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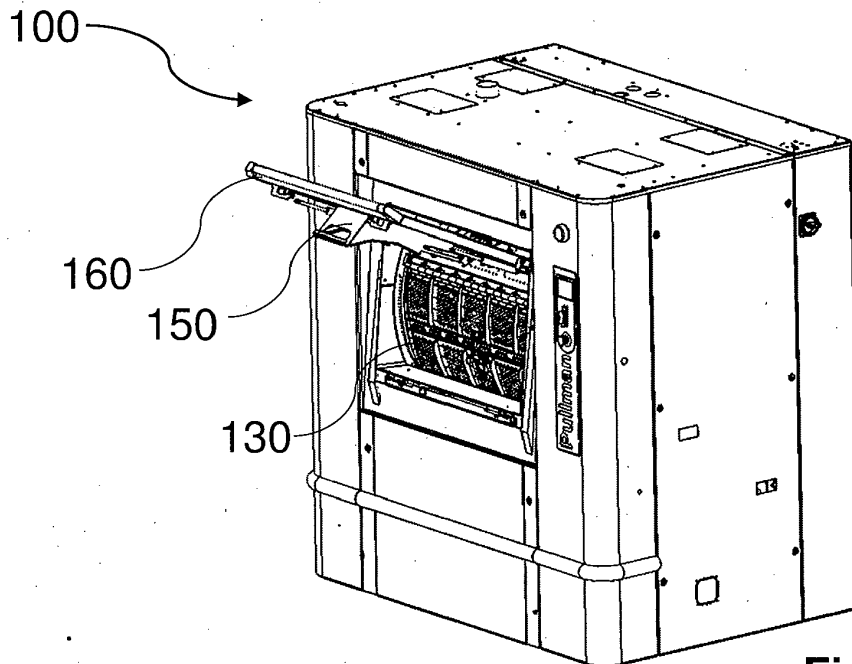
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(54) **WASHING MACHINE**

(57) Disclosed is a washing machine (100) comprising a stationary drum (110) comprising at least one first opening (115). The washing machine further comprises an inner drum (120) rotatably arranged around an axis of rotation A inside the stationary drum. The inner drum comprises a second opening (125) for accessing an interior of the inner drum, a hatch (130) configured to cover

the second opening, and a locking mechanism (430) configured to secure the hatch in a closed position. The washing machine further comprises at least one first safety element (140) extending across the at least one first opening, wherein the at least one first safety element is arranged to provide a sliding surface.



**Fig. 1**

**EP 4 079 956 A1**

## Description

### TECHNICAL FIELD

**[0001]** The present invention relates to the technical field of washing machines. In particular, the present invention relates to the technical field of safety systems for machines such as washing or drying machines.

### BACKGROUND

**[0002]** It is to be noted that in the present application the expression "washing machine" may indicate a "simple" washing machine (i.e. a washing machine which can only wash and rinse the laundry) as well as a washing-drying machine (i.e. a washing machine which can also dry the laundry). It may also indicate a washer-extractor or a washer without extractor. The washing machine may have a horizontal, inclined, or vertical axis of rotation.

**[0003]** Washing machines for household or professional use generally comprise an inner drum with an opening for loading and unloading laundry. This opening may be in a flat side of the drum (e.g. front-loaded washers and vertical-axis top-loaded washers) or in the curved surface of the drum (e.g. top-loaded and side-loaded horizontal-axis washers). An opening in the curved surface of the drum may be closed by a hatch using different types of locking mechanisms, generally some sort of hooking system. In case of failure in the locking mechanism the hatch may open during operation of the washing machine. This may cause the hatch or the locking mechanism to come into contact with and/or get stuck on a stationary outer drum, or an edge of an opening of the stationary outer drum. Depending on the revolution speed of the inner drum such an accidental opening of the hatch may cause damage to the washing machine. Solutions presented in prior art have proven insufficient in solving these kinds of problems.

**[0004]** There is therefore a need in the field for solutions for the above-mentioned problem.

### SUMMARY

**[0005]** The inventors have reached the insight that there is a need for a washing machine that at least partially improves the safety of the washing machine and prevents mechanical damages due to the hatch opening as result of a locking mechanism failing. Further, there is a need for a washing machine which, if such a hatch opening occurs during use, shuts down in a safe manner.

**[0006]** Generally, locking mechanisms securing the hatches of washing machines work properly. However, as with many mechanical product certain features may degrade slightly over time or get damaged when treated improperly. A locking mechanism in a washing machine may fail due to different reasons and it is therefore important to, at least partially, solve the issues such a failure may bring. The present disclosure seeks to provide at

least some embodiments of a washing machine which reduces at least some of the above-mentioned drawbacks. More specifically, the present disclosure aims at providing at least some embodiments offering a safety element which prevents damages to the washing machine in case of a hatch opening mid-use of the washing machine. Further, the present disclosure aims at providing at least some embodiments that, in case of a hatch opening, turns the washing machine off in a secure manner.

**[0007]** In a first aspect of the present disclosure, there is provided a washing machine comprising a stationary drum. The stationary drum comprises at least one first opening. The washing machine further comprises an inner drum rotatably arranged around an axis of rotation A inside the stationary drum. The inner drum comprises a second opening for accessing an interior of the inner drum, a hatch configured to cover the second opening, and a locking mechanism configured to secure the hatch in a closed position. The washing machine further comprises at least one first safety element extending across the at least one first opening, wherein the at least one first safety element is arranged to provide a sliding surface.

**[0008]** Thus, there is provided a washing machine with at least a first function of providing a sliding surface for the hatch in case the hatch accidentally opens during rotation of the inner drum. The hatch may open during use in case of the locking mechanism failing, or if the locking mechanism has not been secured properly. The safety element extends across the first opening during use of the washing machine and together with the stationary drum provides a complete cylinder surface. This is advantageous at least in that the washing machine will not get damaged if the hatch accidentally opens during use. In prior art washing machines, the risk of the hatch getting stuck on the edges of the first opening is present which may cause damage to the machine. Further, it is advantageous in that the sliding surface may help preventing some disturbing noises that may occur if the hatch accidentally opens while the inner drum is rotating. Further, it is advantageous in that the sliding surface may prevent abrupt stops of the washing machine that could occur if the hatch gets stuck if it opens during rotation. The safety element and the sliding surface it provides improve the general safety of the washing machine.

**[0009]** According to an embodiment, the at least one first safety element provides a sliding surface for guiding the hatch on a smooth trajectory in case the hatch accidentally opens during use of the washing machine. If the hatch opens during use it may first come in to contact with the inside of the stationary drum. During rotation it will eventually come into to contact with the safety elements which extend across the first opening. In some prior art the edges of the first opening are exposed, and the hatch may get stuck or simply bump into these during continuous rotation. This may cause disturbing noises or damage the washing machine. By guiding the acciden-

tally opened hatch on a smooth trajectory the acceleration is kept constant and therefore mechanical impacts and vibrations are reduced to a minimum. By providing a sliding surface the present embodiment ensures that such unwanted features are removed, which is advantageous. The smooth trajectory may be a circular trajectory and the sliding surface may be coaxial with the stationary drum, which could be advantageous if the stationary drum is a circular cylinder.

