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(54) Benævnelse: **Støvsuger med tilbagestrømsluftstråle-filterrengøringsindretning**

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EP-A1- 1 464 266
EP-A2- 1 997 411
US-A- 4 007 026

DESCRIPTION

[0001] The present invention relates to the industrial vacuum cleaner sector.

[0002] In particular, the invention relates to a vacuum cleaner with a reverse air jet filter cleaning device.

[0003] A problem with industrial vacuum cleaners is the rapid clogging of the internal filters, requiring frequent interventions to remove the deposits of solid particles from said filters, and to restore their efficiency, at least in part.

[0004] The filters are arranged between a chamber placed under vacuum conditions by an intake turbine and a dust-laden air intake chamber for collecting and accumulating said dust once it has been separated from the air flow drawn up.

[0005] Filters normally comprise one or more cartridges placed in parallel, each cylindrical in shape, with a side surface composed of a sheet of pleated porous material, the bottom of which is closed and the top has a circular opening through which the air flows after being filtered as it passes through said porous material.

[0006] EP 1 464 266 A1 discloses a filter cleaning device which exploits the main air flow of the vacuum cleaner, when the vacuum cleaner is switched off, and which uses, at the same time, a pneumatic mechanical movement to shake the filters.

[0007] It is also known that it is possible to clean a filter by passing a secondary jet of cleaning air through it, in the opposite direction to the primary flow of air that passes through the filter during normal operation.

[0008] Some vacuum cleaners are provided, for this purpose, with a reverse air jet filter cleaning device that, by means of a compressor, generates a high-pressure jet of air adapted to strike each of said filters in turn, thereby cyclically freeing them from the dust that has accumulated thereon.

[0009] US 4 007 026 A describes such a vacuum cleaner according to the preamble of claim 1.

[0010] In general, said devices comprise, for each filter, an emission duct for the reverse jet cleaning air and specific solenoid control valves activated in rotation by a control unit with a timer.

[0011] Said emission ducts and the inlets of said filters are not in direct contact with each other, but are separated from each other by the space taken up by the chamber placed under vacuum conditions by the intake turbine, and the cone of reverse air, which is emitted by each duct in the direction of the circular opening at the top of the filter, therefore only partially strikes the porous material making up the side surface of the cylindrical filter.

[0012] Disadvantageously, therefore, the effectiveness of the filter cleaning depends specifically on the position and range of the cone of reverse air: if the emission ducts are placed far away from the filters, because the chamber under vacuum conditions is high, the air pressure only acts on the top of said filters, and does not have enough power to clean and shake the bottom part thereof, and vice-versa if the emission duct is placed very close to the filters, the cleaning at the top will be ineffective.

[0013] Filter cleaning always takes place while the vacuum cleaner is in operation, and therefore the secondary reverse air jet must be at a very high pressure to overcome the vacuum effect already present inside the vacuum cleaner and required for normal operation thereof.

[0014] Such high pressures can only be achieved by using compressors, which however disadvantageously are quite cumbersome, resulting in high electricity consumption and making the vacuum cleaner heavier and impractical.

[0015] Even more disadvantageously, such high reverse jet air pressures, in addition to the risk of breaking the filters, in most cases also lead to problems of condensation: any humidity that may form in the compressed air storage tank is emitted along with the reverse air jet and mixes with the dust, thereby dirtying the filter even more and damaging the vacuum cleaner.

[0016] The aim of the present invention is to eliminate these disadvantages, by providing a vacuum cleaner with a reverse air jet filter cleaning device that is particularly effective even with a low-pressure reverse jet of secondary cleaning air, which does not damage the filters, consumes little energy, avoids the formation of condensation and can also be easily adapted to any type of vacuum cleaner.

