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(54) **VACUUM-CLEANER FILTER BAG FOR A HAND-HELD VACUUM CLEANER**

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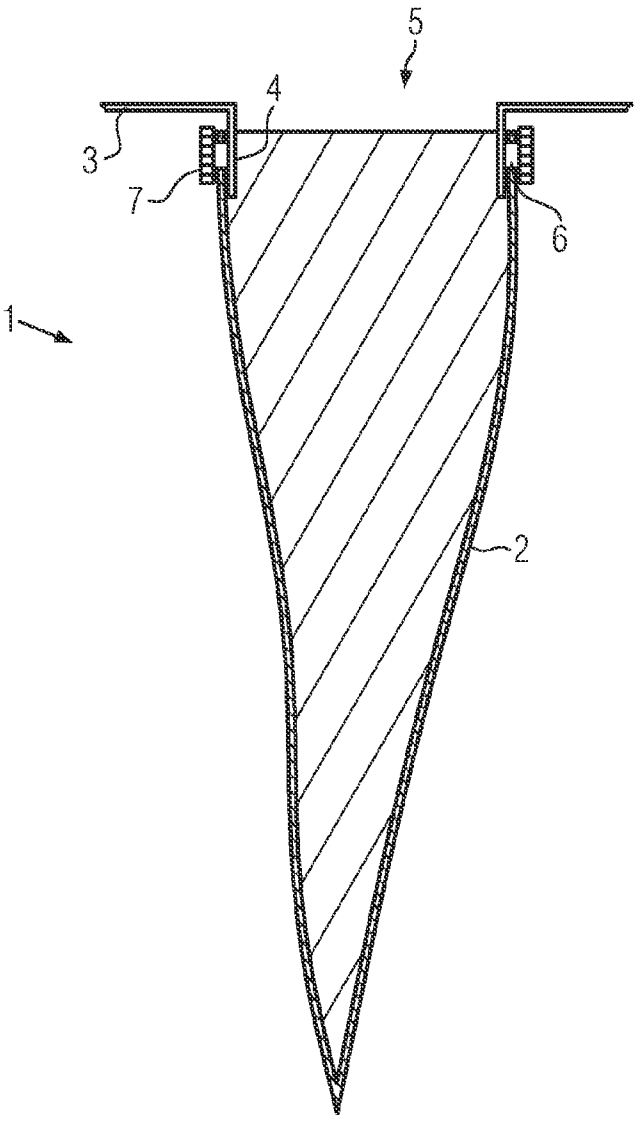
(57) **ABSTRACT**

The invention comprises a vacuum-cleaner filter bag (**1**) having a bag wall (**2**) and a retaining plate (**3**), the retaining plate (**3**) the retaining plate (**3**) comprising an least partially cylindrical connection piece (**4**) extending in the direction of the through opening (**5**) formed in the retaining plate (**3**), the bag wall (**2**) being connected to the lateral surface of the connection piece (**4**) along the periphery of the connection piece.