**[0010]** According to an embodiment, the inner drum and the stationary drum are circular cylinders, and the sliding surface has a circular shape with the same radius as the stationary drum and is arranged concentric about axis A. The present embodiment is advantageous in that the safety element provides a sliding surface that easily guides the hatch in case it accidentally opens during use. It is however understood that other geometries of the inner drum, stationary drum, safety element and sliding surface are plausible. For example, the stationary drum and the inner drum do not need to be coaxial. Further, the stationary drum and/or the inner drum may be shaped as an elliptical cylinder.

**[0011]** According to an embodiment, the at least one first safety element comprises at least two safety element segments, wherein the at least two safety element segments each comprises a first sliding surface segment bridging the first opening in a tangential direction of rotation of the inner drum. The present embodiment is advantageous in that the two safety element segments may provide a sliding surface providing a more stable support to the hatch moving at potentially high speed with high acceleration forces. This is advantageous in that the pressure from the hatch on the sliding surface, in case the hatch opens during use, is exerted evenly over the safety element which reduces damages from friction. Further it is advantageous that the risk of deformation of the hatch is reduced and thus the risk of impacts in the transition from sliding on the first safety element to sliding on the inner surface of the outer drum.

**[0012]** According to an embodiment, the sliding surface is arranged at a radial distance of 5 - 70 millimeters from the inner drum. The present embodiment ensures that if the hatch accidentally opens during rotation it will only be able to open 5 - 70 millimeters before it comes into contact with the safety element. This is advantageous in that the opening angle for the hatch will not be great enough for the hatch to break and in that the risk of the hatch getting stuck is diminished. It is understood that depending on the dimensions of the hatch, inner drum, stationary drum, and other parts of the washing machine other radial distances might be preferable.

**[0013]** According to an embodiment, the hatch comprises at least one protruding rib arranged to engage the at least one first safety element if the hatch accidentally opens during use of the washing machine. The present embodiment is advantageous in that the at least one protruding rib will engage with the safety element if the hatch accidentally opens which may ensure a smoother sliding

along the sliding surface provided by the safety element. Further a rib being the element in contact with the first safety element ensures a good distribution of the contact force within the hatch. The at least one protruding rib may have many shapes and sizes, but it is preferably that the at least one protruding rib engages the safety element before any other part of the hatch, this to ensure a smoother sliding and avoid the locking mechanism to get stuck or damaged. According to an embodiment, the at least one protruding rib has a width of at least 2 millimeters. An increased width of the protruding ribs is preferable since the pressure is smaller upon the protruding ribs if the area in contact with the safety element and/or the inside of the stationary drum is larger. It is understood that other solutions are possible, for example the skilled man understands that providing more protruding ribs may have the same effect as providing a wider area. However, there are also drawbacks arising from increasing the number of ribs and/or their width. The number of ribs and their width may vary depending on other features and dimensions of the washing machine.

**[0014]** According to an embodiment, the at least one protruding rib extends further outward in a radial direction from the axis of rotation A than said locking mechanism and any other part of the hatch when the hatch is in an open position and the at least one protruding rib engages the at least one first safety element and/or the stationary drum. In certain embodiments the protruding rib extends further from the hatch, i.e. has a higher height, then the locking mechanism to ensure that the rib engages the first safety element and/or the stationary drum in case the hatch accidentally opens during use. However, it is possible to achieve this while having a protruding rib with a lower height than for example the locking mechanism. Therefore the present embodiment is preferable where the protruding rib extends further away from the axis of rotation A than any other part of the hatch when the hatch is in the opened position and when the protruding rib touches the stationary drum and/or the at least one first safety element. The locking mechanism may be the part of the hatch that gets stuck when the hatch accidentally opens during use, therefore it is advantageous to ensure that the protruding rib is the first part of the hatch to come into contact with the safety element and/or the stationary drum, and not the locking mechanism. Different types of locking mechanism are used in different designs and washing machines, the protruding ribs may therefore have different heights and shapes ensuring that the invention works properly depending on the model of the washing machine. According to an embodiment, the washing machine further comprises at least one door arranged to cover the at least one first opening, wherein the at least one first safety element is attached to the at least one door. The present embodiment is advantageous in that the safety element may be put into its correct position before operation by closing the door to cover the first opening. Such a solution is more practical since it simplifies for the user and removes possible errors such

as misplacing the safety element across the first opening.

**[0015]** According to an embodiment, the at least one first safety element comprises an interlocking element connected to the stationary drum and arranged to interlock with the at least one first safety element. The present embodiment is advantageous in that the interlocking element may complete the sliding surface of the at least one first safety element and provide a sliding surface extending fully over the at least one first opening. For example, the interlocking element may be arranged to interlock with the safety element segments of the safety element. According to an embodiment, the interlocking element is configured to slidably interlock with the at least one first safety element. The present embodiment is advantageous in that the washing machine is more easily opened. The interlocking element may easily slide in the safety element so that the safety element is placed in the correct operational position extending across the at least one first opening. In a preferred embodiment, the safety element may comprise safety element segments comprising slots extending along the safety element segments. The interlocking element may be slidably interlocked with these slots. According to an embodiment, the washing machine further comprises a sensor configured to detect if the at least one first safety element is in contact with the hatch, and a control unit configured to turn off the washing machine when the sensor detects a contact between the at least one first safety element and the hatch. The present embodiment is advantageous in that the washing machine can detect if the hatch opens during use and safely stop the rotation of the inner drum. Even if the safety element may prevent mechanical damages and disturbing noises the washing machine is preferably stopped as quickly as possible after a hatch malfunction to avoid friction wear. Different sensors may be used to detect that the hatch has opened during use. The control unit may be the same control unit controlling other features of a washing machine. It may also be a different and/or extra control unit.

**[0016]** According to an embodiment, the sensor is an inductive sensor configured to detect a displacement of the at least one first safety element. The present embodiment is advantageous in that the at least one first safety element will be slightly displaced by the hatch in case it opens during use. An inductive sensor may be placed so that it can measure such a movement, or measure if the at least one first safety element is moved closer to the sensor. The at least one first safety element may also be connected to a frame of the washing machine and the sensor configured to detect a movement of the frame. It is understood that different types of displacements may be measured by an inductive sensor. According to an embodiment, the at least one first safety element comprises a spring element configured to be released by the hatch in case the hatch accidentally opens during use of the washing machine. And the sensor is an inductive sensor configured to detect the spring element being released. In the present embodiment the spring may for

example be held in place by plastic screws. In case the hatch opens during rotation of the inner drum, the hatch will break the plastic screws which releases the spring element, and the spring element will come near the inductive sensor which will therefore detect that the hatch has been opened. The present embodiment is advantageous in that it requires an intervention by a technician before the machine can be used again. This will diminish the risk of the user using, the washing machine more times despite the hatch and/or its locking mechanism being damaged or broken. Such a condition may require professional maintenance before further use. Other manners of releasing the spring element are possible and may be implemented as well.