[0017] These aims are achieved by a vacuum cleaner with reverse air jet filter cleaning device comprising:

- suction means of known type associated with a vacuum chamber and activated by a control unit;
- cartridge filter means to filter a primary flow of dust-laden air connected to said vacuum chamber;
- containment means to contain the dust drawn up and retained by said filter means,
  wherein said reverse air jet filter cleaning device comprises:
- feed means to feed a secondary reverse air jet;
- emission ducts connected to said feed means;
- solenoid control valves associated with said emission ducts and that can be selectively activated by said control unit,

characterized in that said filter cleaning device comprises sleeves, connected between said emission ducts and said cartridge filter means,
and each sleeve comprises a plurality of ports adapted to place the inside of the sleeve in communication with said vacuum chamber to ensure suction of the primary flow of dust-laden air, wherein said sleeve comprises movable means slidingly associated therewith, adapted to reversibly close said ports during cleaning of said filter means and to simultaneously allow the passage of said secondary reverse air jet.

[0018] According to a first embodiment of the invention, said movable means comprise a piston, sliding in said sleeve as a result of the thrust of the secondary reverse air jet, against the action of elastic return means, so as to cause, through its alternating movement, the opening and closing of said ports, where said piston is provided on its head with a plurality of holes, adapted to allow the passage of said secondary reverse air jet toward said filter means.

[0019] In particular, said sleeve is associated with said filter means by means of an elastomeric type airtight gasket.

[0020] According to a further embodiment of the invention, said elastic return means comprise a helical spring coaxial with said sleeve, arranged between the head of said piston and a ring fixed to an intermediate section of said sleeve.

[0021] According to a possible embodiment of the invention, said means to feed said secondary reverse air jet comprise a blower controlled by said control unit and placed in connection with the outside atmosphere from which it draws air to transfer it to said emission ducts through a distribution manifold.

[0022] According to a further embodiment of the invention, said filter means comprise a plurality of cartridge filters connected in parallel to said vacuum chamber and to said distribution manifold by means of said sleeves.

[0023] According to a possible embodiment of the invention, said filter cleaning device comprises at least one motorized filter shaker controlled by said control unit, together with said solenoid valves, comprising a striking mass adapted to strike said filter to exert a mechanical shaking action.

[0024] The main advantage of the invention is that said emission ducts for the secondary reverse air jet are connected directly to the filter means by means of sleeves, so that each individual filter, when being cleaned, can be isolated from the remaining vacuum cleaner filters, which remain active, thereby making the cleaning action more effective without losing any power.

[0025] A further advantage is the fact that it is no longer necessary for the cleaning air to have the high pressures needed to overcome the primary flow of dust-laden air created by the vacuum cleaner's suction effect, because it is introduced into a filter without any intake airflow, yet is still connected to the containment chamber for the dust drawn up, which, since it is kept under vacuum conditions, favors the passage of the reverse jet cleaning air from the isolated filter to said drawn up dust containment chamber.

[0026] The use of lower pressures and consequent avoidance of the need for compressed air storage also eliminates problems associated with the formation of condensation, and allows the use of less powerful blowers, making the device more economical, lighter, with lower electricity consumption and much smaller dimensions, and therefore easy to fit to various models of vacuum cleaner, which can therefore be used on sites with a limited electricity supply.

[0027] Furthermore, the use of a piston with a perforated head, sliding alternately inside the sleeve as a result of the thrust of the secondary reverse air jet and of the return action exerted by a spring compressed by the same piston as it moves, allows the ports on the sleeve to be automatically reversibly closed and opened as soon as the relative solenoid valve is selectively activated by the control unit, without the need for any specific additional electromechanical devices.

