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(54) **PORTABLE SUCTION DEVICE FOR SURFACE CLEANING**

(57) The present invention relates to a suction apparatus for surface cleaning, comprising: a suction nozzle, a suction channel connected to the suction nozzle, a water collection container, and a water-air separation apparatus used for separating a liquid-air mixture; the suction channel is arranged inside the water collection container in a penetrating manner, and the water-air separation apparatus is serially arranged on the suction apparatus; the water-air separation apparatus comprises a rotating body arranged inside the suction channel and adapted to rotate, and a rotary shaft of the rotating body is arranged along an airflow direction in the suction channel; and a gap in communication with the water collection container is arranged on the suction apparatus adjacent to the rotating body. The present invention implements separation of liquid and air by using a rotating centrifugation principle, when the liquid-air mixture flows to the rotating body, liquid rotates with the rotating body, generates a centrifugal force, and under the effect of the centrifugal force, enters the water collection container via the gap on the suction channel, and air is discharged via the suction channel, thereby implementing separation of the liquid and air.

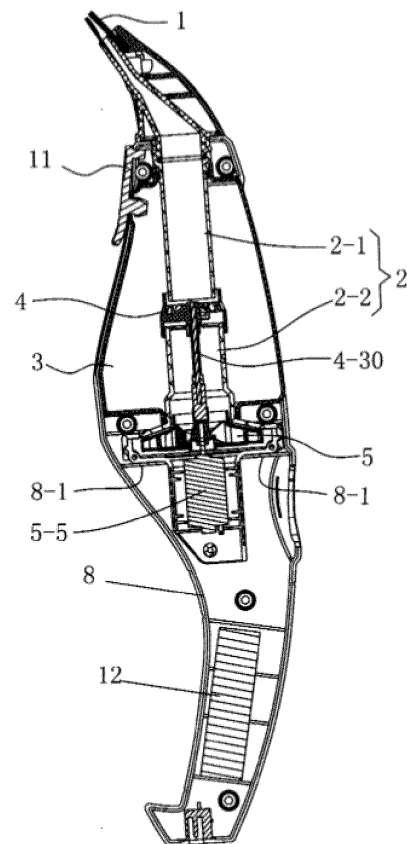


FIG. 1

Description

FIELD OF THE INVENTION

[0001] The present invention relates to a technical field of cleaning tools, and in particular, to a portable suction apparatus for surface cleaning, adapted to suck a liquid-air mixture from a surface of an object, separate liquid from the liquid-air mixture, and then store the liquid into a liquid collection container.

BACKGROUND OF THE INVENTION

[0002] By means of such a suction apparatus, liquid may be sucked from a hard surface, for example, window glass. In order to do this, a suction unit is used to generate a suction airflow and suck a mixture formed by liquid and air via a suction nozzle. The liquid may be separated from the mixture formed by liquid and air by means of a separation apparatus and transferred to a liquid collection container. A user manually guides the surface suction apparatus on a surface to be sucked to move along the surface.

[0003] A Chinese patent document CN101909499B discloses a portable hard surface suction apparatus, including a suction nozzle and a suction unit, as well as a separation apparatus and a waste liquid tank, where the suction unit is in fluid communication with the suction nozzle to be used to suck a liquid-air mixture from a hard surface, the separation apparatus is used to separate liquid from the liquid-air mixture, and the waste liquid tank is used to accommodate the separated liquid. A separation chamber is arranged between the suction nozzle and the suction unit, the separation chamber accommodates the separation apparatus, the separation chamber is in fluid communication with a suction port of the suction nozzle via a suction pipe and is in fluid communication with the suction unit via a low-pressure pipe, and the separation chamber is connected to the waste liquid tank via a flow outlet.

[0004] The foregoing prior art document has the following shortcoming: the separation chamber and waste liquid tank exist at the same time, resulting in that a product has a larger overall volume and is unfavorable for a user to carry and use.

SUMMARY OF THE INVENTION

[0005] A technical problem to be solved by the present invention is to provide a portable suction apparatus for surface cleaning having a simple structure and a smaller volume, adapted to suck a liquid-air mixture from a surface of an object, separate liquid from the liquid-air mixture, and then store the liquid into a liquid collection container.

[0006] In order to solve the foregoing problem, the present invention provides a suction apparatus for surface cleaning, including: a suction nozzle, a suction chan-

nel connected to the suction nozzle, and a water collection container, where the suction apparatus for surface cleaning further includes a water-air separation apparatus used for separating a liquid-air mixture; the suction channel is arranged inside the water collection container in a penetrating manner, and the water-air separation apparatus is serially arranged on the suction channel; the water-air separation apparatus includes a rotating body arranged inside the suction channel and adapted to rotate, and a rotary shaft of the rotating body is arranged along an airflow direction in the suction channel; and a gap in communication with the water collection container is arranged on the suction channel adjacent to the rotating body.

[0007] In order to implement a suction function, as another embodiment that is convenient to carry and use, the suction apparatus for surface cleaning further includes: a suction fan connected to a terminal of the suction channel. If no suction fan is used, a suction pipe of a vacuum may be used to connect to the terminal of the suction channel to implement the suction function.

[0008] The water-air separation apparatus is arranged adjacent to a center of the water collection container, which not only is beneficial to discharging water into the water collection container by the water-air separation apparatus, but also enables the water collection container to store more water, that is, when a water level in the water collection container is lower than a certain value, and the suction apparatus is at any use angle, it is difficult for water in the water collection container to flow back to the water-air separation apparatus or the suction channel.

[0009] In order to improve a centrifugal effect of liquid on the rotating body, the rotating body is a cone, a planar body, or a conical spiral body, and the rotary shaft is located on a central line of the rotating body, where a top surface of the cone or conical spiral body is opposite to the airflow.