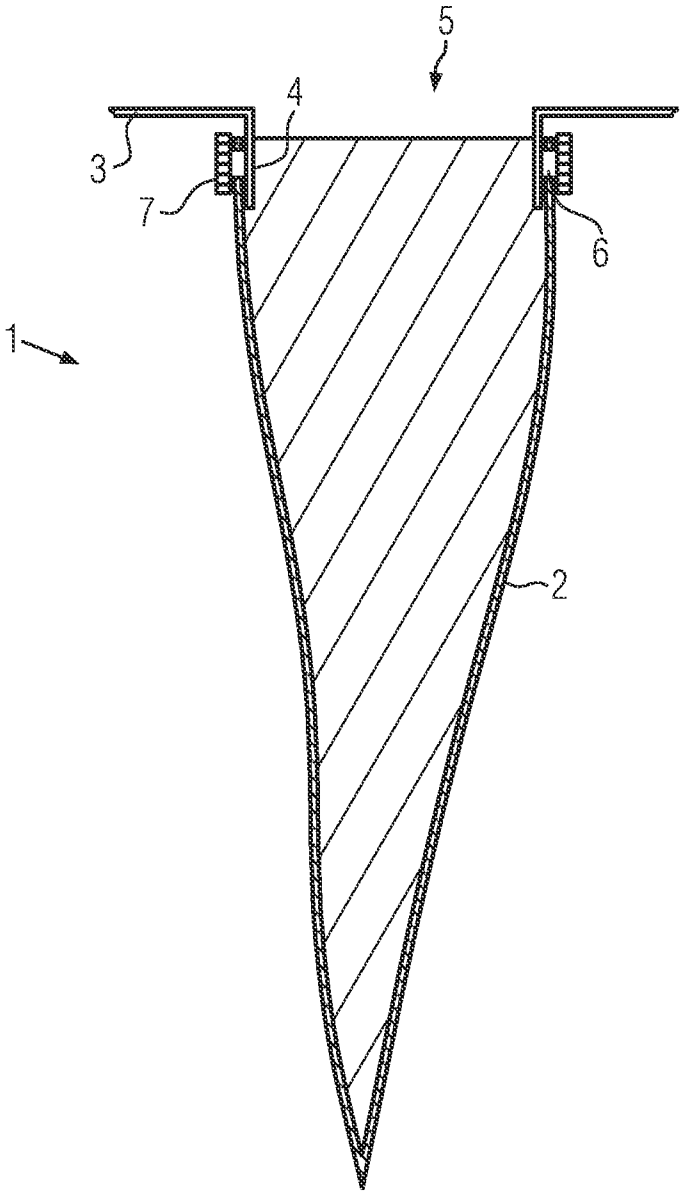


FIG. 1

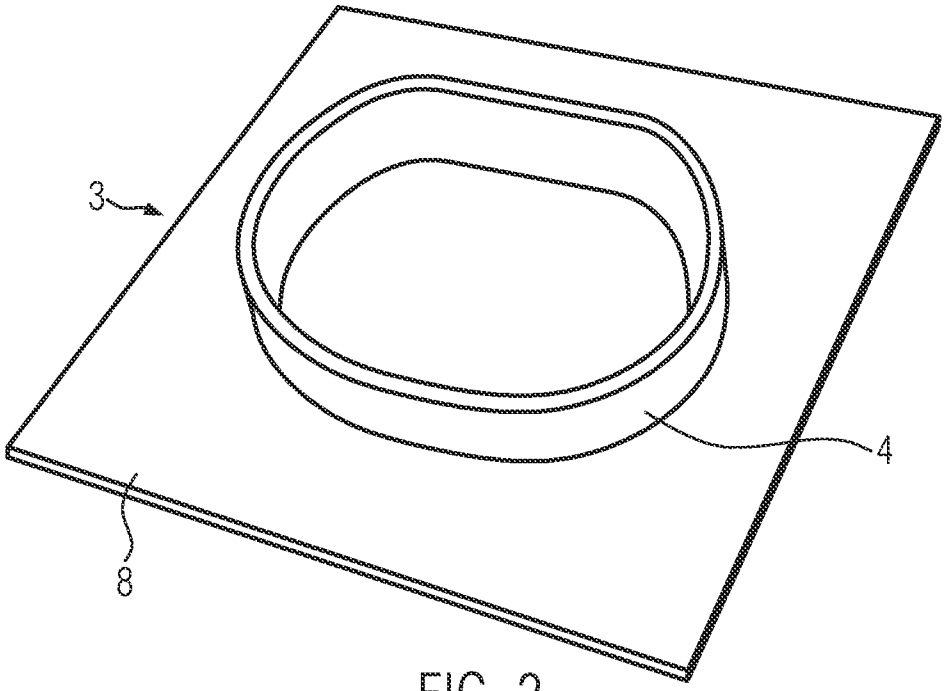


FIG. 2

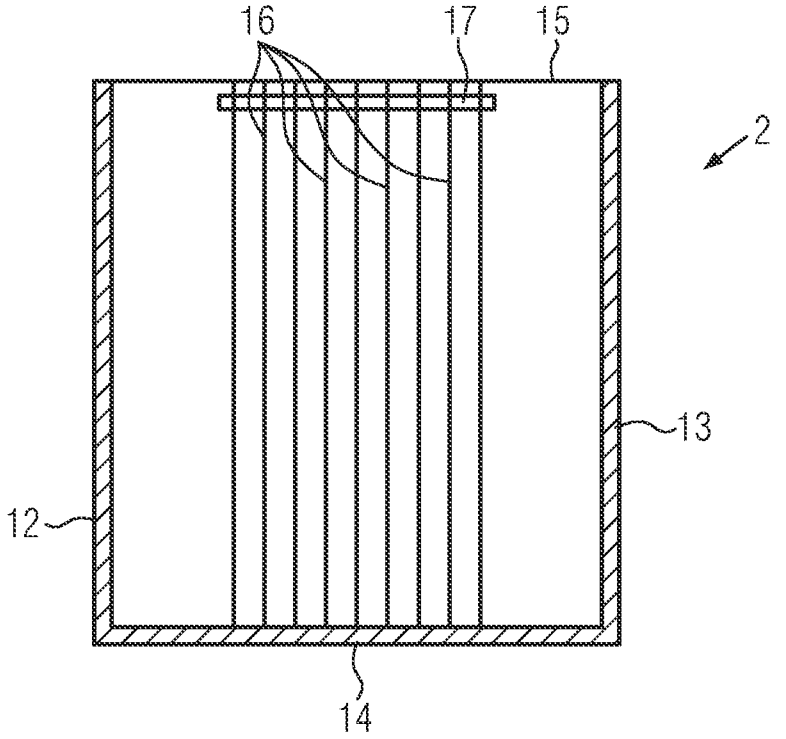


FIG. 3

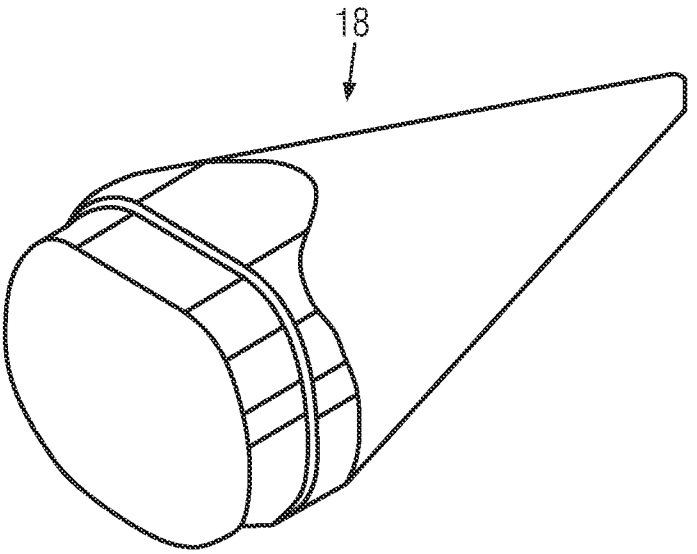


FIG. 4

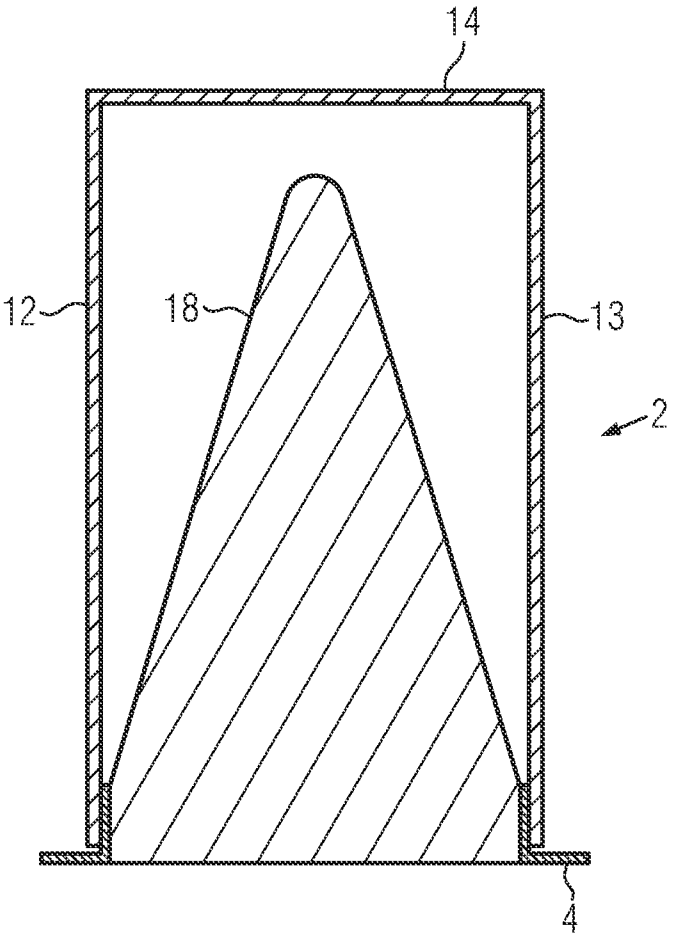


FIG. 5

VACUUM-CLEANER FILTER BAG FOR A HAND-HELD VACUUM CLEANER

[0001] The invention relates to a vacuum-cleaner filter bag, in particular a vacuum-cleaner filter bag for a hand-held vacuum cleaner and/or a so-called stick vacuum cleaner, in particular for cordless models.

[0002] Stick vacuum cleaners are usually, but not always, cordless devices (battery-powered vacuum cleaners) in which an electric brush is connected to the actual housing of the hand-held vacuum cleaner via a suction tube without a suction hose. These devices are very light and handy. The sticks have low input power in the range of about 150 to 600 W. The volume flows achieved are correspondingly low and are in a range of 10 to 30 l/s. The filter housing is typically cylindrical and has a small volume (about 1 to 2 liters). A cyclone separator is usually used as the filter. The cyclone separator accelerates the suction air and the particles contained therein. As a result, a considerable part of the available power is consumed and only little power is left for the generation of a sufficient volume flow. The cleaning effect (dust collection) is often unsatisfactory.

[0003] A filter bag made of modern nonwoven laminates fulfills the separation of dust in a much more energy-efficient way. However, it is difficult to produce a filter bag that fits optimally into the very small installation space available and provides sufficient filter surface.

[0004] Classic flat bags, in which two filter material pre-cuts are welded circumferentially and a retaining plate is connected planarly to one of the filter material pre-cuts, are usually unsuitable because the available installation space is too small. For this reason, bags with a bottom, such as a block bottom, have mainly been used up to now, in which the retaining plate is arranged on the bottom and the bag shape is adapted to the installation space (so-called "three-dimensional" bags). However, producing such bags, especially with a nonwoven material commonly used today, has proved difficult. As a result, manual manufacturing steps are still sometimes required in the production of such bags, which reduces manufacturing efficiency.

[0005] It is therefore the object of the invention to provide a vacuum-cleaner filter bag that can be produced simply and automatically, in particular a vacuum-cleaner filter bag for a hand-held vacuum cleaner and/or a stick vacuum cleaner, which can use the available installation space as optimally as possible.

[0006] This object is solved by a vacuum-cleaner filter bag according to claim **1**. Particularly advantageous further embodiments can be found in the dependent claims.

