



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
03.04.2019 Bulletin 2019/14

(51) Int Cl.:
D06F 37/26 ^(2006.01)
D06F 33/02 ^(2006.01)
D06F 39/08 ^(2006.01)

(21) Application number: **17193890.5**

(22) Date of filing: **28.09.2017**

(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

Designated Validation States:

MA MD

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(54) **WASHING MACHINE AND METHOD OF COOLING A WASHING MACHINE DOOR SEAL**

(57) A washing machine (100) has a door seal (106) and an arrangement (108) for detecting heating of the door seal. Water is directed at the door seal (106) to cool

the door seal (106) if the detected heating indicates that a temperature of the door seal is above a threshold.

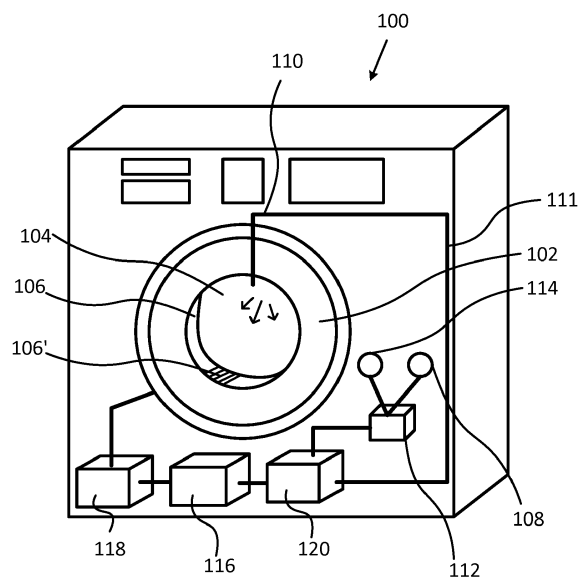


Fig. 1

Description

Technical Field

[0001] The present disclosure relates to a washing machine and a method for cooling a door seal of a washing machine.

Background

[0002] Washing machines typically have a seal between the door of the washing machine and the drum which holds the laundry items and spins during operation. The seal prevents leakage of water from the machine during operation. It is known that the door seal can heat up during operation of the washing machine, which can damage the seal.

Summary

[0003] According to a first aspect disclosed herein, there is provided a method of cooling a door seal of a washing machine, the method comprising: detecting heating of the door seal; and if the detected heating indicates that the temperature of the door seal is above a threshold, directing water at the door seal to cool the door seal.

[0004] Sometimes, during operation of a washing machine, a door seal of the washing machine can heat up, which can damage the door seal. This may be because for example laundry items in the rotating drum of the washing machine rub against the door seal, or because for example laundry items become trapped or lodged in the door seal and other laundry items in the drum rotate over the stuck items. In the present method, when the temperature of the door seal indicated by the detected heating is above the threshold, water is directed at the door seal to cool the door seal.

[0005] In an example, the method comprises: following directing water at the door seal, stopping the directing of water at the door seal if the detected heating indicates that the temperature of the door seal is below a threshold. That is, water may only need to be directed at the door seal until the temperature returns to a normal operating condition. This ensures the minimum amount of energy and water is used during cooling of the door seal.

[0006] In an example, the threshold for causing water to be directed at the door seal may be different from the threshold for causing the directing of water to be stopped. That is, the water seal may be cooled to a desired operating temperature sufficiently far from the threshold for triggering the directing of water. This helps to prevent persistent or frequent switching between the directing of water and the stopping of directing water at the door seal.

[0007] In an example, the detecting heating of the door seal comprises detecting a gas emitted by the door seal as the door seal heats. It has been appreciated that, as the door seal heats up, gases may be emitted from the

seal material. The detection of gases is therefore an indication that the door seal is heating. This provides a way of detecting heating of the door seal without requiring for example an electronic thermometer or thermocouple of the like to be fitted, which may not be convenient or possible in some washing machines.

[0008] In an example, the water is directed from one or more cooling pipes and water is supplied to the one or more cooling pipes from a water box of the washing machine.

[0009] In an example, the water box receives rinsing water which has rinsed laundry items during operation of the washing machine.