[0010] As a preferable embodiment, the suction channel includes front and rear pipes; the water-air separation apparatus further includes a sleeve, where an inner wall of the sleeve is connected to an edge at a bottom of the rotating body via a plurality of connecting ribs; through-holes are distributed on a side wall of the sleeve; and two ends of the sleeve are respectively sleeved on adjacent ports of the front and rear pipes. During working, air passes through gaps among the plurality of connecting ribs, and is discharged via the terminal of the suction channel. Liquid enters the water collection container via the through-holes of the sleeve. The sleeve is adapted to prevent liquid in the water collection container from entering the adjacent ports of the front and rear pipes. At the same time, a sealing ring made from a self-lubricating material (for example, polytetrafluoroethylene) is sleeved on the adjacent ports of the front and rear pipes to enable the two ends of the sleeve to respectively match the adjacent ports of the front and rear pipes in a rotary sealing manner.

[0011] As a variant of the foregoing solution, the rotating body includes a plurality of ribs connected to the rotary shaft; as a preferable solution, the respective ribs are distributed uniformly on a conical surface opposite to the airflow direction, so as to further improve an effect of making liquid generate a centrifugal force and enter the water collection container. The suction channel includes front and rear pipes; the water-air separation apparatus further includes a sleeve, where an inner wall of the sleeve is connected to outer ends of the ribs, and through-holes are distributed on a side wall of the sleeve; and two ends of the sleeve are respectively sleeved on adjacent ports of the front and rear pipes

[0012] As an optional embodiment, the rotary shaft of the rotating body is transmission-connected to a rotary shaft of the suction fan, or the rotating body is driven by a motor.

[0013] In order to implement fast assembly by using components, during specific implementation, the suction fan connected to the terminal of the suction channel includes: an upper air guiding cover integrally connected to a rear end of the rear pipe, and a lower air guiding cover adapted to connect to the upper air guiding cover, where the upper and lower air guiding covers are adapted to constitute a cavity, an air impeller is arranged inside the cavity, air outlets are distributed on an outer side wall of the cavity, a motor housing integrated with the lower air guiding cover is arranged on a rear end of the lower air guiding cover, and a motor used for driving the air impeller is arranged inside the motor housing; and the motor housing is arranged inside a housing of the suction apparatus via a plurality of resilient cushions.

[0014] As another optional embodiment, the rotating body and an air impeller of the suction fan are respectively transmission-connected to front and rear ends of a rotary shaft of a motor

[0015] During specific implementation, the suction nozzle is in a dovetail shape, and an inlet of the nozzle is provided with upper and lower rubber sheets that are strip-shaped and vertically arranged; notches are distributed on a front edge of the lower rubber sheet, and recesses connected to the respective notches are distributed on an upper end surface of the lower rubber sheet; and a front edge of the upper rubber sheet is adapted to cover the front edge of the lower rubber sheet.

[0016] As another optional embodiment, a sleeve piece is fixedly arranged inside the rear pipe, and two ends of a transmission shaft arranged inside the sleeve piece in a penetrating manner are respectively connected to the rotating body and an output shaft of the motor in the suction fan; and the sleeve piece matches the transmission shaft via a pair of copper sheaths or polytetrafluoroethylene sheaths in a rotating manner.

[0017] During specific implementation, the water collection container is a transparent container, and the water collection container is provided with a scale used for indicating that a liquid level reaches a height of the water-air separation apparatus; and when the liquid level in the

water collection container reaches a warning water level on the scale, a user needs to remove a rubber plug from a water discharging opening of the water collection container to discharge water.

[0018] In order to facilitate assembly, the front pipe and an outlet of the nozzle are integrated; the front pipe matches an inlet of the water collection container in a sealing manner; and an outlet of the rear pipe matches an outlet of the water collection container in a sealing manner.

[0019] As a preferable embodiment, the rotary shaft is arranged on a central line of the suction channel.

[0020] With respect to the prior art, the present invention has the following positive effects: (1) the water-air separation apparatus of the present invention implements separation of liquid and air by using a rotating centrifugation principle, and in particular, using the rotating body arranged inside the suction channel and adapted to rotate, when the liquid-air mixture flows to the rotating body, liquid rotates with the rotating body, generates a centrifugal force, and under the effect of the centrifugal force, enters the water collection container via the gap on the suction channel, and air is discharged via the suction channel, thereby implementing separation of the liquid and air; and (2) with regard to the portable suction apparatus for surface cleaning of the present invention because the suction channel is arranged inside the water collection container in a penetrating manner, and the water-air separation apparatus is serially arranged on the suction channel, thereby avoiding the problem that the separation chamber and the waste liquid tank need to separately and independently exist and occupy more space in the prior art, the water-air separation apparatus of the present invention features a smaller volume.

BRIEF DESCRIPTION OF THE DRAWINGS

[0021] In order to make it easier for the disclosure of the present invention to be clearly understood from the detailed description of embodiments and the accompanying drawings, the present invention is further described in detail, wherein:

- FIG. 1 is a schematic diagram showing an internal structure of a suction apparatus according to the present invention;
- FIG. 2 is a left view of FIG. 1;
- FIG. 3 is a diagram illustrating a decomposed structure of a component constituted by a suction fan, a water-air separation apparatus, and a part of a suction channel in FIG. 1;
- FIG. 4 is a structural diagram illustrating assembly of the component shown in FIG. 3;
- FIG. 5 is a three-dimensional diagram of a sleeve in FIG. 3;
- FIG. 6 is a rear view of the sleeve in FIG. 5;
- FIG. 7 is another structural diagram of a rotating body according to an embodiment;
- FIG. 8 is a third structural diagram of the rotating

- body according to the embodiment;
 FIG. 9 is a fourth structural diagram of the rotating body according to the embodiment;
 FIG. 10 is a fifth structural diagram of the rotating body according to the embodiment;
 FIG. 11 is a sixth structural diagram of the rotating body according to the embodiments; and
 FIG. 12 is a local structural diagram of an upper end surface of a lower rubber sheet according to an embodiment.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Embodiment 1

[0022] As shown in FIG. 1, a portable suction apparatus for surface cleaning of the present embodiment includes: a suction nozzle 1, a suction channel 2 connected to the suction nozzle 1, a water collection container 3, a water-air separation apparatus 4 used for separating a liquid-air mixture, and a suction fan 5 connected to a terminal of the suction channel 2.