[0007] Thus, the invention provides a vacuum-cleaner filter bag comprising a bag wall and a retaining plate, the retaining plate comprising an at least partially cylindrical connection piece extending in the direction of the through-opening formed in the retaining plate, the bag wall being connected to the lateral surface of the connection piece along the periphery of the connection piece.

[0008] The fact that the bag wall is connected to the retaining plate via the at least partially cylindrical connection piece and to its outer surface along the lateral surface of the connection piece means that the time-consuming, and otherwise often only manually possible, formation of a bottom during manufacture can be dispensed with. As a result, the vacuum-cleaner filter bag according to the invention can be manufactured more efficiently.

[0009] The vacuum-cleaner filter bag can be provided in particular for hand-held vacuum cleaners and/or a so-called stick vacuum cleaner, especially for cordless models. The filling volume can therefore be between 0.5 and 3 liters, in particular between 0.5 and 2 liters, when fully unfolded.

[0010] The retaining plate of the vacuum-cleaner filter bag may be attached to a retaining means in a vacuum cleaner housing. This allows the retaining plate to be arranged, in particular fixed, in a predetermined position in the vacuum cleaner housing.

[0011] In contrast to a flat bag, in which the retaining plate is connected to a flat wall part of the bag wall, in the case of the manufacture of the vacuum-cleaner filter bag according to the invention, the bag wall, which is provided with a corresponding opening, is slipped over the at least partially cylindrical connection piece of the retaining plate and connected to its lateral surface. As a result, the vacuum-cleaner filter bag extends substantially parallel to the longitudinal axis of the connection piece and thus in the direction of inflow through the through-opening of the retaining plate into the bag. Thus, the vacuum-cleaner filter bag is also better adapted to the usual filter housings of hand vacuum cleaners and/or stick vacuum cleaners, which are typically cylindrical in shape, and which have the retaining means for the retaining plate on one of the top surfaces of the cylinder.

[0012] The at least partially cylindrical connection piece thus comprises the through-opening of the retaining plate so that an inflow opening is formed via which dust-laden air can flow into the interior of the vacuum-cleaner filter bag during operation. The longitudinal axis of the connection piece is defined herein as the direction in which the through-opening extends in the connection piece. In particular, this direction is perpendicular to the plane in which a connecting plate of the retaining plate is arranged, which is connectable to a retaining means of the vacuum cleaner.