[0028] These and other advantages of the present invention will become more apparent from the following detailed description of an embodiment thereof, which is illustrated by no way of limitation in the accompanying drawings, in which:

figure 1 shows a partially exploded perspective view of a vacuum cleaner with a reverse air jet filter cleaning device according to the invention;

figure 2 shows a transparent overhead plan view of the vacuum cleaner with a reverse air jet filter cleaning device shown in fig. 1;

figure 3 shows a schematic, axial cross-section view along the vertical plane III-III shown in figure 2, of the vacuum cleaner with a reverse air jet filter cleaning device shown in figure 1;

figures 4 and 5 show a transparent front view and a cross-section view, according to a vertical plane respectively, of a detail of the reverse air jet filter cleaning device during operation;

figures 6 and 7 show a transparent front view and a cross-section view, according to a vertical plane respectively, of a detail of the reverse air jet filter cleaning device when in standby;

figures 8-10 show an overhead view, a cross-section view along a vertical plane IX-IX, and an axonometric view, respectively, of a detail of the filter cleaning device;

figure 11 shows a cross-section view along a vertical plane of a possible more complete embodiment of the reverse air jet filter cleaning device according to the invention.

[0029] With reference to the details shown in figures 1-3, the invention relates to a vacuum cleaner 1, particularly an industrial type cleaner, with a reverse air jet filter clearing device.

[0030] The vacuum cleaner 1 essentially comprises suction means associated with a vacuum chamber 3 and activated by a control unit (not shown), filter means to filter a primary flow of dust-laden air F connected to said vacuum chamber 3 and containment means 4 to contain the dust drawn up and retained by said filter means.

[0031] Said suction means comprise a turbine 2 adapted to place said chamber 3 under vacuum conditions.

[0032] Said filter means, in the embodiment shown, comprise three cartridge type filters 5.

[0033] Said containment means 4 consist of a cylindrical tank provided with a disposal outlet (not shown) for the dust drawn up, according to prior art.

[0034] Said filter cleaning device comprises feed means 6 to feed a secondary jet of air F' in the opposite direction to the primary flow of dust-laden air F, in order to clean said filters 5.

[0035] The feed means 6 are provided with emission ducts 8 provided with solenoid control valves 7, that can be selectively activated by said control unit, to open or close the passage through said emission ducts 8.

[0036] Said filter cleaning device comprises, for each filter 5, a sleeve 9 connected between said emission ducts 8 and said filters 5, which passes through said vacuum chamber 3.

[0037] In particular, each sleeve 9 is associated with its respective filter 5 by means of an elastomeric type airtight gasket 10, such as an O-Ring.

[0038] Each sleeve 9 comprises a plurality of lateral ports 11 adapted to place the inside of the sleeve 9 in communication with said vacuum chamber 3 to ensure suction of the primary flow of dust-laden air F.

[0039] With reference to the details shown in figures 4-7, each sleeve 9 also comprises movable means slidingly associated therewith and adapted to reversibly close said ports 11 during clearing of said filter means and to simultaneously allow the passage of said secondary reverse air jet F'.

[0040] Said movable means comprise a piston 12 sliding in said sleeve 9 as a result of the thrust of the secondary reverse air jet F' against the action of elastic return means so as to cause, by means of its alternating movement, the reversible opening

(figures. 6-7) and closing (figures. 4-5) of said ports 11.

[0041] The piston 12 slides with a small amount of clearance with respect to the inner surface of the sleeve 9, so that the alternating movement of the piston 12 can cause the substantially airtight opening and closing of the ports 11.

[0042] Advantageously, the sleeve 9 is made of metal, while the piston 12 is made of a self-lubricating material such as Teflon®.

[0043] As shown in figures 8-10, said piston 12 is also provided, on its head 12', with a plurality of holes 13 adapted to allow the passage of said secondary reverse air jet F' toward said filter means.

[0044] The holes 13 are distributed uniformly on the surface of the head 12' of the piston 12.

[0045] Said elastic return means comprise a helical spring 15 coaxial with said sleeve 9, arranged between the head 12' of said piston 12 and a ring 16 fixed to an intermediate section of said sleeve 9.

[0046] The helical spring 15 has a truncated conical shape to better adapt to working conditions.

