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(54) CLEANING BRUSHES, SMART CLEANING DEVICE, AND METHOD FOR MANUFACTURING CLEANING BRUSHES

(57) Cleaning brushes (100, 200), a smart cleaning device, and a method for manufacturing the cleaning brushes (100, 200). The cleaning brushes (100, 200) each comprise a mounting shaft (110), an elastic support member (120), and a tubular member (130); the elastic support member (120) has a through hole extending in the axial direction, and the elastic support member (120) is sleeved on the mounting shaft (110) by means of the through hole; the tubular member (130) is sleeved on the elastic support member (120) and provided with blades (131, 231) integrally formed together with the tubular member (130); an adhesive layer is provided both between the mounting shaft (110) and the elastic support member (120) and between the elastic support member (120) and the tubular member (130), such that the mounting shaft (110), the elastic support member (120), and the tubular member (130) are bonded together.

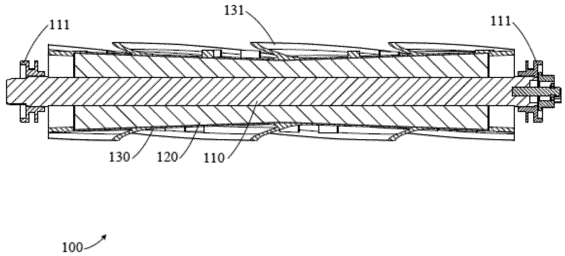

FIG. 1

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Description

CROSS-REFERENCE TO RELATED APPLICATION

[0001] This application claims priority to Chinese Patent Application No. 202010904813.9 filed on September 1, 2020, the content of which is hereby cited in its entirety as a part of this application.

TECHNICAL FIELD

[0002] The present invention relates to the technical field of cleaning tools, and more particularly, to a cleaning brush, a smart cleaning device and a method for manufacturing the cleaning brush.

BACKGROUND

[0003] With the rapid development of communication technologies, the application of smart products in daily life has been becoming increasingly widespread, and many mobile smart cleaning devices, such as smart sweepers, have appeared. The smart cleaning devices can automatically perform cleaning operations for the convenience of users. The existing smart cleaning devices are usually provided with a cleaning assembly including a main brush to sweep rubbish up. The structure of the main brush is various, and the common one is a hair brush, or a rubber brush, i.e., a rubber main brush. The rubber main brush generally includes a mounting shaft and a rubber tube member sleeved the mounting shaft, where the rubber tube member is directly and fixedly connected to the mounting shaft. This structure is unstable, has a poor vibration damping effect, and is thus easily damaged during use.

[0004] Therefore, there is a need for a cleaning brush, a smart cleaning device and a method for manufacturing the cleaning brush so as to at least partially solve the problems existing in the prior art.

SUMMARY

[0005] A series of concepts in simplified form have been introduced in the Summary section, which are described in further detail in the Detailed Description section. The Summary section of the present invention is not intended to define the key features and essential technical features of the claimed technical solutions, nor is it intended to determine the protection scope of the claimed technical solutions.

[0006] In order to at least partially solve the above problems, according to one aspect of the present invention, a cleaning brush for a smart cleaning device is provided. The cleaning brush includes:

a mounting shaft;

an elastic supporting member, which is provided with a through hole extending in an axial direction and is sleeved onto the mounting shaft through the through hole; and

a tubular member, which is sleeved onto the elastic supporting member and is provided with blades integrally formed with the tubular member,

where an adhesive layer is provided between the mounting shaft and the elastic supporting member, as well as between the elastic supporting member and the tubular member respectively, such that the mounting shaft, the elastic supporting member and the tubular member are adhered together.

[0007] According to this scheme, the structure of the cleaning brush can be simplified to achieve a compact structure, good stability, strong vibration damping capability, and is thus hardly damaged during use, thereby prolonging the service life. On the other hand, the cleaning brush is manufactured conveniently and the manufacturing cost is reduced.

[0008] Optionally, the blades extend in the axial direction and are configured as V-shaped sheet bodies or spiral sheet bodies. Therefore, the design freedom of a main shaft can be improved. In addition, in the case that the spiral sheet bodies are adopted as the blades, the cleaning efficiency of the cleaning brush and a cleaning effect can be improved.

[0009] Optionally, a plurality of dot-like protrusions is arranged on the blades. Therefore, rubbish stuck or retained between the cleaning brush and an air duct can be dragged out with the aid of the dot-like protrusions, and then sent into a dust box after rotating for one circle together with the cleaning brush.

[0010] Optionally, end mounting members are detachably arranged at two axial ends of the mounting shaft. Therefore, rubbish such as hair that is not expected to gather at both ends of the mounting shaft can be cleaned to facilitate at least the assembly of the elastic supporting member.

[0011] Optionally, the elastic supporting member is made of a sponge material or foam material; and/or

the mounting shaft is made of a plastic material, and the tubular member is made of a soft rubber material.

[0012] Therefore, the elastic supporting member can provide a desired elastic force and support force, and further improve the structural stability and vibration damping capability of the cleaning brush.

[0013] Optionally, the soft rubber material is at least one of elastic materials of rubber, silicone, TPU and TPE. Therefore, the material for manufacturing the tubular member can be selected according to the needs, thereby improving the design freedom of the soft rubber material.

[0014] Optionally, a size of each blade in a radial direction gradually increases from an end of the tubular member to a middle part of the tubular member. Therefore, the service life of the blades can be prolonged, and a current such as in a carpet can be reduced.

[0015] According to another aspect of the present invention, a smart cleaning device is provided, which in-

cludes the cleaning brush according to any of the above aspects.

[0016] According to yet another aspect of the present invention, a manufacturing method for manufacturing the cleaning brush according to any of the above aspects is provided. The method includes the following steps:

sleeving the elastic supporting member onto the mounting shaft, where at least one of the elastic supporting member and the mounting shaft is coated with a first adhesive being cured;
heating the mounting shaft sleeved with the elastic supporting member, such that the first adhesive is hot-melted and then cured to form an adhesive layer, thereby adhering the elastic supporting member and the mounting shaft together; and
sleeving the tubular member onto the elastic supporting member, and adhering the tubular member to the elastic supporting member through the adhesive layer formed from a second adhesive.

