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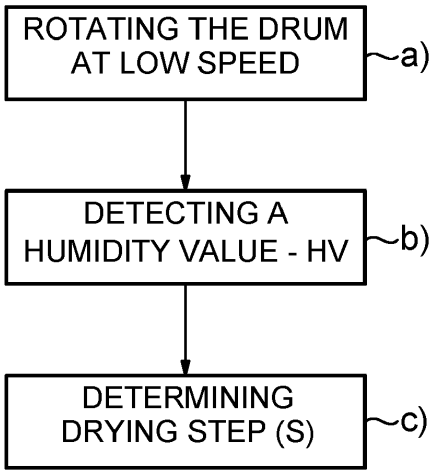
(54) METHOD FOR DRYING A PILLOW-LIKE ITEM IN A LAUNDRY TREATMENT APPLI-ANCE AND LAUNDRY TREATMENT APPLIANCE

(57) Method for drying a pillow-like item (14) in a laundry treatment appliance (10), in particular a laundry drying appliance, wherein the laundry treatment appliance (10) comprises:
a rotatable drum (12) arranged to receive a pillow-like item (14);
a drive unit operatively coupled to the drum (12) to variably drive the drum (12) about an axis of rotation of the drum (12);
a humidity sensing unit configured to detect a humidity value (HV) of the pillow-like item (14) received in the drum (12);
a control unit (32) for controlling operation of the laundry treatment appliance (10);
wherein the method comprises the following steps:
a) rotating the drum (12) at an average drum speed (VADS) of not more than 20 rpm over a first predetermined period of time (t_1);
b) detecting a humidity value (HV) related to the pillow-like item (14) received in the drum (12); and
c) determining one or more drying steps for drying the pillow-like item (14) based on the detected humidity value (HV).

FIG 3A



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Description

[0001] The present invention relates to a method for drying a pillow-like item in a laundry treatment appliance and to a laundry treatment appliance.

[0002] It is known to dry pillow-like items, such as pillows, cushions, sofa pads or the like in laundry treatment appliances, such as laundry drying appliances, at least those items whose material can withstand the applied drying temperature and those where the size of the item allows placement and a proper drying process of the item within the laundry treatment appliance.

[0003] WO 2012/175640 A1 discloses a method of controlling a drying operation of a rotatable drum laundry dryer comprising a rotatable drum for loading laundry and an electronic control system including an electrode sensor for sensing dryness of the laundry. The electrode sensor is a contact electrode sensor type and comprises two metal plates arranged on a flange in a position facing the inside of the drum, for sensing the dryness of laundry by using impedances generated at opposite ends of the metal plates according to moisture content of the laundry when the later is brought into contact with the opposite metal plates, and forwards the dryness as an electrical signal, i.e. a voltage signal. The electrical signal outputted by the electrode sensor could be associated, for example, with the resistance and/or conductance of the laundry sensed between the metal plates.

[0004] WO 2018/121849 A1 discloses a laundry appliance with a humidity sensor provided for measuring the humidity of laundry items contained in a laundry drying chamber. The sensor comprises an operating support having a first surface with a first pad and a second surface with a second pad opposite to the first surface. Both the first pad and the second pad are made of an electrically conductive material and are adapted to be operated as a plate of a capacitor.

[0005] US 2018/0016734 A1 discloses a laundry treating appliance for drying laundry with a rotatable drum where at least one conductivity sensor is located within the treating chamber and a motor rotating the drum tumbles laundry within the treating chamber to ensure contact of the laundry with the conductivity sensor.

[0006] EP 3 162 952 A1 discloses a laundry drying appliance with capacitive laundry drying degree sensing function. The laundry drying appliance comprises a capacitor having, as a part of the capacitor dielectric, the laundry mass; measuring the capacitance of said capacitor may means of an electronic circuit electrically supplied by a supply voltage and a reference voltage.

[0007] DE 10 2010 000 428 A1 discloses a laundry treatment appliance with detection means for the detection of large-volume laundry items, such as comforters and other blankets, sleeping bags, jackets, down jackets, stuffed textile articles (e.g. toys), workwear (e.g. heavy or stiff workwear for stiff workwear for construction workers), etc. As "large-volume" can be defined as washing goods that occupy a large part of the space in the drying chamber, such as a bedspread. In the same way it can be an article, the volume and/or shape of which and/or shape does not change during the treatment e.g. a stuffed textile article. Detection of large-volume laundry items is realised by means of image capturing, e.g. by a camera.

[0008] It is an object of the present invention to improve the drying function of a laundry treatment appliance.

[0009] It is a further object of the present invention to improve the capability of a laundry treatment appliance related to the detection of humidity of laundry received in the drum.

[0010] Furthermore, it is an object of the present invention to provide an improved laundry treatment appliance.

[0011] One or more objects of the present invention are achieved by a method according to claim 1 and by a laundry treatment appliance according to claim 15.

[0012] A method according to the invention is adapted for drying a pillow-like item in a laundry treatment appliance, in particular a laundry drying appliance, wherein the laundry treatment appliance comprises:

- a rotatable drum arranged to receive a pillow-like item;
- a drive unit operatively coupled to the drum to variably drive the drum about an axis of rotation of the drum;
- a humidity sensing unit configured to detect a humidity value of the pillow-like item received in the drum;
- a control unit for controlling operation of the laundry treatment appliance;

wherein the method comprises the following steps:

a) rotating the drum at an average drum speed of not more than 20 rpm over a first predetermined period of time;
b) detecting a humidity value related to the pillow-like item received in the drum;
c) determining one or more drying steps for drying the pillow-like item based on the detected humidity value.

[0013] The method according to the invention allows a substantially correct detection and determination of the humidity value of a pillow-like item in the drum of the laundry treatment appliance, irrespective of the type of the pillow-like item and irrespective of how the user puts the pillow-like item into the drum. Specifically, rotating of the drum at an average drum speed of no more than 20 rpm (revolutions per minute) ensures that a rectangular stuffed pillow is brought into a position in the drum and into an orientation optimized for a proper humidity detection. Based on such a properly prepared and conducted detection of the humidity of the pillow-like item, appropriate drying steps can be determined to be carried out subsequently in dependence on the detected humidity value.

E.g. the duration of the subsequent drying step and/or the temperature of the drying air used in the subsequent drying step can be adapted in accordance with the detected humidity value. Pillow-like items shall be understood in particular, as a not exclusive listing, as pillows, cushions, sofa pads or the like. Further, such items may be items, the volume and/or shape of which does not or only slightly change during a washing and/or drying process in a domestic laundry treatment appliance. Examples are stuffed textile articles, such as stuffed animal toys or stuffed pillows. The method is particularly suitable for being used with a laundry drying appliance. The laundry drying appliance may be a tumble dryer. Further, the laundry drying appliance may be a washer/dryer.

[0014] Advantageously, the humidity value detected according to step b) is determined based on a plurality of single humidity values detected by the humidity sensing unit, in particular wherein determining the one or more drying steps is based on the humidity value being determined based on the plurality of single humidity values detected by the humidity sensing unit, in particular wherein the plurality of single humidity values is detected continuously or at a plurality of discrete points in time over a period of time by the humidity sensing unit.

[0015] If the humidity value is based on a plurality of humidity values detected by the humidity sensing unit, the resulting humidity value reflects the true humidity in the pillow-like item more precisely. The humidity value on which the determination of the drying steps is based may be an average, such as an arithmetic mean, a median, a mid-range or a mode calculated from the single humidity values detected by the humidity sensing unit over a certain time.

[0016] Alternatively, the humidity value detected according to step b) is represented by exactly one single humidity value detected by the humidity sensing unit. To use only one single humidity value detected by the humidity sensing unit is very simple and quick. Thus, an overall duration of a drying program can be held very short if only a single humidity value is used.

[0017] According to an advantageous embodiment of the invention, rotating the drum at an average drum speed of not more than 20 rpm over a first predetermined period of time causes a pillow-like item received in the drum to move into a position in the lower region of the drum and/or into an orientation relative to a central axis of the drum such that the pillow-like item is present in or repeatedly moves through a field of detection of the humidity sensing unit.

[0018] In general, the humidity sensing unit can be arranged such that a field of detection of the humidity sensing unit is provided within a lower region of the drum. More precisely, the field of detection of the humidity sensing unit may be provided mainly within the lower third of the drum. The humidity sensing unit may give more accurate humidity values for laundry items, such as the pillow-like item, when being in the lower third of the drum or the lower fourth of the drum. Further, the humidity sensing unit may give more accurate humidity values for laundry items, such as the pillow-like item, being closer to the door and/or the front end of the laundry treatment appliance, where exemplarily an electrode of a capacitive sensor of the humidity sensing unit may be arranged.

[0019] By assuring that the pillow-like item moves into a position in the lower region of the drum, it is ensured that a large part of the pillow-like item is present or moves through the field of detection of the humidity sensing unit. The field of detection may be spun up substantially between two electrodes of the humidity sensing unit. The two electrodes may be arranged along or parallel to the central axis of the drum. However, the field of detection may also be spun up between an electrode (or plate) of a capacitive sensor of the humidity sensing unit and a virtual electrode (or plate), such that the field of detection is extending from the first electrode in a direction towards the back end of the drum or from the first electrode in a direction towards the centre of the drum. This kind of capacitive sensor generally provides accurate humidity measurements within 10-20 cm from the first electrode towards the virtual electrode. Thus, it is particularly advantageous to position the pillow in the drum such that the pillow stays within 10-20 cm from the first electrode as often as possible during the drum rotations.

