DEVICE FOR COLLECTING DUST PARTICLES OR RESIDUAL MATERIAL IN AN AIRFLOW

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ABSTRACT
The invention relates to a device for collecting particles in an airflow, comprising a casing (2) with a vacuum chamber (4) arranged at the top of the casing, which vacuum chamber has a connection (10) to a vacuum source and is connected to a cyclone device (6) for separating and transporting the particles from the airflow to a collection drum (8) arranged at the bottom of the casing. Said cyclone device (6) has an inlet (11) for the particle-containing airflow and an outlet (18) leading to the collection drum (8). A bag (22) can be attached to said outlet (18) in the collection drum (8) which has a casing (30), which can be closed off (32) in such a way that it provides a seal against the atmosphere around such an attached bag (22). Said vacuum chamber (4) is connected to the collection drum (8) via a duct (36), whereby a first pressure is created in a space between the casing (30) of the collection drum and the outside of the bag, and there is a second relatively higher pressure on the inside of the bag so that a pressure difference is created, by means of which the bag (22) is pressed into contact with the walls (24) and bottom (26) of the collection drum.
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[0001] The invention relates to a device for collecting particles that are generated, for example, during abrasive processes of various kinds, for example dust particles that are released during sanding using sanding machines or during handling of residual material and the like. By means of the invention, all kinds of dry residual material can generally be collected up, including residual material that is generated in, for example, joineries or hairdressing salons.

[0002] Residual material is generated and/or handled in many work elements that are carried out on a building. These work elements can be cutting, drilling, cleaning (light/heavy), decontamination, various kinds of sanding including sanding floors, handling of demolition materials such as joint fillings and excavated material from cellars, etc. Residual material can contain anything from pieces of wallpaper, fine cement dust, nails and screws to bricks and pieces of concrete, and thus comprises both material that can be sucked up and material that cannot be sucked up. What is common to all residual material is that it forms dust and can thereby cause the dispersal of particles of material that are harmful to health.

[0003] An arrangement with a tube-shaped filter in combination with a cyclone device is already known as a coarse filter for a first filtration with the removal and collection of the largest particles of dust in a collection device of the type described above. Remaining particles are then collected by means of additional filters, such as fine filters, microfilters or absolute filters. Collecting means of this type are often constructed with a cone that has a valve or a trapdoor in the bottom that is opened after the vacuum that is present in the cone while it is in operation has been switched off. The particles then fall down into a bag or a tubular bag system and as a rule the bag is changed and the filter is cleaned when the emptying is carried out.

[0004] A reason for the arrangement with the valve or trapdoor is to avoid the danger of the bag being sucked up into the cone and imploding. A disadvantage of this solution is, however, that the capacity of the collecting means is dependent upon the volume of the cone. When the cone is full, it is necessary to switch off and allow it to empty. If the cone has a greater volume than the bag, there is no room for the particles of dust and spillages then often arise when the bag is to be changed. This is not acceptable for reasons of health, in particular if the dust includes particles of harmful substances such as asbestos, silica or PCB. It is also difficult to know how much dust is in the cone prior to switching off the vacuum in the cone. Similarly, it can be difficult to empty the cone after sucking up certain materials such as dust from sanding wood or grinding concrete, which can be due to the dust being statically charged or can be due to the dust having been compacted in the cone by the vacuum.

[0005] The object of the invention is therefore to achieve a device of the kind mentioned in the introduction that makes it possible to solve the problems described in the introduction. This is possible with a device of the kind described in the introduction that has the characteristics that are described in the following patent claims. Advantageous further developments and improvements of the invention are apparent from the description and the independent claims.

[0006] Examples of embodiments of the invention are described in the following with reference to the attached schematic drawing. The figure shows a vertical view in cross section through the device for collecting particles according to the invention, with an extraction duct extending between the collection drum and the vacuum chamber/distribution box.

[0007] According to a first embodiment, the collecting means is constructed of a casing 2 designed as a vertical box or cylinder with a suitable cross section, which, starting at the top, comprises a vacuum chamber 4, which, in turn, is connected where applicable via a coarse filter package 5 to a cyclone device 6 and a collection drum 8 for depositing dust particles in a bag. The bag can, for example, be constructed as a plastic filter bag in a tubular bag system. The collecting means can be constructed of metal, for example steel or aluminium, or of plastic material, for example glass-fibre reinforced plastic or other suitable material.

