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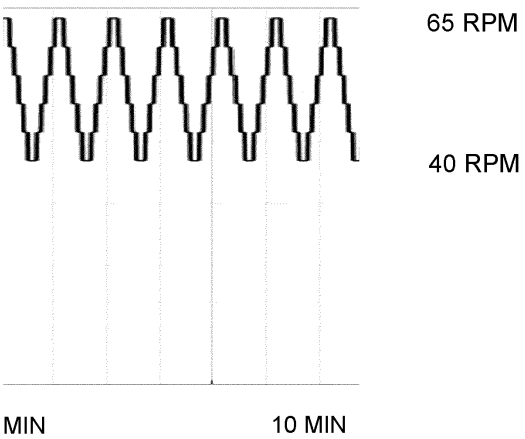
(54) **METHOD FOR REMOVING FOREIGN OBJECTS FROM LAUNDRY IN A LAUNDRY DRYING APPLIANCE AND LAUNDRY DRYING APPLIANCE**

(57) Laundry drying appliance (1), being operable in a foreign objects removal mode which comprises:
step 1: decreasing the speed of the drive unit (26) from a high-speed state, in which the drive unit (26) is operated to rotate the drum (12) at a first rotational drum speed and to drive the conveying element (18) to output a first flow rate of drying air, to a low-speed state, in which the drive unit (26) is operated to rotate the drum (12) at a second rotational drum speed and to drive the conveying element (18) to output a second flow rate of drying air, wherein the first rotational drum speed is higher than the second rotational drum speed and the first flow rate of drying air is higher than the second flow rate of drying air, and
step 2: increasing the speed of the drive unit (26) from the low-speed state to the high-speed state.

FIG 2A



EP 4 321 677 A1

Description

[0001] The present invention relates to a method for removing foreign objects from laundry in a laundry drying appliance and to a laundry drying appliance.

[0002] Laundry drying appliance, such as tumble dryers or washer/dryers are commonly used to dry wet laundry. In the case of washer/dryers, the laundry can be washed and dried in the same appliance.

[0003] EP 2 990 524 A1 discloses a laundry dryer including: a drum for receiving a load to be dried, said drum being apt to rotate around a rotational axis, a process air conduit in fluid communication with the drum where a process air stream is apt to flow, a heat pump system for heating up the process air, the drum is rotated by means of a motor, wherein the motor may define a motor axis, which may be the axis of a shaft of the motor. Furthermore, the motor may also drive a main fan of the air process circuit which blows the process air into the drum.

[0004] EP 2 663 685 B1 discloses a method for operating a clothes treating apparatus comprising a hot air supplying unit (provided with a heater and a blowing device, and having a drying function of drying clothes by supplying hot air into a drum by use of the hot air supplying unit, the method comprising: rotating the drum with the clothes introduced therein; and supplying hot air into the drum by using the heater and the blowing device while the drum is rotated, wherein an air flow rate supplied by the blowing device changes during the hot air supplying step, wherein the hot air supplying step comprises: a first drying step of increasing an inner temperature of the drum; a second drying step of constantly maintaining the inner temperature of the drum after the first drying step; and a third drying step of re-increasing the inner temperature of the drum after the second drying step, wherein the air flow rate changes during the second drying step. It is further known from this document to provide an air flow rate changing step that comprises increasing the air flow rate up to a second air flow rate; maintaining the second air flow rate for a preset time, and decreasing the air flow rate down to a first air flow rate, wherein the second air flow rate is higher than the first air flow rate. At the same time, the rotating speed of the drum may be reduced when the second air flow rate is supplied, and the rotating speed of the drum is recovered to the original state when the first air flow rate is supplied. Briefly summarized, it is disclosed to operate a clothes treating apparatus at a first lower air flow rate with a high rotating speed of the drum and at a second higher air flow rate with a low rotating speed of the drum. The technical objects solved by the teaching of this document are set out as providing a clothes treatment apparatus capable of reducing a drying time and minimizing damages on the clothes by allowing uniform drying of the clothes introduced. Further, the generation of wrinkles shall be minimized.

[0005] DE 10 2013 008 483 A1 discloses a hair and lint scraper with a rubber surface and weighting as an addition to a tumble dryer, especially for removing animal hair from fabric surfaces. The scraper is placed in a tumble dryer together with pieces of fabric and/or laundry to be freed from particles. The necessary scraping movement is created by the inertia and centrifugal force of the scraper during rotation of the tumble dryer drum. The object removal effect is achieved on all known animal hairs, such as those most commonly found on dogs, cats, rodents and hoofed animals and also human hair. The object removal process should be carried out before a washing process.

[0006] It is an object of the present invention to improve the removal of foreign objects from laundry or fabric. The foreign objects may be strands of hair, such as animal hair or human hair or fibrous objects, such as lint that has come off from the laundry. In general, foreign objects shall be understood as objects that are able to float in moved air due to their low weight and that are redistributed by even slight movements of the air in which they are present.

[0007] The object of the present invention is achieved by embodiments according to the invention, in particular by a method for removing foreign objects from laundry in a laundry drying appliance according to claim 1 and by a method for removing foreign objects from laundry in a laundry drying appliance according to claim 10.

[0008] A laundry drying appliance according to the invention comprises:

- a rotatable drum arranged to receive laundry;
- a drying air conveying element configured to convey drying air into the drum;
- a drive unit operatively coupled to the drum and to the conveying element and configured to variably drive the drum about an axis of rotation of the drum and the conveying element so that an increase in a speed of the drive unit results in an increase of a rotational drum speed and in an increase of a flow rate of drying air conveyed by the conveying element and so that a decrease in a speed of the drive unit results in an decrease of the rotational drum speed and in a decrease of the flow rate of drying air conveyed by the conveying element;
- a control unit configured to control operation of the drive unit according to a foreign objects removal mode which comprises,

    - step 1: decreasing the speed of the drive unit from a high-speed state, in which the drive unit is operated to rotate the drum at a first rotational drum speed and to drive the conveying element to output a first flow rate of drying air, to a low-speed state, in which the drive unit is operated to rotate the drum at a second rotational drum speed and to drive the conveying element to output a second flow rate of drying air, wherein the first rotational drum speed is higher than the second rotational drum speed and the first flow rate of drying air is

higher than the second flow rate of drying air;

◦ step 2: increasing the speed of the drive unit from the low-speed state to the high-speed state.

[0009] The laundry drying appliance according to the invention enables to remove foreign objects, such as hair or lint or other fibrous material, from laundry or fabric by using different rotational drum speeds. Particularly, removal of animal hair or human hair from laundry or fabric can be achieved in a very efficient way. During the lower second rotational drum speed the laundry or fabric is subject to increased mechanical effects due to the fact that the laundry tumbles within the drum and is continuously redistributed within the drum. At the higher first rotational drum speed the flow rate of drying air is relatively high in order to remove hair, lint and/or fibrous material by the high rate of air flow. The mechanical impact or mechanical shocks resulting from the continuous redistribution affects the hair or lint of fibrous material adhering to the laundry and may release the hair etc. off the laundry. In the phase of the higher rotational drum speed, the relatively high flow rate of drying air efficiently removes the hair or lint or fibrous material that has been released from the laundry from the drum. It shall be noted that it is not of importance if step 1 or step 2 is carried out as a first step in time. Variably driving the drum and the conveying element shall be understood in particular in a manner that the rotational speed of the drum and the rotational speed of the conveying element can be varied by varying a speed of the drive unit, e.g. of a motor of the drive unit.

[0010] According to an advantageous embodiment of the invention, the control unit may be configured to control operation of the drive unit such that step 1 and step 2 are repeated, in particular immediately one after another, alternatingly for multiple times.

[0011] The effect of the alternating drum speed and the alternating flow rate is, thus, optimized.

[0012] According to a further advantageous embodiment of the invention, the conveying element comprises a fan impeller operably coupled to the drive unit, wherein the drive unit may be configured to drive the fan impeller about an axis of rotation of the fan impeller, such that the drive unit can drive the drum and the fan impeller so that the rotational drum speed and a rotational fan impeller speed are directly proportional to each other.

[0013] In this way, the alternating rotational drum speeds and the alternating flow rates can be controlled in a simple manner via control of the speed output of the drive unit. In such a configuration it is possible to set a high rotational drum speed and a high rotational fan impeller speed or alternatively a low rotational drum speed and a low rotational fan impeller speed. This results in a compact and simple embodiment providing the required functionality.

[0014] Advantageously, the drive unit may comprise a motor operatively coupled, in particular via one common motor shaft, to the drum and to the conveying element, in particular to the fan impeller. In an alternative embodiment, the drum can be coupled directly to the motor shaft and the conveying element can be coupled via a gear and/or a pulley to the motor shaft or the drum can be coupled via a gear and/or a pulley to the motor shaft and the conveying element can be coupled directly to the motor shaft.