[0023] The suction channel 2 is arranged inside the water collection container 3 in a penetrating manner, and the water-air separation apparatus 4 is serially arranged on the suction channel 2; the water air apparatus 4 includes: a rotating body 4-3 arranged inside the suction channel 2 and adapted to rotate, and a rotary shaft 4-30 of the rotating body 4-3 is arranged along an airflow direction in the suction channel 2; and the suction channel 2 adjacent to the rotating body 4-3 is provided with a gap in communication with the water collection container 3. When the rotating body 4-3 rotates around a rotary shaft 4-30 thereof, the rotating body 4-3 is adapted to cover a cross section of the suction channel 2, so as to throw liquid in the airflow into the water collection container 3; the rotating body 4-3 is provided with an opening adapted to be passed through by air in the airflow, which then enters the opening of a rear pipe 2-2, or an opening or space adapted to be passed through by air in the airflow, which then enters a rear pipe 2-2, exists around the rotating body 4-3.

[0024] As an embodiment, the rotary shaft 4-30 of the rotating body 4-3 is arranged on a central line of the suction channel 2.

[0025] In order to improve a centrifugal effect of liquid on the rotating body 4-3, as an optional embodiment, the rotating body 4-3 is a cone (as shown in FIG. 10), a planar body, or a conical spiral body (as shown in FIG. 11), the rotary shaft located on a central line of the rotating body 4-3 is consistent with the airflow direction, and a top surface of the cone or conical spiral body is opposite to the airflow.

[0026] The rotary shaft 4-30 of the rotating body 4-3 is transmission-connected to a rotary shaft of the suction fan 5, or the rotating body 4-3 is driven by a motor alone. As another optional embodiment, the rotating body 4-3

and an air impeller 5-3 of the suction fan 5 are respectively transmission-connected to front and rear ends of a rotary shaft of a motor.

[0027] The water-air separation apparatus 4 is arranged adjacent to a center of the water collection container 3, which not only is beneficial to discharging water into the water collection container 3 by the water-air separation apparatus, but also enables the water collection container 3 to store more water, that is, when a water level in the water collection container 3 is lower than a certain value, and the suction apparatus is at any use angle, it is difficult for water in the water collection container 3 to flow back to the water-air separation apparatus 4 or the suction channel 2.

[0028] As a preferable embodiment, as shown in FIG. 3 to FIG. 6, the suction channel 2 includes a front pipe 2-1 and a rear pipe 2-2; the water-air separation apparatus 4 further includes a sleeve 4-1, where an inner wall of the sleeve 4-1 is connected to an edge at a bottom of the rotating body 4-3 via a plurality of connecting ribs 4-2; through-holes 4-4 are distributed on a side wall of the sleeve 4-1; and two ends of the sleeve 4-1 are respectively sleeved on adjacent ports of the front pipe 2-1 and rear pipe 2-2. During working, under the effect of the suction fan 5, air passes through a gap between the connecting ribs 4-2 and is discharged via the suction fan 5 arranged at the terminal of the suction channel 2. When the rotating body 4-3 rotates, the rotating body 4-3 is adapted to cover an inlet of the rear pipe 2-2.

[0029] Liquid enters the water collection container 3 via the through-holes 4-4 on the sleeve 4-1. The sleeve 4-1 is adapted to prevent liquid in the water collection container 3 from entrance via the adjacent ports of the front pipe 2-1 and rear pipe 2-2. At the same time, a sealing ring made from a self-lubricating material (for example, polytetrafluoroethylene) is sleeved on the adjacent ports of the front and rear pipes to enable the two ends of the sleeve to respectively match the adjacent ports of the front and rear pipes in a rotary sealing manner.

[0030] The suction nozzle 1 is in a dovetail shape, and an inlet of the nozzle 1 is provided with an upper rubber sheet 1-1 and a lower rubber sheet 1-2 which are strip-shaped and vertically arranged; notches 1-3 are distributed on a front edge of the lower rubber sheet 1-2, and recesses 1-4 connected to the respective notches 1-3 are distributed on an upper end surface of the lower rubber sheet 1-2; and a front edge of the upper rubber sheet 1-1 is adapted to cover the front edge of the lower rubber sheet 1-2.

[0031] The water collection container 3 is a transparent container, and the water collection container 3 is provided with a scale used for indicating that a liquid level reaches a height of the water-air separation apparatus; and when the liquid level in the water collection container 3 reaches a warning water level on the scale, a user needs to remove a rubber plug 11 from a water discharging opening of the water collection container 3 to discharge water

[0032] In order to facilitate assembly, the front pipe 2-1 and an outlet of the nozzle 1 are integrated; the front pipe 2-1 matches an inlet of the water collection container 3 in a sealing manner; and an outlet of the rear pipe 2-2 matches an outlet of the water collection container 3 in a sealing manner.

Embodiment 2

[0033] On the basis of Embodiment 1, the following variant exists in the present embodiment.

[0034] As shown in FIG. 9, a suction apparatus of the present embodiment does not need to employ the foregoing suction fan 5, and a tubular interface 9 connected to a terminal of the suction channel 2 is led out from a terminal of a housing 8 of the suction apparatus; and during use, a suction pipe of a vacuum is used to connect to the tubular interface 9 to implement a suction function.

[0035] The rotating body 4-3 alone employs a motor driver 10 fixed inside the housing 8, or the rotating body 4-3 is constituted by air blades and does not need to be driven by a motor at this time.

Embodiment 3

[0036] On the basis of Embodiment 1 or 2, the following variant exists in the present embodiment. As shown in FIG. 8, the rotating body includes a plurality of ribs 4-5 connected to a rotary shaft; as a preferable embodiment, the respective ribs 4-5 are distributed uniformly on a conical surface, so as to further improve an effect of making liquid generate a centrifugal force and enter the water collection container. As a further preferable embodiment, as shown in FIG. 7, a periphery of each of the ribs 4-5 is connected to the sleeve 4-1.

