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(54) Title: SUCKING APPARATUS

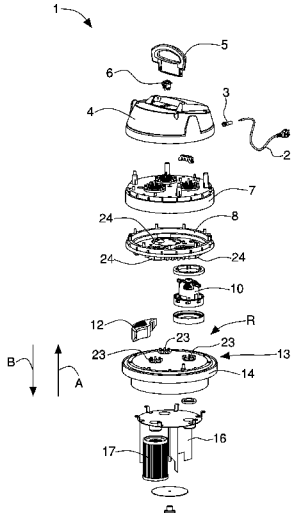

Fig. 1

(57) Abstract: A sucking apparatus (1), in particular for cleaning, comprises at least two sucking motors (10) arranged for generating a flow of air (F) from the outside to the inside of the apparatus (1), at least two filters (17) arranged downstream of the sucking motors (10) for filtering the flow of air, each filter (17) being associated with a respective sucking motor (10), and a plurality of valve elements (23). The valve elements (23) are interposed between, and operationally associated with, each sucking motor (10) and each filter (17), and are movable between a rest position (R) wherein they are received in respective seats (21), and a raised position (S), wherein they are raised from the respective seats (21) when the sucking motor (10) associated therewith is working, to enable the passage of the flow of air (F) prevalently along a first direction (A). The valve elements (23) are provided with a calibrated passage (20) arranged for enabling, when they are in the rest position (R), the passage of at least one portion (F') of the flow of air substantially along a second direction (B), opposite the first direction (A), from the sucking motor (10) to the filter (17) for cleaning the latter.

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Sucking apparatus

The invention relates to a sucking apparatus, in particular for cleaning, for example arranged for sucking fragments of material or objects of small dimensions.

Known sucking apparatuses comprise one or more filters and one or more sucking motors. The filter is interposed between the external environment and the sucking motor for filtering the flow of air sucked by the sucking apparatus. The filter, positioned inside a collecting tank, retains here the sucked material, such that only clean air reaches the sucking motor.

After a certain number of hours of operation of the sucking apparatus the filter has to be cleaned, otherwise it no longer permits the air to pass, which reaches the motor only in extremely reduced quantities or even nothing. This thus compromises the operation of the apparatus, which is thus not usable until the filter is cleaned or replaced with a new filter.

Accordingly, in known sucking apparatuses it is necessary for the operator, i.e. the person who usually uses the sucking apparatus, to clean the filter.

In order to clean the filter, the operator can dismantle the filter from the sucking apparatus and then shake and hit the filter energetically in order to remove the material that has previously been deposited thereupon. This material is generally released into the surrounding environment and so this method of cleaning the filter is not advisable because the material released into the environment is again sucked by the sucking apparatus with the result that the filter will again get dirty very rapidly.

Alternatively, known sucking apparatuses can comprise air-channelling systems comprising pressure switches and/or deviator valves that convey a flow of air to the filters so as to clean the filters.

One drawback of these sucking apparatuses is that they are rather complex, and thus costly, due to the presence of the air channelling systems and of the deviator valves.

One embodiment of these apparatuses provides for these air channelling systems being driven by the operator. One drawback of this embodiment is that the apparatus cannot ensure complete and reliable filter cleaning. Effective filter cleaning in fact substantially depends on the time that the operator dedicates to cleaning the filter. One serious drawback of these apparatuses is the fact that cleaning the filter is manually driven by the operator, who, - typically because of lack of time or negligence – does not dedicate sufficient time to ensure thorough removal of the material deposited on the filter.

One object of the invention is to improve known sucking apparatuses.

Another object of the invention is to supply a sucking apparatus in which the filter is cleaned completely automatically.

A further object of the invention is to supply an efficient sucking apparatus that does not need to be stopped for filter cleaning operations and at the same time ensures good cleaning of the filter.

According to the invention, a sucking apparatus is provided as defined in claim 1.

The invention can be better understood and implemented with reference to the attached drawings, which show an embodiment thereof by way of non-limiting example, in which:

Figure 1 is an exploded view of a sucking apparatus according to the invention in which some elements have been removed for the sake of clarity;

Figure 2 is a perspective bottom view of a portion of the sucking apparatus in Figure 1;

Figure 3 is an enlarged perspective view of a valve element comprised in valve means of the sucking apparatus in Figure 1;

Figure 4 is an exploded schematic perspective view of a portion of the sucking apparatus in Figure 1 shown in an operating configuration by way of example.