[0015] In this way setting of the motor rotational speed can cause the drum and the conveying element to increase or decrease simultaneously being directly coupled to each other via the motor.

[0016] Advantageously, the laundry drying appliance may comprise:

- a humidity sensing unit configured to detect a humidity value of the laundry received in the drum; and/or
- a heating device configured to heat the drying air to be conveyed by the conveying element into the drum; in particular wherein the control unit is configured to control operation of the heating device and/or configured to receive and to process data from the humidity sensing unit related to the humidity value.

[0017] Sensing the humidity of the laundry enables to increase the efficiency of removing foreign objects. The provision of a heating device enables to heat up the drying air conveyed by the conveying element. The heating device can be operated in dependence on the humidity value in order to increase efficiency of the removal of hair or lint or fibrous material. It shall further be noted that, it is particularly advantageous if the steps 1 and 2 within the foreign objects removal mode are carried out on relatively dry laundry.

[0018] According to a further advantageous embodiment, the control unit and/or the humidity sensing unit may be configured to determine whether the detected humidity value is below a first humidity threshold and wherein the control unit is configured to start operation of the drive unit in the foreign objects removal mode in response to detecting the humidity value to be below the first humidity threshold.

[0019] Removal of foreign objects, especially hair removal from laundry is easier when the laundry is relatively dry, i. e. when the humidity of the laundry is below a first humidity threshold. At the beginning of a laundry drying program, when the laundry is wet from washing, it is more efficient to detect the humidity level and to dry the laundry by means of a conventional drying operation until it reaches a relatively low humidity level, before the foreign objects removal mode is started. However, the humidity level shall not be too low, since too dry air and/or laundry may increase electrostatic attraction between the foreign objects and the laundry and may impede the removal effect.

[0020] According to a further advantageous embodiment of the invention, the control unit may be configured to reduce

or to switch off a heating output of the heating device in response to detecting the humidity value to be below the first humidity threshold, or
the control unit may be configured to reduce or to switch off a heating output of the heating device in response to detecting the humidity value to be below a second humidity threshold which is lower than the first humidity threshold.

[0021] By switching off the heating output of the heating device, in response to detecting the humidity value to be below the first humidity threshold, it can be ensured that the humidity level of the laundry is suitable for removal of foreign objects, such as hair. By switching off the heating output of the heating device, in response to detecting the humidity value to be below a second humidity threshold which is lower than the first humidity threshold, the foreign objects removal mode can be started earlier during the drying program. Further, the decrease of the humidity level of the laundry during the foreign objects removal mode may positively influence the removal effect, since during the foreign objects removal mode, the humidity will decrease from the first humidity threshold, when the electrostatic attraction between the foreign objects and the laundry will be lower, and the second humidity threshold, when the laundry will be dryer, leading to a gradually change in which positive (and negative) factor affecting the removal effect that is currently predominant.

[0022] To reduce or switch off the heating output of the heating device in response to the humidity level reaching a first humidity threshold reduces the overall energy consumption. To reduce the heating output or to switch off the heating device in response to the humidity level reaching a second humidity threshold below the first humidity threshold allows to continue operation of the heating device at least during a part of the duration of the foreign objects removal mode. Thus, the overall duration of the program comprising the laundry foreign objects removal mode can be reduced, specifically if the foreign objects removal mode with the hair removal process is started before the laundry is substantially dry. In this embodiment, a balanced solution between the requirements of low energy consumption and a short overall duration has been found.

[0023] In a further advantageous embodiment, the first humidity threshold may be less than 50%, in particular less than 20%, preferably less than 10%, more preferably between 2% and 10%, wherein 100% corresponds to completely wet laundry and 0% corresponds to completely dry laundry. Alternatively or additionally, the second humidity threshold may be less than 30%, in particular less than 15%, preferably less than 5%, more preferably less than 2%, most preferably less than 1%, wherein 100% corresponds to completely wet laundry and 0% corresponds to completely dry laundry.

[0024] These values have been found as providing highly efficient hair removal and/or removal of foreign objects.

[0025] Furthermore, it is advantageous when the heating device may comprise a heat pump.

[0026] Additionally or alternatively, the heating device may comprise at least one electric heater, in particular including at least one radiant heating element.

[0027] Both alternatives have been found to reliably and efficiently heat up the drying air to be conveyed into the drum.

[0028] The technical objective is further solved by a method for removing foreign objects in a laundry drying appliance, in particular in a laundry drying appliance according to the invention, wherein the laundry drying appliance comprises:

- a rotatable drum arranged to receive laundry;
- a drying air conveying element configured to convey drying air into the drum;
- a drive unit operatively coupled to the drum and to the conveying element and configured to variably drive the drum about an axis of rotation of the drum and the conveying element so that an increase in a speed of the drive unit results in an increase of a rotational drum speed and in an increase of a flow rate of drying air conveyed by the conveying element and so that a decrease in a speed of the drive unit results in an decrease of the rotational drum speed and in a decrease of the flow rate of drying air conveyed by the conveying element;
- a control unit configured to control operation of the drive unit;

wherein the method comprises operating the drive unit (26) in a foreign objects removal mode, comprising the following steps:

step 1:	decreasing the speed of the drive unit from a high-speed state, in which the drive unit is operated to rotate the drum at a first rotational drum speed and to drive the conveying element to output a first flow rate of drying air, to a low-speed state, in which the drive unit is operated to rotate the drum at a second rotational drum speed and to drive the conveying element to output a second flow rate of drying air, wherein the first rotational drum speed is higher than the second rotational drum speed and the first flow rate of drying air is higher than the second flow rate of drying air;
step 2:	increasing the speed of the drive unit from the low-speed state to the high-speed state;

wherein the first rotational drum speed is higher than the second rotational drum speed and the first flow rate of drying air is higher than the second flow rate of drying air.

[0029] The method according to the invention enables to remove material such as hair or lint or other fibrous material from laundry or fabric by using different rotational drum speeds. Particularly, removal of animal hair or human hair from laundry or fabric can be achieved in a very efficient way. During the lower second rotational drum speed the laundry or fabric is subject to increased mechanical effects due to the fact that the laundry tumbles within the drum and is continuously redistributed within the drum. The lower rotational drum speed may be selected to cause a large part of the laundry to drop from a point as high as possible within the drum to achieve the highest possible mechanical impact. At the higher rotational drum speed the flow rate of drying air is relatively high in order to remove hair, lint and/or fibrous material by the high rate of air flow. The mechanical impact or mechanical shocks resulting from the continuous redistribution affects the hair or lint of fibrous material adhering to the laundry and may release the hair etc. off the laundry. In the phase of the higher rotational drum speed, the relatively high flow rate of drying air efficiently removes the hair or lint or fibrous material that has been released from the laundry from the drum. It shall be noted that it is not of importance if step 1 or step 2 is carried out as a first step.

[0030] According to an advantageous embodiment of the invention, step 1 and step 2 may be repeated, in particular immediately one after another, alternatingly for multiple times,

in particular wherein step 1 is carried for a period of less than 10min, (i.e. less than 10 minutes), preferably between 10s and 5min (i.e. between 10 seconds and 5 minutes), more preferably between 30s and 2min,
and/or
in particular wherein step 2 is carried for a period of less than 10min, preferably between 10s and 5min, more preferably between 30s and 2min,
and/or
in particular a rate of change of the rotational drum speed from the first rotational drum speed to the second rotational drum speed and/or from the second rotational drum speed to the first rotational drum speed is at least once higher than 2rpm/min (i.e. revolutions per minute per minute), preferably in average between 5rpm/min and 200rpm/min, more preferably in average between 10rpm/min and 100rpm/min. When step 1 and/or 2 is carried out for the period indicated above an efficient effect of hair and/or foreign object removal is obtained. Within the above intervals of rate of change of the rotational drum speed, an efficient removal of hair and/or foreign object is obtained. Further, the rate of change of the rotational drum speed may represent an average rate of change during each of step 1 and/or step 2. In one example, the change of the rotational drum speed is linear during step 1 and/or step 2. However, the change of the rotational drum speed may also be implemented incrementally, by 1, 2, 5 or 10rpm (revolutions per minute) at a time, such that the average rate of change during step 1 and step 2, respectively, corresponds to the indicated rate of change of the rotational drum speed.

[0031] Steps 1 and 2 have been found to be efficient if being alternated in accordance with the claimed time regime. In order to achieve an efficient effect of hair removal, the first and second rotational drum speeds are continuously switched back and forth. An increased number of different forces acting on the laundry increases the hair removal effect. In general, the larger the difference between the first rotational drum speed and the second rotational drum speed, the more efficient the hair removal effect as far as the minimum and maximum values for those speeds are not exceeded.

[0032] According to a further advantageous embodiment, the first rotational drum speed may substantially correspond to a drum speed at which a centrifugal force is exerted on the laundry received in the drum that is high enough to prevent the laundry from tumbling within the drum.