[0020] It is further advantageous if the first predetermined period of time comprises a first fraction and a second fraction and step b) of detecting of the humidity value related to the pillow-like item received in the drum and determining whether the humidity value is below a predetermined humidity threshold is started at the end of the first fraction and is carried out for at least a second fraction of the first predetermined period of time.

[0021] Thus, during the initial step a) the pillow-like item is brought in the proper position for humidity sensing or detection without actually detecting a humidity value. Since it is not known whether the pillow-like item is in the proper position at the very beginning or whether it is in a position not suitable for reliable humidity detection, it is also not known whether a humidity value detected during step a) is valid or not valid. A not valid value detected during step a) would affect the overall detection result and would cause a prolonged overall humidity detection to ensure that a correct humidity value is received. After step a) being carried out for a certain time, it can be assumed that the pillow-like item is in a proper position for humidity detection and so the required time for humidity detection and, consequently, the overall drying program time can be kept short.

[0022] According to a further advantageous embodiment of the invention, step a) comprises a first step a1) for the first fraction of the first predetermined period of time and during which the humidity sensing unit does not detect the humidity value and wherein step a) comprises a second step a2) for the second fraction of the first predetermined period of time and during which the humidity sensing unit detects the humidity value.

[0023] Such an embodiment improves the overall qual-

ity of the detection of the humidity value by the humidity detection unit, because no detection results taken during the step a1) in which it is not known whether the pillow-like item is in a favourable position for humidity detection or not, affect the overall detection result.

[0024] In a further advantageous embodiment, the direction of rotation of the drum is changed at least once or twice or a plurality of times during step a) in which the drum is rotated at an average drum speed of not more than 20 rpm over a first predetermined period of time. Changing the direction of rotation of the drum may assist in the rearrangement or repositioning of the pillow-like item in the drum.

[0025] In yet a further advantageous embodiment, the direction of rotation of the drum is changed during the first fraction of the first predetermined period of time, but not during the second fraction of the first predetermined period of time, or wherein the direction of rotation of the drum is changed during the second fraction of the first predetermined period of time, but not during the first fraction of the first predetermined period of time, or
wherein the direction of rotation of the drum is changed during the first fraction and during the second fraction of the first predetermined period of time.

[0026] If the rotation of the drum is changed during the first fraction, but not during the second fraction, the rearrangement or repositioning of the pillow-like item can be made more efficient, while the humidity detection during the second fraction of time can be carried out without being affected by variations resulting from the drum inversion, i.e. the change of direction of rotation of the drum. Changing the direction of rotation during the second fraction, but not during the first fraction can provide a more robust result of the humidity value, because it would be detected while the drum rotates in the first as well as in the second direction. At the same time the rearrangement step can be shortened, when the drum rotation is not changed during the first fraction. Both effects can be combined by changing the drum rotation during both fractions of time.

[0027] Further advantageously, the first fraction is in the range of 35% to 65% of the first predetermined period of time, in particular in the range of 40% to 60% of the first predetermined period of time, preferably 50% of the first predetermined period of time, and/or
wherein the second fraction is in the range of 35% to 65% of the first predetermined period of time, in particular in the range of 40% to 60% of the first predetermined period of time, preferably 50% of the first predetermined period of time.

[0028] Such ratios have been found to allow the pillow-like item to move into a proper position for humidity sensing or detection and, at the same time, to allow a reliable humidity detection. Also such a ratio allows a relatively short first predetermined period of time sufficient to arrive at both effects.

[0029] Also advantageously, the step of determining one or more drying steps for drying the pillow-like item based on the humidity value comprises determining whether the humidity value is below a predetermined humidity threshold:

(i) when the humidity value is determined to be below the predetermined humidity threshold, one or more drying steps for drying the pillow-like item(s) is/are carried out at least for a second predetermined period of time independent of any further detection of the humidity value related to the pillow-like item; and/or
(ii) when the humidity value is determined to be above the predetermined humidity threshold, one or more drying steps for drying the pillow-like item(s) is/are carried out, wherein the detection and/or determination of the humidity value is continued until the humidity value is determined to be below the predetermined humidity threshold, or a maximum humidity detection time is reached, and wherein the one or more drying steps is/are continued at least for a second predetermined period of time once the humidity value is determined to be below the predetermined humidity threshold, or the maximum humidity detection time is reached, independent of any further detection of the humidity value related to the pillow-like item.

[0030] Thus, a reliable humidity detection can be achieved for a specific pillow-like item irrespective of the way a user puts it into the drum, wherein the detected humidity value can be used to decide about the duration of the drying step following thereto. The expression "drying step" shall be understood in a way that at least during a part of the duration of the drying step a heating device is operated to heat up the air conveyed into the drum for drying the pillow-like item.

[0031] Furthermore, it can be advantageous if the humidity value is determined by calculating an average of the plurality of single humidity values. The humidity value calculated by an average of the plurality of single humidity values may be based on an arithmetic mean, a median, a mid-range or a mode calculated from the single humidity values detected by the humidity sensing unit over a certain time.

[0032] A further advantageous embodiment includes that a variation over time is calculated based on the plurality of single humidity values, wherein the variation over time is determined to be below or above a variation threshold, wherein

(j) when the variation over time is determined to be below the variation threshold, the humidity value is confirmed to be a valid humidity value and the step of determining one or more drying steps continues with determining whether the humidity value is below a predetermined humidity threshold, and
(jj) when the variation over time is determined to be above the variation threshold, the humidity value is

confirmed to be a not valid humidity value and step a) and step b) are repeated.

[0033] It has been found that calculating a variation over time based on the plurality of single humidity values and comparing it to a predefined variation threshold is a simple, in the sense of requiring only few computing resources, and reliable way to determine whether the calculated humidity value can be considered as being valid, such that the step of determining one or more drying steps may continue with determining whether the humidity value is below a predetermined humidity threshold, or not valid, such that step a) and step b) have to be repeated in order to obtain a valid and reliable humidity value. Thus, it is possible to determine whether the detected humidity value is a valid humidity value or is a not valid humidity value, e.g. resulting from incorrect detection due to a bad position of the pillow-like item within the drum. A valid humidity value is an indication that the pillow-like item is in a proper position for being sensed by the humidity sensing unit, i.e. being present in the field of detection of the sensor. If no valid humidity value can be detected, it can be derived that the pillow-like item is not in a proper position for being sensed by the humidity sensing unit. Furthermore, a humidity value being zero or close to zero may be determined as being not valid, since a humidity value being zero or close to zero is an indication that the pillow is not present in the field of detection of the sensor.

[0034] The variation over time as an indicator of a valid or not valid humidity value may be specifically useful in a case where wherein a pillow-like item, such as a pillow, is entered in the drum, wherein the longside is longer than the broadside and the longside is longer than about 70-90% of the drum diameter. In such a case, it is important to determine if the pillow-like item is more or less constantly positioned in the field of detection of the humidity sensing unit or if the pillow-like item is only sometimes passing the field of detection of the humidity sensing unit. The humidity variation detected over time will become larger the higher the rate is of detected humidity values being zero or close to zero in relation to detected non-zero humidity values. The humidity variation detected over time will become larger and/or a lower rate of non-zero humidity values will be detected if the pillow is arranged such that its longside is transverse to the z axis of the drum, i.e. the longside is rotating along the x and y axes, since the pillow-like item or pillow will only sometimes be in the field of detection. Hence, the humidity variation detected over time will become larger the higher the rate is of detected humidity values being zero or close to zero in relation to detected humidity values being non-zero. On the other hand, if the pillow is arranged such that its longside is in parallel to the z axis, it is more likely that the pillow is mainly present in the lower part of the drum, such that pillow is mainly present within the field of detection of the humidity sensing unit. Therefore, the humidity variation detected over time will be smaller than if the pillow is arranged such that its longside is transverse to the z axis. When the variation over time is determined to be above the variation threshold, the detected humidity value or the average humidity value that is calculated based on the plurality of humidity values is confirmed to be a not valid humidity value, i.e. the pillow-like item is not correctly positioned in the drum to determine a valid humidity value.

[0035] In one example, when the variation over time is determined to be above the variation threshold, the direction of rotation of the drum is changed prior to or during repeating step a) and step b), in order to increase the probability that the pillow will be rearranged, such that its longside takes a position in parallel to the central axis of the drum and thereby takes place in the lower part of the drum within the field of detection of the humidity sensing unit.

[0036] It may further be advantageous that the pillow-like item(s) is/are received in the drum before step a) is started, wherein step a) is the first step of a drying program to be carried out by the laundry treatment appliance after the pillow-like item(s) has/have been received in the drum.

[0037] Thus, in any case, even if the pillow-like item is a rectangular pillow that is put into the drum in an unfavourable way, it can be ensured that the pillow-like item is brought in a position suitable for humidity sensing by the humidity sensing unit at the beginning of the drying program. Thus, the drying program is very efficient in terms of its drying function, because correct humidity values are available from the very beginning and the overall duration of the drying program can be kept relatively short.

[0038] According to a further advantageous embodiment of the invention, step a), step b) and step c) are included in a drying program that can be carried out or that is carried out by the laundry treatment appliance in response to a user selecting the drying program.

