

(19)



(11)

**EP 2 843 106 A1**

(12)

**EUROPEAN PATENT APPLICATION**

(43) Date of publication:  
**04.03.2015 Bulletin 2015/10**

(51) Int Cl.:  
**D06F 39/14 (2006.01) D06F 58/04 (2006.01)**

(21) Application number: **13182521.8**

(22) Date of filing: **30.08.2013**

(84) Designated Contracting States:  
**AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR**  
Designated Extension States:  
**BA ME**

(72) Inventors:  
• **Pillot, Sergio**  
**33080 Porcia (PN) (IT)**  
• **Santarossa, Marco**  
**33080 Porcia (PN) (IT)**

(71) Applicant: **Electrolux Appliances Aktiebolag**  
**105 45 Stockholm (SE)**

(74) Representative: **Petrucelli, Davide et al**  
**Electrolux Italia S.p.A.**  
**Corso Lino Zanussi 30**  
**33080 Porcia (PN) (IT)**

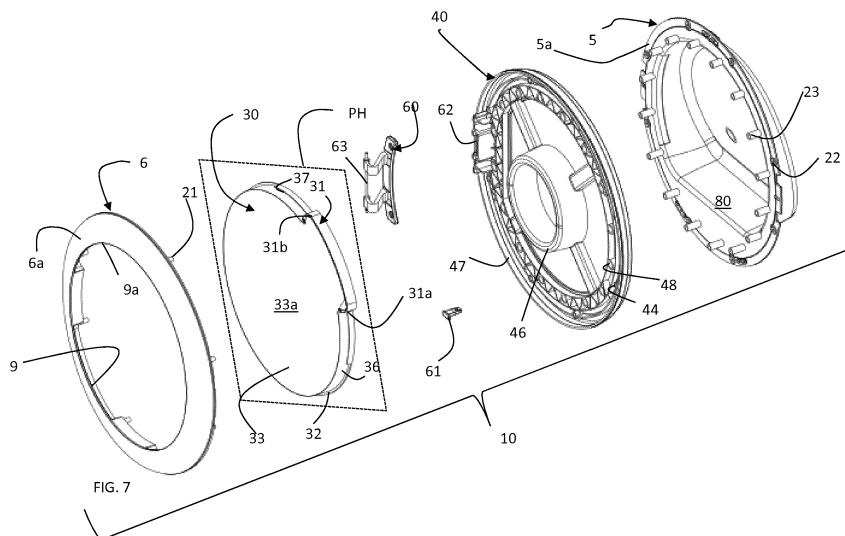
(54) **A door assembly for a laundry treatment device and method of operation**

(57) The present invention relates to a door assembly (10) for a laundry treatment device (1), apt to open and/or close an opening (4) defined in said laundry treatment device, said door assembly comprising a frame (5,6), said frame including:

- A front door frame (6) forming a front surface (6a) of the door assembly, said front surface defining a front plane (PA), said front door frame including a front aperture (9) defining an inner edge (9a);
- A rear door frame (5) forming a rear surface (5b) of said door assembly, said rear surface defining a closure plane (PB) apt to abut against the opening formed in said laundry treatment device, said front plane (PA) and said clo-

sure plane (PB) intersecting one the other so as to form an angle ( $\alpha$ ) different from 0° and 180°;

- a handle-carrying element (30) interposed between said rear door frame (5) and front door frame (6), and a handle (31) coupled to said handle-carrying element, said handle-carrying element being apt to be mounted in at least a first and a second alternative positions, so that said handle (31) can be positioned in proximity of said inner edge (9a) of said front frame at least in a first and second different locations (L1; L2; L3; L4); and
- a cap element (40) interposed between said front door frame (6) and said rear door frame (5) and at least partly covering said front aperture (9).



**EP 2 843 106 A1**

## Description

### Field of the invention

**[0001]** The present invention relates to a door assembly for a laundry treatment device, in particular for a washing machine, a dryer or a washer/dryer, i.e., a washing machine having also dryer functions. The door assembly is so construed to have an appealing aesthetic appearance and to minimize the number and type of parts associated with manufacturing and installing such door assembly in different devices. Further, the invention relates to a method to change the location of a handle of the door assembly.

### Background of the invention

**[0002]** Conventionally, laundry treatment devices include a casing within which a laundry treatment chamber, such as a drum, is located. In the casing, more in particular in a front wall of the same, an opening is formed, to allow the user to accede to the treatment chamber in order to load or unload the laundry before and after the washing and/or drying cycle(s). A door assembly, also called porthole, is rotatably fixed, for example hinged, to the casing and it is apt to open and close the mentioned opening.

**[0003]** It is known that the aesthetic appearance of the laundry treatment device is important and represents a characteristic that might determine the device's choice by the user. Among the preferred aesthetic characteristics, a smooth, even and glossy door assembly is particularly important. In order to improve the aesthetical appearance of the door assembly, in the prior art it is known to provide the door assembly with a cover ring element, generally shaped as a ring, for protecting and/or decorating the door assembly and hiding joints or connecting elements. Moreover, alternatively or in addition, it is particularly desired that the door outer surface follows substantially the outer surface of the front wall where it is hinged, in other words that the door does not, or only to a minor extent, protrude or stick out or is recessed from the wall where it is attached to.

**[0004]** "Curved" or tilted front walls are increasingly popular in known laundry treatment devices. In these devices, the front wall is not completely flat, but it presents a finite radius of curvature, e.g., it has a roundish shape. This means that the front wall presents at least a portion which is inclined with respect to a vertical plane. In this non-flat front wall, to obtain a substantially uniform surface, without edges of the door visibly protruding or being recessed from the same, becomes rather cumbersome.

**[0005]** A possible known solution is to incline the door itself, so that the axis of rotation of the door is also inclined with respect to a vertical plane. This is shown for example in EP 1466047 where a washing machine and a dryer are disclosed, in which a user can watch the inside thereof, and a user can put the laundry into the inside thereof,

and draw out the same. The washing machine includes a cabinet having an opening at the front thereof; a tub provided inside the cabinet for storing washing water; a drum being rotatably provided to a spinning shaft by a motor inside the tub; and a door provided at the opening for being tilted to the inside of the washing machine. The dryer has the same structure as the washing machine.

**[0006]** It is also known that, in laundry treatment device, it is desired to be able to change the position of the handle with respect to the door to open and/or close the door. For example, depending on the location of the device in the user's premises, it might be preferable to have a device with a left-hand opening with respect to the axis of rotation of the door, or alternatively a right-hand opening. The position of the handle in the two configurations typically differs by a rotation of the handle with respect to the door. In addition, in case the handle is not located along the centerline of the door, it is also desired to change the position of the handle from a "lower" position to an "upper" position or vice-versa, in case the device is mounted on the floor or on top of another appliance or piece of furniture. In this case, the "distance" between the two desired handle positions is less than 180°, generally of about 90°. This need arises for example in case of dryers than are commonly mounted either on the floor of a room or on top of a washing machine.

**[0007]** In addition, when a reversible door assembly is considered in a curved or tilted front wall, a good "matching" between the outer surface of the front wall and the outer surface of the door assembly becomes even more critical. The reversibility indeed requires that the door assembly fits into the front wall in two configurations separated by a 180° rotation, which imposes even more constraints onto the door assembly itself, so that the appliance can still achieve an acceptable aesthetic appearance in both configurations.

**[0008]** Due to these needs, the number and type of parts, steps, time and costs associated with manufacturing and installing a prior art door on a laundry treatment device are relatively high because many different doors with different handle's configurations have to be available, which may affect the efficiency, cost and time of manufacturing the appliance itself. Moreover, different manufacturing lines or stations may be needed to manufacture the different doors, which again may affect the efficiency, cost and time of manufacturing of the laundry treatment device.

**[0009]** This problem has for example being considered in WO 2011/012593. In this application, a household appliance is described, which includes a housing having an opening for accessing an interior of the housing, a tub disposed inside the housing and having a rotating drum therein for receiving laundry through the opening, and a door assembly having a see-through portion for viewing into the tub and being pivotably coupled to the housing and movable between an open position and a closed position. The door assembly includes a door frame and a front ring coupled directly or indirectly to the door frame.

The front ring includes a front face having an outside and inside edge, the inside edge defining an opening that substantially corresponds to the see-through portion, and a recessed rear face on an opposite side of the front ring from the front face, wherein the recessed rear face includes a handle portion extending around at least a portion of the front ring.

#### Summary of the invention

**[0010]** The present invention relates to a door assembly for a laundry treatment device, wherein with "laundry treatment device" a washing machine, a laundry dryer or a combined washer/dryer machine is indicated.

**[0011]** It is an object of the present invention to provide a door assembly for a laundry treatment device which can be assembled in an easy and reliable manner and which can be adapted so as to be assembled in different handle's configurations, that is to say a door assembly in which the handle can be located differently, using the same parts and components. Therefore, with such a door assembly, there is no need of realizing a plurality of door assemblies, one for each desired handle position.

**[0012]** Another object is to provide a door assembly which can be used in different types of laundry treatment devices with minor changes.

**[0013]** Additionally, a further object is to provide a laundry treatment device the aesthetic appearance of which is improved. Moreover, the surface of the door assembly and the surface of the front wall are better "matching" than in the prior art.

**[0014]** Applicants have realized that, in order to obtain the above mentioned objects of the invention, a door assembly defining different planes is to be used, angled one with respect to the other. Preferably, a first plane is the plane in which the closure of the opening in the casing of the laundry treatment device is formed and a second plane is the plane following substantially the contour of an outer surface of the casing of the laundry treatment device. In this door assembly, a handle-carrying element is provided, sandwiched between the two planes, which can rotate on a plane parallel to the second plane from one position to the other.

**[0015]** Indeed, in a non-symmetrical door, such as a door defining two different planes in order to better fit into a curved laundry treatment device, reversibility of the door itself, i.e., a change from a left-hand door assembly to a right-hand door assembly or vice-versa, is rather complex because the rotation of certain elements in the door can cause the rotation of the "tilted" plane, so that the curvature of the door does not correspond any more to the curvature of the front door of the laundry treatment device, but it is substantially contrary to the same. In an analog manner, any change in the location of the handle, without reversibility of the door, can cause the same problem.

**[0016]** Thus, Applicants have introduced in the door assembly of the invention a handle-carrying element car-

rying the handle which can rotate, so that the handle can be positioned in a plurality of different locations, and the plane in which the rotation takes place is "inclined", so that, also after a change in handle location, the door assembly remains with a correct shape.

**[0017]** In the following, with "right-hand" doors and "left-hand" doors, door assemblies which can be opened from the right side or from the left side, respectively, with respect to an axis of rotation of the door itself are meant.

**[0018]** In addition, the aforementioned invention applies not only to washing machines, but also to dryers and to combined washer/dryers without substantially modifications, being the construction of the door assembly substantially similar in all the named appliances.

**[0019]** Preferably, the present invention is applicable to dryers, where the reversibility of the door is an especially felt need.

**[0020]** According to a first aspect, the invention relates to a door assembly for a laundry treatment device, apt to open and/or close an opening defined in said laundry treatment device, said door assembly comprising a frame, said frame including:

- A front door frame forming a front surface of the door assembly, said front surface defining a front plane, said front door frame including a front aperture defining an inner edge;
- A rear door frame forming a rear surface of said door assembly, said rear surface defining a closure plane apt to abut against the opening formed in said laundry treatment device, said front plane and said closure plane intersecting one the other so as to form an angle different from 0° and 180°;
- a handle-carrying element interposed between said rear door frame and front door frame, and a handle coupled to said handle-carrying element, said handle-carrying element being apt to be mounted in at least a first and a second alternative positions, so that said handle can be positioned in proximity of said inner edge of said front frame in at least a first and second different locations; and
- a cap element interposed between said front door frame and said rear door frame and at least partially covering said front aperture.

**[0021]** The door assembly of the invention is apt to be coupled to a laundry treatment device having an opening. The door assembly, when connected to the laundry treatment device, can be moved, preferably oscillated, from an open configuration or position, which is the configuration in which the door assembly is detached from the opening and the treatment chamber of the device is accessible, and a closed configuration or position, which is the configuration in which the door assembly closes the opening.

**[0022]** The present invention is relative to an "asymmetric" door assembly including a frame divided in two portions, a front frame and a rear frame. "Asymmetric" means that the door frame, when sectioned by a median horizontal plane passing through a frontal centerline of the frame, is not symmetrical: in the resulting section, the lower and upper part of the section have different shapes, in particular if seen from the side.

**[0023]** The rear frame is the portion that abuts against the opening formed in a front wall of the laundry treatment device. Generally, but not necessarily, the rear door frame is not visible from the outside when the door assembly is in a closed operative position.

**[0024]** The rear door frame includes a rear surface, which is the one that faces the opening in the casing when the door assembly is in a closed configuration. The rear surface defines a plane which is called closure plane, due to its function of "closing" the laundry treatment device when the door assembly is in a closed operative position. It is to be understood that not all the rear surface has to lie on the same closure plane; moreover it does not even mean that the majority of the rear surface lies on the same closure plane. The closure plane is the plane defined by a portion of the rear surface which abuts on the casing, or front wall, of the laundry treatment device. In other words, the closure plane is defined by the surface which is in contact to, when the door assembly is in a closed configuration, the laundry treatment device (e.g., to any portion thereof), such as for example a closure bellow.

**[0025]** In addition, the rear door frame has preferably also a surface opposite to the rear surface and facing the front door frame, called front door of the rear door frame.

**[0026]** For example, the rear door frame includes an annular element, from which a bowl shaped member preferably extends towards the interior of the casing, when the door assembly is in a closed position on the laundry treatment device. Preferably, the annular element surrounding an edge of the bowl shaped member defines the closure plane. Indeed, in this case, when the door assembly is in a closed position on the device, the annular element abuts on an edge of the opening of the casing, while the bowl shaped member penetrates into the opening inside the casing. The annular element thus defines a first and a second opposite surface. One of the two surfaces is the rear surface in contact with the casing, e.g., with the front wall of the laundry treatment device, while the opposite second surface, the front surface, is facing the front door frame for connection thereof.

**[0027]** Preferably, annular element and bowl shaped member are formed one integral to the other, e.g., as a single piece.

**[0028]** The front door frame is the portion of frame that represents the most visible part of the door assembly and one of its surfaces, called front surface of the front door frame, defines the outer surface of the door assembly.

**[0029]** Therefore, the aesthetical appearance of the door assembly is mainly given by the shape and finishing

of the front door frame.

**[0030]** The front door frame has an aperture, general centrally located.

**[0031]** According to the invention, the front surface of the front door frame defines a plane which is not parallel to the plane defined by the rear surface of the rear door frame; on the contrary the two planes form an angle therebetween.

**[0032]** The front door frame includes, in addition to the front surface, a rear surface. The rear surface faces the front surface of the rear door frame when the door assembly is in an assembled configuration.

**[0033]** The front frame plane, which is a maximal area front plane, is defined as follows. Taken a "virtual" plane, it is put into contact with the front surface of the front door frame. The location where the plane is "stable" on the front frame, i.e., where it contacts the front surface in at least three different points, defines the location of a candidate front plane.

**[0034]** Also planes that section a portion of the front surface can be considered as candidate front planes. However, no point belonging to the surface of the sectioned portion of the front frame can be considered as generating one of the three points of front surface to which the candidate front plane is in contact. In other words, the "cut", i.e., sectioned part, of the front frame does not form a locating point for the candidate front frame. The three points defining the candidate front plane have all to belong to the "uncut", i.e., unsectioned, front surface.

