(54) Title: A COMPACT FILTER BASED DUST COLLECTOR FOR HAZARDOUS DUST

(57) Abstract: This invention relates to a back-flushable dust collector for collection of hazardous dust, for example asbestos and silica dust. One major disadvantage with existing filter technology is that a filter arrangement needs a bulky stand-alone pre-separator and the handling of the contaminated filter media exposes the persons involved for very dangerous dust. The present invention solves this by integrating a filter body (1) containing a filter media (6), inside a cyclone body (17) in such a way that most of the coarse dust is trapped in an outer dust chamber (20) and never reaches the filter media (6). The fine dust is then trapped by the filter media (6) and is back flushed into a dust chamber (12) and finally both dust chambers (20) and (12) are emptied into one common dust bag (14), or separate dust bags (14a, 14b), where the dust bag (14) or (14b) also acts as a seal between the two chambers. The invention is mainly used where the dust load is heavy, for example in rock-drilling and concrete machining.

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A compact filter based dust collector for hazardous dust

This invention relates to a back-flushable dust collector for hazardous dust, for example asbestos and silica dust, with an integrated pre-separator function.

Today, the majority of dust collectors are based on some kind of filter technology with a filter medium consisting of socks, or so-called folded cartridge filters, usually integrated in a container with an inlet similar to a tangential cyclone inlet. One major disadvantage with the above filter technology is that the handling of the contaminated filter media exposes the area and persons involved for very dangerous dust, for example asbestos and silica. In concrete floor grinding it is common that the dust collector filter is clogged and most of the dust is left on the floor and the operator, who is paid per square meter, starts cleaning the filters by hand, either by shaking the filter media against the floor or with some tool. Quite a messy job. Some dust collectors of prior art, has a cleaning option called depression valve, which usually consists of a lever the operator can use repeatedly to release the vacuum and hopefully make the dust cakes fall of the filter media. This method is obsolete and just delays the final cleaning of the filter media, as described above. A better method is back-flushing with compressed air, which has shown to be able to keep a cartridge filter at a constant pressure drop. However in the floor grinding sector, you can not expect to have access to compressed air out on working sites and customers do not want to handle big compressors. Another problem is that the filter media is overloaded with dust, for example in floor grinding, causing the need for an extra pre-separator device relieving the filter media from too much dust load.

The present invention solves at least some of the problems mentioned above by having the features stated in claim 1.

Examples of embodiments of the invention are shown in Figure 1-3, described below.

Figure 1A is a side view of the dust collector, with one dust bag, configured according to an exemplifying embodiment of the herein disclosed technology in an operating configuration.
Figure 1B is a side view of the dust collector, with two dust bags, configured according to an exemplifying embodiment of the herein disclosed technology in an operating configuration.

Figure 2 is a top plan view of the dust collector of Figure 1.

Figure 3 is a side view of the dust collector equipped with two dust bags, configured with a top mounted fan, according to an exemplifying embodiment of the herein disclosed technology in a switched off and back flushed configuration.

Detailed description

The present invention utilize a dust collector solution that eliminates the problem of exposure people to dangerous dust, through dividing the dust collector into one permanent fixed clean part and one dismountable contaminated part, which can be changed without the risk for any exposure to the environment. The so-called contaminated part can then be cleaned and reloaded with a new filter in a special room or device intended for this purpose. Alternatively, the contaminated part may be designed and made of a disposable material, so the whole contaminated part may be disposed of after use and be replaced with a new one.

Such a filter based collector intended to catch also the smallest and most dangerous particles, should not be exposed to large amounts of dust, since the filter part clogs very fast and needs to be cleaned, which slow down the work. Previously, this has been solved by protecting the collector by a stand-alone pre-separator unit, usually some type of cyclone, taking approximately 85% of the dust. However for small and medium sized dust collecting appliances this is too bulky and costly to meet the market demand. The present invention solves this by integrating a particle filter inside a cyclone, forming a compact unit. Depending on the efficiency of the cyclone and amount and type of dust, the filter media has to be cleaned in certain intervals, in order to reduce the increased pressure resistance over it, which eliminates the sucking force of the system. One example of a context where a dust collector according to the invention could be applied is, for exemple in association with concrete floor grinding. Such a collector system, according to the invention, can be designed as follows.
A dust collecting system for floor grinding