[0017] According to this scheme, the elastic supporting member can be adhered to the mounting shaft through the adhesive layer formed from the first adhesive, and the tubular member can be adhered to the elastic supporting member through the adhesive layer formed from the second adhesive, thereby forming the cleaning brush of an adhesive structure. In addition, a hot melt adhesive can be selected as the first adhesive, such that the elastic supporting member can be quickly sleeved in a simple adhesion manner, thereby improving the manufacturing efficiency of the cleaning brush.

[0018] Optionally, prior to the sleeving of the tubular member, at least one of the tubular member and the elastic supporting member is coated with the second adhesive being cured; and after the sleeving of the tubular member, the elastic supporting member sleeved with the tubular member is heated, such that the second adhesive is hot-melted and then cured to form the adhesive layer, thereby adhering the tubular member and the elastic supporting member together.

[0019] Therefore, a hot melt adhesive can be selected as the second adhesive, such that the adhesion manner is simple, the tubular member can be prevented from deformation, and a good molding effect can be achieved.

[0020] Optionally, prior to the sleeving of the tubular member, at least one of the tubular member and the elastic supporting member is coated with the second adhesive in liquid state, which is cured after the sleeving of the tubular member.

[0021] Therefore, an irreversible adhesive can be selected to adhere the tubular member to the elastic supporting member.

[0022] Optionally, in the sleeving process of the tubular member, the tubular member is elastically deformed to increase an inner diameter, so as to facilitate the insertion of the elastic supporting member. Therefore, the interior of the tubular member can be expanded by means of auxiliary means to form a gap between the elastic supporting member and the tubular member to facilitate the insertion of the tubular member, thereby realizing fast insertion of the tubular member and further improving the assembling efficiency.

[0023] Optionally, the inner diameter of the tubular member is increased by means of a tool acting on the tubular member.

[0024] Optionally, an end of the tubular member is sleeved onto the elastic supporting member first, and then a predetermined pressure gas is introduced to another end of the tubular member, such that the inner diameter of the tubular member is increased.

[0025] Optionally a hot-melt temperature of the first adhesive is higher than a hot-melt temperature of the second adhesive. Therefore, when the second adhesive is heated to adhere the tubular member to the elastic supporting member, a heating temperature can be controlled to be lower than the hot-melt temperature of the first adhesive, such that the adhesive layer formed from the first adhesive is not affected by temperature, thereby maintaining relatively high adhesiveness, high adhesive strength and a good effect.

[0026] Optionally, the hot-melt temperature of the first adhesive is lower than or equal to 160□, and the hot-melt temperature of the second adhesive is lower than or equal to 100 . Therefore, the deformation of the mounting shaft and the tubular member due to too high temperature can be at least avoided.

[0027] Optionally, the first adhesive is coated to the mounting shaft in a rotating state by means of spraying; and the second adhesive is coated to the elastic supporting member in a rotating state by means of spraying. Therefore, the adhesive can be uniformly sprayed onto the outer surface of a component to be coated by means of rotation, with high coating efficiency and a good coating effect.

[0028] Optionally, the first adhesive is a polyurethane adhesive; and/or the second adhesive is a polyurethane adhesive. Therefore, the deformation of the plastic shaft and the tubular member can be avoided by selecting a suitable adhesive, thereby further ensuring a molding effect and the structural stability.

BRIEF DESCRIPTION OF THE DRAWINGS

[0029] The following accompanying drawings of the present invention are used here as a part of the present invention for understanding the present invention. The embodiments and their descriptions of the present invention are illustrated in the accompanying drawings to explain a device and its principle of the present invention. In drawings:

FIG. 1 is a schematic cross-sectional view of a cleaning brush according to an embodiment of the present invention;
FIG. 2 is a schematic perspective view of a cleaning

brush according to another embodiment of the present invention; and

FIG. 3 is a block flowchart for manufacturing a cleaning brush according to a preferred embodiment of the present invention.

Description of reference numerals:

[0030]

100, 200-cleaning brush; 110-mounting shaft;
111-end mounting member; 120-elastic supporting member;
130-tubular member; 131, 231-blade;
232-protrusion.

DETAILED DESCRIPTION

[0031] In the following description, numerous details are set forth to provide a more thorough understanding of the present invention. However, it is apparent for a person skilled in the art that the present invention may be implemented without one or more such details. In other examples, in order to avoid obscuring the present invention, some technical features known in the art have not been described.

[0032] For a thorough understanding of the present invention, detailed structures will be presented in the following description in order to explain the present invention. Obviously, the implementation of the present invention is not limited to the specific details familiar to a person skilled in the art. The preferred embodiments of the present invention are described in detail below, however, the present invention may have other embodiments in addition to these detailed descriptions, and should not be construed as being limited to the embodiments set forth herein.

[0033] It should be understood that the terms used herein are for the purpose of describing particular embodiments only and not as limitations of the present invention, and that the singular forms "a", "an" and "the/this" are intended to include the plural forms as well, unless the context clearly indicates otherwise. Terms "include" and/or "comprise", when used in the present description, indicate the presence of the stated feature, integer, step, operation, element and/or component, but could not preclude the presence or addition of one or more other features, integers, steps, operations, elements, components and/or their combinations thereof. The terms "upper", "lower", "front", "rear", "left", "right" and similar expressions used in the present invention are for the purpose of illustration but not limitation.

[0034] Ordinal numbers such as "first" and "second" referenced in the present invention are merely identifications, and do not have any other meanings, such as a specific order and the like. In addition, for example, the term "first component" does not by itself imply the presence of a "second component" nor does the term "second component" by itself imply the presence of a "first component".

[0035] Hereinafter, specific embodiments of the present invention will be described in more detail with reference to the accompanying drawings, which illustrate representative embodiments of the present invention and do not limit the present invention.

[0036] Generally, a smart cleaning device mainly includes a device main body. The device main body has an approximately circular shape (round front and rear), but may have other shapes. It may be understood that the smart cleaning device shown in the present invention may be a sweeping robot, a mopping robot, a sweeping and mopping integrated robot, or the like.

[0037] The smart cleaning device includes a cleaning system, a perception system, a control system, a driving system, an energy system, a human-computer interaction system, and the like. The respective systems coordinate with each other, such that the smart cleaning device can move autonomously to perform a cleaning function. In the smart cleaning device, functional elements and the like that constitute the respective systems above are integrated in the device main body. The device main body includes an upper sealing cover, a chassis, and a middle frame disposed between the upper sealing cover and the chassis. The middle frame serves as a basic frame for providing various functional elements. The upper sealing cover and the chassis cover the surface of the device main body to protect internal components and enhance the aesthetics of the smart cleaning device.

