



(11)

EP 4 825 247 A1

(12)

EUROPEAN PATENT APPLICATION
published in accordance with Art. 153(4) EPC

(43) Date of publication:
21.10.2026 Bulletin 2026/43

(51) International Patent Classification (IPC):
A45D 20/08 ^(2006.01) **A45D 20/04** ^(2006.01)
A45D 20/00 ^(2006.01)

(21) Application number: **23961051.2**

(52) Cooperative Patent Classification (CPC):
A45D 20/12; **A45D 2200/205**

(22) Date of filing: **11.12.2023**

(86) International application number:
PCT/CN2023/137955

(87) International publication number:
WO 2025/123185 (19.06.2025 Gazette 2025/25)

(84) Designated Contracting States:
**AL AT BE BG CH CY CZ DE DK EE ES FI FR GB
GR HR HU IE IS IT LI LT LU LV MC ME MK MT NL
NO PL PT RO RS SE SI SK SM TR**
Designated Extension States:
BA
Designated Validation States:
KH MA MD TN

(72) Inventors:
• **HUANG, Tongyao**
Shenzhen, Guangdong 518057 (CN)
• **XU, Xingwang**
Shenzhen, Guangdong 518057 (CN)
• **TANG, Yin**
Shenzhen, Guangdong 518057 (CN)

(71) Applicant: **SZ Zuvi Technology Co., Ltd.**
Shenzhen, Guangdong 518057 (CN)

(74) Representative: **Appelt, Christian W.**
Boehmert & Boehmert
Anwaltpartnerschaft mbB
Pettenkoferstrasse 22
80336 München (DE)

(54) **HEATING ASSEMBLY AND DRYING DEVICE**

(57) The present disclosure discloses a heating element (10) and a drying apparatus (100). The heating element (10) comprises a core column assembly (11), wherein an outer wall of the core column assembly (11) is configured with a recess (114); a plurality of supporting elements (12), each supporting elements (12) is configured on the core column assembly (11) and extends radially along an airflow channel; a heater (13), wherein the heater (13) surrounds outer edges of the plurality of supporting elements; a fuse (15), wherein the fuse (15) is located in the recess (114) and is configured to disconnect the heater (13) when a temperature exceeds a threshold.

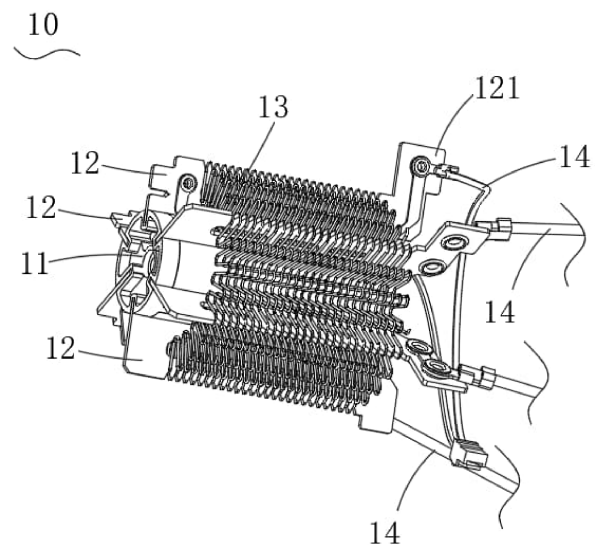


Fig. 1

Description

TECHNICAL FIELD

[0001] The present disclosure relates to the technical field of drying, and in particular, to heating assemblies and drying apparatus.

BACKGROUND

[0002] Hairdryers in the prior art may output hot airflow to quickly dry hair. In order to prevent the electric heating wires inside the hairdryer from overheating, it is necessary to set a fuse to disconnect when overheated. Since the fuse needs to maintain a certain distance from the electric heating wires, the size of the airflow channel and electric heating wires of the hairdryer are limited, and the heating efficiency of the airflow is low.

SUMMARY

[0003] The present disclosure provides a heating element and a drying apparatus, aiming to solve the problem of low heating efficiency of airflow in hairdryers of the prior art.

[0004] The heating element disclosed by the present disclosure comprises a core column assembly, wherein an outer wall of the core column assembly is configured with a recess; a plurality of supporting elements with each supporting element being configured on the core column assembly and extending radially along the airflow channel; a heater, which surrounds outer edges of the plurality of supporting elements; and a fuse, which is located in the recess and configured to disconnect the heater when a temperature exceeds a threshold value

The present disclosure also discloses a drying apparatus, comprising an airflow generating element, which comprises a motor for generating airflow; an airflow channel, which is configured downstream of the airflow generating element; and the above-mentioned heating element.

[0005] In the heating element and the drying apparatus of the present disclosure, by setting the fuse in the recess on the surface of the core column assembly, the fuse is configured radially inside the heater, it is therefore possible to enable the heating element to achieve greater heating power without changing the size of the airflow channel. It may also be understood that, under the premise of having the same heating power and outputting airflow of the same temperature, the drying apparatus in the present disclosure may have a smaller airflow channel size.

[0006] Additional aspects and advantages of embodiments of the present disclosure will be given, in part, in the following detailed description, part of which will become apparent from the following detailed description

or will be learned through the implementation of the present disclosure.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007] The foregoing and/or additional aspects and advantages of the present disclosure will become apparent and readily understood from the detailed description of the embodiments in conjunction with the following accompanying drawings, wherein:

FIG. 1 is a schematic diagram of the heating element in some embodiments of the present disclosure;

FIG. 2 is a schematic diagram of the structure of the heating element in some embodiments of the present disclosure with the heater removed;

FIG. 3 is a partially enlarged schematic view of A in FIG. 2;

FIG. 4 is a schematic diagram of a core column assembly in some embodiments of the present disclosure;

FIG. 5 is an explosive schematic view of the core column assembly in some embodiments of the present disclosure;

FIG. 6 is a schematic diagram of a partial structure of a drying apparatus in some embodiments of the present disclosure;

FIG. 7 is a schematic diagram of a portion of the structure of a hair dryer in the prior art;

FIG. 8 is a schematic diagram of the structure of a motor and a heating element in some embodiments of the present disclosure.

DETAILED DESCRIPTION

[0008] The embodiments of the present disclosure are described in detail below, and examples of said embodiments are shown in the drawings wherein the same or similar designations denote the same or similar elements or elements having the same or similar functions throughout. The embodiments described below by reference to the drawings are illustrative and are intended to explain the embodiment of the present disclosure only and should not be construed as limiting the embodiment of the present disclosure.

[0009] In the description of this disclosure, it is necessary to understand that the terms "center", "longitudinal", "horizontal", "length", "width", "thickness", "up", "down", "front", "back", "left", "right", "vertical", "horizontal", "top", "bottom", "inner", "outside", "clockwise", "counterclockwise", such orientation or positional relationship indicated is based on the orientation or positional relationship shown in the drawings, only for the convenience of describing the present disclosure and simplifying the description, and does not indicate or imply that the apparatus or element referred to must have such specific orientation, be constructed and operated

in such particular orientation, and therefore cannot be construed as a limitation on the present disclosure. In the description of this disclosure, "plurality" means two or more than two, unless otherwise expressly and specifically qualified.

[0010] In the description of the present disclosure, it is noted that, unless otherwise expressly specified or qualified, the terms "attached", "connected", "connected" are to be understood broadly, for example, they may be fixed, detachable, or integrally connected. It may be mechanically or electrically connected. It may be directly connected or indirectly connected through an intermediate medium, it may be the internal connection of two elements or the interaction relationship between two elements. For those of ordinary skill in the art, the specific meaning of the above terms in the present disclosure may be understood on a case-by-case basis.

[0011] In the present disclosure, unless otherwise expressly specified and qualified, the first feature "above" or "below" the second feature may include direct contact between the first and second features, or the first and second features are not in direct contact but through additional feature contact between them. Moreover, the first feature is "above", "above", and "above" the second feature comprises the first feature directly above and obliquely above the second feature, or simply indicates that the first feature is horizontally higher than the second feature. The first feature is "below", "below", and "below" the second feature, comprising the first feature directly below and diagonally below the second feature, or simply indicating that the horizontal height of the first feature is less than that of the second feature.

[0012] The publication of this disclosure provides a number of different embodiments or examples to implement the different structures of the present disclosure. In order to simplify the disclosure of the present disclosure, the parts and settings for specific examples are described in this disclosure. They are only examples and are not intended to limit the present disclosure. In addition, the present disclosure may repeat the reference numbers and/or reference letters in different examples, and this repetition is for the purpose of simplification and clarity and does not in itself indicate the relationship between the various embodiments and/or settings in question. In addition, the present disclosure provides examples of various specific processes and materials, but those of ordinary skill in the art may be aware of The present disclosure of other processes and/or the use of other materials.

[0013] As shown in FIG. 1, 2 and 6, a heating element 10 is provided in embodiments of the present disclosure, and is configured in an airflow channel 20 of a drying apparatus 100. The drying apparatus 100 comprises an airflow generating element 30, and the airflow generating element 30 generates an airflow in the airflow channel 20 during operation. The heating element

10 may heat the airflow in the airflow channel 20, so that the drying apparatus 100 outputs hot airflow. After the hot airflow flows to a target object, it acts on the moisture through fluid convection and heat exchange simultaneously, thereby achieving higher drying efficiency.