[0039] Thus, it is possible to provide a specific drying program for a user, e.g. a drying program for drying stuffed textile articles that implements the steps a), b) and c) for aligning the pillow-like item within the drum with the humidity sensing unit.

[0040] In a further advantageous embodiment, the average drum speed during step a) is not allowed to exceed an average of 15 rpm, in particular of 10 rpm, and/or wherein the drum speed during step a) is not allowed to exceed a maximum of 20 rpm, in particular a maximum of 15 rpm, preferably a maximum of 10 rpm.

[0041] Those drum speeds have been found as the most efficient in order to bring the pillow-like item in the favourable position relative to the humidity sensing unit. It shall be noted that the efficiency of the drum speed is associated with the diameter of the drum for which it is selected. An average drum speed of not more than 20 rpm is most efficient in combination with a drum having a diameter of 57 cm.

[0042] Another advantageous embodiment comprises

that the first predetermined period of time is at least 10 seconds, in particular at least 20 seconds, preferably at least 30 seconds, more preferably from 1 minute to 10 minutes, and/or
wherein the second predetermined period of time is in a range from 0 to 240 minutes, in particular from 60 minutes to 180 minutes, preferably from 120 minutes to 180 minutes.

[0043] These durations have been found to be the best compromise between achieving a reliable function and a desired short overall duration of the drying program in which the steps a), b) and c) may be implemented.

[0044] Furthermore, it may be advantageous that the humidity sensing unit comprises at least one or more capacitive sensor(s), wherein a first electrode of at least one capacitive sensor is arranged close or adjacent to a lower region of the drum, and a second electrode of the at least one capacitive sensor is configured such that a field of detection of the capacitive sensor is arranged at least partially inside the drum, in particular such that the field of detection of the capacitive sensor is arranged in a lower region within the drum.

[0045] The second electrode may be a virtual electrode. A virtual electrode or plate is constituted by a reference electric potential which is routed by conductive tracks provided in the electrical system of the laundry treatment appliance.

[0046] A laundry treatment machine having a capacitive sensor of such a configuration can be advantageously operated in accordance with the claimed method. The intended movement of the pillow-like item is adapted to such a capacitive sensor.

[0047] Additionally or alternatively, the humidity sensing unit may have a conductimetric sensor for detecting the humidity of the pillow-like item.

[0048] The objective of the invention is further solved by a laundry treatment appliance, in particular a laundry drying appliance, that is configured to carry out method of claim 1 or of one of the dependent claims.

[0049] The invention will be described further in the following, also with reference to the drawings.

FIGs 1A and 1B illustrate a sectional view of a laundry treatment appliance, such as a laundry drying appliance, wherein a pillow-like item is received within a drum of the laundry treatment appliance in two different positions;

FIG 2A illustrates a front view of the laundry treatment appliance according to the pillow-like item's position shown in FIG 1A;

FIG 2B illustrates a front view of the laundry treatment appliance according to the pillow-like item's position shown in FIG 1B;

FIG 3A illustrates a schematic diagram of the method steps according to the invention;

FIG 3B illustrates a detailed schematic diagram of an exemplary operational sequence of step c) according to the invention;

FIG 4 illustrates a schematic diagram of an exemplary drying program according to the invention.

[0050] FIGs 1A and 1B illustrate a laundry treatment appliance 10 having a cabinet 30 in which a drum 12 is rotatably supported. The drum 12 has a substantially cylindrical shape and is rotatable about a central axis substantially parallel or identical with a z-coordinate shown in FIGs 1A and 1B which may correspond to the rotational axis. In the exemplary embodiment shown in FIGs 1A and 1B, the central axis of the drum 12 is identical to the z-coordinate and therefore further referred to as z-axis. The drum 12 has an open front end 20 for charging and discharging laundry into and from the inside of the drum 12 and a closed rear end 22 at the rear of the drum 12. The laundry treatment appliance 10 has further a door 26 for opening and closing the open front end 20 of the drum 12. The laundry treatment appliance 10 may be a laundry drying appliance. The laundry drying appliance may be a tumble dryer. Further, the laundry drying appliance may be a washer/dryer.

[0051] Drying air can be generated and conveyed into, through and out of the drum 12 by means of a drying air circuit comprising a fan 36 for creating air movement that leads to an air flow AF, a heating device 34 for heating up the moved air or the air flow AF, one or more conduits for guiding the air flow AF into, through and out of the drum 12 and a condenser or condensing device 28 arranged down-stream of the drum 12 for precipitating the humidity that was caught by the warm air of the air flow AF inside the drum 12 and that was transported out of the drum. The heating device 34 may comprise an electrical heating element or a heat pump for heating up the drying air and in particular the moved air of the generated air flow AF. The components may be arranged in a different order than illustrated in FIGs 1A and 1B. For example, as mentioned above, the laundry treatment appliance 10 may comprise a heat pump, wherein the heat pump comprises a first heat exchanger (for example a condenser), a second heat exchanger (for example an evaporator), a compressor and an expansion device arranged along a refrigerant closed circuit in which a refrigerant fluid flows. When the laundry treatment appliance 10 is in operation, the refrigerant fluid cools off and may condense in correspondence of the condenser, releasing heat, and warms up, in correspondence of the second heat exchanger (evaporator), absorbing heat. The compressor receives refrigerant in a gaseous state from the evaporator and supplies the condenser, thereby closing the refrigerant cycle.

[0052] Further, the laundry treatment appliance 10 comprises at least a drive unit (not shown) operatively coupled to the drum 12 to variably drive the drum 12 about an axis of rotation of the drum 12. In other words,

the drive unit is configured to rotate the drum 12 at a predetermined drum rotation speed. Further, the drive unit may be driving both the drum 12 and the fan 36. Alternatively, a separate drive unit is driving the fan 36. The drive unit or each of the drive unit may be a motor, such as an electric motor. Yet further, the laundry treatment appliance 10 may comprise a control unit 32. The control unit 32 may be configured to control operation of the drive unit. Further, the control unit 32 may be configured to control operation of the heating device 34, such as increase or reduce the output of the heating device 34. Yet further, the control unit 32 may be configured to process and determine a humidity value of the laundry in the drum 12. Data processing can be carried out directly by the humidity sensing unit or, alternatively, by the control unit 32 external to the humidity sensing unit, e.g. a higher level control unit of the laundry treatment appliance 10. In one example, at least some of the data processing is taking place remotely from the control unit 32 and is being sent to the control unit 32 by wire or wireless. Further, the functionality of the control unit 32 may be divided on different entities. The control unit 32 can be mechanically fixed to the laundry drying appliance 10, or it can be separate from the laundry treatment appliance 10 connected only via cable or wires or a data communication line to the laundry treatment appliance 10, or it can be a remotely arranged control unit connected to the laundry treatment appliance 10 via wireless data communication.

[0053] Further, the laundry treatment appliance 10 comprises a humidity sensing unit. The humidity sensing unit may comprise at least one capacitive sensor. The capacitive sensor comprises a first electrode 16 close to or adjacent to a lower front region of the drum 12. The first electrode 16 may be arranged below the front end 20 of the drum 12. The capacitive sensor may comprise a second electrode close or adjacent to a lower rear region of the drum 12.

[0054] In this configuration, the humidity sensing unit is substantially capable to detect a capacitance within a field of detection 24 as illustrated in the FIGs 1A, 1B. The field of detection 24 shall be understood in a way that the humidity sensing unit is adapted to detect a humidity value HV of laundry items or a piece of laundry or at least a sufficiently large part thereof present within this field. The humidity sensing unit is also influenced and thus detects a humidity value also of an item outside of the strictly delimited field of detection 24 as shown in FIGs 1A, 1B, but a proper and reliable humidity detection is ensured only for the area within the field of detection 24.

[0055] The capacitance detected or measured in the field of detection 24 by the humidity sensing unit varies depending on the degree or value of the humidity of the laundry being present within the field of detection 24.

[0056] Additionally or alternatively, the humidity sensing unit may comprise a conductimetric sensor for detecting the humidity of the laundry.

[0057] FIGs 2A and 2B illustrate two different options how to place a pillow 14 as an example of a pillow-like item 14 in the drum 12 of the laundry treatment appliance 10. The pillow 14 has a substantially rectangular form. The pillow may be stuffed such that it retains its shape at least to a certain degree even after being bent or compressed and regains its original form after that. The rectangular pillow 14 comprises a longside LS and a broadside BS. The longside LS is longer than the broadside BS. The longside LS is in this case as long or almost as long as the inner diameter of the drum 12. The longside LS of the pillow 14 may be at least 20% longer than the broadside BS. Alternatively, the longside LS of the pillow 14 may be at least 50% longer than the broadside BS. In FIGs 2A and 2B, the longside LS of the pillow 14 is about twice as long as the broadside BS of the pillow 14.