[0013] "At least partially cylindrical" means that the connection piece comprises at least one section which is formed in the shape of a cylinder, i.e. defined by a lateral surface and two boundary surfaces. The cylindrical shape is not limited to a circular cylinder. The cross-section of the cylindrical section, i.e., the directrix of the general cylinder, may be of any shape. The cross-section of the cylindrical section may also be a polygon. In this case, one can also speak of a prism-shaped section. In particular, the cylindrical section may have the shape of a straight or perpendicular cylinder, with the generatrices extending parallel to the longitudinal axis of the connection piece.

[0014] The connection piece may comprise a second section, in particular adjacent to the cylindrical section, with an enlarged circumference compared to the cylindrical section. In particular, the second section may project outwardly beyond the lateral surface of the cylindrical section. This second section may correspond to the connecting plate of the retaining plate or be part thereof.

[0015] The connecting plate may in particular be a flat component, in particular with its extension in two directions (length, width) being substantially greater, in particular at least three times greater, than in a direction perpendicular thereto (thickness). The connecting plate may in particular completely surround the through-opening of the retaining plate. The through-opening of the retaining plate may in particular extend through the connecting plate and the connection piece.

[0016] The retaining plate may comprise or consist of one or a plurality of plastic materials. In particular, recycled plastics may be used, such as recycled polypropylene, rPP, and/or recycled polyethylene terephthalate, rPET.

[0017] The retaining plate may comprise a closure element for closing the inflow opening. This allows the suction material to be retained inside the bag, in particular when the bag is removed.

[0018] The retaining plate is formed integrally with the connection piece. The retaining plate and the connection piece are thus a common component.

[0019] The retaining plate may be an injection-molded part or a part produced by thermoforming. The retaining plate may also be manufactured partly by injection molding and partly by thermoforming.

[0020] The retaining plate may further comprise a sealing lip surrounding the through-opening. The sealing lip may comprise or consist of a thermoplastic elastomer, for example based on polypropylene. The sealing lip is intended to prevent or limit the escape of dust from the vacuum-cleaner filter bag by sealing the area between the inner edge of the through-opening and the outside of a connecting connection piece of the vacuum cleaner.

[0021] The bag wall is made of an air-permeable material and can have a multilayer structure. In the latter case, it is also referred to as a laminate. A plurality of layers of the laminate, in particular each layer of the laminate, may comprise or consist of a nonwoven fabric and/or a fiber nonwoven.

[0022] As the material for the bag wall, in particular for one or a plurality of layers of nonwoven fabric or fiber nonwoven, a wide variety of plastics may be used, for example polypropylene and/or polyester. The bag wall may also comprise or consist of plastic recyclate and/or recycled material from the manufacture of textiles (Textile Left-Over—TLO).

[0023] Relevant international standards exist for many plastic recyclates. For PET plastic recyclates, for example, DIN EN 15353:2007 is relevant. PP recyclates are characterized in DIN EN 15345:2008. For the purpose of the corresponding special plastic recyclates, the present patent application adopts the definitions of these international standards. The plastic recyclates may be non-metallized. An example of this is plastic flakes or chips recovered from PET beverage bottles. Likewise, the plastic recyclates may be metallized, for example, if the recyclates were obtained from metallic plastic films, in particular metallized PET films (MPET).

[0024] Recycled polyethylene terephthalate (rPET) can be obtained, for example, from beverage bottles, in particular from so-called bottle flakes, i.e. pieces of ground beverage bottles.

[0025] The recycled plastics, in particular recycled PET and/or recycled PP, in both the metallized and non-metallized versions, can be spun into the appropriate fibers from which the corresponding staple fibers or meltblown or spunbond nonwoven fabrics can be made for the purposes of the present invention.

[0026] Recycled material from the manufacture of textiles (TLO) is generated in particular during the processing of textile materials (in particular textile fibers and filaments, as well as linear, planar and spatial textile structures produced therewith), such as the manufacture (comprising carding, spinning, cutting and drying) or recycling of textile materials. These powdery and/or fibrous materials represent waste materials that can deposit on the machines or filter materials used to process the textiles. The dusts (powders) or fibers are normally disposed of and thermally recycled.

[0027] The recycled powdery and/or fibrous recycled material is therefore, for example, production waste; this applies in particular to material that is a waste product produced during carding, spinning, cutting or drying of textile materials. In this case, one also speaks of "pre-consumer waste".

[0028] The recycling of textile materials, i.e. the processing (e.g. shredding) of used textile materials or textiles (e.g. old clothes) also produces powdery and/or fibrous recycled material; this is referred to as "post-consumer waste".

[0029] Thus, the recycled material from the manufacture of textiles, TLO, may include, in particular, fibers and or filaments obtained from waste materials from the textile and clothing industry, post-consumer waste (textiles and the like) and/or products collected for recycling.

[0030] For the purposes of the present invention, a nonwoven fabric means a random mesh that has undergone a solidification step so that it has sufficient strength to be wound or unwound into rolls, for example by machine (i.e. on an industrial scale). The minimum web tension required for winding is 0.044 N/mm. The web tension should not be higher than 10% to 25% of the minimum maximum tensile force (according to DIN EN 29073-3:1992-08) of the material to be wound. This results in a minimum maximum tensile force for a material to be wound of 8.8 N per 5 cm strip width.

[0031] A fiber nonwoven, or in short "nonwoven" corresponds to a random mesh, which, however, has not undergone a solidification step so that, unlike a nonwoven, such a random mesh does not have sufficient strength to be wound or unwound into rolls by machine, for example.

[0032] The term nonwoven fabric ("nonwoven") is used in other words according to the definition given in ISO Standard ISO9092:1988 or CEM Standard EN29092. Details on the use of the definitions and/or processes described herein can also be found in the standard work "Vliesstoffe" (Nonwovens), W. Albrecht, H. Fuchs, W. Kittelmann, Wiley-VCH, 2000.