[0038] The perception system is used for the smart cleaning device to perceive the external environment such as terrain, and includes a position determining apparatus, a buffer, a cliff sensor and an ultrasonic sensor, an infrared sensor, a magnetometer, an accelerometer, a gyroscope, an odometer and other sensing apparatuses. These sensing apparatuses provide various position information and movement status information of the machine to the control system. The position determining apparatus includes, but is not limited to, an infrared transmitting and receiving apparatus, a camera, and a laser distance sensor (LDS). The buffer is used to buffer the collision of the smart cleaning device with surrounding objects during the movement. A layer of flexible glue is provided on the surface of the buffer, and the buffer is spaced from the device main body by a predetermined distance when being mounted on the device main body, thereby ensuring that the device main body can have sufficient deceleration time in the event of a collision.

[0039] The control system is arranged on a circuit board in the device main body. It may be understood that various control circuits for controlling the smart cleaning device to operate are arranged on the circuit board. The control system includes a non-transitory memory, a computing processor, and the like. The computing processor may be a central processing unit, an application processor, etc., and is configured to draw a real-time map of an environment where the smart cleaning device is located

by using a positioning algorithm according to obstacle information fed back by the LDS. In addition, the computing processor is further configured to comprehensively determine a current working state of the smart cleaning device, such as crossing a threshold, putting on a carpet, being stuck at, above or below a cliff, or full of a dust box, being picked up, etc., by combining distance information and speed information fed back by the buffer and the sensing apparatuses. And, the computing processor is further configured to give specific next-step action strategies for different situations, so that the work of the smart cleaning device is more in line with requirements and improves the user experience.

[0040] The human-computer interaction system may include buttons on a host panel, the buttons being used by a user to select functions; also include a display screen and/or indicator light and/or a horn, all of which are configured to show the user the current state or function option of the machine; and also include a mobile phone client program. For a route navigation type smart cleaning device, a mobile phone client may show the user a map of the environment where the device is located, as well as a position of the smart cleaning device, which can provide the user with more abundant and user-friendly function options.

[0041] The energy system is used to supply electrical energy to the functional elements of the respective systems, and mainly includes a rechargeable battery and a power supply circuit. The rechargeable battery may be a NiMH battery or a lithium battery. In the case that the power in the rechargeable battery is lower than a predetermined minimum power, the rechargeable battery may be charged by connecting a charging electrode arranged on the lateral side of or below the device main body with a charging device.

[0042] The cleaning system, as the most important core system of the smart cleaning device, is used to implement a cleaning function, and includes a dry cleaning portion and a wet cleaning portion. The dry cleaning portion mainly cleans fixed particle pollutants on a surface to be cleaned through structures such as a cleaning brush. The wet cleaning portion mainly wipes the surface to be cleaned (e.g., floor) with a cleaning cloth containing cleaning liquid.

[0043] The dry cleaning portion mainly includes a cleaning assembly, a dust box and a fan. A cleaning brush 100 (see FIG. 1) in the cleaning assembly is capable of sweeping rubbish up. The fan is communicated with the dust box through an air duct and the fan is used to generate a wind force required for dust suction. Specifically, with the movement of the smart cleaning device, rubbish on the floor is swept up by the cleaning brush 100 having certain interference with the floor, rolled up to the front of a dust suction port between the cleaning brush 100 and the dust box, and then sucked into the dust box by a suction gas that is generated by the fan and passed through the dust box.

[0044] The wet cleaning portion mainly includes a liquid storage tank and a cleaning cloth. The liquid storage tank of the wet cleaning portion contains cleaning liquid, and the cleaning cloth is detachably arranged on the liquid storage tank. After the dry cleaning portion has completed the sweeping, the liquid in the liquid storage tank of the wet cleaning portion flows to the cleaning cloth, and the cleaning cloth wipes the swept floor by the cleaning brush 100 and the like.

[0045] The dry cleaning portion may further include a side brush. The side brush is arranged on the device main body through a rotating shaft. Specifically, the side brush is mounted from below to the edge of the device main body by means of the rotating shaft. The side brush may be rotatable relative to the device main body around a rotation axis where the rotation shaft is located, for moving debris (such as debris, hair, or the like) into a cleaning area of the cleaning brush 100.

[0046] The cleaning brush 100 provided according to a preferred embodiment of the present invention will be described below with reference to FIG. 1 and FIG. 2.

[0047] As shown in FIG. 1, the cleaning brush 100 for a smart cleaning device may include a mounting shaft 110, an elastic supporting member 120 and a tubular member 130. Two ends of the mounting shaft 110 are used to be connected to a body of a cleaning assembly, and the mounting shaft 110 is rotatable about its central axis relative to the body of the cleaning assembly. The elastic supporting member 120 may be provided with a through hole extending in an axial direction, to be specific, a through hole extending in an axial centerline. The elastic supporting member 120 can be sleeved to the mounting shaft 110 through the through hole. In other words, the mounting shaft 110 can be inserted into the through hole of the elastic supporting member 120 so as to support the elastic supporting member 120. The tubular member 130 can be sleeved onto the elastic supporting member 120 and be supported by the elastic supporting member 120. The tubular member 130 can be provided with blades 131 integrally formed with the tubular member 130. Therefore, the rubbish can be swept away by means of the blades 131.

[0048] The tubular member 130 in this embodiment may be made of a soft rubber material, so that the integrally formed blades 131 are also made of a soft rubber material. The soft rubber material may be at least one of elastic materials such as rubber, silicone, thermoplastic urethane (TPU), thermoplastic elastomer (TPE) and the like. Furthermore, the tubular member 130 may constitute a rubber tube, and the blades 131 may constitute a rubber brush. In this way, the cleaning efficiency, the cleaning effect and the durability in use can be improved. In addition, the tubular member 130 can be elastically deformed, e.g., expanded to increase the inner diameter, so as to facilitate the insertion of the elastic supporting member 120. The blades 131 may extend in the axial direction. The shape of each blade 131 can be set as required. In the embodiment shown in FIG. 1, the blades 131 are configured as V-shaped sheet bodies.