[0058] In the case shown in FIG 2B, the pillow 14 is received within the drum 12 with its longside LS parallel to the central axis z of the cylindrical drum 12 and with its broadside BS transverse to the central axis z. In this case, the length of the broadside BS is smaller than the diameter of the drum 12. Since the length of the broadside BS is smaller than the diameter of the drum 12, the pillow will rest at a lower position of the drum 12, within the field of detection 24 of the humidity sensing unit. During the slow rotation of the drum 12, i.e. the low drum speed, the pillow 14 will roll or tumble along the inner drum wall such the centre of rotation of the pillow 14 is kept below the central axis z of the cylindrical drum 12. Thus, during the low drum speed, the pillow 14 will remain in the lower portion of the drum 12, at least mainly within the field of detection 24 of the humidity sensing unit. In FIG 2B, the length of the broadside BS of the pillow 14 is less than 50% of the diameter of the drum 12. In some examples, the slow rotation of the drum 12 may be defined as an average drum speed of less than 20 rpm, preferably less than 15 rpm, in particular less than 10 rpm. Alternatively or in addition, the slow rotation of the drum 12 may be defined as not allowed to exceed a maximum of 20 rpm, in particular a maximum of 15 rpm, preferably a maximum of 10 rpm.

[0059] In the case shown in FIG 2A, the pillow 14 is placed, i.e. received, within the drum 12 with its longside LS transverse to the central axis z of the cylindrical drum 12 and in a substantially flat or horizontal position, i.e. mainly along the x axis. In this case, the longside LS of the pillow 14 extends across or almost across the whole inner diameter of the drum 12. Consequently, due to its size and pillow-like or form-retaining properties, the pillow 14 is clammed in the drum 12 in a position distant from a lower region of the drum 12, and thus distant or at least to substantial extent outside of the field of detection 24. Alternatively, the pillow 14 can be placed, i.e. received, transverse to the central axis z and upright, i.e. mainly along the y axis, which would as well result in a position distant from the lower region of the drum 12.

[0060] The position of the pillow 14 shown in FIG 2A corresponds to the pillow position shown in FIG 1A. As can be seen in FIG 2A, the pillow 14 is arranged such

that the longside LS of the pillow 14 is extending in a direction transverse to the central axis z. Thus, the longside LS of the pillow 14 extends across or almost across the whole inner diameter of the drum 12. When the pillow 14 is arranged such that the longside LS of the pillow 14 is extending transverse to the central axis z, across or almost across the whole inner diameter of the drum 12, there is not enough space for the pillow 14 to take a position at a lower part of the drum, i.e. within the field of detection 24, since the pillow 14 is restricted by the respective sides of the inner wall of the drum 12. The pillow 14 is restricted by the respective sides of the inner wall of the drum 12 when the longside LS of the pillow 14 is at least longer than 70% of the inner diameter of the drum 12, and even more restricted when the longside LS of the pillow 14 is longer than 90% of the inner diameter of the drum 12.

[0061] It can be easily seen and understood that the pillow's position is distant from the field of detection 24 of the humidity sensing unit.

[0062] During rotation of the drum 12, since the pillow 14 is restricted by the respective sides of the inner wall of the drum, the pillow 14 cannot roll or tumble along the inner drum wall such the centre of rotation of the pillow 14 is within the field of detection 24. Instead, the centre of rotation of the pillow 14 will be closer to the central axis z during drum rotations. Thus, the pillow 14 may sometimes pass through the field of detection 24 for a short period of time, resulting in a large variation of humidity values determined over time, wherein many humidity values will be zero or close to zero, when the pillow is not in the field of detection 24.

[0063] Accordingly, detection or measurement of the humidity of the pillow by the humidity sensing unit may fail or result in incorrect values, since the pillow 14 is not in an optimal position relative to the humidity sensing unit.

[0064] FIG 3A illustrates schematically the method steps a), b) and c) according to the invention. In principle, the method steps a), b) and c) can be implemented in drying program executable by the control unit of the laundry treatment appliance 10. In step a), the drum 12 of the laundry treatment appliance 10 is rotated at a low speed. The low speed may be defined as an average drum speed VADS of not more than 20 rpm over a first predetermined period of time t_1. During the first predetermined period of time t_1, the drum speed is not constantly accelerating. Instead, the drum speed may be kept at a low drum speed, i.e. preferably below 20 rpm, also by the end of the first predetermined period of time t_1. However, in some examples, the low speed may be defined as that the average drum speed VADS during step a) is not allowed to exceed an average of 15 rpm, in particular not allowed to exceed an average of 10 rpm. Further, in some examples, the drum speed during step a) is not allowed to exceed a maximum of 20 rpm, in particular not allowed to exceed a maximum of 15 rpm, preferably not allowed to exceed a maximum of 10 rpm. In step b), a humidity value HV related to the pillow-like item 14 received in the drum 12 is detected. The humidity value HV may be determined during the first predetermined period of time t_1. In step c), one or more drying steps for drying the pillow-like item 14 based on the detected humidity value HV is or are determined. At least one of the one or more drying steps may be determined during the first predetermined period of time t_1. Alternatively, the one or more drying steps may be determined after the first predetermined period of time t_1. The steps a), b) and c) can be controlled by the control unit 32 of the laundry treatment appliance 10. Further, the laundry treatment appliance 10 can be caused by the control unit 32 to carry out the steps a), b) and c) accordingly.

[0065] FIG 3B illustrates an operational sequence for step c) according to an exemplary embodiment of the invention. Accordingly, after the execution of step b) in which the humidity value HV related to the pillow-like item 14 received in the drum 12 is detected, the one or more drying steps for drying the pillow-like item 14 can be determined based on the detected humidity value HV. For this purpose, after the humidity value HV is detected according to step b), it may be assessed , e.g. by the control unit 32, if the humidity value HV is a valid humidity value or a not valid humidity value.

[0066] In general, a valid humidity value can be understood as a humidity value which is a value or which lies within a range of values accepted as potentially plausible humidity values or as a potentially plausible range of values for the humidity within the pillow-like item 14. A not valid humidity value shall be understood as a value to that is not accepted as a potentially plausible humidity value or as not lying in a range of potentially plausible humidity values and therefore has to be considered as not reflecting the correct humidity value of the pillow-like item 14.

[0067] The assessment whether the humidity value HV is a valid or not valid humidity value can be done e.g. by evaluating a variation over time VOT of the plurality of single humidity values detected or measured for calculating the humidity value HV. If the variation over time VOT for the plurality of single humidity values exceeds a variation threshold VTH, the assessment whether the humidity value HV is not valid is answered "YES", otherwise "NO". If the assessment results in that the humidity value is a valid humidity value, the humidity value HV is compared with the humidity threshold HTH. As long as the humidity value HV is above the humidity threshold HTH, a prolonged drying step is carried out. During the prolonged drying step, the drum 12 may be rotated at a drying drum speed. The drying drum speed is higher than 20 rpm. As an example, the drying drum speed may be a constant speed in the range of 40 rpm and 70 rpm. During the prolonged drying step, the humidity value HV is detected and/or determined and compared with the humidity threshold HTH repeatedly. Simultaneously, it can be assessed whether a maximum humidity detection time $t_{max}HD$ has been reached. The prolonged drying step can be prolonged either for as long as the humidity

value HV is above the humidity threshold HTH or until the maximum humidity detection time $t_{max}HD$ is exceeded or whichever of these two conditions is met first. Subsequently, a fixed drying step can be added for a second predetermined period of time t_2.

[0068] Alternatively or additionally, the assessment whether the humidity value HV is a valid or not valid humidity value can be done e.g. by evaluating whether one or more of the single humidity values of the plurality of single humidity values equals zero. As an exemplary threshold, it may be defined that if the ratio of single humidity values of the plurality of single humidity values that equals zero or close to zero is higher than a predetermined ratio, then the assessment whether the humidity value HV is not valid is answered "YES".

[0069] It is possible that the assessment is whether the humidity value HV is not valid is answered "YES" either when one of the before described conditions are met or only when both of the before described conditions are met.

[0070] One or both of these two assessments can be used to determine whether the step a) has had the desired result to arrange the pillow-like item 14 in a position within the drum 12 which allows proper detection of the humidity of the pillow-like item 14 and achieving correct results for the humidity value HV.

[0071] If the assessment results in that the humidity value is not valid, it can be further assessed, whether number of times the humidity value has been determined to be not valid exceeds a predefined threshold for a predefined number of times, X times. If the number of times the humidity value has been determined to be not valid exceeds the threshold for the predefined number of times, X times, the assessment is answered "YES", otherwise "NO". Alternatively, instead of a predefined threshold for a predefined number of times, the threshold may be a time-based threshold, for example based on time passed since the drying program started. This assessment is introduced to make sure that the total time of the drying program does not exceed a certain time limit, even when no valid humidity value can be determined.

[0072] If one or both of the before described assessments come to a result from which it can be concluded that the humidity value detected in step b) is a not valid humidity value, a drum inversion may be carried out, i.e. a change in the direction of rotation of the drum, before rotating the drum speed at low speed as in step a), and subsequently with repeating step b) and subsequent step c). Alternatively, the drum continues to rotate at low speed in the same direction as previously, i.e. as in step a) before repeating step b) and c).

[0073] However, if it is concluded that the humidity value for a number of times has been determined to be a not valid humidity value or if the time-based threshold has been passed, then the assessment whether the humidity value HV is a valid or not valid humidity value may be stopped and the drying program may be continued with an additional drying step for a predetermined third period of time t_3 in addition to the fixed drying step for a predetermined second period of time t_2.

[0074] Therefore, according to the exemplary embodiment illustrated in by the diagram of FIG 4, the drum 12 is rotated slowly at an average drum speed VADS of not more than 20 rpm over a first predetermined period of time t_1. During the first predetermined period of time t_1, the heating device 34 may be turned on or may be turned off. According to FIG 4, the first predetermined period may be t_1 = 2 minutes overall. However, the first predetermined period of time t_1 may be in a range from 20 seconds to 15 minutes, in particular from 30 seconds to 10 minutes, preferably from 1 minute to 5 minutes.

