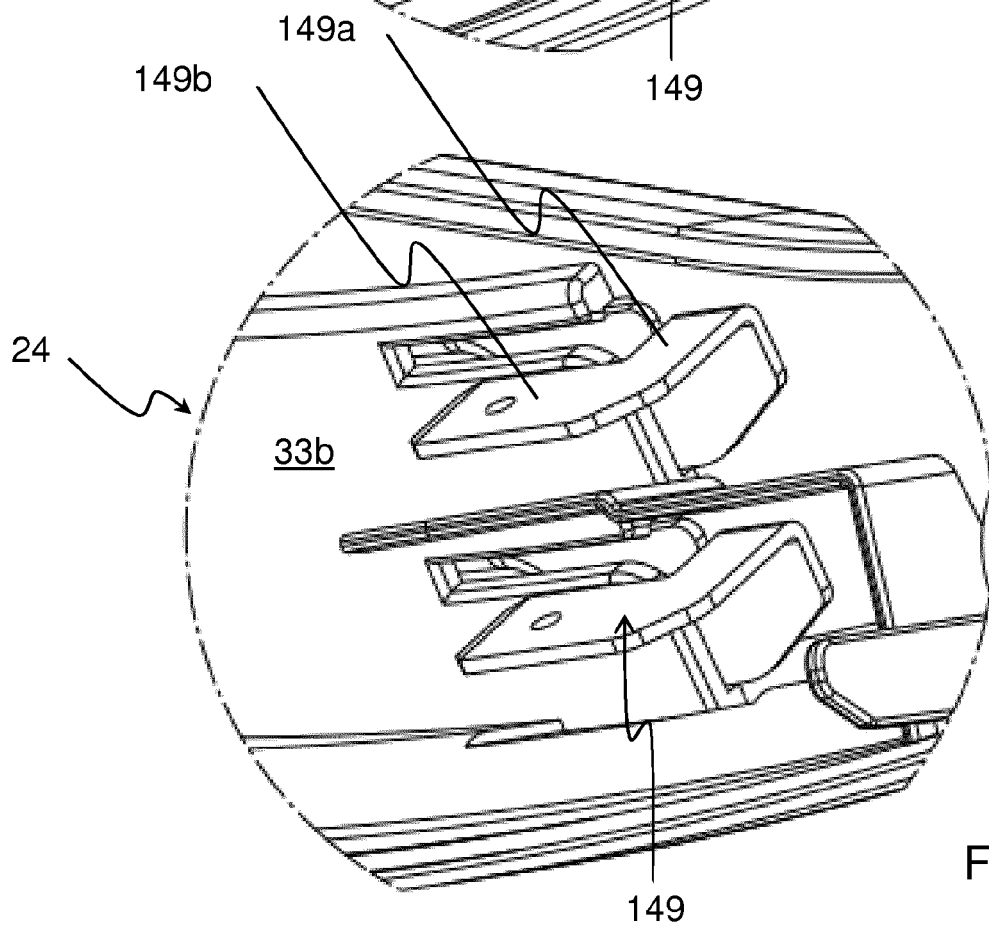
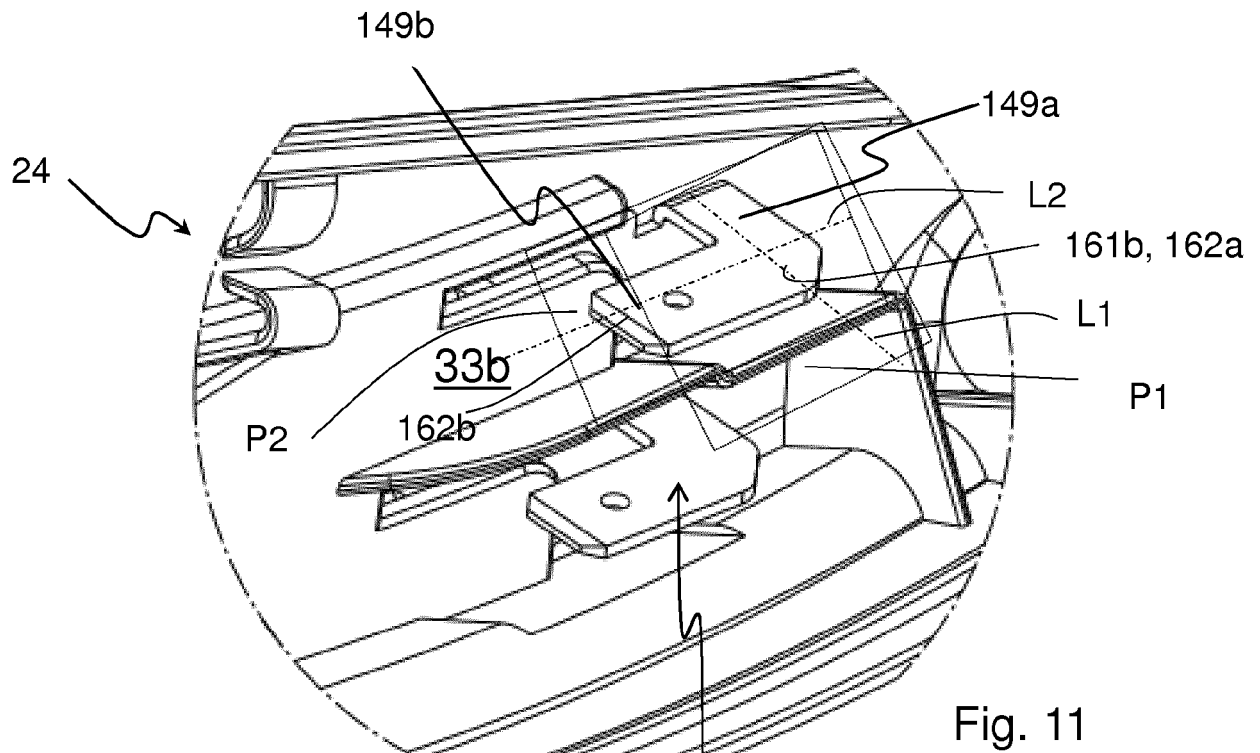


