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(71) Applicant: **Hisense Refrigerator Co., Ltd.**
Qingdao, Shandong 266736 (CN)

(72) Inventors:
• **LIN, Changjin**
Qingdao, Shandong 266736 (CN)
• **WEN, Jiqing**
Qingdao, Shandong 266736 (CN)
• **WANG, Bin**
Qingdao, Shandong 266736 (CN)
• **YANG, Ruihua**
Qingdao, Shandong 266736 (CN)
• **LI, Wenyu**
Qingdao, Shandong 266736 (CN)

(74) Representative: **Petrz, Gilberto Luigi et al**
GLP S.r.l.
Viale Europa Unita, 171
33100 Udine (IT)

(54) **CLOTHES DRYER AND DRYING CONTROL METHOD THEREFOR**

(57) A clothes dryer and a drying control method therefor. The clothes dryer comprises a cabinet (20), a drum (30), an electric motor (32), a compressor (71), a fan (60), a resistive sensor (41), a capacitive sensor (42), and a processor (50), wherein the processor (50) is configured to execute a first drying task, which is configured to control the compressor (71) to operate at a first frequency, the fan (60) to operate, and the electric motor (32) to operate; when executing the first drying task, the processor (50) is further configured to control the duration of the running of the first drying task; the processor (50) is configured to execute a second drying task when a humidity value is less than a first threshold and the moisture content of the air is less than a second threshold, the second drying task being configured to control the compressor (71) to operate at a second frequency, the fan (60) to operate, and the electric motor (32) to operate continuously; and when executing the second drying task, the processor (50) is further configured to control the duration of the running of the second drying task.

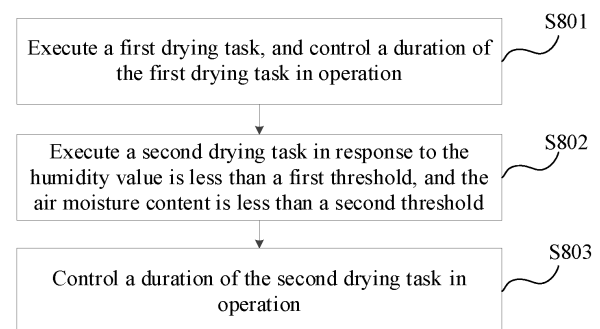


FIG. 8

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Description

[0001] The present application claims priority to Chinese Patent Application No. 202411061041.1, filed with the China National Intellectual Property Administration on Aug. 2, 2024, and Chinese Patent Application No. CN202411339554.4, filed with the China National Intellectual Property Administration on Sep. 24, 2024, which are incorporated herein by reference in their entirety.

TECHNICAL FIELD

[0002] Some embodiments of the present application relate to the technical field of household appliances, and in particular to a clothes dryer and a drying control method therefor.

BACKGROUND

[0003] After clothes are washed and spin-dried, they usually need to be air-dried before normal use, and the air-drying process generally takes a long time. In order to shorten the air-drying duration, related technologies typically adopt a clothes dryer or provide a corresponding drying function in a washing machine.

[0004] In order to determine a drying end time, humidity needs to be accurately detected. Clothes dryers in the related art usually employ a resistive humidity detection device. However, when clothes are entangled or excessively piled up, the resistive humidity detection device can only detect the moisture content of clothes on the surface, while moisture inside the clothes is not easily detected by the resistive humidity detection device. As a result, the clothes dryer cannot accurately determine the drying end time, which may lead to clothes being insufficiently dried or over-dried. This not only wastes drying resources but also results in a poor drying effect.

SUMMARY

[0005] Some embodiments of the present application provide a clothes dryer and a drying control method therefor, which can solve the problem that, when clothes are entangled or excessively piled up, a resistive humidity detection device can only detect the moisture content of clothes on the surface, while moisture inside the clothes is not easily detected by the resistive humidity detection device, resulting in inaccurate determination of a drying end time by the clothes dryer, which further leads to clothes being insufficiently dried or over-dried. This not only wastes drying resources but also results in a poor drying effect.

[0006] In one aspect, a clothes dryer is provided in some embodiments of the present application, comprising:

a housing, the housing being configured as an outer casing of the clothes dryer;

a drum, the drum being disposed in the housing, and a drying chamber being formed in the drum;
a motor, the motor being connected to the drum, and the motor being configured to drive the drum to rotate relative to the housing;
a compressor;
a fan, the fan being configured to deliver an airflow into the drum;
a resistive sensor, the resistive sensor being configured to at least acquire a humidity value of clothes to be dried;
a capacitive sensor, the capacitive sensor being configured to at least acquire an air moisture content in the drum; and
a processor, the processor being configured to:

execute a first drying task, the first drying task being configured to control the compressor to operate at a first frequency, the fan to operate, and the motor to operate; and the processor being further configured to control a duration of the first drying task in operation in response to executing the first drying task, where the resistive sensor operates to acquire the humidity value used to adjust the duration of the first drying task, and the capacitive sensor operates to acquire the air moisture content not used to adjust the duration of the first drying task; and
execute a second drying task in response to the humidity value is less than a first threshold and the air moisture content is less than a second threshold, the second drying task being configured to control the compressor to operate at a second frequency, the fan to operate, and the motor to continuously operate, where the second frequency is less than the first frequency; and the processor being further configured to control a duration of the second drying task in operation in response to executing the second drying task, where the capacitive sensor operates to acquire the air moisture content used to adjust the duration of the second drying task, and the resistive sensor operates to acquire the humidity value not used to adjust the duration of the second drying task.

[0007] The motor drives the drum to rotate so that clothes to be dried in the drum come into contact with the resistive sensor, thereby obtaining a humidity value of the clothes to be dried. The humidity value indicates the moisture condition of the portion of clothes in contact with the resistive sensor. Moreover, since the rotation of the drum drives the clothes to be dried continuously move, the resistive sensor can detect the humidity of different parts of the clothes and can roughly determine the drying status of the clothes to be dried, so as to determine whether to continue executing the first drying task. However, rotation of the clothes in the drum may cause

entanglement or knotting, such that central regions of the entangled portions are unable to contact the resistive sensor. Therefore, a non-contact capacitive sensor is introduced to detect the humidity. The capacitive sensor detects the air moisture content throughout the drum, and based on the air moisture content, indirectly determines whether the clothes to be dried are insufficiently dried due to conditions such as entanglement or knotting, thereby improving the accuracy of dryness determination. By setting different compressor frequencies for the first drying task and the second drying task, clothes with a higher moisture content can be quickly dried during the first drying task, while clothes with lower moisture content can be slowly dried during the second drying task. The drying efficiency and resource allocation are both taken into account, thereby improving the drying quality of the clothes. In combination with the improved accuracy of dryness determination, the clothes dryer can stop drying the clothes under slow-drying conditions, reducing unnecessary energy consumption during drying.

[0008] In some embodiments of the present application, the processor is configured to:

continue executing the first drying task in response to the humidity value is less than the first threshold, and the air moisture content exceeds the second threshold.

[0009] When it is determined based on the humidity value acquired by the resistive sensor that the drying task should switch from rapid drying to slow drying, but the air moisture content acquired by the capacitive sensor indicates that the drying task has not met the conditions for slow drying, the air moisture content acquired by the capacitive sensor shall prevail, and the slow drying operation shall not be executed; instead, the fast drying operation shall be continued, thereby reducing the problems of prolonged drying duration and poor drying efficiency caused by prematurely entering slow drying.

[0010] In some embodiments of the present application, the processor is further configured to:

control the second drying task to terminate in response to the processor satisfies a preset condition, the compressor and the fan to stop operating in response to the second drying task terminates, and the motor to continuously operate for a first preset duration and then stop operating.

[0011] For example, a predetermined duration control is used as a fallback to determine the end time point; that is, the preset condition is that the duration of the second drying task in operation is completed.

[0012] Further, before reaching the fallback end time point, the actual humidity state in the drum can be determined in a timely manner through real-time detection by the capacitive sensor. If the actual humidity state in the drum has met the drying end state, the drying task can be ended directly without waiting for the end time point; that is, the preset condition is that the duration of the second drying task in operation is incomplete and the air moisture content is less than a third threshold, where the third threshold is lower than the second threshold.

[0013] Furthermore, before reaching the end time point controlled by the preset duration, multiple air moisture content values can be obtained through real-time detection by the capacitive sensor. If these values change little within a continuous time period, it indicates that the moisture content of the clothes changes little, and it can be inferred that the clothes are in a dried state. Thus, it can be determined that the drying task can be ended, that is, the preset condition is that, within a third preset duration of the duration of the second drying task in operation that is incomplete, a variation amount of the air moisture content is less than a preset variation threshold.

The moisture content of the clothes during the second drying task is close to the dried state of the clothes in the later stage of the execution of the second drying task, relative to the moisture content of the clothes during the first drying task. Therefore, the second drying task may be ended using multiple determination methods, so that the clothes dryer can terminate the second drying task in a timely manner when any end condition is satisfied, reducing the waste of drying resources caused by the continuous output due to the clothes dryer undergoing an unexpected failure and failing to satisfy a certain end condition.

[0014] Since the possibility of a clock failure is generally low, the duration control scheme can be used as a fallback scheme. When executing the duration control scheme, it is not necessary to consider the detection results of the resistive sensor and the capacitive sensor. Because the fallback duration control scheme is set to ensure that the clothes are fully dried, the duration is generally longer than the actual drying duration of the clothes. Therefore, by detecting the air moisture content in real time, the actual time point at which the clothes are dried can be more accurately determined, thereby enabling the second drying task to be ended in advance and saving drying resources. The dielectric constant detected by the capacitive sensor needs to be processed and converted to obtain the air moisture content. When the clothes are being dried, the small amount of water causes the dielectric constant to change very little; that is, the air moisture content changes very little. Therefore, by comparing the air moisture content over a period of time and observing small variations, it can be inferred that the clothes are currently in a drying state, thereby reducing the waste of drying resources caused by an inappropriate air moisture content threshold set for ending the second drying task.

[0015] In other embodiments, the processor is further configured to:

continue executing the second drying task in response to the duration of the second drying task in operation is completed, and the air moisture content exceeds the third threshold.

[0016] Although the above duration scheme can determine the ending time point of the second drying task, it is still necessary to determine whether the second drying

task meets the end condition based on the air moisture content acquired by the capacitive sensor. If the air moisture content exceeds a third threshold, it indicates that the clothes in the same space have a high moisture content, and thus the second drying task needs to continue executing, reducing the risk of insufficient drying and thereby improving the drying quality.

[0017] In still other embodiments, the processor is further configured to:

execute a drying preparation task before executing the first drying task, the drying preparation task being configured to control the compressor and the fan not to operate, and the motor to operate for a second preset duration, where the resistive sensor operates to acquire the humidity value not used to adjust the operating states of the compressor, the fan and the motor, and the capacitive sensor operates to acquire the air moisture content not used to adjust the operating states of the compressor, the fan and the motor.

[0018] By setting the drying preparation task before the drying task, the drum is driven to rotate by simple rotation of the motor, so that the clothes to be dried can be loosened as much as possible before being dried, thereby reducing the risk of entanglement and knotting, enabling the clothes to fully contact the air in the drying chamber, facilitating the removal of moisture during the drying process, and improving the drying efficiency.

[0019] In some embodiments, the clothes dryer further comprises the capacitive sensor configured to at least acquire an air temperature value in the drum; the processor is further configured to:

control the execution of a first drying sub-task in response to the second drying task is executed and the air temperature value is low, for example, the air temperature value is less than a fourth threshold; the first drying sub-task is configured to control the compressor to operate at the second frequency, the fan to operate at a first rotation speed, and the motor to continuously operate, where the capacitive sensor operates to acquire the air temperature value used to adjust the duration of the first drying sub-task, and the capacitive sensor operates to acquire the air temperature value not used to adjust the duration of the first drying sub-task, and the resistive sensor operates to acquire the humidity value not used to adjust the running duration of the first drying sub-task.

[0020] The signal acquired by the capacitive sensor can be separated to obtain a sensed temperature, so that during the drying process, the rotation speed of the fan can be adjusted according to the temperature condition, thereby enabling reasonable utilization of drying heat to dry the clothes to be dried, reducing ineffective output of the air volume of the fan, and saving drying resources.