[0075] The relatively low drum speed, i.e. slow rotation of the drum 12, is selected to cause the gravitational force impacting the pillow 14 to be high compared to the centrifugal force impacting the pillow 14. This may lead to a high mechanical impact on the pillow 14 during slow rotation of the drum 12, i.e. during the low drum speed. That is, during slow rotation of the drum 12, the pillow 14 may make a large drop within the drum, i.e. falling from the upper part of the drum 12 to the lower part of the drum 12. During the low drum speed it is mainly the gravitational force impacting the pillow 14, which increase the probability that the pillow 14 changes extension direction in the drum compared to when the drum rotation speed is higher. By rotating the drum 12 at the low drum speed, there is a high probability that the pillow 14 at an earlier point in time is rearranged to an extension direction wherein the longside LS of the pillow 14 is parallel to the central axis z of the drum 12. Thus, the low drum speed, during which mainly the gravitational force influences the pillow-like item 14, may cause rearrangement of the pillow-like item 14 to tumble within the drum in the lower region. A pillow 14 of the size and shape as shown in the exemplary embodiment tends to take a position as shown in FIGs 1B and 2B, i.e. with its longside LS parallel to the central axis z of the drum 12 and with its broadside BS transverse to the central axis z, if moved by such a slow drum rotation.

[0076] Consequently, the pillow 14 can take a position in a lower region of the drum 12 such that it rolls or tumbles along the drum wall during low rotational speed such that at least a substantial part of the pillow 14 is within the field of detection 24 of the humidity sensing unit as shown in FIG 2B.

[0077] The detection or determination of a humidity value HV related to the pillow-like item 14 received in the drum 12 may take place during any time during the first predetermined period of time t_1. In one example, the humidity value corresponds to a humidity value detected by the humidity sensing unit at the end of the first predetermined period of time t_1. However, the humidity value may also be determined based on a plurality of detected humidity values during the first predetermined period of time t_1. In such a case, the determined humidity value may correspond to an average or a median of the detect-

ed humidity values.

[0078] The diagram of FIG 4 illustrates an exemplary program sequence that implements the steps a), b) and c) which ensure that the pillow 14 is positioned or at least moved in the sense of a rotation about its longitudinal axis in the drum 12 at least at a lower rotational speed of the drum 12, in an optimized way such that the humidity sensing unit can detect the humidity of the pillow 14 in a valid and correct manner.

[0079] Step a) may comprise a step a1) of a first fraction, of for example 1 minute, of an overall duration of the first predetermined period of time t_1, of for example 2 minutes, during which the drum 12 rotates at $V_{ADS} \leq$ 20 rpm in which the humidity sensing unit does not detect a humidity value, e.g. in that the humidity sensing unit is switched off or humidity sensing signal values, detected during the first fraction of the first predetermined period of time t_1, are not taken into account during processing of the humidity value. The humidity sensing unit may comprise a capacitive sensor.

[0080] Further, Step a) comprise a step a2) a second fraction of 1 minute of the overall duration t_1 of Step a) and the same rotational speed of VADS $\leq$ 20 rpm.

[0081] However, the first fraction may be in the range of 35% to 65% of the first predetermined period of time, in particular in the range of 40% to 60% of the first predetermined period of time, preferably 50% of the first predetermined period of time. The second fraction may be in the range of 35% to 65% of the first predetermined period of time, in particular in the range of 40% to 60% of the first predetermined period of time, preferably 50% of the first predetermined period of time.

[0082] During step a1), the humidity sensing unit does not detect a humidity value. During step a2), the humidity sensing unit detects a humidity value. By not detecting the humidity value during the initial step a1), it is ensured that a detection result that would be achieved during step a1) in which the pillow-like item 14 still may be in an unfavourable position for humidity detection, does not influence the overall detection result determined in step b) and does not falsify the determined humidity value.

[0083] Since there is no information available about whether the pillow 14 is arranged in a position according to FIGs 1A, 2A or in a position according to FIG 1B, 2B, during the step a), the pillow 14 is brought into the position shown in FIG 1B, 2B without affecting the correctness of the result of the detection or determination of the humidity value in step b).

[0084] The detection of the humidity value according to step b) is started at the end of step a1) and at the start of step a2) which takes place at least partially concurrently to step b). At the end of step a1), it can be assumed that the pillow 14 is in or at least moves towards the optimized position for detection of the humidity value by the humidity sensing unit in which the pillow 14 has been brought in step a1). In any way, the quality of the humidity value detected during step a2) is greater compared to a humidity value HV that would be detected during step a1) and a2).

[0085] During or after step b), the humidity signal value or humidity signal values over time is processed or calculated to output a humidity value HV. Processing or calculating can be carried out directly by the humidity sensing unit or, alternatively, by a control unit 32 external to the humidity sensing unit.

[0086] The resulting humidity value HV is compared to a humidity threshold HTH. The humidity threshold HTH may define a threshold for humidity within the piece of laundry or textile item 14 above which it is considered to have or be at a high level of humidity and below which it is considered to have or to be at a low level of humidity.

[0087] As part of step c), if the detected humidity value HV is determined to be below the humidity threshold HTH, a fixed drying step can be carried out with a fixed second predetermined period of time t_2 and preferably at a drying drum speed, which is higher than during the first predetermined period of time t_1, more preferably above 40 rpm (V_{ADS} > 40 rpm). Further, preferably the drying drum speed is below 70 rpm (V_{ADS} < 70 rpm) or in average below the speed where laundry is fully attached to the drum wall, i.e. below satellization speed. Just as an example, the average drying drum speed may be V_{ADS} of 58 rpm. No further detection or consideration of the humidity value HV is necessary in such a drying step. During the drying step, the heating device 34 is preferably turned on in order to dry the pillow-like item 14.

[0088] Further as part of step c), if the detected humidity value HV is determined to be above the humidity threshold HTH, a prolonged drying step can be carried out by operating the laundry treatment appliance 10, when the detection and determination of the humidity value HV is continued until the humidity value HV arrives below the humidity threshold HTH or, alternatively, as soon as a predetermined maximum humidity detection time t_{max}HD is reached.

[0089] Preferably, the prolonged drying step is carried out by operating the laundry treatment appliance 10 at a drying drum speed which is higher than during the first predetermined period of time t_1, more preferably above 40 rpm (V_{ADS} > 40 rpm). Further, preferably the drying drum speed is below 70 rpm (V_{ADS} < 70 rpm) or in average below the speed where laundry is fully attached to the drum wall, i.e. below satellization speed. Just as an example, the average drying drum speed may be at V_{ADS} = 58 rpm. The predetermined maximum humidity detection time may be in a range from 1 to 240 minutes, in particular from 15 minutes to 180 minutes, preferably from 30 to 120 minutes. Just as an example, the predetermined maximum humidity detection time may be 90 minutes. During the prolonged drying step, the heating device 34 is preferably turned on in order to dry the pillow-like item 14.

[0090] Thereafter, the fixed drying step may be added for an additional second predetermined period of time t_2. During the drying step(s), the heating device 34 is turned on in order to dry the pillow-like item 14.

[0091] It is possible even after the step a), that the pillow 14 may still be in a position in which it is not sufficiently aligned with the field of detection 24 of the humidity sensing unit. In such a case, the humidity values or humidity measurements detected by the humidity sensing unit result in the determination of a not valid humidity value, based on that the variation over time VOT of the humidity values or humidity measurements is determined to be above a variation threshold VTH. The variation of humidity values over time will be larger if the pillow 14 is arranged with its longside LS in a direction transverse to the central axis z, such that the pillow 14 is only sometimes in the field of detection 24, than if the pillow 14 is arranged with its longside LS in a direction in parallel to the central axis z, such that the pillow 14 is remaining in the field of detection 24, at least during most of the time. When the variation over time VOT is determined to be above the variation threshold VTH, the detected humidity value or the average humidity value that is calculated based on the plurality of single humidity values is confirmed to be a not valid humidity value.

[0092] In this case steps a1), a2) and b) can be repeated until a valid humidity value HV is detected and a comparison with the humidity threshold HTH leads to a result that can be processed by the laundry treatment appliance 10 validly.

[0093] Alternatively, in particular if even the repetition of steps a1), a2) and b) does not output any valid humidity value, a prolonged drying step can be carried out for the duration of the second predetermined period of time t_2 and during an additional drying step of an additional third predetermined period of time t_3 in order to ensure proper drying of the pillow-like item 14 even when no valid humidity value can be detected and/or determined. The third predetermined period of time is in a range from 0 to 120 minutes, in particular from 30 minutes to 90 minutes, preferably 60 minutes.

[0094] In both cases, the laundry treatment appliance 10 may terminate the drying sequence with a cooling step.