**[0017]** According to an embodiment, the stationary drum further comprises a third opening. And the washing machine further comprises a heating box configured to contain a heating element for heating a content of the stationary drum via the third opening, and a second safety element extending across the third opening, wherein the second safety element is arranged to provide a second sliding surface. Today, most washing machines provide heat to the water in the stationary drum by heating elements placed in a heating box extending from the stationary drum. The water can circulate between the heating box and the inside of the stationary drum through an opening in the stationary drum. The present embodiment is advantageous in that the stationary drum has a third opening for allowing water to circulate between the heating box and the stationary drum and provides a sliding surface for both the first opening and the third opening. This diminishes the risk of the hatch getting stuck after a malfunction during use which decreases the risk of mechanical damages to the machine. According to an embodiment, the second safety element comprises at least two metal strips extending across the third opening, wherein each of the at least two metal strips comprises a second sliding surface segment bridging the third opening in a tangential direction of rotation of the inner drum. The second sliding surface segments may complete the shape of the stationary drum. In case the stationary drum is a circular cylinder, they may have the shape of circular arcs. The segments may for example be made when cutting the third opening, instead of cutting one opening the stationary drum may be cut so that at least two metal strips extending across the opening are left intact. This will ensure that the metal strips have the correct radius as well as allowing the heating element to heat the inner drum via the opening. Other ways of providing these segments are possible. According to an embodiment, each first sliding surface segment and/or each second sliding surface segment is extending in a plane defined by a circular trajectory of one of the at least one protruding ribs when the inner drum is rotating. The present embodiment is advantageous in that it ensures that the first sliding surface segments and the second sliding surface segments are in the same plane as the protruding ribs. This ensures that the protruding ribs engages the first and

second sliding surface segments during rotation in case the hatch accidentally opens during use of the washing machine.

**[0018]** It is noted that other embodiments using all possible combinations of features recited in the above described embodiments may be envisaged. Thus, the present disclosure also relates to all possible combinations of features mentioned herein. Any embodiment described herein may be combinable with other embodiments also described herein, and the present disclosure relates to all combinations of features.

#### Brief description of the drawings

**[0019]** Exemplifying embodiments will now be described in more detail, with reference to the following appended drawings: Figure 1 schematically illustrates a washing machine in accordance with an embodiment of the present invention; Figure 2 schematically illustrates a washing machine in accordance with an embodiment of the present invention; Figure 3 schematically illustrates an exemplary first safety element in accordance with an embodiment of the present invention; Figure 4 schematically illustrates an exemplary first safety element in accordance with an embodiment of the present invention; Figure 5 schematically illustrates a washing machine in accordance with an embodiment of the present invention; Figure 6a and 6b schematically illustrates a sensor arrangement in accordance with an embodiment of the present invention; Figure 7a and 7b schematically illustrates an exemplary second safety element in accordance with an embodiment of the present invention; Figure 8 schematically illustrates an exemplary first safety element in accordance with an embodiment of the present invention; Figure 9 schematically illustrates an exemplary first safety element in accordance with an embodiment of the present invention.

#### Detailed description of the drawings

**[0020]** As illustrated in the figures, the sizes of the elements and regions may be exaggerated for illustrative purposes and, thus, are provided to illustrate the general structures of the embodiments. Like reference numerals refer to like elements throughout.

**[0021]** Exemplifying embodiments will now be described more fully hereinafter with reference to the accompanying drawings, in which currently preferred embodiments are shown. The invention may, however, be embodied in many different forms and should not be construed as limited to the embodiments set forth herein; rather, these embodiments are provided for thoroughness and completeness, and fully convey the scope of the invention to the skilled person. With reference to Figure 1 a washing machine 100 in accordance with an embodiment of the present invention is disclosed.

**[0022]** The washing machine 100 may be a "simple" washing machine (i.e. a washing machine which can only

wash and rinse the laundry) as well as a washing-drying machine (i.e. a washing machine which can also dry the laundry). It may also be a washer-extractor or a washer without extractor.

**[0023]** The washing machine 100 comprises a door 160 arranged to cover a first opening. Attached to the door 160 is a first safety element 150. Visible through the opening is a hatch 130 of an inner drum of the washing machine 100. The washing machine 100 may comprise a similar door (not shown) on an opposite side to the door 160 shown in Figure 1. The washing machine 100 may be configured for home use or for professional use. The washing machine 100 may for example be placed within a wall dividing two rooms and allow for access from each of the two rooms. This may be advantageous in certain environments where unwashed laundry and washed laundry may not be kept in the same room, for example in certain hospital environments.

**[0024]** Further details regarding the washing machine 100 and plausible embodiments will follow with reference to the remaining Figures. With reference to Figure 2 a washing machine 100 in accordance with an embodiment of the present invention is disclosed. The washing machine 100 in Figure 2 comprises a stationary drum 110 and an inner drum 120 arranged within the stationary drum. The inner drum 120 is rotatably arranged around an axis of rotation A. Both the inner drum 120 and the stationary drum 110 are concentric around the axis A.

**[0025]** The stationary drum 110 comprises two doors 160 covering two first openings (not shown). The doors may have a safety element each attached in accordance with the invention and described with reference to the remaining Figures. The washing machine 100 disclosed in Figure 2 has two doors 160 and is a side-loaded washing machine 100. However, it is understood that possible embodiment of the invention includes top-loaded, side-loaded with one door, front-loaded or any other type of conventional washing machine.

**[0026]** In the following Figures, details regarding features of the washing machine 100 will be discussed. With reference to Figure 3 an exemplary first safety element 150 in accordance with an embodiment of the present invention is disclosed. Figure 3 discloses a section of a washing machine 100, for example the washing machine 100 as described with reference to Figure 1 and 2.

**[0027]** The washing machine 100 comprises a stationary drum 110 comprising a first opening 115. The first opening 115 is placed in the curved surface of the stationary drum. The washing machine further comprises a door 160, shown in an opened position, to cover the first opening 115. The washing machine 100 further comprises an inner drum 120 rotatably arranged around an axis of rotation A inside the stationary drum 110. The inner drum 120 comprises a second opening (not shown) for accessing an interior of the inner drum. The inner drum 120 further comprises a hatch 130 configured to cover the second opening, and a locking mechanism 140 configured to secure the hatch 130 in a closed position. The

washing machine 100 further comprises a first safety element 150 extending across the first opening 115 when the door 160 is closed. The first safety element 150 is arranged to provide a sliding surface 152a, 152b.

**[0028]** The placement of the second opening is such that it can be accessed through the first opening 115 when the inner drum 120 is rotated to a specific position.

**[0029]** The first safety element 150 provides a sliding surface 152a, 152 for guiding the hatch 130 on a smooth trajectory in case the hatch 130 accidentally opens during use of the washing machine 100. The inner drum 120 and the stationary drum 110 may be circular cylinders and the smooth trajectory may be a circular trajectory. The sliding surface 152a, 152b may have a circular shape with the same radius as the stationary drum 110 and be arranged concentric about the axis A. The hatch 130 may accidentally open during use of the washing machine 100 in case the locking mechanism 140 fails or breaks. This may happen after heavy or repeated misuse of the washing machine 100. The hatch 130 may also open during use in case the locking mechanism 140 has not been secured properly. Such a failure may cause various problems which the safety element 150 at least partially solves. The first safety element 150 of the washing machine 100 disclosed in Figure 2 comprises two safety element segments 155a, 155b. The two safety element segments 155a, 155b each comprise a first sliding surface segment 152a, 152b bridging the first opening in a tangential direction of rotation of the inner drum 120. The safety element segments 155a, 155b are arranged to engage with the hatch 130 in case it opens during rotation of the inner drum 120 so that the hatch 130 does not get stuck on the edges of the first opening 115. It is understood that there could be less or more than two safety element segments 155a, 155b. The sliding surface 152a, 152b of Figure 3 has a circular shape with the same radius as the stationary drum 110 and is arranged concentric about axis A, when the door 160 is closed. It is however understood that the sliding surface 152a, 152b may have other shapes depending on the shape of the stationary drum 110. In case the stationary drum 110 is elliptically cylindrical, the shape of the sliding surface 152a, 152b, may be configured to match this. The stationary drum 110 may also be arranged about a second axis than the axis A which the inner drum 120 is arranged about, then the sliding surface 152a, 152b may be concentric about this second axis. This ensures that the first opening 115 is bridged by the sliding surface 152a, 152b and the tangential path along the surface of the stationary drum 110 is completed across the first opening 115 which decreases the risk for the hatch 130, in case it accidentally opens during use, to get stuck during rotation.