**[0035]** In case there is a single location in which the plane is stable, this single location defines the location of the front plane, i.e., the single candidate front plane is the front plane. Otherwise, a plurality of such locations, and thus a plurality of candidate front planes, can be present.

**[0036]** The candidate front plane defining the largest area on the front surface is the front plane (thus the maximal area front plane). The largest area is calculated as follows.

**[0037]** In a first possible case, all candidate front planes, when in contact to the front surface of the front frame, define on the front surface at least a closed curve (or even an area, in case a candidate front plane is in contact with a planar portion of the front surface). Each closed curve encircles an area (or, as mentioned, the area is directly defined): the candidate front plane which forms the largest of these areas is the front plane. The area may include a portion of front surface, but it may also include portion(s) not belonging to the front surface.

**[0038]** In case a candidate front plane which sections a portion of the front frame is present, the sectioned portion of the front frame cannot be considered as part of the closed curve. In addition, the sectioned portion has to be internal to the closed curve, with an unsectioned portion of front surface present therebetween, i.e., the sectioned portion and the closed curve are not in contact to each other.

**[0039]** Otherwise, there is (are) candidate front plane(s) which, when in contact with the front surface, do not form a closed curve. The front surface might include only such candidate front planes, or a combination of candidate front planes forming closed curves (and/or area(s)) and candidate front planes not forming such closed curves. For each of those candidate front planes which do not form a closed curve, the points of contact between the candidate front plane and the front surface are first established and then connected via segments, and a closed curve is in this way then formed. Again, as above, the largest area encircled by these closed curves (among both the "manually" formed closed curves and the closed curves defined by the candidate front planes themselves) selects the front plane.

**[0040]** Also in this case, when a candidate front plane is sectioning a portion of the front frame, the sectioned portion has to be internal to the "manually formed" closed curve, with an unsectioned surface present therebetween, i.e., the sectioned portion and the "manually formed" closed curve are not in contact to each other.

**[0041]** In practice, the front plane is defined either by the most extended flat portion of front surface, or by the most extended "virtual flat portion" defined by a plane tangent to the front surface. In addition, the front plane can also be a sectioning plane, however in this case the sectioned part can only be substantially "centrally located" with respect to the front frame surface, otherwise it cannot be encircled by the closed curve defined above.

**[0042]** Moreover, considering a normal to the closure plane and a normal to the front plane, a non-zero angle is formed between the two.

**[0043]** In this way, according to the layout of the invention, the rear door frame can effectively open and/or close the opening in the laundry treatment device to access the drum, e.g., the rear surface of rear door frame abuts against the opening of the casing and thus it is adaptable to close drums in casings formed according to the prior art, without the need of changing any component of the laundry treatment device. In other words, the door assembly of the invention does not impose modifications in the laundry treatment device. In addition, the rear door frame could be used for assembling a door usable in many different laundry treatment devices, such as washing machine or dryer, as better detailed below. The closure plane could be selected for example as the vertical plane, however also a tilted closure plane is envisaged as well, in case of laundry treatment devices having a tilted opening (i.e., an opening defining a tilted plane with respect to a vertical plane).

**[0044]** The front surface of the front door frame, when the door assembly is in a closed configuration on the front wall, preferably substantially follows the contour of the surface of the front wall of the laundry treatment device, in particular preferably when the latter is also inclined, in order not to protrude excessively from the same so as to create a uniform continuous appearance of the front wall.

**[0045]** The front and rear door frame can have any

shape, for example they can have an oval, circular or rectangular cross section. Preferably they have a substantially ring-shaped design.

**[0046]** In addition, the front surface of the front door frame, could be colored, textured, smooth or wrapped in metal, an additional cover ring could be placed on top of it, etc., in order to improve the aesthetical appearance of the overall laundry treatment device.

**[0047]** The front aperture of front door frame can also have any shape, preferably matching the shape of the frame itself (e.g., in a circular frame, a circular aperture is formed). The aperture in the front frame could be centered with the frame itself, e.g., it could be concentric in case of a ring-shaped door or it could be off-center, e.g., the center of the aperture is offset from a center of the frame.

**[0048]** It is to be understood that several other elements can be fastened or attached to the front and/or rear door frame. However, the rear surface of the rear door frame can always be defined as the surface that enters into abutment with the opening in the casing of the laundry treatment device and the front surface as the surface covering most of the front frame or along which most of the front frame aligns, or on which a plane is tangent in at least three points and forms the widest "virtual area".

**[0049]** Preferably, front door frame and/or rear door frame are made of plastic. Preferably, each of them is molded as a single piece of plastic.

**[0050]** In addition, according to the invention, the door assembly includes a handle and a handle-carrying element interposed between said rear door frame and front door frame, said handle-carrying element being apt to be mounted in said door assembly in a plurality of alternative positions, so that said handle can be positioned on said frame at different locations.

**[0051]** The location of the handle is preferably substantially on the inner edge of the aperture formed in the front frame. The handle "moves" along the inner edge of the front frame in different locations depending on the position of the handle-carrying element.

**[0052]** Preferably, said handle-carrying element is so construed that said first and second alternative positions are separated by a rotation of said handle-carrying element on a handle plane; and said handle plane and said closure plane are intersecting one the other so as to form an angle different from 0° and 180°.

**[0053]** The different locations of the handle are obtained by a rotation of the handle-carrying element. In order to move the handle from one location to another, the rotation of the handle-carrying element is performed on a single plane, i.e., all positions of the handle-carrying element lie on the same plane, called handle plane. The handle plane and said closure plane are intersecting one the other so as to form an angle different from 0° and 180°. In other words, the handle plane, i.e., the plane on which the handle-carrying element rotates, is "tilted" with respect to the plane defined by the opening in the casing

of the the laundry treatment device. The handle plane and the front plane are substantially one parallel to the other so as to guarantee the uniformity of the external surface of the front door. The inclination of the handle plane corresponds to the inclination of the front plane.

**[0054]** Due to the fact that the handle is not attached directly to the front or rear door frame, but it is connected to a handle-carrying element, changing the position of the handle-carrying element which is sandwiched between the front and the rear door frame, changes the configuration of the door assembly. The handle can be positioned in the location most comfortable for the user to grasp, depending on the positioning of the laundry treatment device with respect to the surroundings.

**[0055]** A repositioning of the handle can be desirable mainly for two reasons: either to reverse the door's opening direction, for example from a left-hand to a right-hand configuration, or to change the location of the handle from an "upper" location to a "lower" location, or vice-versa, for example when the position in space of the appliance is changed.

**[0056]** Considering now a front view of the door assembly, a hinge direction or rotational axis of the door assembly can be identified, which is substantially the direction along which the door opens. Also a centerline direction can be defined, which substantially is the direction passing through a geometrical center of the front frame and perpendicular to the hinge direction. An axis parallel to the rotational axis and also traversing the geometrical center of the front frame - called in the following vertical axis of the door assembly - divides, together with the center-line, the door assembly into four quarters, an upper right quarter, a upper left quarter, a lower right quarter and a lower left quarter.

**[0057]** Preferably, the handle is located in one of the quarters, between the centerline and the vertical axis, more preferably substantially in the middle of one of the quarters of the door assembly, e.g., the location of the handle is not positioned on the center-line or vertical axis, but it is "off-center". Therefore, preferably, the possible locations of the handle due to a rotation of the handle-carrying element in the door are as follows.

**[0058]** In case a change from a left-hand door to a right-hand door is required in a laundry treatment device, a substantially mirror image of the handle about the vertical axis of the door assembly is preferred. The new location of the handle is a reflection across the vertical axis of the door assembly of the old location of the handle. For example, if the location of the handle in a right-hand door was in the upper-left quarter, then in the reversed door it is preferably in the upper-right quarter.

**[0059]** Alternatively, if only the location of the device changes, e.g., from a floor-positioned laundry treatment device to a laundry treatment device mounted on top of another one, and the door assembly is still to be opened on the same side, then preferably the two handle locations, "old" and "new", are substantially one the mirror image of the other about the center-line of the door frame.

**[0060]** The handle can have any shape and could also include a recess in which a hand or finger(s) may be introduced in order to pull out the door assembly. Alternatively, the handle includes a flap protruding from the front frame.

**[0061]** Preferably, when assembled, the handle is fixed, e.g., it does not operate any mechanism to fasten or unfasten the door. The locking mechanism of the door is preferably of the pull-to-open type, in other words the door assembly is opened pulling the handle: when the pulling force exceeds a certain threshold, a hook or similar element present in the door frame disengages from a corresponding seat on the casing in a known manner, via a release mechanism. The handle therefore, during the pulling, does not perform any movement relative to the door frame.

**[0062]** Preferably, said handle plane and said front plane are substantially parallel.

**[0063]** The inclination of the handle plane in this preferred embodiment corresponds to the inclination of the front plane.

**[0064]** Advantageously, said handle-carrying element is apt to be mounted in at least said first, said second and a third and a fourth alternative positions, so that said handle can be positioned on said frame in at least four different locations, at least two of said first, second, third and fourth positions being one the reflection across an axis of said door frame of the other, said at least two positions coinciding to a position for a right-hand door assembly with respect to an axis of the opening of the door assembly and to a position for a left-hand door assembly with respect to the axis of the opening of the door assembly.

**[0065]** As mentioned, preferably the preferred changes in positioning of the handle take places when the door has to be reversed from a left-hand door configuration to a right-hand door configuration or vice-versa, or when the door stays with the opening direction on the same side, but the handle from a lower quarter position moves to an upper quarter position or vice-versa. Both these changes are represented by a reflection of the position of the handle across an axis of the door frame. In case of door reversibility, the axis is the vertical axis, otherwise in the second case it is the center-line. Thus, four preferred different locations for the handle are envisaged in the present invention, encompassing all possible desired changes in the handle's location.

**[0066]** In a preferred embodiment, said first and/or said second different location of said handle is located at a given angle between 0° and 90° from a center line of said door assembly substantially perpendicular to an axis of opening of said door assembly.

**[0067]** The handle is preferably not positioned along a symmetry axis of the door frame, but it is preferably located within one of the quarters of the front frame, as defined above.

**[0068]** Preferably, said handle-carrying element is coupled to said front frame.

**[0069]** In this way, the inclination of the front frame becomes substantially the same as the inclination of the handle-carrying element in an easy manner.

**[0070]** The coupling between the handle-carrying element and the door frame can be of any type, for example via a flange protruding from the handle-carrying element or the front door frame housed in a seat formed in the other of said handle-carrying element or front door frame, or via a snap-fitting connection.

**[0071]** In a preferred embodiment, said handle-carrying element includes a plate-like member substantially closing said inner aperture.

**[0072]** Preferably, the aperture in the front frame is closed to avoid that the user could touch the surface directly in contact with the laundry, surface which could reach a high temperature. This surface can be for example a surface of the bowl-shaped member attached to the rear door frame. A protective element is generally interposed. In this case, the protective element and the handle-carrying element are the same component of the door assembly.

**[0073]** Creating a handle at an internal part of the front surface of the front door frame, and not at its outer edge, and more preferably at the inner edge of the front aperture, gives also a very pleasant aesthetic appearance.

**[0074]** In this embodiment, preferably said plate-like member defines an external surface, said external surface being substantially flush with said front surface.

**[0075]** The user, as already mentioned, prefers generally to experience a smooth and substantially uniform front wall of the laundry treatment appliance, without elements which stick out or are recessed therein. In this respect, therefore, the handle-carrying element with its external surface preferably crates a geometrical continuation of the front surface of the front door frame to form a substantially continuous single surface.

**[0076]** Preferably, said handle includes a recess formed in said handle-carrying element.

**[0077]** Another possibility in order to avoid that any element protrudes from the front wall of the laundry treatment device is to create an integrated handle which does not extend outwardly from the front surface of the front door frame. On the contrary, the handle includes a recess formed in the plate-like member defined by the handle-carrying element, so it is substantially "hidden" in the external surface of the plate-like member itself.

**[0078]** In this embodiment, preferably said recess extends from the external surface of the plate-like member to underneath said front frame.

**[0079]** In order to have a stable grip on the handle, preferably the handle includes a flap portion on which the fingers of a user's hand can abut to pull the door. In order to avoid introducing further elements, this flap portion includes a portion the inner surface of the front door frame; the recess goes underneath the front frame and thus a portion of the rear surface of the front door frame is exposed and reachable.

**[0080]** Advantageously,

○ said front door frame comprises a plurality of coupling elements for the coupling to said rear door frame, said coupling elements extending from a rear surface of said front door frame opposite to said front surface; and

○ said rear door frame includes a plurality of coupling counter-elements engaging with said coupling elements of said front frame,  
or

○ said front door frame comprises a plurality of coupling elements for the coupling to said rear door frame; and

○ said rear door frame includes a plurality of coupling counter-elements engaging with said coupling elements of said front frame, said coupling counter-elements extending from a front surface of said rear door frame opposite to said rear surface.

**[0081]** In order to couple the front door frame to the rear door frame, many different coupling elements and coupling counter-elements could be used. For example, the coupling elements could be screws and the counter-elements could be appropriate receptacles with a corresponding screw thread. Other coupling elements could include bolts, plastic fasteners or the like, rivet coupling, etc. The counter-coupling elements could be the receptacles or seats to fasten with the corresponding coupling elements.

**[0082]** Preferably, a first height of a first one of said coupling elements from said rear surface of said front door frame is higher than a second height of a second one of said coupling elements from said rear surface of said front door frame.

**[0083]** In this preferred embodiment, in order to obtain a door frame defining two different planes one tilted with respect to the other, forming an angle therebetween different from 0° and 180° (i.e., not parallel one to the other), the coupling element on the front and/or rear frame could be used. In this embodiment, the coupling elements are formed so as to have different heights, so that a slope can be formed when the front and rear door frame are coupled together.

**[0084]** More preferably, the coupling elements change heights gradually from a maximum height to a minimum height.

**[0085]** The height is calculated starting from the surface from which the elements or counter-elements having a variable height protrude. For example, the elements can have a variable height and this height is calculated starting from the rear surface of the front frame along a perpendicular axis to such a surface, till the end of the element is reached.

**[0086]** Alternatively, in a different embodiment, the counter-elements can have a variable height and this height is calculated perpendicularly to the front surface

of the rear frame.

**[0087]** The achieved tilt of one of the door surfaces is a function of the difference in height among the coupling elements or the coupling counter-elements.

**[0088]** Preferably, either only the coupling elements or the coupling counter-elements are obtained with a variable height, so that the other of the elements/counter elements can be obtained in such a way that they all have the same height.

**[0089]** Advantageously, the cap element interposed between said front frame and said rear frame includes a strengthening member located at said front aperture.

**[0090]** Preferably, in order to avoid that the user, exerting an excessive pressure on the front door frame, in particular on the surface of the handle-carrying element, breaks the same, a strengthening member is located at the inner aperture. Generally, the rear door frame includes a bowl-shaped member which extends from the closure plane into the laundry treatment chamber of the laundry treatment device. A large gap is therefore present between the bowl-shaped member and the external surface of plate-like member, and it is not uncommon that a pressure on the external surface could cause damage to the latter. Locating a strengthening member at the inner aperture, for example behind the plate-like member of the handle-carrying element, minimizes such a risk.

**[0091]** Preferably, the door assembly includes a hinge and a portion of a door locking mechanism, said hinge and said portion of door locking mechanism being mounted on said cap element.

**[0092]** The cap element has - in this embodiment - the function both of strengthening the door and also as a holder of the hinge and door locking mechanism.