[0033] Alternatively or additionally, the second rotational drum speed may substantially correspond to a speed in which the laundry received in the drum is allowed to tumble within the drum,
in particular wherein the second rotational drum speed may substantially correspond to a speed in which a centrifugal force exerted on the laundry received in the drum is high enough to prevent the laundry from detaching from the inner drum wall before being transported into the region of the highest point of rotation of the drum and which is low enough to allow the laundry to detach from the inner drum wall when having reached the region of the highest point of rotation of the drum.

[0034] More specifically, at least the second or lower rotational drum speed should be below a satellization speed in which the laundry is attached to the inner drum wall due to the centrifugal force. At such a rotational drum speed, the laundry receives the necessary mechanical impact for releasing the hair or lint or fibrous material therefore. The first rotational drum speed may be below or at the satellization speed, since during the first rotational speed the focus is on moving the free hairs or lint or fibres out of the drum by means of the drying air flow.

[0035] According to a further advantageous embodiment, the laundry drying appliance further comprises:

- a humidity sensing unit configured to detect a humidity value of the laundry received in the drum; and
- a heating device configured to heat the drying air to be conveyed by the conveying element into the drum;
  in particular wherein the control unit and/or the humidity sensing unit is/are configured to determine whether the

detected humidity value is below a first humidity threshold, wherein the method further comprises:

- detecting a humidity value of the laundry received in the drum; and operating the drive unit in the foreign objects removal mode in response to detecting the humidity value being below the first humidity threshold.

[0036] Sensing the humidity of the received in the drum, i.e. laundry in the laundry drying appliance, enables to determine whether a status of dryness of the laundry is suitable or optimized for starting the foreign objects removal mode. The first humidity threshold may indicate a status of dryness that is most suitable for the foreign objects removal mode to be started.

[0037] According a further advantageous embodiment, the method further comprises:

- reducing or switching off the heating output of the heating device in response to detecting the humidity value being below the first humidity threshold; or
- reducing or switching off the heating output of the heating device in response to detecting the humidity value being below a second humidity threshold which is lower than the first humidity threshold.

[0038] By switching off the heating output of the heating device, in response to detecting the humidity value being below the first humidity threshold, it can be ensured that the humidity level of the laundry is suitable for removal of foreign objects, such as hair. By switching off the heating output of the heating device, in response to detecting the humidity value to be below a second humidity threshold which is lower than the first humidity threshold, the foreign objects removal mode can be started earlier during the drying program. Further, the decrease of the humidity level of the laundry during the foreign objects removal mode may positively influence the removal effect, since during the foreign objects removal mode, the humidity will decrease from the first humidity threshold, when the electrostatic attraction between the foreign objects and the laundry will be lower, and the second humidity threshold, when the laundry will be dryer, leading to a gradually change in which positive (and negative) factor affecting the removal effect, that is currently predominant.

[0039] In a further advantageous embodiment, the first rotational drum speed is in the range between 55rpm to 90rpm, in particular in the range between 55rpm to 80rpm, preferably in the range between 55rpm to 65rpm,
and/or

wherein the second rotational drum speed is in the range between 20rpm to 50rpm, in particular in the range between 30rpm to 50rpm, preferably in the range between 35rpm to 45rpm,
and/or
wherein the difference between the first rotational drum speed and the second rotational drum speed is at least 10rpm, in particular at least 15rpm, preferably at least 20rpm, more preferably at least 25rpm.

[0040] In general, the behaviour of the laundry within the drum depends on the rotational drum speed, but also on the diameter of the drum as well as on the laundry itself. However, the ranges of rotation drum speeds set out have been found as providing efficient hair removal for a variety of drum diameters and a variety of laundry loads introduce into the drum that may differ in the number of laundry pieces or in the laundry size. A typical diameter of a drum for which the above outlined rotational drum speeds are valid is 57cm.

[0041] According to a further advantageous embodiment, the direction of the drum rotation is changed during step 1 and/or during step 2 after a predetermined period of time.

[0042] Additionally or alternative, a change of direction of the drum rotation is caused in response to a humidity value related to the laundry to be cleaned in the laundry drying appliance being determined to be below a predetermined humidity threshold, in particular a first humidity threshold or a second humidity threshold.

[0043] Changes in the direction of drum rotation increase the distribution of the laundry in the drum which increase the hair removal effect on the laundry as well as a more uniform hair removal effect by removing hair from different parts of the laundry.

[0044] According to a further advantageous embodiment of the invention, the method may further comprise:

- drying the laundry received in the drum by: rotating the drum, switching on the heating output of the heating device and conveying drying air heated by the heating output into the drum.

[0045] Thus, the laundry can be dried before the foreign objects removal mode is started, resulting in a more efficient removal of foreign objects from the laundry.

[0046] The invention will be described in further detail in the following, also with reference to the drawings.

FIG 1A illustrates a schematic diagram of a laundry drying appliance with a heat pump;

FIG 1B illustrates a schematic diagram of a laundry drying appliance with an air-to-air condenser;

FIGs 2A to 2C illustrate examples of rotational drum speed changes during a foreign objects removal mode;

FIG 2D illustrate an example of the rotational drum speed before and after the foreign objects removal mode is initiated;

FIG 3 illustrates a method for removing foreign objects from laundry in a laundry drying appliance according to the invention;

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

[0047] An embodiment of the invention may comprise a laundry drying appliance 1, such as a tumble dryer or a washer dryer having a rotatable drum 12 in which laundry or fabric to be dried can be loaded. At least one drying air conveying element 18 is provided which can convey drying air into the drum 12 to dry the laundry placed therein. Further, a heating device 42 may be provided that may be arranged to heat the drying air to be conveyed into the drum 12. A drive unit 26, e.g. including a motor, is coupled to the drum 12 and to the conveying element 18 such that the drum 12 and the conveying element 18 are simultaneously driven by the drive unit 26. In this way, the rotational speed of the drum 12 and the rotational speed of the conveying element 18, e.g. comprising a fan impeller, may be increased and decreased simultaneously by controlling the drive unit 26.

[0048] FIG 1A illustrates a schematic diagram of a laundry drying appliance 1 with a heat pump. The heat pump comprises a drying air stream circuit 10, preferably a closed loop drying air stream circuit 10, and a closed refrigerant circuit 20. The drying air stream circuit 10 is formed by a laundry drum 12, an evaporator 14, a condenser 16 and a drying air conveying element 18. The drying air conveying element 18 may be a drying air stream fan. More precisely, the drying air conveying element 18 may comprise a fan impeller. The refrigerant circuit 20 is formed by a compressor 22, the condenser 16, an expansion device 24 and the evaporator 14. For example, the expansion device 24 is an expansion valve. The evaporator 14 and the condenser 16 are heat exchangers and form the thermal interconnections between the drying air stream circuit 10 and the refrigerant circuit 20.

[0049] In the drying air stream circuit 10, the evaporator 14 cools down and dehumidifies the drying air stream, after the warm and humid drying air stream has passed the laundry drum 12. Then, the condenser 16 heats up the drying air stream, before the drying air stream is re-inserted into the laundry drum 12 again. The drying air stream is driven by the drying air conveying element 18 arranged between the condenser 16 and the laundry drum 12. In the refrigerant circuit 20, a refrigerant is compressed and heated up by the compressor 22, cooled down and condensed in the condenser 16, expanded in the expansion device 24, vaporised and heated up in the evaporator 14. In this embodiment, the heating device 42 may be represented by the heat pump or at least a part of the heat pump for heating up the drying air. It may be considered that only the components of the refrigerant circuit 20 are part of the heating device 42, i.e. the compressor 22, the condenser 16, an expansion device 24 and the evaporator 14. The flow within the refrigerant circuit 20 may be stopped or reduced by switching off or reducing the power to the compressor 22, which consequently would affect the heat exchange to the drying air stream circuit 10 and thereby the temperature of the drying air in the drum 12. Hence, in this example, it may be considered that the heating device 42 comprises a condenser 16, wherein the output of the condenser is affected by switching on or off or reducing the speed or the power of the compressor 22, since if the compressor 22 is switched on or off, or its functionality is reduced or increased, the heating functionality for heating up the drying air is affected accordingly.

[0050] The drying air conveying element 18 and the laundry drum 12 are driven by a drive unit 26, such as a motor. The drive unit 26 is controlled by a control unit 30. The drive unit 26 may be connected to the control unit 30 by a control line 28 or by a wireless connection. In one example, at least some of the data processing is taking place remotely from the control unit 30 and is being sent to the control unit 30 by wire or wireless. Further, the functionality of the control unit 30 may be divided on different entities. The control unit 30 can be mechanically fixed to the laundry drying appliance 1 or it can be separate from the laundry drying appliance 1 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 drying appliance 1 via wireless data communication.

[0051] FIG 1B illustrates a schematic diagram of a laundry drying appliance 1 with an air-to-air condenser 32. The laundry drying appliance 1 comprises the closed drying air stream circuit 10. The drying air stream circuit 10 of the second embodiment is formed by a laundry drum 12, an air-to-air condenser 32, a drying air conveying element 18 and a heating device 40. The drying air conveying element 18 may be a drying air stream fan.