[0008] For all filtration comprising, as in this case, coarse filtration, a large filter surface is desirable while at the same time there should be little risk of the filter blocking, that is the filter should have a long life. Folded paper filters have a large filter surface but they block relatively quickly, due to the filter surface becoming smaller as the folds fill with fine dust. Cleaning is inconvenient and can be difficult to carry out without damaging the filter. Conventional filter bags are usually completely cylindrical with a circular cross section and filtration can be carried out either inwards or outwards. As such a filter bag has smooth filter surfaces, it is less subject to becoming blocked.

[0009] The vacuum chamber 4 can therefore be designed as a distribution box for a coarse filter package 5 of conventional type connected between the distribution box and the cyclone device, which coarse filter package contains a suitable number of known single-wall filter cartridges 9 or cloth filter bags 9 of already known type attached either at the top or at the base. At the top of the casing 2, the vacuum chamber 4 has a connection 10 to a vacuum source (not shown), either a direct-mounted motorized fan with control unit and fine filter in the form of a microfilter or absolute filter, or an external dust extractor with filter, which is connected via pipes or hoses. The connection 10 to the vacuum source is only shown centrally arranged on the vacuum chamber 4 in the drawing as an example, and it is possible to arrange it in any position, including on the side of the casing 2, provided that the connection is located on the “clean” side, that is the outlet side of the coarse filter package. The coarse filter package 5 can either be incorporated in the vacuum chamber 4 or can be arranged in the external dust extractor.

[0010] The cyclone device 6 has a tangential inlet 11 on one side of the casing 2 in the conventional way to achieve a cyclone effect in association with a cone arrangement connected to the inlet to bring about the separation and collection of particles. The cone arrangement has, however, two interacting cones. A first cone 12 with a relatively large conical angle, in the embodiment illustrated an upper cone 12, the lower narrower part of which, that is suitably shaped as a cylinder with a circular cross section, constitutes a cyclone centre part 13, around which a cyclone funnel chamber 14 is constructed. The cyclone funnel chamber 14 is also suitably shaped as a cylinder with a circular cross section that is connected at the top to the external outer surface of the first cone 12 and becomes at the bottom a second cone 16 that tapers downwards with a relatively small conical angle, in the
embodiment illustrated a lower cone 16 that extends towards the collection drum 8 and opens out into the collection drum at an outlet 18. The lower part of the first cone 12 that faces towards the collection drum 8 opens out at its cyclone centre part 13 into the second cone 16 approximately on a level with the transition from the cyclone funnel chamber 14.

[0011] As a result of the special design of the cyclone funnel chamber 14 and the second cone 16 described above, particle-containing air is drawn in through the inlet 11 by the action of the vacuum from the connection 10 to the vacuum source and is caused to rotate quickly at an increased speed in comparison to a conventional cyclone. This means that the level of separation can be as high as between 95 and 98%, as a result of the majority of the dust particles in the air being concentrated on the inner surface of the cyclone funnel chamber 14 and the second cone 16 and falling down through the outlet 18. The airflow that is largely cleaned of dust particles and that now has only 2-5% of the particle content left, namely the finest dust particles, now goes upwards through the cyclone centre part 13 and into the first cone 12. As a result of the shape of the first cone 12 with a cross section that increases in the direction of the airflow until it joins the filter package 9, the speed and pressure of the airflow decrease, which airflow is distributed in a funnel chamber or distribution box thus formed between the first cone 12 and the filter package 9. By means of the airflow thereby going more slowly, a significant part of the fine dust is dropped in the first cone 12 (the funnel 12) and can fall down through the cyclone centre part 13 and the outlet 18. The dust that remains is trapped by the coarse filter package 5, when the airflow reaches and passes through the coarse filter package before the airflow leaves the collecting means through the connection 10 to the vacuum source (not shown). As described in our previous patent application 0401446-0 with the same inventor, and as will therefore not be described here in greater detail, cleaning of the coarse filter package 9 can be carried out in a corresponding way, as described briefly in the third paragraph from the end of the description. Accordingly the fine dust trapped by the coarse filter package 5 falls down from the coarse filter package 9 into the funnel 12 and leaves the funnel together with the remainder of the fine dust that was previously dropped in the funnel 12 and falls down through the cyclone centre part 13 and the outlet 18.