In the above example the particle filter is integrated with the pre-separator into one compact unit, while the fan is stand-alone. However in other embodiments, the fan could also be integrated into the same unit e.g. in order to save cost and for better handling characteristics. Typically a prior art dust collecting system, comprising a stand alone collecting cyclone as pre-separator, shows 3kPa constant pressure drop over the grinding machine and hose, 1 kPa over the collecting cyclone pre separator and 1 kPa over a clean high efficiency filter media and up to 3 kPa over a clogged one, that needs to be cleaned. In the present invention the filter media cleaning is done by means of back-flushing with compressed air. In the case of a movable dust collector for floor grinding, a small mini-compressor is fitted to the unit, feeding compressed air to a pressure vessel integrated into the dust collector or immediately on the outside, in order to deliver an instant powerful shock wave into the filter media arrangement, for example a cartridge filter, which cleans the filter and deliver the dust cakes down to a dust container with two chambers or two separate dust bags, one for the cyclone and one for the filter unit.

Different strategies can be used to choose the number of flushes and the interval between them, for example the pressure drop after the filter or over the filter can activate the back-flush procedure. A small PLC computer controlling the back flushes, can then check if the flushes were effective and if not, flush some more and/or make the cleaning more effective by releasing the pressure difference over the filter media, via a relief or block valve for a short while, when the system back flushes. For normal light floor grinding it is normally enough to back flush e.g. twice a minute and then once when the operator stops the fan and the vacuum just is disappearing, but before the dust bag is removed.

In a dust collector system suitable for floor grinding the PLC can also control the electric phase order and if found wrong correct the order, so the fan will suck and not cause a blow out of dust. Further the PLC can monitor, direct or indirect via the current, the temperature in the fan & motor and stop the fan when a specific temperature is reached. Overheating is a common failure cause in the working field.
An exemplifying dust collector, in a version with two dust bags, illustrated in figure 1b, comprises an outer cyclone body 17, which internally contains a filter media 6 integrated into a filter body 1. The dusty gas first enters an outer inlet 18, preferably tangentially connected to the cyclone body 17 and preferably pointing downward, whereby the major part of the dust swirls down towards an outer dust chamber 20, in some cases with the help of a spiral vane 19a to 19c, mounted inside the cyclone body 17. The now partially cleaned gas, then turns up and enters the integrated filter media 6 through one or several inlets 2, which preferably are tangential in relation to the nearby main flow direction.

The filter body 1 represents one part of the dust collector which is contaminated with dust particles. Further connected to the filter body 1 is an outlet chamber 3, representing a clean side of the dust collector, having an outlet 4 for cleaned fluid. The contaminated part of the dust collector can be separated from the clean part by releasing a coupling 5. This coupling could be e.g. a V-clamp or similar.

Inside the filter body 1, the filter media 6, which may be conical or straight, is arranged and fixed with a centric shaft 7 in a way such that the filter media 6 form a barrier between the contaminated and the clean side of the dust collector, by means of a bottom sealing plate 8 and a sealing device 16 in an upper plate with spokes 9 in the center, letting the clean fluid pass up in an outlet chamber 3 and further to the outlet 4.

The outlet chamber 3 is connected to a pressure vessel 10, containing a compressed gas, for example air and is communicating with the clean part of the filter media 6, via a valve 11 and a high velocity nozzle part 15 containing one or several nozzles, which clean the filter media 6 through back flushing it from the inside with high velocity gas bursts.

As mentioned above the dust enters the filter body 1 through the inlet 2 and is then trapped by the filter media 6. It is here implicitly understood that the outlet 4 is connected to a suction device, such as a fan or some other device driving the flow through the dust collector.

After some time of operation, the filter media 6 will be covered with a dust layer and the pressure drop over the filter media 6 will go up and it is time to clean the filter media 6 by one or more back flush gas bursts. This can be done during operation, but is preferably done after the flow is shut off, which is more effective, whereby the dust falls down into a dust chamber 12 and further down through a dismountable grit device 13b into a dust bag or lock.
dovico 14b, or a tight dust canister compartment. Here the dust bag 14b can be replaced by a lock device, e.g. a flexible rubber tube, fulfilling both a locking function under normal running conditions and also a dust emptying function into the dust bag (14a) in a switched off condition.

The dust collected in the outer dust chamber 20, then in a switched off condition, falls through another dismountable grit device 13a into a dust bag 14a or a tight dust canister compartment. During normal operation both dust bags are sucked up against the grit devices 13a, 13b, with the already collected dust still in the dust bags 14a, 14b. Thereby the bag 14a creates a lock and seal against the atmosphere by blocking the grit 13a and further the bag 14b creates a lock and seal between the two dust chambers 12 and 20 by blocking the grit 13b. This is important since dust chamber 12 has a lower static pressure than dust chamber 20 and a leak over of dust must be avoided.