[0021] In some embodiments of the present application, the processor is further configured to:

control the compressor to stop operating in response to the first drying sub-task is executed and the air moisture content is less than the third threshold; in response to controlling the compressor to stop operating, the proces-

sor is further configured to control the fan and the motor to continuously operate for the first preset duration, the third threshold being less than the second threshold, where the resistive sensor operates to acquire the humidity value not used to adjust the first preset duration, the capacitive sensor operates to acquire the air temperature value that is not used to adjust the first preset duration of the first drying sub-task, and the capacitive sensor operates to acquire the air moisture content not used to adjust the first preset duration.

[0022] In response to a low air moisture content is detected during the execution of the first drying sub-task, the compressor can be turned off to terminate the first drying sub-task, reducing the energy consumption of the compressor, and maintaining the operation of the fan and the motor for a period of time to loosen the clothes, so as to increase the contact area between different parts of the clothes and the air in the drying chamber, thereby further reducing a small amount of moisture that may remain in the clothes after being loosened by utilizing residual heat and dry air.

[0023] In other embodiments, the processor is further configured to:

control the execution of a second drying sub-task in response to the second drying task is executed and the air temperature value is high, for example, the air temperature value satisfies the fourth threshold; where the second drying sub-task is configured to control the compressor to operate at the second frequency, the fan to operate at a second rotation speed, and the motor to continuously operate; where the second rotation speed is lower than the first rotation speed.

[0024] In some embodiments, the compressor is controlled to stop operating in response to the second drying sub-task is executed and the air moisture content is less than the third threshold; in response to controlling the compressor to stop operating, the processor is further configured to control the fan and the motor to continuously operate for the first preset duration, the third threshold being lower than the second threshold, where the resistive sensor operates to acquire the humidity value not used to adjust the first preset duration, the capacitive sensor operates to acquire the air temperature value not used to adjust the first preset duration of the first drying sub-task, and the capacitive sensor operates to acquire the air moisture content not used to adjust the first preset duration.

[0025] The second drying sub-task utilizes a high air temperature value in the drying chamber to maintain the drying capacity of the drying chamber, and reduces the rotation speed of the fan, thereby reducing the energy consumption of the fan, achieving reasonable allocation of drying resources during the drying process, and improving the drying effect. The selection of the ending time point of the second drying sub-task is consistent with the selection of the ending time of the first drying sub-task, both of which are determined by detecting the air moisture content. The compressor may be turned off to termi-

nate the second drying sub-task, thereby reducing the energy consumption of the compressor, and maintaining the operation of the fan and the motor for a period of time to loosen the clothes, so as to increase the contact area between different parts of the clothes and the air in the drying chamber, thereby further reducing a small amount of moisture that may remain in the clothes after being loosened by utilizing residual heat and dry air.

[0026] In a second aspect, some embodiments of the present application provide a drying control method applied to a clothes dryer, the clothes dryer comprising:

a housing, the housing being configured as an outer casing of the clothes dryer;
 a drum, the drum being disposed in the housing, and a drying chamber being formed in the drum;
 a motor, the motor being connected to the drum, and the motor being configured to drive the drum to rotate relative to the housing;
 a compressor;
 a fan, the fan being configured to deliver an airflow into the drum;
 a resistive sensor, the resistive sensor being configured to at least acquire a humidity value of clothes to be dried; and
 a capacitive sensor, the capacitive sensor being configured to at least acquire an air moisture content in the drum.

[0027] The method comprises:

executing a first drying task, the first drying task being configured to control the compressor to operate at a first frequency, the fan to operate, and the motor to operate; controlling a duration of the first drying task in operation in response to executing the first drying task, where the resistive sensor operates to acquire the humidity value used to adjust the duration of the first drying task, and the capacitive sensor operates to acquire the air moisture content not used to adjust the duration of the first drying task; executing a second drying task in response to the humidity value is less than the first threshold and the air moisture content is less than the second threshold, and the second drying task being configured to control the compressor to operate at a second frequency, the fan to operate, and the motor to continuously operate, where the second frequency is less than the first frequency; and controlling a duration of the second drying task in operation in response to executing the second drying task, where the capacitive sensor operates to acquire the air moisture content used to adjust the duration of the second drying task, and the resistive sensor operates to acquire the humidity value not used to adjust the duration of the second drying task.

DESCRIPTION OF THE DRAWINGS

[0028] In order to more clearly describe the implementations in the embodiments of the present application or in the related art, the accompanying drawings for describing the embodiments or the related art will be briefly described below. Apparently, the accompanying drawings in the description below show some embodiments of the present application, and those of ordinary skill in the art may still derive other drawings from these accompanying drawings.

FIG. 1 is a schematic diagram of a clothes dryer in some embodiments of the present application.

FIG. 2 is a first schematic diagram of a partial internal structure of a clothes dryer in some embodiments of the present application.

FIG. 3 is a second schematic diagram of a partial internal structure of a clothes dryer in some embodiments of the present application.

FIG. 4 is a first schematic diagram of the structure of a sensor assembly inside a clothes dryer in some embodiments of the present application.

FIG. 5 is a second schematic diagram of the structure of a sensor assembly inside a clothes dryer in some embodiments of the present application.

FIG. 6 is a third schematic diagram of the structure of a sensor assembly inside a clothes dryer in some embodiments of the present application.

FIG. 7 is a schematic diagram of the drying principle of a clothes dryer provided in some embodiments of the present application.

FIG. 8 is a first schematic flow chart of a drying control method provided in some embodiments of the present application.

FIG. 9 is a second schematic flow chart of a drying control method provided in some embodiments of the present application.

FIG. 10 is a schematic diagram of the composition of the partial internal structure of a clothes dryer provided in some embodiments of the present application.

Description of reference numerals:

[0029] 10. door body; 20. housing; 21. front structural panel; 211. front support; 212. loading port; 213. horizontal baffle; 22. contact rail; 23. support wheel; 30. drum; 31. drying chamber; 32. motor; 40. sensor assembly; 41. resistive sensor; 411. sensing strip; 42. capacitive sensor; 421. sensing block; 43. sensor mounting plate; 431. fixed plate; 432. snap-fit joint; 50. processor; 60. fan; 71. compressor; 72. condenser; 73. evaporator.

DETAILED DESCRIPTION OF EMBODIMENTS

[0030] In order to make the objectives, implementations and advantages of embodiments of the present

application clearer, the technical solutions in the exemplary embodiments of the present application will be described clearly and completely below with reference to the accompanying drawings in the embodiments of the present application. Apparently, the exemplary embodiments described are some of, rather than all of, the embodiments of the present application.

[0031] It should be noted that the brief description of terms in the present application is only for facilitating the understanding of the embodiments described herein-after, and is not intended to limit the embodiments of the present application. Unless otherwise specified, these terms should be understood according to their ordinary and customary meanings.

[0032] In addition, the terms "comprise" and "have", as well as any variations thereof, are intended to cover a non-exclusive inclusion, such that a product or device comprising a series of components is not necessarily limited to those components explicitly listed, but may include other components not explicitly listed or inherent to such product or device.

[0033] In the description of the present application, it should be understood that orientation or position relationships indicated by terms such as "center", "upper", "lower", "front", "rear", "left", "right", "vertical", "horizontal", "top", "bottom", "inner", and "outer" are based on orientation or position relationships shown in the accompanying drawings and are merely for ease of description of the present application and simplification of the description, rather than indicating or implying that the apparatuses or elements referred to must have a specific orientation or be constructed and operated in a specific orientation, and therefore cannot be construed as limiting the embodiments of the present application.

[0034] The terms "first" and "second" are configured for descriptive purposes only and are not to be construed as indicating or implying relative importance or implicitly indicating the number of technical features indicated. Thus, features limited by "first" and "second" may expressly or implicitly include one or more features. In the description of the present application, unless otherwise specified, "a plurality of" means two or more.

[0035] In the description of the present application, it should be noted that, unless otherwise expressly specified or limited, the terms "disposed," "linked," and "connected" shall be interpreted broadly. For example, they may refer to a fixed connection, a detachable connection, or an integral connection; a mechanical connection or an electrical connection; a direct connection or an indirect connection via an intermediate medium; or internal communication between two components. The specific meanings of the above terms in the present application may be understood by those of ordinary skill in the art according to specific circumstances.

[0036] In the related art, a clothes dryer adopts a resistive humidity detection device to detect the moisture content of clothes. The resistive humidity detection device is a contact-type detection device; that is, it is ne-

cessary to contact the clothes, and after the contact, the moisture content of the clothes is obtained by converting the variation in resistance value caused by moisture on the clothes. However, this method may be accurate for detecting the surface moisture content of clothes, but for clothes that are entangled and wrapped, waterproof clothes, down jackets, or in cases where the drying amount is small, such that the clothes cannot contact the resistive humidity detection device, the detection method is inaccurate and cannot obtain the actual moisture content. As a result, the clothes can only be dried according to a preset fixed duration, which may cause the clothes to be over-dried, resulting in a waste of drying energy, or not completely dried, thereby reducing the drying quality and affecting user experience.

[0037] In view of this, a clothes dryer provided in some embodiments of the present application uses the detection result of a resistive sensor as a basis, and further determines, based on the detection result of a capacitive sensor, whether the clothes enter a supplemental drying stage. The detection result of the capacitive sensor may also be used to assist in determining whether the supplemental drying duration meets actual requirements, thereby reducing the cases of insufficient drying or over-drying caused by solely using the resistive detection method, and aiming to solve the above problems in the related art.

[0038] The clothes dryer provided in the present application is a device for removing moisture from clothes. Those skilled in the art can understand that various electrical appliances having a similar moisture removal function, such as a dryer or a washing machine with a drying function, may also be configured with the control scheme of the present application and corresponding device configurations.

[0039] The technical solutions in the embodiments of the present application will be clearly and completely described below with reference to the accompanying drawings in the embodiments of the present application, taking a clothes dryer as an example. Apparently, the described embodiments are only some of the embodiments of the present application, rather than all the embodiments. Based on the embodiments of the present application, all other embodiments obtained by those of ordinary skill in the art without creative efforts shall fall within the scope of protection of the present application.

[0040] It should be first noted that, in the embodiments of the present application, when a user faces a door body of the clothes dryer, the width direction of the clothes dryer, that is, the left-right direction, corresponds to the X-axis direction in the accompanying drawings; the depth direction of the clothes dryer, that is, the depth direction of a chamber, corresponds to the front-back direction, and corresponds to the Y-axis direction in the accompanying drawings; and the height direction of the clothes dryer, that is, the up-down direction, corresponds to the Z-axis direction in the accompanying drawings. The width of the door body of the clothes dryer is a dimension along the X-axis direction when the door body is closed, the thickness

of the door body is a dimension along the Y-axis direction when the door body is closed, and the height of the door body is a dimension along the Z-axis direction.

[0041] FIG. 1 is a schematic diagram of a clothes dryer in some embodiments of the present application; FIG. 2 is a first schematic diagram of a partial internal structure of a clothes dryer in some embodiments of the present application. Referring to FIGS. 1 and 2, the clothes dryer in the embodiment of the present application includes a door body 10 and a housing 20, where the housing 20 includes a front structural panel 21, a drum 30 is disposed inside the housing 20, a drying chamber 31 is formed inside the drum 30, and the drying chamber 31 is configured to accommodate clothes to be washed and/or dried.

[0042] The door body 10 is mounted on the front side of the front structural panel 21 and is configured to open or close the drying chamber.

[0043] One drying chamber 31 may be provided, or a plurality of drying chambers 31 may be provided, and arranged at intervals along the height direction and/or the width direction of the housing 20 of the clothes dryer.

[0044] In some embodiments, the door body 10 is rotatably mounted on the housing 20 to open or close the drying chamber 31. By way of example, the door body 10 is rotatably connected to the housing 20 through a hinge assembly.

[0045] When a plurality of drying chambers 31 are provided, one door body 10 may be provided, and the plurality of drying chambers share one door body 10; alternatively, a plurality of door bodies 10 may be provided and arranged corresponding to different drying chambers 31.

[0046] In some embodiments, the door body 10 is also slidably mounted on the housing 20 to open or close the drying chamber 31.