Fig. 8





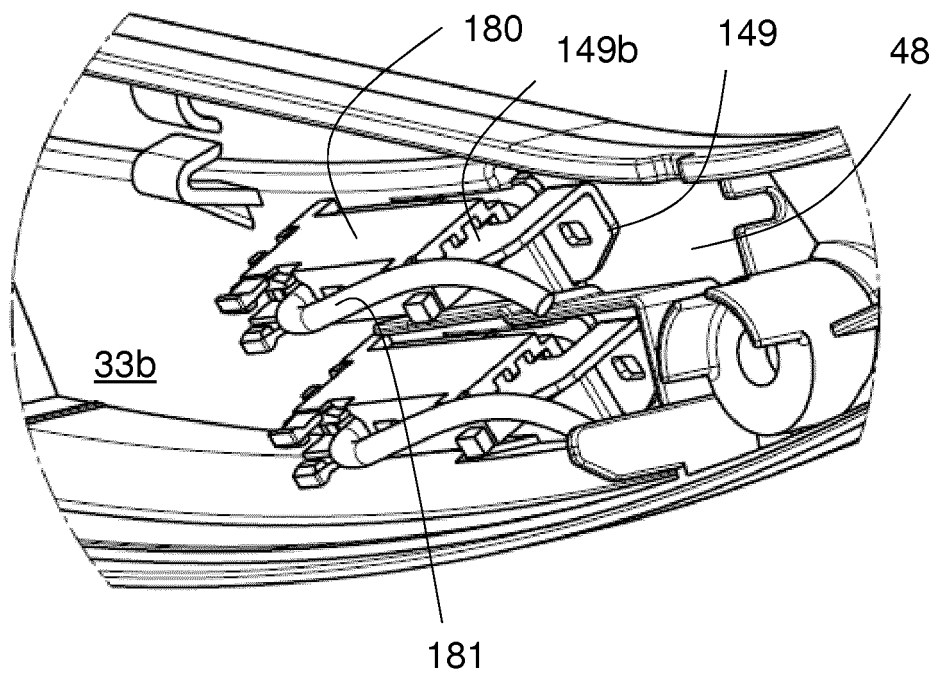


Fig. 13



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The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 12 January 2018	Examiner Kising, Axel
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