[0014] The heating element 10 comprises a core column assembly 11, a plurality of supporting elements 12, a heater 13, and a fuse 15. The core column assembly 11 constitutes the basic part of the heating element 10. The core column assembly 11 is mounted on related structures in the drying apparatus 100, for example, mounted on the housing, the airflow generating element 30, the airflow channel 20, etc. Other parts of the heating element 10 may be mounted on the core column assembly 11.

[0015] Each supporting element 12 is configured on the core column assembly 11 and extends radially along the airflow channel 20. A plurality of electric heating wires surrounds an outer edges of the plurality of supporting elements 12 to form the heater 13. The supporting elements 12 themselves are formed of insulating and heat-resistant materials, and are mainly configured to spatially support the shape of the heater 13. In some specific embodiments, the material of the supporting elements 12 may be mica sheet, ceramic, or the like. The supporting elements 12 are generally also configured for mounting the electrical structure of the heating element 10, such as a plurality of wires 14, wiring terminals, jacks, contacts, contact pieces, plugs, circuit boards, and the like. In some specific embodiments shown in FIG. 1, the quantity of the supporting elements 12 is six, and they are uniformly distributed along the circumferential direction of the core column assembly 11. In other embodiments, the quantity of the supporting elements 12 may be more or less, for example, 3, 5, 7, 8, 11, etc.

[0016] Referring to FIG. 2 and 4, the fuse 15 is located in a recess 114 located on the surface of the core column assembly 11. In other words, the fuse 15 is located radially inside the core column assembly 11, so the fuse 15 will not form air resistance to the airflow passing through the heating element 10. The fuse 15 is a structure that may disconnect circuits in case of over-temperature, and is configured to avoid the risk of overheating of related components.

[0017] As shown in FIG. 6, a drying apparatus 100 is also provided in some embodiments of the present disclosure, comprising an airflow generating element 30, an airflow channel 20, and the heating element 10 described above. The airflow generating element 30 comprises a motor 31 for generating an airflow. The airflow channel 20 is configured downstream of the airflow generating element 30. The motor 31 generates an airflow during operation, and the airflow passes through the airflow channel 20 and is heated by the heating element 10 in the airflow channel 20. The hot airflow output to the target object may achieve higher drying

efficiency.

[0018] When designing the drying apparatus 100, it is necessary to determine the maximum temperature threshold of the heater 13, and design the heat resistance of related structures, the power of circuit devices, the airflow speed and airflow rate, etc. based on the maximum temperature threshold, to ensure that when the temperature of the heater 13 is lower than the maximum threshold, the drying apparatus 100 may operate normally according to the preset state. However, when abnormal conditions such as hardware or software failure, circuit short, etc. occur, the temperature of the heater 13 may exceed the above-mentioned maximum threshold, which may not only cause the risk of overheating or even burning of related structures of the drying apparatus 100, but also may heat the airflow to an excessively high temperature, and the excessively high temperature airflow may cause the risk of scalding users or igniting flammable materials. In order to avoid the occurrence of the above situations, a fuse 15 is configured in series in the circuit of the heater 13. When the fuse 15 reaches a fusing temperature, it fuses and disconnects the heater 13 to avoid it continuing to generate heat and causing the aforementioned dangers.

[0019] The fusing temperature of the fuse 15 is generally lower than the maximum threshold of the heater 13 temperature. If the fuse 15 is directly configured in a position close to the heater 13, the fuse 15 will fuse before the heater 13 reaches the maximum temperature threshold. Therefore, the fuse 15 needs to be located at a position at a certain distance from the heater 13, so that when it reaches the fusing temperature corresponding to the maximum temperature threshold of the heater 13.

[0020] Combining FIG. 1 and the foregoing description, the heater 13 is formed of electric heating wires surrounding a plurality of the supporting elements 12, and its shape may be approximately cylindrical. The larger the radial dimension of the heater 13, the larger its surface area and the greater the total amount of electric heating wire contained, and the greater the corresponding heating power. In the prior art, in order to ensure the distance between the fuse and the heater, it is necessary to limit the maximum radial dimension of the heater. For example, if the radial dimension of the airflow channel of a hairdryer is R and the distance between the fuse and the heater is L , then the maximum radius of the heater is $(R-L)$. It may also be understood that the radial dimension of the airflow channel and the characteristics of the fuse jointly limit the maximum heating power of the heater. If the maximum heating power of the heater is to be increased, the radial dimension of the airflow channel must be increased accordingly.

[0021] However, in the foregoing embodiments of the present disclosure, the fuse 15 is located in the recess 114 on the surface of the core column assembly 11,

that is, the fuse 15 is located radially inside the heater 13. In the same example as the above-mentioned hair-dryer, if the heating element 10 in the present disclosure is adopted, it is only necessary to ensure that the radius of the heater 13 is in the range of (L, R) , so that the heater 13 may have a larger radius and accordingly greater heating power. In other words, under the premise of the same airflow channel 20 size and fuse 15 characteristics, the heating element 10 in the present disclosure may achieve greater heating power and heat the airflow to a higher temperature. It may also be understood that, under the premise of having the same heating power and outputting airflow of the same temperature, the drying apparatus 100 in the present disclosure may have a smaller airflow channel 20 size.

[0022] In addition, the motor 31 configured in the drying apparatus 100 in some embodiments is a high-speed motor (speed exceeding 100,000r/min), and it is desired to output high-speed airflow with high airflow speed and/or airflow pressure to achieve higher drying efficiency. In order for the high-speed motor to generate high-speed airflow, it is necessary to limit the size of the airflow channel 20. Under the premise that the speed and power of the high-speed motor remain unchanged, the smaller the size of the airflow channel 20, the higher the airflow speed of the output airflow. In the prior art, in order to reserve sufficient space for the fuse, the minimum size of the airflow channel is limited, so it is difficult to achieve a higher airflow speed. However, the drying apparatus 100 with the heating element 10 of the above embodiment comprises an airflow channel 20 of smaller size under the premise of having the same heating power and being able to prevent overheating of the heater 13, so it is easy to achieve a higher airflow speed.

[0023] As shown in FIG. 1 and 6, in some specific embodiments, the axes of the airflow channel 20, the airflow generating element 30, and the core column assembly 11 are coaxial. When the airflow generated by the airflow generating element 30 passes through the airflow channel 20 and the core column assembly 11, it may be uniformly distributed in the radial direction, forming a hot airflow with relatively uniform airflow temperature and airflow speed in the radial direction. Taking the hair drying process using the drying apparatus 100 as an example, the hot airflow with uniform airflow temperature and airflow speed in the radial direction may make the hair in the affected area heated evenly without being dried into disorder, and the hair has better smoothness after drying.

[0024] In some embodiments shown in FIG. 1, 4 and 5, the core column assembly 11 comprises a first insulation sleeve 112 and two end caps 113. The first insulation sleeve 112 is located radially inside the heater 13, and defines a notch 1121 corresponding to the recess 114. The first insulation sleeve 112 comprises a part of the outer wall of the core column assembly 11. The first insulation sleeve 112 is formed of a material

with heat resistance and/or low thermal conductivity, and itself has better heat resistance and/or low thermal conductivity.

[0025] The two end caps 113 are formed of insulating material, and the two are respectively configured at both ends of the first insulation sleeve 112. Each supporting element 12 is coupled to the end cap 113. The end cap 113 itself is configured for coupling to the supporting elements 12 and related electrical structures (such as a plurality of wires 14, contacts, terminals, etc.), and it needs to be kept insulated to avoid short circuits with the electrical structures.

[0026] Electric heating wires surrounds the area of the supporting elements 12 corresponding to the first insulation sleeve 112 to form the heater 13. It may also be understood that, in reference to the core column assembly 11, the first insulation sleeve 112 is located radially inside the heater 13, and at least part of the end cap 113 is not radially inside the heater 13.

[0027] When the heating element 10 is in operation, the heater 13 continuously dissipates heat. The first insulation sleeve 112 itself may maintain structural stability at a high temperature, and only transfers less heat to the end cap 113. In other words, during the operation of the heating element 10, the temperature of the end cap 113 is lower than the temperature of the first insulation sleeve 112, which may reduce the heat resistance requirement for the end cap 113.

[0028] In some more specific embodiments, the end cap 113 is formed of a material that is easy to form, such as plastic, rubber, etc., and may be easily formed into a preset shape to meet the coupling requirements of the supporting elements 12. It is easy to understand that within a certain cost range, materials may hardly provide both easy formability and high heat resistance. Therefore, for the core column assembly 11, the middle part is formed of the first insulation sleeve 112 made of a material with better heat resistance, which is configured to support the overall shape of the core column assembly 11 and isolate heat transfer; the two end caps 113 are made of a material that is easy to form, which are configured to be coupled to a plurality of supporting elements 12. In this way, the core column assembly 11 as a whole may take into account both heat resistance and easy assembly without increasing the cost.

[0029] In some embodiments shown in FIG. 2, at least one supporting element 12a of the plurality of supporting elements 12 comprises a mounting portion 121, the mounting position of the supporting element 12 corresponds to the recess 114, and the mounting portion 121 is at least partially located inside the recess 114. The fuse 15 is configured on the mounting portion 121 of the supporting element 12a. It may also be understood that the shape of at least one supporting element 12a is different from other supporting elements 12, and it has a mounting portion 121 protruding radially inward, and may only be mounted on the core

column assembly 11 at a position corresponding to the recess 114. If the supporting element 12a is mounted at other positions, interference with the surface of the core column assembly 11 will occur.