Reference numerals

[0095]

10	Laundry treatment appliance
12	Drum
14	Pillow-like item/ Pillow
16	First electrode
20	Front end of drum
22	Rear end of drum
24	Field of detection
26	Door
28	Condensing device
30	Cabinet
32	Control unit
34	Heating device
36	Fan
LS	Longside
BS	Broadside
x,y,z	spatial coordinates
V_{ADS}	Average drum speed
HV	Humidity value
HTH	Humidity threshold
VOT	Variation over time
VTH	Variation threshold
AF	Air flow
$t_{max}HD$	maximum humidity detection time

Claims

1. Method for drying a pillow-like item (14) in a laundry treatment appliance (10), in particular a laundry drying appliance, wherein the laundry treatment appliance (10) comprises:

   a rotatable drum (12) arranged to receive a pillow-like item (14);
   a drive unit operatively coupled to the drum (12) to variably drive the drum (12) about an axis of rotation of the drum (12);
   a humidity sensing unit configured to detect a humidity value (HV) of the pillow-like item (14) received in the drum (12);
   a control unit (32) for controlling operation of the laundry treatment appliance (10);

   wherein the method comprises the following steps:

   a) rotating the drum (12) at an average drum speed (V_{ADS}) of not more than 20 rpm over a first predetermined period of time (ti);
   b) detecting a humidity value (HV) related to the pillow-like item (14) received in the drum (12); and
   c) determining one or more drying steps for drying the pillow-like item (14) based on the detected humidity value (HV).

2. Method according to claim 1, wherein the humidity value (HV) detected according to step b) is determined based on a plurality of single humidity values (HV) detected by the humidity sensing unit, in particular wherein determining the one or more drying steps is based on the humidity value (HV) being determined based on the plurality of single humidity values (HV) detected by the humidity sensing unit, in particular wherein the plurality of single humidity values (HV) is detected continuously or at a plurality of discrete points in time over a period of time by the humidity sensing unit.

3. Method according to any one of the preceding

claims, wherein rotating the drum (12) at an average drum speed (V_{ADS}) of not more than 20 rpm over a first predetermined period of time (ti) causes a pillow-like item (14) received in the drum (12) to move into a position in the lower region of the drum (12) and/or into an orientation relative to a central axis (z) of the drum (12) such that the pillow-like item (14) is present in or repeatedly moves through a field of detection (24) of the humidity sensing unit.

4. Method according to any one of the preceding claims, wherein the first predetermined period of time (ti) comprises a first fraction and a second fraction and step b) of detecting of the humidity value (HV) related to the pillow-like item (14) received in the drum (12) is carried out for at least the second fraction of the first predetermined period of time (ti).

5. Method according to claim 4, wherein step a) comprises a first step a1) for the first fraction of the first predetermined period of time (ti) and during which the humidity sensing unit does not detect the humidity value (HV) and wherein step a) comprises a second step a2) for the second fraction of the first predetermined period of time (ti) and during which the humidity sensing unit detects the humidity value (HV).

6. Method according to any one of the preceding claims, wherein the direction of rotation of the drum (12) is changed at least once or twice or a plurality of times during step a) in which the drum (12) is rotated at an average drum speed (V_{ADS}) of not more than 20 rpm over a first predetermined period of time (ti).

7. Method according to claim 4 or claim 5 and claim 6, wherein the direction of rotation of the drum (12) is changed during the first fraction of the first predetermined period of time (ti), but not during the second fraction of the first predetermined period of time (ti), or

wherein the direction of rotation of the drum (12) is changed during the second fraction of the first predetermined period of time (ti), but not during the first fraction of the first predetermined period of time (ti),
or
wherein the direction of rotation of the drum (12) is changed during the first fraction and during the second fraction of the first predetermined period of time (ti).

8. Method according to any one of the preceding claims, wherein:
the step of determining one or more drying steps for drying the pillow-like item (14) based on the humidity value (HV) comprises determining whether the humidity value (HV) is below a predetermined humidity threshold (HTH):

(i) when the humidity value (HV) is determined to be below the predetermined humidity threshold (HTH), one or more drying steps for drying the pillow-like item(s) (14) is/are carried out at least for a second predetermined period of time (t_2) independent of any further detection of the humidity value (HV) related to the pillow-like item (14);
and/or
(ii) when the humidity value (HV) is determined to be above the predetermined humidity threshold (HTH), one or more drying steps for drying the pillow-like item(s) (14) is/are carried out, wherein the detection and/or determination of the humidity value (HV) is continued until the humidity value (HV) is determined to be below the predetermined humidity threshold (HTH), or a maximum humidity detection time ($t_{max}HD$) is reached, and wherein the one or more drying steps is/are continued at least for a second predetermined period of time (t_2) once the humidity value (HV) is determined to be below the predetermined humidity threshold (HTH), or the maximum humidity detection time ($t_{max}HD$) is reached, independent of any further detection of the humidity value (HV) related to the pillow-like item (14).

9. Method according to any of claims 2 to 7 and claim 8, wherein the humidity value (HV) is determined by calculating an average of the plurality of single humidity values (HV).

10. Method according to any of claim 2 to claim 7 and any of claim 8 and claim 9, wherein a variation over time (VOT) is calculated based on the plurality of single humidity values (HV), wherein the variation over time (VOT) is determined to be below or above a variation threshold (VTH), wherein

(j) when the variation over time (VOT) is determined to be below the variation threshold (VTH), the humidity value (HV) is confirmed to be a valid humidity value and the step of determining one or more drying steps continues with determining whether the humidity value (HV) is below a predetermined humidity threshold (HTH), and/or
(jj) when the variation over time (VOT) is determined to be above the variation threshold (VTH), the humidity value (HV) is confirmed to be a not valid humidity value and step a) and step b) are repeated.

11. Method according to claim 10, wherein (jj), when the

variation over time (VOT) is determined to be above the variation threshold (VTH), the direction of rotation of the drum (12) is changed prior to or during repeating step a) and step b).

12. Method according to any one of the preceding claims, wherein the average drum speed (V_{ADS}) during step a) is not allowed to exceed an average of 15 rpm, in particular of 10 rpm,
and/or
wherein the drum speed during step a) is not allowed to exceed a maximum of 20 rpm, in particular a maximum of 15 rpm, preferably a maximum of 10 rpm.

13. Method according to any one of the preceding claims, wherein the first predetermined period of time (ti) is at least 10 seconds, in particular at least 20 seconds, preferably at least 30 seconds, more preferably from 1 minute to 10 minutes,
and/or
wherein the second predetermined period of time (t_2) is in a range from 0 to 240 minutes, in particular from 60 minutes to 180 minutes, preferably from 120 minutes to 180 minutes.

14. Method according to any one of the preceding claims, wherein the humidity sensing unit comprises at least one or more capacitive sensor(s), wherein a first electrode (16) of at least one capacitive sensor is arranged close or adjacent to a lower region of the drum (12), and a second electrode of the at least one capacitive sensor is configured such that a field of detection (24) of the capacitive sensor is arranged at least partially inside the drum (12), in particular such that the field of detection of the capacitive sensor is arranged in a lower region within the drum (12).

15. Laundry treatment appliance (10), in particular laundry drying appliance, configured to carry out a method according to any one of the preceding claims.