**[0030]** The hatch 130 further comprises at least one protruding rib 135. The at least one protruding rib is arranged to engage the first safety element 150 if the hatch 130 accidentally opens during use of the washing machine 100. The protruding ribs 135 may have a width of at least 2 millimeters depending on the material they are

made from. An increasing width may be advantageous in that the wear will decrease on the ribs 135. Each of the first sliding surface segments 152a, 152b are preferably extending in a plane defined by a circular trajectory of one of the at least one protruding ribs 135 when the inner drum 120 is rotating. This ensures that the protruding ribs 135 are engaging the at least one first safety element 150 in case the hatch 130 opens during use.

**[0031]** The at least one protruding rib 135 may extend further outward in a radial direction from the axis A than the locking mechanism 140. In particular the at least one protruding rib 135 may extend further outward radially than the locking mechanism 140 in the situation when the hatch 130 is opened to the degree that any of its elements touches either the stationary drum 110 and/or the first safety element 150. This so that the at least one protruding rib 135 engages the stationary drum 110 and/or the first safety element 150 in case the hatch 130 accidentally opens during use of the washing machine 100. The washing machine 100 further comprises a door 160. In Figure 3 the door 160 is shown in an opened position. The door 160 is arranged to cover the at least one first opening 115 when the door 160 is in its closed position. The first safety element 150 is attached to the at least one door 160. It is understood that the washing machine 100 may comprise two first openings 115 and two doors 160 covering the openings 115. It is further understood that one first safety element 150 may be attached to each door 160.

**[0032]** The locking mechanism 140 may be of different kinds depending on the embodiment and type of washing machine 100. It may for example be a hook and loop solution, or any other locking mechanism 140.

**[0033]** In Figure 3, the hatch 130 comprises two hatch doors 132a, 132b but it is understood that other hatch designs are plausible.

**[0034]** The washing machine 100 according to the invention may be used in the following manner. Firstly, the inner drum 120 may be loaded with laundry while the hatch 130 is in an open position. When the inner drum 120 has been loaded the hatch 130 may be closed and the locking mechanism 140 may be used to secure the hatch 130 in its closed position. The door 160 may then be closed. When closing the door 160 the first safety element 150 will be placed so that it is extending across the first opening 115 providing a sliding surface 152. The washing machine 100 may then be started. During rotation of the inner drum 120 the hatch 130 may accidentally open due to different reasons. In case this happens the hatch 130 will engage the stationary drum 110 and the at least one first safety element 150 during rotation. The sliding surface 152a, 152b will ensure that the washing machine 100 does not get damaged. Preferably the washing machine further comprises a sensor as described throughout the application. The sensor may detect that the hatch 130 has opened and a control unit may shut down the washing machine 100.

**[0035]** With reference to Figure 4 an exemplary first

safety element in accordance with an embodiment of the present invention is disclosed. Figure 4 discloses a section of a washing machine 100 with at least one first opening in a stationary drum 110 and at least one first safety element 150 extending across the first opening.

**[0036]** In both Figure 3 and Figure 4 the at least one first safety element 150 comprises an interlocking element 157a, 157b connected to the stationary drum 110 and arranged to interlock with the at least one first safety element 150. The interlocking element 157a, 157b may be configured to slidably interlock with the at least one first safety element 150. In certain embodiments the interlocking element 157a, 157b may be connected to the stationary drum 110 and arranged to interlock with the safety element segments 155a, 155b of the at least one first safety element 150. In certain embodiments the safety element segments 155a, 155b may comprise slots extending along the safety element segments 155a, 155b. The interlocking element 157a, 157b may be arranged to interlock with the safety element segments 155a, 155b via these slots allowing it to be slidably interlocked with the safety element segments 155a, 155b.

**[0037]** As can be seen in Figure 3 the interlocking element 157a, 157b comprises two interlocking parts 157a, 157b configured to slidably interlock with the first safety element 150. In Figure 4 one of the interlocking parts 157b is visible. The interlocking part 157b is rotary connected on one end to the stationary drum 110. On the other end the interlocking part 157b is connected to the first safety element 150 by interlocking with one of the safety element segments 155b. The interlocking parts 157a, 157b are slidably connected to the safety element 150 which is advantageous when opening the washing machine 100. The safety element 150 is connected to the door 160, and when a user opens the door 160 the interlocking parts 157a, 157b easily slide in slots formed in the safety element segment 155a, 155b. Thanks to the rotary connection to the stationary drum 110 and the slidable connection to the safety element segment 155a, 155b, the interlocking part 157a, 157b is passively placed in the first opening 115 when the door 160 is closed and moved to the edge and out of the opening 115, when the door 160 is opened.

**[0038]** The safety element 150 may be arranged so that the sliding surface 152 is arranged at a radial distance of 5 - 70 millimeters from the inner drum 120. The safety element 150 may be constructed so that the sliding surface 152 completes the surface provided by the inside of the stationary drum 110. A relatively small distance between the inner drum 120 and the hatch 130 is advantageous in case the hatch 130 accidentally opens during rotation of the inner drum 120. Depending on the type and model of the washing machine 100 other radial distances may be advantageous.

**[0039]** With reference to Figure 5 an exemplary washing machine 100 in accordance with an embodiment of the present invention is disclosed. The washing machine 100 disclosed in Figure 5 may for example be

the washing machine 100 disclosed in Figure 1 but with open doors 160. The washing machine 100 comprises two doors 160 covering one first opening 115 each when closed. Attached to the two doors 160 are a first safety elements 150 each extending across the first openings 115 when the doors 160 are closed. It is advantageous but not essential that the safety elements 150 are attached to the doors 160 since it simplifies usage of the washing machine 100, as the first safety elements 150 are passively moved out of the first openings 115 when the doors 160 are opened and placed in the openings 115 when the doors 160 are closed.

**[0040]** The washing machine 100 disclosed in Figure 5 also comprises a heating box 180 configured to contain a heating element for heating water contained in the stationary drum 110. The stationary drum 110 and the heating box 180 may be configured to be connected by a third opening (not shown) in the stationary drum 110, through which the water can circulate freely between the inside of the stationary drum 110 and the heating box 180.

**[0041]** The inner drum 120 of the washing machine 100 comprises two hatches 130 configured to cover the second openings (not shown) in the inner drum 120. It is understood that an embodiment with two doors 160 and two first safety elements 150 may comprise an inner drum 120 with only one hatch 130. The placement of the second openings is such that it can be accessed through the first opening 115 when the inner drum 120 is rotated to a specific position.