[0052] The air-to-air condenser 32 corresponds with an ambient air conveying element or ambient air fan 34. The air-to-air condenser 32 is an air-to-air heat exchanger and forms a thermal interconnection between the drying air stream circuit 10 and the ambient air. The air-to-air condenser 32 includes two separate channels. A first channel is provided

for the drying air stream of the drying air stream circuit 10. A second channel is provided for the ambient air. The ambient air is blown through the second channel by the ambient air fan 34.

[0053] The air-to-air condenser 32 cools down and dehumidifies the drying air stream by ambient air, after the warm and humid drying air stream has passed the laundry drum 12. Then, the drying air stream is heated up by a heating device 40, for example by an electric heating element, before the drying air stream is re-inserted into the laundry drum 12 again. The drying air stream is driven by the drying air conveying element 18 arranged between the air-to air condenser 32 and the laundry drum 12.

[0054] The drying air conveying element 18 and the laundry drum 12 are driven by a drive unit 26, such as a motor. The drive unit 26 is controlled by a control unit 30. The drive unit 26 may be connected to the control unit 30 by a control line 28 or by a wireless connection.

[0055] The drive unit 26 of any of FIGs 1A or FIGs 1B may comprise a motor operatively coupled, in particular via one common motor shaft, to the drum 12 and to the conveying element 18, in particular to the fan impeller. In an alternative embodiment, the drum 12 can be coupled directly to the motor shaft and the conveying element 18 can be coupled via a gear and/or a pulley to the motor shaft or the drum 12 can be coupled via a gear and/or a pulley to the motor shaft and the conveying element 18 can be coupled directly to the motor shaft. The respective gear or the respective pulley is introduced to change the transmission rate between the motor and the drum 12 and/or between the motor and the conveying element 18.

[0056] Further, the laundry drying appliance 1 of any of FIGs 1A or FIGs 1B may comprise a humidity sensing unit 44. The humidity sensing unit 44 may comprise at least one capacitive sensor. The capacitive sensor comprises a first electrode. The first electrode may be arranged close to or adjacent to a lower front region of the drum 12. The first electrode may be arranged below the front end of the drum 12. The capacitive sensor may comprise a second electrode being a virtual electrode. The virtual electrode is constituted by a reference electric potential which is routed by conductive tracks provided in the electrical system of the laundry drying appliance 1. Alternatively, the capacitive sensor may comprise a second electrode arranged close or adjacent to a lower rear region of the drum 12. Alternatively or additionally, the humidity sensing unit 44 may comprise at least one conductometric sensor.

[0057] The laundry drying appliance 1 comprises a control unit 30, in particular an electronic control unit, e.g. including a microprocessor or a microcontroller, that is configured to operate the drive unit 26 in accordance with a foreign objects removal mode. The foreign objects removal mode comprises:

step 1: decreasing the speed of the drive unit 26 from a high-speed state, in which the drive unit 26 is operated to rotate the drum 12 at a first rotational drum speed and to drive the conveying element 18 to output a first flow rate of drying air, to a low-speed state, in which the drive unit 26 is operated to rotate the drum 12 at a second rotational drum speed and to drive the conveying element 18 to output a second flow rate of drying air, wherein the first rotational drum speed is higher than the second rotational drum speed and the first flow rate of drying air is higher than the second flow rate of drying air, and
step 2: increasing the speed of the drive unit 26 from the low-speed state to the high-speed state.

[0058] The foreign objects removal mode is adapted to the aim of removing animal hair and/or human hair or the like from laundry, wherein the drive unit 26 is repeatedly increasing/decreasing the speed of the drive unit 26 between the low-speed state and the high-speed state in order to remove hair from the laundry items. In particular, the control unit 30 may be configured to control the laundry drying appliance 1 according to any one or both processes illustrated in FIGs 3 and 4. E.g. the control unit 30 can be programmed to control operation of the laundry drying appliance 1 according to these processes. However, in another alternative example, the control unit 30 is configured to operate the drive unit 26 according to the foreign objects removal mode without any previous drying phase. That is, the control unit 30 may be configured to operate the drive unit 26 according to the foreign objects removal mode directly when starting a program of the laundry drying appliance 1. Alternatively, the control unit 30 may be configured to operate the drive unit 26 according to the foreign objects removal mode a predetermined time after starting a program of the laundry drying appliance 1.

[0059] The foreign objects removal effect or hair removal effect is based on mechanical effects affecting the laundry within the drum 12, when the drum 12 is accelerated and decelerated alternatingly, and on the drying air flow flowing through the drum 12.

[0060] At lower drum speeds, the mechanical effect on the laundry or fabric is higher, i.e. redistribution of the laundry by tumbling is high which also causes redistribution of the hair on the piece of laundry and increases the probability that the hair is released from the laundry. Further, at lower drum speeds also the flow rate of drying air conveyed by the conveying element 18 is lower as the drum 12 and the conveying element 18 are driven by the same drive unit 26 and in particular by the same motor. At lower conveying element rotational speed, the air flow rate is decreased and may not be sufficient to carry hair into the filter.

[0061] At higher drum speeds also the conveying element speed and thus also the air flow rate is higher, since the same drive unit 26 is driving the drum 12 and the conveying element 18. In this situation, the laundry may attach to the

drum wall during drum rotation and the increased flow rate may remove hair, lint or fibrous material that has released from the laundry and that is present free floating in the drum 12 into an exhaust channel with a filter or into a filter arranged in flow direction before the exhaust channel.

[0062] The most efficient effect of removing hair is achieved by repeatedly switching between lower drum speeds, where the mechanical effects are higher, and higher drum speeds, where the air flow rate is higher, since in this way the hair is exposed to an increased number of different forces that can cause the hair to be removed from the laundry.

[0063] The first (higher) flow rate of drying air causes a larger part of the hair removal due to air flow rate than the second (lower) flow rate of drying air. The second (lower) rotational drum speed causes a larger part of the hair removal effect due to mechanical effects than the first (higher) rotational drum speed, since the second rotational drum speed is chosen to accomplish a high degree of tumbling of the laundry, while at the first (higher) rotational drum speed the laundry is more attached to the drum wall.

[0064] The first (higher) rotational drum speed is particularly efficient if it is just below or just above the satellization speed of the laundry, i.e. the speed when the laundry is attached to the inner wall of the drum 12. The satellization speed is dependent on the diameter of the drum. For a drum diameter of 57cm, the highest drum speed, i.e. the first rotational drum speed, may be set to 65rpm (revolutions per minute). However, the first rotational drum speed may be in the range between 55rpm to 90rpm, in particular in the range between 55rpm to 80rpm, preferably in the range between 55rpm to 65rpm.

[0065] The second (lower) rotational drum speed is particularly efficient, if it is a speed where the laundry makes the largest or close to the largest drop per time unit within the drum 12. Thus, the highest or close to the highest mechanical effects on the laundry are obtained. For a drum diameter of 57cm, the second (lower) rotational drum speed may be set to 40rpm. However, the second rotational drum speed may be in the range between 20rpm to 50rpm, in particular in the range between 30rpm to 50rpm, preferably in the range between 35rpm to 45rpm.

[0066] The difference between the first rotational drum speed and the second rotational drum speed may be at least 10rpm, in particular at least 15rpm, preferably at least 20rpm, more preferably at least 25rpm.

[0067] The foreign objects removal mode may be carried out such that step 1 and step 2 are repeated, immediately one after another, alternatingly for multiple times. Step 1 may be carried for a period of less than 10min, (i.e. less than 10 minutes), preferably between 10s and 5min (i.e. between 10 seconds and 5 minutes), more preferably between 30s and 2min. Step 2 may be carried for a period of less than 10min, preferably between 10s and 5min, more preferably between 30s and 2min. Further, a rate of change of the rotational drum speed from the first rotational drum speed to the second rotational drum speed and/or from the second rotational drum speed to the first rotational drum speed may be higher than 2rpm/min (i.e. revolutions per minute per minute) in average, preferably in average between 5rpm/min and 200rpm/min, more preferably in average between 10rpm/min and 100rpm/min. Within the above intervals of rate of change of the rotational drum speed, an efficient removal of hair and/or foreign object is obtained. In one example, the change of the rotational drum speed is linear during step 1 and/or step 2. However, the change of the rotational drum speed may also be implemented incrementally, by 1, 2, 5 or 10rpm (revolutions per minute) at a time, such that the average rate of change during step 1 and step 2, respectively, corresponds to the indicated rate of change of the rotational drum speed.