**[0093]** Advantageously, said handle is formed integral to said handle-carrying element.

**[0094]** In this way, the number of total parts realizing the door assembly is reduced.

**[0095]** In a preferred embodiment, the door assembly includes one or more locating elements, configured such that said handle-carrying element can have only two positions for a left-hand door assembly and only two positions for a right-hand door assembly.

**[0096]** Not all locations which are possible for the handle along the frame are also suitable locations for the handle. For example, positioning the handle on a quarter, either upper or lower, on the same side of the vertical axis where also an hinge to open and close the door assembly is mounted, causes a very difficult door operation by the user, requiring a very strong force.

**[0097]** In order to avoid the door assembly's configurations which are not suitable to be used, a plurality of locating elements are mounted on the door assembly, for example either on the front or on the rear door frame, in order to avoid any configuration in which the handle is too close to the hinge.

**[0098]** For example, the door assembly could include a plurality of surfaces or protrusions in the front and/or rear door frame and corresponding surfaces or seat in

the handle-carrying element, or vice-versa, that do not mate or match each other, e.g., that do not allow the assembly of the door, when the handle-carrying element is located in a configuration not suitable to be used.

**[0099]** According to a second aspect, the invention relates to a laundry treatment device comprising:

- A casing containing a treatment chamber for receiving load to be treated,
- A front wall covering a side of said casing, said front wall including an opening for accessing said treatment chamber;
- A door assembly associated to said casing for opening and/or closing said opening, said door assembly being formed according to the first aspect.

**[0100]** The laundry treatment device comprising the door assembly of the invention has an opening to access the treatment chamber in which the laundry is treated which is opened and closed via the door assembly.

**[0101]** Preferably, said laundry treatment device is a washing and/or drying machine. Preferably, it is a front loading laundry treatment device. Most preferably, it includes a dryer.

**[0102]** More preferably, said laundry treatment device is a front loading washing and/or drying machine. In front loading laundry treatment devices, the door assembly is hinged to a front wall in order to open and close the opening which is substantially vertical (or slightly tilted with respect to the vertical direction).

**[0103]** Commonly, front loading laundry treatment device includes a casing which encloses an inner compartment comprising the laundry treatment chamber, for example a rotating drum for housing the laundry to be treated and a tub encasing the drum. The laundry within the drum is moved by means of the rotation of the drum and by the action of gravity.

**[0104]** Preferably, said opening defines an opening plane, said closure plane of said door assembly substantially being parallel to said opening plane, when said door assembly is in a closed configuration.

**[0105]** The door assembly of the invention perfectly closes the opening formed in the front wall of the laundry treatment device. No modification has to be made to the laundry treatment device, besides the door assembly itself.

**[0106]** Advantageously, said front wall defines a front wall plane which forms, at least for a portion of the same, a non-zero angle with said opening plane, said front surface of said front frame forming substantially the same non-zero angle with said opening plane.

**[0107]** In case of a tilted front wall of the laundry treatment device, the door assembly perfectly fits the same, being the inclination of the front wall and the inclination of the front surface of the front frame substantially the same and thus improving the overall aesthetical appear-

ance of the device.

**[0108]** According to a third aspect, the invention relates to a method to reverse a door assembly associated to a laundry treatment device from a left-hand door assembly to a right-hand door assembly or vice-versa, said door assembly including

- a front door frame forming a front surface of the door assembly, said front surface defining a front plane, said front door frame including a front aperture (9) defining an inner edge;
- a rear door frame forming a rear surface of said door assembly, said rear surface defining a closure plane;
- a handle-carrying element interposed between said rear door frame and front door frame, and a handle coupled to said handle-carrying element;
- a cap element interposed between said front frame and said rear frame, a hinge and a portion of a door locking mechanism, said hinge and said portion of a door locking mechanism being mounted on said cap element;
- wherein said front plane and said closure plane are intersecting one the other so as to form an angle different from 0° and 180°, the method comprising the steps of:
  - releasing said front door frame (6) from said rear door frame;
  - rotating said cap element of 180°;
  - rotating said handle-carrying element on a handle plane angled with respect to said closure plane of an angle comprised between 0° and 180°; and
  - fastening said front door frame to said rear door frame.

**[0109]** It is to be understood that the step of rotating the handle-carrying element may further include other steps; for example, when the front door frame is released from the rear door frame, the handle-carrying element is preferably first lifted and separated from the frames and then rotated.

**[0110]** It is to be understood that there is no need of completely separating the front and rear door frame in order to rotate the handle-carrying element: only the elements that block the rotation of the handle-carrying element need to be removed, or shifted or rotated.

**[0111]** In this way, no complex removal and re-fastening of elements, such as of the hinge and door locking mechanism, has to be performed in order to reverse the aperture direction of the door assembly. A simple rotation

already exchanges the position of the handle and the door locking mechanism in the door assembly of the invention.

#### 5 Brief description of the drawings

**[0112]** These and other features and advantages of the invention will better appear from the following description of some exemplary and non-limitative embodiments, to be read with reference to the attached drawings, wherein:

- figure 1 is a perspective view of a first embodiment of a laundry treatment device realized according to the present invention;
- figure 2 is a side view, in section, of the laundry treatment device of figure 1;
- figure 3 is a front view of a door assembly realized according to the present invention and used in the laundry treatment device of figures 1 and 2;
- figure 4 is a lateral view, in section along the B-B line of figure 3, of the door assembly of figure 3;
- figure 5 is a lateral view, in section along the A-A line of figure 3, of the door assembly of figure 3;
- figures 5a and 5b are two details, in an enlarged view, of the cross section of fig. 5;
- figure 5c is a rear view of door assembly of fig. 3;
- figure 5d is a lateral view of a component of door assembly of figure 3;
- figure 6 is a perspective rear view of the door assembly of figure 3 in a disassembled configuration;
- figure 7 is a further perspective front view of the door assembly of figure 3 in a disassembled configuration;
- figure 8 is an enlarged perspective view of two components of the door assembly shown in figures 6 and 7;
- figures 9a and 9b are two front views of the door assembly in a first and second assembled configurations according to the invention;
- figures 10a and 10b are two front views of the door assembly in a third and fourth assembled configurations according to the invention;
- figures 11a and 11b are a lateral view in section and a front view, respectively, of an embodiment of a door assembly in an assembled configuration;

- figures 12a and 12b are a lateral view in section and a front view, respectively, of an additional embodiment of a door assembly in an assembled configuration;
- figures 13a-13c are a lateral view in section and two front views, respectively, of an additional embodiment of a door assembly in an assembled configuration;
- figures 14a and 14b are a lateral view in section and a front view, respectively, of an additional embodiment of a door assembly in an assembled configuration; and
- figures 15a and 15b are a lateral view in section and a front view, respectively, of an additional embodiment of a door assembly not according to the invention in an assembled configuration.

#### Detailed description of the preferred embodiments

**[0113]** With initial reference to figs. 1, 2 an embodiment of a laundry treatment device realized according to the present invention is globally indicated with 1. In this preferred embodiments, the laundry treatment device 1 is a dryer, however the present teaching can be applied to washing machines and washer-dryers as well.

**[0114]** Laundry treatment device 1 comprises an outer box casing 7 preferably but not necessarily parallelepiped-shaped, and a treatment chamber, such as a drum 3 for example having the shape of a hollow cylinder, for housing the laundry and in general the clothes and garments to be washed and/or dried. The drum 3 is preferably contained into the casing. In a preferred embodiment, drum 3 can rotate around a preferably horizontal axis (in alternative embodiments, rotation axis may be vertical or tilted).

**[0115]** Access to the drum 3 is achieved for example via an opening 4 formed on the casing 7 itself. Opening 4 preferably faces drum 3 and it is apt to be closed - or even sealed - by a door assembly 10.

**[0116]** The door assembly 10 is adapted to alternatively open and close the laundry loading opening 4 of the laundry treatment device 1 and is advantageously pivotally mounted, for example hinged, and thus supported at the casing 7 of the device 1. Door assembly 10 can be operated, preferably, by a handle 31 and better detailed below.

**[0117]** Preferably, casing 7 generally includes a front wall 2 to which the door assembly 10 is pivotally mounted, a rear wall panel (not visible in the appended drawings) and two sidewall panels 71, 72 all mounted on a basement 74. Casing 7 is then topped by a top wall panel 73. Front wall 2, top wall 73, sidewall panels 71, 72, rear wall panel and basement 74 can be of any suitable material. Preferably, the basement 74 is made of plastic material.

**[0118]** Preferably, sidewall panels, front wall, rear wall,

top wall and basement are separated pieces which are then assembled together via suitable fastening means. However, it is also encompassed by the present invention that some of these walls can be a single piece, for example lateral walls and rear wall can be a single U-shaped piece.

**[0119]** Walls are preferably made of metal, however also plastic is possible. Also, in a non-depicted embodiment, some of the walls can be made of a material, and some other(s) can be made of a different material.

**[0120]** By the laundry treatment device 1 itself, in a standard operative position, a horizontal plane is defined (plane (XY) in Figure 1), which is generally the plane on which the bottom wall or basement 74 lies and generally it is also parallel to the top wall 73 of the casing 7 in a mounted configuration. The device 1 also extends along a vertical direction denoted with Z.

**[0121]** In a preferred embodiment, the front wall 2 includes an external continuous surface 2a having one or more openings, such as laundry opening 4. Further openings, for example to house a control panel or a water or detergent drawer, etc. are also possible. According to a preferred embodiment, the front external surface 2a of front wall 2 is the external front surface of the device 1.

**[0122]** Front wall 2 is preferably made of a metallic material, for example in stainless steel.

**[0123]** The front surface 2a is preferably continuous and even more preferably seamless, at least in the visible portion(s) of the same. Continuous surface means that the surface is formed as a single member. "Seamless" means that, in addition to be continuous, there are no seams which indicate that for example welding has been used to join together different parts. In the covered (i.e., not visible from outside of the laundry treatment device 1 in the assembled condition of the latter) portions of the front wall 2, seams can be present. The absence of seams improves the overall appearance of the laundry treatment device 1.

**[0124]** In addition, the front wall 2 preferably includes four rounded corners 4a, 4b, 4c, and 4d along its outer edge. "Rounded corner" means a corner which does not include sharp and abrupt changes in directions of the surfaces forming the same; on the contrary in a rounded corner the surfaces merges smoothly and with continuity. The round corners give a more aesthetically pleasant look to the device 1.

**[0125]** In an embodiment of the invention, the front wall 2 can be obtained by a single sheet of metal. For example, it can be obtained by a sheet of stainless steel. In addition, the front wall can be coated by suitable coating to prevent corrosion. Moreover, the front wall can be colored of any color and gloss.

**[0126]** Preferably, the front wall 2 defines a top portion 4a', a middle portion 4a" and a bottom portion 4a"', the terms "top", "middle" and "bottom" used with reference to the above defined standard standing configuration of the laundry treatment device 1 when in use.

**[0127]** In a preferred embodiment, as shown in figure

1, only the top portion 4a' and the middle portion 4a" of the front wall 4 are a single (or one-piece) element, i.e., having a continuous and/or seamless front surface, while the bottom portion 4a''' is a separate piece and is to be assembled to the rest of the front wall.

**[0128]** Preferably, but not necessarily, the opening 4 and thus the door assembly 10 are located in the middle portion 4a" of the front wall 2.

**[0129]** Advantageously, the front wall 2 is not flat, i.e., it does not lie completely on a single plane. On the contrary, it includes a concavity pointing towards the inside of the casing 7 being convex on the outside. In the depicted embodiment, better visible in the side view of fig. 2, the front wall 2 - in a section along a plane parallel to the Z direction - has substantially a smoothed trapezoidal shape, the top 4a', the bottom 4a''' and the middle portion 4a" lying on three different planes which form an angle one with respect to the other(s) and also with the vertical direction Z defined by the casing 7, forming in this way the inward concavity. The three planes are preferably connected smoothly and without sharp corners. However, other layouts of the front wall 2 are possible as well, for example the front wall can include a substantially constant curvature, the concavity still oriented towards the inside of the casing 7. For example, the front wall could be a portion of a cylindrical mantel. In a preferred embodiment, the middle portion 4a" including the opening 4 defines a surface not parallel to the Z direction, but tilted with respect to the latter. The section of casing 7 along a vertical plane parallel to side walls 71, 72 as in fig. 2 shows a slight inclination of portion 4a" with respect to the Z axis. Therefore it is preferred that the door assembly 10 "matches" with this surface tilted with respect to the Z direction.

**[0130]** Laundry treatment device 1 also comprises an electrical motor (not shown) assembly for rotating, on command, revolving drum 3 along its axis inside casing. Casing 7 revolving drum 3 and electrical motor are common parts in the technical field and are considered to be known; therefore they will not be described further in details.

**[0131]** With now reference to figs. 3-5, door assembly 10 includes a frame, which in turn includes two "half frames", a rear frame 5 and a front frame 6, one attached to the other.

**[0132]** The door assembly 10 can have two different operative positions or configurations: a closed position in which it is abutting against the front wall 2, and an open position in which is separated from the front wall, with the exception of the connecting element (e.g., hinge) location. In order to move door assembly from the closed to the open configuration or vice-versa, handle 31 is used.

**[0133]** The wording "rear frame" 5 is indicating in the following the portion of the frame of door assembly 10 a surface of which, called rear surface 5b, is substantially in contact with casing 7 when the door assembly 10 is in the closed operative position (as shown in fig. 2), while the front frame 6 is defined as the portion of the frame of

door assembly 10 a surface of which, called front surface 6a, is mainly facing the exterior when the door assembly 10 is closed onto casing 7, i.e., it faces a direction opposite to the casing.

**[0134]** Preferably, with now reference to figs. 4, 5, front frame 6 includes in addition to the front surface 6a also a rear surface 6b, the latter being apt to be in contact with or facing the rear frame 5 when the door assembly 10 is in an assembled configuration. Analogously, rear frame 5 includes a front surface 5a which is apt to be in contact with or facing rear surface 6b of front frame 6 when the door assembly 10 is in an assembled configuration, and it is also opposite to rear surface 5b in contact with the casing 7 when door assembly 10 is mounted and in a closed operative position (as in fig. 2).

**[0135]** Preferably, rear and front frame 5, 6 are made of plastic, more preferably each of them is formed as an integral piece of plastic, for example by injection molding.

**[0136]** In door assembly 10, as visible in figures 6 and 7, front frame 6 is ring-shaped including an aperture 9, while rear frame 5 is disc-shaped and does not include an aperture.

**[0137]** However, the shape of door assembly 10 and thus of front and rear frame 6, 5, is arbitrary, for example the door assembly 10 can be substantially polygonal, such as rectangular, quadratic, triangular, or elliptical when a front view of the same is considered.

**[0138]** Door frame assembly 10, when assembled, defines an outer perimeter edge 11, which is the outer contour of the frame. As discussed above, in the depicted embodiment, preferably the outer perimeter edge 11 describes a circumference, however any other shape is envisaged by the present invention depending on the door assembly final desired shape 10.

**[0139]** A bowl-shaped element 80 is present in embodiment of door assembly 10, however it is not a separate component, on the contrary it is an integral piece of rear frame 5, for example rear frame 5 including bowl-element 80 can be molded as a single block (see figs. 4 and 5).

**[0140]** In the preferred embodiment in which a door aperture 9 is present in front frame 6, an inner edge or border 9a is consequently defined in the front frame 6 itself as the edge of the door aperture 9.