[0030] Combining some of the foregoing embodiments, the related electrical structure of the heating element 10 is at least partially mounted on the supporting elements 12. Therefore, mounting the fuse 15 on the supporting element 12 may simultaneously realize the structural mounting and electrical connection of the fuse 15. For example, the pins of the fuse 15 are fixed to the mounting portion 121 of the supporting element 12 by structures such as metal rivets, soldering, screws, etc., and related electrical structures are connected to structures such as metal rivets, soldering, screws, etc., so as to simultaneously realize the structural mounting and electrical connection of the fuse 15.

[0031] In other embodiments not shown, all supporting elements 12 have the same shape and structure. The fuse 15 has bent pins, which may extend out from the recess 114 and be coupled to the supporting element 12 corresponding to the recess 114, thereby realizing structural mounting and electrical connection. In this way, the assembly difficulty of the supporting elements 12 may be reduced, so that it is not necessary to pay special attention to the mounting position when coupling them to the core column assembly 11.

[0032] In other embodiments not shown, the fuse 15 may be directly mounted in the recess 114 through related insulating and heat-insulating buckles, support blocks, and other structures, and then electrically connected to related electrical structures through connecting wires or bent pins.

[0033] In some specific embodiments shown in FIG. 2, 3 and 5, a plurality of slots 1131 respectively corresponding to the supporting elements 12 are defined in the end cap 113. The supporting elements 12 are inserted into the slots 1131 to form an interference fit, thereby realizing mutual mounting with the end cap 113. In other embodiments, the coupling between the supporting elements 12 and the end cap 113 may also be realized by bolts, welding, adhesive bonding, snap connection, etc.

[0034] Among the plurality of slots 1131 on the end cap 113, at least one slot 1131a extends through to the recess 114 and forms a wire passage hole. As is known from the foregoing, the fuse 15 is located in the recess 114, and the fuse 15 needs to be connected to the circuit of the heating element 10, so it must be connected to related electrical structures. In the above embodiment, the electrical structure comprises a plurality of wires 14, and the plurality of wires 14 may pass through the wire passage hole of the slot 1131a to enter the recess 114 and connect the fuse 15.

[0035] In some specific embodiments, the fuse 15 itself is mounted on the supporting element 12, and the plurality of wires 14 are also fixed on the supporting element 12. The supporting element 12a is mounted in

the slot 1131a forming the wire passage hole, and the plurality of wires 14 may pass through the wire passage hole along the supporting element 12a and connect the fuse 15. Fixing the plurality of wires 14 on the supporting element 12 may make the plurality of wires 14 always remain in a preset position, so as to avoid the wires 14 from being displaced by the airflow and contacting the heater 13 to form a short circuit or being burned out by the high temperature of the heater 13.

[0036] In some embodiments not shown, among the plurality of wires 14 of the heating element 10, at least one wire 14 passes through the inside of the core column assembly 11, so that the wire 14 may pass through the core column assembly 11 along the axial direction and connect the corresponding position. The plurality of wires 14 located inside the core column assembly 11 will not contact the hot airflow, which may avoid them from being melted or damaged in a high temperature environment.

[0037] In other embodiments not shown, all slots 1131 on the end cap 113 have the same shape and are not formed with wire passage holes. The plurality of wires 14 may extend along the surface of the core column assembly 11 and connect to the fuse 15.

[0038] According to the foregoing description, the first insulation sleeve 112 is a hollow cylindrical structure and defines a notch 1121, so the strength of the first insulation sleeve 112 is low, and then the overall strength of the core column assembly 11 is low. During the assembly and use of the heating element 11, insufficient strength of the core column assembly 11 may easily cause deformation, which may cause the positions of the supporting elements 12 to change, and then cause problems such as short circuits due to mutual contact of the electric heating wires of the heater 13.

[0039] In order to strengthen the overall strength of the core column assembly 11, in some embodiments shown in FIG. 4 and 5, the core column assembly 11 further comprises a base 111. The base 111 extends axially and both ends are respectively coupled to the corresponding end caps 113, and the recess 114 is defined on the base 111. The first insulation sleeve 112 is mounted outside the base 111. The base 111 is located in the radial center of the core column assembly 11, and is formed of a material with high strength. The base 111 simultaneously connects and supports the first insulation sleeve 112 and the two end caps 113, so that the core column assembly 11 as a whole has high strength and deformation of the core column assembly 11 is avoided.

[0040] In addition, since the first insulation sleeve 112 mounted outside the base 111 performs heat insulation, it may isolate the heat from the heater 13, reduce the temperature rise range of the base 111, and prevent the base 111 from transferring high temperature to the end cap 113.

[0041] In some specific embodiments, the first insula-

tion sleeve 112 is formed of mica material. Mica is a rock-forming mineral, presenting a hexagonal flake-like crystal shape, is one of the main rock-forming minerals, and has the characteristics of insulation, high temperature resistance, etc. The mica crystal has a layered structure inside. Since it is a flake-like crystal, it is easy to process it into a thin flake-like structure. In some specific embodiments, the foregoing supporting elements 12 are also formed of mica material.

[0042] In some specific embodiments, the base 111 is formed of metal material, such as steel, aluminum, copper, and various alloy materials, etc. Metal materials generally have better strength, and may be conveniently processed and formed by die casting, CNC machine tool cutting, and other methods. Although metal materials may have high thermal conductivity, according to the foregoing content, the first insulation sleeve 112 isolates heat between the heater 13 and the base 111, so that the temperature rise range of the base 111 itself is small, and high temperature is not transferred to the end cap 113.

[0043] In some specific embodiments, each end cap 113 is formed of plastic. Plastic itself is easy to process and form, and may be formed into structures with a certain complexity by injection molding, extrusion molding, compression molding, thermoforming, 3D printing, and other methods, and is configured to adapt to the mounting of the base 111, the first insulation sleeve 112, and a plurality of supporting elements 12.

[0044] In some specific embodiments, as shown in FIG. 5, the base 111 has an axially extending mounting hole 1111, and each end cap 113 is coupled to the base 111 through the mounting hole 1111, thereby realizing the coupling between the base 111 and the end cap 113. In some more specific embodiments, the end cap 113 is formed with studs, which may be screwed into the mounting hole 1111 for mutual coupling. In some more specific embodiments, the end cap 113 is configured with through holes at positions corresponding to the mounting hole 1111, and structures such as screws, rivets, etc. are used to pass through the through holes on the end cap 113 and insert into the mounting hole 1111 for fixation, thereby realizing the coupling between the base 111 and the end cap 113. In some more specific embodiments, the end cap 113 is configured with through holes at positions corresponding to the mounting hole 1111, and the mounting hole 1111 may be exposed from the through holes, and other parts in the drying apparatus 100, such as the housing, the airflow generating element 30, etc., are coupled to the mounting hole 1111 of the base 111 through bolts, so as to mutually fix the heating element 10 and other parts of the drying apparatus 100.

[0045] In some embodiments, the surface color of the fuse 15 is configured to have a high absorption rate for thermal radiation from the heater 13. For example, the surface color of the fuse 15 may be black, purple, dark brown, or the like. According to the foregoing, the work-

ing principle of the fuse 15 is that it fuses when its temperature reaches the fusing temperature. When the heater 13 is in operation, it dissipates heat in two simultaneous ways: thermal radiation and heat conduction. Among them, the heat emitted by heat conduction heats the airflow, and the airflow then heats the surface of the fuse 15; the heat emitted by thermal radiation is directly transferred to the surface of the fuse 15. Since the transmission speed of thermal radiation is the speed of light, the heating speed of thermal radiation to the fuse 15 is much faster than that of heat conduction. Configuring the surface color of the fuse 15 to have a high thermal radiation absorption efficiency may make the fuse 15 more sensitive to the heat of thermal radiation, and it is easier to fuse quickly when the heater 13 is over-temperature.

[0046] For example, the maximum temperature threshold of the heater 13 is C1, and the fusing temperature of the fuse 15 is C2. When the heater 13 fails and causes over-temperature, the airflow temperature is heated to C1 after time t1, and after time t2, the fuse 15 is heated by the airflow to temperature C2 and as a result fuses. The fusing delay time of the fuse 15 is, therefore, (t1+t2). It may also be understood that the heater 13 continues to operate for (t1+t2) time after a failure causes over-temperature before being powered off. If the fuse 15 in the above embodiment is adopted, when the heater 13 fails and causes over-temperature, the fuse 15 simultaneously absorbs heat from the heated airflow and the thermal radiation emitted by the heater 13, and the time it takes to reach temperature C2 is t3, and t3 is necessarily smaller than (t1+t2). That is, the fuse 15 may cut off the power supply at a faster speed after the heater 13 is over-temperature, so that the time it runs in the over-temperature state is shorter, thereby further reducing the dangers such as airflow overheating and structural overheating caused by the heater 13 operating in the over-temperature state.

[0047] In some embodiments, the surface color of the end cap 113 is configured to have a low absorption rate for thermal radiation. For example, the surface color of the end cap 113 is white, bright silver, light gray, etc. The end cap 113 should avoid being heated by the heater 13 as much as possible. Configuring its surface color to have a low thermal radiation absorption rate may reduce the heat absorbed by the end cap 113 from the heater 13 in the form of thermal radiation, thereby reducing the temperature rise range of the end cap 113, and also reducing the heat resistance requirement for the end cap 113.

[0048] In the drying apparatus 100 provided in some embodiments as shown in FIG. 6, the motor 31 is operable to output an annular airflow. The annular airflow may be understood as: in a plane perpendicular to the axis of the airflow, the airflow speed of the airflow in the radial center area is low or even zero, and the airflow speed is high in the annular area at the edge. The inner diameter of this annular area is called the inner dia-

meter of the annular airflow, and the outer diameter of the annular area is called the outer diameter of the annular airflow.