[0012] In the cone arrangement, concentrated dust particles thus fall down through the outlet 18 and through a known holder or a hopper 20 mounted in association with the outlet, to a bag 22 attached to the outlet 18 and arranged in the collection drum 8. The hopper can, for example, be designed to hold a conventional tubular bag of plastic film.

[0013] The collection drum 8 comprises a casing 30 formed by a wall arrangement 24, a bottom 26 and a lid 28, which is thereby sealed against the atmosphere around the bag 22 that is attached to the outlet. A door 32 that forms a seal is arranged in the casing 30 of the collection drum, in such a way that it can be opened and closed easily in a known way. The door is advantageously provided with a transparent window 34 or alternatively the whole door is constructed of transparent material, whereby it is possible to determine easily when it is time to change the bag 22.

[0014] The collection drum 8 is connected to the vacuum chamber 4 via a duct, for example an extraction duct 36. The duct 36 can be designed in a suitable way on the inside of the casing 30, for example as a hose or a pipe, for example of metal or plastic of a particular diameter. The duct has a pre-
determined diameter that affects the speed of the procedure described below. Tests have shown that a suitable diameter of the duct 36 should as a rule lie within the range 15-30 mm in order to ensure a reliable function for the most common sizes of collecting means. The duct makes it possible to create a lower pressure on the outside of the bag than on its inside, which in turn means that the bag is pressed towards the wall arrangement 24 and bottom 26 of the collection drum 8 as a result of the higher pressure inside the bag, so that the dust particles can fall directly down to the bottom of the bag without obstruction.

[0015] There is thus a first pressure in the space between the casing 30 of the collection drum and the outside of the bag 22 and a second relatively higher pressure on the inside of the bag, so that a pressure difference is created, by means of which the bag 22 is “blown up” and is pressed into contact with the wall arrangement 24 and bottom 26 of the collection drum. By this means, a trapdoor arranged at the bottom of a conventional cone can be omitted, which trapdoor could only be opened when the vacuum in the cone ceased, that is, according to conventional technology, the collecting means first had to be switched off before emptying of the cone could be carried out (not shown). Due to the fact that, according to the invention, the dust particles can fall straight to the bottom of a bag instead of first being accumulated in the cone that is smaller in volume; it is possible to obtain a longer operating time between the occasions when emptying is required.

[0016] According to an embodiment, the container or hopper 20 for a conventional tubular bag of plastic film (not shown) is mounted in such a way that it surrounds the outlet 18. By this means, it is possible to utilize the pressure difference between the first pressure and the second pressure, not only to press the bag against the wall arrangement 24 and bottom 26 of the collection drum, but also to draw out a new plastic film from the hopper automatically when a filled plastic film bag has been closed, separated off and removed from the collection drum 8 through the door 32 in the conventional way.

[0017] Drawing out of the plastic film tube is carried out in such a way that the plastic film tube that is closed at its free end during closing of the filled bag, is “blown out” from the hopper 20 after closing of the door 32 and continues to be drawn out until it forms a new bag 22 that is pressed toward the wall arrangement 24 and bottom 26 of the collection drum and is ready to be filled with dust particles.

[0018] An important advantage of the collecting means according to the invention is that the whole of this procedure comprising closing, separating and removal of a filled bag and drawing out of the plastic film tube so that it forms a new bag for continued collection can be carried out essentially without any spillage of dust particles. That is, practically all the particles are enclosed by means of the tubular bag system so that the risk of harmful substances escaping into the surroundings are reduced to a minimum.

[0019] As described in our previous patent application 0401446-0 with the same inventor, the inlet to the cyclone funnel chamber 14 can be provided with a first valve or shutting-off valve 38. Where applicable, a second valve or separating valve 40 can be arranged in the connection 10 between the fine filter and the vacuum chamber of the distribution box on the outlet side of the coarse filter package, which second valve can be closed to separate the fine filter from the coarse filter package 5. Similarly, for carrying out cleaning of the filters, the distribution box or vacuum cham-
ber 4 can be provided with a third valve or atmospheric air valve 42 for admitting atmospheric air, mounted in such a way that it is directed towards and/or admits atmospheric air to the outlet side of the coarse filter package 5.