**[0042]** The washing machine 100 comprises a sensor 170 configured to detect if at least one first safety element 150 is in contact with one of the hatches 130. The sensor 170 is arranged on the stationary drum 110 or on the frame around the at least one first opening 115, facing one of the two first safety elements 150. It is understood that there might be more than one sensor 170 and two similar, or two different sensors may be used to detect if any one of the first safety elements 150 is in contact with one of the hatches 130. With reference to Figure 6a and 6b a sensor arrangement in accordance with an embodiment of the present invention is disclosed. The washing machine may comprise a sensor 170 configured to detect if at least one safety element is in contact with the hatch 130. The washing machine may further comprise a control unit 200 configured to turn off the washing machine when the sensor detects a contact between the at least one first safety element and the hatch 130. The control unit 200 may further prevent any new start of the washing machine 100 before the at least one first safety element is restored to its original configuration.

**[0043]** Different types of sensors 170 are possible to achieve the objective of the invention. Figures 6a and 6b discloses an embodiment that is preferred. The at least one safety element, more details are found throughout the application, may comprise a spring element 175. The spring element 175 may be configured to be released by the hatch 130 in case the hatch 130 accidentally opens during use of the washing machine. The sensor 170 may

be an inductive sensor configured to detect the spring element 175 being released.

**[0044]** The spring element 175 may be kept in place by screws 177. In case the hatch 130 opens while the inner drum of the washing machine is rotating, the screws 177 may be beheaded, i.e. part of the screws 177 may be mechanically removed by the hatch 130 so that the spring element 175 is released. It is preferable if the screws 177 are made of a material that can be easily broken by the hatch 130, for example a plastic material. There may be more than two screws 177. There may also be less than two screws 177. It is also understood that other solutions may be available.

**[0045]** There are other solutions present for detecting in case the hatch 130 is in contact with one of the at least one safety element. The sensor 170 may for example be an inductive sensor configured to detect a displacement of the at least one first safety element. The displacement may be a result of the hatch 130 accidentally opening during use of the washing machine and pressing on the at least one first safety element.

**[0046]** The sensor 170 may also be configured to detect a displacement of certain parts of the at least one first safety element. For example, the sensor 170 may be configured to detect a displacement of the interlocking element 157a, 157b.

**[0047]** With reference to Figure 7a and 7b an exemplary second safety element 190 is disclosed. Figure 7a discloses a washing machine according to the invention where the inner drum has been removed in order to explain certain features.

**[0048]** Figure 7b shows a detailed view of certain features present in Figures 7a.

**[0049]** The stationary drum 110 may comprise a third opening 117. The washing machine may comprise a heating box 180 configured to contain a heating element for heating a content of the stationary drum 110 via the third opening 117. The washing machine may further comprise a second safety element 190 extending across the third opening 117. The second safe element 190 is arranged to provide a second sliding surface. 197a, 197b.

**[0050]** The second safety element 190 may comprise at least two metal strips 195a, 195b extending across the third opening 117. Each of the at least two metal strips 195a, 195b may comprise a second sliding surface segment 197a, 197b bridging the third opening in a tangential direction of the inner drum. Depending on the shape of the stationary drum 110 the shape of the second sliding surface segments 197a, 197b may vary. In the present embodiment they may each comprise a circular arc shaped surface with the same radius as the stationary drum 110 and be arranged to face the inner drum. Each of the second sliding surface segments 197a, 197b may be extending in a plane defined by a circular trajectory of one of the at least one protruding ribs when the inner drum is rotating. In case the hatch of the inner drum opens during rotation the protruding ribs will engage the second sliding surface segments 197a, 197b during rotation

which is preferable and advantageous. With reference to Figure 8 an exemplary first safety element 150 in accordance with an embodiment of the present invention is disclosed. In Figure 8 the protruding ribs 135 are extending further outward in a radial direction from the axis of rotation of the inner drum 120 than the locking mechanism 140. This is to ensure that the at least one protruding rib 135 engages the stationary drum 110 or the at least one first safety element in case the hatch 130 accidentally opens during use of the washing machine. It is also understood that in other embodiments the locking mechanism 140 or other parts of the hatch 130 may extend further outwards in a radial direction from the axis of rotation of the inner drum 120. However, the at least one protruding rib 135 preferably extends further outward in a radial direction from the axis of rotation A than said locking mechanism 140 and any other part of the hatch 130 when the hatch 130 is in an open position and the at least one protruding rib 135 engages the at least one first safety element 150 and/or the stationary drum 110. Depending on the embodiment, the locking mechanism 140 may extend further outward in a radial direction from the hatch 130 when the hatch 130 is closed, but the at least one protruding rib 135 may still be the part of the hatch 130 engaging the at least one safety element 150 or the stationary drum 110 in case the hatch 130 opens during use.

**[0051]** The locking mechanism 140 disclosed in Figure 8 is a hook and loop type solution, however other locking mechanisms 140 are possible.

**[0052]** With reference to Figure 9 an exemplary first safety element 150 in accordance with an embodiment of the present invention is disclosed.

**[0053]** In Figure 9 the hatch 130 has accidentally opened during rotation of the inner drum 120. As can be seen in the Figure one of the at least one protruding ribs 135 is engaging the at least one first safety element 150. The at least one protruding rib 135 extends further outward in a radial direction from the axis of rotation A than said locking mechanism 140 and any other part of the hatch 130 when the hatch 130 is in an open position and the at least one protruding rib 135 engages the at least one first safety element 150 and/or the stationary drum 110. The sensor 170 may detect that one of the at least one protruding ribs 135 engages the at least one first safety element 150 and the control unit (not shown) may turn of the machine.

**[0054]** Although features and elements are described above in particular combinations, each feature or element can be used alone without the other features and elements or in various combinations with or without other features and elements. Additionally, variations to the disclosed embodiments can be understood and effected by the skilled person in practicing the claimed invention, from a study of the drawings, the disclosure, and the appended claims. In the claims, the word "comprising" does not exclude other elements, and the indefinite article "a" or "an" does not exclude a plurality. The mere fact that

certain features are recited in mutually different dependent claims does not indicate that a combination of these features cannot be used to advantage.

## Claims

1. A washing machine (100) comprising;

- a stationary drum (110) comprising at least one first opening (115);
- an inner drum (120) rotatably arranged around an axis of rotation A inside said stationary drum, comprising;
- a second opening (125) for accessing an interior of said inner drum;
- a hatch (130) configured to cover said second opening; and
- a locking mechanism (140) configured to secure said hatch in a closed position;

**characterized in that** the washing machine further comprises at least one first safety element (150) extending across said at least one first opening, wherein said at least one first safety element is arranged to provide a sliding surface (152a, 152b).

2. The washing machine according to claim 1 wherein said at least one first safety element provides a sliding surface for guiding said hatch on a smooth trajectory in case said hatch accidentally opens during use of said washing machine.

3. The washing machine according to claim 1 or 2 wherein said inner drum and said stationary drum are circular cylinders, and wherein said sliding surface has a circular shape with the same radius as said stationary drum and is arranged concentric about axis A.

4. The washing machine according to any one of the preceding claims wherein said at least one first safety element comprises at least two safety element segments (155a, 155b), wherein said at least two safety element segments each comprises a first sliding surface segment (152a, 152b) bridging said first opening in a tangential direction of rotation of said inner drum.

5. The washing machine according to any one of the preceding claims wherein said sliding surface is arranged at a radial distance of 5 - 70 millimeters from said inner drum.

6. The washing machine according to any one of the preceding claims wherein said hatch comprises at least one protruding rib (135) arranged to engage said at least one first safety element if said hatch

accidentally opens during use of said washing machine.

7. The washing machine according to claim 6 wherein said at least one protruding rib has a width of at least 2 millimeters.