[0049] FIG. 2 shows a cleaning brush 200 in another embodiment. In this embodiment, blades 231 on the cleaning brush 200 are configured as spiral sheet bodies. Specifically, the blades 231 may extend in the axial direction and are spiral. This can improve the cleaning efficiency and the cleaning effect. Optionally, the tubular member 130 may also be provide with a plurality of protrusions 232 spaced apart. The protrusions 232 protrude radially outward from the outer surface of the tubular member 130. The protrusions 232 can be respectively arranged between adjacent blades 231. The protrusions 232 are configured as rectangular sheet bodies. The plurality of protrusions 232 may be arranged in an extending direction of the blades 231. In this embodiment, by arranging the protrusions 232, the cleaning efficiency and the cleaning effect can be improved, and in particular, a better cleaning effect is provided for a carpet.

[0050] A size of each of the blades 131 and 231 in a radial direction can gradually increase from the end of the tubular member 130 to the middle part of the tubular member 130. In other words, the blades 131, 231 at the end of the tubular member 130 has a larger size in the radial direction than the blades 131, 231 in the middle part of the tubular member 130. In this way, the service life of the blades 131, 231 can be well prolonged, and a current such as in a carpet can be reduced.

[0051] Further, the mounting shaft 110 may be made of a plastic material, that is, a plastic shaft. A cross-sectional shape of the mounting shaft 110 may be circular, and both ends thereof can extend beyond the elastic supporting member 120 and the tubular member 130 so as to be connected to the body of the cleaning assembly. End mounting members 111 may be detachably arranged at two axial ends of the mounting shaft 110. Each end mounting member 111 may be an end cover. Since the end mounting members 111 may be detached from the mounting shaft 110, it is easy to clean up rubbish such as hair that is not expected to gather at both ends of the mounting shaft 110.

[0052] The elastic supporting member 120 can be configured to match the shape of the mounting shaft 110, and to have a cross-sectional shape of a circular ring. The elastic supporting member 120 may be made of a sponge material or foam material. In this embodiment, the vibration damping capability of the cleaning brush 100 can be improved to avoid a damage to the cleaning brush 100 due to collision during use.

[0053] The tubular member 130 can be configured to match the shape of the elastic supporting member 120, and to have a cross-sectional shape of a circular ring. In this embodiment, the size (thickness) of the tubular member 130 in the radial direction is smaller than the size of the elastic supporting member 120 in the radial direction. Optionally, the tubular member 130 is a thin rubber tube, which has a thickness of about 0.5 mm. The size of the tubular member 130 of the mounting shaft 110 in an axial direction may be larger than that of the elastic supporting member 120 in the axial direction.

[0054] An adhesive layer (not shown) may be arranged between the mounting shaft 110 and the elastic supporting member 120, as well as between the elastic supporting member 120 and the tubular member 130 respectively, such that the mounting shaft 110, the elastic supporting member 120 and the tubular member 130 are adhered together. In this embodiment, the structure of the cleaning brush 100 can be simplified to achieve a compact structure and good stability. Therefore, the cleaning brush 100 is hardly damaged during use, thereby prolonging the service life. On the other hand, the cleaning brush 100 can be manufactured conveniently and the manufacturing cost can be reduced.

[0055] The adhesive layer between the mounting shaft 110 and the elastic supporting member 120 extends in the axial and circumferential directions, and at least partially covers the inner surface of the elastic supporting member 120. Optionally, the adhesive layer substantially covers the entire inner surface of the elastic supporting member 120. The adhesive layer between the elastic supporting member 120 and the tubular member 130 extends in the axial and circumferential directions, and at least partially covers the outer surface of the elastic supporting member 120. Optionally, the adhesive layer substantially covers the entire outer surface of the elastic supporting member 120.

[0056] Further, in an embodiment not shown, a plurality of dot-like protrusions may be arranged on the blade. A typical arrangement is to evenly distribute the dot-like protrusions on the blades. Therefore, rubbish stuck or retained between the cleaning brush and an air duct can be dragged out with the aid of the point-like protrusions, and then sent to a dust box after rotating for one circle together with the cleaning brush. The applicant found upon researching that there are often large particles of rubbish, such as sunflower seed shells and peanut shells, etc., that have always been stuck in a gap between the cleaning brush and the air duct. With the cleaning, there will be more and more large particles of rubbish retained in this gap. Therefore, the dot-like protrusions are arranged on the blades. In the process of cleaning brush rotation, the dot-like protrusions can contact and act on the rubbish stuck or retained in the gap between the cleaning brush and the air duct, and drag the rubbish out.

[0057] In this embodiment, the shape of the blade is not limited, which may be the above blade having a V-shaped or spiral sheet body, and of course may also be a blade with other shape. The dot-like protrusions may be arranged on a side surface of the blade facing a rotational direction of the cleaning brush. In other words, the dot-like protrusions may be arranged on a side surface of the blade to clean rubbish. The dot-like protrusions can protrude from the side surface of the blade.

[0058] The dot-like protrusions can be arranged on the edge of the blade in the radial direction of the cleaning brush. In other words, the dot-like protrusions can be arranged on the outer edge of the blade. The dot-like protrusions may be arranged in a row in the axial direction

of the cleaning brush at this edge. Of course, the dot-like protrusions may also be arranged in more than one row if needed and/or desired.

[0059] According to another aspect of the present invention, a smart cleaning device is provided, which includes the above cleaning brush 100. The structure of the smart cleaning device has been described above, which is not be repeated for the sake of brevity.

[0060] According to yet another aspect of the present invention, a method for manufacturing the cleaning brush 100 is provided. The method approximately includes the following steps:

sleeving the elastic supporting member 120 onto the mounting shaft 110, where at least one of the elastic supporting member 120 and the mounting shaft 110 is coated with a cured first adhesive;

heating the mounting shaft 110 sleeved with the elastic supporting member 120, such that the first adhesive is hot-melted and then cured to form the adhesive layer, thereby adhering the elastic supporting member 120 and the mounting shaft 110 together; and

sleeving the tubular member 130 onto the elastic supporting member 120 and adhering the tubular member 130 to the elastic supporting member 120 through the adhesive layer formed from a second adhesive.