**[0141]** With now reference to figs. 2 and 5, according to one aspect of the invention, the rear surface 5a of rear door frame 5 defines a closure plane PB. The closure plane is defined by the portion of rear surface that abuts on the casing 7, when the door assembly 10 is in a closed configuration on casing 7. Generally, such plane PB is parallel to an opening plane PC defined by the opening 4 obtained in the front wall 2. The opening plane PC is the plane on which the opening 4 lies. The opening plane PC and the closure plane PB may coincide or they can be one parallel to the other. Opening and closure plane PC, PB are better visible in figure 2.

**[0142]** Preferably, closure plane PB and opening plane PC are substantially parallel to the Z axis. However a closure plane and/or an opening plane tilted with respect

to the Z axis are included as well.

**[0143]** Front surface 6a of front frame 6 also define a plane, called maximal area front plane PA.

**[0144]** Front plane PA and closure plane PB form an angle  $\alpha$  therebetween which is different from  $0^\circ$  and  $180^\circ$ , i.e., planes PA and PB are not parallel one to the other, but they are incident.

**[0145]** With now reference to figures 11a-15b, the front frame plane PA is defined as follows. A "virtual" plane is considered and it is put into contact, again "virtually", with the front surface 6a of the front frame 6. The location where the virtual plane is "stable" on the front frame 6, i.e., it contacts the front surface 6a in at least three different points, defines the location of a candidate front plane.

**[0146]** The candidate front plane which defines the maximal virtual area on the front surface of front frame 6 is the maximal area front plane. The area is calculated as follows, for each candidate front plane.

**[0147]** In a first possible situation, all candidate front planes, when put in contact to the front surface 6a of the front frame 6 define, on the front surface, at least a closed curve or an area. The latter case takes place when the front surface 6a includes a planar (e.g., flat) portion. This means that the geometrical locus of the points belonging to the front surface 6a which "touches" the candidate front plane defines either a closed curve or an area (it is also possible that it defines two or more closed curves or two or more distinct areas). Each closed curve encircles an area. The candidate front plane is then the plane that forms the largest of these areas, the largest among all the areas encircled by the closed curves and the areas defined automatically by the direct contact between the candidate planes and the front surface 6a.

**[0148]** In a second possible situation, there is (are) candidate front plane(s) which, when in contact with the front surface 6a, do not form a closed curve. These candidate front planes might be the only defined candidate front planes in the door assembly of interest, or candidate front planes defining closed curves or areas can be present as well, e.g., a combination of candidate front planes forming closed curves or areas and candidate front planes not forming such closed curves can be defined. For each of those candidate front planes which do not form a closed curve, the locus of points of contact between the candidate front plane and the front surface includes at least a set of isolated points, or a set of isolated points and curves (not closed) or a set of curves separated one from the other. Connecting all elements of the set, e.g., connecting all points and/or curves of the set via segments forms a closed curve. As above, this closed curve defines an area, which is the area encircled by the closed curve. Again, the largest area among all defined areas, i.e., among the areas defined by candidate front planes which by themselves define closed curves or areas and the areas encircled by these closed curves initially formed by separated element, selects the front plane.

**[0149]** In both cases, the candidate front plane defining the largest area (regardless of how this area is formed, either directly, or as the internal area of the closed curve or as the internal area of the curve which is closed joining different points or curves) on the front surface is the maximal area front plane.

**[0150]** The closure plane PB is depicted, as the vertical dashed line in figs. 11a, 12a, 13a, 14a and 15a: the closure plane is defined by the portion of rear frame that abuts against the front wall 2 or casing 7. Rear frame 5 is not depicted for clarity. In the depicted embodiments, the door assembly 10; 10PA is positioned parallel to the Z axis; however the closure plane PB could be tilted as well.

**[0151]** Figs. 11b, 12b, 13b, 14b and 15b represent a front view of the five different embodiments of the door assembly 10; 10PA, while figs. 11a, 12a, 13a, 14a, and 15a represent a section of the door assembly 10; 10PA of figs. 11b, 12b, 13b, 14b, and 15b, respectively, along a vertical plane passing through the center axis of the respective front view (section along line A-A of the front views).

**[0152]** Figures 11a and 11b, and 12a and 12b show two different embodiments of a door assembly 10 in which a single location for a stable front plane is present.

**[0153]** As clear from the figs. 11a and 11b, the front frame includes a prism "prism" having a triangular base and axis substantially perpendicular to the Z axis. On one face of the prism, a quarter of a cylinder "cylinder" is attached, the cylinder having an axis parallel to the axis of the triangular prism. The triangular prism has a right rectangle as a base, a side of which lies on the closure plane PB, the other side being in contact to the cylinder portion. The front surface 6a thus includes a rectangular flat portion, which is one side of the prism, and a curved portion being a portion of the outer surface of a cylindrical mantel of the cylinder. The outer edge 11 of the frame is substantially rectangular. The section of the front frame along line A-A includes a triangle to the bottom base of which a quarter of circumference is connected. The front surface 6a includes as said a flat surface (a rectangle), therefore the area defined by "putting into contact a candidate front plane PA" onto the front surface of front frame corresponds to the area of the rectangular portion of the front surface itself. There are no other possible positions for a candidate front plane, due to the fact that there is no other stable position for a plane on this door assembly layout, thus the plane PA defining an area equal to the area of the flat portion of front surface is the front plane itself. The gray area depicted in fig. 11b is therefore the area defined by the single candidate front plane which is also the front plane (or maximal area front plane). As shown, planes PA and PB define an angle  $\alpha$  therebetween different from  $0^\circ$  and  $180^\circ$ .

**[0154]** In figures 12a and 12b, a single candidate front plane is also present. However in this case, the front frame is torus-shaped, defining aperture 9, where the torus has a generating circumference having variable di-

ameter, in particular it has its minimal diameter at its top-most edge and its maximal diameter at the lower-most edge. The outer edge 11 of the frame is thus a circumference, as visible in fig. 12b. The front surface 6a includes a portion of a torus outer surface. Putting onto contact a virtual front plane with the front surface of the front frame described above, which is curved without any flat portion, defines a closed curve, in this particular case an ellipse, i.e., the locus of points of the contact between the front surface 6a; 106a and the candidate plane PA is an ellipse, which is a closed curve. This closed curve of contact is represented in fig. 12b as a dashed line. The area internal to this curve (which, as said, is an ellipse) is the area defined by the candidate front plane. It is clear that this area includes portions of the front surface 6a as well as additional portions, such as portions of aperture 9 (in this case the whole area of the aperture). In this case, there is no comparison to be made among different areas because a single candidate front plane PA is present which is the front plane. No other plane can be stably positioned on the front surface.

**[0155]** In figures 13a-13c, an embodiment of a door assembly 10 in which five different candidate front planes PA1, PA2, PA3, PA4, PA5 are defined is depicted. Figures 13a and 13b corresponds to the same view of figures 11a, 12a and 11b, 12b above described. The front frame of this embodiment has a substantially rectangular outer edge 11 and includes an aperture 9 substantially centrally located. The rectangle defined by edge 11 has two opposite sides, in particular the top most and lower most side with respect to the Z axis, substantially parallel to the (X,Y) plane. The front frame 6 of this embodiment includes, in a position corresponding to the top most and lower most sides, two prisms "prism 1" and "prism 2" having a triangular base. The two triangular prisms have an axis perpendicular to the Z axis and are positioned one on top of the other. Preferably, the base triangle of each prism is a right triangle, which one side lying on the closure plane PB. Therefore, the section of the front frame 6 along the vertical plane defines two triangles, one for each prism, as visible in fig. 13a; thus a top-most and lower-most triangle are formed. The two triangles have different dimensions. Five candidate front planes are defined by the present front frame of this embodiment:

- a first candidate front plane PA1 which lies on one face of the upper-most triangular prism, corresponding to the hypotenuse of the triangle, and thus the contact between the plane PA1 and the front surface 6a defines a first virtual surface area equal to the surface area of the prism face;
- a second candidate front plane PA2 which lies on one face of the lower-most triangular prism, corresponding to the hypotenuse of the triangle, and thus the contact between the plane PA2 and the front surface defines a second virtual surface area equal to

the surface area of the prism face;

- a third candidate front plane PA3 which is in contact to an edge of the top-most prism and an edge of the lower-most prism. The third candidate front plane thus defines two parallel lines as locus of contact points. These two parallel lines form a closed curve when connected at their opposite ends, so that a rectangle is defined. The area inscribed in the rectangle is the third virtual surface area;
- a fourth candidate front plane PA4 which lies on another face of the upper-most triangular prism, corresponding to the free side of the triangle, and thus the contact between the plane PA4 and the front surface defines a fourth virtual surface area equal to the surface area of the prism face;
- a fifth candidate front plane PA5 which lies on another face of the lower-most triangular prism, corresponding to the free side of the triangle, and thus the contact between the plane PA5 and the front surface defines a fifth virtual surface area equal to the surface area of the prism face.

**[0156]** In figure 13b the virtual surface areas defined by the candidate front planes P1-P5 in a front view of the door assembly 10 are shown. Surface areas defined by PA4 and PA5 are perpendicular to the drawing and thus are not visible. However, the area defined by P5 is less extended than the area defined by PA3 and the area defined by PA4 is smaller than the area defined by PA1, so they cannot define the maximal area and thus none of them can be the front plane of this door assembly 10.

**[0157]** The first virtual area defined by PA1 is represented as a rectangle filled with diagonal lines. The second virtual area defined by PA2 is represented as a rectangle filled with horizontal lines. The third virtual area defined by PA3 is also a rectangle that overlaps completely with the second virtual area and is filled with vertical lines. It is clear from the drawing that the maximal area, i.e., the most extended area, is the one defined by PA3 which is then the front plane. The front plane PA3=PA and its area are depicted alone in fig. 13c.

**[0158]** Figs. 14a and 14b shows an embodiment of a door assembly 10 where the front frame has the same layout as in the embodiment of figs. 13a-13c and in addition, in the location of front frame where in figs. 13a-13c the aperture 9 is present, a half cylindroid "cylindroid" is realized covering the aperture completely. The half cylinder has an axis which is positioned parallel to the axis of the two triangular prisms. The section of this door assembly defines two triangles and a semi-ellipsoid in between the two triangles, without any overlap between the various geometrical figures. The candidate front planes which are definable in this embodiment are:

- a first candidate front plane PA1 which lies on one

face of the upper-most triangular prism, corresponding to the hypotenuse of the triangle, and thus the contact between the plane PA1 and the front surface defines a first virtual surface area equal to the surface area of the prism face;

- a second candidate front plane PA2 which lies on one face of the lower-most triangular prism, corresponding to the hypotenuse of the triangle, and thus the contact between the plane PA2 and the front surface defines a second virtual surface area equal to the surface area of the prism face;
- a third candidate front plane PA3 which in contact to an edge of the top-most prism and an edge of the lower-most prism. The third candidate front plane thus defines two parallel lines as locus of contact points. These two parallel lines form a closed curve when connected at their opposite ends, so that a rectangle is defined. The area inscribed in the rectangle is the third virtual surface area;
- a fourth candidate front plane PA4 which lies on another face of the upper-most triangular prism, corresponding to the free side of the triangle, and thus the contact between the plane PA4 and the front surface defines a fourth virtual surface area equal to the surface area of the prism face;
- a fifth candidate front plane PA5 which lies on another face of the lower-most triangular prism, corresponding to the free side of the triangle, and thus the contact between the plane PA5 and the front surface defines a fifth virtual surface area equal to the surface area of the prism face;
- a sixth candidate front plane PA6 which is in contact to an edge of the top-most prism and a contact line defined on the half-cylindroid. The sixth candidate front plane thus defines two parallel lines as locus of contact points. These two parallel lines form a closed curve when connected at their opposite ends, so that a rectangle is defined. The area inscribed in the rectangle is the sixth virtual surface area;
- a seventh candidate front plane PA7 which is in contact to an edge of the lower-most prism and a contact line defined on the half-cylindroid. The sixth candidate front plane thus defines two parallel lines as locus of contact points. These two parallel lines form a closed curve when connected at their opposite ends, so that a rectangle is defined. The area inscribed in the rectangle is the seventh virtual surface area.

**[0159]** In other words, two candidate front planes in addition to the five of the previous embodiment are present in this frame layout. It is also clear that one plane,

the third plane PA3, sections a portion of the front frame, e.g., it sections the central half-cylindroid. However, as better visible in fig. 13b, the curve defined by the sectioned portion, is not part of the closed curve which encircles the area defined by the third plane and thus it is acceptable according to the set rules.

**[0160]** Checking the dimensions of the seven different areas, it is clear that the largest area is the one defined by PA3 which is then the front plane PA, as in the previous case.

**[0161]** In all the described embodiments, the closure plane PB and the front plane PA form an angle therebetween, i.e., they are not parallel. This angle  $\alpha$  can vary in values, as long as it is different from  $0^\circ$  and  $180^\circ$ . Preferably it is smaller than  $10^\circ$ .

**[0162]** In figs. 15a and 15b, a different embodiment of a door frame 10PA not according to the invention is described. In this door assembly, the front frame includes a parallelepiped portion in the center of which a half-cylinder is positioned. In section along line A-A, therefore, the front frame defines a rectangle on which - in the central portion - a half-circumference is located protruding outwardly from the rectangle. The parallelepiped portion is positioned with two opposite faces substantially parallel to the closure plane PB.

**[0163]** The front surface 6a of this embodiment includes two opposite faces, flat surfaces, of the parallelepiped and one portion, substantially perpendicular to the two faces, which is partly flat and partly a portion of a cylinder mantel. Five candidate front planes are thus defined:

- a first candidate front plane PA1 which lies on the upper-most face of the parallelepiped and thus the contact between the plane PA1 and the front surface defines a first virtual surface area equal to the surface area of the parallelepiped face;
- a second candidate front plane PA2 which lies on the lower-most face of the parallelepiped and thus the contact between the plane PA2 and the front surface defines a second virtual surface area equal to the surface area of the parallelepiped face;
- a third candidate front plane PA3 which lies on the face of the parallelepiped substantially parallel to the closure plane PB and which sections the central cylindrical portion. The contact between the plane PA3 and the front surface is thus two parallel rectangular areas separated in the middle by an additional rectangular portion. In order to form a closed curve, the two rectangles are connected at their ends so that a single closed rectangle is obtained including the two initial rectangles and the one defined therebetween;
- a fourth candidate front plane PA4 which is in contact to a top-most edge of the parallelepiped and a contact line defined on the half-cylinder. The fourth can-

didate front plane thus defines two parallel lines as locus of contact points. These two parallel lines form a closed curve which, when connected at their opposite ends, defines a rectangle. The area inscribed in the rectangle is the fourth virtual surface area;

- a fifth candidate front plane PA5 which is in contact to a lower-most edge of the parallelepiped and a contact line defined on the half-cylinder. The fifth candidate front plane thus defines two parallel lines as locus of contact points. These two parallel lines form a closed curve when connected at their opposite ends, so that a rectangle is defined. The area inscribed in the rectangle is the fifth virtual surface area.

**[0164]** Comparing the extension of these areas, the maximal area is given by PA3, which is parallel to the closure plane PB.  $\alpha = 0^\circ$ . This door assembly 10PA therefore does not belong to the invention.