[0047] In a preferred embodiment of the invention, said feed means 6 to feed the secondary reverse air jet F' comprise a blower 17 controlled by said control unit and placed in connection with the outside atmosphere from which it draws air to transfer it to said emission ducts 8 through a distribution manifold 14.

[0048] The device subject of the present invention, however, may similarly be provided with other feed means adapted to generate the secondary reverse air jet F' in the sleeves 9, including for example a suction assembly different from the one shown, or a compressed air intake connectable to an external compressor, or simply an air intake connected to the outside atmosphere.

[0049] In the embodiment shown in figure 11, on the filter cleaning device a known solenoid-type motorized filter shaker 18 is fitted, for each filter 5, in parallel with the piston 12.

[0050] Said motorized filter shaker 18 is controlled by the control unit at the same time as the respective solenoid valve 7 and, during the passage of the secondary reverse air jet F', produces a mechanical cleaning action, thanks to an alternating vertical translation movement of a striking mass adapted to repeatedly strike the top surface of the respective filter 5 on which it is fitted, causing the shaking of said filter and thereby helping to remove the dust.

[0051] According to the invention, during normal operation of the vacuum cleaner, the primary flow of dust-laden air F passes through the filters 5 to the vacuum chamber 3 through the ports 11 and is then emitted clean to the outside atmosphere through the turbine 2.

[0052] During the cyclical cleaning operation of the filters 5, the control unit is pre-set to feed pressurized air F' into the manifold 14, into the emission ducts 8 and into the sleeves 9, by activating the compressed air feed means 6 connected thereto.

[0053] Said control unit, controlling the cyclical opening of the solenoid valves 7, simultaneously also activates the blower 17 that draws air in from the outside and introduces it under pressure into the emission ducts 8, to which the device sleeves 9 are connected.

[0054] The secondary reverse air jet F' thus generated pushes each piston 12 in turn downwards inside the respective sleeve 9, as shown in figures 4 and 5.

[0055] As it descends, the piston 12 compresses the spring 15 and its cylindrical body causes the ports 11 to close, so that all the reverse air jet F' is directed inside the filter 5 without any dispersion.

[0056] In particular, the passage of the reverse air jet F' inside the sleeve 9 goes through the holes 13 provided in the head 12' of the piston.

[0057] Once the filter 5 has been cleaned, the control unit closes the respective solenoid valve 7, the pressure on the piston head 12' decreases and, consequently, the piston 12 rises as a result of the thrust from the helical spring 15, as shown in figures 6 and 7.

[0058] The rising piston 12 re-opens the ports 11 and the filter 5 is placed under vacuum conditions once again by being re-connected to the suction chamber 3.

[0059] If the motorized filter shaker device 18 is also present, the control unit activates it at the same time as the respective solenoid valve 7 is opened, and the cleaning action of the filter 5, generated by the secondary reverse air jet F', is increased by the mechanical action of striking and vibrating the motorized filter shaker 18.

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- EP1464266A1 [0006]
- US4007026A [0009]

Patentkrav

1. Støvsuger (1) med tilbagestrømsluftstråle-filterrengøringsindretning omfattende:

- sugningsorgan (2) af kendt type associeret med et vakuumkammer (3) og aktiveret af en styringsenhed;
- patronfilterorgan (5) til at filtrere en primær strømning af støvfyldt luft (F) forbundet til vakuumkammeret (3);
- inddæmningsorgan (4) til at indeholde støvet suget op og tilbageholdt af filterorganet,

hvor tilbagestrømsluftstråle-filterrengøringsindretningen omfatter:

- tilføringsorgan (6) til at tilføre en sekundær tilbagestrømsluftstråle (F');
- udledningskanaler (8) forbundet til tilføringsorganet (6);
- solenoidstyringsventiler (7) associeret med udledningskanalerne (8) og som kan blive selektivt aktiveret af styringsenheden,

kendetegnet ved at filterrengøringsindretningen omfatter hylstre (9), forbundet mellem udledningskanalerne (8) og patronfilterorganet (5), og hvert hylster (9) omfatter en flerhed af udgange (11) indrettet til at placere det indre af hylsteret (9) i forbindelse med vakuumkammeret (3) for at sikre sugning af den primære strømning af støvfyldt luft (F), hvor hylsteret (9) omfatter bevægeligt organ glideligt associeret dermed, indrettet til reversibelt at lukke udgangene (11) under rengøring af filterorganet (5) og til samtidig at tillade passagen af den sekundære tilbagestrømsluftstråle.