With reference to Figure 1 there is shown a sucking apparatus 1, in particular for cleaning. The sucking apparatus 1 can be a vacuum cleaner, for example of the professional and/or industrial type.

The sucking apparatus 1 comprises at least two sucking motors 10 arranged for generating a flow of air F from the outside to the inside of the apparatus.

The sucking apparatus 1 further comprises at least two filters 17 arranged downstream of the sucking motors 10 for filtering the flow of air F in such a manner as to retain on the filter the sucked material, such that substantially clean air reaches the sucking motor 10. The filters 17 are positioned inside a collecting tank (which is not shown) where the sucked material is retained, such that only clean air reaches the sucking motor 10.

Each filter 17 is associated with a respective sucking motor 10. It should be noted that in Figure 1 for the sake of clarity only one sucking motor 10 and one filter 17 are shown.

The sucking apparatus 1 further comprises a base 14 that supports the sucking motors 10. A supporting element 16 on which the filters 17 are fixed is connected to the base 14 on a side opposite the sucking motors 10. The base 14 is thus interposed between the sucking motors 10 and the filters 17. The sucking apparatus 1 can comprise, for example, three sucking motors 10 and three filters 17.

The sucking apparatus 1 comprises valve means 13 interposed between, and operationally associated with, each sucking motor 10 and each filter 17. The valve means 13, comprises, for example, three valve elements 23, each of which is received in a respective seat 21 made on the base 14. The valve elements 23, for example the same as and independent of one another, are movable between a rest position R (shown in Figure 1), in which they are housed in the seats 21 (visible in Figures 2 and 4), and a raised position S (Figure 4), in which they are raised from the respective seats 21. This occurs when the sucking motor 10 associated with the valve element 23 is working, as will be explained in greater detail below with particular reference to Figure 4. When a valve element 23 is in the raised position S it allows the passage of the flow of air F prevalently along a direction indicated by the arrow A in Figure 1.

Each sucking motor 10 can be axially aligned along a direction that is substantially parallel to the first direction A, to a valve element 23 and to a respective filter 17.

In alternative embodiments of the invention, each sucking motor can be not aligned axially on the valve element 23 and on the filter 17 associated therewith, provided that the motor, the valve element and the filter are arranged in such a manner as to be traversed in sequence by the same flow of air.

With reference to Figure 3, a valve element 23 is visible which has been significantly enlarged.

The valve means 13, in particular each valve element 23 comprised therein, is provided with a calibrated passage 20 arranged for enabling, when the valve means 13 is in the rest position R, the passage of at least one portion F' of the flow of air substantially along a second direction B, opposite the first direction A, from the sucking motor 10 to the filter 17 for cleaning the latter.

The calibrated passage 20 is suitably sized in such a manner as to enable, on one hand, the passage of a flow of air F that is suitable for ensuring good sucking capacity of the sucking apparatus 1, and on the other hand, to enable a suitable portion F' (Figure 4) of the flow of air to reach the filter 17 to clean the filter 17. In other words, the calibrated passage 20 has dimensions that are such as to enable a portion F' of the flow of air to reach a filter 17 and clean the filter without there being a loss in sucking capacity of the apparatus 1.

The valve element 23 comprises a base portion 23a, for example disc-shaped, and a plurality of flaps 23b, for example eight flaps 23b that are angularly equidistant at an edge of the base portion 23a. The flaps 23b are arranged for defining a suitable thickness for enabling the passage of the flow of air F when the valve element 23 is in the raised position S.

The calibrated passage 20, for example shaped as a circular hole, can be made substantially at a central zone of the base portion 23a (i.e. substantially at the centre of the disc).

In an alternative embodiment of the invention, the base portion 23a can have any other shape than the disc shape, for example a square shape or any other polygonal shape.

When the valve element 23 is in the rest position R the base portion 23a abuts on the surface of the base 14 such as to ensure that the valve element 23 remains inside the seat 21 thereof.