[0049] An annular air duct is configured between the core column assembly 11 and the airflow channel 20. Moreover, the outer diameter of the core column assembly 11 is less than or equal to the inner diameter of the annular airflow. Therefore, the core column assembly 11 itself is in an area with low airflow speed, the air resistance formed to the airflow is small, and the impact on the smoothness and wind noise of the airflow is also small. The inner diameter of the airflow channel 20 is greater than or equal to the outer diameter of the annular airflow. The annular airflow output from the airflow generating element 30 may smoothly enter the annular air duct in the airflow channel 20 without being affected by additional air resistance at the connection between the airflow channel 20 and the airflow generating element 30.

[0050] In some specific embodiments, as shown in FIG. 6, the motor 31 comprises a housing and a rotor assembly. The housing has an inner wall 313 and an outer wall 311, and an annular cavity 312 is configured between the inner wall 313 and the outer wall 311. The rotor assembly comprises a rotating shaft rotatably mounted on the inner wall 313 and a propeller 314 mounted on the rotating shaft. When the propeller 314 rotates, it generates an annular airflow in the annular cavity 312 and outputs it outward.

[0051] According to aerodynamics, when the propeller 314 rotates, it does work on the air to generate airflow, and the overall airflow direction is approximately parallel to the axial direction of the rotating shaft of the propeller 314. However, since the propeller 314 cannot constrain the airflow in the radial direction, the generated airflow will quickly diffuse as it passes, resulting in a decrease in airflow speed. In order to make the airflow output by the motor 31 more concentrated, in the above embodiment, the airflow generated by the propeller 314 in the annular cavity 312 is constrained in the radial direction by the outer wall 311 when passing, so that the airflow output by the motor 31 has a smaller diffusion angle, and may maintain a higher airflow speed over a longer distance.

[0052] Correspondingly, the outer diameter of the core column assembly 11 is less than or equal to the outer diameter of the inner wall 313, that is, less than or equal to the inner diameter of the annular airflow. In this way, the core column assembly 11 is in an area with low airflow speed in the airflow, the air resistance formed is small, and the impact on the smoothness and wind noise of the airflow is also small. The inner diameter of the airflow channel 20 is greater than or equal to the inner diameter of the outer wall 311, and the airflow will not be affected by additional air resistance at the connection between the airflow channel 20 and the airflow generating element 30.

[0053] FIG. 7 shows a partial structure of a typical

hairdryer 200 in the prior art. According to the foregoing, in the prior art, in order to reserve sufficient space for the fuse, the airflow channel 20a of the hairdryer 200 has a larger size, and is larger than the airflow outer diameter of the airflow generating element 30a. That is, the airflow of the airflow generating element 30a will diffuse when entering the airflow channel 20a. Moreover, in order to ensure that the airflow output by the hairdryer 200 has a high airflow speed, it is necessary to limit the air outlet to have a smaller size. Therefore, when the airflow flows out of the air outlet from the airflow channel 20a, shrinkage occurs. In the above process, the cross-section of the airflow has undergone a process of becoming smaller to larger (from the airflow generating element 30a to the airflow channel 20a), and then from larger to smaller (from the airflow channel 20a to the air outlet). According to aerodynamics, each change in the cross-section during airflow transmission will cause energy loss. Therefore, the heating process of the airflow by the hairdryer 200 has a lower energy utilization rate.

[0054] According to FIG. 6 and the foregoing, the drying apparatus 100 in the present disclosure has a smaller size airflow channel 20, and the cross-section formed by the airflow channel 20 and the core column assembly 11 does not change on the axis, and is approximately the same size as the annular cavity 312 of the airflow generating element 30. Therefore, the cross-section of the airflow generated by the airflow generating element 30 remains substantially unchanged and almost no energy loss occurs when passing through the airflow channel 20 until flowing out of the drying apparatus 100. Therefore, the heating process of the airflow by the heating element 10 has a higher energy utilization rate. It may also be understood that, under the premise of inputting the same energy, the drying apparatus 100 in the present disclosure may output airflow with a higher temperature; or, under the premise of outputting airflow of the same temperature, the drying apparatus 100 in the present disclosure consumes less energy.

[0055] In some embodiments shown in FIG. 6, the airflow generating element 30 also comprises a mounting base 32, and the motor 31 is mounted inside the mounting base 32. The mounting base 32 is configured inside the drying apparatus 100. The mounting base 32 may be mounted on the housing or other structures of the drying apparatus 100, and the specific mounting method is not the focus of the present disclosure.

[0056] In some specific embodiments, the airflow channel 20 is positioned at one end of the mounting base 32 and is tightly adjacent to the downstream end of the motor 31. The airflow generated when the motor 31 is operating may directly enter the airflow channel 20 without leaking between the mounting base 32 and the airflow channel 20.

[0057] In some specific embodiments, the heating element 10 is positioned at one end of the mounting

base 32 and is tightly adjacent to the downstream end of the motor 31. The airflow generated by the motor 31 during operation immediately contacts the heating element 10 after flowing out of the motor 31, maximizing the contact area between the heating element 10 and the airflow in a limited axial space, so as to increase the heating efficiency of the airflow as much as possible.

[0058] In some specific embodiments, the airflow channel 20 and the heating element 10 are both positioned on the mounting base 32. The mounting base 32 may simultaneously couple the motor 31, the airflow channel 20, and the heating element 10, so that these structures constitute a whole. Since the motor 31 will vibrate in various directions during operation, slight displacement may occur. Coupling the airflow channel 20 and the heating element 10 to the mounting base 32 may ensure sufficient fixed strength between the motor 31, the airflow channel 20, and the heating element 10. When the motor 31 vibrates, the relative positional relationship between the three will not be affected, and the airflow may always pass through the preset path and be heated.

[0059] In some specific embodiments, the drying apparatus 100 further comprises a seal (not shown) mounted between the mounting base 32 and the airflow channel 20, and the seal may axially extend and retract along the airflow generating element 30. The seal is configured to seal between the mounting base 32 and the airflow channel 20 to ensure that all the airflow formed by the motor 31 enters the airflow channel 20.

[0060] During operation, the motor 31 does work on the airflow, pushing the airflow to accelerate and flow towards the airflow channel 20. At the same time, the motor 31 itself is also subjected to the reaction force of the airflow, and the reaction force is directed away from the airflow channel 20. Especially at the moment when the motor 31 rotates, the motor 31 changes from a state of being unstressed to a state of being subjected to the reaction force of the airflow, which may cause the motor 31 to be displaced in the direction away from the airflow channel 20, that is, the distance between the motor 31 and the airflow channel 20 will suddenly increase. In order to avoid air leakage in this state, the seal is configured to be axially extendable and retractable along the airflow generating element 30. When displacement occurs at the moment when the motor 31 rotates, the mounting base 32 pulls the seal to deform, and the seal may still maintain a sealed state after deformation. In other conditions, when the motor 31 accelerates and decelerates, the reaction force it receives will change and displacement will occur accordingly, and the seal will be correspondingly stretched and deformed in the axial direction, and may always maintain the sealed state between the mounting base 32 and the airflow channel 20.

[0061] In some specific embodiments shown in FIG. 8, the motor 31 has a connecting board 315 for coupling with an external circuit, so as to send control sig-

nals and/or power input to the motor 31. Since the rotor assembly of the motor 31 is located on the inner wall 313, one end of the connecting board 315 is connected to the inner wall 313, and the other end radially spans the annular cavity 312 and extends to the outside of the outer wall 311. In other words, at least part of the connecting board 315 is located in the airflow formed by the motor 31, which will affect the airflow. According to some of the foregoing content, the supporting elements 12 in the heating element 10 themselves also extend radially along the airflow, and will also affect the airflow.

[0062] In order to minimize the impact on the airflow, in any plane perpendicular to the airflow direction, the projection of at least one supporting element 12 overlaps at least partially with the projection of the connecting board 315, so that the connecting board 315 and the supporting element 12 overlap in the airflow direction, and the connecting board 315 located upstream will shield the supporting element 12 in the airflow, reducing the impact of the supporting element 12 on the airflow, and also reducing the impact of the heating element 10 and the airflow generating element 30 as a whole on the airflow.

[0063] In some embodiments not shown, a plurality of guide vanes is also arranged in the annular cavity 312 of the motor 31, and is configured to guide the airflow in the annular cavity 312. In any plane perpendicular to the airflow direction, the projection of at least one supporting element 12 overlaps at least partially with the projection of at least one guide vane, so that the guide vane shields the supporting element 12 in the airflow, reducing the impact of the supporting element 12 on the airflow. In a more specific embodiment, the quantity of the supporting elements 12 is set to be the same as the quantity of the guide vanes (for example, both are 6, 7, 9, etc.), and the positions of the supporting elements 12 and the guide vanes are in one-to-one correspondence, so that all supporting elements 12 are shielded by the corresponding guide vanes. On the one hand, the impact of the supporting elements 12 on the airflow may be reduced, and on the other hand, it is equivalent to extending the length of the guide vanes in the airflow direction, increasing the directional guidance to the airflow, and making the output airflow by the drying apparatus 100 have better smoothness.