[0061] According to the above manufacturing steps, the elastic supporting member 120 can be adhered to the mounting shaft 110 through the adhesive layer formed from the first adhesive, and the tubular member 130 can be adhered to the elastic supporting member 120 through the adhesive layer formed from the second adhesive, thereby forming the cleaning brush 100 with an adhesive structure. In addition, a hot melt adhesive can be selected as the first adhesive, such that the sleeving of the elastic supporting member 120 can be quickly realized in a simple adhesion manner, thereby improving the manufacturing efficiency of the cleaning brush 110.

[0062] In this embodiment, at least one of the elastic supporting member 120 and the mounting shaft 110, e.g., the mounting shaft 110, may be selectively coated with the first adhesive. Therefore, the first adhesive can be coated by means of spraying. Similarly, at least one of the elastic supporting member 120 and the tubular member 130, e.g., the elastic supporting member 120, may be selectively coated with the second adhesive. Therefore, the second adhesive can be coated by means of spraying. Hereinafter, the description will be given by taking the example of applying the first adhesive to the mounting shaft 110 and applying the second adhesive to the elastic supporting member 120.

[0063] The manufacturing method provided by the present invention is exemplarily described below in conjunction with FIG. 3. It should be noted that FIG. 3 only schematically shows a preferred block flowchart for manufacturing the cleaning brush 100. The sequence of steps of the manufacturing method in this embodiment of the present invention can be adjusted, combined or deleted according to actual needs.

[0064] As shown in FIG. 3, the manufacturing method specifically includes the following steps.

[0065] In step S10 of coating the mounting shaft with an adhesive: the mounting shaft 110 is coated with the first adhesive.

[0066] In an exemplary embodiment, the outer surface of the mounting shaft 110 is coated with the first adhesive by means of spraying. In the adhesive coating process of the mounting shaft 110, the mounting shaft 110 is in a rotating state, for example, may be rotated around its central axis relative to a spraying device by means of a tool. Therefore, a desired thickness of the first adhesive can be obtained by controlling a rotational speed of the mounting shaft 110. The coating thickness of the first adhesive may be selected from 0.2 mm to 0.3 mm, for example, 0.2 mm, 0.25 mm, or 0.3 mm. Of course, in this embodiment, the coating thickness of the first adhesive is not limited, and may be set according to actual needs.

[0067] In step S20 of manufacturing the elastic supporting member: the elastic supporting member 120 is manufactured by cutting and punching a raw material, etc.

[0068] In an exemplary embodiment, the elastic supporting member 120 is obtained by cutting and punching an elastic and porous raw material such as a cotton material or foam material. In this embodiment, the step S20 of manufacturing the elastic supporting member 120 can be omitted.

[0069] In step S30 of the sleeving the elastic supporting member: the elastic supporting member 120 is sleeved onto the mounting shaft 110 coated with the cured first adhesive.

[0070] In an exemplary embodiment, after the first adhesive is cured, a through hole of the elastic supporting member 120 is aligned with the mounting shaft 110 by means of an auxiliary machine, and then the elastic supporting member 120 is pushed or pulled to move on the mounting shaft 110 until the elastic supporting member 120 is moved to a predetermined position. The auxiliary machine can provide a push or pull force to move the elastic supporting member 120. In addition, optionally, a final position of the movement of the elastic supporting member 120 may be determined by means of a tool.

[0071] In step S40 of adhering the elastic supporting member: the mounting shaft 110 sleeved with the elastic supporting member 120 is heated, such that the first adhesive is hot-melted and then cured to form the adhesive layer, thereby adhering the elastic supporting member 120 and the mounting shaft 110 together.

[0072] In an exemplary embodiment, the mounting shaft 110 sleeved with the elastic supporting member 120 is placed in a heating device, and the heating device is then started to heat. The heating time may be, for example, about 7 minutes, and the heating temperature is

preferably not higher than 160°C, such as 110°C, 120°C, 130°C, 140°C, 150°C, or the like. It may be understood that the heating temperature is related to the heating time, and an appropriate heating time may be selected according to the heating temperature, or vice versa. After the first adhesive is hot-melted, the heating is stopped, the first adhesive is cured and the adhesive layer is formed between the elastic supporting member 120 and the mounting shaft 110.

[0073] Further, the first adhesive in this embodiment is a hot melt adhesive, and its curing time is short under normal temperature conditions, which may be several tens of seconds, one minute, several minutes, etc. For example, the curing time may be about one minute. The hot melt temperature of the first adhesive is preferably lower than 160°C. Therefore, the deformation of the mounting shaft 110 due to too high temperature can be at least avoided. Optionally, the first adhesive may be a polyurethane adhesive.

[0074] In step S50 of reprocessing the elastic supporting member: the outer surface of the elastic supporting member 120 is cut.

[0075] In an exemplary embodiment, the outer surface of the elastic supporting member 120 is cut, such that the outer surface thereof is smooth.

[0076] In step S60 of coating the elastic supporting member with an adhesive: the elastic supporting member 120 is coated with the second adhesive.

[0077] In an exemplary embodiment, the outer surface of the elastic supporting member120 is coated with the second adhesive by means of spraying. In the adhesive coating process of the elastic supporting member 120, the elastic supporting member 120 is in a rotating state as the mounting shaft 110 rotates. Therefore, a desired thickness of the second adhesive can be obtained by controlling a rotational speed of the mounting shaft 110. The coating thickness of the second adhesive may be selected from 0.2 mm to 0.3 mm, for example, 0.2 mm, 0.25 mm, or 0.3 mm. Of course, in this embodiment, the coating thickness of the second adhesive is not limited, and may be set according to actual needs.

[0078] In step S70 of sleeving the tubular member: the tubular member 130 is sleeved onto the elastic supporting member 120 coated with the second adhesive.

[0079] In an exemplary embodiment, in order to facilitate the sleeving of the tubular member 130, the tubular member 130 may be elastically deformed to increase the inner diameter with the aid of auxiliary means in the process of sleeving the tubular member 130. In other words, the interior of the tubular member 130 can be expanded to form a gap between the elastic supporting member 120 and the tubular member 130 to facilitate the insertion of the tubular member 130, thereby facilitating the insertion of the elastic supporting member 120.

[0080] For example, one embodiment is to increase the inner diameter of the tubular member 130 by means of a tool acting on the tubular member 130. Another embodiment is to increase the inner diameter of the tubular member 130 by means of a gas acting on the tubular member 130. Specifically, one end of the tubular member 130 can be sleeved onto the elastic supporting member 120 first, and then a predetermined pressure gas is introduced into the other end of the tubular member 130, such that the inner diameter of the tubular member 130 is increased.