[0033] The nonwoven layers of the bag wall may comprise, in particular, a staple fiber nonwoven and/or an extrusion nonwoven. In particular, filament spunbond nonwovens (also abbreviated to "spunbond nonwoven" or "spunbond") and/or meltblown nonwovens can be used.

[0034] One or a plurality of layers of the bag wall may comprise a carded material. Both mechanical processes (e.g. needling) and thermal processes (e.g. calendering) may be used as the binding step. Also possible is the use of binding fibers or adhesives, such as a latex adhesive. Airlaid materials are also possible.

[0035] The nonwoven of one or a plurality of layers of the bag wall may comprise bi-component fibers. Bi-component fibers (BiCo fibers) can be formed from a core as well as a sheath encasing the core. In addition to core/sheath bi-component fibers, the other common variants of bi-component fibers, e.g. side-by-side, can also be used.

[0036] The bi-component fibers may be present as staple fibers or formed as filaments in an extrusion nonwoven (for example, meltblown nonwoven).

[0037] Correspondingly unsolidified fiber nonwovens are also conceivable, as mentioned.

[0038] The nonwoven of one or a plurality of layers of the bag wall may also have a micro-creping (Micrex).

[0039] The bag wall may also include an odor absorbent.

[0040] In particular, the bag wall may include a capacitance layer. A capacitance layer provides high resistance to impact loading, and allows filtration of large dirt particles, filtration of a significant portion of small dust particles, and storage or retention of large quantities of particles, while allowing the air to flow through easily, resulting in a low pressure drop at high particle loading.

[0041] The bag wall may also include a fine filter layer. A fine filter layer is used to increase the filtration performance of the multilayer filter material by trapping particles that pass through the capacitance layer, for example. To further increase the separation efficiency, the fine filter layer can preferably be electrostatically charged (e.g. by corona discharge or hydrocharging), in particular to increase the separation of fine dust particles.

[0042] The fine filter layer may adjoin the capacitance layer, in particular towards the outside of the bag wall.

[0043] A support layer may adjoin the fine filter layer. A support layer (sometimes also called a "reinforcing layer") is a layer that gives the multilayer composite of the filter material the necessary mechanical strength. The support layer may be, in particular, an open, porous nonwoven with a light surface weight. In particular, the support layer may be a spunbonded nonwoven.

[0044] However, it is also possible to use a single-layer filter material for the bag wall. In this case, it may be a meltblown nonwoven in particular. A suitable material for such a single-layer bag wall is known, for example, from EP 2 311 360 B1.

[0045] In particular, the bag wall may be connected to the outside of the connection piece, i.e. to the side facing away from the through-opening of the connection piece. This enables advantageous optical control of the fastening process during manufacture, in particular visually and/or via automated image processing.

[0046] In particular, the length of the side of the bag wall connected to the connection piece may correspond to the outer circumference of the cylindrical section of the connection piece. In particular, the bag wall may be connected to the lateral surface of the connection piece along the entire circumference of the connection piece. Both the bag wall and the lateral surface of the cylindrical section of the connection piece thus fully surround the through-opening of the connection piece.

[0047] The bag wall may be bonded or welded to the lateral surface, and/or the bag wall may be clamped between the lateral surface and a clamping element. The clamping element may in particular be a hollow cylinder. In this case, one can also speak of a clamping ring. Fastening by means of a clamping element alone enables a detachable connection and thus recycling of the retaining plate and the connection piece.

[0048] The retaining plate may be arranged on a short side of the bag wall. In other words, the longitudinal axis of the vacuum-cleaner filter bag may extend parallel to the longitudinal axis of the connection piece.

[0049] The bag wall may have a surface pleating with at least five pleats. The surface pleating of the filter medium has considerable advantages. Due to the surface pleating, the area through which the flow passes is considerably larger than the regular area available for the flow (inflow area). In other words, the surface pleating allows the bag wall to be at least partially pleated.

[0050] The term pleating is defined in the sense of the present invention as a sequence of two or more pleats, a single pleat being defined in the sense of the present invention by two pleat legs and a pleat hinge, respectively.

[0051] A surface pleat is a sequence of pleats provided on the bag wall. Such a surface pleat is fixed at most by a part of the seam along a side edge. However, this part of the seam is neither a pleat hinge nor a part of the pleat leg of one of the pleats of the pleating.

[0052] The vacuum-cleaner filter bag, in particular its bag wall, may further comprise at least one side pleat.

[0053] A side pleat is a sequence of pleats in the area of the side edge of the vacuum-cleaner filter bag. The seam along the relevant side edge of the vacuum-cleaner filter bag is here a part of one of the pleats forming the side pleat; for example, the seam in the region of the relevant side edge is a pleat hinge or the seam lies almost completely in a pleat leg.

[0054] The at least five pleats of the surface pleat may extend along the longitudinal axis of the filter bag. Alternatively, the pleats may also extend transversely to the longitudinal axis.

[0055] A fixing device may also be provided to prevent at least one of the at least five pleats from fully unfolding.

[0056] The pleats of a bag wall may be at least partially connected to each other by means of a fixing device. The fixing device may also keep pleats of the bag wall at a predetermined distance from each other.

[0057] The fixing device may comprise at least one material strip, in particular a nonwoven material strip, or consist of at least one material strip, in particular at least one nonwoven material strip. A plurality of material strips may be spaced apart or directly adjacent to each other.

[0058] A plurality of material strips may extend transversely, in particular perpendicularly or at a predetermined angle, to the longitudinal direction of the pleats. The predetermined angle may be greater than 0° and smaller than 180°, in particular greater than 30° and smaller than 150°.

[0059] The fixing device is preferably arranged on the upstream side in relation to the bag wall. Here, on the upstream side means facing the interior of the vacuum-cleaner filter bag. The fixing device may be at least partially connected in particular directly in particular bonded and/or welded to the bag wall, in particular to the pleats of the bag wall. Furthermore, the fixing device may be bonded and/or welded at points where pleat legs of two different pleats of the bag wall adjoin each other.