[0064] As shown in FIG. 6, in some specific embodiments, the drying apparatus 100 also comprises an air guide grille 21. The air guide grille 21 is configured at the air outlet downstream of the airflow channel 20, and is configured on the core column assembly 11. The air guide grille 21 may guide the outflowing airflow and reduce the turbulence generated when the airflow passes through the heating element 10. Moreover, the air guide grille 21 also forms a barrier between the heating element 10 and the external environment, preventing overheating dangers caused by fingers or foreign objects such as cloth, hair, and paper from entering the airflow channel 20 from the air outlet and con-

tacting the heating element 10.

[0065] In some embodiments, as shown in FIG. 6, the drying apparatus 100 also comprises a radiation element 40 capable of outputting infrared radiation. The radiation element 40 is annular, and the airflow channel 20 is mounted inside the annular inner edge of the radiation element 40. As is known from the foregoing, the drying apparatus 100 itself may output normal temperature airflow or hot airflow, and the infrared radiation output by the radiation element 40 and the airflow jointly act on the target object. Infrared radiation does not bake the object to be dried at a high temperature, so damage to the object to be dried caused by high-temperature baking may be avoided under the premise of increasing drying efficiency.

[0066] As is known from the foregoing, the heating element 10 in the present disclosure may be adapted to an airflow channel 20 with a smaller size. Therefore, a larger area on the end face of the drying apparatus 100 may be designed to output infrared radiation to the outside (hereinafter referred to as a light emitting portion), and a smaller area is designed as an air outlet for outputting airflow to the outside. This enables the drying apparatus 100 to output sufficient infrared radiation without significantly increasing the size.

[0067] In addition, compared with infrared radiation, airflow is more likely to diffuse on the transmission path. In order to make the airflow and infrared radiation act on approximately overlapping areas at a preset distance, so as to realize simultaneous drying of the area by infrared radiation and airflow, it is necessary to control the diffusion of the airflow as much as possible. In the above embodiment, the size of the air outlet of the drying apparatus 100 is small, and the size of the light emitting portion is large. At a preset distance, the airflow that has diffused to a greater extent just overlaps with the infrared radiation that has diffused to a less extent, and jointly acts on the target area of the target object.

[0068] In some specific embodiments, the airflow channel comprises a second insulation sleeve 20 formed of a material with heat resistance and/or low thermal conductivity. The heating element 10 is located in the second insulation sleeve 20 and the two are maintained coaxial. An annular space with a uniform radial dimension is formed between the core column assembly 11 and the second insulation sleeve 20 for the annular airflow output by the motor 31 to pass through.

[0069] The material of the second insulation sleeve 20 and the first insulation sleeve 112 may be the same or different, and the function of both is to isolate heat. More specifically, the second insulation sleeve 20 may isolate heat transfer between the heating element 10 and the radiation element 40, so as to avoid the heat emitted by the heating element 10 during operation from heating the radiation element 40.

[0070] In summary, combining the foregoing multiple

embodiments, the multiple parts in the drying apparatus 100 are coupled to each other, so that the drying apparatus 100 has a unique drying effect. Specifically, in the heating element 10, the fuse 15 is located in the recess 114 of the core column assembly 11, so that under the premise of ensuring that the fuse 15 has a sufficient distance from the heater 13, the airflow channel 20 may be designed to have a smaller size. The smaller size airflow channel 20 helps to achieve a higher airflow speed, and the air outlet occupies a smaller space on the end face of the drying apparatus 100. In this way, sufficient space may be reserved for arranging the radiation element 40 without increasing the overall size of the drying apparatus 100. The airflow and infrared radiation of the drying apparatus 100 form an overlapping acting area at a preset distance, so as to efficiently dry the object to be dried in three ways: fluid convection, heat exchange, and thermal radiation simultaneously.

[0071] In the description of this specification, references to the terms "one embodiment", "some embodiments", "schematic embodiments", "examples", "specific examples" or "some examples", etc., are intended to mean that the specific features, structures, materials or features described in conjunction with the embodiments or examples are contained in at least one embodiment or example of the present disclosure. In this specification, indicative representations of the above terms do not necessarily refer to the same embodiments or examples. Further, the specific features, structures, materials, or features described may be combined in an appropriate manner in any one or more embodiments or examples. In addition, without contradicting each other, those skilled in the art may combine and combine the different embodiments or examples described in this specification and the features of the different embodiments or examples.

[0072] Notwithstanding the above illustrations and descriptions of the embodiments of the present disclosure, it is understood that the said embodiments are illustrative and cannot be construed as limiting the present disclosure, and those skilled in the art may change, modify, replace and variate the said embodiments within the scope of the present disclosure.

Claims

1. A heating element, configured in an airflow channel of a drying apparatus, the heating element comprising:

a core column assembly, wherein an outer wall of the core column assembly is configured with a recess;
a plurality of supporting elements, each supporting element being configured on the core column assembly and extending radially along

the airflow channel;
a heater, wherein the heater surrounds outer edges of the plurality of supporting elements;
a fuse, wherein the fuse is located in a recess and configured to disconnect the heater when a temperature is higher than a threshold.

2. The heating element of claim 1, wherein the core column assembly comprises:

a first insulation sleeve, wherein an outer wall of the first insulation sleeve comprises a part of the outer wall of the core column assembly, the first insulation sleeve defines a notch corresponding to the recess, the first insulation sleeve is formed of a material with heat resistance and/or low thermal conductivity;
two end caps, wherein the two end caps are respectively configured at two ends of the first insulation sleeve, the end caps are formed of an insulating material;
and wherein each supporting element is coupled to the end caps.

3. The heating element of claim 2, wherein at least one supporting element comprises a mounting portion located within the recess, and the fuse is configured on the mounting portion.

4. The heating element of claim 2, wherein the end cap defines a plurality of slots for insertion and mounting of the supporting elements, and at least one slot extends through to the recess and forms a wire passage hole for wires of the fuse to pass through.

5. The heating element of claim 2, wherein the core column assembly further comprises a base defining the recess, wherein the base extends axially and both ends of the base are respectively coupled to corresponding end caps, the first insulation sleeve is mounted outside the base.

6. The heating element of claim 5, wherein the first insulation sleeve is formed of mica material, the base is formed of metal material, and each end cap is formed of plastic.

7. The heating element of claim 5, wherein the base has an axially extending mounting hole, and each end cap is coupled to the base through the mounting hole.

8. The heating element of any of claims 1 to 7, wherein a surface color of the fuse is configured to have a high absorption rate for thermal radiation.

9. The heating element of any of claims 2 to 7, wherein a surface color of the end cap is configured to have a low absorption rate for thermal radiation.
10. The heating element of any of claims 1 to 7, wherein it further comprises a plurality of wires, wherein the plurality of wires is configured to be connected to an external circuit, wherein at least one wire passes through the core column assembly.
11. The heating element of any of claims 1 to 7, wherein the quantity of the supporting elements is six, and the supporting elements are uniformly arranged along a circumferential direction of the core column assembly.
12. A drying apparatus, the drying apparatus comprising:
 an airflow generating element, wherein the airflow generating element comprises a motor for generating airflow;
 an airflow channel, wherein the airflow channel is configured downstream of the airflow generating element;
 the heating element of any of claims 1 to 11.
13. The drying apparatus of claim 12, wherein the axes of the airflow channel, the airflow generating element, and the core column assembly are coaxial.
14. The drying apparatus of claim 12, wherein the motor is operable to output an annular airflow; and,
 the outer diameter of the core column assembly is less than or equal to the inner diameter of the annular airflow;
 the inner diameter of the airflow channel is greater than or equal to the outer diameter of the annular airflow.
15. The drying apparatus of claim 12, wherein the motor comprises a housing and a rotor assembly, the housing comprises an inner wall and an outer wall, an annular cavity is defined between the inner wall and the outer wall; the rotor assembly comprises a rotating shaft rotatably mounted on the inner wall and a propeller mounted on the rotating shaft, the propeller generates an annular airflow in the annular cavity when rotating;
 the outer diameter of the core column assembly is less than or equal to the outer diameter of the inner wall;
 the inner diameter of the airflow channel is greater than or equal to the inner diameter of the outer wall.
16. The drying apparatus of claim 15, wherein the motor comprises a connecting board for providing control signals and/or power input, the connecting board is coupled at one end to the rotor assembly, and extends radially across the annular cavity and extends to the outside of the housing; and, in any plane perpendicular to the airflow direction, a projection of at least one supporting element overlaps at least partially with a projection of the connecting board.
17. The drying apparatus of any of claims 12 to 16, wherein the airflow generating element further comprises a mounting base, wherein the motor is configured inside the mounting base; the airflow channel and/or the heating element are positioned at one end of the mounting base and are tightly adjacent to the downstream end of the motor.
18. The drying apparatus of claim 17, wherein the drying apparatus further comprises a seal axially extending and retracting along the airflow generating element, the seal seals between the mounting base and the airflow channel.
19. The drying apparatus of any of claims 12 to 16, wherein an air outlet is configured downstream of the airflow channel, and an air guide grille is configured at the air outlet, the air guide grille is configured on the core column assembly.
20. The drying apparatus of any of claims 12 to 16, wherein the drying apparatus further comprises an annular radiation element configured to output infrared radiation, and the airflow channel is configured inside the annular inner edge of the radiation element.
21. The drying apparatus of claim 20, wherein the airflow channel comprises a second insulation sleeve formed of a material with heat resistance and/or low thermal conductivity, the heating element is configured in the second insulation sleeve and kept coaxial with the second insulation sleeve.