8. The washing machine according to claim 6 or 7 wherein said at least one protruding rib extends further outward in a radial direction from said axis of rotation A than said locking mechanism and any other part of said hatch when said hatch is in an open position and said at least one protruding rib engages said at least one first safety element and/or said stationary drum.

9. The washing machine according to any one of the preceding claims further comprising at least one door (160) arranged to cover said at least one first opening, wherein said at least one first safety element is attached to said at least one door.

10. The washing machine according to any one of the preceding claims wherein said at least one first safety element comprises an interlocking element (157a, 157b) connected to said stationary drum and arranged to interlock with said at least one first safety element.

11. The washing machine according to claim 9 wherein said interlocking element (157a, 157b) is configured to slidably interlock with said at least one first safety element.

12. The washing machine according to any one of the preceding claims further comprising;

- a sensor (170) configured to detect if said at least one first safety element is in contact with said hatch, and
- a control unit (200) configured to turn off said washing machine when said sensor detects a contact between said at least one first safety element and said hatch.

13. The washing machine according to claim 12 wherein said sensor is an inductive sensor configured to detect a displacement of said at least one first safety element.

14. The washing machine according to claim 12, wherein said at least one first safety element comprises a spring element (175) configured to be released by said hatch in case said hatch accidentally opens during use of said washing machine, and wherein said sensor is an inductive sensor configured to detect said spring element being released.

15. The washing machine according to any one of the preceding claims wherein said stationary drum further comprises a third opening (117), and wherein said washing machine further comprises, a heating box (180) configured to contain a heating element for heating a content of said stationary drum via said third opening; and  
a second safety element (190) extending across said third opening, wherein said second safety element is arranged to provide a second sliding surface (197a, 197b).
16. The washing machine according to claim 15, wherein said second safety element comprises at least two metal strips (195a, 195b) extending across said third opening, wherein each of said at least two metal strips each comprises a second sliding surface segment (197a, 197b) bridging said third opening in a tangential direction of rotation of said inner drum.
17. The washing machine according to claim 16 wherein each first sliding surface segment (152a, 152b) and/or each second sliding surface segment (197a, 197b) is extending in a plane defined by a circular trajectory of one of said at least one protruding ribs when said inner drum is rotating.

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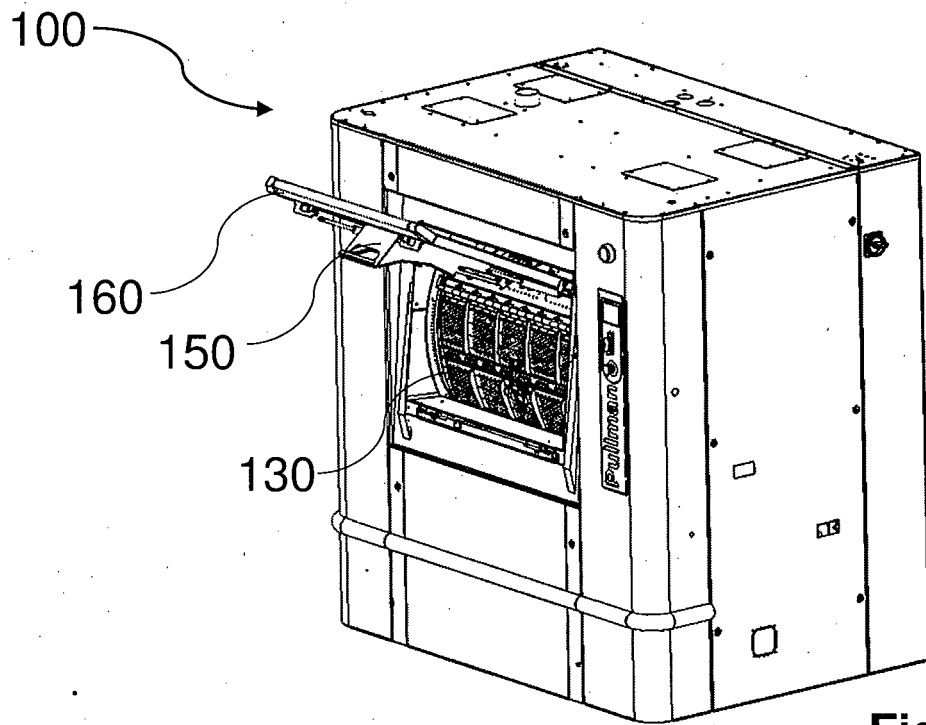
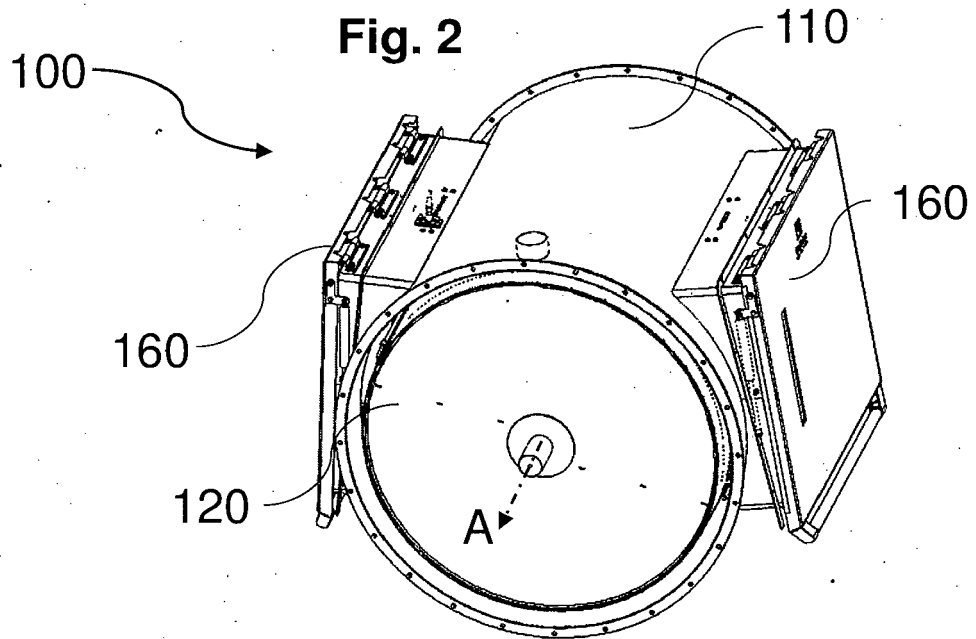