**[0165]** In the frame of the invention, the front 6 and rear frame 5 define two different planes, PB and PA, which are not parallel one to the other. Due to the fact that the front and the closure plane PA, PB form an angle  $\alpha$  therebetween different from  $0^\circ$  and  $180^\circ$ , the frame including front frame 6 and rear frame 5 does not have a uniform thickness in proximity of its perimeter edge 11. Preferably, the thickness of the frame changes gradually and continuously along its edge 11, from a minimum to a maximum thickness. More preferably, the thinnest portion of door frame in proximity of its edge and the thickest portion of door frame in proximity of its edge 11 are located in such a way that one is the reflection of the other across an axis of the door assembly 10. Preferably, this axis is perpendicular to a hinge axis H of rotation of the door assembly 10 when the latter is assembled on the casing 7 and more preferably this axis passes through a geometrical center of the door assembly. This in turn means that preferably the top-most portion of the frame, which includes a first portion of the edge 11, and the lower-most portion of the frame, including a second portion of the edge 11, are respectively the thinner and thickest portion of the frame which contains the edge of the same.

**[0166]** For example, as visible in figure 5, which is the section along line A-A of figure 3, the shown door assembly 10 has a thickness T1, which is the thinnest thickness of the frame along its edge, in a portion of front frame 6 which is top-most located when the door assembly 10 is attached to the casing 7, while it has a thickness T2, which is the thickest thickness of the door frame along its edge 11, in a portion of door frame which is lower-most located when the door assembly 10 is attached to casing 7. Planes PA and PB are depicted as well.

**[0167]** The frame may include thicker or thinner portions than the portions having thickness T1 and/or T2 in its geometrical layout, however these additional portions do not include the edge 11 of the frame. An example is the embodiment depicted in fig. 14a, where the central

cylinder can be thicker, in its central portion, than the prism, so defining a thicker thickness of the frame in that position than in the lower-most edge portion of the frame..

**[0168]** Front frame 6 and rear frame 5 can be realized as a single piece or as an assembly of different pieces.

**[0169]** The front frame 6 and the rear frame 5 are coupled one to the other, preferably in a removable manner. Preferably, the coupling is obtained by means of coupling elements 21 and corresponding coupling counter elements 22 formed in the front and rear frame, respectively.

**[0170]** In the depicted embodiments, said coupling elements 21 extend from the rear surface 6b of the front frame 6 while said coupling counter elements 22 extend from the front surface 5a of said rear frame 5.

**[0171]** Preferably, coupling elements 21 extend substantially perpendicularly to the rear surface 6b of front frame 6 at least locally, e.g. they are substantially perpendicular to the portion of the rear surface from which they depart. Counter elements 22 have substantially a negligible height or extension.

**[0172]** With reference to figs. 5a, 5b, in the depicted embodiment, each coupling element 21 includes an appendix 90. Preferably the appendix 90 includes a tubular sleeve 91, having an open end. Alternatively, in a non-depicted variant, the element 21 may include a cylindrical rod. It is desired that the dimensions of the sleeves and/or cylindrical rods, e.g., the diameters of elements and counter-elements, are such that the elements can be inserted within the counter elements or vice-versa. Even more preferably, the insertion of the elements into the counter-elements or vice-versa is obtained with interference so that, when a coupling element is inserted in a coupling counter element (or vice-versa) the removal requires the application of a non-negligible force, so that the possibility of accidental removals is minimized.

**[0173]** As better visible in figs. 5a, 5b, and 6, each coupling element 21 departing from the rear surface 6b of front frame 6 includes a tubular sleeve 91 departing from a pedestal 92. In other words, the tubular sleeve is not directly connected to the rear surface 6b of front frame 6, but it is positioned on the pedestal 92. Coupling counter-elements 22 are realized as through holes on rear frame 5, in which the tubular sleeve 91 of coupling elements 21 can be inserted. Instead of through-holes, coupling counter-elements 22 could include appendices 90 as well. It is preferred that in this embodiment coupling elements 21 includes tubular sleeves 91 and not cylindrical rod, so that fastening screws 25 can be inserted from rear surface 5b of rear frame 5 into the through-holes defined by coupling counter-elements 22 and then into the tubular sleeves 91 of coupling elements 21, so as to better fasten front and rear frame 6, 5 together..

**[0174]** The coupling elements 21 and the coupling counter-elements 22 are located in the front 6 and rear frame 5 respectively, in proximity of the outer edge 11 of the door frame. More preferably, the coupling elements 21 and counter elements 22 are angularly spaced one from the other, even more preferably with a substantially

constant spacing one from the other so that the whole extension of the edge 11 contour of the door frame is substantially followed by the elements and counter elements. It is to be understood that, fixed the location of one of the plurality of elements or counter-elements in the front or rear frame, the location of the other of the plurality of elements or counter-elements on the other of the front or rear frame is fixed as well, the elements having to match with the corresponding counter-elements.

**[0175]** Preferably, for each element 21 in the front frame 6, a counter element 22 is present in the rear frame 5 in a bijection correspondence.

**[0176]** Preferably, coupling elements 21 and/or coupling counter elements 22 are integrally formed with the front 6 and/or rear frame 5. Preferably, elements and/or counter elements are made of plastic material, so that elements and counter elements are realized with the respective front and rear frame in a single molding process.

**[0177]** According to an aspect of the invention, either the coupling elements 21, or the coupling counter-elements 22, or both, have different heights among themselves. In other words, either the plurality of elements 21 includes at least a first element having a first height D1 different from a height D2 of a second element of the plurality, or the plurality of counter elements 22 includes at least a first counter element having a first height D1 different from a height D2 of a second counter element of the plurality. Alternatively, both plurality of elements 21 and counter elements 22 include, within the same plurality, two elements/counter elements having different heights.

**[0178]** In the depicted embodiment, the coupling elements have a variable height, and the counter-elements not.

**[0179]** More preferably, the plurality of coupling elements 21 includes a plurality of different heights so that the thickness of the frame of the door assembly 10 can vary continuously and smoothly. Being the elements and counter-elements located in correspondence of the edge of the frame 11, having a plurality of different heights allow to give to the frame a continuous variation in thickness at its edge 11.

**[0180]** Coupling counter-elements 22 are through-holes and thus have a substantially negligible height which is thus equal among all coupling counter-elements. On the other hand, the front frame 6, as better visible in fig. 6, includes a plurality of coupling elements 21 having different heights extending from the rear surface 6b of front frame 6. These elements 21 include sleeves 91, all having the same height, positioned on respective pedestals 92 which have different heights; thus also coupling elements 21 have different heights among themselves. Preferably, a plurality of different heights is defined in the pedestals. Even more preferably, a number of different heights equal to the number of coupling elements 21 is present.

**[0181]** As shown in fig. 4, the plurality of counter-elements 22 have different heights from a minimum height

D1 in the top-most portion of the front frame 6 to a maximum height D2 in the lower-most portion of the front frame 6.

**[0182]** As better visible in figure 5d, which is a sides view of rear frame 5 in a position as if it were assembled on casing 7 and in a closed configuration of door assembly 10, rear frame 5 further includes a plurality of centering-elements 23 protruding from front surface 5a, substantially perpendicularly to the latter. Centering elements 23 are located in proximity of the edge of rear frame 5, in a radially inward position with respect to the position of coupling counter-elements 22 and they are angularly spaced one from the others. These centering-elements 23 also, among themselves, have different heights, from a maximum height L2 at the lower-most portion of rear frame 5 and a minimum height L1 at the top-most portion of rear frame 5. The function of these centering elements 23 is three-folds: to support of additional elements positioned on top of the rear frame, to improve the centering of such additional elements and to avoid rotations of the same, as better detailed below.

**[0183]** The coupling between the front frame 6 and the rear frame 5, is realized by inserting the coupling elements 21 into the coupling counter-elements 22. At the same time, due to the different heights of the coupling elements 21 and/or coupling counter elements 22, the resulting thickness of the frame at its edge 11 varies depending on the position along the edge itself.

**[0184]** Therefore, the coupling elements 21 and counter-elements 22 can be used not only to couple front 6 and rear frame 5 together, but also to determine the angle  $\alpha$  different from  $0^\circ$  and  $180^\circ$  between the front plane PA and the closure plane PB due to their different heights. However, the "tilt" present between the front PA and closure plane PB can be created in other ways and it is not necessary that the front 6 and rear frame 5 are coupled using coupling elements 21 and coupling counter-elements 22 having different heights. Moreover, coupling elements 21 and coupling counter-elements 22 may have many different other shapes and configurations than the tubular one above described.

**[0185]** As mentioned above, the door assembly 10 further includes the handle 31 so that it can be moved from an open to a closed position and vice-versa. The handle 31 is coupled to a handle-carrying element 30 which carries the handle 31. The handle-carrying element 30 is positioned, e.g., partially sandwiched, between the front 6 and rear frame 5 of door assembly 10. Preferably, the handle-carrying element defines an outer edge 32 which is sandwiched between the front 6 and the rear frame 5. The handle-carrying element 30 is so construed that relative movements between the handle 31 and the element 30 are not possible, i.e., handle 31 is firmly fixed on handle-carrying element 30.

**[0186]** Preferably, handle 31 has an elongated shape defining a first and a second distal ends 31a, 31b.

**[0187]** Handle 31 preferably belongs to a system which may be named "pull-to-open" door opening system: the

door assembly 10 is provided with a latch, and the casing 7, preferably front wall 2, is provided with a latch retaining mechanism that includes a mobile part which is configured to be movable between a retaining position, in which it engages the latch so as to retain the door assembly in the closed condition, and an opening position in which it releases the latch so as to allow the opening of the door assembly. The mobile part of the latch allows the releasing of the latch when a releasing force is applied which is greater than a threshold force, as better described below. The door assembly is therefore opened by pulling it outwards with enough force, and can also be opened by pushing it from the inside of the treatment chamber 3.

**[0188]** The handle 31 of the door assembly 10 has only the function of providing a grip to the user, and it is fixed to the frame of door assembly via the handle-carrying element 30.

**[0189]** Preferably, the handle-carrying element 30 does not change the angle between the front frame PA and the closure frame PB; in other words it is not responsible for tilting any part of the front frame with respect to the rear frame or vice-versa. Therefore, the insertion of the handle-carrying element 30 between the front 6 and rear frame 5 does not modify the angle formed between the above defined closure and front frame. The outer edge 32 of handle-carrying element 30 has thus preferably substantially a uniform thickness.

**[0190]** As visible in the drawings, door assembly 10 includes a front frame 6 defining an internal opening 9. Preferably handle 31 is located at the aperture 9, and it extends in a radially inward direction from the inner edge 9a of the aperture 9.

**[0191]** Preferably, the door assembly of the invention is reversible, i.e., door assembly 10 can be mounted in a right-hand configuration or in a left-hand configuration.

**[0192]** With reference to figs. 3, 5, 6 and 7, the handle-carrying element 31 of door assembly 10 includes a plate-like member 33, substantially disc-shaped, the outer edge 32 of which is sandwiched between the front 6 and rear frame 5. The plate-like member 33 is substantially a single element realized integral to the handle 31. The handle is realized at the outer edge 32 of the plate-like member 33, protruding in a radially outward direction from the outer edge 32 and defining a radial protuberance of plate-like member 33. The plate-like member, when the door assembly is in an assembled configuration as depicted in fig. 3, covers completely aperture 9. Preferably, the diameter of plate-like member 33 is substantially identical to the diameter of aperture 9. Plate like member 33 includes a surface 33a which results visible from the exterior of casing 7, when door assembly 10 is in an assembled configuration and closed on casing 7, and which is adjacent to the front surface 6a of door assembly 10. Preferably, surface 33a is substantially flush with front surface 6a of front frame 6. Handle 31 results visible from the outside of casing 7 and it includes a recess 34, which is best visible in fig. 5 where the door is sectioned along a plane sectioning also the handle 31 (figure 5 is the

section along line B-B of fig. 3). The recess 34 is a recess in the surface 33a at the edge 32 and it extends underneath the front frame, so that the front frame itself forms a gripping element for the user's fingers when he/she introduces the hand in the recess 34 in order to open the door assembly 10. Thus, the handle 31 is partly formed by the plate-like member 33 and partly by the front frame 6, that is to say, by a cooperation of the two.

**[0193]** Handle-carrying element 30 is preferably realized in plastic material.

**[0194]** Handle-carrying element 30 is preferably coupled directly to front frame 6. The plate like member 33 thus further includes, extending from its edge 32, an annular flange 36, substantially perpendicular to the plate-like member 33. A terminal end of annular flange 36, or at least of portions of the terminal end of annular flange 36, is folded in itself, defining a seat 37 formed by parallel walls defined by the annular flange's fold.

**[0195]** In order to couple the handle-carrying element 30 on the front frame, the front frame 6, in its rear surface 6b, includes also a protruding flange 39 which is insertable or inserted in seat 37, preferably with interference. The coupling between the flange 39 and seat 37 is clearly visible in fig. 5. Protruding flange 39 preferably extends from the rear surface 6b of front frame 6 substantially perpendicularly to the rear surface itself. When handle-carrying element 30 is mounted on front frame 6, protruding flange 39 and annular flange 36 are substantially parallel at least for a portion.

**[0196]** Protruding flange 39, which is to be inserted in seat 37, is interrupted in at least four locations, by four different C-shaped wall members 38 mating the boundary external contour of the handle 31. Thus flange 39 is separated in at least four different portions.

**[0197]** During the assembly, handle-carrying element 30 is inserted in the aperture 9, the annular flange 36 being in contact to the edge 9a of the aperture 9 and to the flange 39. The insertion terminates when flange 39 reaches the bottom of seat 37. Seat 37 and flange 39 are so dimensioned that the outer surface 33a results flush with the front surface 6a of front frame 6.

**[0198]** At the same time, handle 31 is inserted within one of the C-shaped wall members 38, as better described below. At the two distal ends of each C-shaped wall member 38, from where flange 39 departs, two coupling elements 21 are positioned, one coupling element at each end. Thus, when the handle 31 is mounted on front frame 6, each of the two distal ends 31a, 31b of the handle 31 is located substantially adjacent to a coupling element 21 (see fig. 6).

**[0199]** Door assembly 10 further comprises a hinge 60, which is provided to pivot the door assembly 10 to the casing 7 so that it can be opened by rotating it about a hinge axis H, as shown in figs. 3 and 5c. Preferably, hinge 60 is arranged across, and more preferably centered across, a horizontal median plane of the door assembly 10 substantially perpendicular to hinge axis H. The horizontal median plane defines center line C, which

is an axis passing through the center of the front section of the door assembly. A vertical median plane V is also defined, as the plane parallel to the hinge or rotational axis H and passing through the geometrical center of the door assembly.

**[0200]** Preferably but not necessarily, hinge axis is parallel to the Z axis and centerline C is parallel to the (X,Y) plane, i.e. it is an horizontal axis.

**[0201]** Hinge 60 may be any conventional hinge, preferably of the type that is not visible when the door assembly 10 is closed. In the embodiment shown in the figures, hinge 60 comprises a portion (not visible in the figures) fixed to the front wall 2, a seat 62 for housing it provided in the door assembly 10, and a hinge pin 63 extending in holes of the portion fixed to front wall and of the seat 62.

**[0202]** In a washing machine, it is preferred to introduce an electromechanical lock (not all components of which are visible) is provided between the door assembly 10 and the front wall 2. The lock comprises a portion or first member fixed to the front wall 2 and a portion or second, matching member fixed to the door assembly 10 that cooperate with each other.

**[0203]** The lock is configured to avoid opening of the door assembly during operation of the laundry treatment device 1, and to possibly to avoid operation of the device with the door assembly open, for example by issuing a consent signal to an electronic control unit of the device only when the door assembly is closed and/or delay opening of the door assembly after the end of an operation cycle. The electromechanical lock is therefore also an interlock.