FIG 1A

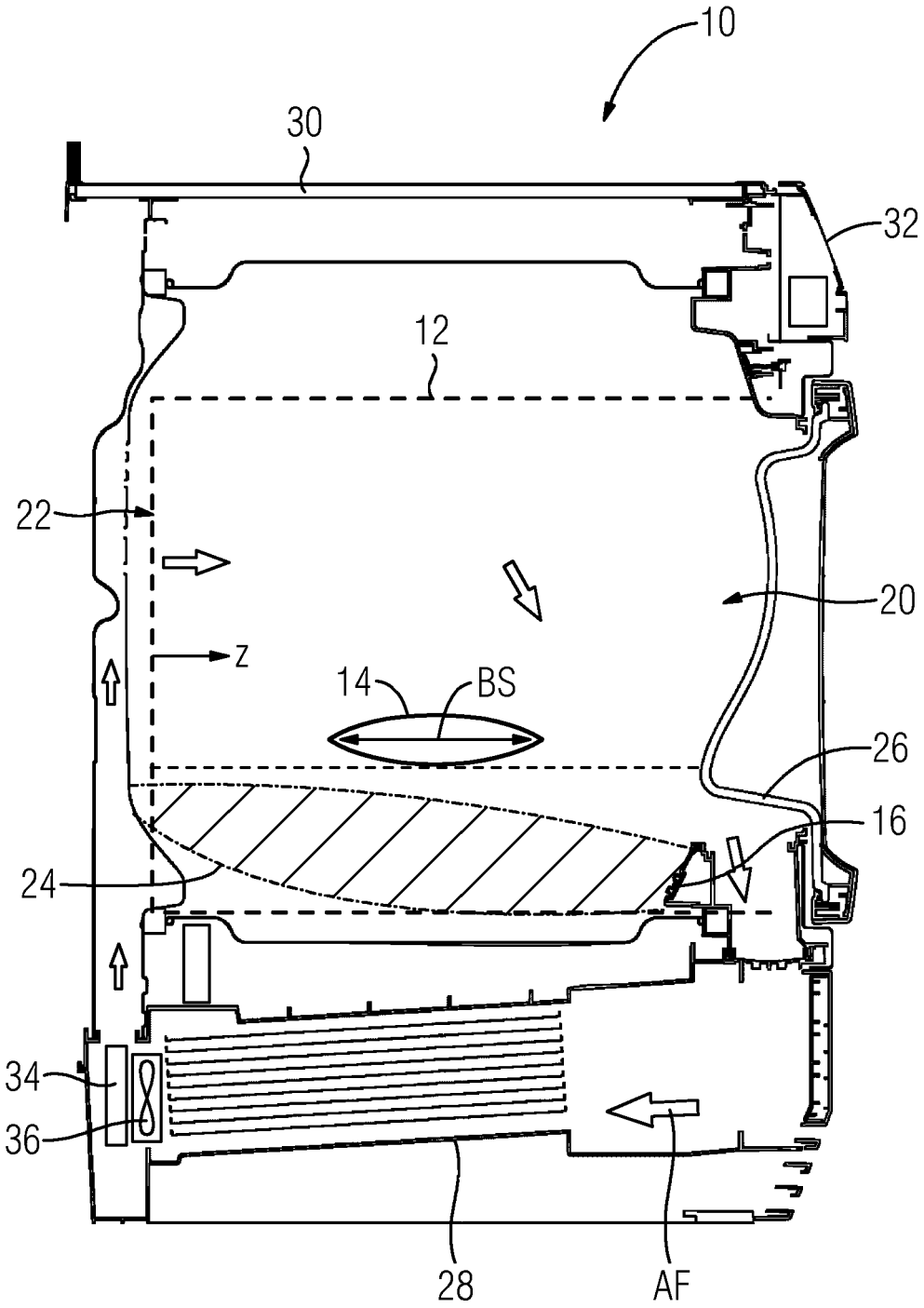


FIG 1B

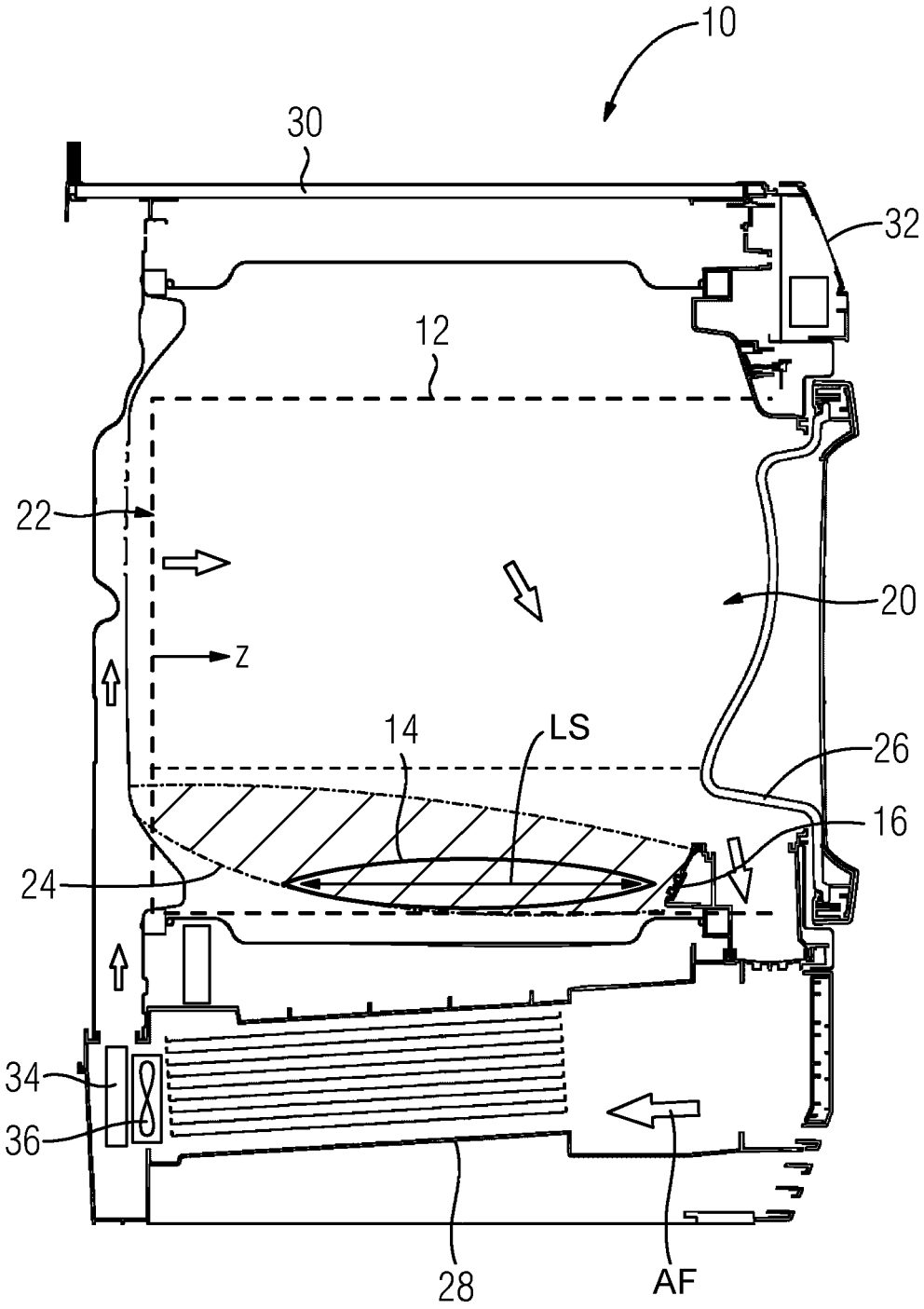


FIG 2A

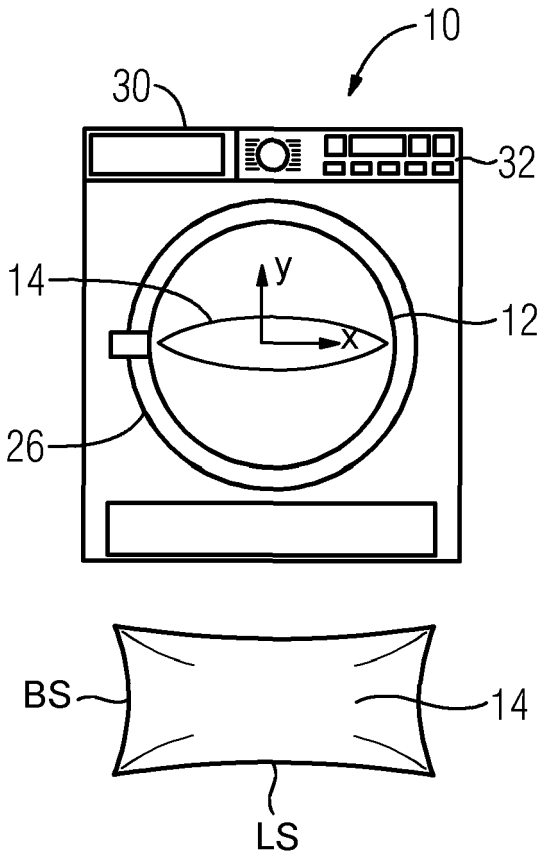


FIG 2B

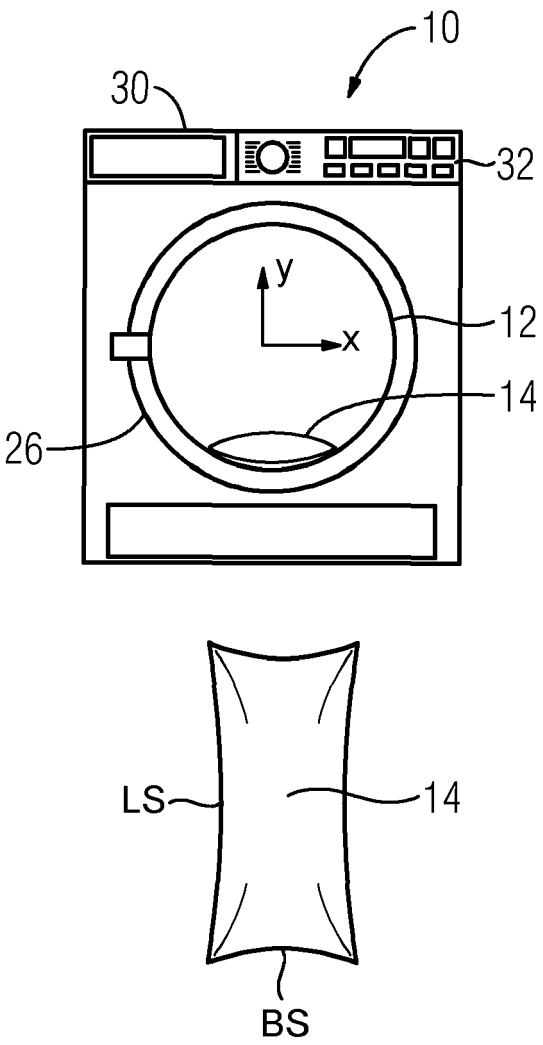


FIG 3A

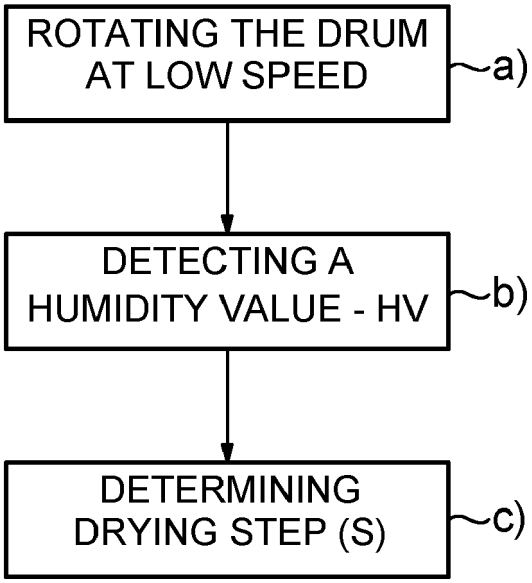

ROTATING THE DRUM AT LOW SPEED
a)
DETECTING A HUMIDITY VALUE - HV
b)
DETERMINING DRYING STEP (S)
c)