[0081] Meanwhile, the tubular member 130 is pushed or pulled to move relative to the elastic supporting member 120 by means of an auxiliary machine until the tubular member 130 is moved to a predetermined position.

[0082] The hot-melt temperature of the first adhesive is higher than the hot-melt temperature of the second adhesive. When the second adhesive is heated to adhere the tubular member 130 to the elastic supporting member 120, the heating temperature can be controlled to be lower than the hot-melt temperature of the first adhesive, so that the adhesive layer formed from the first adhesive is not affected by temperature.

[0083] In one embodiment, the second adhesive may be a hot melt adhesive, and its curing time is short under normal temperature conditions, which may be about one minute; the hot melt temperature of the second adhesive is preferably lower than 100°C. Further, the second adhesive may be a low-temperature hot melt adhesive. Therefore, the deformation of the tubular member 130 due to too high temperature can be at least avoided. Optionally, the second adhesive may be a polyurethane adhesive.

[0084] In another embodiment, the second adhesive may be irreversible, and its curing time is relatively long, which may be tens of minutes, several hours, or dozens of hours. For example, the curing time may be about 12 hours, i.e., about 12 hours curing after coating.

[0085] In step S80 of adhering the tubular member: the tubular member 130 is adhered to the elastic supporting member 120 through the adhesive layer formed from the second adhesive.

[0086] Exemplarily, in an embodiment in which the second adhesive is a hot melt adhesive, prior to sleeving the tubular member 130, the elastic supporting member 120 is coated with the cured second adhesive. That is, after the second adhesive applied to the elastic supporting member 120 is cured, the tubular member 130 is sleeved onto the elastic supporting member 120. After the sleeving of the tubular member 130, the elastic supporting member 120 sleeved with the tubular member 130 is heated, such that the second adhesive is hot-melted and then cured to form the adhesive layer, so as to adhere the tubular member 130 and the elastic supporting member120 together.

[0087] Specifically, after the second adhesive is cured, the tubular member 130 is sleeved to the elastic supporting member 120. Then, the cleaning brush 100 is placed in a heating device, and the heating device is then started to heat for a predetermined time. The heating temperature is preferably not higher than 100°C, and may be 80°C to 100°C, e.g., 80°C, 85°C, 90°C, 95°C, 100°C, and

the like. Similar to the above, the heating temperature is related to the heating time, and an appropriate heating time may be selected according to the heating temperature, or vice versa. After the second adhesive is hot-melted, the heating is stopped, the second adhesive is cured and an adhesive layer is formed between the tubular member 130 and the elastic supporting member 120.

[0088] For an embodiment in which the second adhesive is irreversible, prior to the sleeving of the tubular member 130, the elastic supporting member 120 is coated with the liquid-state second adhesive. That is, the liquid-state second adhesive is cured after the sleeving of the tubular member 130. Specifically, after applying the second adhesive, the tubular member 130 is directly sleeved onto the elastic supporting member 120 without waiting for the second adhesive to cure. During the process of placing the cleaning brush 100, the second adhesive is slowly cured.

[0089] In summary, according to the method for manufacturing the cleaning brush 100 provided by the present invention, the elastic supporting member 120 can be adhered to the mounting shaft 110 through the adhesive layer formed from the first adhesive, and the tubular member 130 can be adhered to the elastic supporting member 120 through the adhesive layer formed from the second adhesive, thereby forming the cleaning brush 100 of an adhesive structure. In addition, a hot melt adhesive can be selected as the first adhesive, such that the sleeving of the elastic supporting member 120 can be quickly realized in a simple adhesion manner, thereby improving the manufacturing efficiency of the cleaning brush 110.

[0090] Unless otherwise defined, technical and scientific terms used in the present invention have the same meaning as commonly understood by a person of ordinary skill in the art. The terms used herein are only for the purpose of describing specific embodiments, and are not intended to limit the present invention. Terms such as "part", "member" and the like appearing herein may refer to either a single part or a combination of parts. Terms such as "mounted", "arranged" and the like appearing herein may mean either the direct attachment of one component to another component or the attachment of one component to another component through an intermediation member. A feature described herein in one embodiment may be applied to another embodiment alone or in combination with other features, unless this feature is not applicable in the other embodiment or stated otherwise.

[0091] The present invention has been described by the above-mentioned embodiments. However, it should be understood that the foregoing embodiments are only for the purpose of illustration and description, and are not intended to limit the present invention to the scope of the described embodiments. In addition, a person skilled in the art can understand that the present invention is not limited to the above-mentioned embodiments, and more variations and modifications may also be made according to the teachings of the present invention. These variations and modifications all fall within the protection scope claimed in the present invention. The protection scope of the present invention is defined by the appended claims and their equivalents.

Claims

1. A cleaning brush for a smart cleaning device, **characterized by** comprising:

   a mounting shaft;
   an elastic supporting member, provided with a through hole extending in an axial direction and sleeved onto the mounting shaft through the through hole; and
   a tubular member, sleeved onto the elastic supporting member and provided with blades integrally formed with the tubular member,
   wherein an adhesive layer is provided between the mounting shaft and the elastic supporting member, as well as between the elastic supporting member and the tubular member respectively, such that the mounting shaft, the elastic supporting member and the tubular member are adhered together.

2. The cleaning brush according to claim 1, wherein the blades extend in the axial direction and are configured as V-shaped sheet bodies or spiral sheet bodies.

3. The cleaning brush according to claim 2, wherein a plurality of dot-like protrusions is arranged on the blades.

4. The cleaning brush according to claim 1, wherein end mounting members are detachably provided at two axial ends of the mounting shaft.

5. The cleaning brush according to claim 1, wherein,

   the elastic supporting member is made of a sponge material or a foam material; and/or
   the mounting shaft is made of a plastic material, and the tubular member is made of a soft rubber material.

6. The cleaning brush according to claim 5, wherein the soft rubber material is at least one of elastic materials of rubber, silicone, TPU and TPE.

7. The cleaning brush according to claim 1, wherein a size of each of the blades in a radial direction gradually increases from an end of the tubular member to a middle part of the tubular member.

8. A smart cleaning device, comprising the cleaning

brush according to any of claims 1 to 7.