[0010] This advantageously avoids the requirement for an additional connection between the washing machine and a building's water supply. Instead, rinsing water, which is ordinarily removed from the washing machine completely, can be recycled.

[0011] In an example, the method comprises: detecting a laundry item as being lodged in the door seal; and directing water at the laundry item to dislodge the laundry item from the door seal. That is, a laundry item can be dislodged from the door seal to prevent any further heating of the door seal and/or to prevent any wear and tear of the door seal.

[0012] According to a second aspect disclosed herein, there is provided a washing machine comprising: a door seal; an arrangement for detecting heating of the door seal; an arrangement for directing of water at the door seal; and a controller configured to control directing of water at the door seal to cool the door seal if the detected heating indicates that the temperature is above a threshold.

[0013] In an example, the controller is configured to stop the directing of water at the door seal if, following the directing of water at the door seal, the detected heating indicates that the temperature of the door seal is below a threshold.

[0014] In an example, the washing machine comprises: a gas detector for detecting a gas emitted by the door seal as the door seal heats.

[0015] In an example, the arrangement for directing of water at the door seal comprises one or more cooling pipes for directing water at the door seal; and comprises a water box in fluid communication with the one or more cooling pipes to supply water to the one or more cooling pipes from the water box.

[0016] In an example, the water box is configured to receive rinsing water which has rinsed laundry items during operation of the washing machine.

[0017] In an example, the washing machine comprises: an arrangement for detecting a laundry item as being lodged in the door seal, wherein the one or more cooling pipes are configured to direct water at the laundry item to dislodge the laundry item from the door seal.

Brief Description of the Drawings

[0018] To assist understanding of the present disclosure and to show how embodiments may be put into effect, reference is made by way of example to the accompanying drawings in which:

Figure 1 shows schematically an example of a washing machine for cooling the door seal of the washing machine.

Detailed Description

[0019] As mentioned, during operation of the washing machine the door seal can heat up. This may be because for example laundry items in the rotating drum of the washing machine rub against the door seal, or because for example laundry items become trapped or lodged in the door seal and other laundry items in the drum rotate over the stuck items. In the present method, when the temperature of the door seal indicated by the detected heating is above a first threshold, water is directed at the door seal to cool the door seal.

[0020] This is particularly problematic during the spin cycle of the washing machine. For example, during the spin cycle, rotation of the drum (often in excess of one thousand revolutions per minute) can result in laundry items rotating over trapped items, which in turn heats the door seal.

[0021] There are several problems caused by heating of the door seal. First, excessive heating can cause a fire. This is particularly problematic when washing machines are used when the environment in which the machine is used is unattended. Secondly, gases may be emitted from the door seal due to heating of the material of the door seal, which may be harmful or at least unpleasant and possibly resulting in the laundry smelling of chemicals. Thirdly, repeated heating of the door seal due to friction and subsequent gas emission can result in wearing of the door seal. The door seal may therefore require replacing sooner than would normally be required.

[0022] Referring to Figure 1, there is shown schematically an example of a washing machine 100. The washing machine 100 may be a stand-alone washing machine or a combined washer/dryer (i.e. a combined washing machine and tumble dryer). In the present specification, any reference to the "washing machine" is in general applicable to a stand-alone washing machine or a combined washer/dryer.

[0023] The washing machine 100 has a door 102 which can be opened to place laundry items in a washing drum 104. Laundry items may be e.g. items of clothing, bed linen, towels, etc. The washing drum 104 is configured to rotate during operation of the washing machine 100 (e.g. during a wash, rinse or spin operation).

[0024] The washing machine 100 also has a door seal 106 between the door 102 and the drum 104. The door

seal 106 is configured to prevent water leakage from the drum 104 during and after operation of the washing machine 100. The door seal 106 is typically made from rubber material. Specific materials used for washing machine door seals 106 will be known to the skilled person.

[0025] The washing machine 100 also has a heat detecting arrangement 108 for detecting heating of the door seal 106. Some specific examples for the heat detecting arrangement 108 will be discussed further below.