Fig. 1



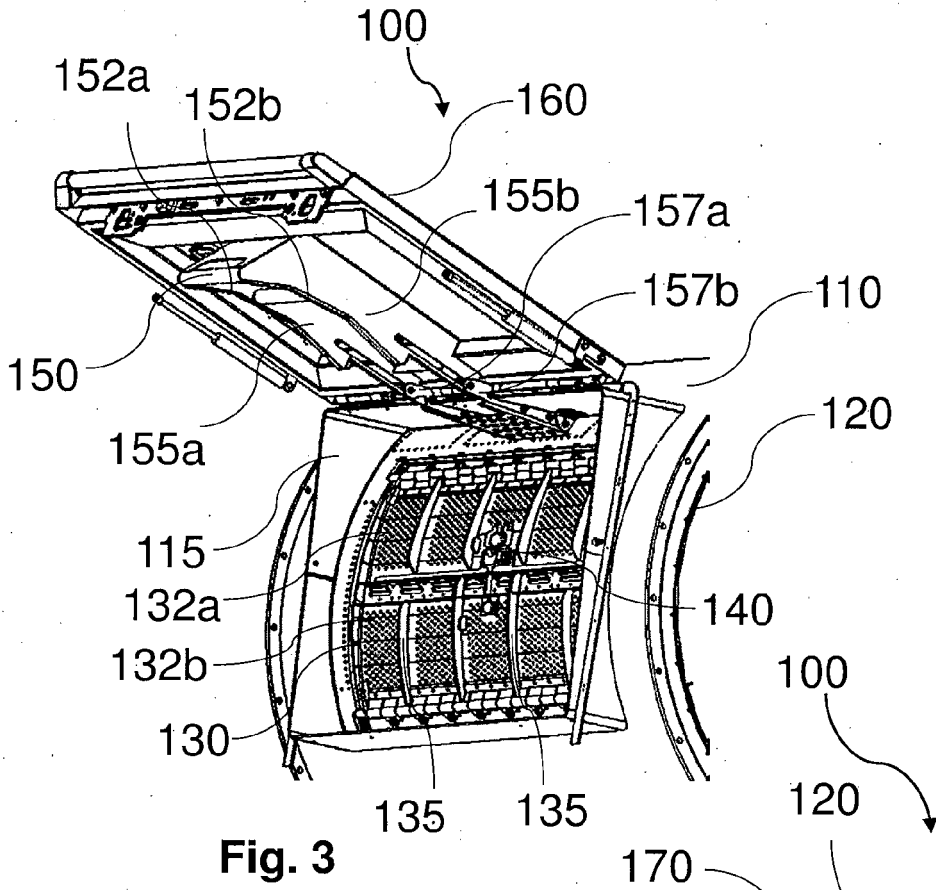


Fig. 3

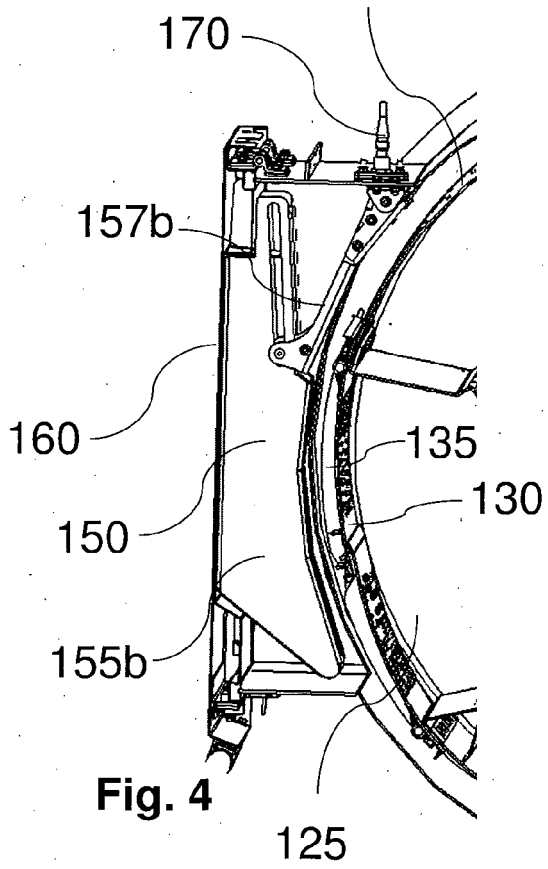


Fig. 4

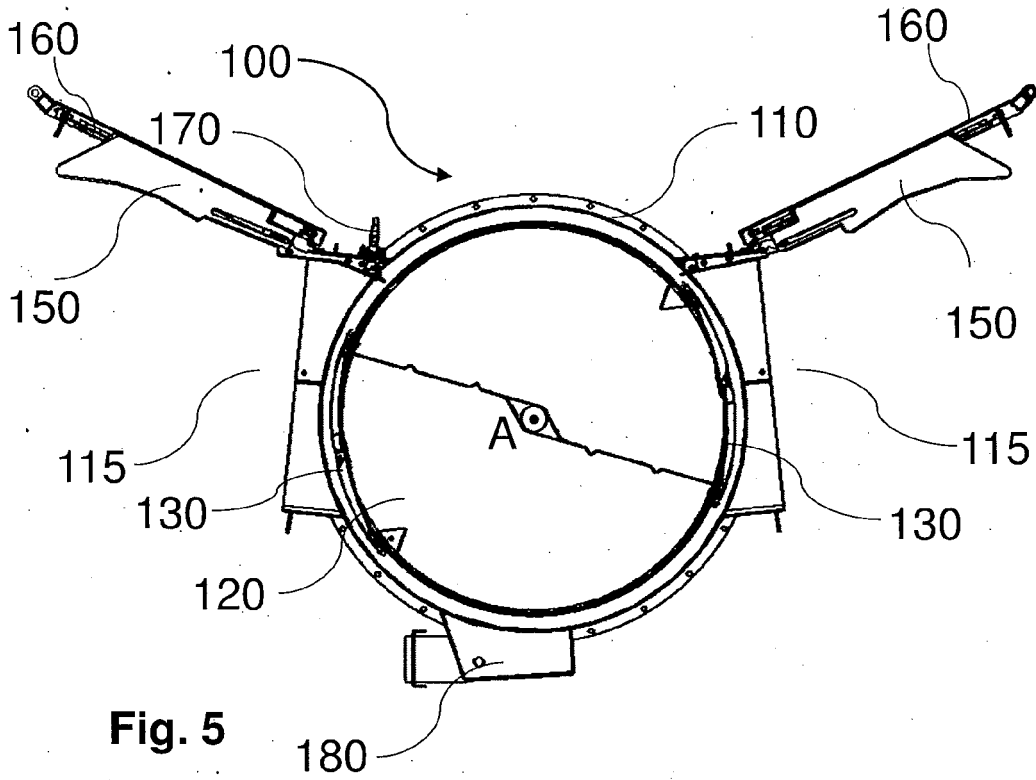


Fig. 5

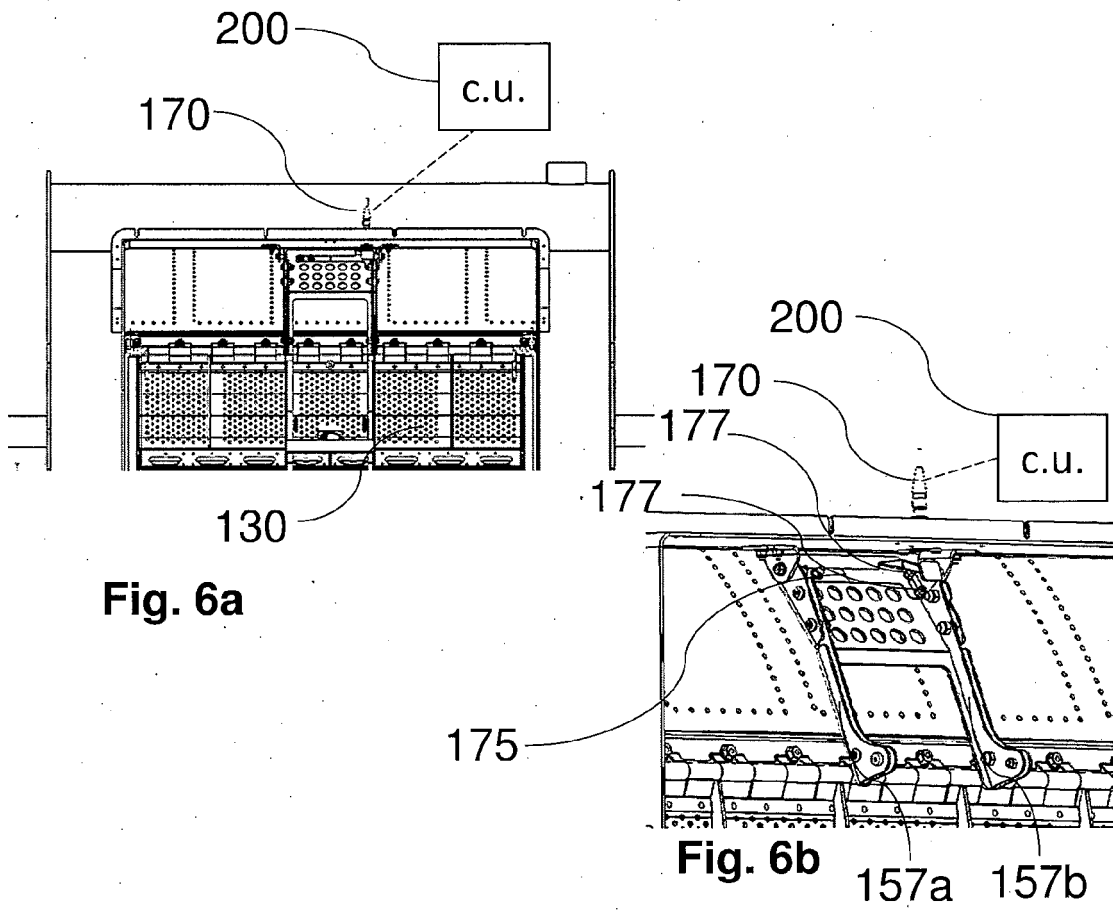
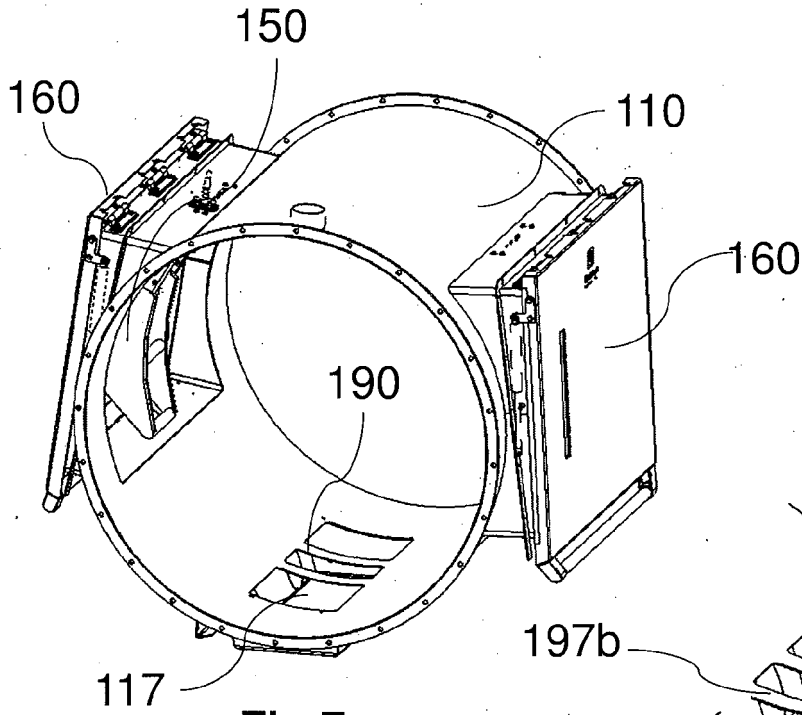
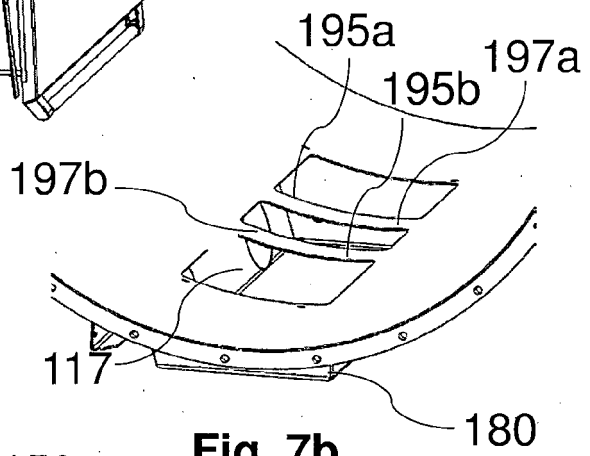