The sucking apparatus 1 comprises a locking element 8 (Figure 1), fixed to the base 14, and in which a plurality of cavities 24 are made that are aligned on the seats 21 parallel to the first direction A. The sucking apparatus 1 thus comprises a number of cavities 24 that is equal to the number of seats 21. Each cavity 24, on one side receives an end of a sucking motor 10, and on the other side is shaped as a conduit that projects to the base 14,

in particular to the seat 21 underneath. The locking element 8 thus enables the sucking motors 10 to be stopped, and, owing to the cavities 24 that act as a guiding element for the valve elements 23 – the valve means 13 to be moved between the rest position R and the raised position S.

The sucking apparatus 1 further comprises a cover 4 that, together with the base 14, bounds a chamber in which the sucking motors 10 are positioned.

Inside this chamber different known elements of the sucking apparatus 1 are positioned, such as, for example, a soundproofing element 12 - arranged for reducing the noise produced by the sucking motors 10 that spreads outside the apparatus – or a cover 7 for the sucking motors 10.

With the cover 4 a plurality of known elements are further associated such as, in particular: a pushbutton 6 for switching on and switching off the apparatus, a handle 5 for carrying the apparatus, an electric cable 2 (provided with a cable gland 3) to supply the apparatus.

The sucking apparatus 1 can further comprise a plurality of wheels (not shown) owing to which the operator can position the sucking apparatus 1 in the desired position.

The operation of the sucking apparatus 1 will now be explained with reference to Figure 4.

In the sucking apparatus 1, two sucking motors 10 are always working, whilst the remaining third sucking motor 10 is not working.

For this purpose, the sucking apparatus 1 comprises an electronic control unit U, for example an electronic card, which has been schematised in Figure 4. The control unit U is further programmed for controlling the sucking motors 10 in such a manner that at least one of the sucking motors 10 is stopped and the remaining sucking motors 10 are operational. The electronic control unit U thus drives the three sucking motors by suitably combining switch-ons and switch-offs of the latter. In particular, the electronic control unit U controls the sucking motors 10 according to preset cyclical temporal sequences such that in successive work cycles of the same duration, the sucking motors 10 are stopped in sequence one after the other. Therefore, in the embodiment of the sucking apparatus 1 disclosed above and shown in Figure 4, in which there are three sucking motors 10, the electronic control unit U drives the apparatus 1 by repeating over time three different successive work cycles, during each of which a different sucking motor 10 is stopped.

The valve elements 23 positioned respectively below the two sucking motors 10 that are working are maintained in the raised position S. In Figure 4, the distance of the two valve elements 23 in a raised position S from the respective seats 21 has been emphasised for the sake of clarity and the movement of the valve elements 23 has been indicated by the arrows S1 and S2. The third valve element 23, arranged below the non-working sucking

motor 10 is in the rest position R. When a non-working sucking motor 10 is driven by the electronic control unit U, the valve element 23 arranged below the motor goes from the rest position R to the raised position S owing to the vacuum created by the sucking motor. On the other hand, when a working sucking motor is stopped, the vacuum created by the motor stops suddenly and the underneath valve element 23 moves from the raised position S to the rest position R.

The two working sucking motors 10 thus create a vacuum inside the collecting tank of the sucked material. A flow of air F is thus created that is sucked inside the apparatus 1 and which, after having passed through the two filters 17 arranged below the working motors, passes through the seats 21 and enters the chamber in which the sucking motors 10 are arranged. From here, a portion F' of the flow of air passes through the calibrated passage 20 of the valve element 23 which is in the rest position R, so as to be directed to the third filter 17, i.e. the filter arranged below the non-working sucking motor (on the left in Figure 4). This third filter 17 is then cleaned by the portion F' of flow of air, which is clean air inasmuch as it was previously filtered by the remaining two filters 17 arranged below the two working sucking motors 10.

Owing to the presence of the calibrated passages 20, which enable the sucking motor 10 to be obtained constantly in communication with the respective filter 17 associated therewith, it is possible to clean in turn the filters 17 of the sucking apparatus 1 in a completely automatic manner. In fact, whilst the sucking apparatus 1 is in operation, stopping in turn one of the three sucking motors 10, it is thus possible to clean effectively the filter associated with the non-working sucking motor 10 without this reducing the flowrate of the flow of air F sucked by the apparatus 1.