[0026] The washing machine 100 also has a water-directing arrangement 110 for directing of water at the door seal 106. The water-directing arrangement 110 may generally be, for example, located within the body of the washing machine 100. The water-directing arrangement 110 may comprise one or more cooling pipes 111 for directing water at the door seal 106. The or each pipe may have a nozzle or the like at the outlet facing the door seal 106 for assisting in spraying or ejecting water. Figure 1 shows a single cooling pipe 111 in this example but more than one cooling pipe 111 may be used to direct water at the door seal 106 in other examples. For example, multiple cooling pipes 111 may be constructed and arranged such that water may be directed at the entire door seal 106. Alternatively, multiple cooling pipes 111 may be arranged to direct water at a number of specific points on the door seal 106, such as for example the topmost, bottommost, leftmost and rightmost points of the door seal 106.

[0027] The washing machine 100 also has a controller 112 configured to control directing of water at the door seal 106. The controller 112 is operatively coupled to the heat detecting arrangement 108 in order to receive an indication of heating of the door seal 106. The controller is also operatively coupled to the water-directing arrangement 110 in order to control directing of water at the door seal 106 from the water-directing arrangement 110.

[0028] In an example, heating of the door seal is detected 106 by the heat detecting arrangement 108. If the detected heating indicates that the temperature of the door seal 106 is above a first threshold, the water-directing arrangement 110 is controlled so that water is directed at the door seal 106 to cool the door seal 106.

[0029] For example, as shown in Figure 1, a region 106' of the door seal 106 at or near the lowermost part of the door seal 106 has become heated (e.g. due to lodged items of laundry). The heating of the door seal 106 may be detected and may indicate that the temperature of the door seal 106 is above the first threshold. In response, water is directed towards the heated region 106' of the door seal 106 (here, the lowermost part of the door seal 106), as shown by the arrows in Figure 1.

[0030] In an example, if it is then determined that the temperature of the door seal 106 is below a second threshold (which may or may not be the same threshold used to trigger the directing of water at the door seal 106), water is stopped from being directed at the door seal 106 as the door seal 106 is deemed as having been sufficiently cooled. In that case, it is not necessary to continue

directing water at the door seal 106. In an alternative example, water is directed at the door seal 106 for a predetermined period of time. For example, water may be directed at the door seal 106 for a minimum of one minute.

[0031] In an example, the first threshold for triggering the directing of water and the second threshold for stopping the directing of water may be the same. That is, if the door seal is heated above a threshold, water is directed at the door seal until the door seal is cooled to below that same threshold. In an alternative example, the two thresholds are different. That is, if the door seal is heated above a first threshold, water is directed at the door seal until the door seal is cooled to below a second, different threshold. This helps to prevent persistent or frequent switching between the directing of water and the stopping of directing water at the door seal.

[0032] In an example, the first and second thresholds for starting and stopping directing of water at the door seal 106 may be programmed by the manufacturer of the washing machine 100 or an end-user of the washing machine 100. In an example, the predetermined period of time may be programmed by the manufacturer of the washing machine 100 or an end-user of the washing machine 100.

[0033] In an example, the washing machine 100 may comprise a gas detector 114 for detecting a gas emitted by the door seal 106 as the door seal 106 heats. The gas detector may generally be, for example, located within the body of the washing machine 100. The gas detector 114 may be any suitable detector for detecting gas including for example an electrochemical gas detector, an infrared imager, a semiconductor sensor, an ultrasonic gas detector, or a holographic gas sensor.

[0034] In an example, detecting the heating of the door seal 106 comprises detecting a gas emitted by the door seal 106 as the door seal 106 heats. For example, the gas emitted by the door seal 106 may be detected by the gas detector 114. In an example, only the heating of the door seal 106 being above the first threshold is required in order to direct water at the door seal. In another example, both the heating of the door seal 106 being above the first threshold and the presence of gas are required in order to direct water at the door seal 106. In an alternative example, only the presence of gas is required in order to direct water at the door seal 106. That is, the presence of gas (or an amount of gas above a threshold) is taken by the controller 112 to be indicative of the door seal 106 having been heated above the first threshold.

[0035] In an example, the heat detecting arrangement 108 comprises the gas detector 114. That is, the gas detector 114 is used to determine that the door seal has been heated. For example, the presence of a particular gas or a particular quantity of a gas indicates heating of the door seal 106.