9. A manufacturing method for manufacturing the cleaning brush according to any of claims 1 to 7, comprising the following steps:

sleeving the elastic supporting member onto the mounting shaft, wherein at least one of the elastic supporting member and the mounting shaft is coated with a first adhesive being cured;
heating the mounting shaft sleeved with the elastic supporting member, such that the first adhesive is hot-melted and then cured to form the adhesive layer, thereby adhering the elastic supporting member and the mounting shaft together; and
sleeving the tubular member onto the elastic supporting member and adhering the tubular member to the elastic supporting member through an adhesive layer formed from a second adhesive.

10. The manufacturing method according to claim 9, wherein prior to the sleeving of the tubular member, at least one of the tubular member and the elastic supporting member is coated with the second adhesive being cured; and after the sleeving of the tubular sleeve, the elastic supporting member sleeved with the tubular member is heated, such that the second adhesive is hot-melted and then cured to form the adhesive layer, thereby adhering the tubular member and the elastic supporting member together.

11. The manufacturing method according to claim 9, wherein prior to the sleeving of the tubular member, at least one of the tubular member and the elastic supporting member is coated with the second adhesive in liquid state, which is then cured after the sleeving of the tubular member.

12. The manufacturing method according to claim 9, wherein in the sleeving process of the tubular member, the tubular member is elastically deformed to increase an inner diameter, so as to facilitate the insertion of the elastic supporting member.

13. The manufacturing method according to claim 12, wherein the inner diameter of the tubular member is increased by means of a tool acting on the tubular member.

14. The manufacturing method according to claim 12, wherein an end of the tubular member is sleeved onto the elastic supporting member first and then a predetermined pressure gas is introduced to another end of the tubular member, such that the inner diameter of the tubular member is increased.

15. The manufacturing method according to claim 9, wherein a hot-melt temperature of the first adhesive is higher than a hot-melt temperature of the second adhesive.

16. The manufacturing method according to claim 15, wherein the hot-melt temperature of the first adhesive is lower than or equal to 160°C, and the hot-melt temperature of the second adhesive is lower than or equal to 100°C.

17. The manufacturing method according to claim 9, wherein the first adhesive is coated to the mounting shaft in a rotating state by means of spraying, and the second adhesive is coated to the elastic supporting member in a rotating state by means of spraying.

18. The manufacturing method according to claim 9, wherein the first adhesive is a polyurethane adhesive, and/or the second adhesive is a polyurethane adhesive.