[0060] The fixing device may be bonded and/or welded to the bag wall in one or a plurality of areas of the bag wall, each of which is arranged between two pleats of the bag wall. Particularly in the case of horizontal pleats that do not overlap one another, this allows simple production of the vacuum-cleaner filter bag.

[0061] Two or more of the pleats of the bag wall may also be connected together by the fixing device, while two or more of the pleats of the bag wall are not connected together by the fixing device.

[0062] Alternatively or additionally, the fixing device may be bonded and/or welded to one or a plurality of pleats of the bag wall in such a way that the connection loosens during operation of the vacuum-cleaner filter bag. Thus, the air flow

within the vacuum-cleaner filter bag can be influenced by the at least partially loosening fixing device.

[0063] In other words, parts of the fixing device can serve as air distributors during operation of the vacuum-cleaner filter bag.

[0064] The surface pleats, side pleats and/or fixing devices may be configured in particular as described in European patent application EP 2 366 319 or European patent application EP 2 366 320.

[0065] The side of the bag wall opposite the retaining plate may be concave or convex. This allows better utilization of the installation space.

[0066] The invention also provides a method for manufacturing a vacuum-cleaner filter bag according to claim **10**, in particular for manufacturing a vacuum-cleaner filter bag described above. Thus, the method according to the invention comprises the following steps:

[0067] a) forming a tubular bag of a filter material open at one side;

[0068] b) arranging a retaining plate comprising an at least partially cylindrical connection piece at the wide end of a conical guide element so that the connection piece of the retaining plate rests against the lateral surface of the conical guide element;

[0069] c) slipping the bag over the conical guide element;

[0070] d) connecting the bag to the lateral surface of the connection piece facing away from the guide member; and

[0071] e) lifting the bag connected to the connection piece from the guide element.

[0072] This method allows efficient and automated production.

[0073] Forming the tubular bag open at one side may include overlapping two filter material webs and forming two longitudinal welding seams and one transverse welding seam. Alternatively, forming the tubular bag open on one side may comprise flipping over a single filter material web and forming a longitudinal welding seam to join two edges of the web of filter material that overlap after flipping over, and forming a transverse welding seam.

[0074] Forming the tubular bag open at one side may further include forming the surface pleat and/or side pleat described above.

[0075] In particular, the surface pleats may be introduced along the conveying direction of the filter material web. If the pleats are to run along the longitudinal direction of the vacuum-cleaner filter bag, the open side is provided transverse to the conveying direction of the filter material web. If the pleats are to run transversely to the longitudinal direction of the vacuum-cleaner filter bag, the open side is provided in the conveying direction of the filter material web.

[0076] The conical guide element can be arranged on a worktable, in particular a rotary table. In particular, a plurality of conical guide elements can be provided, especially along the circumference of the rotary table. The radius of the conical guide element may decrease away from the surface of the worktable in particular.

[0077] The conical guide element may be configured so that its diameter can be changed or adjusted on the surface of the worktable. For example, the conical guide element may be arranged in a through-opening of the worktable and can be moved perpendicular to the surface of the worktable. Alternatively, the conical guide element may be formed from a plurality of radially displaceable elements.

[0078] Arranging the retaining plate with the at least partially cylindrical connection piece at the wide end of a conical guide element may comprise slipping the retaining plate over the conical guide element. The inner diameter of the at least partially cylindrical connection piece, i.e. the diameter of its aforementioned through-opening, may correspond to the outer diameter of the conical guide element at the surface of the worktable, so that the connection piece abuts the outer surface of the conical guide element. For this purpose, the conical guide element may have a cylindrical portion at its wide end, the shape and extension of which correspond to the shape and extension of the cylindrical portion of the connection piece, but the outer radius of the cylindrical portion of the conical guide element corresponds to the inner diameter of the cylindrical section of the connection piece.

[0079] Slipping the bag over the conical guide element may comprise gripping and opening the tubular bag that is open on one side. Slipping the bag over the conical guide element may be performed in particular automatically by a robot gripper.

[0080] In the case of pleats provided transverse to the longitudinal direction of the vacuum-cleaner filter bag, the open side of the bag is provided in the conveying direction of the filter material web. In this case, the robot gripper rotates the bag before it slips it over the conical guide element.

[0081] In the case of pleats provided in the longitudinal direction of the vacuum-cleaner filter bag, the open side of the bag is provided transverse to the conveying direction of the filter material web. In this case, the robot gripper can take over the bag in the conveying direction of the filter material web and slip it over the conical guide element.

[0082] The bag may be connected to the outer surface of the connection piece facing away from the guide element in particular by ultrasonic welding. The conical guide element forms the anvil for the sonotrode. Welding can be carried out in several steps. For example, a rotary table can be used to move the conical guide element with the bag slipped over it to different welding stations, which are arranged and configured to weld different segments of the circumference of the connection piece to the bag wall. Alternatively, a welding sonotrode movable in the circumferential direction can also be used.

[0083] Alternatively or additionally, connecting the bag to the lateral surface of the connection piece facing away from the guide member may comprise arranging a clamping member over the bag wall so that the bag wall is clamped between the lateral surface of the connection piece and the clamping member in a region of the lateral surface of the connection piece.

[0084] The lifting of the bag connected to the connection piece from the guide element may again be automated via a robot gripper. Lifting the bag connected to the connection piece from the guide element may also include reducing the diameter of the conical guide element on the surface of the worktable, for example by lowering the conical guide element in a through-opening of the worktable.

[0085] The method may further comprise an optical inspection of the connection between the bag wall and the lateral surface according to step d). In particular, at least one digital image of the connection area of the bag wall with the

lateral surface may be generated. This digital image may be subjected to automated image processing to detect defects at the connection, such as insufficiently formed welding seams. Based on the detection of an insufficient connection, a warning signal can be issued and/or the bag in question can be outfed.