[0047] By way of example, the door body 10 is slidably connected to the housing 20 through a slide rail assembly. When a plurality of drying chambers 31 are provided, a plurality of door bodies 10 may be provided correspondingly and are arranged in correspondence with different drying chambers 31.

[0048] FIG. 3 is a second schematic diagram of a partial internal structure of a clothes dryer in some embodiments of the present application. Referring to FIG. 3, a sensor assembly 40 is disposed on the rear side of the front structural panel 21, and a humidity sensor is disposed on the sensor assembly 40.

[0049] By way of example, the front structural panel 21 includes a front support 211 and a loading port 212 provided at a middle opening of the front support 211, and an opening size of the loading port 212 is smaller than a drum diameter of the drum 30, so as to reduce the overflow possibility of clothes, increase the loading amount of clothes, and further limit the front end of the drum 30 by means of a small-diameter opening, thereby improving rotation stability of the drum 30, and reducing noise caused by rotational displacement.

[0050] In some embodiments, a horizontal baffle 213 is provided at the bottom of the loading port 212, and the horizontal baffle 213 is integrally connected with the front support 211 to improve the overall supporting strength of the front structural panel 21, and further limit the position of clothes in the drum 30, thereby reducing the possibility of automatic overflow of clothes. Meanwhile, the contact area with clothes may be increased through a position close to a lower portion of the drum 30, thereby facilitating the humidity sensor disposed on the horizontal baffle 213 to contact the clothes, and further obtaining the humidity condition inside the drum 30 through the contact.

[0051] A motor is further disposed in the housing 20, and an output end of the motor is in transmission connection with the drum 30 to drive the drum 30 to rotate, thereby driving clothes in the drum 30 to continuously move during the drying process, so as to achieve the effects of loosening and increasing the drying contact area.

[0052] Further referring to FIG. 3, in some embodiments, the front structural panel 21 is further provided with a contact rail 22 configured to be connected with the drum 30, and support wheels 23 configured to support stable rotation of the contact rail 22. The contact rail 22 abuts against the support wheels 23, and both the contact rail 22 and the support wheels 23 are rotatably connected with the front structural panel 21.

[0053] Two support wheels 23 may be provided, and the two support wheels 23 are respectively arranged at left and right sides of the rear end of the front structural panel 21 and located at a lower half portion of the contact rail 22, so as to support the contact rail 22 from both sides and reduce the friction loss of the contact rail 22 during rotation supporting.

[0054] FIG. 4 is a first schematic diagram of the structure of a sensor assembly inside a clothes dryer in some embodiments of the present application; FIG. 5 is a second schematic diagram of the structure of a sensor assembly inside a clothes dryer in some embodiments of the present application; and FIG. 6 is a third schematic diagram of the structure of a sensor assembly inside a clothes dryer in some embodiments of the present application. Referring to FIGS. 4, 5, and 6, the humidity sensor in the embodiments of the present application includes a resistive sensor and a capacitive sensor, where the resistive sensor includes a sensing strip 411, the capacitive sensor includes a sensing block 421, and a sensor mounting plate 43 is further disposed on the housing.

[0055] By way of example, the sensor mounting plate 43 includes a fixed plate 431 and snap-fit joints 432 provided on both sides of the fixed plate 431. Corresponding openings are provided on the horizontal baffle 213 at the rear end of the front structural panel 21, aligned with the positions of the snap-fit joints 432. When the snap-fit joints 432 are engaged into the connection ports, the sensor mounting plate 43 can be secured to the horizontal baffle 213, thereby allowing the humidity sen-

sors on the sensor mounting plate 43 to contact the clothes by taking advantage of the contact between the horizontal baffle 213 and the clothes.

[0056] The sensor mounting plate 43 is disposed at the bottom of the front end of an opening of the drum 30. Since the rotation of the drum 30 drives the clothes to move circumferentially along a drum wall, or in a parabolic manner, or in a rolling manner, the bottom of the drum is a necessary path for the clothes. In some embodiments, lifting ribs are provided inside the drum 30, which, on one hand, can improve the load inside the drum, such as improving the clothes loosening capability, and on the other hand, can push the clothes forward, so that the clothes move toward the sensor mounting plate 43 with the assistance of the lifting ribs.

[0057] In some embodiments, a fan is further disposed in the housing 20. The fan blows from the rear side toward the front side of the drum 30, so that the clothes move toward the sensor mounting plate 43 at the front side. This facilitates contact between the sensing strip 411 of the resistive sensor and the clothes, thereby allowing the sensing strip 411 to acquire a sensed resistance value from which the moisture content of the clothes can be analyzed.

[0058] In some embodiments, the sensor mounting plate 43 is configured in a semi-arc shape, and the curvature of the bottom of the arc is consistent with the curvature of the bottom end of the drum 30, thereby increasing the probability of contact between clothes and the sensor mounting plate in the drum.

[0059] The sensing strip 411 and the sensing block 421 are respectively arranged on left and right sides of the sensor mounting plate 43, so that the two sensors have equal opportunities to detect humidity.

[0060] By way of example, the sensing strip 411 and the sensing block 421 may adopt the following distribution design:

[0061] The sensing strip 411 is configured as a strip shape, and the direction of the strip is oblique along an arc direction, thereby increasing the probability of contact between the sensing strip 411 and the clothes.

[0062] One or a plurality of sensing strips 411 may be provided, and the plurality of sensing strips 411 are arranged in parallel up and down. This not only increases the probability of contact but also allows data from the plurality of sensing strips 411 to be averaged and fitted, thereby improving the accuracy of humidity detection.

[0063] The sensing block 421 is configured as a square structure, and a plurality of sensing blocks 421 are provided and are inclined along the arc direction.

[0064] In some embodiments, the distribution of the sensing blocks 421 on the sensor mounting plate 43 is symmetrical with respect to the distribution of the sensing strips 411 on the sensor mounting plate 43.

[0065] Since water is a good conductor of electricity, and the resistance of wet clothes is low, as the clothes gradually become dry, the resistance value gradually increases. The resistive sensor 41 generally includes a

voltage source, a known resistor, and the sensing strip 411. The sensing strip 411 is generally made of a conductive material. In response to clothes contact the sensing strip 411, moisture in the clothes changes the resistance value of the sensing strip 411, and the resistance value of the sensing strip 411 is calculated by measuring a voltage drop.

[0066] There is a certain relationship between the resistance value obtained by the sensing strip 411 and a humidity value of the clothes, and this relationship can be obtained in advance through experiments. Generally, the higher the humidity, the lower the resistance; and the lower the humidity, the higher the resistance. For example, the resistance values of the sensing strips can be measured by using samples with different known humidity values, and after statistical analysis, a calibration curve or relationship between resistance values and humidity values is established. In this way, based on the resistance value obtained by the sensing strip 411 and the established calibration curve or relationship, the humidity value corresponding to that resistance value can be obtained, and this humidity value is the data output by the resistive sensor 41 after acquisition.

[0067] The capacitive sensor 42, by detecting changes in a dielectric constant of the medium within a certain spatial distance and using the corresponding relationship between the dielectric constant and a spatial moisture content, enables non-contact spatial detection of the moisture content. Since this detection is not affected by the position of the clothes, the measurement results are more accurate.

[0068] The corresponding relationship between the dielectric constant and the spatial moisture content is obtained in advance through experiments. For example, during the pre-production testing phase of the clothes dryer, clothes with different known moisture contents are placed inside the drum 30 of the clothes dryer, and the capacitive sensor 42 is used to measure their respective dielectric constants. A corresponding relationship table between the dielectric constant and the moisture content is thereby obtained. The experimental data are then fitted to derive the corresponding relationship between the dielectric constant and the spatial moisture content, so that in subsequent use, the clothes dryer can directly output the corresponding spatial moisture content based on the values detected by the capacitive sensor 42.

[0069] FIG. 7 is a schematic diagram of the drying principle of a clothes dryer provided in some embodiments of the present application. Referring to FIG. 7, the clothes dryer includes a compressor 71, a condenser 72, an evaporator 73, and a connecting pipeline. The compressor 71 compresses a low-pressure gaseous refrigerant into a high-pressure and high-temperature gaseous refrigerant. A large amount of heat is generated in this process. In response to the high-temperature refrigerant passing through the condenser 72 (a first heat exchanger), heat will be transferred to the air around the condenser 72. The hot air is then sent into the drum 30 of

the clothes dryer to dry the clothes. In the process of drying the clothes, the humid and hot air is guided to pass through the evaporator 73 (a second heat exchanger), where the refrigerant absorbs the heat in the air, cools the air, and condenses water vapor, and the water is collected in a water tank or discharged. The cooled refrigerant is transported to the compressor 71 through the connecting pipeline, so that it is compressed again by the compressor 71 and enters the next cycle. This cycle process enables the clothes dryer to efficiently utilize thermal energy and reduce energy consumption.

[0070] By way of example, during the execution of the drying task, the clothes dryer can be divided into different drying stages according to different moisture contents, and the processor 50 of the clothes dryer needs to control different components to perform corresponding operations for each drying stage. The drying stages include:

[0071] Preparation stage: At this time, only the motor 32 is started to drive the drum 30 to rotate and loosen the clothes, reducing the adverse effects of agglomeration of the clothes during loading on drying, and also enabling the resistive sensor 41 to contact the clothes during the loosening process, thereby obtaining the initial humidity value of the clothes, and then determining, based on the initial humidity value, the duration of the first drying task in operation in the main drying stage.

[0072] Main drying stage: the moisture content of the clothes is 20~30% or more, and the clothes dryer needs to execute the main drying stage at this time. In the main drying stage, the compressor 71 is started to deliver heat for drying the clothes into the drum 30, the fan 60 is started to deliver airflow into the drum 30 for drying the clothes, and the motor 32 is started to drive the drum 30 to rotate and loosen the clothes.

Ironing stage: the moisture content of the clothes is 8~15%, and the humidity of the clothes is very suitable for ironing at this time, so the clothes dryer suspends the operation of the compressor 71 and the fan 60 at this time, so that the user can take out the clothes from the clothes dryer for ironing in this stage; it should be understood that this stage is a stage where the user can take out the clothes from the clothes dryer for ironing, that is, if the user has an ironing demand, the processor 50 of the clothes dryer is at a stage of suspending the operation of each component at this stage, waiting for the user's ironing operation, and performing the next step of operation only after receiving a signal from the user to continue the operation, and if the user has no ironing demand, this stage may be omitted, and the process may directly proceed to the supplemental drying stage.

supplemental drying stage: the moisture content of the clothes is 3~8%, and the clothes have reached the final stage of drying at this time, and it is necessary to determine whether to terminate the drying in advance or extend the drying duration by using the

supplemental drying operation; this stage is also an important stage for the main identification and processing of the processor 50 of the present application. Since the clothes are in the final stage of drying during supplemental drying, from the perspective of saving energy and avoiding over-drying, the frequency of the compressor 71 can be reduced, thereby reducing the heat delivered into the drum 30, and further avoiding over-drying. The fan 60 and the motor 32 will not cause over-drying of the clothes, and therefore do not need to be decelerated or turned off. In some embodiments, from the perspective of energy saving, if the temperature of the clothes is high, the drying rate is also fast, and the wind speed of the fan 60 can be reduced at this time, so that the lower wind speed output can be used on the premise of not affecting the drying of the clothes, thereby further reducing energy loss.

[0073] Cold air stage (i.e., ready-to-wear stage): the moisture content of the clothes is -3% to 3%, and the clothes dryer has completed the drying task at this time, and the drying function of the compressor 71 is turned off if there is no other demand, waiting for the user to take out the clothes; if a standard deviation of the detected moisture content is less than a preset standard deviation threshold, it indicates that the moisture content is stable, and it can also indicate that the clothes are dry, and the clothes dryer can enter the cold air stage at this time. The possible reason for a negative moisture content value is that the moisture content in the present application is determined based on a corresponding relationship between the moisture content obtained from a preset reference parallel experiment and the dielectric constant acquired by the capacitive sensor 42, rather than an absolute moisture content of the clothes. In response to the moisture content of the clothes set in the experiment is higher than the absolute moisture content, the moisture content in the cold air stage obtained through proportional conversion may be negative.

[0074] The following describes how the clothes dryer implements the drying control method by taking the processor of the clothes dryer as an execution entity, as an example.