Another exemplifying embodiment of the invention can have a fan unit 21 integrated in the design. That is, the fan can form part of the dust collector instead of being a stand-alone unit. An example of such an embodiment with an integrated fan is illustrated in figure 3. The cleaned gas then leaves the outlet chamber 3 by, means of the fan 22 driven by a motor 23, through an outlet 24. In this embodiment the pressure vessel 10 is moved from its top position, preferably to a side position. The valve 11 and the high velocity nozzle part 15 are in this embodiment fixed to the centric shaft 7, in order to take up the reaction force from the air bursts.
Claims

1. A filter based dust collector with an integrated pre-separation function, consisting of an outer cyclone body (17) acting as a pre-separator, which internally contains a filter media (6) integrated into a filter body (1), with inlet (2) for contaminated gas and an outlet chamber (3) with an outlet (4) for cleaned gas. The filter media (6) is dividing the dust collector flow paths into a clean and a contaminated side and the outer cyclone body (17) having an outer inlet (18), communicating with the inlet (2), characterized by having a dust collecting function by means of one grit (13) or two grits (13a, 13b).

In case of one grit, this grit (13) is serving both an outer dust chamber (20) and a dust chamber (12), both connected to one common dust bag (14), which together with the grit (13), fulfills a lock function to the atmosphere and also between the two dust chambers (20) and (12). In case of two grits, the grit (13a) serves the outer dust chamber (20), connected to the dust bag (14a) and the grit (13b) serves the dust chamber (12), connected to the dust bag (14b). Further the grit (13a) together with the dust bag (14a) fulfills a lock function to the atmosphere and the grit (13b) together with the dust bag (14b), fulfills a lock function between the two dust chambers (20) and (12).

2. A filter based dust collector according to claim 1, characterized by that the dust bag (14b) is replaced by a lock device, e.g. a flexible rubber tube, fulfilling both a locking function under normal running conditions and also a dust emptying function into the dust bag (14a) in a switched off condition.

3. A filter based dust collector according to claim 1 or 2, characterized by the possibility to separate the clean and the contaminated sides from each other without anyone coming into contact with the collected dust, by releasing a coupling (5).

4. A filter based dust collector according to any of the preceding claims, characterized by the whole contaminated side is made in a low cost disposable material and can be disposed according to regulations regarding handling of hazardous material.

5. A filter based dust collector according to any of the preceding claims, characterized by a back-flush arrangement consisting of a valve (11),
communicating with an integrated pressure vessel (10) on one side and a high velocity nozzle part (15) on the clean side of the filter media (6).

6. A filter based dust collector according to claim 5, characterized by that the valve (11) is controlled by a programmable PLC-controller, adapting the back-flushing frequency to the pressure difference build up over the filter media (6).

7. A filter based dust collector according to claim 6, characterized through that the PLC-controller also control a relief valve or a blocking valve, eliminating the pressure difference over the filter media a short while, when the filter media is back flushed.

8. A filter based dust collector according to claim 6 or 7, characterized by the PLC-controller is used in making the system fail safe through controlling both a star-delta starting of the fan and the phase order in the power socket and correct the order if wrong and also controlling the fan and motor temperature, direct or indirect via the current and stop the motor before it overheats.

9. A filter based dust collector according to any of the above claims, characterized by the inlet (2) consists of two or more openings, in order to spread out the dust around the filter media (6).

10. A filter based dust collector according to any of the preceding claims, characterized by the inlet (2) having at least one opening, tangential oriented in order to create extra cyclonic effect and relieve the filter media (6) from dust overload in the vicinity of the inlet (2).

11. A filter based dust collector according to any of the above claims, characterized by the filter media (6) having a bigger diameter in the end close to the inlet (2), which speeds up the gas flow giving a better dust distribution over the filter media (6).

12. A filter based dust collector according to any of the above claims, characterized by having a spiral vane (19a), (19b), (19c) going from a position (19a) above the outer inlet (18) and extending downward to a position (19c) in the outer dust chamber (20), forcing the dust particles collected against the inner wall of the cyclone body (17), to slide downwards against the inner wall towards the outer dust chamber (20), at the same time the particles are shaded by the vane and not affected by the upward going gas flow aiming the inlet (2).
INTERNATIONAL SEARCH REPORT

PCT/SE2013/000168

A. CLASSIFICATION OF SUBJECT MATTER

IPC: see 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: B01 D, B04C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE, DK, FI, NO classes as above

Electronic database consulted during the international search (name of database and, where practicable, search terms used)

EPO-Internal, PAJ, WPI data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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International Patent Classification (IPC)

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