[0086] Further features and advantages of the invention are described below with reference to the exemplary Figures.

[0087] FIG. **1** shows a cross-section through an exemplary vacuum-cleaner filter bag;

[0088] FIG. **2** shows a perspective view of an exemplary retaining plate with an at least partially cylindrical connection piece;

[0089] FIG. **3** shows a top view of an exemplary tubular bag open at one side for the production of a vacuum-cleaner filter bag;

[0090] FIG. **4** shows a perspective view of an exemplary conical guide member for the production of a vacuum-cleaner filter bag; and

[0091] FIG. **5** shows an illustration of a manufacturing step in the production of an exemplary vacuum-cleaner filter bag.

[0092] FIG. **1** shows a cross-section through an exemplary vacuum-cleaner filter bag **1** with a bag wall **2** and a retaining plate **3**. The retaining plate **3**, in particular its flat connecting plate, serves to fix the vacuum cleaner filter bag **1** in a corresponding holder in a housing of a vacuum cleaner.

[0093] The bag wall is not directly connected to the flat part of the retaining plate **3**, i.e. the connecting plate, as is usual in the prior art, but to an at least partially cylindrical connection piece **4** of the retaining plate **3**. In particular, the connection piece extends in the direction of the through-opening **5** formed in the retaining plate **3**, i.e. perpendicular to the plane in which the connecting plate lies. The bag wall **2** is connected along the circumference of the connection piece **4** to its lateral surface, which also extends in the direction perpendicular to the connecting plate.

[0094] FIG. **2** shows a perspective view of an exemplary retaining plate with an at least partially cylindrical connection piece **4**. The connection piece **4** comprises a cylindrical section. The shape of the cylindrical section can be freely selected and is not limited to the shape of a circular cylinder. The axis of the cylindrical section defines the longitudinal axis of the connection piece **4**. Along this longitudinal axis of the cylindrical section, the through-opening of the retaining plate is provided. This forms an inflow opening for the suction material into the filter bag, as can be seen in FIG. **1**.

[0095] The exemplary retaining plate **3** of FIG. **2** comprises a second section **8** adjoining the cylindrical section and having an enlarged circumference compared to the cylindrical section.

[0096] In particular, the second section **8** projects radially outwardly beyond the lateral surface of the cylindrical section. This second section **8** may correspond to the connecting plate as shown in FIG. **1**.

[0097] In the embodiment of FIG. **1**, the bag wall **2** is welded to the lateral surface of the cylindrical section of the connection piece **4**. In particular, the ultrasonic welding seams **6** can be seen. In addition, a clamping ring **7** is shown in this embodiment, which clamps the bag wall **2** to the lateral surface of the cylindrical section of the connection piece **4**. Such a clamping ring **7** can also alone provide the connection of the bag wall to the lateral surface.

[0098] Not shown here, a sealing lip can further be provided at the through-opening **5**.

[0099] FIG. **3** shows a top view of an exemplary tubular bag open on one side, as can be used in the manufacture of a vacuum-cleaner filter bag according to FIG. **1**. The bag wall **2** of the exemplary bag of FIG. **3** comprises two longitudinal weld seams **12**, **13** and a transverse weld seam **14**. At the transverse side **15**, the bag is open, i.e. without a weld seam, in order to enable a connection there with a connection piece as exemplarily shown in FIG. **2**.

[0100] The transverse weld seam **14** could also be configured with a concave or convex curvature for better utilization of installation space. A bottom, for example in the form of a block bottom, or a side pleat would also be conceivable in the area of the transverse weld seam **14**.

[0101] In addition, the bag wall **2** in FIG. **3** comprises a plurality of surface pleats **16** which extend along the longitudinal weld seams **12**, **13**. At the open end **15**, the pleats are fixed in position by a fixing device **17**.

[0102] As stated above, the term pleat in the sense of the present invention is defined as a sequence of two or a plurality of pleats, a single pleat in the sense of the present invention being defined by two pleat legs and a pleat hinge, respectively.

[0103] A pleat hinge is the point of a pleat with the smallest radius of curvature. A so-called pleat axis is obtained by the imaginary connection of the pleat hinges. The pleat axis is also referred to as the pleat back. The pleat axis may correspond to the longitudinal axis of a pleat. Areas of a pleat with a radius of curvature greater than the minimum radius of curvature of the pleat are called pleat legs. The area lying between the pleat legs of a pleat is called the pleat core. The pleat legs of a pleat can therefore also have a curvature in particular.

[0104] Pleats can also have inflection points. Inflection points are those points of a pleat, in particular the pleat legs, at which the curvature of the pleat changes from concave to convex. A line connecting several inflection points of a pleat is called an inflection line (helix line).

[0105] Two adjacent pleats can also share a pleat leg. If a plurality of pleats are provided in this way, a pleat pack or a pleat band can be realized.

[0106] A plurality of pleats can also be arranged in a zigzag pattern.

[0107] Pleats may also have legs that run parallel to the bag wall. Such legs may be located between pleats that protrude from the plane of the bag wall and thus have an upstream opening with respect to the bag wall. In particular, the width of the parallel leg may be less than, preferably less than half of, or most preferably less than a quarter of, the width of the opening of the pleat protruding from the bag wall.

[0108] The pleat legs of the pleats can in particular be smooth. "Smooth" in this context means that the pleat legs do not have any compactions and/or structuring, in particular which is intended to stabilize the shape of the pleats.

[0109] One or a plurality of pleat legs of one or a plurality of pleats may comprise one or a plurality of embossed structures, in particular wherein the embossed structures do not serve to stabilize the shape of the pleats. In this way, a further increase in the area available for filtration can be achieved.

[0110] In particular, the bag wall **2** may have more than 5, 10, 20, 30, 40 or 50 pleats, and in particular folds of these pleats.

[0111] The pleats of the bag wall may have a substantially regular spacing between them. In other words, the distance between the backs of the pleats of each two adjacent pleats may be substantially constant.