[0075] The technical solutions of the present application will be described in detail below in conjunction with specific embodiments. The following specific embodiments can be combined with each other, and the same or similar concepts or processes may not be repeated in some embodiments.

[0076] FIG. 8 is a first schematic flow chart of a drying control method provided in some embodiments of the present application. As shown in FIG. 8, the method includes the following steps:

S801. Execute a first drying task, and control a duration of the first drying task in operation.

[0077] The first drying task corresponds to the main drying stage in the drying stages. Execute the first drying

task, which is configured to control the compressor to operate at a first frequency, the fan to operate, and the motor to operate. The resistive sensor operates to acquire a humidity value used to adjust the duration of the first drying task in operation, and the capacitive sensor operates to acquire an air moisture content not used to adjust the duration of the first drying task in operation.

[0078] Therefore, in response to executing the first drying task, the processor needs to control the compressor to operate at the first frequency, so that the heat generated by the compressor is delivered into the drum to dry the clothes by using the heat; the processor controls the fan to operate at a first rotation speed, so that the moisture on the clothes can enter the compressor cycle faster under the drive of the airflow, thereby improving the drying efficiency; the motor is controlled to start to drive the drum to rotate, thereby driving the clothes in the drum to perform a tumbling motion in the drum, changing the contact parts of the clothes with heat and airflow, and further improving the drying efficiency.

[0079] By way of example, during the execution of the first drying task, the resistive sensor and the capacitive sensor are always in operation, and the processor acquires the data collected by both, but the duration of the first drying task in operation is determined based on the humidity value acquired by the resistive sensor, rather than the air moisture content acquired by the capacitive sensor, so that a conventional resistive sensor can be used to quickly determine the drying degree of the clothes. The resistive sensor has a larger detection range for humidity than the capacitive sensor, and there is no need to obtain a fitted moisture content through a large number of experiments like the capacitive sensor. Using the resistive sensor to detect and determine the humidity of the clothes is simple over a large range, the computational complexity of the processor can be reduced compared with the capacitive sensor.

[0080] Since the humidity in the drum continuously decreases during the operation of the compressor, the humidity value corresponding to the detected sensed resistance value can be determined based on the preset corresponding relationship between the sensed resistance value and the moisture content by using the sensed resistance value acquired by the resistive sensor.

[0081] The preset corresponding relationship between the sensed resistance value and the air moisture content is obtained through the sensed resistance values of clothes with different moisture contents detected in advance.

[0082] In some embodiments, the first drying task is in the main drying stage during the drying task of the clothes dryer, and a processor is disposed in the clothes dryer, used to control the running duration of the main drying stage.

[0083] The first drying task is configured to control the compressor to operate, so that the moisture contained in the clothes in the drum is compressed, collected, and discharged together with the air. Since the moisture

content in the clothes is high at this time, the compressor needs to maintain operation at a high frequency compared with the final drying stage, thereby improving the drying efficiency.

[0084] In addition, the first drying task is also configured to operate the fan. The operation of the fan can enhance the circulation of air in the drum, so that moisture in the clothes is continuously transferred into the air, and then the moisture in the air is continuously removed by the compressor.

[0085] In addition, the first drying task is also configured to operate the motor. The operation of the motor causes the drum to rotate, thereby tumbling the clothes to be dried inside the drum, increasing the contact area between the clothes and the air, and continuously reducing the moisture content in the clothes.

[0086] S802. Execute a second drying task in response to the humidity value is less than the first threshold, and the air moisture content is less than the second threshold.

[0087] The second drying task corresponds to the supplemental drying stage in the drying stages. Execute the second drying task, which is configured to control the compressor to operate at a second frequency, the fan to operate, and the motor to continuously operate, the second frequency being lower than the first frequency.

[0088] The processor obtains the humidity value acquired by the resistive sensor, and the humidity value is a humidity value corresponding to the resistance value after the sensing strip in the resistive sensor contacts the clothes.

[0089] To further improve the detection accuracy, the processor then obtains the detection result of the capacitive sensor from the capacitive sensor, that is, the capacitive sensor detects the dielectric constant in the drying chamber in the drum.

[0090] Since the humidity value is obtained based on the resistive sensor, its result is strongly dependent on the contact between the resistive sensor and the clothes. In response to the humidity value detected by the resistive sensor is lower than the humidity value for completing the main drying stage, to improve the detection accuracy, auxiliary determination based on the air moisture content corresponding to the capacitive sensor is increased.

[0091] Since the capacitive sensor detects the humidity in the space, which includes the parts of the clothes that cannot contact the resistive sensor, the air moisture content can be used to further assist in determining whether the undetected parts meet the completion condition of the main drying stage in the drying operation.

[0092] Therefore, the dielectric constant acquired by the capacitive sensor is obtained, and the air moisture content in the drum is determined based on the preset corresponding relationship between the dielectric constant and the air moisture content.

[0093] The preset corresponding relationship between the dielectric constant and the moisture content is obtained by detecting the dielectric constants of clothes with

different moisture contents in advance.

[0094] By way of example, humidity-related signal values, such as a sensed resistance value obtained by the resistive sensor and a dielectric constant obtained by the capacitive sensor, are initial data that require preprocessing, including filtering, averaging, statistical processing, and normalization, to obtain humidity-related signal values of the drying device. Since the resistive sensor and the capacitive sensor are of different types, the signal values need to be processed separately to obtain a corresponding humidity value and air moisture content, respectively.

[0095] Filtering is performed on signal values by the underlying algorithm to enhance the effective signal output; averaging is mainly used for filtering, and normalization is primarily achieved by fitting a functional relationship based on experiments.

[0096] It should be noted that the above data preprocessing methods belong to the related technology and are not the main inventive points of the present application; therefore, further details of the processing are not described herein.

[0097] In some embodiments, when the first threshold is 4%, a corresponding resistance value detected by the sensing strip is 53500, and when the humidity value is less than or equal to 4%, the corresponding resistance value is greater than or equal to 53500, indicating that most of the clothes to be dried in the drum have been dried at this time. 53500 is a humidity signal value related to the humidity in the drying device obtained by processing the sensed resistance value obtained by the resistive sensor through data preprocessing means such as filtering, averaging, statistical analysis, and normalization.

[0098] In some embodiments, the second threshold is 10%, and when the air moisture content is less than or equal to 10%, it is further determined that the air moisture in the drying chamber is low, and it is indirectly determined that the clothes to be dried in the drum have ended the main drying stage in the above drying stages and can enter the next drying stage, such as the supplemental drying stage.

[0099] S803. Control the execution of the duration of the second drying task in operation.

[0100] The capacitive sensor operates to acquire an air moisture content used to adjust the duration of the second drying task, and the resistive sensor operates to acquire a humidity value not used to adjust the duration of the second drying task in operation.

[0101] Since the second drying task needs to dry the clothes more gently to avoid over-drying, the compressor can be controlled to operate at the second frequency, and the second frequency is set to be lower than the first frequency, thereby reducing the drying temperature to reduce the damage to the clothes caused by high temperature and reduce the risk of over-drying damage. Since the drying airflow has no negative impact on the over-drying result of the clothes, there is no need to

reduce the rotation speed of the fan, and the processor controls the fan to operate at the first rotation speed, so that the moisture on the clothes can enter the compressor cycle faster under the drive of the airflow, thereby improving the drying efficiency. Similar to the first drying task, the motor is controlled to start to drive the drum to rotate, thereby causing the clothes in the drum to perform a tumbling motion in the drum, changing the contact parts of the clothes with heat and airflow, and further improving the drying efficiency.

[0102] By way of example, during the execution of the second drying task, the resistive sensor and the capacitive sensor are always in operation, and the processor will obtain the data acquired by both, but the running duration of the compressor and the fan is determined based on the air moisture content acquired by the capacitive sensor, rather than the humidity value acquired by the resistive sensor, so that the characteristic of the capacitive sensor that can acquire the air moisture content inside the drum is utilized to reflect the humidity of the clothes more accurately. Compared with the resistive sensor, it can reflect the internal humidity condition of tangled, knotted, or highly fluffy clothes more accurately, and reduce the phenomenon of incomplete drying of clothes caused by insufficient setting of drying duration.

[0103] In some embodiments, the second drying task is in the supplemental drying stage during the drying task of the clothes dryer.

[0104] In this embodiment, by arranging a resistive sensor that can detect the humidity of the clothes and a capacitive sensor that can detect the spatial moisture content of the drying space at the same time, the drying stage is determined based on the humidity of the clothes detected by the capacitive sensor, and the spatial moisture content is used as auxiliary determination of the start and end time of the supplemental drying stage, thereby improving the accuracy of dryness determination of the clothes, improving the drying quality of the clothes and reducing the meaningless loss of drying energy.

[0105] Based on the above embodiment, in response to the humidity value acquired by the processor from the resistive sensor is less than the first threshold during the execution of the first drying task, and the air moisture content acquired by the capacitive sensor exceeds the second threshold, the duration of the first drying task in operation may be extended under control, such that the air moisture content acquired by the capacitive sensor is less than the second threshold.

[0106] In response to executing the first drying task, the processor controls the resistive sensor and the capacitive sensor to operate continuously, and the increased duration of the first drying task in operation is determined based on the air moisture content acquired by the capacitive sensor, rather than the humidity value acquired by the resistive sensor, so that the required extended duration can be determined more accurately.

[0107] By way of example, before the clothes dryer leaves the factory, the corresponding relationship be-

tween the remaining drying duration and the moisture content acquired by the capacitive sensor can be obtained through experimental tests, so that the corresponding relationship between different moisture contents and the extended duration of the first drying task in operation can be obtained by fitting according to the acquired corresponding relationship.

[0108] For example, in response to the moisture content acquired by the capacitive sensor is 15%, the remaining drying duration until the end of the first drying task is recorded as 10 min, and in response to the duration of the first drying task in operation has been reduced to 0 and the measured moisture content is 15% at this time, it is inferred that the extended duration of the first drying task in operation is 10 min.

[0109] In some embodiments, based on the above embodiment, the completion of the second drying task can be determined in the following manner: control the compressor and the fan to be turned off to terminate the drying task, but maintain the motor to operate for a first preset duration and then be turned off, so that the heat of the tangled parts of the clothes can be released during the loosening process.

[0110] By way of example, after the completion of the second drying task, the clothes dryer can enter the cold air stage in the drying stages. In the cold air stage, the processor presets a running duration of the motor in the cold air stage, that is, the first preset duration, for example, 2 min. The first preset duration is not affected by the data acquired by the resistive sensor and the capacitive sensor.

[0111] In some embodiments, in the cold air stage, since the clothes have been dried, the fan for assistant drying is usually in a turned-off state, but the fan can also be preset according to actual needs to operate synchronously with the motor, for example, accelerating cooling through the fan.

[0112] Specifically, the conditions for determining the completion of the second drying task include:

Condition 1: Completion of the duration of the second drying task in operation.

[0113] Since the duration of the second drying task in operation is determined based on the moisture content detected by the capacitive sensor, upon completion of the determined duration of the second drying task in operation, if no other control feedback signal is received, the second drying task may be determined to be completed.

[0114] For example, in a case where signal feedback from the capacitive sensor or other components becomes abnormal during execution of the second drying task, the drying task may be terminated based on a preset duration of the second drying task in operation, thereby reducing the risk of over-drying and energy loss caused by prolonged over-drying. That is, time-based control serves as a fallback control scheme for the drying task.

[0115] It should be understood that under the condition where Condition 1 is satisfied, if the detected air moisture content does not meet a required threshold, the second

drying task is not terminated. For example, after completion of the duration of the second drying task in operation, in response to the air moisture content exceeds a third threshold, the second drying task continues to be executed.

[0116] Condition 2: Before completion of the duration of the second drying task in operation, the air moisture content acquired by the capacitive sensor is less than the third threshold, the third threshold being lower than the second threshold.

[0117] During execution of the second drying task, due to differences in fabric materials, load weight, and other factors, the actually determined duration of the second drying task in operation may be consistent with an actually required running duration. Therefore, the remaining drying duration may be determined based on the air moisture content acquired by the capacitive sensor in real time, thereby further improving the accuracy of determining the drying duration.