[00020]  For certain special purposes, the coarse filter package 5 and/or the cyclone device 6 can be omitted, whereby the collection drum 8 can be used separately, for example when it is just a matter of sucking up and handling residual material such as, for example, hair clippings in hairdressing salons or wood chips in joineries. In addition, the collection drum 8 can, of course, be combined with any filter units and/or cyclone devices of varying designs.

[00021]  Similarly, for certain additional purposes, the collection drum 8 can instead be omitted completely or can have a different function, in cases when, for example, the cyclone device is provided in a conventional way with a valve or hatch that is opened manually or automatically for emptying into a tubular bag system or into a container of another kind, when the collecting means is switched off. The advantages of the arrangement described above with the coarse filter package 5 and cyclone device 6 for filter cleaning and concerning the handling of fine dust can also be utilized here.

What is claimed is:

1. A device for collecting dust particles or residual material in an airflow, comprising a casing with a vacuum chamber arranged at the top of the casing, which vacuum chamber has a connection to a vacuum source and is connected to a cyclone device for separating and transporting the particles from the airflow to a collection drum arranged at the bottom of the casing, which cyclone device has an inlet for the particle-containing airflow and an outlet leading to the collection drum to which a bag can be attached and the collection drum has a casing, comprising walls and a bottom, which can be closed off, in such a way that it provides a seal against the atmosphere, around such an attached bag, and it is the case that the vacuum chamber is connected to the collection drum via a duct, whereby a first pressure is created in a space between the casing of the collection drum and the outside of the bag, and there is a second relatively higher pressure on the inside of the bag so that a pressure difference is created, by means of which the bag is pressed into contact with the walls and bottom of the collection drum, and further wherein a hopper for a tubular bag is mounted in such a way that it surrounds the outlet, from which hopper the tubular bag can be drawn out automatically, after closure of its free end, by the action of the pressure difference between the first pressure and the second pressure until the tubular bag forms the bag that is pressed against the walls and bottom of the collection drum.

2. The device according to claim 1, wherein duct has a predetermined through-flow area.

3. The device according to claim 1, wherein the collection drum has a door that forms a seal.

4. The device according to claim 3, wherein the door is provided with a window.

5. The device according to claim 3, wherein the door is made of a transparent material.

6. The device according to claim 1, wherein the vacuum chamber is arranged in conjunction with a coarse filter package which, in turn, is arranged in conjunction with the cyclone device.

7. The device according to claim 6, wherein the vacuum chamber is designed as a distribution box for the coarse filter package, that is connected between the distribution box and the cyclone device.

8. The device according to claim 6, wherein the coarse filter package is incorporated in the vacuum chamber and is connected to the cyclone device.

9. The device according to claim 6, wherein the coarse filter package includes upright filter cartridges that are attached at the bottom.

10. The device according to claim 6, wherein the coarse filter package includes suspended cloth filter bags.

11. The device according to claim 1, wherein the cyclone device has a first cone that faces towards a coarse filter package with its upper part that has the larger diameter, which upper part is connected to the inside of the casing, and which first cone has a lower part that faces towards the collection drum, which lower part changes into a circular cylindrical part that forms a cyclone centre in a cyclone funnel chamber to which the tangential inlet leads, and in that the cyclone funnel chamber changes into a second cone, that extends towards the collection drum and opens out into the collection drum at an outlet, whereby it is possible to achieve a satisfactorily high degree of separation in the device.

12. The device according to claim 11, wherein the lower part of the first cone that faces towards the collection drum opens out with its cyclone centre part into the second cone approximately on a level with the transition from the cyclone funnel chamber.

13. The device according to claim 11, wherein the airflow is caused to move more slowly in a funnel chamber or distribution chamber formed between the first cone and the filter package, whereby a considerable part of the fine dust is dropped in the first cone and can fall down through the cyclone centre part and the outlet.

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