[0068] Examples of the drum speed changes during the foreign objects removal mode can be seen in FIGs 2A to 2D. In FIG 2A, the high-speed state drum speed, i.e. the first rotational drum speed, is 65rpm and the low-speed state drum speed, i.e. the second rotational drum speed, is 40rpm. The time period to complete the drum speed decrease from 65rpm to 40rpm, i.e. step 1, is 60s. Similarly, the time to complete the drum speed increase from 40rpm to 65rpm, i.e. step 2, is 60s. The drum speed decrease and/or drum speed increase may be stepwise, for example by 5rpm every 10s, such as shown in FIG 2A. Alternatively, the drum speed may decrease linearly and/or the drum speed may increase linearly. However, the speed decrease in step 1 and speed increase in step 2 may be non-linear. In the example of FIG 2A, step 1 and step 2 are carried out repeatedly for more than 10min.

[0069] FIG 2B shows another example, wherein the high-speed state drum speed, i.e. the first rotational drum speed, is 60rpm and the low-speed state drum speed, i.e. the second rotational drum speed, is 45rpm. The time period to complete the drum speed decrease from 60rpm to 45rpm, i.e. step 1, is 90s. In this example, also the time period to complete the drum speed increase from 45rpm to 60rpm, i.e. step 2, is 90s. Although in this example, the time period to complete step 1 and step 2 is the same, the time period may be different for step 1 and step 2. In the example of FIG 2B, step 1 and step 2 are carried out repeatedly for more than 15min.

[0070] FIG 2C shows a further example, wherein the high-speed state drum speed, i.e. the first rotational drum speed, is 70rpm and the low-speed state drum speed, i.e. the second rotational drum speed, is 35rpm. The time period to complete the drum speed decrease from 70rpm to 35rpm, i.e. step 1, is 45s. Similarly, the time period to complete the drum speed increase from 35rpm to 70rpm, i.e. step 2, is 45s. In the example of FIG 2C, step 1 and step 2 are carried out repeatedly for more than 8min.

[0071] Examples of a laundry treating program that integrates drying of laundry after being washed as well as a foreign objects removal mode for the removal of foreign objects such as animal hair or lint etc. are shown in FIGs 3 and 4.

[0072] Initially, wet laundry is placed into the drum 12. An initial drying step may be carried out in order to reduce the humidity in the laundry. For this purpose, the heating output of the heating device 40, 42 is switched on, whereas the drum 12 rotates and the conveying element 18 conveys drying air heated by the heating device 40, 42 into the drum 12 to dry the laundry. The initial drying step may be carried out for a predetermined period of time, such as 15 minutes or more. However the initial drying step may also be carried out for a period of time shorter than 15 minutes.

[0073] Then, a humidity value HV of the laundry may be measured and it may be determined whether the humidity value HV is below a predetermined first humidity threshold HTH1 which indicates whether the laundry is dry enough for starting the foreign objects removal mode including the alternating steps 1 and 2 or whether the laundry is not yet dry enough. The humidity value HV corresponds to a humidity level of the laundry items contained in the laundry drum 12, wherein 100% corresponds to completely wet laundry and 0% corresponds to completely dry laundry.

[0074] In this example, if the laundry is not yet dry enough, the drying step is continued until the humidity value HV has dropped below the first humidity threshold HTH1.

[0075] If the laundry is dry enough, or after the predetermined time of the drying step, the foreign objects removal mode is started in which step 1 and step 2 are carried out. Step 1 comprises decreasing the speed of the drive unit 26 from a high-speed state, in which the drive unit 26 is operated to rotate the drum 12 at a first rotational drum speed and to drive the conveying element 18 to output a first flow rate of drying air, to a low-speed state, in which the drive unit 26 is operated to rotate the drum 12 at a second rotational drum speed and to drive the conveying element 18 to output a second flow rate of drying air, wherein the first rotational drum speed is higher than the second rotational drum speed and the first flow rate of drying air is higher than the second flow rate of drying air. Step 2 comprises increasing the speed of the drive unit 26 from the low-speed state to the high-speed state. It is not of importance if step 1 or step 2 is carried out first. Step 1 and 2 may be alternatingly repeated to remove foreign objects, such as animal hair or lint from the laundry.

[0076] FIG 2D illustrate an example of the rotational drum speed before and after the foreign objects removal mode is initiated due to the humidity value HV being determined to be below the predetermined first humidity threshold HTH. As shown in FIG 2D, the rotational drum speed may be 60rpm prior to starting the foreign objects removal mode. However, the drive unit 26 may be operated to rotate the drum 12 at any other rotational drum speed. Additionally, the rotational direction of the drum 12 may be inverted after a certain time period, illustrated by the vertical lines in FIG 2D. However, in another example no drum inversion is initiated by the drive unit 26 during the drying step.

[0077] As can be seen in FIG 3, the control unit 30 may be configured to reduce a heating output of the heating device 40 or 42, in particular to switch off the heating output of the heating device 40 or 42, in response to detecting the humidity value HV to be below the first humidity threshold HTH1. Alternatively, the control unit 30 may be configured to reduce a heating output of the heating device 40 or 42, in particular to switch off the heating output of the heating device 40 or 42, in response to detecting the humidity value HV to be below a second humidity threshold HTH2 which is lower than the first humidity threshold HTH1. The foreign objects removal mode may continue for a predetermined period of time. Thereafter, a cooling phase for cooling down the laundry may follow, prior to the end of the laundry drying cycle.

[0078] As an alternative, as shown in the example of FIG 4, if the humidity value HV is below the first humidity threshold HTH1, the laundry is considered to be dry, and the foreign objects removal mode is started. The foreign objects removal mode can comprise a first phase in which the heating output of the heating device 40, 42 is switched off (or reduced), in particular for a predetermined period of time. The predetermined period of time of the first phase may be between 5min and 30min, e.g. for example 20min. After lapse of this predetermined period of time, a second phase can start in which the heating output of the heating device 40, 42 can be switched on and the foreign objects removal mode can be continued by alternatingly repeating the steps 1 and 2, in particular also for a predetermined period of time. The predetermined period of time of the second phase may be between 5min and 30min, e.g. for example 10min. The purpose of switching on the heating output of the heating device 40, 42 during the second phase is that the user will receive warm laundry by the end of the drying cycle.

[0079] Subsequently, a third phase can start in which the heating output of the heating device 40, 42 can be switched off again and the foreign objects removal mode can be continued by alternatingly repeating the steps 1 and 2, in particular also for a predetermined period of time. The predetermined period of time of the third phase may be between 5min and 30min, e.g. for example 15min.

[0080] As shown in the example of FIG 4, if the humidity value HV is above the first humidity threshold HTH1, the laundry is considered to be wet, and the drying step continues until the humidity value HV falls under the first humidity threshold HTH1. Alternatively, the drying step is prolonged until the humidity value HV falls under a third humidity threshold HTH3, which is lower than the first humidity threshold HTH1. Thus, in the example of FIG 4, the foreign objects removal mode may start when the humidity value HV is determined to be below the first humidity threshold HTH1. However, in an alternative example, the foreign objects removal mode may start when the humidity value HV is determined to be below the third humidity threshold HTH3, which is lower than the first humidity threshold HTH1. One reason to start the foreign objects removal mode when the humidity value HV is below the third humidity threshold HTH3 is that, in the example of FIG 4, only one phase of objects removal mode is taking place after a prolonged drying step, wherein

the heating device 40, 42 is switched off and thus there will be less time to dry the laundry after the drying phase. In this phase, the heating output of the heating device 40, 42 is switched off for a predetermined period of time. The predetermined period of time of this phase may be between 5min and 30min. An advantage of only having one phase of objects removal mode after a prolonged drying step, is to shorten the total time of the drying program, so that the total time of the drying program will be more equal to the cases when the laundry is considered to be dry, i.e. when the drying step was not prolonged.

[0081] After that a cooling phase for cooling down the laundry can follow and the laundry drying cycle can end.

Reference numerals

[0082]

1	laundry drying appliance
10	drying air stream circuit
12	drum
14	evaporator
16	condenser
18	conveying element
20	refrigerant circuit
22	compressor
24	expansion device
26	drive unit
28	control line
30	control unit
32	air-to-air condenser
34	ambient air fan
40, 42	heating device
44	humidity sensing unit

HV	humidity value
HTH1	first humidity threshold
HTH2	second humidity threshold
HTH3	third humidity threshold

Claims

1. Laundry drying appliance (1), in particular tumble dryer, comprising:

- a rotatable drum (12) arranged to receive laundry;
- a drying air conveying element (18) configured to convey drying air into the drum (12);
- a drive unit (26) operatively coupled to the drum (12) and to the conveying element (18) and configured to variably drive the drum (12) about an axis of rotation of the drum (12) and the conveying element (18) so that an increase in a speed of the drive unit (26) results in an increase of a rotational drum speed and in an increase of a flow rate of drying air conveyed by the conveying element (18) and so that a decrease in a speed of the drive unit (26) results in a decrease of the rotational drum speed and in a decrease of the flow rate of drying air conveyed by the conveying element (18);
- a control unit (30) configured to control operation of the drive unit (26) according to a foreign objects removal mode which comprises:
    - step 1: decreasing the speed of the drive unit (26) from a high-speed state, in which the drive unit (26) is operated to rotate the drum (12) at a first rotational drum speed and to drive the conveying element (18) to output a first flow rate of drying air, to a low-speed state, in which the drive unit (26) is operated to rotate the drum (12) at a second rotational drum speed and to drive the conveying element (18) to output a second flow rate of drying air, wherein the first rotational drum speed is higher than the second rotational drum speed and the first flow rate of drying air is higher than the second flow rate of drying air, and
    - step 2: increasing the speed of the drive unit (26) from the low-speed state to the high-speed state.