[0118] In some embodiments, the third threshold is 3%. In response to the air moisture content is less than 3%, the processor controls the second drying task to terminate. A first preset duration is 2 min. After the drying task is terminated, the motor is maintained in operation for 2 min before being shut down. During the 2-min period in which the motor drives the rotation of the drum, the clothes are tumbled within the drying chamber, thereby increasing the degree of loosening of the clothes and further increasing the contact area between the clothes and the air within the drying chamber, so as to reduce the moisture content of the clothes.

[0119] Condition 3: During a third preset duration, the variation amount of the air moisture content acquired by the capacitive sensor is less than a preset variation threshold.

[0120] When the variation amount of the air moisture content acquired by the capacitive sensor is small, such a condition generally occurs only when the remaining moisture is insufficient to be further removed, indicating that the clothes have reached a dried state, and the second drying task may be terminated.

[0121] In some embodiments, the capacitive sensor actually detects a spatial dielectric constant. Therefore, when no corresponding relationship between the dielectric constant detected by the capacitive sensor and the air moisture content is preset, whether the second drying task has been completed can be directly determined based on the variation of the dielectric constant, without converting it into the air moisture content.

[0122] For example, based on the dielectric constant acquired by the capacitive sensor during the third preset duration, a fitted mean value and a fitted standard deviation corresponding to the dielectric constant are determined. If the fitted mean value corresponding to the dielectric constant is less than a mean threshold and the fitted standard deviation corresponding to the dielectric constant is less than a standard deviation threshold, the compressor is turned off, and the drying operation is

completed.

[0123] In some embodiments, the third preset duration is 2 min, the mean threshold is 500, and the standard deviation threshold is 100. If, for a continuous 2-min period, the fitted mean value of the dielectric constant is less than 500 and the fitted standard deviation is less than 100, the supplemental drying is terminated in advance.

[0124] The above approach further defines the method for calculating the supplemental drying duration using the capacitive sensor. By fitting the mean and standard deviation, the instability of sensor sampling can be reduced: the mean filters out abnormal values to improve calculation accuracy, while the standard deviation assists in determining the uniformity of drying. That is, the higher the uniformity, the more accurate the dryness determination conditions.

[0125] In this embodiment, the end time of the second drying task is defined, and the capacitive sensor is used to further precisely determine the completion time point. This fully utilizes drying resources to enhance the drying effect on clothes, while also employing a time-based fallback scheme to reduce over-drying and drying resource waste caused by sensor failures. In addition, by optimizing the capacitive sensor data processing method, the computational complexity is reduced, the processing efficiency of the processor is improved, and consequently, the drying effect on clothes is further enhanced.

[0126] Before performing step S801 in the above embodiments, the method may further include the following step:

S800. Control the compressor and the fan to stop operating, and control the motor to continuously run for a second preset duration.

[0127] This operation corresponds to the preparation stage in the drying stages. While controlling the motor to run for the second preset duration, the processor controls the resistive sensor and the capacitive sensor to continue operating, and neither the resistive sensor nor the capacitive sensor is used to control the operating state of the compressor, the fan, or the motor.

[0128] The continuous operation of the motor may cause the drum to rotate alternately in forward and reverse directions, thereby reducing the risk of clothes tangling in the drum and improving the drying effect.

[0129] In this embodiment, before executing the drying task, the motor is controlled to operate so that the clothes are loosened in the drum, thereby reducing the likelihood of tangling and increasing the contact area between the clothes and the drying resources during the drying task, which in turn improves the drying effect on the clothes.

[0130] In some embodiments, the second preset duration is 1 min. After the clothes dryer starts, the motor is first driven to run for 1 min, causing the drum to rotate and driving the clothes to rotate in the drum for 1 min, achieving loosening and completing the preparation stage. It should be understood that the motor runs alternately in forward and reverse directions for 1 min, so that the drum

rotates clockwise and counterclockwise, thereby loosening the clothes. This stage is only a pre-treatment for the clothes to be dried, and does not dry the clothes, so the compressor and the fan do not need to be activated.

[0131] After performing step S803 in the above embodiments, the method may further include the following step:

S804. Continue the execution of the second drying task in response to the duration of the second drying task in operation has been completed, and the air moisture content acquired by the capacitive sensor exceeds the third threshold.

[0132] During the execution of the second drying task, the processor controls the resistive sensor and the capacitive sensor to continuously operate. The resistive sensor is not used to control the extension of the duration of the second drying task in operation, whereas the capacitive sensor is used to control the extension of the duration of the second drying task in operation.

[0133] Specifically, the extended duration is related to the air moisture content, reflecting that there may still be undried portions inside the clothes. This may occur because the initially set running duration for the second drying task is inaccurate; that is, the preset corresponding relationship between the dielectric constant and the air moisture content obtained from factory experiments may not be sufficiently accurate, or the actual clothes load differs from the clothes load used in factory experiments, resulting in a mismatched air moisture content.

[0134] Therefore, to further improve dryness determination accuracy and reduce the risk of partially dried clothes, the duration of the second drying task in operation can be re-determined based on real-time feedback from the capacitive sensor during execution of the second drying task.

[0135] In some embodiments, when the third threshold is 1%, if the air moisture content acquired by the capacitive sensor is greater than or equal to the third threshold (e.g., $\geq 1\%$), it indicates that the moisture content in the drying chamber is high, and since the clothes are a main moisture-bearing medium in the drying chamber, further drying is required. Consequently, the supplemental drying stage, i.e., the second drying task, still needs to be performed. Conversely, if the air moisture content is less than the third threshold ahead of schedule (e.g., $< 1\%$ during the execution of the second drying task), the second drying task may be ended according to the conditions for determining the completion of the second drying task as described in the above embodiments, thereby completing the supplemental drying stage.

[0136] In this embodiment, the air moisture content acquired by the capacitive sensor during the execution of the second drying task is used to determine the humidity in the drum in real time, thereby further improving dryness determination accuracy, reducing the risk of insufficient drying of clothes when ending the second drying task solely based on time, and enhancing the drying effect.

[0137] In some embodiments, the capacitive sensor may also be configured to acquire at least an air temperature value in the drum. Similar to how the air moisture content is obtained by analyzing data, including the spatial dielectric constant acquired by the capacitive sensor, the air temperature value can also be obtained by analyzing the spatial dielectric constant.

[0138] Since the air temperature value in the drum has a certain impact on the drying efficiency and is mainly determined by the operating state of the compressor, the operating states of the components of the clothes dryer may be adjusted in combination with the air temperature value to achieve an optimal drying effect using minimal drying resources.

[0139] FIG. 9 is a second schematic flow chart of a drying control method provided in some embodiments of the present application. Referring to FIG. 9, based on the above embodiments, during execution of the second drying task, the drying task is implemented by the following steps:

S901. Determine whether the air temperature value acquired by the capacitive sensor is lower than a fourth threshold; if yes, execute S902-S904; if not, execute S905-S907.

[0140] S902. Control execution of the second drying sub-task.

[0141] The second drying sub-task is configured such that the compressor operates at a second frequency, the fan operates at a second rotation speed, and the motor continuously operates; the second rotation speed is lower than the first rotation speed. During the execution of the second drying sub-task, the processor controls the resistive sensor and the capacitive sensor to continue operating, and the humidity value acquired by the resistive sensor is not used to control the running duration of the second drying sub-task. The air temperature value acquired by the capacitive sensor is used to control the running duration of the second drying sub-task.

[0142] S903. Determine whether the air moisture content acquired by the capacitive sensor is lower than the third threshold; if yes, execute S903; if not, continue executing the second drying sub-task.

[0143] S904. Control the compressor to stop operating, and control the fan and the motor to continuously operate for the first preset duration.

[0144] The third threshold is lower than the second threshold. While controlling the fan and motor to continue operating for the first preset duration, the processor controls the resistive sensor and the capacitive sensor to continue operating, and neither the resistive sensor nor the capacitive sensor is used to control the operating states of the fan and the motor.

[0145] S905. Control execution of the first drying sub-task.

[0146] The first drying sub-task is configured such that the compressor operates at the second frequency, the fan operates at the first rotation speed, and the motor continuously operates. During execution of the first dry-

ing sub-task, the capacitive sensor operates to acquire an air temperature value used to adjust the duration of the first drying sub-task, and the resistive sensor operates to acquire a humidity value not used to adjust the duration of the first drying sub-task.

[0147] S903. Determine whether the air moisture content acquired by the capacitive sensor is lower than the third threshold; if yes, execute S903; if not, continue executing the first drying sub-task.

[0148] S904. Control the compressor to stop operating, and control the fan and the motor to continuously operate for the first preset duration.

[0149] The third threshold is lower than the second threshold. While controlling the fan and motor to continue operating for the first preset duration, the processor controls the resistive sensor and the capacitive sensor to continue operating, and neither the resistive sensor nor the capacitive sensor is used to control the operating states of the fan and the motor.

[0150] In some embodiments, the fourth threshold is 50°C, the first frequency of the compressor is 60 Hz, the second frequency is 45 Hz, the first rotation speed of the fan is 2500 rpm, and the second rotation speed is 2300 rpm. When entering the supplemental drying stage to execute the second drying task, if the air temperature value acquired by the capacitive sensor is greater than 50°C, the compressor frequency can be reduced, and simultaneously, the fan speed can also be reduced, thereby reducing energy loss from both aspects; and with high-temperature assistance, the drying efficiency is not significantly affected. When the air temperature value is not greater than 50°C, although the compressor frequency may be reduced to avoid adverse effects of over-drying on the clothes, the fan speed may be maintained at the original rotation speed, thereby utilizing airflow that does not damage the clothes to improve drying efficiency.

[0151] In this embodiment, by adding a drum temperature detection function, the allocation of drying resources is further optimized. High drying efficiency in high-temperature conditions allows reduction of the fan speed to save energy, while in low-temperature conditions, the fan runs at a higher rotation speed to improve drying efficiency.

[0152] In some embodiments, for determining the remaining drying duration, besides using the above methods, more precise duration determination may be performed according to the actual configuration of the clothes dryer.

[0153] The clothes dryer further includes a vision sensor, which is configured to conduct classified statistics based on acquired images and determine the type of clothes using a preset classification model. The types of clothes include a first type and a second type, where the first type has a higher water absorption rate than the second type.

[0154] Therefore, during the second stage of executing the drying task, the following cases are also considered:

Case 1: During the second stage of the drying task, if the clothes are of the first type, the second duration is determined as a supplemental drying duration.

[0155] Case 2: During the second stage of the drying task, if the clothes are of the second type, the third duration is determined as a supplemental drying duration, the second duration being greater than the third duration.

[0156] By way of example, the first type includes clothes with strong water absorption, such as cotton or linen, and the second type includes clothes with low water absorption, such as silk or polyester. In the above embodiments, the corresponding remaining drying duration can be determined based on the clothes load and the moisture content. The remaining drying duration is determined based on the initially determined supplemental drying duration, which is usually determined based on the detection results of the resistive sensor or a preset program duration and may not be accurate.

[0157] Therefore, before executing the second stage, the corresponding supplemental drying duration can first be determined based on the type of clothes, so that the clothes can be classified and processed in more precise time segments, improving the clothes handling effect.

[0158] In this embodiment, the images obtained by the vision sensor can be used for further material analysis, thereby determining a supplemental drying duration corresponding to the analyzed material, which helps reduce over-drying or insufficient drying, thereby improving the drying quality of clothes.

[0159] FIG. 10 is a schematic diagram of the structural composition of a clothes dryer provided in some embodiments of the present application. Referring to FIG. 10, the clothes dryer provided by the present application includes a resistive sensor 41, a capacitive sensor 42, a motor 32, a compressor 71, a fan 60, and a processor 50. The processor 50 is connected to the resistive sensor 41, the capacitive sensor 42, the motor 32, the compressor 71, and the fan 60, respectively.

[0160] The resistive sensor 41 is configured to at least acquire a humidity value of clothes to be dried and transmit the acquired humidity value to the processor 50. The capacitive sensor 42 is configured to at least acquire an air moisture content in the drum 30 and transmit the acquired air moisture content to the processor 50.

[0161] The processor 50 is further configured to execute the methods in the above embodiments and control the operating states of the motor 32, the compressor 71, and the fan 60.