[0037] In order to implement fast assembly by using components, the suction fan 5 connected to the terminal of the suction channel 2 includes: an upper air guiding cover 5-1 integrally connected to a rear end of the rear pipe 2-2, and a lower air guiding cover 5-2 adapted to connect to the upper air guiding cover 5-1, where the upper and lower air guiding covers are adapted to constitute a cavity, an air impeller 5-3 is arranged inside the cavity, air outlets are distributed on an outer side wall of the cavity, a motor housing 5-4 integrated with the lower air guiding cover 5-2 is arranged on a rear end of the lower air guiding cover 5-2, and a motor 5-5 used for driving the air impeller 5-3 is arranged inside the motor housing 5-4; and the motor housing 5-4 is arranged inside a housing 8 of the suction apparatus via a plurality of resilient cushions 5-6.

[0038] A sleeve piece is fixedly arranged inside the rear pipe 2-2, and two ends of a transmission shaft arranged inside the sleeve piece in a penetrating manner are respectively connected to the rotating body 4-3 and an output shaft of the motor 5-5 in the suction fan; and the sleeve piece matches the transmission shaft via a pair of copper sheaths or polytetrafluoroethylene sheaths 5-7 in a ro-

tating manner.

[0039] A bottom surface of the lower air guiding cover is provided with a first double seal 5-8 made from soft rubber in a secondary injection molding manner, the suction apparatus includes a pair of symmetrically arranged housings 8, and a retaining rib 8-1 matching the first double seal 5-8 is arranged inside the housings 8.

[0040] A matching surface of the housings 8 is provided with a second double seal made from soft rubber in a secondary injection molding manner, so as to ensure tightness of the whole suction apparatus, where the retaining rib 8-1 and a part, located below the retaining rib 8-1, of the housings 8 constitute a sealed cavity, and a battery 12 is arranged inside the sealed cavity.

[0041] It is apparent that the foregoing embodiments are merely exemplary embodiments for clearly describing the present invention, but are not intended to limit embodiments of the present invention. Persons of ordinary skill in the art could make other modifications or alternations in different forms on the basis of the foregoing description. It is unnecessary and impossible to exhaustively exemplify all embodiments. Moreover, apparent modifications and alternations derived from the spirit of the present invention shall fall within the protection scope of the present invention.

Claims

1. A suction apparatus for surface cleaning, comprising: a suction nozzle, a suction channel connected to the suction nozzle, and a water collection container, wherein:
 - the suction apparatus for surface cleaning further comprises a water-air separation apparatus used for separating a liquid-air mixture;
 - the suction channel is arranged inside the water collection container in a penetrating manner, and the water-air separation apparatus is serially arranged on the suction channel;
 - the water-air separation apparatus comprises a rotating body arranged inside the suction channel and adapted to rotate, and a rotary shaft of the rotating body is arranged along an airflow direction in the suction channel; and
 - a gap in communication with the water collection container is arranged on the suction channel adjacent to the rotating body.
2. The suction apparatus for surface cleaning according to claim 1, wherein the rotating body is a cone, a planar body, or a conical spiral body, and the rotary shaft is located on a central line of the rotating body, wherein a top surface of the cone or conical spiral body is opposite to the airflow.
3. The suction apparatus for surface cleaning accord-

- ing to claim 1, wherein the water-air separation apparatus is arranged adjacent to a center of the water collection container.
4. The suction apparatus for surface cleaning according to claim 1, wherein the suction apparatus further comprises a suction fan connected to a terminal of the suction channel. 5
 5. The suction apparatus for surface cleaning according to claim 2, wherein: the suction channel comprises front and rear pipes; the water-air separation apparatus further comprises a sleeve, wherein an inner wall of the sleeve is connected to an edge at a bottom of the rotating body via a plurality of connecting ribs; through-holes are distributed on a side wall of the sleeve; and two ends of the sleeve are respectively sleeved on adjacent ports of the front and rear pipes. 10 15 20
 6. The suction apparatus for surface cleaning according to claim 1, wherein the rotating body comprises a plurality of ribs connected to the rotary shaft. 25
 7. The suction apparatus for surface cleaning according to claim 6, wherein: the suction channel comprises front and rear pipes; the water-air separation apparatus further comprises a sleeve, wherein an inner wall of the sleeve is connected to outer ends of the ribs, and through-holes are distributed on a side wall of the sleeve; and two ends of the sleeve are respectively sleeved on adjacent ports of the front and rear pipes. 30 35
 8. The suction apparatus for surface cleaning according to claim 4, wherein the rotary shaft of the rotating body is transmission-connected to a rotary shaft of the suction fan, or the rotating body is driven by a motor. 40
 9. The suction apparatus for surface cleaning according to claim 5 or 7, wherein: a suction fan connected to a terminal of the suction channel comprises an upper air guiding cover integrally connected to a rear end of the rear pipe, and a lower air guiding cover adapted to connect to the upper air guiding cover, wherein the upper and lower air guiding covers are adapted to constitute a cavity, an air impeller is arranged inside the cavity, air outlets are distributed on an outer side wall of the cavity, a motor housing integrated with the lower air guiding cover is arranged on a rear end of the lower air guiding cover, and a motor used for driving the air impeller is arranged inside the motor housing; and the motor housing is arranged inside a housing of the suction apparatus for surface cleaning via a plurality of resilient cushions. 45 50
 10. The suction apparatus for surface cleaning according to claim 4, wherein: the rotating body and an air impeller of the suction fan are respectively transmission-connected to front and rear ends of a rotary shaft of a motor.
 11. The suction apparatus for surface cleaning according to claim 1, wherein: the suction nozzle is in a dovetail shape, and an inlet of the nozzle is provided with upper and lower rubber sheets that are strip-shaped and vertically arranged; notches are distributed on a front edge of the lower rubber sheet, and recesses connected to the respective notches are distributed on an upper end surface of the lower rubber sheet; and a front edge of the upper rubber sheet is adapted to cover the front edge of the lower rubber sheet.
 12. The suction apparatus for surface cleaning according to claim 5 or 7, wherein: a sleeve piece is fixedly arranged inside the rear pipe, and two ends of a transmission shaft arranged inside the sleeve piece in a penetrating manner are respectively connected to the rotating body and an output shaft of the motor in the suction fan; and the sleeve piece matches the transmission shaft via a pair of copper sheaths or polytetrafluoroethylene sheaths in a rotating manner.
 13. The suction apparatus for surface cleaning according to claim 1, wherein: the water collection container is a transparent container, and the water collection container is provided with a scale used for indicating that a liquid level reaches a height of the water-air separation apparatus.
 14. The suction apparatus for surface cleaning according to claim 5 or 7, wherein: the front pipe and an outlet of the nozzle are integrated; the front pipe matches an inlet of the water collection container in a sealing manner; and an outlet of the rear pipe matches an outlet of the water collection container in a sealing manner.
 15. The suction apparatus for surface cleaning according to claim 1, wherein the rotary shaft is arranged on a central line of the suction channel.
 16. The suction apparatus for surface cleaning according to claim 5 or 7, wherein a sealing ring made from a self-lubricating material is sleeved on the adjacent ports of the front and rear pipes to enable the two ends of the sleeve to respectively match the adjacent ports of the front and rear pipes in a rotary sealing 55