2. Laundry drying appliance (1) according to claim 1, wherein the control unit (30) is configured to control operation of the drive unit (26) such that step 1 and step 2 are repeated, in particular immediately one after another, alternatingly for multiple times.

3. Laundry drying appliance (1) according to any one of the preceding claims, wherein the conveying element (18) comprises a fan impeller operably coupled to the drive unit (26), wherein the drive unit (26) is configured to drive the fan impeller about an axis of rotation of the fan impeller, such that the drive unit (26) can drive the drum (12) and the fan impeller so that the rotational drum speed and a rotational fan impeller speed are directly proportional to each other.

4. Laundry drying appliance (1) according to any one of the preceding claims, wherein the drive unit (26) comprises a motor operatively coupled, in particular via one common motor shaft, to the drum (12) and to the conveying element (18), in particular to the fan impeller.

5. Laundry drying appliance (1) according to any one of the preceding claims, wherein the laundry drying appliance (1) further comprises:

- a humidity sensing unit (44) configured to detect a humidity value (HV) of the laundry received in the drum (12); and/or
- a heating device (40, 42) configured to heat the drying air to be conveyed by the conveying element (18) into the drum (12);

in particular wherein the control unit (30) is configured to control operation of the heating device (40, 42) and/or configured to receive and to process data from the humidity sensing unit related to the humidity value.

6. Laundry drying appliance (1) according to claim 5, wherein the control unit (30) and/or the humidity sensing unit is/are configured to determine whether the detected humidity value is below a first humidity threshold (HTH1) and wherein the control unit (30) is configured to start operation of the drive unit (26) in the foreign objects removal mode in response to detecting the humidity value to be below the first humidity threshold (HTH1).

7. Laundry drying appliance (1) according to claim 6, wherein the control unit (30) is configured to reduce or to switch off a heating output of the heating device (40, 42) in response to detecting the humidity value to be below the first humidity threshold (HTH1),
or
wherein the control unit (30) is configured to reduce or to switch off a heating output of the heating device (40, 42) in response to detecting the humidity value (HV) to be below a second humidity threshold (HTH2) which is lower than the first humidity threshold (HTH1).

8. Laundry drying appliance (1) according to claim 6 or claim 7, wherein the first humidity threshold (HTH1) is less than 50%, in particular less than 20%, preferably less than 10%, more preferably between 2% and 10%, wherein 100% corresponds to completely wet laundry and 0% corresponds to completely dry laundry,
and/or
wherein the second humidity threshold (HTH2) is less than 30%, in particular less than 15%, preferably less than 5%, more preferably less than 2%, most preferably less than 1%, wherein 100% corresponds to completely wet laundry and 0% corresponds to completely dry laundry.

9. Laundry drying appliance (1) according to any one of the claims 5 to 8,

wherein the heating device (40, 42) comprises a heat pump,
and/or
wherein the heating device (40, 42) comprises at least one electric heater, in particular including at least one radiant heating element.

10. Method for removing foreign objects from laundry in a laundry drying appliance (1), in particular in a laundry drying appliance (1) according to any of the preceding claims, wherein the laundry drying appliance (1) comprises:

- a rotatable drum (12) arranged to receive laundry;
- a drying air conveying element (18) configured to convey drying air into the drum (12);

• a drive unit (26) operatively coupled to the drum (12) and to the conveying element (18) and configured to variably drive the drum (12) about an axis of rotation of the drum (12) and the conveying element (18) so that an increase in a speed of the drive unit (26) results in an increase of a rotational drum speed and in an increase of a flow rate of drying air conveyed by the conveying element (18) and so that a decrease in a speed of the drive unit (26) results in a decrease of the rotational drum speed and in a decrease of the flow rate of drying air conveyed by the conveying element (18);
• a control unit (30) configured to control operation of the drive unit (26); wherein the method comprises operating the drive unit (26) in a foreign objects removal mode, comprising the following steps:

step 1:	decreasing the speed of the drive unit (26) from a high-speed state in which the drive unit (26) is operated to rotate the drum (12) at a first rotational drum speed and to drive the conveying element (18) to output a first flow rate of drying air, to a low-speed state in which the drive unit (26) is operated to rotate the drum (12) at a second rotational drum speed and to drive the conveying element (18) to output a second flow rate of drying air, wherein the first rotational drum speed is higher than the second rotational drum speed and the first flow rate of drying air is higher than the second flow rate of drying air;
step 2:	increasing the speed of the drive unit (26) from the low-speed state to the high-speed state.

11. Method according to claim 10, wherein step 1 and step 2 are repeated, in particular immediately one after another, alternatingly for multiple times, in particular wherein step 1 is carried for a period of less than 10min, preferably between 10s and 5min, optionally between 30s and 2min,
and/or

in particular wherein step 2 is carried for a period of less than 10min, preferably between 10s and 5min, optionally between 30s and 2min,
and/or
in particular a rate of change during step 1 and/or during step 2 is higher than 2rpm/min, preferably in average between 5rpm/min and 200rpm/min, optionally in average between 10rpm/min and 100rpm/min.

12. Method according to claim 10 or 11, wherein the laundry drying appliance (1) further comprises:

• a humidity sensing unit (44) configured to detect a humidity value (HV) of the laundry received in the drum (12); and
• a heating device (40; 42) configured to heat the drying air to be conveyed by the conveying element (18) into the drum (12);

in particular wherein the control unit (30) and/or the humidity sensing unit is/are configured to determine whether the detected humidity value (HV) is below a first humidity threshold (HTH1), wherein the method further comprises:

• detecting a humidity value (HV) of the laundry received in the drum (12); and
• operating the drive unit (26) in the foreign objects removal mode in response to detecting the humidity value (HV) being below the first humidity threshold (HTH1).

13. Method according to claim 12, wherein the method further comprises:

• reducing or switching off the heating output of the heating device (40, 42) in response to detecting the humidity value (HV) being below the first humidity threshold (HTH1); or
• reducing or switching off the heating output of the heating device (40, 42) in response to detecting the humidity value (HV) being below a second humidity threshold (HTH2) which is lower than the first humidity threshold (HTH1).

14. Method according to any one of the claims 10 to 13, wherein the first rotational drum speed is in the range between 55rpm to 90rpm, in particular in the range between 55rpm to 80rpm, preferably in the range between 55rpm to 65rpm, and/or

wherein the second rotational drum speed is in the range between 20rpm to 50rpm, in particular in the range

between 30rpm to 50rpm, preferably in the range between 35rpm to 45rpm,
and/or
wherein the difference between the first rotational drum speed and the second rotational drum speed is at least 10rpm, in particular at least 15rpm, preferably at least 20rpm, more preferably at least 25rpm.

15. Method according to any one of the claims 12 to 14, wherein the method further comprises, prior to any previous step:

• drying the laundry received in the drum (12) by: rotating the drum (12), switching on the heating output of the heating device (40, 42), and conveying drying air heated by the heating output into the drum (12).