One advantage of the sucking apparatus 1 is to make available automatic cleaning of the filters 17 with which the apparatus is provided without this reducing the performance of the apparatus in terms of vacuum and flowrate of the sucked air. In fact, the portion F' of flow of air that cleans the filter 17 is already included in the flow of air F found inside the sucking apparatus 1.

Another advantage of the sucking apparatus 1 is that the filters 17 are cleaned during normal operation of the apparatus.

A further advantage is that cleaning of the filters no longer depends on the time that the operator dedicates thereto, as it is no longer performed manually by the operator but automatically by the apparatus.

Still another advantage consists of the fact that the sucking apparatus 1 has lower structural complexity and manufacturing costs than those of known apparatuses, or at the limit structural complexity and manufacturing costs that are comparable with those of known apparatuses. In fact, the sucking apparatus 1 does not require any external system,

in particular it requires neither pipes, nor solenoid valves nor diverter valves for the air that would make the apparatus 1 more complex and costly.

A still further advantage is that the filters 17 of the sucking apparatus 1 are more durable and must therefore be replaced significantly less often than known apparatuses. Owing to this, the time that the operator has to dedicate to checking the state of cleanliness of the filters 17, and to replacing the filters 17 is significantly less than known apparatuses.

In alternative embodiments of the invention a different number of sucking motors 10, of filters 17 and of valve elements 23 can be provided, as long as one sucking motor 10 is always associated with a respective filter 17 and a respective valve element 23 is placed therebetween that maintains the sucking motor 10 and the filter 17 always in reciprocal communication owing to the presence of a calibrated passage 20.

Possible variations and/or additions are possible to what has been disclosed above and/or shown in the attached drawings.

CLAIMS

1. Sucking apparatus (1), in particular for cleaning, comprising:
   - at least two sucking motors (10) arranged for generating a flow of air (F) from the outside to the inside of said apparatus (1);
   - at least two filters (17) arranged downstream of said sucking motors (10) for filtering said flow of air, each filter (17) being associated with a respective sucking motor (10);
   - valve means (13) interposed between, and operationally associated with, each sucking motor (10) and each filter (17), and movable between a rest position (R) wherein said valve means (13) is received in respective seats (21), and a raised position (S), wherein said valve means (13) is raised from said respective seats (21) when the sucking motor (10) associated therewith is working, to enable the passage of said flow of air (F) prevalently along a first direction (A);
   characterised in that said valve means (13) is provided with a calibrated passage (20) arranged for enabling, when said valve means (13) is in said rest position (R), the passage of at least one portion (F') of said flow of air substantially along a second direction (B), opposite said first direction (A), from said sucking motor (10) to said filter (17) for cleaning said filter (17).
2. Apparatus according to claim 1, comprising an electronic control unit (U) arranged for controlling said sucking motors (10) such that at least one of said sucking motors (10) is stopped and the remaining sucking motors (10) are working.
3. Apparatus according to claim 2, wherein said electronic control unit (U) controls said sucking motors (10) according to preset cyclical temporal sequences such that said sucking motors (10) are stopped in sequence one after the other in successive work cycles.
4. Apparatus according to claim 3, wherein said work cycles have the same duration.
5. Apparatus according to any preceding claim, wherein each sucking motor (10) is axially aligned, along a direction that is substantially parallel to said first direction (A), to a valve element (23) comprised in said valve means (13) and to a respective filter (17).
6. Apparatus according to any preceding claim, wherein said calibrated passage (20) is sized in such a manner as to enable a portion (F') of said flow of air to reach said filter (17) and clean said filter (17) without there being a loss in the sucking capacity of the apparatus.
7. Apparatus according to claim 5 or 6, comprising a base (14) in which said seats (21) for said valve elements (23) are made.

8. Apparatus according to claim 7, comprising a locking element (8) fixed to said base (14) and arranged for locking said sucking motors (10).
9. Apparatus according to claim 8, wherein said locking element (8) comprises a plurality of cavities (24) aligned on said seats (21).
10. Apparatus according to claim 9, wherein said cavities (24) are shaped as conduits and arranged for acting as guiding elements for guiding the movement of said valve means (13) between said rest position (R) and said raised position (S).
11. Apparatus according to any one of claims 7 to 10, wherein said at least two sucking motors (10) are supported by said base (14) and enclosed in a chamber bounded by said base (14) and by a cover (4) of said sucking apparatus (1).
12. Apparatus according to any one of claims 7 to 11, wherein said filters (17) are fixed to a supporting element (16) connected to said base (8).
13. Apparatus according to any preceding claim, comprising three sucking motors (10), three valve elements (23) and three filters (17).