[0162] The present application further provides a computer-readable storage medium, which may include various media capable of storing program codes, such as a USB drive, portable hard drive, read-only memory (ROM), random-access memory (RAM), magnetic disc, or optical disc. Specifically, the computer-readable storage medium stores program instructions configured for the methods in the above embodiments.

[0163] The present application further provides a program product, which includes execution instructions stored on a readable storage medium. At least one control module of the clothes dryer can read the execution instructions from the readable storage medium, and the at least one control module executes the instructions to enable the clothes dryer to implement the methods provided by the various embodiments of the present application.

[0164] Finally, it should be noted that: the above embodiments are only used to illustrate the technical solution of the present application, not to limit it; although the present application has been illustrated in detail by referring to the aforementioned embodiments, those of ordinary skill in the art should understand that: they can still make modification to the technical solution recorded in each foregoing embodiment, or make equivalent replacement to part of or all the technical features thereof, but these modifications or replacements do not make the nature of the corresponding technical solution departing from the scope of the technical solution of each embodiment of the present application.

[0165] For the convenience of explanation, the foregoing description has been made in conjunction with specific embodiments. However, the above exemplary discussions are not intended to be exhaustive or to limit the embodiments to the specific forms disclosed above. Based on the above teachings, various modifications and variations can be derived. The selection and description of the above embodiments are intended to better explain the principles and practical applications, thereby enabling those skilled in the art to better use the embodiments and various modified embodiments suitable for specific usage considerations.

Claims

1. A clothes dryer, comprising:

- a housing, the housing being configured as an outer casing of the clothes dryer;
- a drum, the drum being disposed in the housing, and a drying chamber being formed in the drum;
- a motor, the motor being connected to the drum, and the motor being configured to drive the drum to rotate relative to the housing;
- a compressor;
- a fan, the fan being configured to deliver an airflow into the drum;
- a resistive sensor, the resistive sensor being configured to at least acquire a humidity value of clothes to be dried;
- a capacitive sensor, the capacitive sensor being configured to at least acquire an air moisture content in the drum; and
- a processor, the processor being configured to:

- execute a first drying task, the first drying task being configured to control the compressor to operate at a first frequency, the fan to operate, and the motor to operate; and the processor being further configured to control a duration of the first drying task in operation in response to executing the first drying task, wherein the resistive sensor operates to acquire the humidity value used to adjust the duration of the first drying task, and the capacitive sensor operates to acquire the air moisture content not used to adjust the duration of the first drying task; and
- execute a second drying task in response to the humidity value is less than a first threshold and the air moisture content is less than a second threshold, the second drying task being configured to control the compressor to operate at a second frequency, the fan to operate, and the motor to continuously operate, wherein the second frequency is less than the first frequency; and the processor being further configured to control a duration of the second drying task in operation in response to executing the second drying task, wherein the capacitive sensor operates to acquire the air moisture content used to adjust the duration of the second drying task, and the resistive sensor operates to acquire the humidity value not used to adjust the duration of the second drying task.
2. The clothes dryer according to claim 1, wherein the processor is further configured to: continue executing the first drying task in response to the humidity value is less than the first threshold, and the air moisture content exceeds the second threshold.
 3. The clothes dryer according to claim 1, wherein the processor is further configured to: control the second drying task to terminate in response to the processor satisfies a preset condition, the compressor and the fan to stop operating in response to the second drying task terminates, and the motor to continuously operate for a first preset duration and then stop operating.
 4. The clothes dryer according to claim 3, wherein the preset condition is that the duration of the second drying task in operation is completed.
 5. The clothes dryer according to claim 3, wherein the preset condition is that the duration of the second drying task in operation is incomplete, and the air moisture content is less than a third threshold, wherein the third threshold is lower than the second threshold.
 6. The clothes dryer according to claim 3, wherein the preset condition is that, within a third preset duration of the duration of the second drying task in operation that is incomplete, a variation amount of the air moisture content is less than a preset variation threshold.
 7. The clothes dryer according to claim 4, wherein the processor is further configured to: continue executing the second drying task in response to the duration of the second drying task in operation is completed, and the air moisture content exceeds a third threshold.
 8. The clothes dryer according to claim 1, wherein the processor is further configured to: execute a drying preparation task before executing the first drying task; wherein the drying preparation task is configured to control the compressor and the fan not to operate, and control the motor to operate for a second preset duration, wherein the resistive sensor operates to acquire the humidity value not used to adjust operating states of the compressor, the fan, and the motor, and the capacitive sensor operates to acquire the air moisture content not used to adjust operating states of the compressor, the fan, and the motor.
 9. The clothes dryer according to claim 1, further comprising the capacitive sensor configured to at least acquire an air temperature value in the drum, wherein the processor is further configured to: control execution of a first drying sub-task in response to the second drying task is executed and the air temperature value exceeds a fourth threshold, the first drying sub-task being configured to control the compressor to operate at a second frequency, the fan to operate at a first rotation speed, and the motor to continuously operate, wherein the capacitive sensor operates to acquire the air moisture content used to adjust a duration of the first drying sub-task, the capacitive sensor operates to acquire the air temperature value not used to adjust the duration of the first drying sub-task, and the resistive sensor operates to acquire the humidity value not used to adjust the duration of the first drying sub-task.
 10. The clothes dryer according to claim 9, wherein the processor is further configured to: control the compressor to stop operating in response to the first drying sub-task is executed

and the air moisture content is less than a third threshold;
 wherein the processor, in response to controlling the compressor to stop operating, is further configured to control the fan and the motor to continuously operate for a first preset duration, and the third threshold being less than the second threshold; wherein the resistive sensor operates to acquire the humidity value not used to adjust the first preset duration, the capacitive sensor operates to acquire the air temperature value not used to adjust the first preset duration of the first drying sub-task, and the capacitive sensor operates to acquire the air moisture content not used to adjust the first preset duration.

11. The clothes dryer according to claim 9, wherein the processor is further configured to:
 control execution of a second drying sub-task in response to the second drying task is executed and the air temperature value is less than the fourth threshold; wherein the second drying sub-task is configured to control the compressor to operate at the second frequency, the fan to operate at a second rotation speed, and the motor to continuously operate; wherein the second rotation speed is less than the first rotation speed.

12. The clothes dryer according to claim 11, wherein the processor is further configured to:

control the compressor to stop operating in response to the second drying sub-task is executed and the air moisture content is less than a third threshold;
 wherein the processor, in response to controlling the compressor to stop operating, is further configured to control the fan and the motor to continuously operate for a first preset duration, and the third threshold being less than the second threshold; wherein the resistive sensor operates to acquire the humidity value not used to adjust the first preset duration, the capacitive sensor operates to acquire the air temperature value not used to adjust the first preset duration of the first drying sub-task, and the capacitive sensor operates to acquire the air moisture content not used to adjust the first preset duration.

13. A drying control method applied to a clothes dryer, wherein the clothes dryer comprises:

a housing, the housing being configured as an outer casing of the clothes dryer;
 a drum, the drum being disposed in the housing, and a drying chamber being formed in the drum;
 a motor, the motor being connected to the drum, and the motor being configured to drive the drum

to rotate relative to the housing;
 a compressor;
 a fan, the fan being configured to deliver an airflow into the drum;
 a resistive sensor, the resistive sensor being configured to at least acquire a humidity value of clothes to be dried; and
 a capacitive sensor, the capacitive sensor being configured to at least acquire an air moisture content in the drum; and
 the method comprises:

executing a first drying task, the first drying task being configured to control the compressor to operate at a first frequency, the fan to operate, and the motor to operate; controlling a duration of the first drying task in operation in response to executing the first drying task, wherein the resistive sensor operates to acquire the humidity value used to adjust the duration of the first drying task, and the capacitive sensor operates to acquire the air moisture content not used to adjust the duration of the first drying task; and

executing a second drying task in response to the humidity value is less than a first threshold and the air moisture content is less than a second threshold, and the second drying task being configured to control the compressor to operate at a second frequency, the fan to operate, and the motor to continuously operate, wherein the second frequency is less than the first frequency; and controlling a duration of the second drying task in operation in response to executing the second drying task, wherein the capacitive sensor operates to acquire the air moisture content used to adjust the duration of the second drying task, and the resistive sensor operates to acquire the humidity value not used to adjust the duration of the second drying task.