[0036] In an example, water is directed at the door seal 106 until the presence of gas is no longer detected or until the level of detected gas is below a predetermined level.

[0037] The controller 112 is operatively coupled to the gas detector 114 in order to receive an indication of the presence of gas and/or the particular gas detected by the gas detector 114. In an example, the gas detector 114 may be configured to continuously monitor for gas. This is advantageous as it enables instantaneous detection of gas being emitted and therefore that the door seal 106 has heated up. In another example, the gas detector 114 may be configured to periodically monitor for gas being emitted and therefore that the door seal 106 has heated up.

[0038] In an example, the gas detector 114 may be configured to detect gas inside of the drum 104. In additional or alternative examples, the gas detector 114 may be configured to detect gas outside of the drum 104 but within the body of the washing machine 100.

[0039] In other examples, the heat detecting arrangement 108 may be any arrangement for directly detecting heat, including thermometers, thermistors (e.g. negative temperature coefficient thermistors), resistance temperature detectors, thermocouples, semiconductor-based sensors, infrared sensors, optical sensors, etc. In an example, the heat detecting arrangement 108 may be configured to continuously detect the temperature of the door seal 106. This is advantageous as it enables instantaneous measurement of the temperature of the door seal 106. In another example, the temperature detecting arrangement 108 may be configured to periodically detect the temperature of the door seal 106. It will be appreciated that in some scenarios one or more of the above examples may not be suitable. If a thermometer or the like is used, then a threshold temperature may be used. In an example, the threshold temperature may be programmed by the manufacturer of the washing machine 100 or an end-user of the washing machine 100. For example, the threshold temperature may be programmed to be 50°C or 60°C or so. It will be appreciated that the threshold temperature may be programmed to be any suitable value.

[0040] In an example, the washing machine 100 may comprise a water box 116 in fluid communication with the water-directing arrangement 110 to supply water to the water-directing arrangement 110. The water supply from the water box 116 may flow through the one or more cooling pipes 111.

[0041] In an example, the water box 116 is arranged to receive rinsing water which has rinsed laundry items during operation of the washing machine 100. For example, rinsing water may be drained into the water box 116 during a rinsing operation. In another example, rinsing water may be drained into the water box 116 during a draining operation. In another example, rinsing water may be drained into the water box 116 during a spinning cycle.

[0042] In an example, the washing machine 100 may comprise a first pump 118 constructed and arranged to extract water from the drum 104 and pump water into the water box 116 for use in cooling the door seal 106. Al-

ternatively, rinsing water may drain directly from the drum 104 to the water box 116 without the need for the first pump 118.

[0043] In an example, the washing machine 100 may comprise a second pump 120 constructed and arranged to extract water from the water box 116 and pump water through the water-directing arrangement 110 for use in cooling the door seal 106. In an example, the one or more cooling pipes 111 may each be connected to the second pump 120. In examples, the second pump 120 may be controlled by the controller 112 to vary the pressure of the water throughout the water-directing arrangement 110.

[0044] In another example, the washing machine 100 may comprise a laundry detecting arrangement (not shown) for detecting a laundry item as being lodged in the door seal 106. The controller 112 is operatively coupled to the laundry detecting arrangement in order to receive an indication of the presence of a laundry item lodged in the door seal 106. The laundry detecting arrangement may be for example an optical sensor. For example, the optical sensor can optically monitor the door seal 106 to detect when an item is lodged in the door seal 106, e.g. a laundry item has remained in the same place for a certain amount of time. In another example, the laundry detecting arrangement may be a contact sensor. For example, the contact sensor may detect that a laundry item has remained in contact with the same point of the door seal 106 for a certain amount of time. In yet another example, the laundry detecting arrangement may be a weight sensor. For example, the weight sensor may detect the presence of a laundry item from the increase in weight of the door seal 106 for a certain amount of time.

[0045] In an example, the water-directing arrangement 110 may be configured to direct water at the laundry item to dislodge the laundry item from the door seal 106. For example, in response to detecting the position of the lodged laundry item via the laundry detecting arrangement, one or more cooling pipes 111 may be chosen to direct water at the detected position of the lodged laundry item. For example, if the laundry item is detected as being lodged at the bottom of the door seal 106, one or more cooling pipes 111 that are positioned such that the water emitted impinges on the bottom of the door seal are selected by the controller 112. In an example, the water pressure of the directed water may be increased to ensure the laundry item is dislodged from the door seal 106.