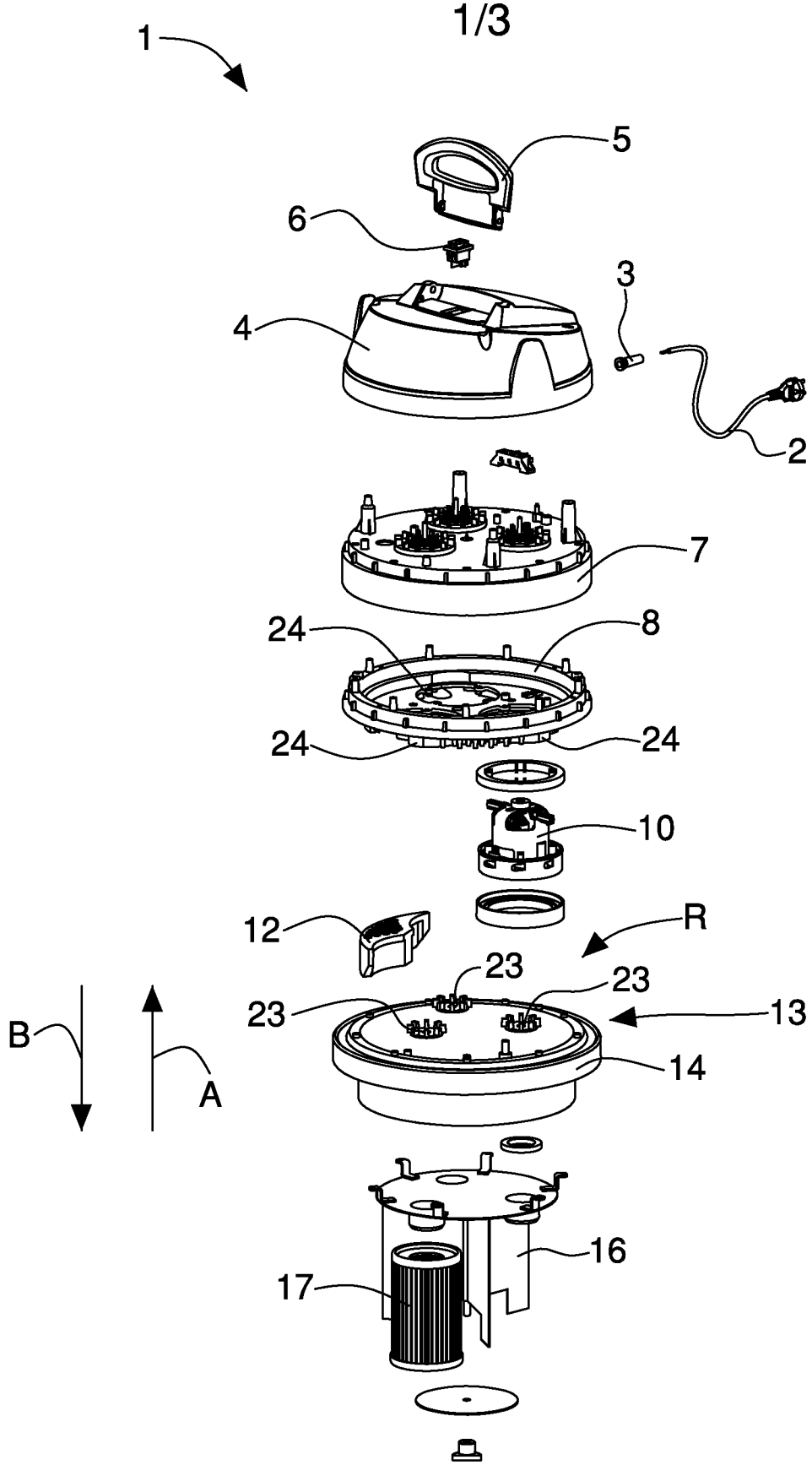

Fig. 1

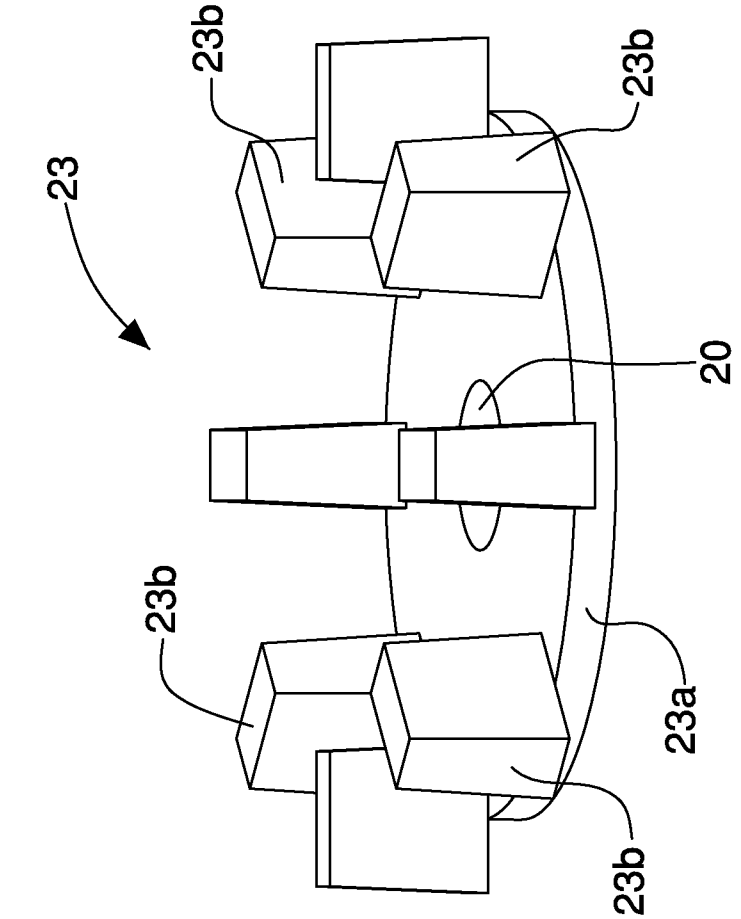

Fig. 3

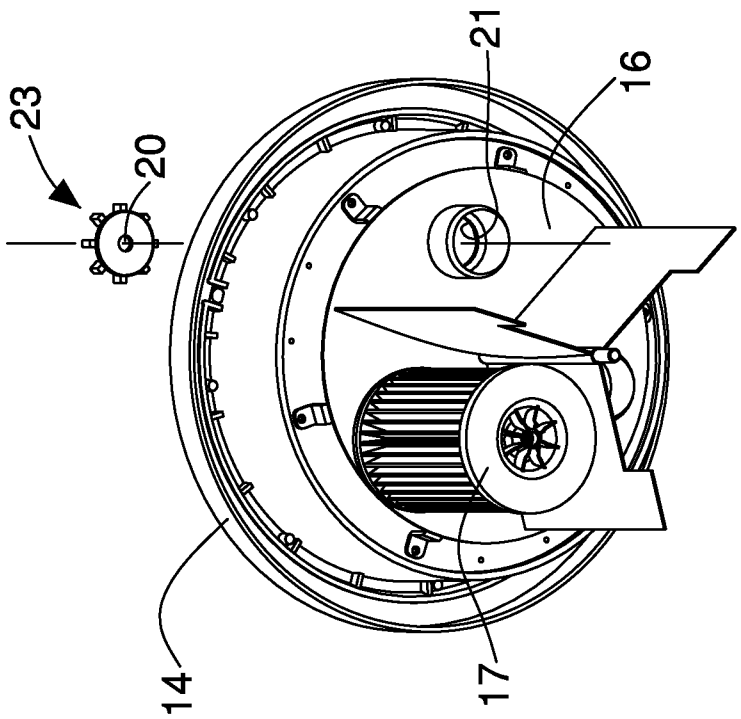

Fig. 2

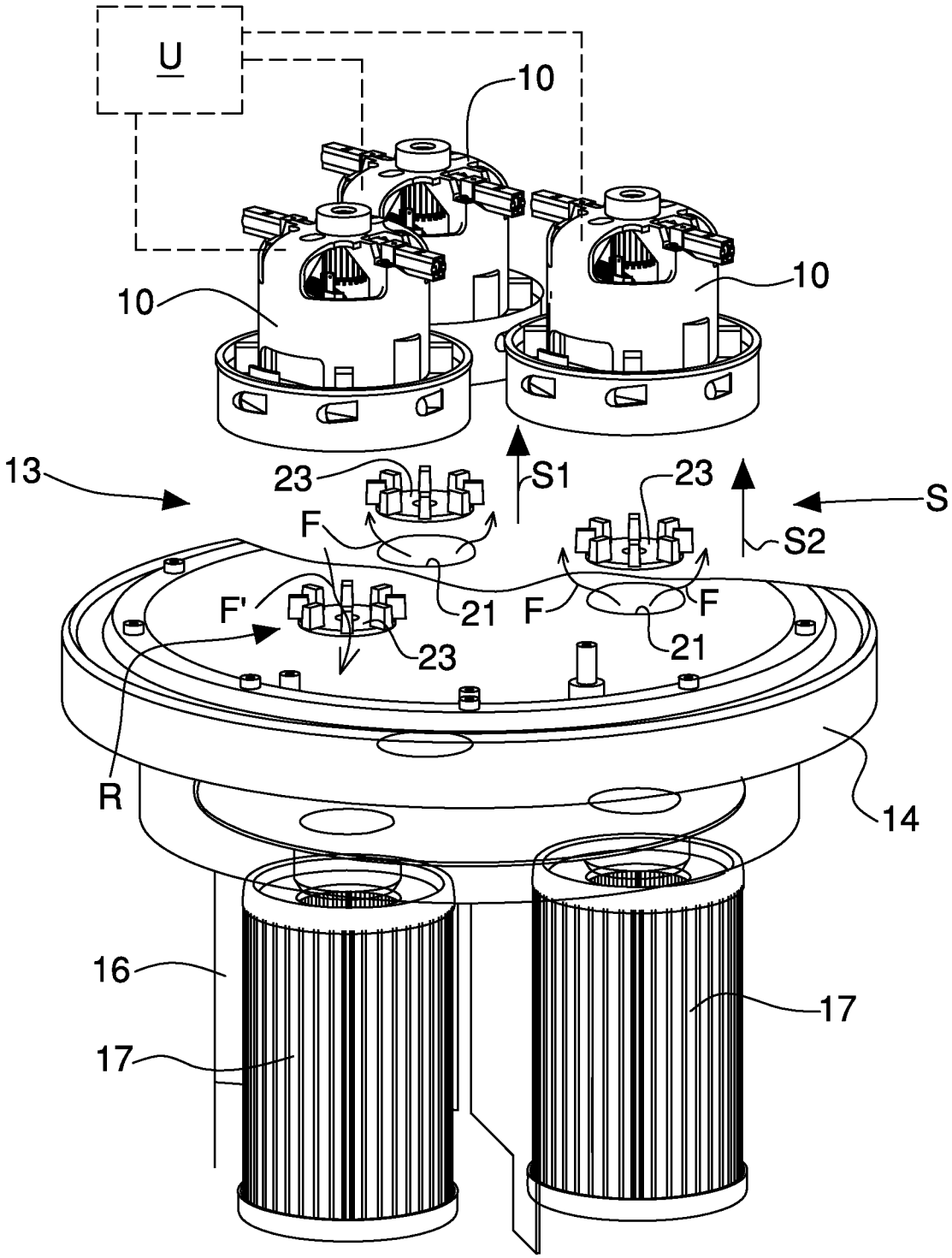

Fig. 4

INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2013/053605

A. CLASSIFICATION OF SUBJECT MATTER
INV. A47L9/20
ADD.

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

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)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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A	WO 2010/121656 A1 (KAERCHER GMBH & CO KG ALFRED [DE]; RENTSCHLER WERNER [DE]; ENGELHARDT) 28 October 2010 (2010-10-28) page 18, paragraph 3 - page 22, paragraph 1	1-13
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☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents :

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Date of the actual completion of the international search	Date of mailing of the international search report
19 July 2013	31/07/2013

Name and mailing address of the ISA/	Authorized officer
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INTERNATIONAL SEARCH REPORT

Information on patent family members

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