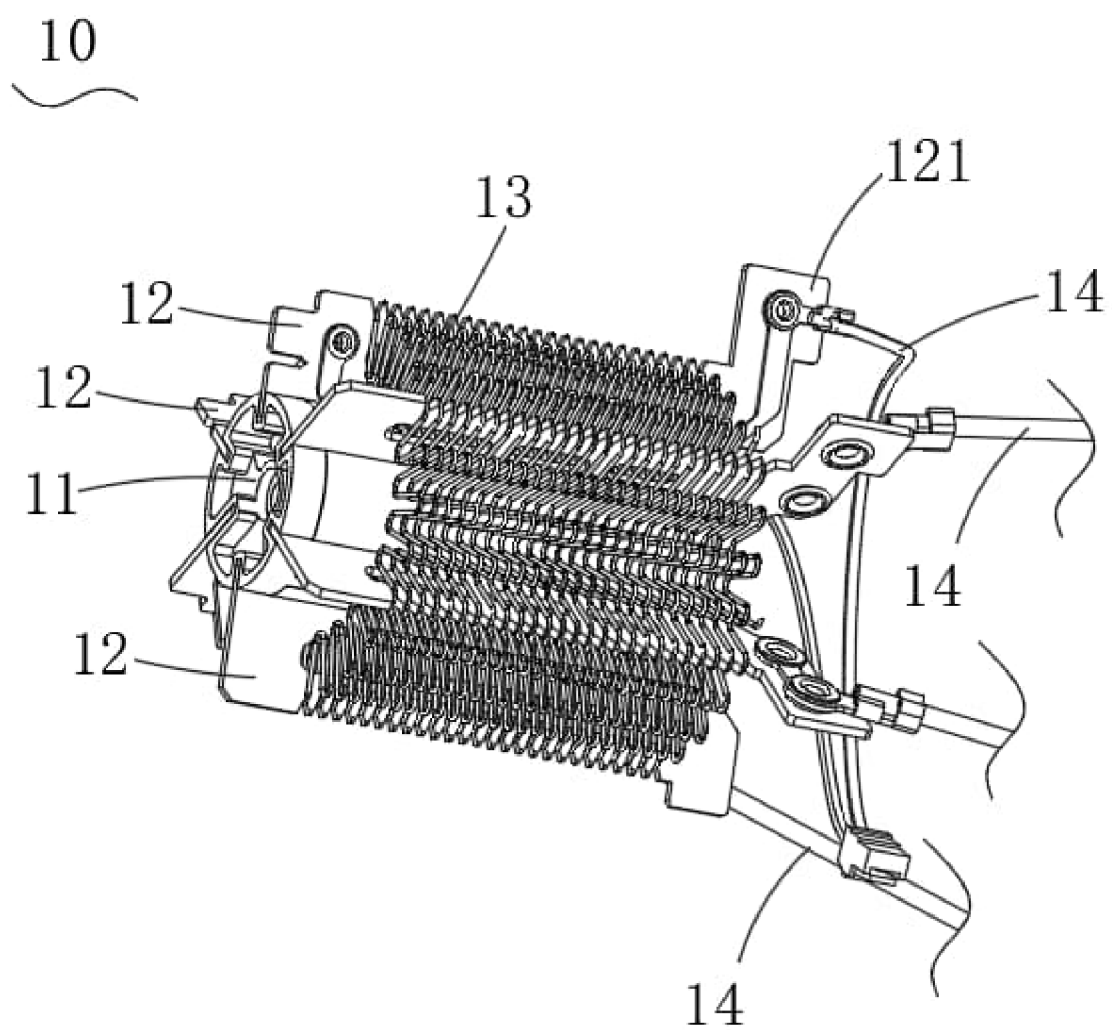


Fig. 1

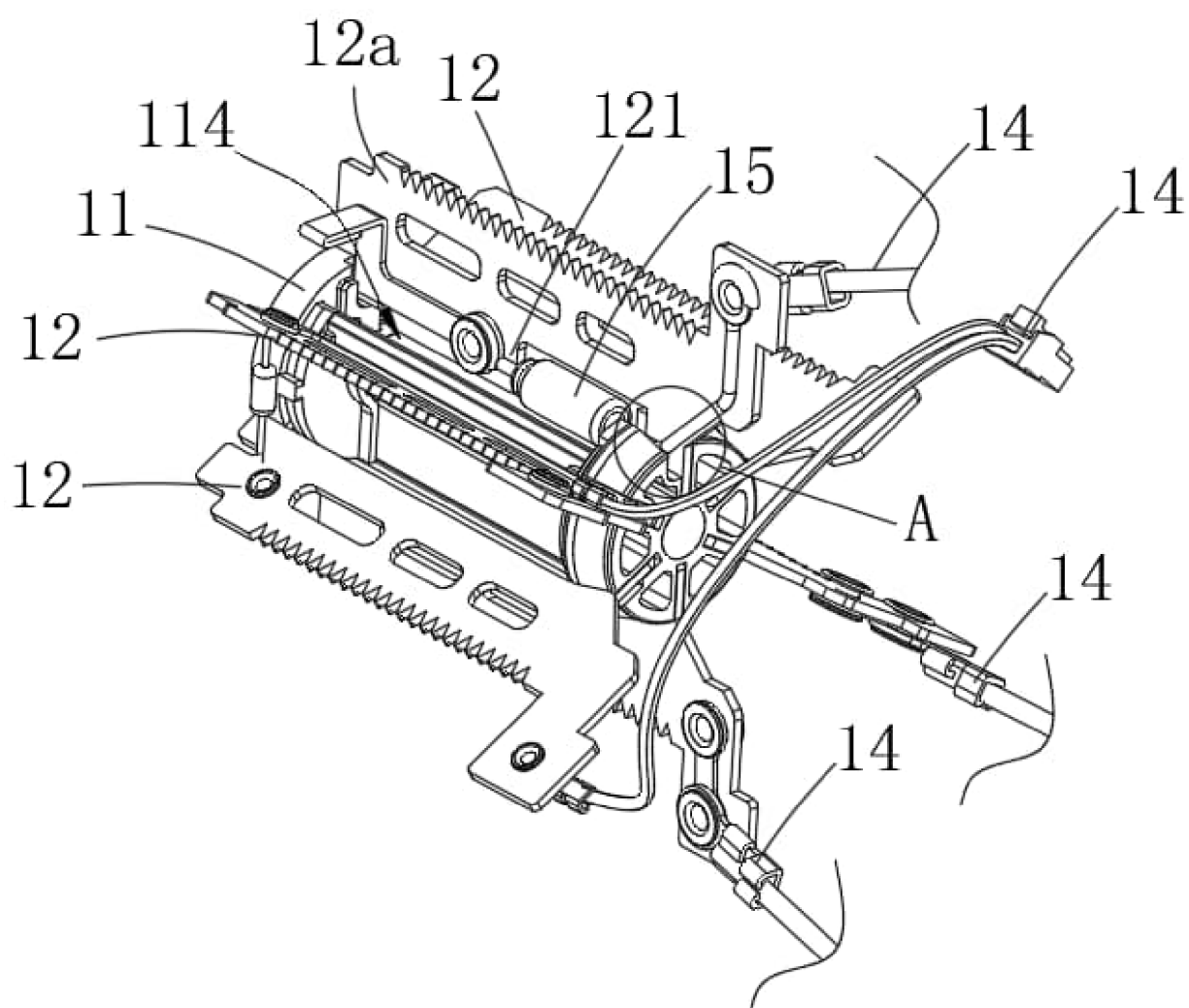


Fig. 2

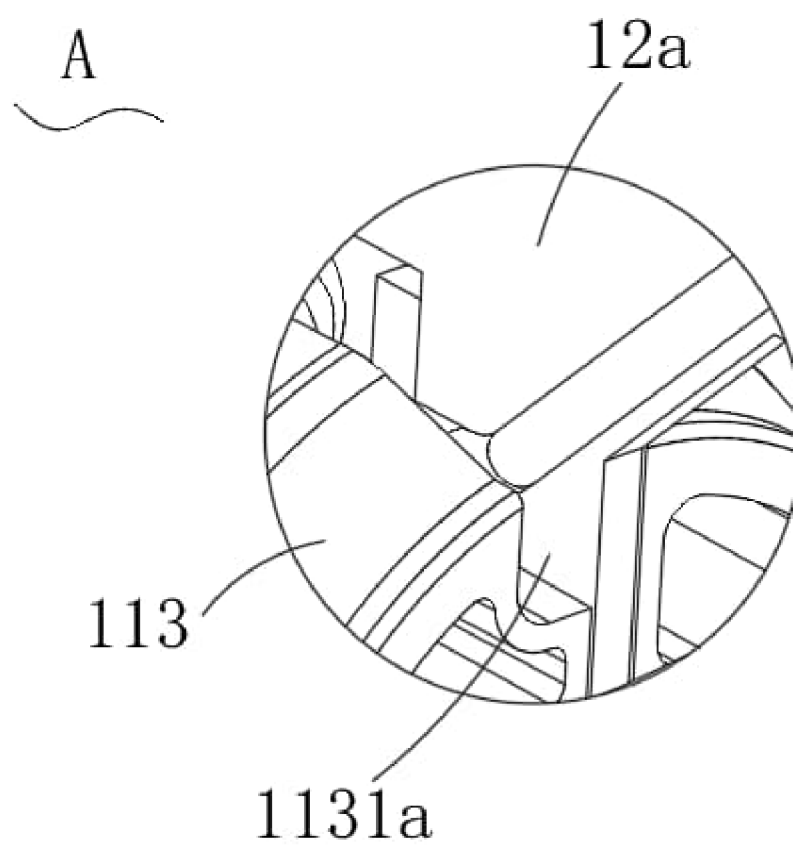


Fig. 3

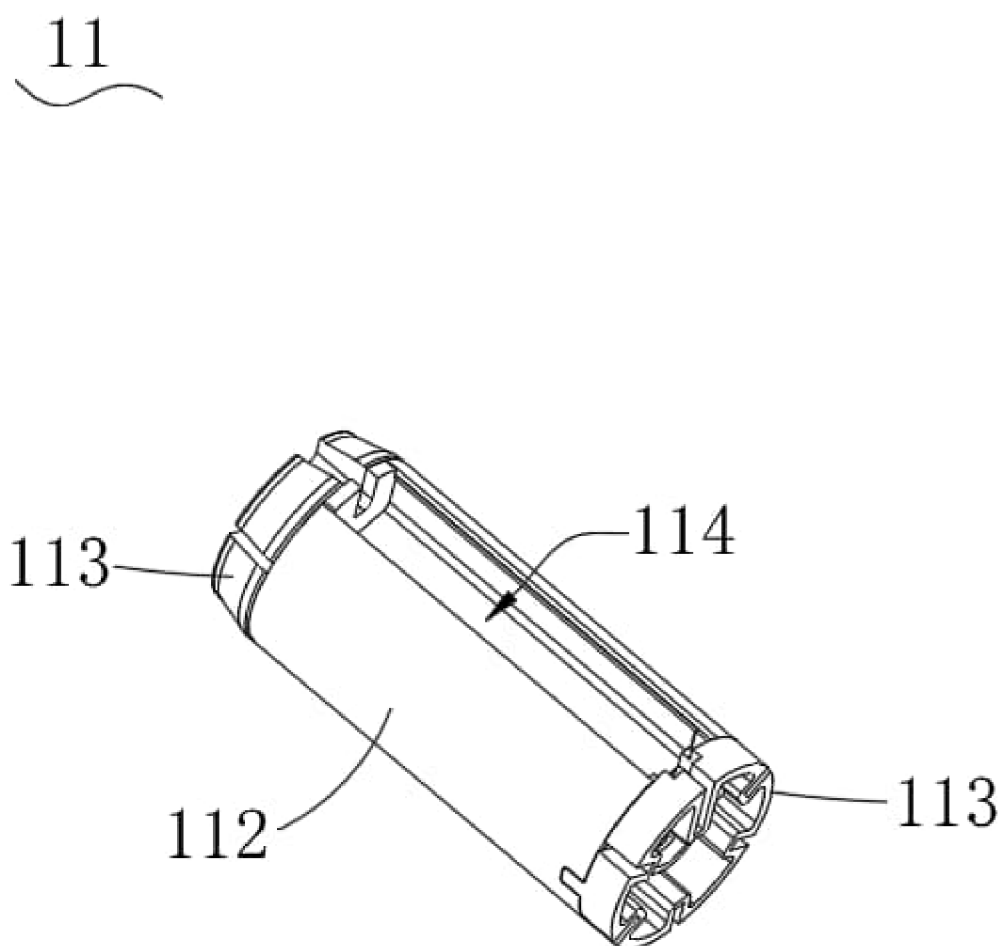


Fig. 4

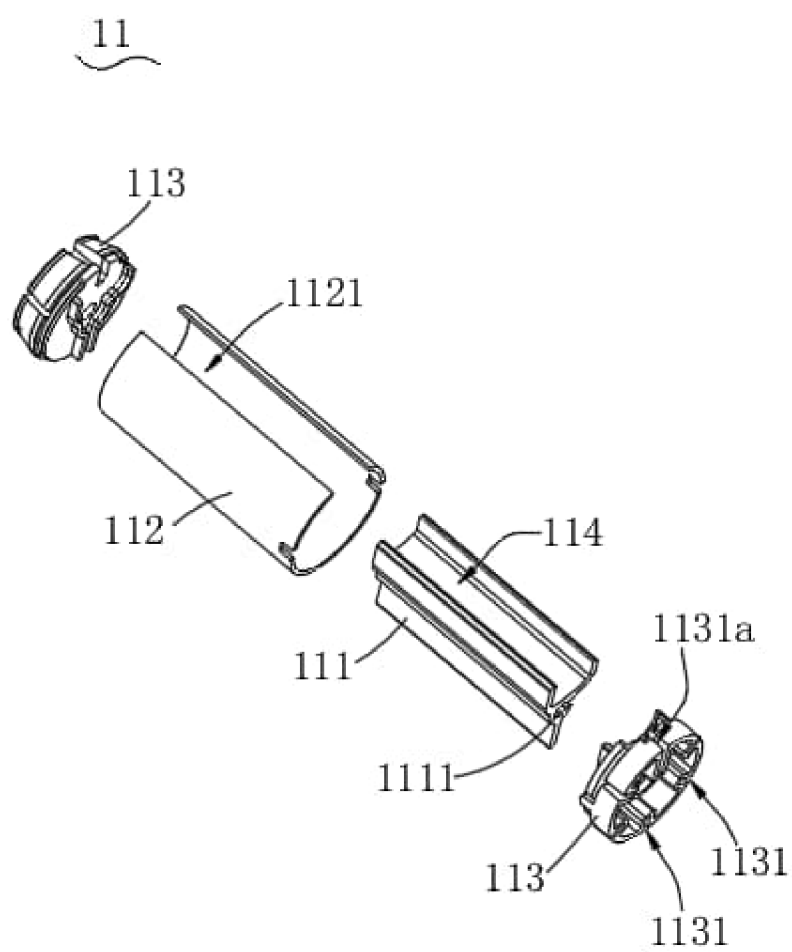


Fig. 5

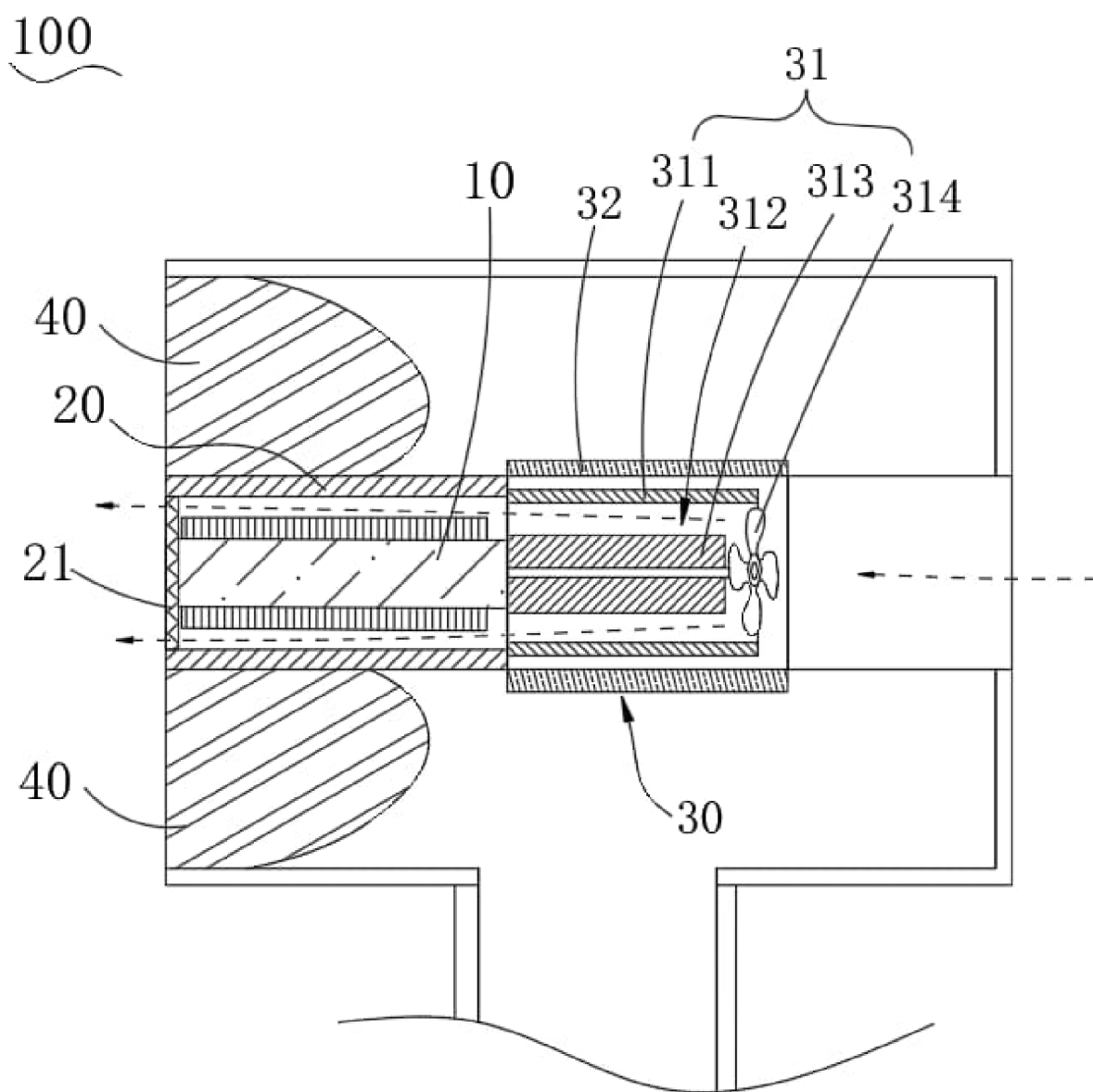


Fig. 6

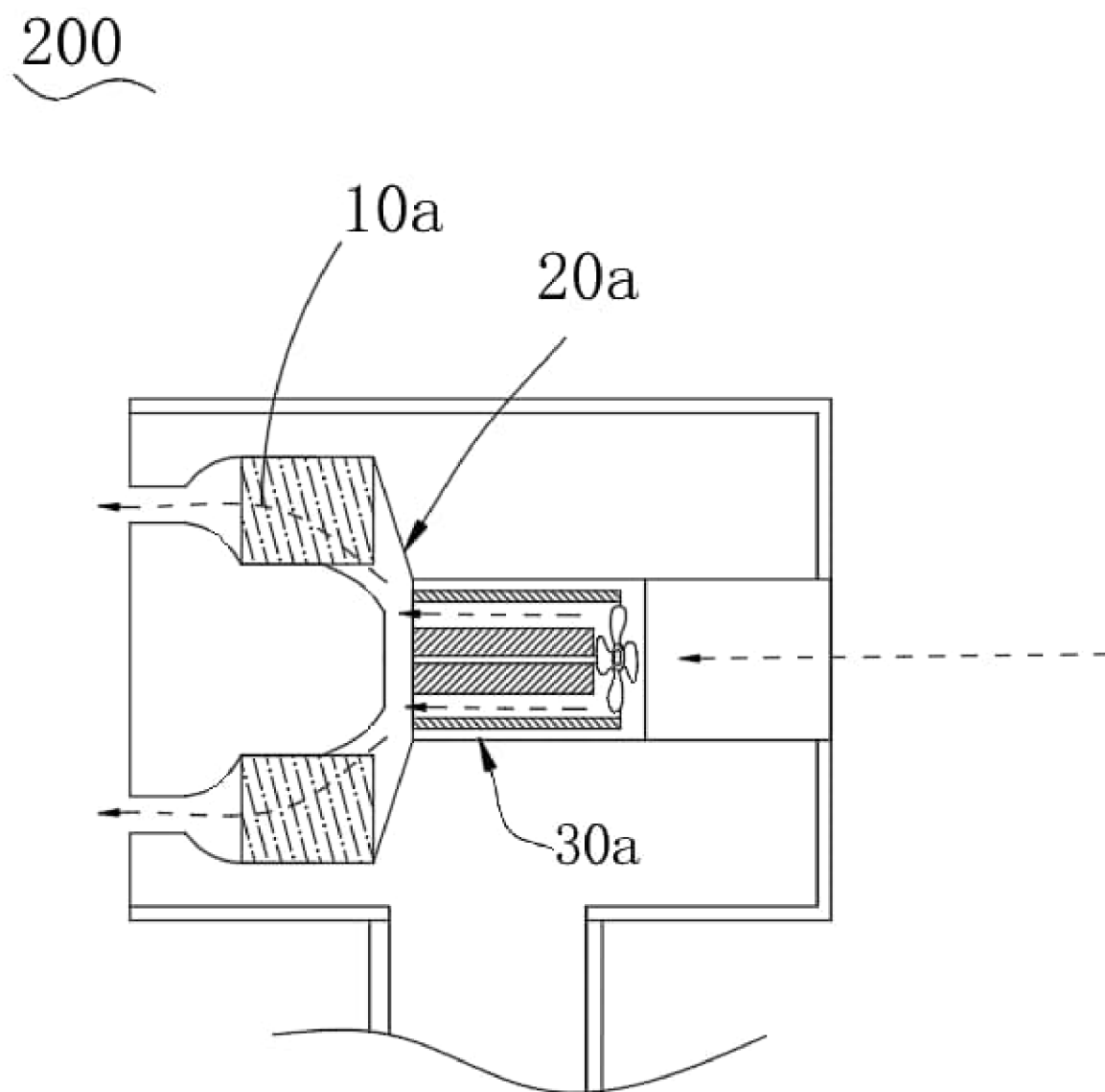


Fig. 7

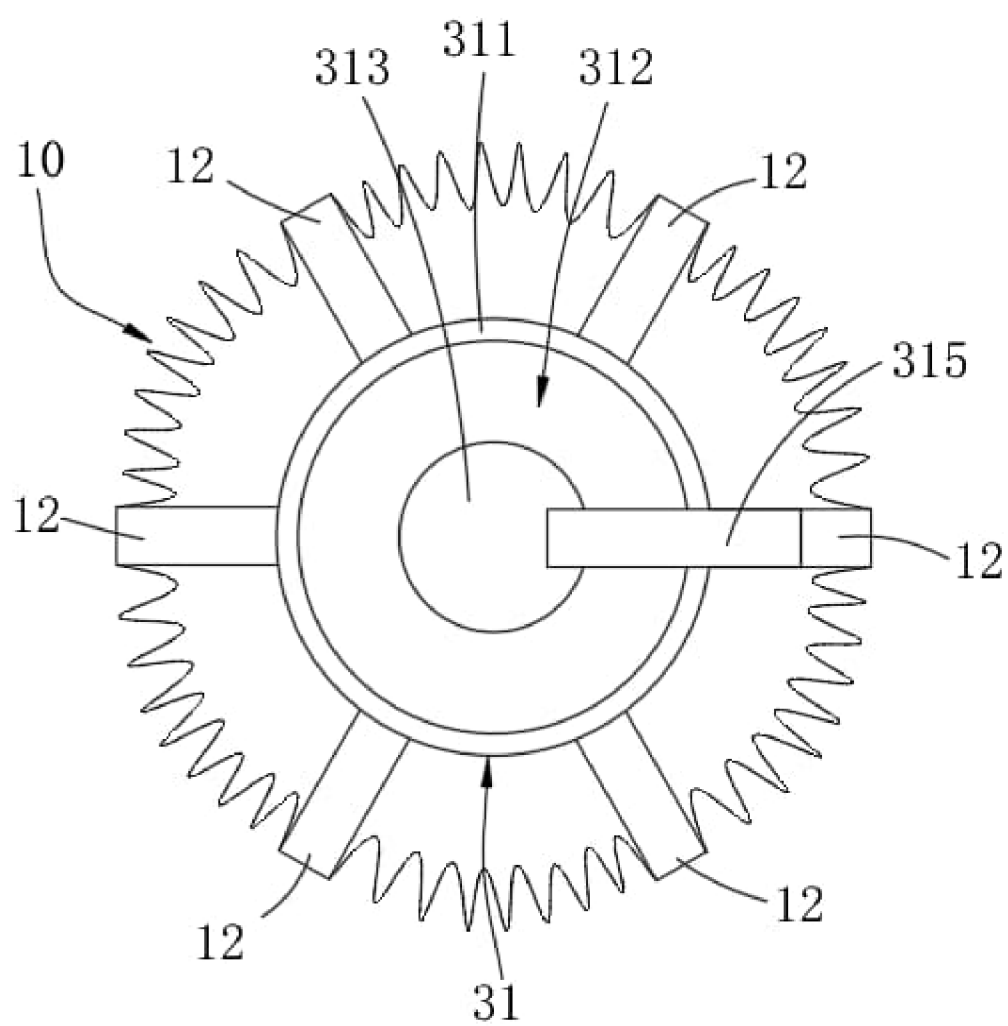


Fig. 8

INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2023/137955

A. CLASSIFICATION OF SUBJECT MATTER

A45D20/08(2006.01)i; A45D20/04(2006.01)i; A45D20/00(2006.01)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: A45D

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; VEN; WPABS; CNTXT; ENTXTC; ENTXT; CNKI: 热熔, 熔断, 加热, 干燥, 气流, 流体, 电机, 电动机, 吹风机, 电吹风, thermal, fuse, heat+, dryer, hair, fluid, motor