[0046] In another example, all of the one or more cooling pipes 111 may be selected by the controller 112 to emit water in order to dislodge the laundry item.

[0047] In an example, the water-directing arrangement 110 and/or the one or more cooling pipes may be movable to direct water at the lodged laundry item. For example, the water-directing arrangement may be controlled by the controller 112. The controller 112 may use the information provided by the laundry detecting arrangement to aim the water-directing arrangement 110 at the

lodged item of laundry. For example, the water-directing arrangement 110 may comprise a moveable nozzle.

[0048] It will be understood that the controller 112, processor or processing system or circuitry referred to herein may in practice be provided by a single chip or integrated circuit or plural chips or integrated circuits, optionally provided as a chipset, an application-specific integrated circuit (ASIC), field-programmable gate array (FPGA), digital signal processor (DSP), graphics processing units (GPUs), etc. The chip or chips may comprise circuitry (as well as possibly firmware) for embodying at least one or more of a data processor or processors, a digital signal processor or processors, baseband circuitry and radio frequency circuitry, which are configurable so as to operate in accordance with the exemplary embodiments. In this regard, the exemplary embodiments may be implemented at least in part by computer software stored in (non-transitory) memory and executable by the processor, or by hardware, or by a combination of tangibly stored software and hardware (and tangibly stored firmware).

[0049] Reference is made herein to data storage for storing data. This may be provided by a single device or by plural devices. Suitable devices include for example a hard disk and non-volatile semiconductor memory.

[0050] The examples described herein are to be understood as illustrative examples of embodiments of the invention. Further embodiments and examples are envisaged. Any feature described in relation to any one example or embodiment may be used alone or in combination with other features. In addition, any feature described in relation to any one example or embodiment may also be used in combination with one or more features of any other of the examples or embodiments, or any combination of any other of the examples or embodiments. Furthermore, equivalents and modifications not described herein may also be employed within the scope of the invention, which is defined in the claims.

Claims

1. A method of cooling a door seal of a washing machine, the method comprising:

detecting heating of the door seal; and
if the detected heating indicates that a temperature of the door seal is above a threshold, directing water at the door seal to cool the door seal.

2. A method according to claim 1, comprising:

following directing water at the door seal, stopping the directing of water at the door seal if the detected heating indicates that the temperature of the door seal is below a threshold.

3. A method according to claim 1 or claim 2, wherein:
the detecting heating of the door seal comprises
detecting a gas emitted by the door seal as the
door seal heats. 5
4. A method according to any of claims 1 to 3, wherein
the water is directed from one or more cooling pipes
and wherein water is supplied to the one or more
cooling pipes from a water box of the washing ma- 10
chine.
5. A method according to claim 4, wherein the water
box receives rinsing water which has rinsed laundry
items during operation of the washing machine. 15
6. A method according to any of claims 1 to 5, compris-
ing:
detecting a laundry item as being lodged in the 20
door seal; and
directing water at the laundry item to dislodge
the laundry item from the door seal.
7. A washing machine comprising: 25
a door seal;
an arrangement for detecting heating of the door
seal;
an arrangement for directing of water at the door 30
seal; and
a controller configured to control directing of wa-
ter at the door seal to cool the door seal if the
detected heating indicates that a temperature of
the door seal is above a threshold. 35
8. A washing machine according to claim 7, wherein:
the controller is configured to stop the directing
of water at the door seal if, following the directing 40
of water at the door seal, the detected heating
indicates that the temperature of the door seal
is below a threshold.
9. A washing machine according to claim 7 or claim 8, 45
comprising:
a gas detector for detecting a gas emitted by the
door seal as the door seal heats. 50
10. A washing machine according to any of claims 7 to 9,
wherein the arrangement for directing of water at the
door seal comprises one or more cooling pipes for
directing water at the door seal; and comprising a 55
water box in fluid communication with the one or
more cooling pipes to supply water to the one or more
cooling pipes from the water box.
11. A washing machine according to claim 10, wherein
the water box is configured to receive rinsing water
which has rinsed laundry items during operation of
the washing machine.
12. A washing machine according to any of claims 7 to
11, comprising:
an arrangement for detecting a laundry item as
being lodged in the door seal, wherein the one
or more cooling pipes are configured to direct
water at the laundry item to dislodge the laundry
item from the door seal.