FIG 3B

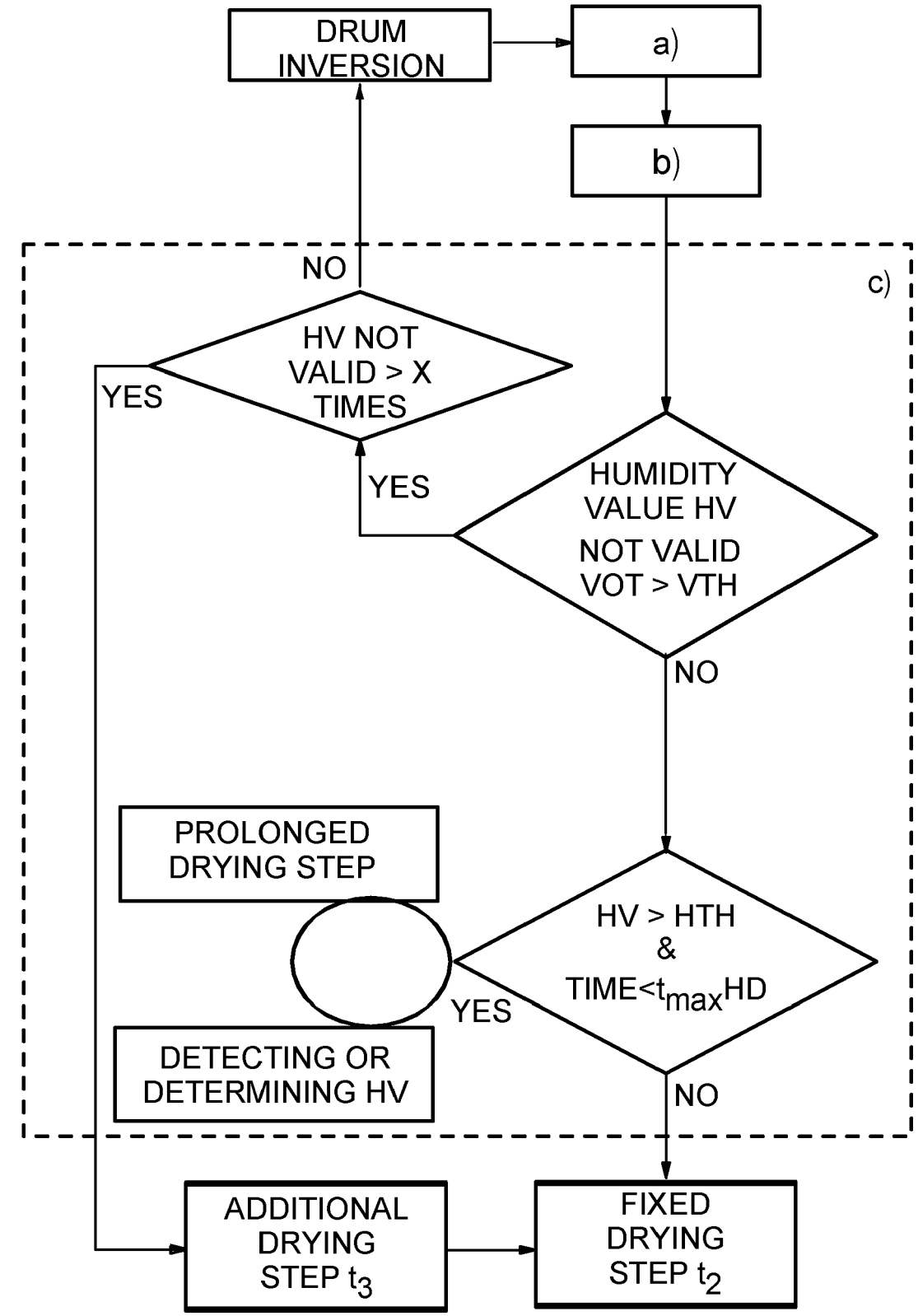
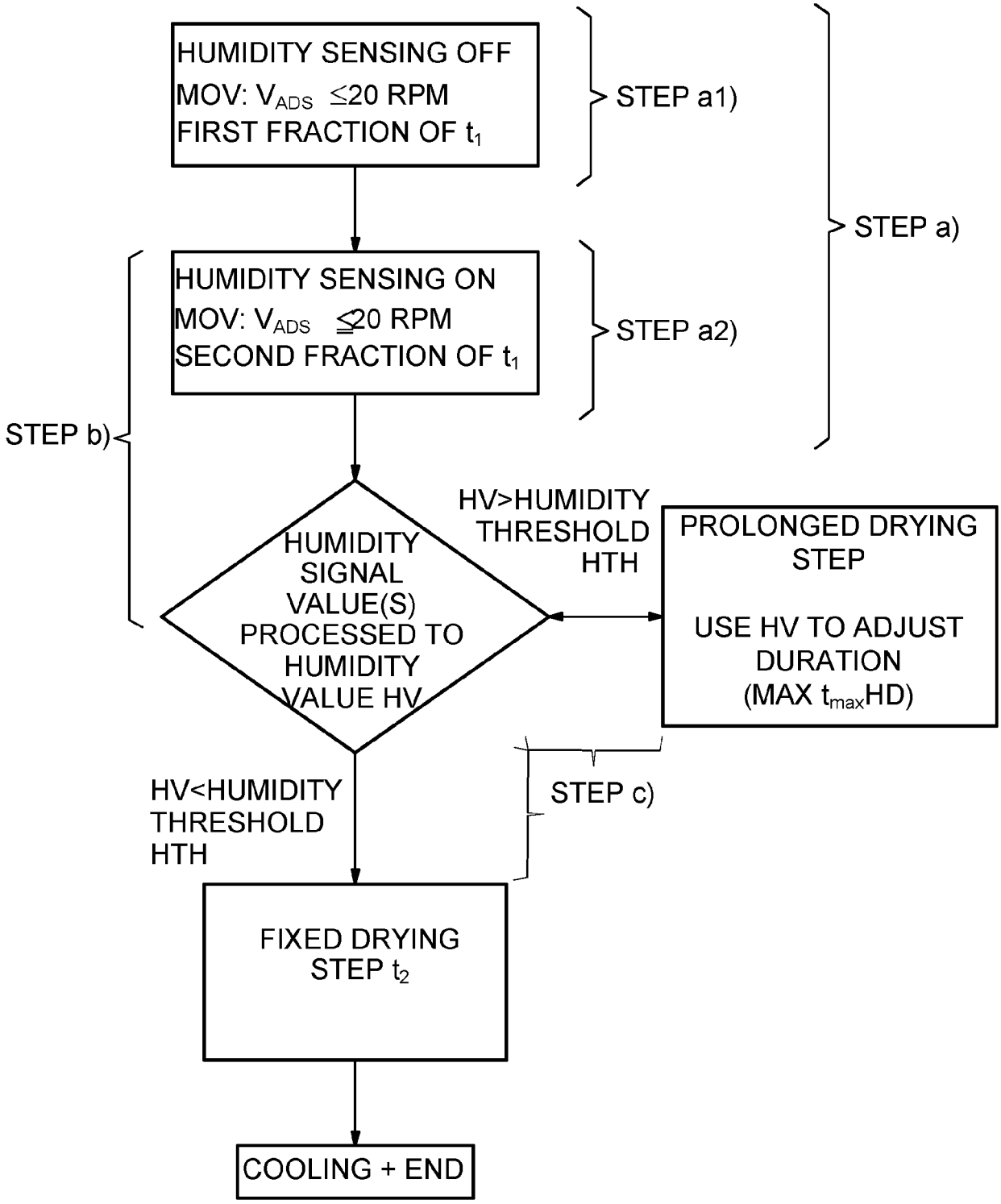

DRUM INVERSION
a)
b)
c)
NO
HV NOT VALID > X TIMES
YES
YES
HUMIDITY VALUE HV NOT VALID VOT > VTH
NO
PROLONGED DRYING STEP
HV > HTH & TIME<tmaxHD
YES
DETECTING OR DETERMINING HV
NO
ADDITIONAL DRYING STEP t3
FIXED DRYING STEP t2

FIG 4


HUMIDITY SENSING OFF
MOV: V_{ADS} ≤20 RPM
FIRST FRACTION OF t_1
STEP a1)
HUMIDITY SENSING ON
MOV: V_{ADS} ≦20 RPM
SECOND FRACTION OF t_1
STEP a2)
STEP a)
STEP b)
HUMIDITY SIGNAL VALUE(S) PROCESSED TO HUMIDITY VALUE HV
HV>HUMIDITY THRESHOLD HTH
PROLONGED DRYING STEP
USE HV TO ADJUST DURATION
(MAX t_{max}HD)
STEP c)
HV<HUMIDITY THRESHOLD HTH
FIXED DRYING STEP t_2
COOLING + END

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EUROPEAN SEARCH REPORT

Application Number
EP 22 18 9380

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D06F

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	7 February 2023	Diaz y Diaz-Caneja

CATEGORY OF CITED DOCUMENTS

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