**[0204]** Advantageously, the second member comprises a hook or latch 61 protruding from the door assembly 10 towards the casing 7 and the first member comprises a latch retaining mechanism for receiving the hook or latch 61, positioned at the casing 7.

**[0205]** The latch retaining mechanism preferably includes, in a manner known *per se*, a mobile part which is configured to be movable between a retaining position, in which it engages the hook or latch 61 so as to retain the door assembly 10 in a closed condition, and an opening position in which it releases the hook or latch 61 so as to allow the opening of the door assembly 10. The mobile part of the latch retaining mechanism at the front wall 2 preferably interacts with an elastic element, for example a spring, which allows the releasing of the hook or latch 61 when a releasing force is applied which is greater than a threshold force. The door assembly is therefore, as already mentioned, of the "pull-to-open type", opened by applying a force beyond a threshold onto the door assembly 10 away from the casing 7.

**[0206]** The lock is preferably arranged across, and more preferably centered across, the horizontal centerline C of the door assembly 10. Therefore, hinge 60 and lock lie substantially on the same axis C.

**[0207]** In the door assembly 10, the hinge 60 and hook or latch 61 are mounted, in a releasable manner, to a

cap element 40. In other words, cap member 40 includes seat 62 for the housing of the hinge 60 and an additional seat (not visible in the drawings) for the housing of the hook or latch 61 (see figs. 6 and 7). Cap element 40, visible in an enlarged view in fig. 8, is sandwiched between rear frame 5 and front frame 6 in correspondence of its edge 47 and it covers at least in part the aperture 9 realized in the front frame. Cap element 40 is covered by handle-carrying element 30, which covers aperture 9 completely, when the door assembly 10 is in an assembled configuration, therefore it is not visible from the outside, with the exception of part of hinge 60 and latch 61 which have to be mounted on or cooperate with casing 7.

**[0208]** Further, in proximity of its edge 47, cap element 40 includes a first and a second plurality of through holes 44 and 48 through which coupling elements 21 and centering-elements 23 can pass. Coupling elements 21 and centering elements 23, when inserted in holes 44 and 48, respectively, avoids any rotation of cap element 40.

**[0209]** From each through-hole 44 also a tubular mantle may depart, in order to firmly house the inserted coupling element 21.

**[0210]** Cap element 40 does not change the inclination present between the front plane PA and the closure plane PB, in other words the angle between these two planes is unchanged with or without the presence of cap element 40.

**[0211]** Advantageously, cap element 40 includes a strengthening member 46, substantially centrally located, which reinforces front frame 6 and in particular handle-carrying element 30. As better visible in the sections of figs. 4 and 5, a large gap is present within door assembly 10 in an assembled configuration between bowl-shaped element 80 and the plate-like member 33 of handle-carrying element 30. The presence of a central strengthening member 46 of cap element 40, for example in the shape of a hollow cylinder, avoids that pressure applied on plate-like member 33 could break the latter.

**[0212]** In figure 8, cap element 40 is shown mounted on rear frame 5. The centering-elements 23 protruding from rear surface 5b of rear frame 5 are inserted into through holes 48 and protrude from the latter. The different heights of centering-elements 23 are visible, being the thickness of cap element 40 substantially constant.

**[0213]** The handle 31, when door assembly 10 is in an assembled configuration, is provided at a location which is not aligned or not corresponding with the position of the lock, e.g., hook or latch 61 and of handle 60. The handle 31 is arranged outside the horizontal median plane C of the door assembly 10. The handle 31 is thus offset with respect to hinge 60 and the lock. In case of a large extent of the handle 31 and/or of the lock and/or of the hinge, hinge and handle and/or hinge and lock might however overlap in part.

**[0214]** According to the invention, the handle-carrying element 30 can be positioned between the front 6 and rear frame 5 at least in two different positions and more

preferably in at least four different positions. The difference between one position and the other lies in the handle location: for each position of the handle-carrying element 30 a different location L1, L2, L3, L4 of the handle 31 within the frame is achieved.

**[0215]** In the case shown in figures 9a to 9b, the door assembly 10 is in a left-hand configuration being hinged at its left (as viewed from the front of the laundry treatment device 1 when the door assembly 10 is closed), i.e., the rotation axis, or hinge axis, H is on the left side of the door assembly. The hinge 60 is advantageously centered across a position at 9 o'clock or 180° in a conventional angular reference system (see figure 9a), and the latch 61 is across a position at 3 o'clock or 0° in the same reference system (not visible in the figures). The reference system is defined by centerline C and vertical centerline V, parallel to hinge axis H. The axes C and V of door assembly 10 are also indicated in figs. 9a-9b and 10a-10b to easily identify four quadrants.

**[0216]** In figure 9a, handle 31 is shown arranged in the first quadrant, i.e., between 0° and 90°. Advantageously, the handle 31 extends for an arc or circumference lying in the generally central portion of the first quadrant. This position is indicated with "L1".

**[0217]** In case the laundry treatment device 1 is to be arranged on top of another equipment or piece of furniture, like in the case of a dryer machine arranged on top of a washing machine, the handle 31 may be arranged in the fourth quadrant, i.e. between 270° and 360°, as shown in fig. 9b. This position is called "L2".

**[0218]** Preferably, position L2 corresponds to the reflection of the position L1 of handle 31 across the centerline C.

**[0219]** In case the door assembly 10 is in a right-hand configuration, i.e. it is hinged at its right, as for example depicted in fig. 10a, and the device 1 is arranged on top of another equipment or piece of furniture, then the handle 31 may be arranged in the third quadrant, i.e. between 180° and 270° as shown in fig. 10a. This is position "L3".

**[0220]** Finally, in case the door assembly 10 is hinged at its right, and arranged on the floor, as shown in fig. 10b, then the handle 31 may be arranged in the second quadrant, i.e. between 90° and 180°. This is the position "L4".

**[0221]** Preferably, position L4 corresponds to the reflection of the position L3 of handle 31 across the centerline C.

**[0222]** Furthermore, preferably position L4 corresponds to the reflection of the position L1 of handle 31 across the vertical centerline V. Analogously, position L3 corresponds to the reflection of the position L2 of handle 31 across the vertical centerline V.

**[0223]** Moreover, in all four cases the handle 31 and hook or latch 61 are arranged such that, when the door assembly is closed, they are located at angular positions that are reciprocally spaced by less than 90°. On the contrary, hinge 60 and handle 31 are arranged such that, when the door assembly is closed, they are located at

angular positions that are reciprocally spaced by more than 90°. As the position of hinge, handle, latch, etc., the position of their center of mass is considered.

**[0224]** The assembly of the door assembly 10 takes place as follows.

**[0225]** On cap element 40, hinge 60 and latch or hook 61 are attached.

**[0226]** The cap element 40 is positioned on door frame 5 in such a way that the centering elements 23 are inserted into through-holes 48 of the cap element 40 and the through-holes 44 are aligned with the through-holes defined by the coupling counter-elements 22. Suitable recesses or openings are realized in the edge of rear door frame 5 so that the hinge 60 and the latch or hook 61 can protrude rearward outside the door assembly 10.

**[0227]** Handle-carrying element 30 is inserted into opening 9 of front door frame 6, till the flange 39 abuts onto the bottom of seat 37. The handle 31 is positioned within one of the C-shaped wall members 38 which substantially defines a seat for the handle 31 itself. C-shaped wall members 38 are formed at locations L1, L2, L3, and L4 for handle 31. The C-shaped wall member 38 is chosen among the four available ones according to the desired location of handle 31 to be achieved in the assembled door assembly 10.

**[0228]** Front frame 6 including handle-carrying element 30 is then mounted on rear frame 5 including cap element 40 and fastened inserting the coupling elements 21 first into the through holes 44 in cap element 40 and then into the coupling counter elements 22 in rear frame 5, by the application of pressure.

**[0229]** The centering-elements 23 are so located to substantially abut against the terminal end of flange 36, in other words against seat 37, so as to keep the seat 37 pressed against flange 39 of the front frame 5 and avoid possible expulsion of the latter. The centering elements 23 define, by means of their free ends, a plane which is tilted with respect to the closure plane, due to their different heights. More preferably this plane is parallel, even more preferably is coinciding to the handle plane. Therefore, when the door assembly is in an assembled configuration, the free ends of centering elements 23 define the plane on which the handle-carrying element 30 should lay. In this way, movements of the handle-carrying element 30 towards or away the front frame 6, thus movements of the handle plane, are avoided, because an abutment is present of the centering elements 23 against flange 36 for all the angular extension of the latter.

**[0230]** Additional fastening elements might be present to fix the front 6 and rear door frame 5 together, such as screws and bolts or snap-fit elements. For example, screws 25 are inserted into through holes defined by the coupling counter-elements 22 from the rear surface 5b of rear frame 5 and screwed into the tubular elements 91 of coupling elements 21.

**[0231]** In an assembled configuration of door assembly 10, rear door frame 5 and cap element 40 lie on planes substantially parallel to closure plane PB, while front door

frame and handle-carrying element 30 are substantially lying, at least on one side, on the front plane PA.

**[0232]** The meaning of lying on a plane is the following. Rear door frame 5 has two opposite surfaces 5a and 5b. Surface 5b defines closure plane PB. Surface 5a also defines a plane; the portion of surface 5a to be considered for the definition of the plane is the one which is in abutment against the "neighbouring" component of the door assembly 10, in this case cap element 40. This portion of surface 5a is planar and defines a plane which is parallel to the closure plane, due to the front frame layout. A component lying on such a plane defined by surface 5a is also, as far as the surface of the component lying on such a plane is concerned, parallel to the closure plane. Cap element 40, in the same way, defines two opposite surfaces forming two opposite planes. Cap element 40 is so construed that these two opposite surfaces and planes are parallel to each other and thus result parallel to closure plane PB, due to the fact that cap element 40 is in abutment against front surface 5a of rear frame 5 which defines a plane parallel to PB.

**[0233]** Conversely, being the handle-carrying element 30 mounted directly onto the front door frame 6 which defines a front plane which is "tilted" with respect to the closure plane PB due to the different heights of coupling elements 21, it lies on a tilted plane with respect to the closure plane as well. Being the top-most element(s) 21 the shortest, the front door frame 6 is in the top-most position closer to the closure plane PB than in the lower-most position, where the element(s) 21 is the longest, so the front door frame in this position is the farthest from the closure plane PB.

**[0234]** The front frame 6 defines the front plane PA by means of front surface 6a. Rear surface 6b defines a plane as well, for example parallel to PA. Therefore any component abutting on such a plane remains, at least for the surface in abutment, parallel to PA. Being the handle-carrying element 30 mounted on the front frame 6, it is also parallel to the front plane PA.

**[0235]** However, the handle-carrying element 30 can define, by means of one of its opposite surfaces, a plane, called handle plane PH, which can be tilted with respect to the closure plane of a different angle than the angle  $\alpha$  present between the front plane PA and the closure plane PB. In this case, a further angle or tilt has to be realized between the front frame 6 and the handle-carrying element 30, i.e. between the front plane PA and handle plane PH.

**[0236]** In an assembled configuration, rotations of the cap element 40 are avoided due to the antirotational function of the coupling elements 21 inserted in the trough holes 44 and of the centering elements 23 inserted into the through holes 48. Rotations of the handle-carrying element 30 are avoided as well due to the shape-mating of the handle 31 and the C-shaped wall member 38 and to the presence of a coupling element 21 at each distal end 31a, 31b of the handle 31.

**[0237]** In case it is desired that the door assembly 10

is reversed, for example from a left-hand door assembly to a right-hand door assembly, the location of the handle 31 has to move from the location indicated with L1 in figure 19a (although these figures refers to door assembly 110, the possible locations of the handle are applicable to door assembly 10 as well) to the location indicated with L4 in figure 20a. In order to achieve the reversibility, the front 6 and rear frame 5 have to be released one from the other. The front and rear frame 6,5 can be completely detached or simply a gap can be formed therebetween, without a complete separation of the two elements.

**[0238]** The cap element 40 which is carrying the hinge 60 and latch or hook 61 is rotated by 180° so that the position of the hinge and latch or hook are exchanged. The rotation of the cap element 40 takes place on a plane parallel to the closure plane PB.

**[0239]** It is to be understood that further movements of the cap element 40, not only a rotation, might be necessary as well, such as a translation of the same to disengage coupling elements 21 and centering elements 23 from through holes 44 and 48. However the final rotated configuration represents a rotation of 180° of the starting configuration on a plane parallel to PB.

**[0240]** Cap element 40 is then inserted again into centering-elements 23.

**[0241]** The handle-carrying element 30 is then also rotated, but of an angle smaller than 180°: it has to be rotated of the angle present between location L1 and L4. This rotation takes place on a plane which is the handle plane PH, tilted with respect to the closure plane and preferably parallel to the front plane PA.

**[0242]** The fact that the rotation takes place on the handle plane HA, means that both locations L1 and L4 lie on the same plane PH, using the same reasoning as in the rotation of cap element 40. Other movements of handle-carrying element might be necessary as well, as above described.

**[0243]** Front and rear frame 6, 5 are then fastened again one on the other, inserting the coupling elements into the holes 44 and coupling counter-elements 22, and finally screws 25 are inserted in the holes defined by coupling counter-elements 22 and screwed in tubular elements 91

**[0244]** Similarly, in case a change from a right-hand door assembly to a left-hand door assembly is desired, handle 31 has to be moved, in the same manner above described, from location L3 to location L2.

**[0245]** Alternatively, in case no reversibility of door assembly 10 is requested, which remains in a left-hand configuration, but the laundry treatment device 1 changes position from a floor-positioned device with handle 31 in position L1 to an "elevated" position, the handle 31 from location L1 preferably is to be moved to location L2 in order to be more easily accessible to the user.

**[0246]** As above, the front 6 and rear frame 5 have to be released one from the other. The front and rear frame 6, 5 can be completely detached or simply a gap can be formed therebetween.

**[0247]** No movement is requested to the cap element 40. On the contrary, the handle-carrying element 30 is rotated, again of an angle smaller than 180°: it has to be rotated of the angle present between location L1 and L2. This rotation takes place on a plane which is the handle plane PH, tilted with respect to the closure plane and preferably parallel to the front plane PA. The meaning of a rotation on plane PH is the same as above.

**[0248]** Front and rear frame 6, 5 are then fastened again one on the other.

**[0249]** Similarly, changing from a floor position to an elevated position a device 1 having a left-hand door assembly configuration, handle 31 has to be moved from location L3 to location L4.

**[0250]** Door assembly 10 is then hinged on front wall 2. Due to the tilt present between the front plane PA and the closure plane PB, the front surface 6a defining the front plane matches with the portion of front surface 2a of front wall 2 in which opening 4 is formed. Indeed, preferably such front surface 2a, around opening 4, is tilted as well.

**[0251]** Although not visible in the drawings, in door assembly 10, locating elements can be provided, to avoid that in a left-hand door configuration locations L3 or L4 are selected, and similarly, in a right-hand configuration, to avoid that locations L1 or L2 are selected by the user.

## Claims

1. A door assembly (10) for a laundry treatment device (1), apt to open and/or close an opening (4) defined in said laundry treatment device, said door assembly comprising a frame (5,6), said frame including:

- a front door frame (6) forming a front surface (6a) of the door assembly, said front surface defining a front plane (PA), said front door frame including a front aperture (9) defining an inner edge (9a);
- a rear door frame (5) forming a rear surface (5b) of said door assembly, said rear surface defining a closure plane (PB) apt to abut against the opening formed in said laundry treatment device, said front plane (PA) and said closure plane (PB) intersecting one the other so as to form an angle ( $\alpha$ ) different from 0° and 180°;
- a handle-carrying element (30) interposed between said rear door frame (5) and front door frame (6), and a handle (31) coupled to said handle-carrying element, said handle-carrying element being apt to be mounted in at least a first and a second alternative positions, so that said handle (31) can be positioned in proximity of said inner edge (9a) of said front frame at least in a first and second different locations (L1; L2; L3; L4); and
- a cap element (40) interposed between said

front door frame (6) and said rear door frame (5) and at least partly covering said front aperture (9).