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	CN 112425258 A (GAMMA S.P.A.) 26 February 2021 (2021-02-26) description, paragraphs [0049]-[0125], and figures 1-7c	1-4, 8-14, 17-21
Y	CN 112425258 A (GAMMA S.P.A.) 26 February 2021 (2021-02-26) description, paragraphs [0049]-[0125], and figures 1-7c	5-14, 17-21
Y	CN 212390618 U (DREAME TECHNOLOGY (SHANGHAI) CO., LTD.) 22 January 2021 (2021-01-22) description, paragraphs [0029]-[0046], and figures 1-8	5-14, 17-21
X	CN 217218396 U (MA QIANJUN) 19 August 2022 (2022-08-19) description, paragraphs [0023]-[0034], and figures 1-3	1-4, 8-13, 19-21
X	CN 215189805 U (WUXI ROIDMI INFORMATION TECHNOLOGY CO., LTD.) 17 December 2021 (2021-12-17) description, paragraphs [0048]-[0063], and figures 1-9	1-4, 8-13, 19-21
A	CN 107028320 A (DYSON TECHNOLOGY LTD.) 11 August 2017 (2017-08-11) entire document	1-21

☐ 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
"A" document defining the general state of the art which is not considered to be of particular relevance	"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"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

16 May 2024

Date of mailing of the international search report

01 June 2024

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/CN2023/137955

5

10

15

20

25

30

35

40

45

50

55

Patent document cited in search report			Publication date (day/month/year)	Patent family member(s)	Publication date (day/month/year)
CN	112425258	A	26 February 2021	None	
CN	212390618	U	22 January 2021	None	
CN	217218396	U	19 August 2022	None	
CN	215189805	U	17 December 2021	None	
CN	107028320	A	11 August 2017	None	