FIG 1A

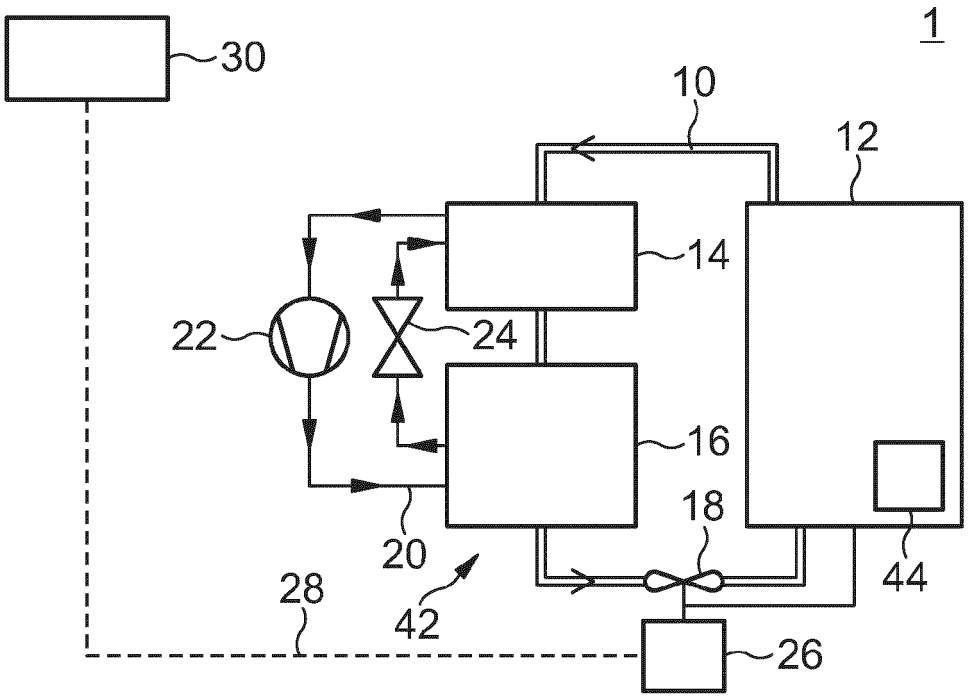


FIG 1B

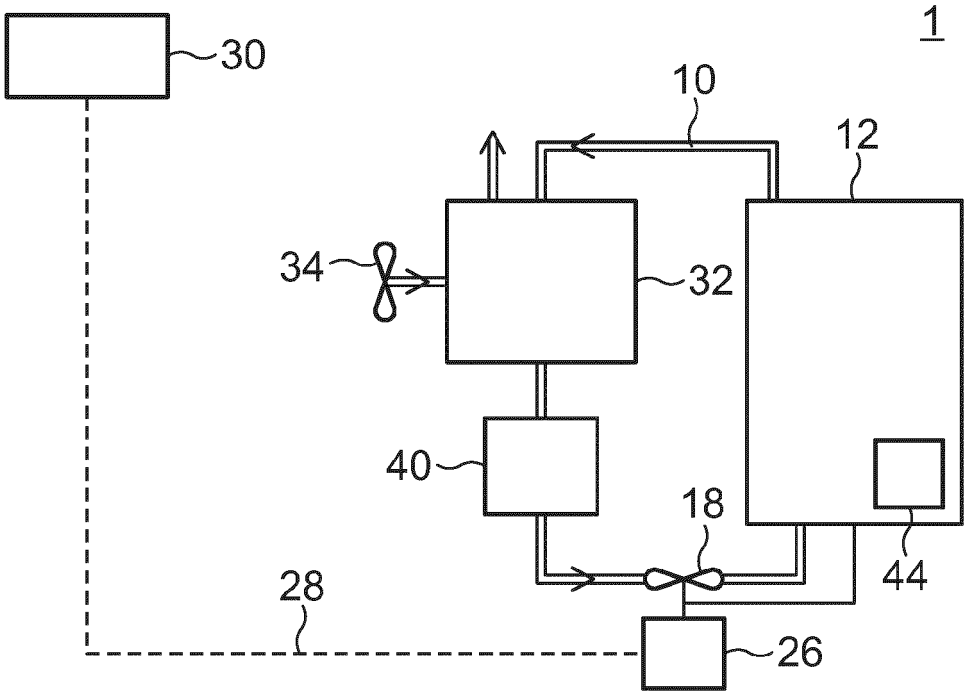


FIG 2A

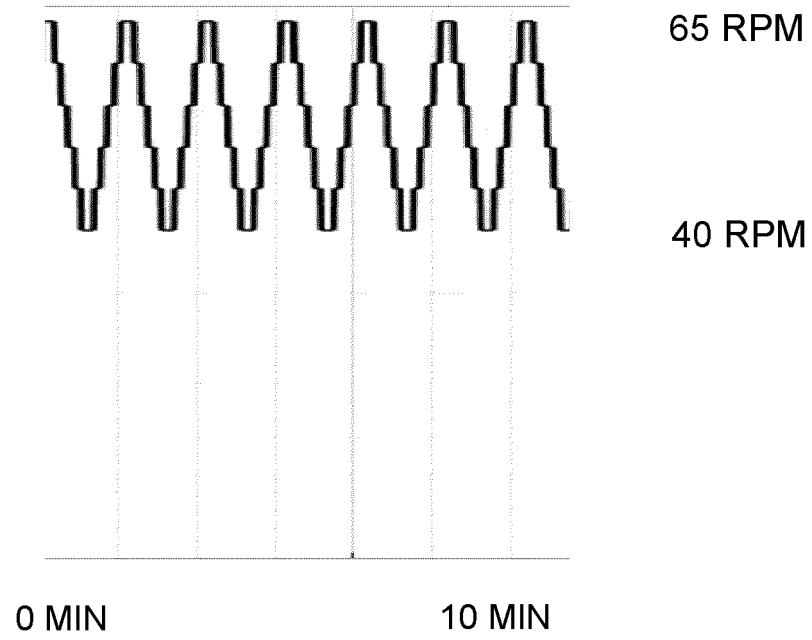


FIG 2B

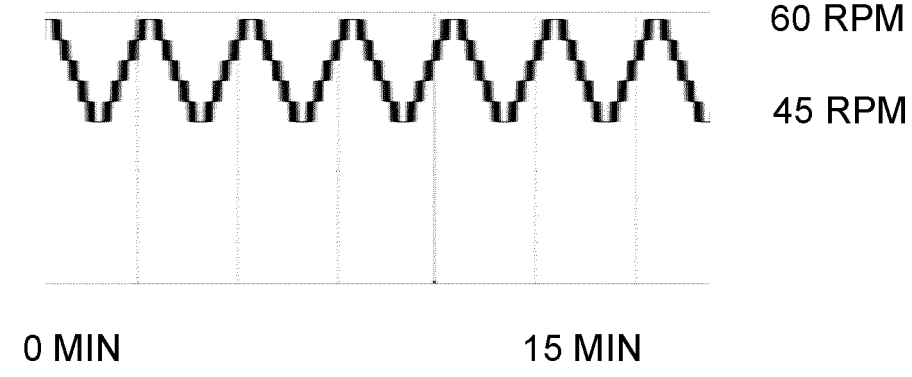


FIG 2C

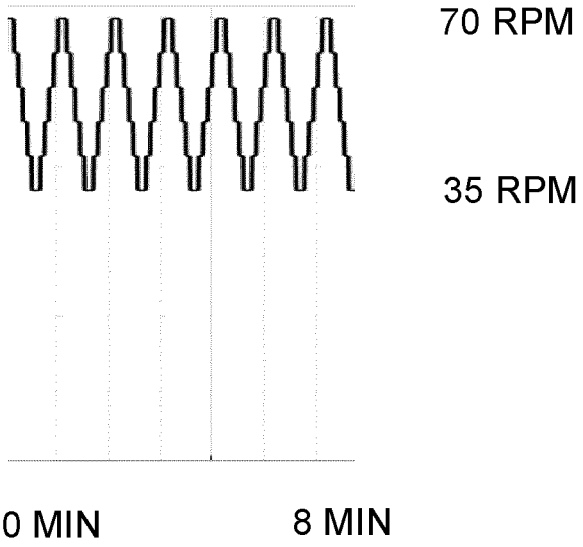


FIG 2D

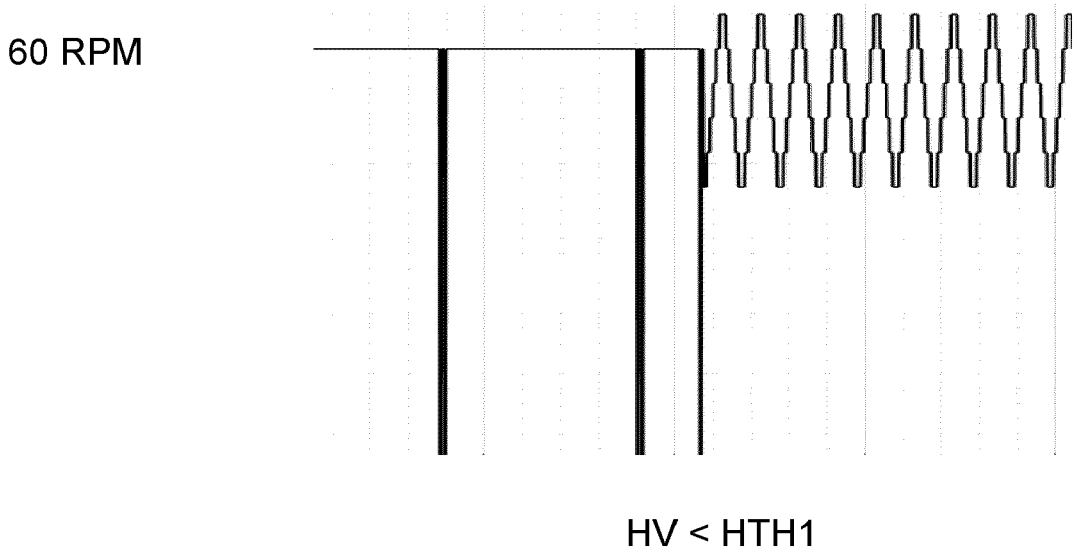


FIG 3

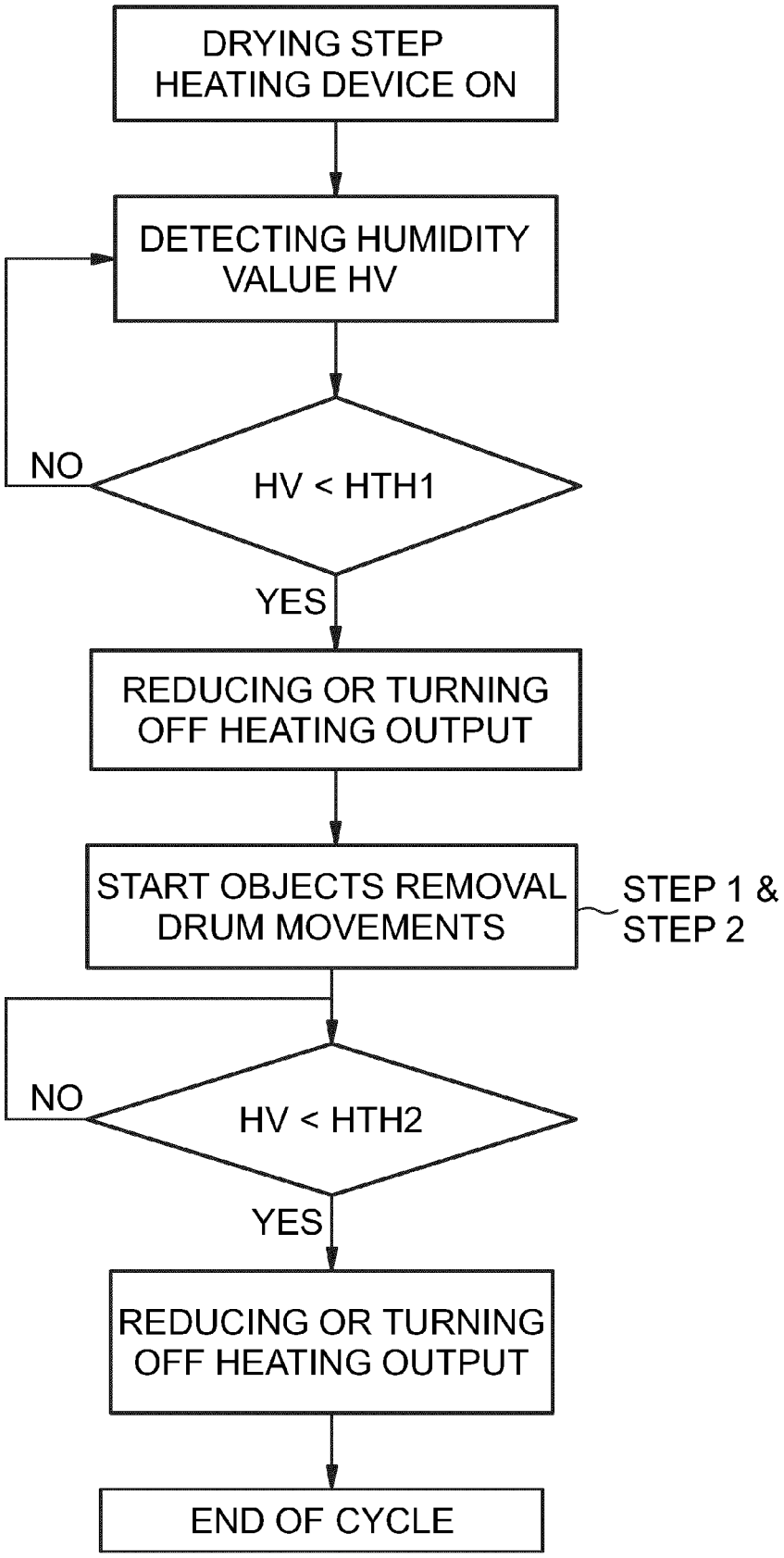
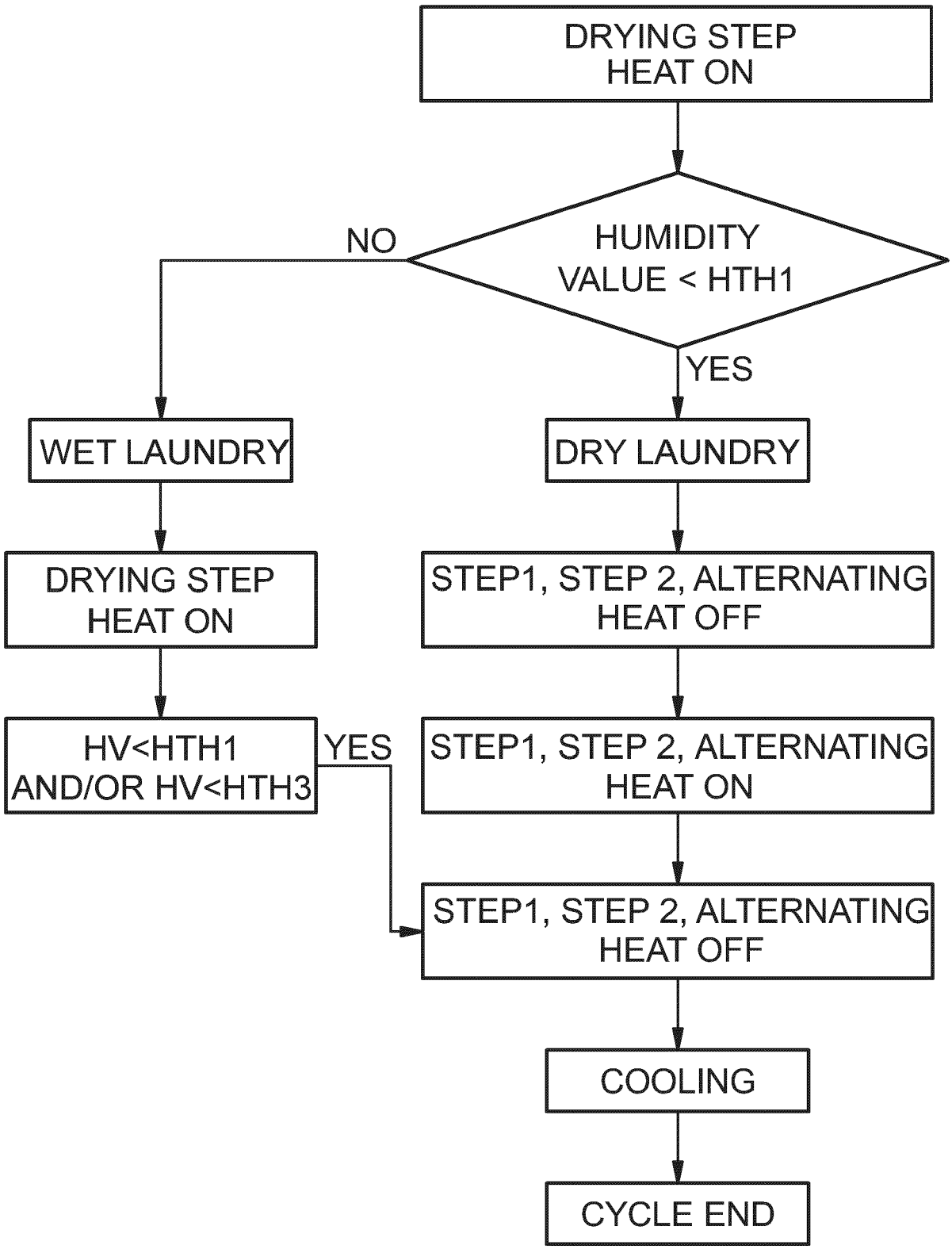

DRYING STEP
HEATING DEVICE ON
DETECTING HUMIDITY
VALUE HV
NO
HV < HTH1
YES
REDUCING OR TURNING
OFF HEATING OUTPUT
START OBJECTS REMOVAL
DRUM MOVEMENTS
STEP 1 &
STEP 2
NO
HV < HTH2
YES
REDUCING OR TURNING
OFF HEATING OUTPUT
END OF CYCLE

FIG 4


DRYING STEP
HEAT ON
HUMIDITY
VALUE < HTH1
NO
YES
WET LAUNDRY
DRY LAUNDRY
DRYING STEP
HEAT ON
STEP1, STEP 2, ALTERNATING
HEAT OFF
HV<HTH1
AND/OR HV<HTH3
YES
STEP1, STEP 2, ALTERNATING
HEAT ON
STEP1, STEP 2, ALTERNATING
HEAT OFF
COOLING
CYCLE END

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European Patent Office
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EUROPEAN SEARCH REPORT

Application Number
EP 22 18 9377

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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X	EP 2 738 303 A1 (ELECTROLUX HOME PROD CORP [BE]) 4 June 2014 (2014-06-04) * paragraph [0067] - paragraph [0077]; claim 17; figure 5 *	1,2,4, 10,11	
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