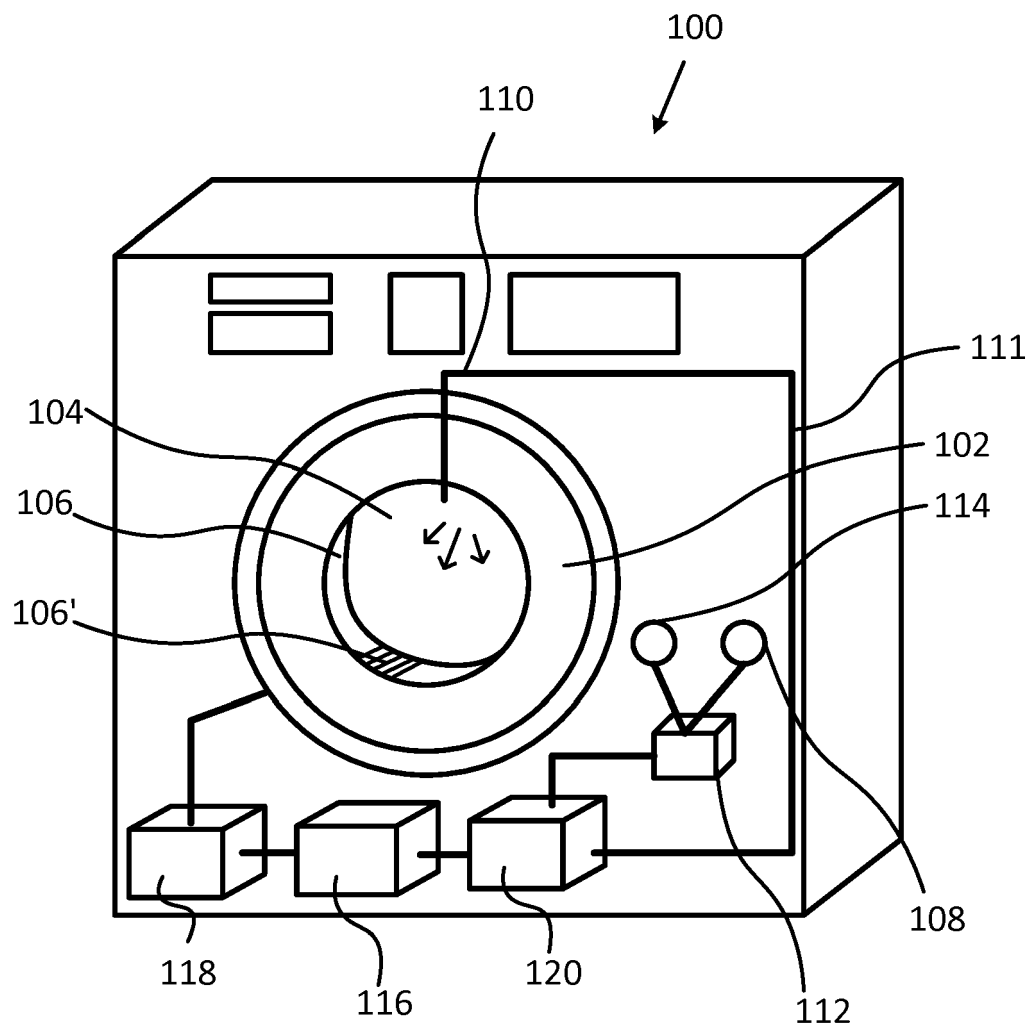


Fig. 1



EUROPEAN SEARCH REPORT

Application Number
EP 17 19 3890

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Place of search Munich		Date of completion of the search 28 February 2018	Examiner Weidner, Maximilian
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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**ANNEX TO THE EUROPEAN SEARCH REPORT
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This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
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