manner.

17. The suction apparatus for surface cleaning according to claim 6, wherein the ribs are distributed uniformly on a conical surface opposite to the airflow direction. 5

18. The suction apparatus for surface cleaning according to claim 1, wherein when the rotating body rotates, the rotating body is adapted to cover a cross section of the suction channel. 10

19. The suction apparatus for surface cleaning according to claim 18, wherein the rotating body is provided with an opening adapted to be passed through by air in the airflow, or an opening or space adapted to be passed through by air in the airflow exists around the rotating body. 15

20. The suction apparatus for surface cleaning according to claim 1, wherein the rotating body is constituted by air blades. 20

21. The suction apparatus for surface cleaning according to claim 1, wherein: 25

a bottom surface of the lower air guiding cover is provided with a first double seal made from soft rubber in a secondary injection molding manner, the suction apparatus comprises a pair of symmetrically arranged housings, and a retaining rib matching the first double seal is arranged inside the housings; and 30

a matching surface of the housings is provided with a second double seal made from soft rubber in a secondary injection molding manner, wherein the retaining rib and a part, located below the retaining rib, of the housings constitute a sealed cavity, and a battery is arranged inside the sealed cavity. 35 40

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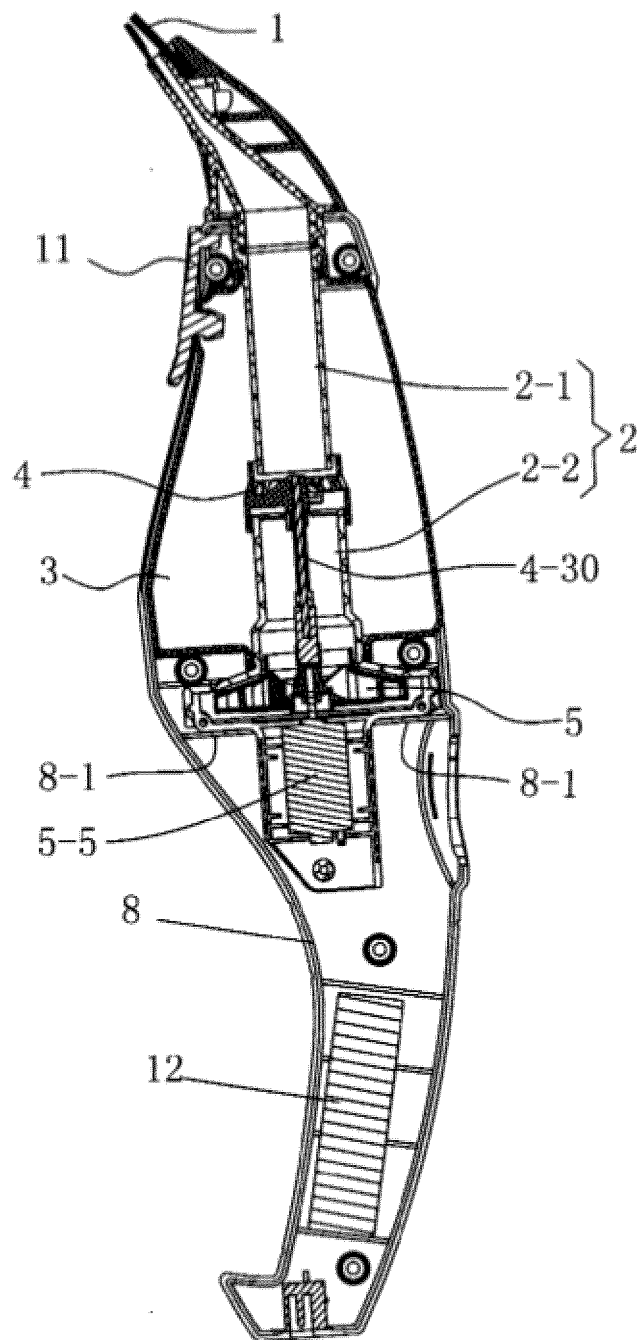