Fig. 6a

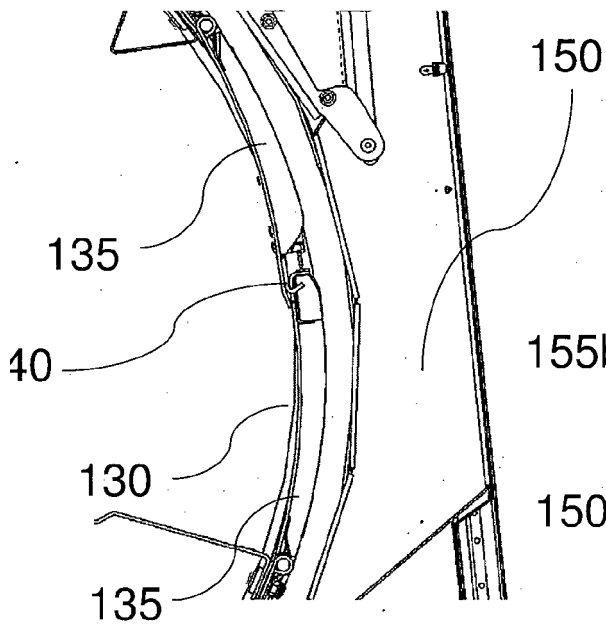
Fig. 6b



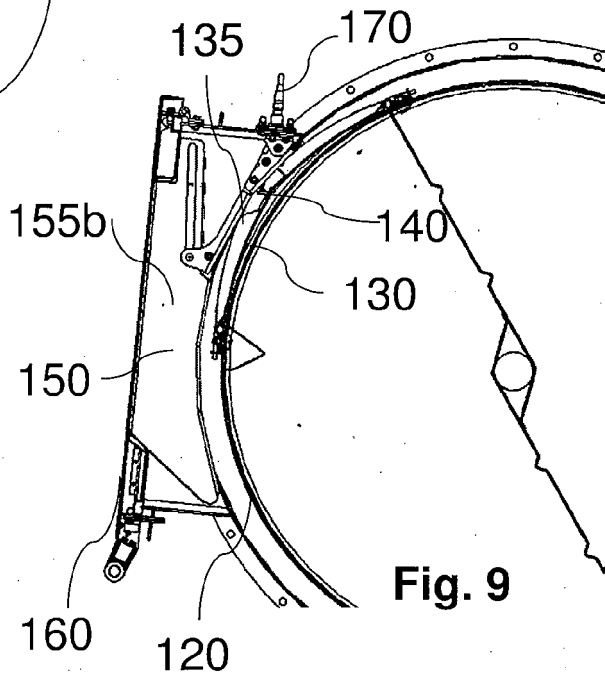
**Fig. 7a**



**Fig. 7b**



**Fig. 8**



**Fig. 9**



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Application Number  
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