2. Støvsuger (1) med tilbagestrømsluftstråle-filterrengøringsindretning ifølge krav 1, **kendetegnet ved at** det bevægelige organ omfatter et stempel (12), som glider i hylsteret (9) som et resultat af stødet fra den sekundære tilbagestrømsluftstråle (F'), mod påvirkningen af elastisk tilbageføringsorgan, for at forårsage, igennem dens alternerende bevægelse, åbningen og lukningen af udgangene (11), hvor stemplet (12) er tilvejebragt på dets hoved (12') med en flerhed af huller (13), indrettet til at tillade passagen af den sekundære tilbagestrømsluftstråle (F') mod filterorganet.

3. Støvsuger (1) med tilbagestrømsluftstråle-filterrengøringsindretning ifølge krav 1, **kendetegnet ved at** hylsteret (9) er associeret med filterorganet ved hjælp af en elastomer-type lufttæt pakning (10).

4. Støvsuger (1) med tilbagestrømsluftstråle-filterrengøringsindretning ifølge krav 2, **kendetegnet ved at** det elastiske tilbageføringsorgan omfatter en spiralfjeder (15) koaksial med hylsteret (9), anbragt mellem hovedet (12') af stemplet og en ring (16) fastgjort til et mellemliggende afsnit af hylsteret (9).

5. Støvsuger (1) med tilbagestrømsluftstråle-filterrengøringsindretning ifølge krav 1, **kendetegnet ved at** organet (6) til at føre den sekundære tilbagestrømsluftstråle (F') omfatter en blæser (17) styret af styringsenheden og placeret i forbindelse med den udvendige atmosfære fra hvilken den trækker luft til at føre den til udledningskanalerne (8) igennem en distributionsmanifold (14).

6. Støvsuger (1) med tilbagestrømsluftstråle-filterrengøringsindretning ifølge krav 1, **kendetegnet ved at** filterorganet omfatter en flerhed af patronfiltre (5) forbundet i parallel med vakuumkammeret (3) og med distributionsmanifolden ved hjælp af hylstrene (9).

7. Støvsuger (1) med tilbagestrømsluftstråle-filterrengøringsindretning ifølge krav 1, **kendetegnet ved at** den omfatter mindst en motoriseret filterryster (18) styret af styringsenheden, sammen med solenoidventilerne (7), omfattende en slagmasse indrettet til at slå filteret (5) for at udøve en mekanisk rystehandling.