2. The door assembly (10) according to claim 1, wherein

- said handle-carrying element (30) is so construed that said first and second alternative positions are separated by a rotation of said handle-holding element (30) on a handle plane (PH); and
- said handle plane (PH) and said front plane (PB) are substantially parallel.

3. The door assembly (10) according to claim 1 or 2, wherein said handle-carrying element (30) is apt to be mounted in at least said first, said second and a third and a fourth alternative positions, so that said handle (31) can be positioned on said frame in at least four different locations (L1; L2; L3; L4), at least two (L1,L3; L2,L4) of said first, second, third and fourth positions being one the reflection across an axis of the other, said at least two positions coinciding to a position for a right-hand door assembly with respect to an axis (H) of the opening of the door assembly (10) and to a position for a left-hand door assembly with respect to the axis (H) of the opening of the door assembly.

4. The door assembly (10) according to any of the preceding claims, wherein said first and/or said second different location (L1; L2; L3; L4) of said handle (31) is located at a given angle between 0° and 90° from a center line (C) of said door assembly substantially perpendicular to an axis (H) of opening of said door assembly (10).

5. The door assembly (10) according to any of the preceding claims, wherein said handle-carrying element (30) is coupled to said front door frame (5).

6. The door assembly (10) according to any of the preceding claims, wherein said handle-carrying element (30) includes a plate-like member (33) substantially closing said front aperture (9).

7. The door assembly (10) according to claim 6, wherein said plate-like member (33) defines an external surface (33a), said external surface (33a) being substantially flush with said front surface (6a).

8. The door assembly (10) according to any of the preceding claims, wherein said handle (31) includes a recess (34) formed in said handle-carrying element (30).

9. The door assembly (10) according to claim 7 and 8,

wherein said recess (34) extends from the external surface (33a) of said plate-like member (33) to underneath said front frame (5).

10. The door assembly (10) according to any of the preceding claims, wherein
- said front door frame (6) comprises a plurality of coupling elements (21) for the coupling to said rear door frame, said coupling elements extending from a rear surface (6b) of said front door frame opposite to said front surface; and
  - said rear door frame (5) includes a plurality of coupling counter-elements (22) engaging with said coupling elements (21) of said front door frame,
- or
- said front door frame (6) comprises a plurality of coupling elements (21) for the coupling to said rear door frame, and
  - said rear door frame (5) includes a plurality of coupling counter-elements (22) engaging with said coupling elements (21) of said front door frame, said coupling counter-elements extending from a front surface (5a;105a) of said rear door frame opposite to said rear surface.
11. The door assembly (10) according to claim 10, wherein a first height (D1) of a first one of said coupling elements from said rear surface (6b) of said front door frame (6) is higher than a second height (D2) of a second one of said coupling elements (21) from said rear surface (6b) of said front door frame.
12. The door assembly (10) according to one or more of the preceding claims, wherein said cap element (40) includes a strengthening member (46) located at said front aperture (9).
13. The door assembly according to claim 12 when dependent on claim 6 or 7, wherein said strengthening member (46) is located behind said plate-like member (33).
14. The door assembly according to any of the preceding claims, including a hinge (60) and a portion of a door locking mechanism (61), said hinge and said portion of a door locking mechanism being mounted on said cap element (40).
15. The door assembly (10) according to any of the preceding claims, wherein said handle (31) is formed integral to said handle-carrying element (30).
16. The door assembly (10) according to any of the preceding claims, including one or more locating elements, configured such that said handle-carrying element (30) can have only two positions (L1,L2) for

a left-hand door assembly and only two positions (L3,L4) for a right-hand door assembly.

17. A laundry treatment device (1) comprising:

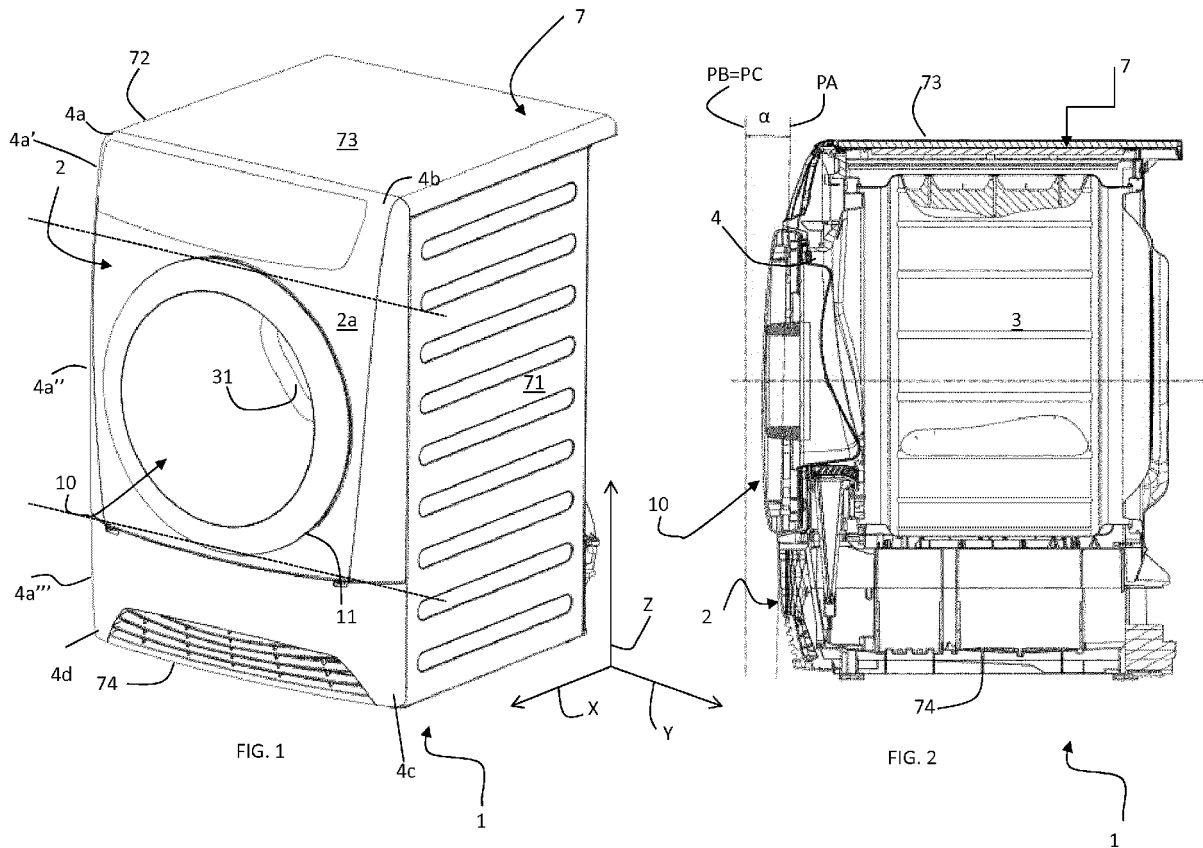
- A casing (7) containing a treatment chamber (3) for receiving load to be treated,
- A front wall (2) covering a side of said casing (7), said front wall including an opening (4) for accessing said treatment chamber;
- A door assembly (10) associated to said casing for opening and/or closing said opening (4), said door assembly (1) being formed according to one or more of claims from 1 to 16.

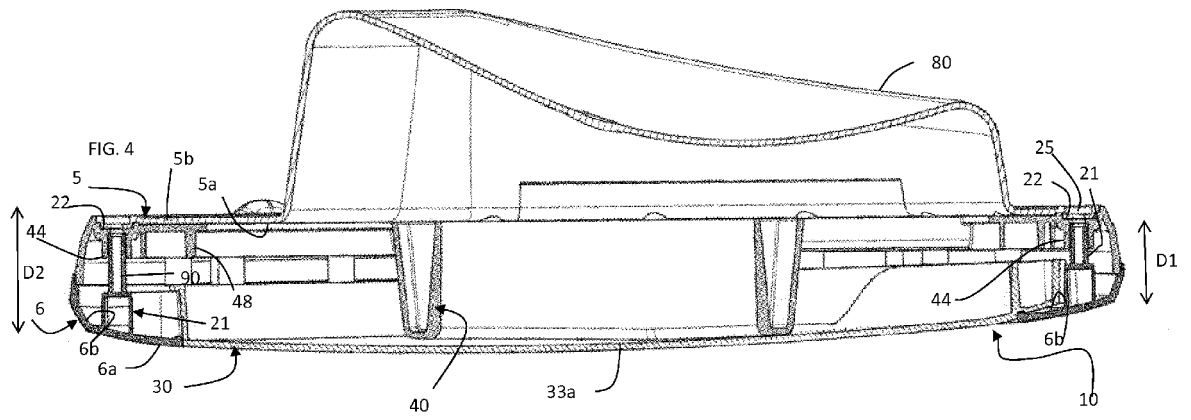
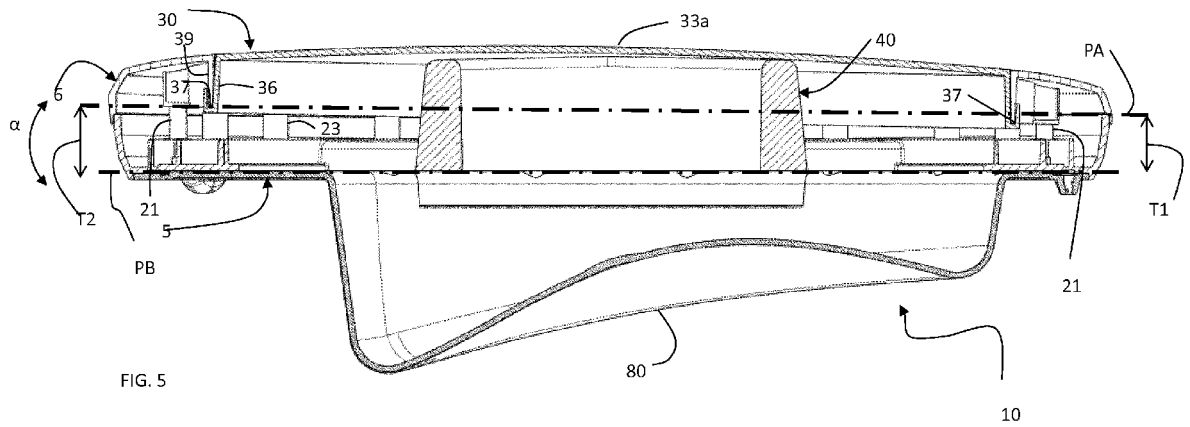
18. Method to reverse a door assembly (10) associated to a laundry treatment device (1) from a left-hand door assembly to a right-hand door assembly or vice-versa, said door assembly (10) including

- a front door frame (6) forming a front surface (6a) of the door assembly, said front surface defining a front plane (PA), said front door frame including a front aperture (9) defining an inner edge (9a);
- a rear door frame (5) forming a rear surface (5b) of said door assembly, said rear surface defining a closure plane (PB);
- a handle-carrying element (30) interposed between said rear door frame (5) and front door frame (6), and a handle (31) coupled to said handle-carrying element;
- a cap element (40) interposed between said front frame (6) and said rear frame (5), a hinge (60) and a portion of a door locking mechanism (61), said hinge and said portion of door locking mechanism being mounted on said cap element;
- wherein said front plane (PA) and said closure plane (PB) are intersecting one the other so as to form an angle different from 0° and 180°,

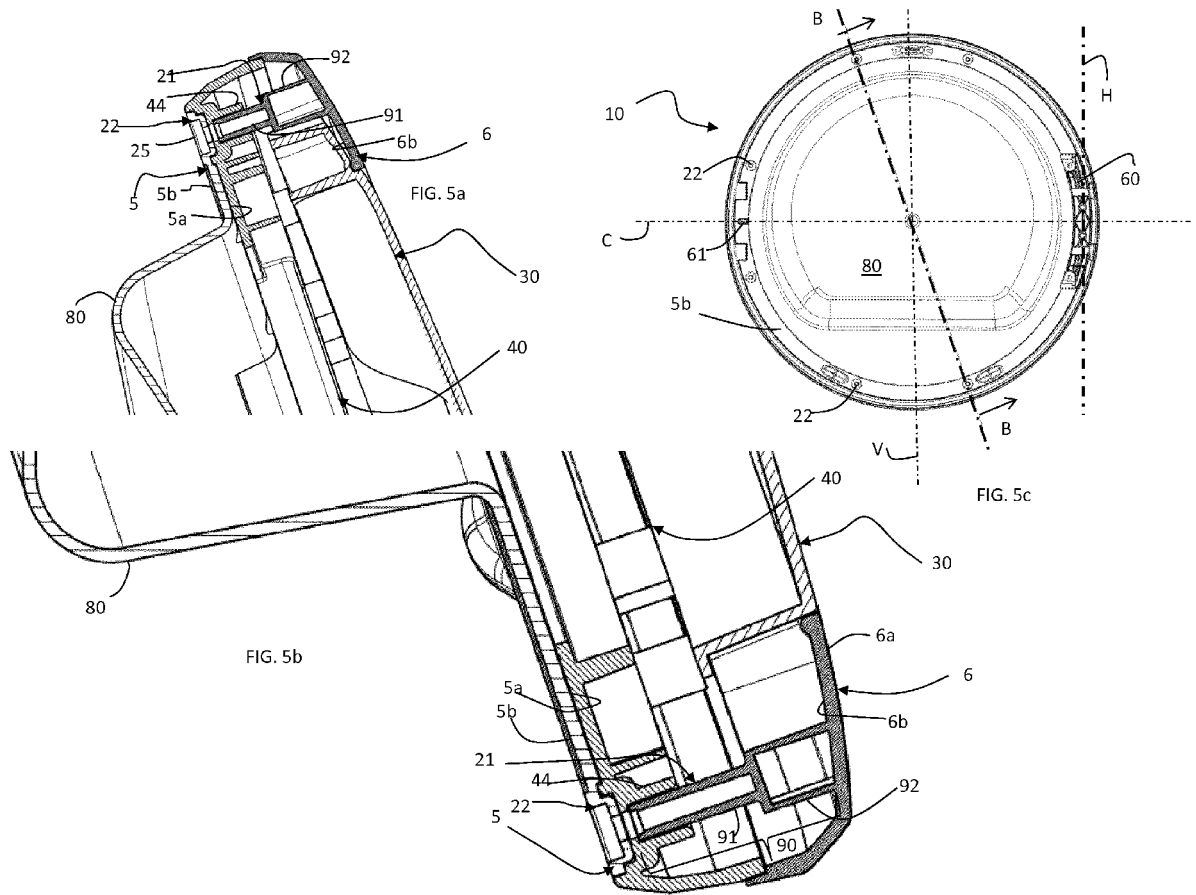
the method comprising the steps of:

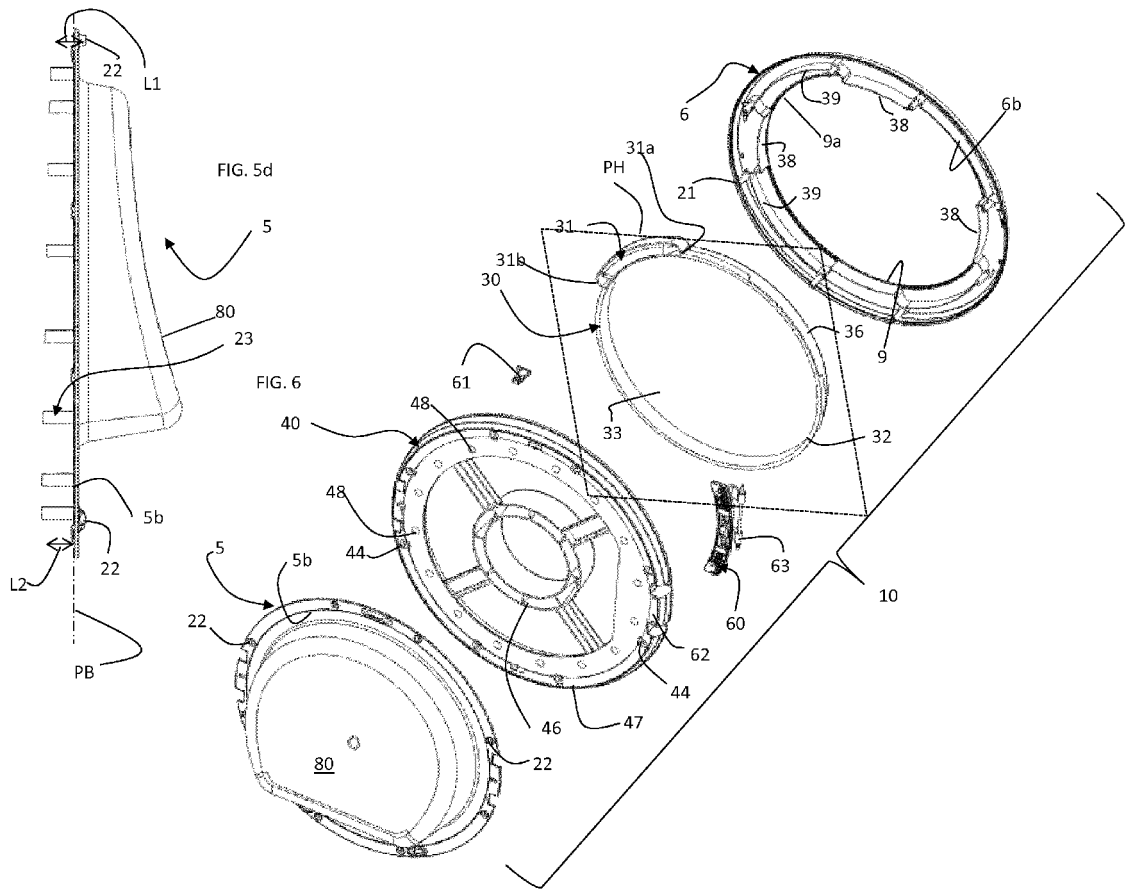
- releasing said front door frame (6) from said rear door frame (5);
- Rotating said cap element (40) of 180°;
- rotating said handle-carrying element (30) on a handle plane (PH) angled with respect to said closure plane (PB) of an angle comprised between 0° and 180°; and
- fastening said front door frame (6) to said rear door frame (5).

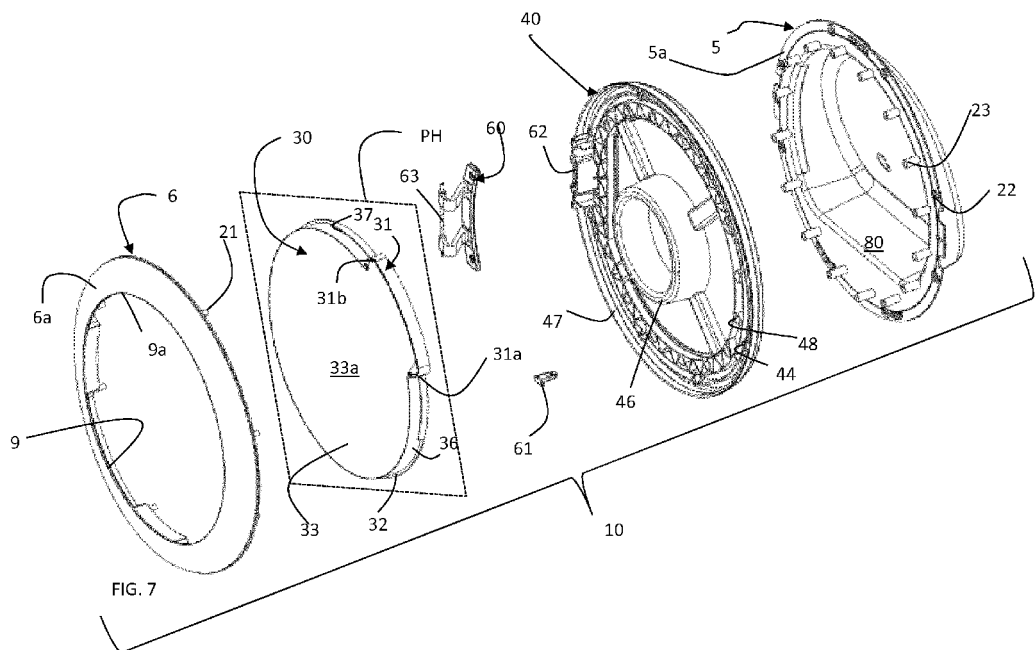


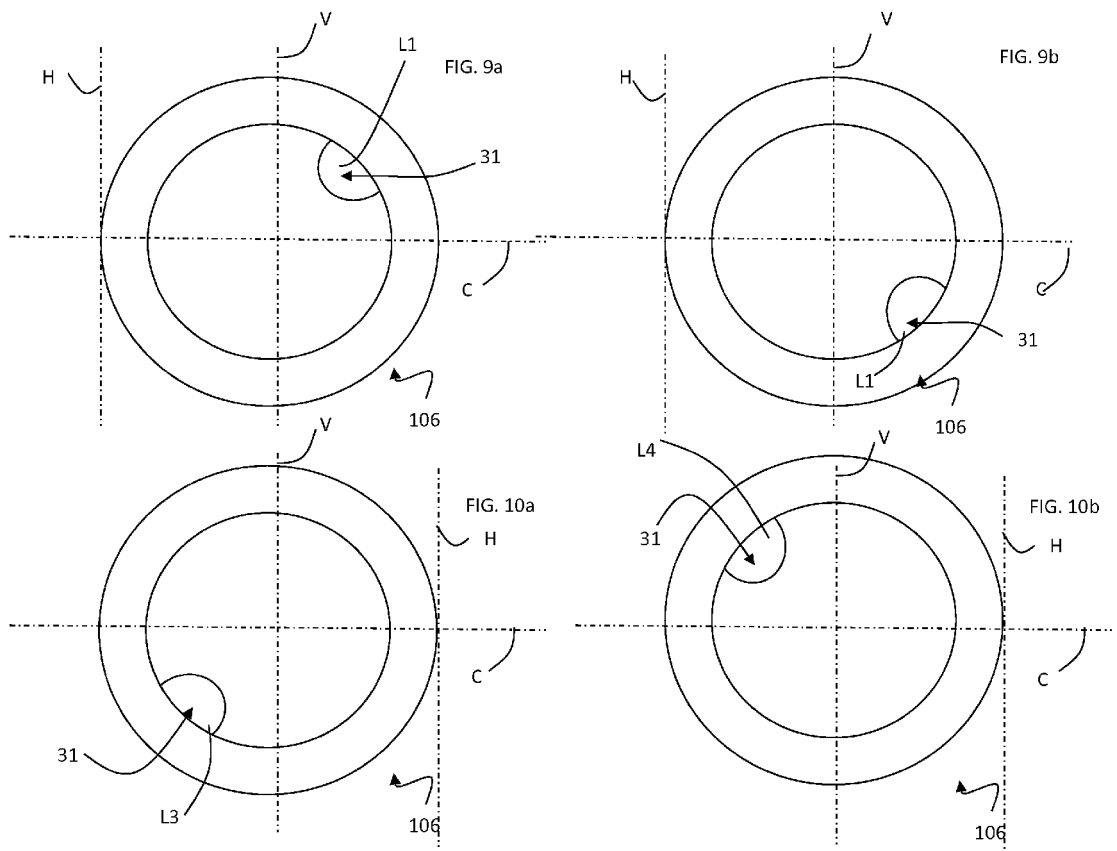


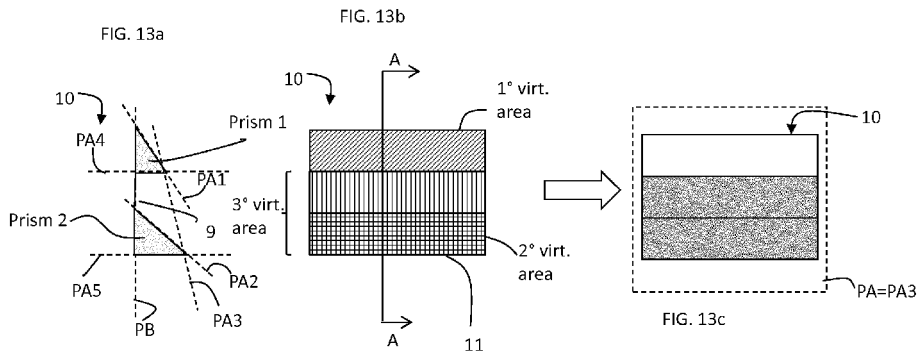
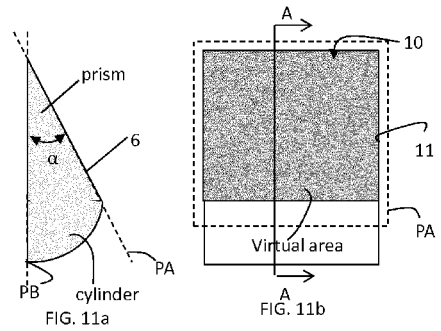
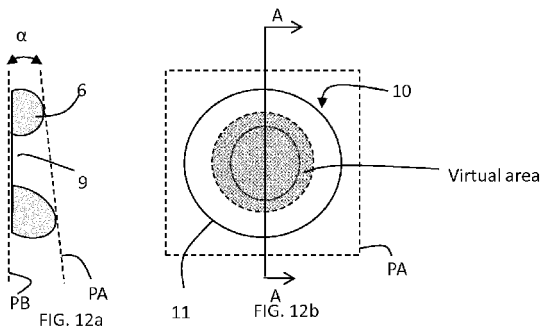


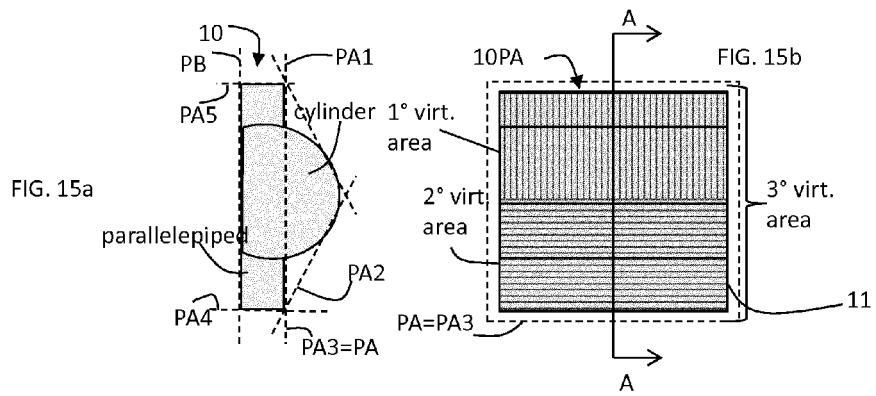
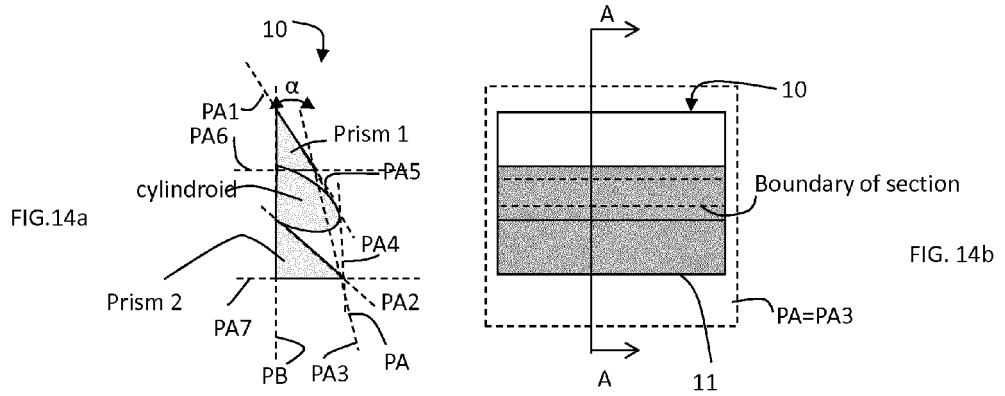














EUROPEAN SEARCH REPORT

Application Number  
EP 13 18 2521

5

10

15

20

25

30

35

40

45

50

55

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	EP 1 386 994 A1 (LG ELECTRONICS INC [KR]) 4 February 2004 (2004-02-04) * paragraph [0046] - paragraph [0054] * * paragraph [0077] - paragraph [0088] * -----	1-18	INV. D06F39/14 D06F58/04
A,D	WO 2011/012593 A1 (BSH BOSCH SIEMENS HAUSGERAETE [DE]; SCHOENE OLIVER [US]) 3 February 2011 (2011-02-03) * the whole document * -----	1-18	
A,D	EP 1 466 047 A1 (LG ELECTRONICS INC [KR]) 13 October 2004 (2004-10-13) * the whole document * -----	1-18	
			TECHNICAL FIELDS SEARCHED (IPC)
			D06F
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 14 November 2013	Examiner Jeziarski, Krzysztof
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons ..... & : member of the same patent family, corresponding document	

3

EPO FORM 1503 03.82 (P04C01)

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

EP 13 18 2521

5

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.  
The members are as contained in the European Patent Office EDP file on  
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

14-11-2013

10

15

20

25

30

35

40

45

50

55

Patent document cited in search report	Publication date	Patent family member(s)	Publication date	
EP 1386994	A1	04-02-2004	AU 2003227351 A1	19-02-2004
			CN 1475621 A	18-02-2004
			EP 1386994 A1	04-02-2004
			JP 4376010 B2	02-12-2009
			JP 2004065957 A	04-03-2004
			KR 20040012000 A	11-02-2004
			US 2004020246 A1	05-02-2004
			US 2008256988 A1	23-10-2008
-----				
WO 2011012593	A1	03-02-2011	CA 2709557 A1	31-01-2011
			US 2011023316 A1	03-02-2011
			WO 2011012593 A1	03-02-2011
-----				
EP 1466047	A1	13-10-2004	AU 2003235643 A1	30-07-2003
			CN 1496422 A	12-05-2004
			DE 60320634 T2	09-07-2009
			EP 1466047 A1	13-10-2004
			JP 2005514995 A	26-05-2005
			KR 20030062484 A	28-07-2003
			US 2004103691 A1	03-06-2004
			WO 03060224 A1	24-07-2003
-----				

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

**REFERENCES CITED IN THE DESCRIPTION**

*This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.*

**Patent documents cited in the description**

- EP 1466047 A [0005]
- WO 2011012593 A [0009]