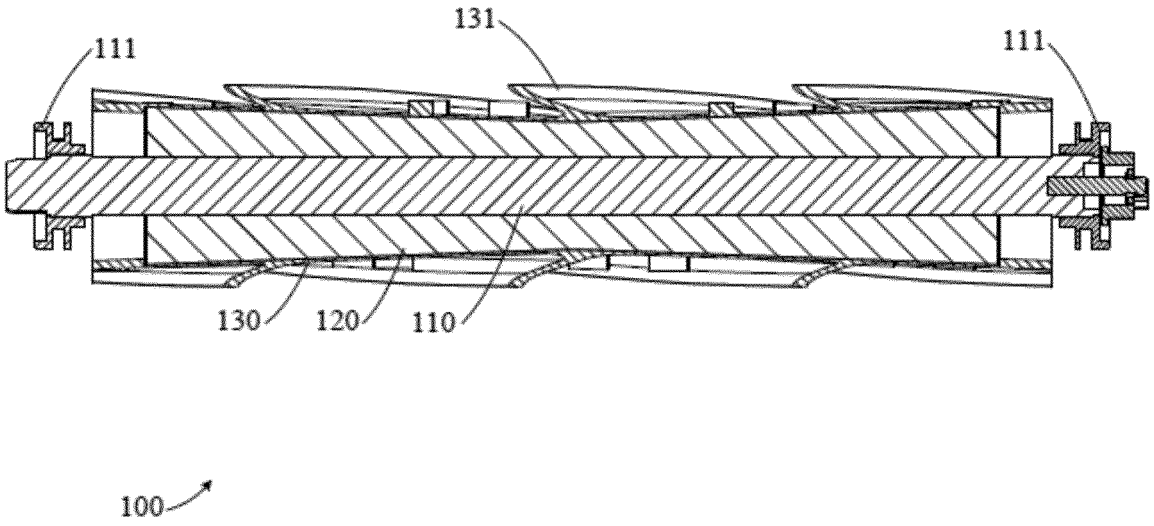

FIG. 1

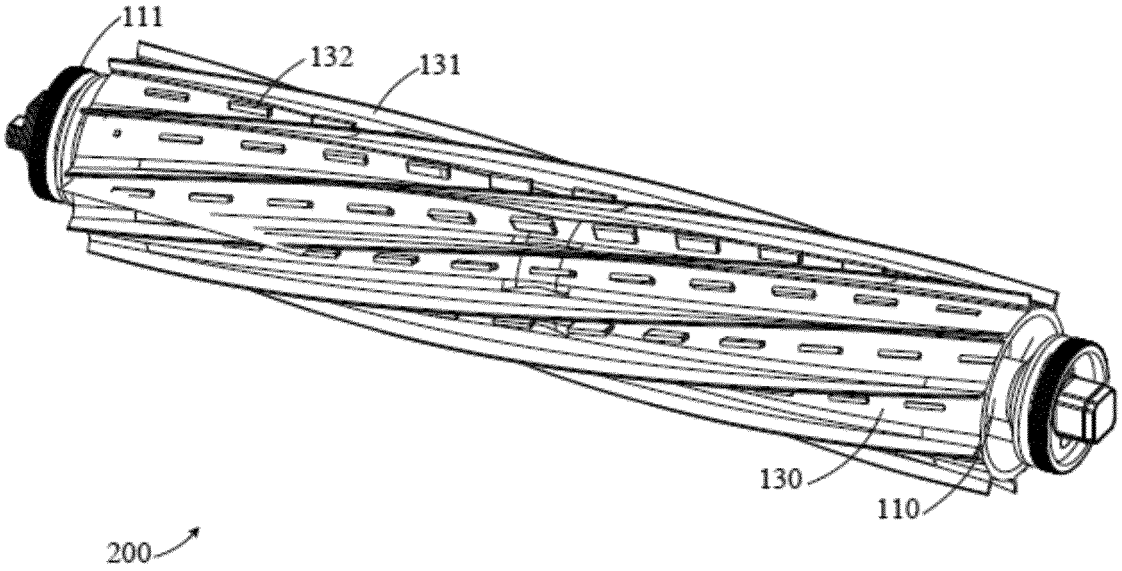

FIG. 2

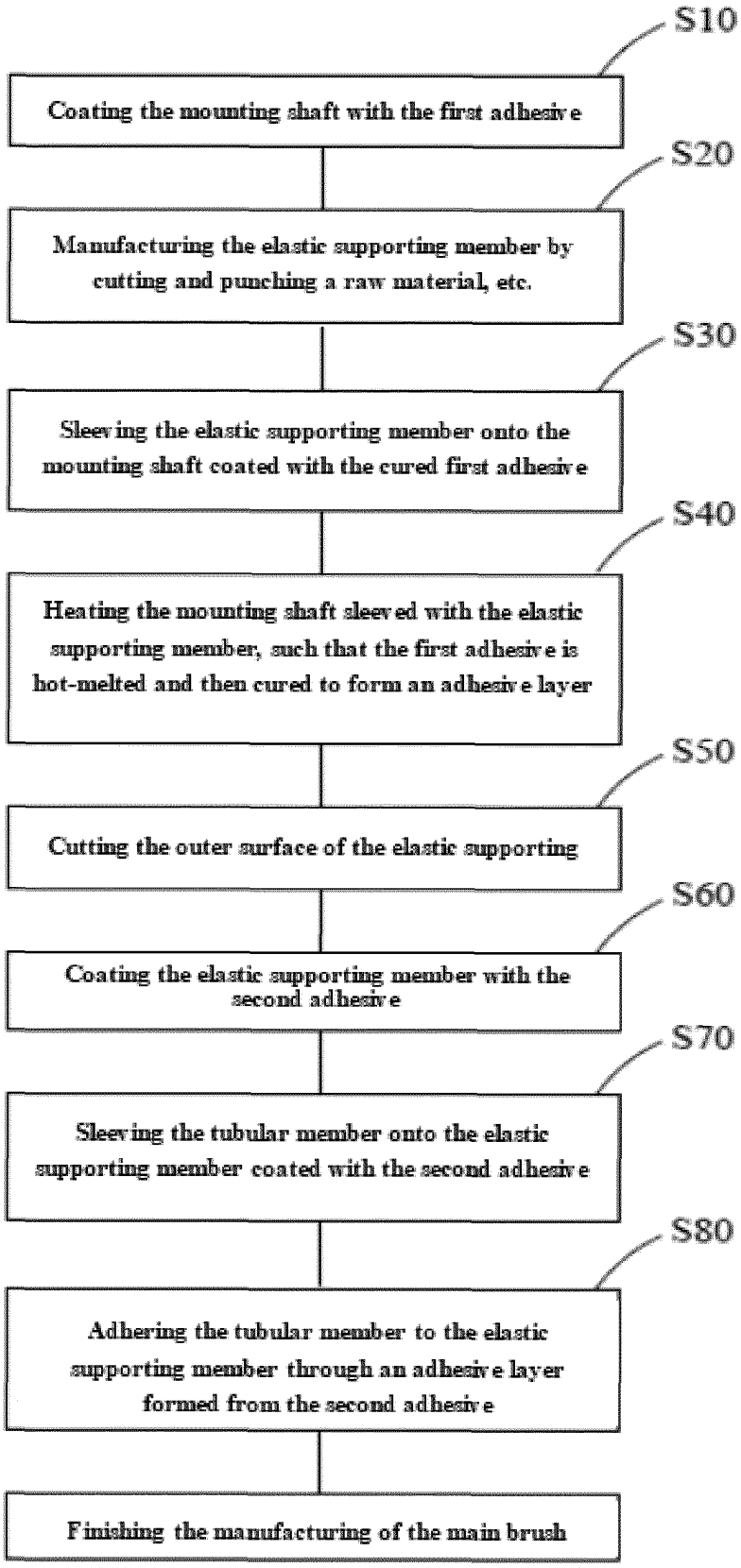
S10
Coating the mounting shaft with the first adhesive
S20
Manufacturing the elastic supporting member by cutting and punching a raw material, etc.
S30
Sleeving the elastic supporting member onto the mounting shaft coated with the cured first adhesive
S40
Heating the mounting shaft sleeved with the elastic supporting member, such that the first adhesive is hot-melted and then cured to form an adhesive layer
S50
Cutting the outer surface of the elastic supporting
S60
Coating the elastic supporting member with the second adhesive
S70
Sleeving the tubular member onto the elastic supporting member coated with the second adhesive
S80
Adhering the tubular member to the elastic supporting member through an adhesive layer formed from the second adhesive
Finishing the manufacturing of the main brush

FIG. 3

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2021/098738

A. CLASSIFICATION OF SUBJECT MATTER

A47L 9/04(2006.01)i; A47L 9/06(2006.01)i; A47L 9/00(2006.01)i; A47L 11/40(2006.01)i; A46B 3/02(2006.01)i; A46B 5/00(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)

A47L; A46B

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; USTXT; WOTXT; EPTXT: 吸尘器, 吸头, 刷, 搅拌, 弹性, 缓冲, 减震, 支撑, 海绵, 叶片, 点, vacuum, nozzle, brush, agitator, damp, support, sponge, vane, dot

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	CN 103491838 A (IROBOT CORPORATION) 01 January 2014 (2014-01-01) claims 1-39, description paragraphs [0095]-[0148], figures 10-20	1, 2, 4-18
Y	CN 103491838 A (IROBOT CORPORATION) 01 January 2014 (2014-01-01) claims 1-39, description paragraphs [0095]-[0148], figures 10-20	3, 8-18
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A	CN 206354993 U (XIAOGOU ELECTRICAL APPLIANCE INTERNET TECHNOLOGY BEIJING CO., LTD.) 28 July 2017 (2017-07-28) entire document	1-18

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

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"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
"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
"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
"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
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
05 July 2021	**02 August 2021**

Name and mailing address of the ISA/CN	Authorized officer
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Facsimile No. **(86-10)62019451**	Telephone No.

Form PCT/ISA/210 (second sheet) (January 2015)

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INTERNATIONAL SEARCH REPORT
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