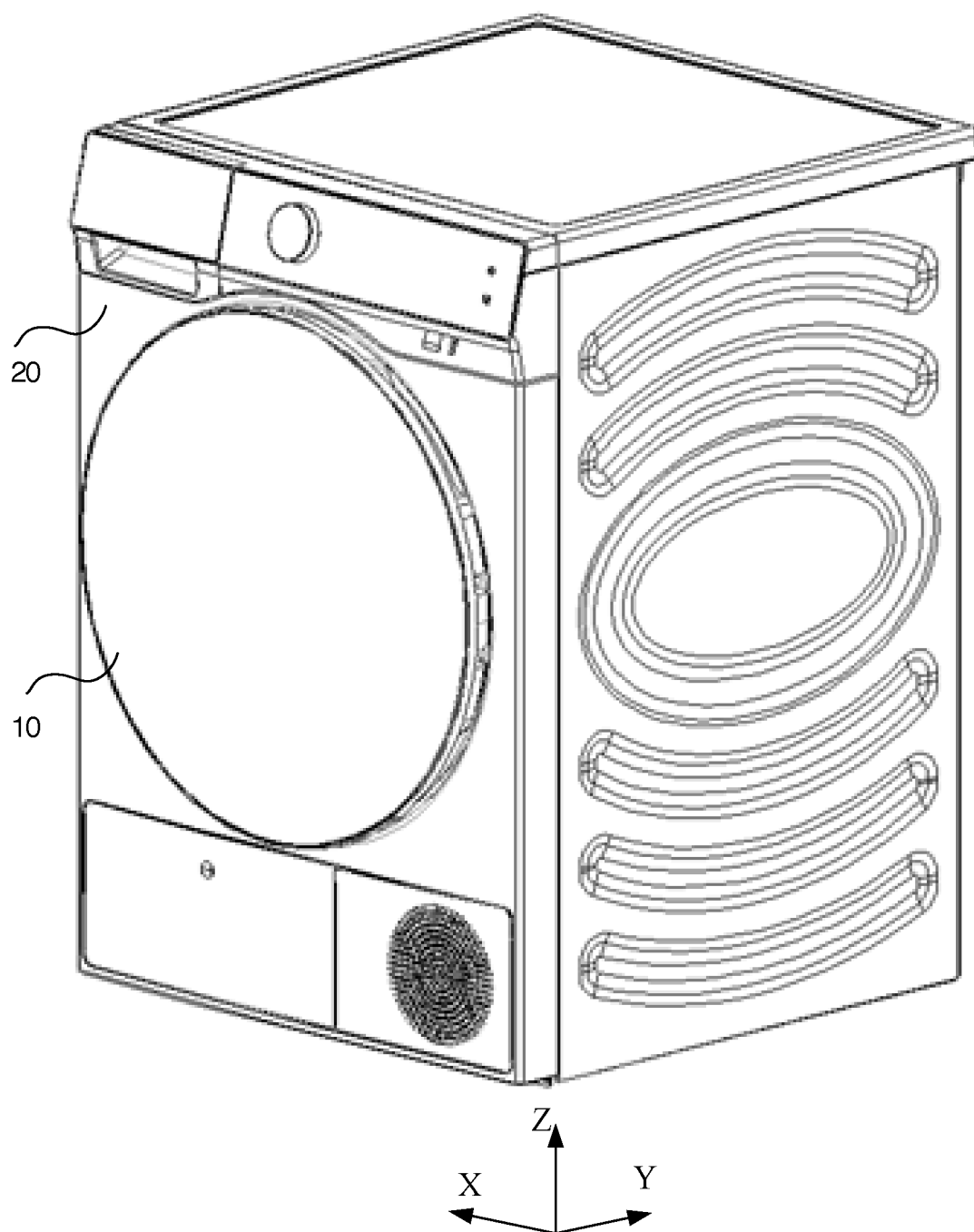


FIG. 1

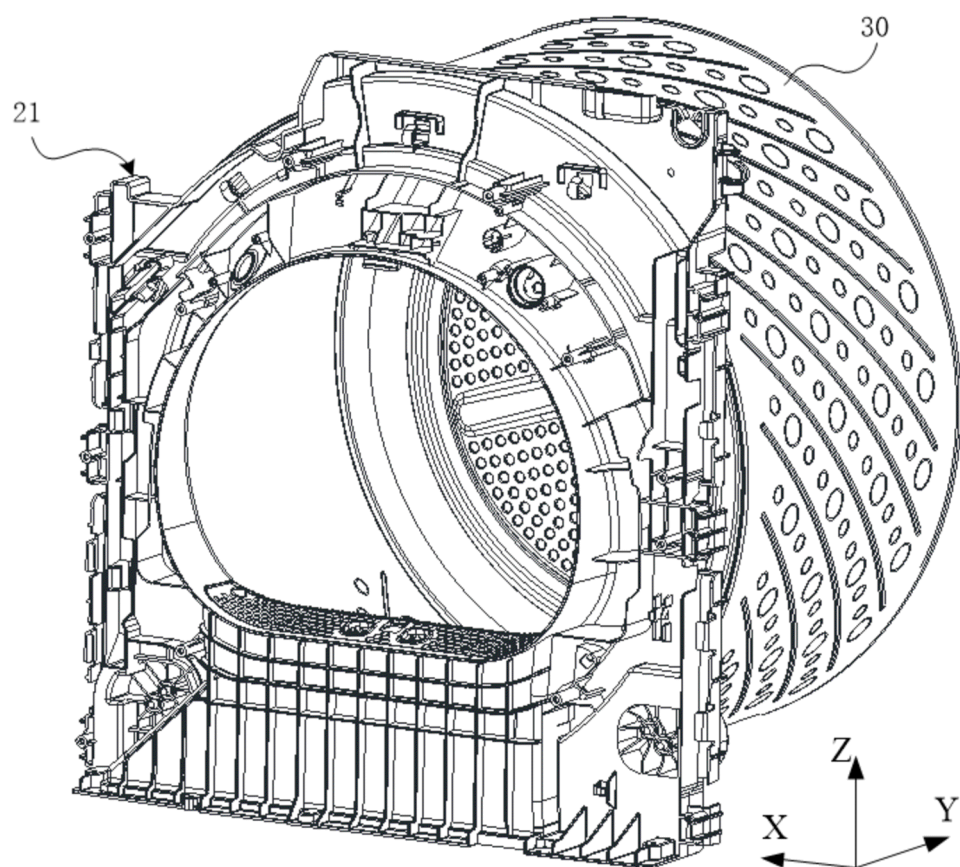


FIG. 2

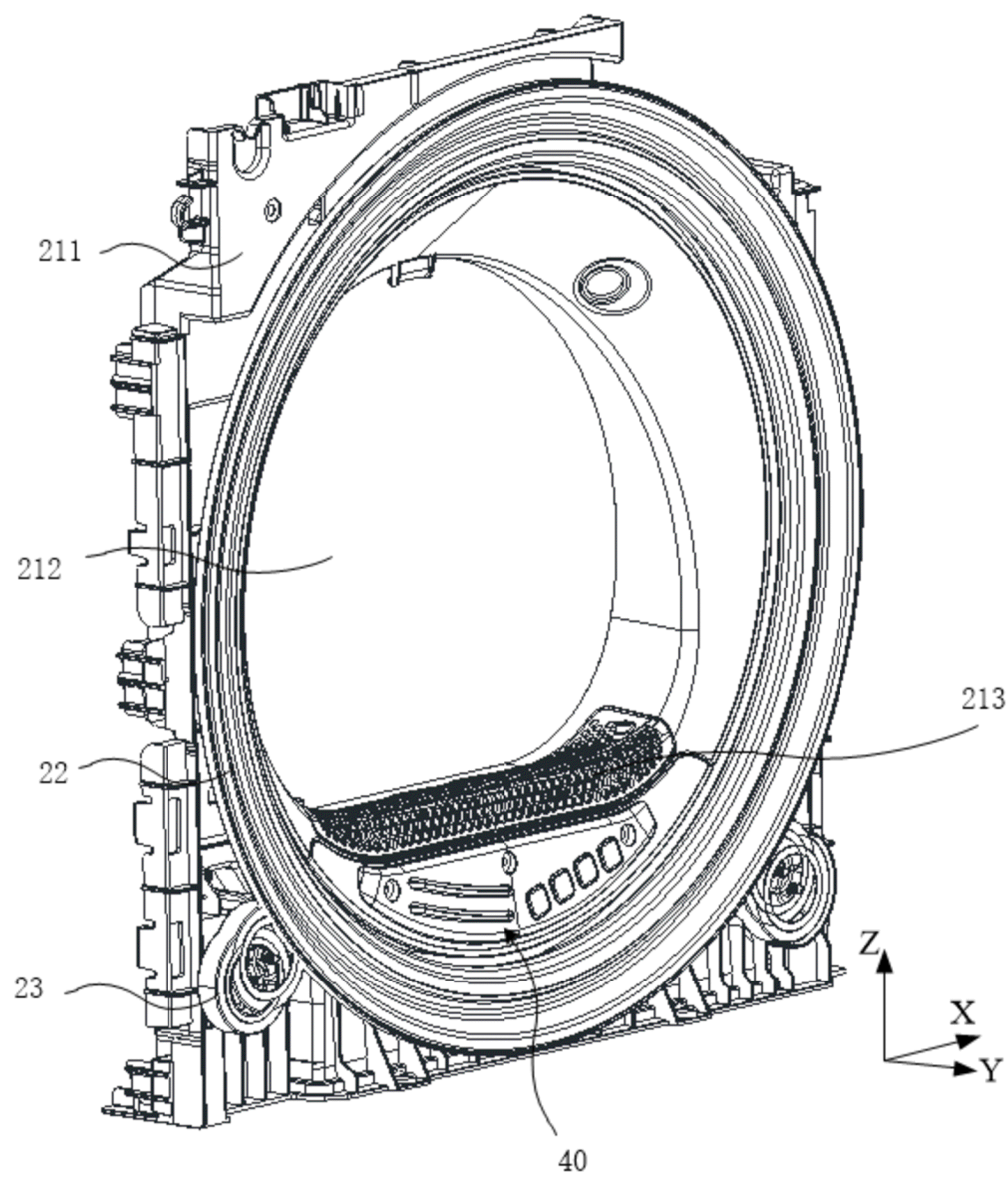


FIG. 3

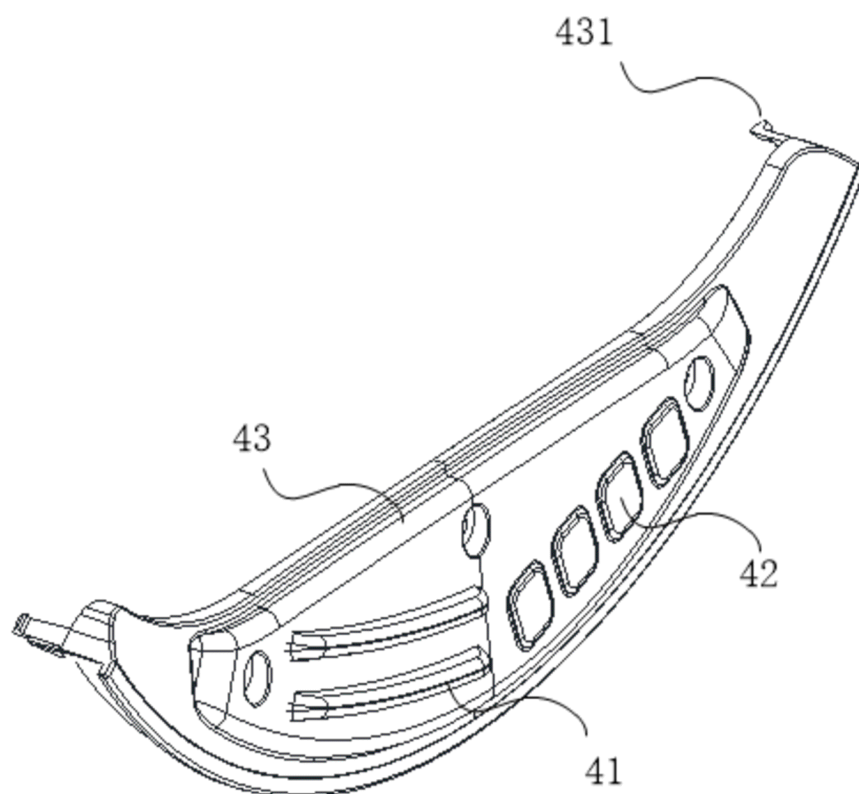


FIG. 4

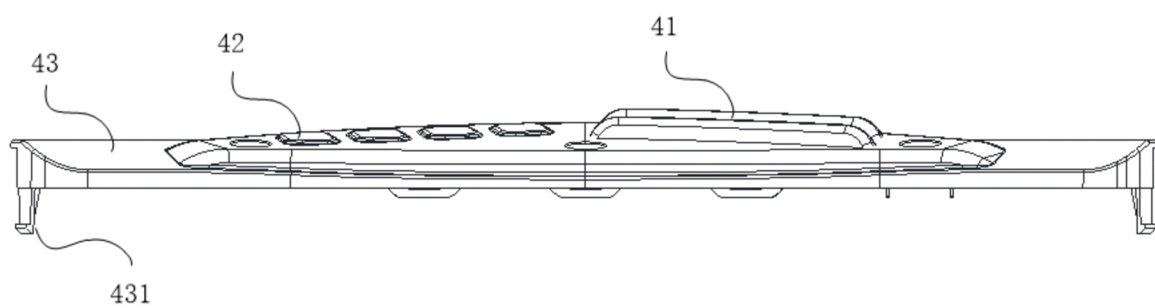


FIG. 5

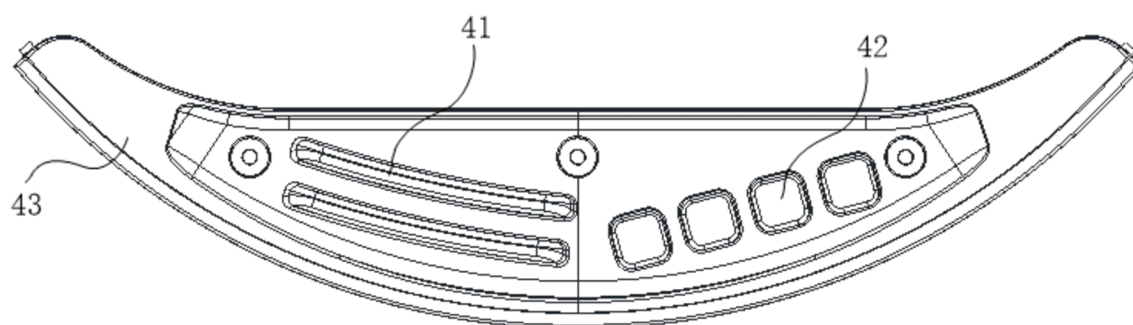


FIG. 6

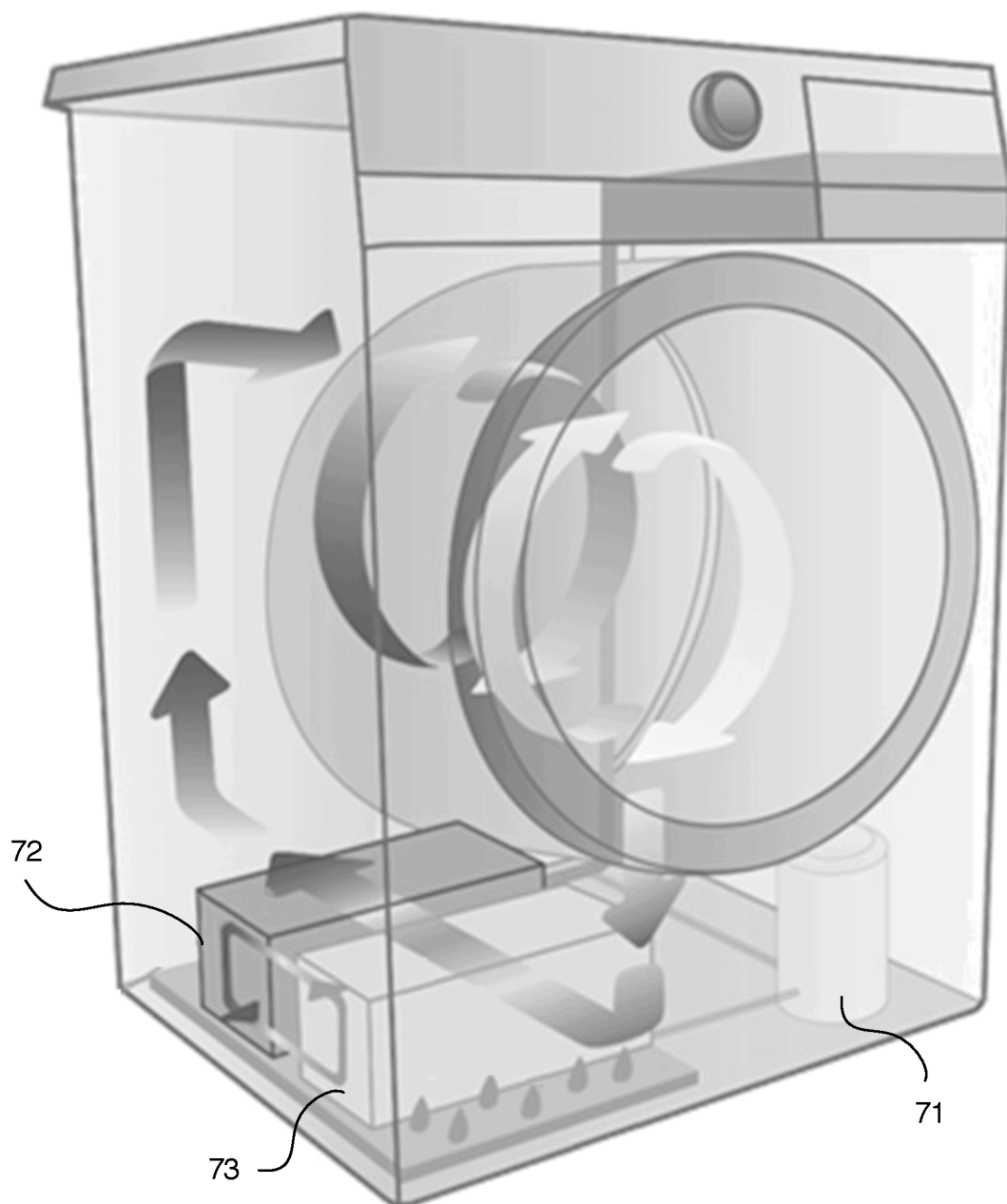


FIG. 7

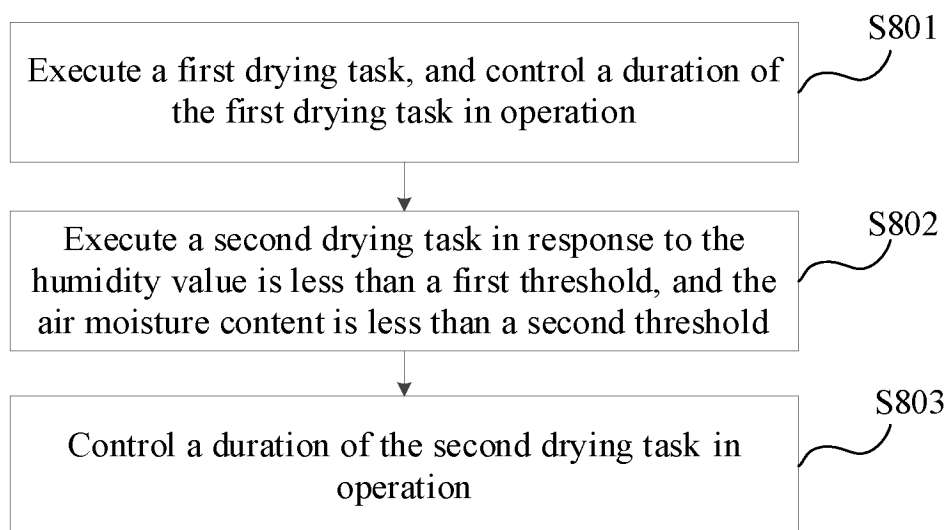


FIG. 8

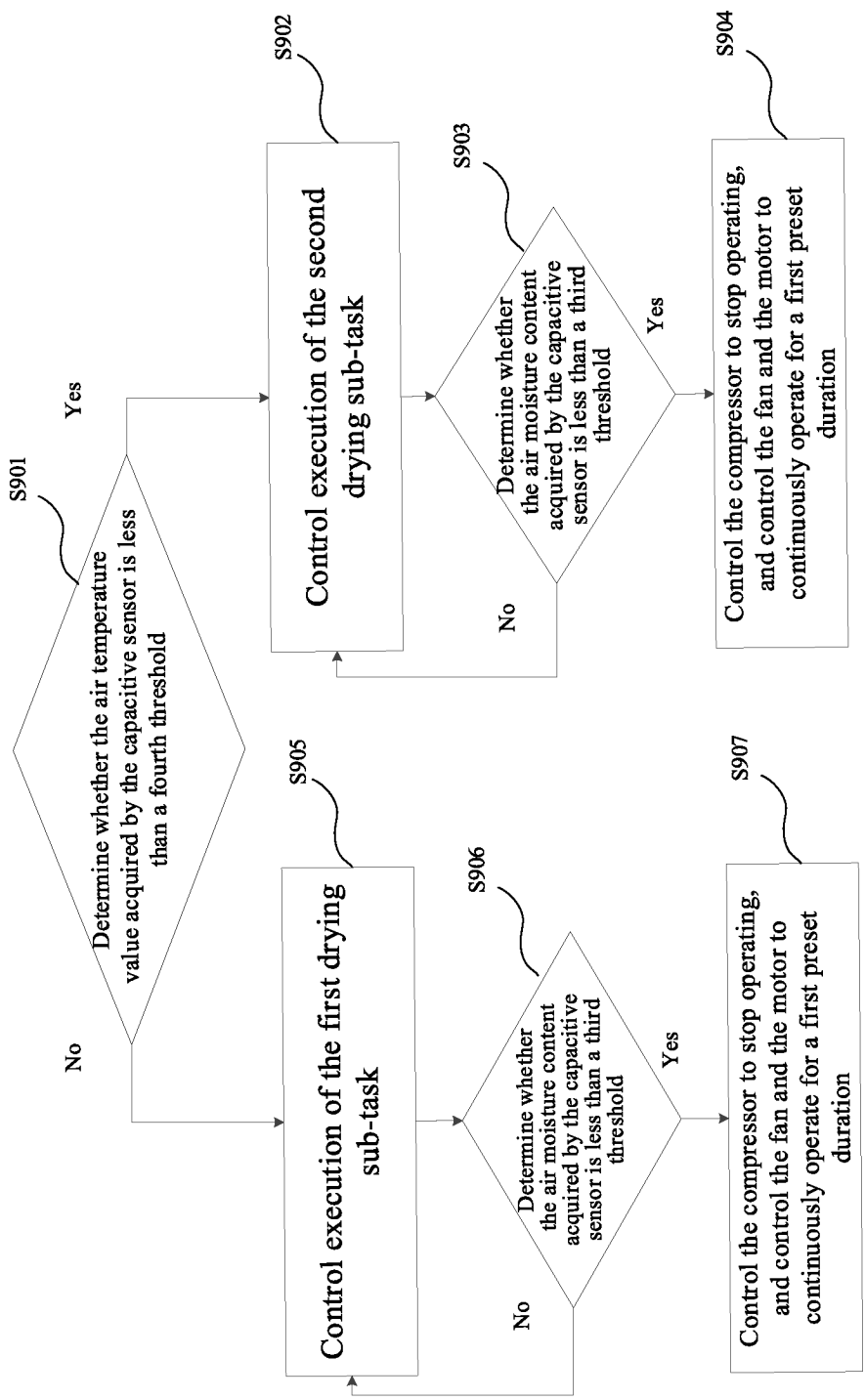


FIG. 9

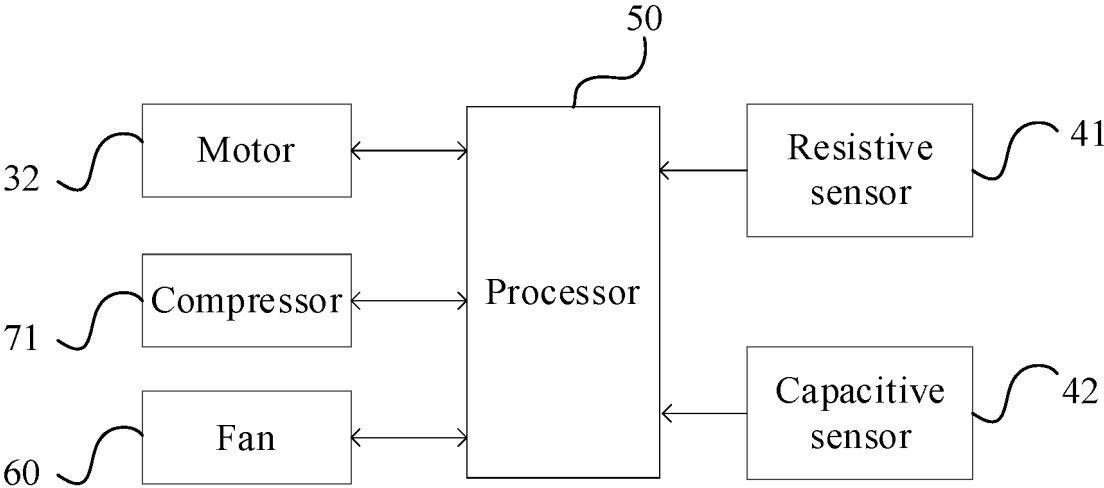


FIG. 10

INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2025/105559

A. CLASSIFICATION OF SUBJECT MATTER

D06F58/38(2020.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC: D06F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

CNABS, CNTXT, CNKI, VEN, WOTXT, EPTXT, USTXT, ENTXTC: 烘干, 干燥, 干衣, 晒干, 控制, 检测, 测量, 获取, 监测, 采集, 感应, 传感, 湿度, 湿润, 潮湿, 湿气, 含水, 电容, 电阻, 风机, 风扇, 压缩机, 频率, dry, control, compressor, frequency, humidity, moisture, measure, detect, induce, sensor, capacit+, resistance

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	CN 114687188 A (WUXI LITTLE SWAN ELECTRIC CO., LTD.) 01 July 2022 (2022-07-01) description, paragraphs [0003]-[0243], and figures 1-7	1-13
A	CN 105648723 A (QINGDAO HAIER INTELLIGENT TECHNOLOGY RESEARCH AND DEVELOPMENT CO., LTD.) 08 June 2016 (2016-06-08) entire document	1-13
A	CN 107841862 A (GUANGDONG MIDEA REFRIGERATION EQUIPMENT CO., LTD.) 27 March 2018 (2018-03-27) entire document	1-13
A	CN 109208290 A (ELECTROLUX APPLIANCES AB) 15 January 2019 (2019-01-15) entire document	1-13
A	KR 20190103879 A (LG ELECTRONICS INC.) 05 September 2019 (2019-09-05) entire document	1-13

☐ Further documents are listed in the continuation of Box C.☒ See patent family annex.

* Special categories of cited documents:	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
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"D" document cited by the applicant in the international application	"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"E" earlier application or patent but published on or after the international filing date	"&" document member of the same patent family
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	
"O" document referring to an oral disclosure, use, exhibition or other means	
"P" document published prior to the international filing date but later than the priority date claimed	

Date of the actual completion of the international search

24 August 2025

Date of mailing of the international search report

19 September 2025

Name and mailing address of the ISA/CN

China National Intellectual Property Administration (ISA/
CN)
China No. 6, Xitucheng Road, Jimenqiao, Haidian District,
Beijing 100088

Authorized officer

Telephone No.

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.

PCT/CN2025/105559

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CN 114687188 A	01 July 2022	CN 114687188 B	24 November 2023
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		EP 3425109 B1	04 May 2022
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Form PCT/ISA/210 (patent family annex) (July 2022)

REFERENCES CITED IN THE DESCRIPTION

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- CN 202411339554 [0001]