FIG. 1

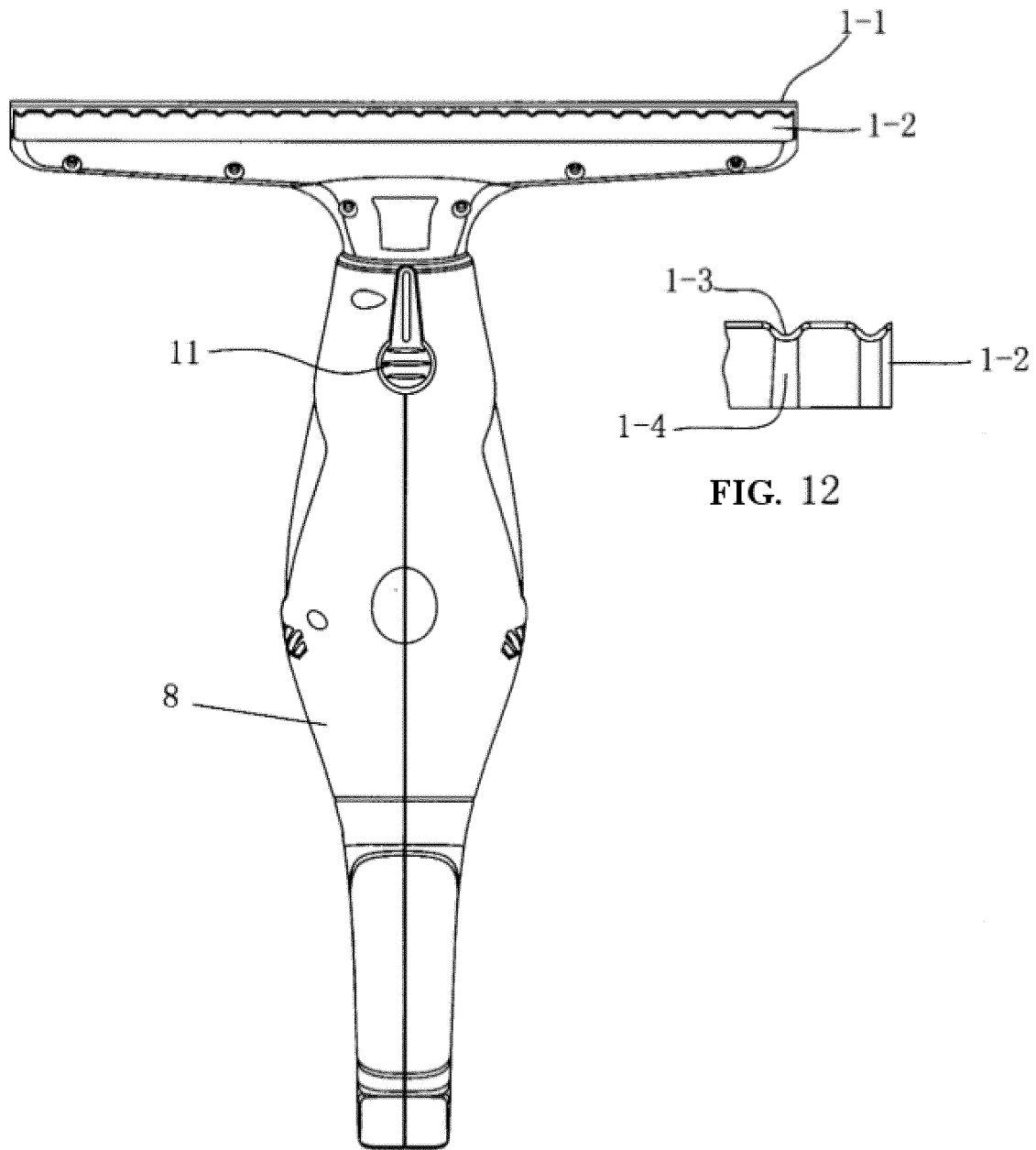


FIG. 12

FIG. 2

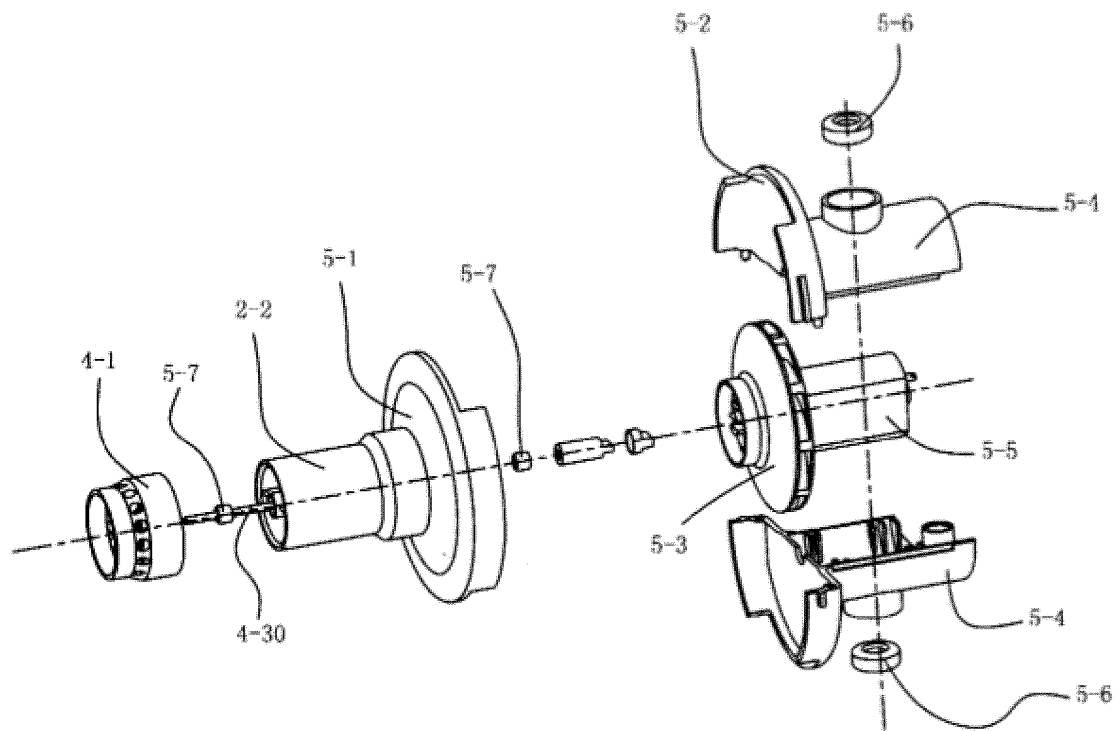


FIG. 3

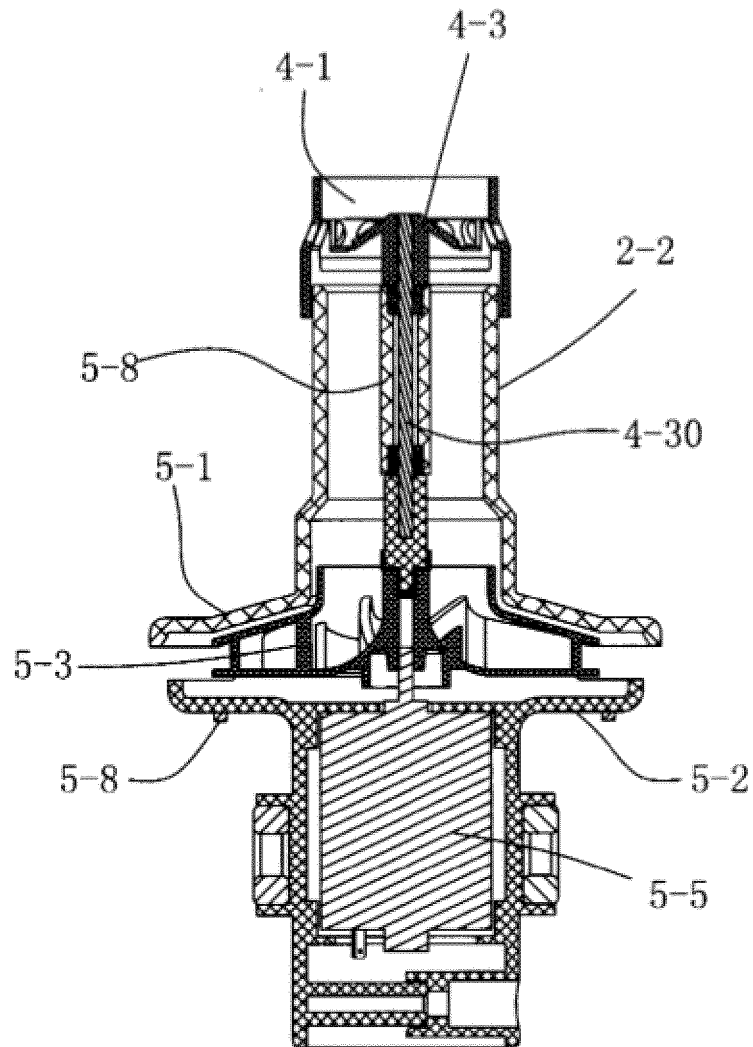


FIG. 4

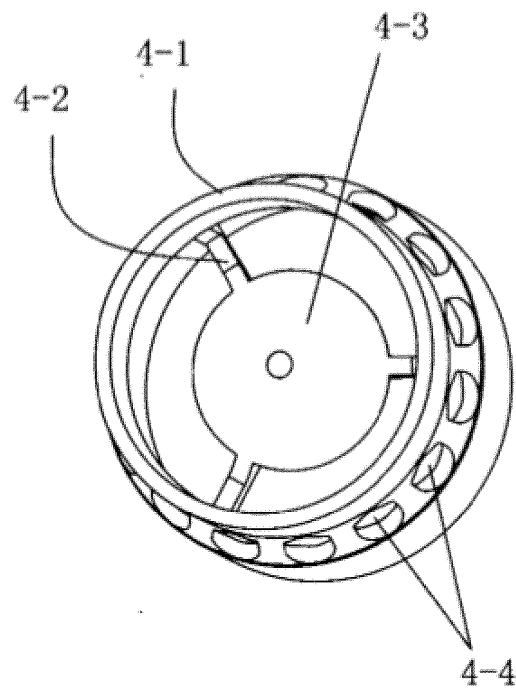


FIG. 5

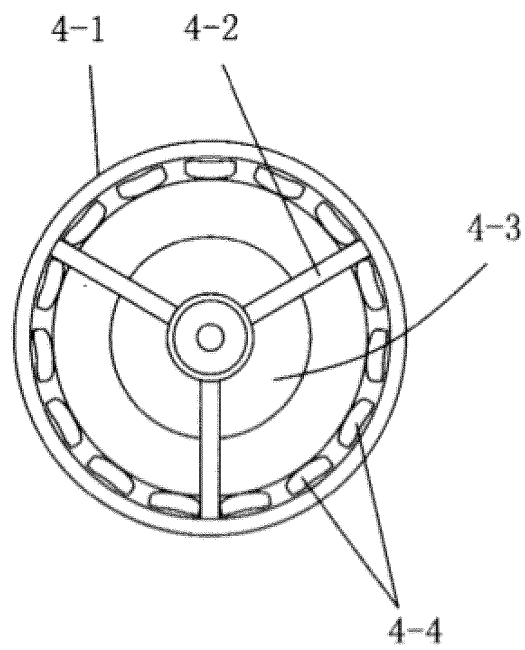


FIG. 6

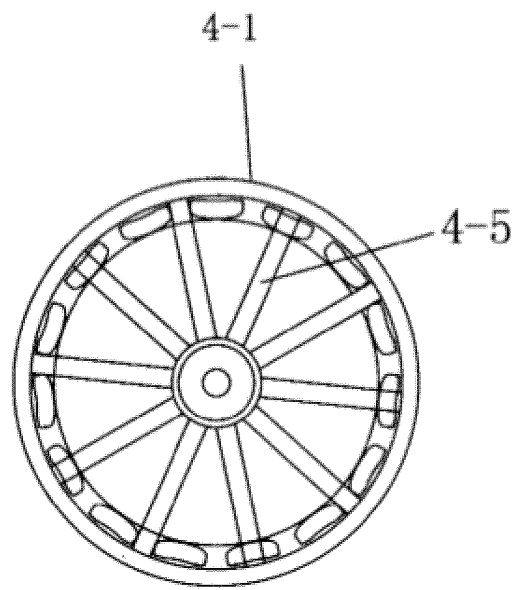


FIG. 7

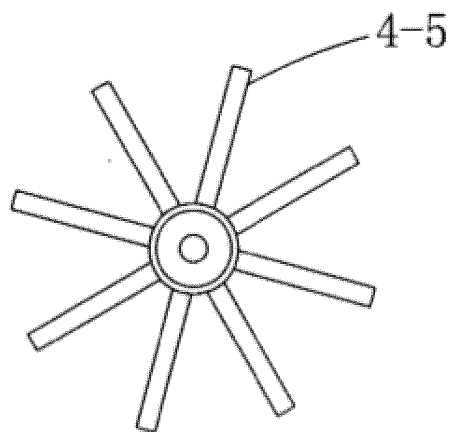


FIG. 8

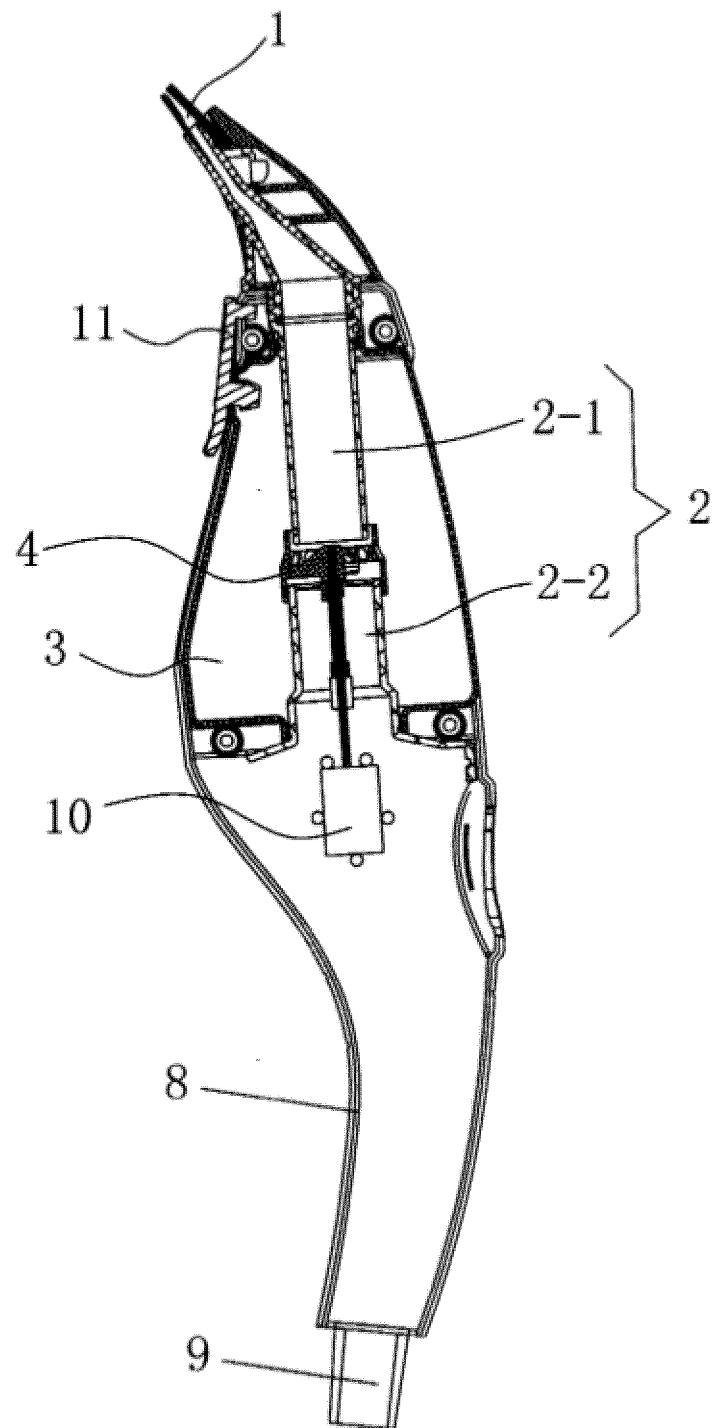


FIG. 9

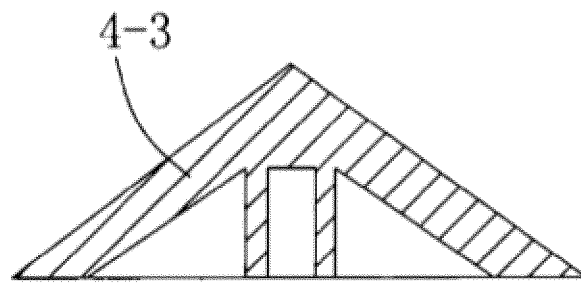


FIG. 10

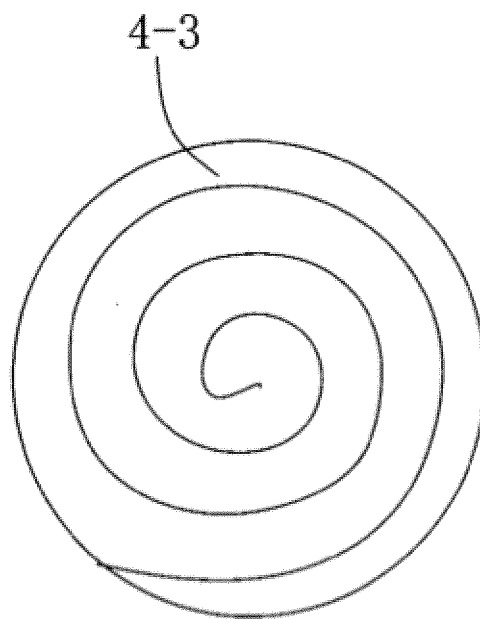


FIG. 11

INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2013/000076

A. CLASSIFICATION OF SUBJECT MATTER

See the extra sheet

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: A47L

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: water, liquid, whirl, swirl, cyclone, vortex, centrifugal, separate, handheld, portable

WPI, EPODOC: eddy, spiral, swirl???, whirl???, centrifugal, cyclone, cyclonic, vortex, tangential+, helical, air, gas, liquid, water, fluid, separat+

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	DE 102011050697 A1 (LEIFHEIT AG), 29 November 2012 (29.11.2012), description, paragraphs [0051]-[0065], and figures 1-4	1-4, 6, 8, 10, 11, 13, 15, 17-20
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INTERNATIONAL SEARCH REPORT
 Information on patent family members

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CLASSIFICATION OF SUBJECT MATTER

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REFERENCES CITED IN THE DESCRIPTION

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