[0112] Pleats can be horizontal or vertical. Horizontal pleats are pleats whose pleat legs are arranged essentially parallel to the bag wall **2**. Vertical pleats are pleats whose pleat legs enclose an angle greater than 0° and less than 180°, in particular greater than 20° or greater than 45°, with the bag wall **2**.

[0113] A vertical pleat is also understood to be a pleat in which a plane in which both the pleat axis and the inflection line of the pleat lie encloses an angle greater than 45°, in particular greater than 30° particular greater than 10°, with a flat, horizontal surface on which the first and/or second bag wall is arranged. In this case, a horizontal pleat can be understood as a pleat in which the plane encloses with this surface an angle smaller than 45°, in particular smaller than 30°, in particular smaller than 10°.

[0114] To measure or determine the above angles, the vacuum-cleaner filter bag, in particular the pleated nonwoven material, is arranged on a flat, horizontal surface. For this purpose, the vacuum-cleaner filter bag can also be cut open and, in particular, arranged on the surface in such a way that the upstream side or inner side of the original vacuum-cleaner filter bag rests on the surface.

[0115] Horizontal pleats may be mutually overlapping, non-overlapping and/or partially overlapping.

[0116] For the manufacture of an exemplary vacuum-cleaner filter bag, as shown in FIG. **1**, it is necessary to connect the bag wall **2** to the connection piece **4**. Although the connection piece **4** is made of plastics and has a certain strength, in the case of a connection by welding it would be advantageous if an anvil were provided to form an abutment. FIG. **4** shows such an anvil in the form of a conical guide element **18**.

[0117] As shown in FIG. **5**, the conical guide element **18** can be arranged vertically on a worktable. The conical guide element **18** is configured in such a way that its outer diameter at the wide end corresponds to the inner diameter of the cylindrical section of the connection piece **4**. The retaining plate **3** with connection piece **4** is then slipped over the conical guide element **18** as shown in FIG. **5**. A robot gripper can then grip a tubular bag open on one side, as shown for example in FIG. **3**, and likewise slip it over the conical guide element **18**. Here, too, the conical shape of the guide element **18** is advantageous. Thereupon, a welding of the bag wall **2** to the lateral surface of the cylindrical section of the connection piece **4** can take place, and this from the outside. The latter has the advantage that the welding result can be checked, for example via image processing.

[0118] Finally, the retaining plate **3** and the bag wall **2** connected to it are pulled off the conical guide element **18**.

[0119] It is understood that features mentioned in the previously described embodiments are not limited to these particular combinations and are also possible in any other combinations. Furthermore, it is understood that geometries shown in the Figures are only exemplary and are also possible in any other embodiments.

1. A vacuum-cleaner filter bag, comprising: a bag wall and a retaining plate, the retaining plate comprising an at least partially cylindrical connection piece extending in a direction of a through-opening formed in the retaining plate, and the bag wall being connected to a lateral surface of the connection piece along a periphery of the connection piece.

2. The vacuum-cleaner filter bag according to claim **1**, wherein the bag wall is bonded or welded to the lateral surface of the connection piece.

3. The vacuum-cleaner filter bag according to claim **1**, wherein the connection piece and the retaining plate are integrally formed.

4. The vacuum-cleaner filter bag according to claim **1**, wherein the retaining plate and the connection piece are arranged on a short side of the bag wall.

5. The vacuum-cleaner filter bag according to claim **1**, wherein the bag wall has a surface pleat with at least five pleats.

6. The vacuum-cleaner filter bag according to claim **5**, wherein the at least five pleats extend along a longitudinal axis of the vacuum-cleaner filter bag or transverse to the longitudinal axis of the vacuum-cleaner filter bag.

7. The vacuum-cleaner filter bag according to claim **5**, further comprising a fixing device which prevents at least one of the at least five pleats from unfolding completely.

8. The vacuum-cleaner filter bag according to claim **1**, further comprising at least one side pleat.

9. The vacuum-cleaner filter bag according to claim **1**, wherein a side of the bag wall opposite the retaining plate is concave or convex.

10. A method of producing a vacuum-cleaner filter bag having a bag wall and a retaining plate, the retaining plate comprising an at least partially cylindrical connection piece extending in a direction of a through-opening formed in the retaining plate, and the bag wall being connected to a lateral surface of the connection piece along a periphery of the connection piece, the method comprising the steps of:

a) forming a tubular bag of a filter material open at one side;

b) arranging the retaining plate at a wide end of a conical guide element so that the connection piece of the retaining plate rests against a lateral surface of the conical guide element;

c) slipping the tubular bag over the conical guide element;

d) connecting the tubular bag to the lateral surface of the connection piece facing away from the conical guide member; and

e) lifting the tubular bag connected to the connection piece from the conical guide element.

11. The method according to claim **10**, wherein the bag wall is bonded or welded to the lateral surface of the connection piece.

12. The method according to claim **10**, wherein the connection piece and the retaining plate are integrally formed.

13. The method according to claim **10**, wherein the retaining plate and the connection piece are arranged on a short side of the bag wall.

14. The method according to claim **10**, wherein a side of the bag wall opposite the retaining plate is concave or convex.

15. The vacuum-cleaner filter bag according to claim **1**, wherein the bag wall is clamped between the lateral surface of the connection piece and a clamping element.

16. The vacuum-cleaner filter bag according to claim **2**, wherein the connection piece and the retaining plate are integrally formed.

17. The vacuum-cleaner filter bag according to claim **2**, wherein the retaining plate and the connection piece are arranged on a short side of the bag wall.

18. The vacuum-cleaner filter bag according to claim **4**, wherein the bag wall has a surface pleat with at least five pleats.

19. The vacuum-cleaner filter bag according to claim **4**, further comprising at least one side pleat.

20. The vacuum-cleaner filter bag according to claim **4**, wherein a side of the bag wall opposite the retaining plate is concave or convex.

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