DRAWINGS

Fig. 1

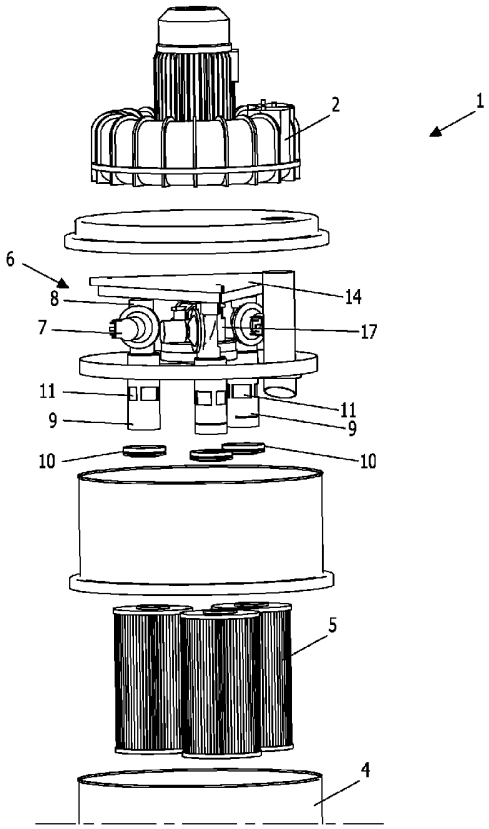

Fig. 2

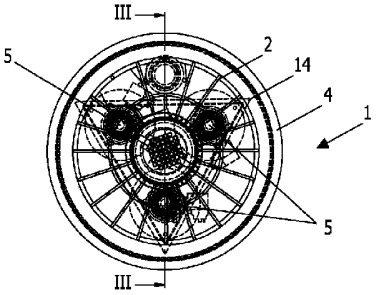

Fig. 3

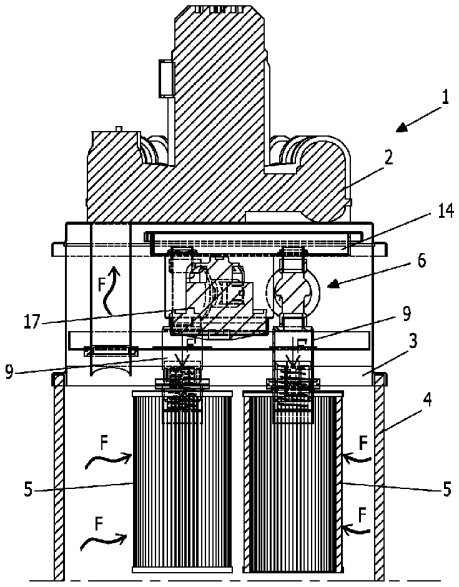

Fig. 4

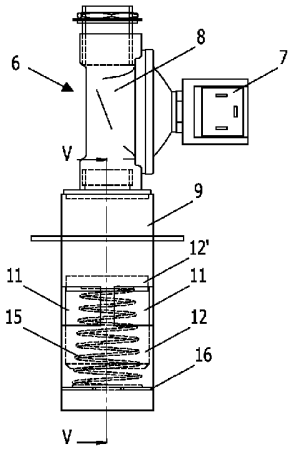

Fig. 5

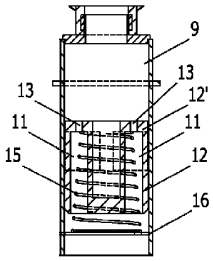

Fig. 6

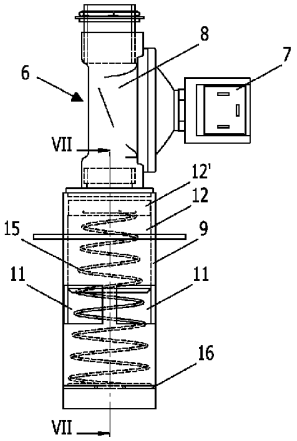

Fig. 7

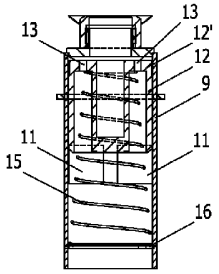

Fig. 8

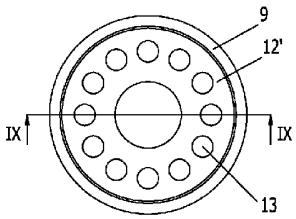

Fig. 9

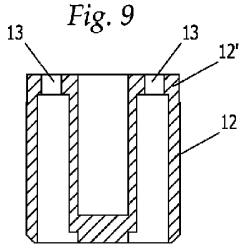

Fig. 10

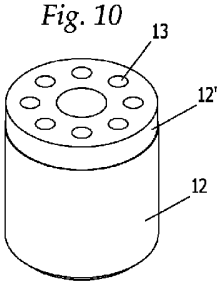

Fig. 11