

(19) **Japan Patent Office**  
**Gazette of Unexamined**  
**Patent Applications**

(11) Publication Number  
**S53-50580**

|                           |          |                 |                    |                              |
|---------------------------|----------|-----------------|--------------------|------------------------------|
| (51) Int.Cl. <sup>2</sup> | ID Codes | (52) Jpn.Cl.    | Internal File Nos. | (43) Publication May 9, 1978 |
| B 01 D 39/16              |          | 72 C 52         | 6759-33            |                              |
| A 47 L 9/12               |          | 92 (3) D 103.12 | 6420-34            |                              |

No. of Independent Claims: 1  
Examination Request: Received

(Total of 5 Pages)

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(54) Filter Device for Vacuum Cleaner

|                      |                           |                |                               |
|----------------------|---------------------------|----------------|-------------------------------|
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| (22) Filing Date     | October 20, 1976          |                | 1-5-1 Marunouchi, Chiyoda-ku, |
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Specification

Title of the Invention

Filter Device [hw: {for Vacuum Cleaner}]

Claims

1. A filter device for a vacuum cleaner, characterized in that an antistatic agent that is a surfactant is applied to a filtration medium with numerous pores obtained by layering numerous chemical fibers of, for example, polyester polypropylene, nylon, etc. and bonding the fibers to each other by the application of pressure and melt bonding.

Detailed Description of the Invention

The present invention relates to a vacuum cleaner, and more specifically, to a filter device with high dust collecting performance, easy separability of adhering dust, high mechanical strength, and washability.

When using filter paper with high dust collection performance as the filtration medium for a filter (for example, a filtration medium obtained by making paper that is about 1 mm thick by mixing cotton linter pulp as the main

component with a synthetic fiber such as rayon as a binder, and impregnating the paper with phenol or melamine resin as a bonding and curing material between fibers), fibers on the surface of the filtration medium are microscopically fluffed, and fine dust becomes entangled in them and is difficult to remove completely. Because the mechanical strength, such as tensile strength, is weak at about 5 kg/15 mm and is even weaker when exposed to moisture, the filtration medium is susceptible to tearing. This makes it impossible to wash off dust adhering to the filtration medium with water or to immerse the filtration medium in water to wash away hardened dust. The use of a non-woven fabric (a filtration medium obtained by layering numerous chemical fibers of, for example, polyester, polypropylene, nylon, etc., and pressure-bonding the fibers together without using phenol or some other impregnating material as a bonding and curing material), which has excellent mechanical strength and does not lose its strength when wet, solves these problems. However, static electricity generated between the chemical fibers and the dust or the air current accumulates in the filtration medium, attracting the dust electrically and making it difficult to remove the attached dust.

It is an object of the present invention to overcome these shortcomings by providing a filter device that has excellent mechanical strength, that is resistant to a change in strength when wetted by moisture, that is washable in water, that allows for easy separation of adhering dust during general use, and that has a long service life.

The present invention is characterized in that an antistatic agent is applied to a filtration material made by pressurizing and heat-bonding chemical fibers of, for example, polyester without using a phenol resin etc., as a bonding and curing material.

An example of the present invention will now be described in detail with reference to the drawings. Fig. 1 shows an example of a vacuum cleaner using a filter device in an example of the present invention, in which 1 is a substantially round motor base with a fan motor 7 installed in the center of the upper surface, a reel case 17 fixed on the lower surface, a raised portion 2 at the rear, and a suction intake portion 3 at the front. 4 is a cylindrical motor case portion formed in the center of the motor base 1. An end bracket portion 8 of a fan motor 7 is suspended and fixed to the upper end opening of the motor case portion 8 via annular vibration-absorbing rubber 6. 9 is a protective cover covering the intake to the fan motor 7. 10 is a soundproofing capacitor attached to the fan motor, 11 is an annular sound absorbing cover around the fan motor, 14 is an annular sound insulating wall with an L-shaped cross section, and a bottom portion 15 covers the outer circumferential portion of the top surface of the reel case. 12 is an annular sound insulation plate, and 13 is a sound insulation plate provided at the bottom of the sound insulating wall 14. 16 is an exhaust space provided between the motor case portion 4 of the motor base 1 and the sound insulation plate 13 and is provided along the entire circumference of the motor case portion 4. 17 is a reel case fixed to the underside of the motor base 1, and a cord reel 18 that rotates around a shaft 19 is provided inside. The cord reel 18 automatically winds up the cord 21 using the resilience of a built-in spring 20. 22 is an operating lever for the stopper of the cord reel. By pushing the lever down and pushing another lever 23 horizontally, the freely moving stopper roller 24 at the end of the lever 23 is moved away from the cord reel 18, and the cord reel 18 is rotated. 25 is a contact base that holds a fixed contact 26, and the fixed contact 26 makes sliding contact with a slip ring 27 on the cord reel. 30

is a hose coupling that is detachably inserted into the distribution port 34 of the suction intake portion 3 and is secured to the suction intake portion 3 by a clamp 31. 32 is a dust case that is placed on the motor case portion 4 of the motor base 1 and removably attached in a doughnut-like manner that surrounds the motor case portion 4. The dust case 32 is positioned in front of and behind the raised portions of the motor base 1 and the suction intake portion 3. The dust case 32 has a suction intake portion 33 which, when placed on the motor case portion 4, is in a position that communicates with the distribution port 34 of the suction intake portion 3. 35 is a doughnut-shaped primary filter that is placed over the top opening of the dust case 32 and is covered with a mesh 67 that filters out coarse dust. 36 is an upper case that is placed on the outer peripheral annular flat portion 37 of the dust case 32 via a gasket 38. The same gasket 38 holds the outer peripheral flange 40 of a double cylindrical main filter 39 attached to the bottom opening side of the upper case 36. In Fig. 5, 40a denotes triangular protrusions that conform to the filtration medium corrugation on the lower side of the triangular protrusions 40a and that are not connected to each other.

A radial grate 42 is integrated into the inside of the inner cylinder 41 of the main filter 39, and the central portion 43 is fixed to a wall of the upper case 36 with bolts 44. 65 is a gasket affixed to the lower end of the inner cylinder 41 to keep it airtight with the inner annular flat portion 66 of the dust case 32. 45 is the filtration medium of the main filter 39, which is corrugated and integrally molded between the outer peripheral flange 40 and the inner cylinder 41, which are molded with resin so that the ridges of the ribs are radial. The filtration medium 45 is a type of non-woven fabric with high dust collection performance and numerous pores obtained by layering chemical fibers of, for example, polyester, polypropylene, or nylon, and bonding them together by pressure and heat bonding. The surface has less fluff 5 than filter paper, etc., and no phenolic resin or other impregnating material is used to bind the fibers together.

The enlarged view in Fig. 7 will now be used to describe the filtration medium in greater detail. The shaded portions 70 show where chemical fibers 71 are subjected to pressure and heat-bonded as described above.

The filtration medium is also coated with an antistatic agent, such as an amine-based

cationic surfactant. While applied to all fibers shown in Fig. 7, this is represented by the single fiber in the figure indicated by dashed lines 73. The surfactant 73 is resinized to some extent and adheres to the fibers so that it does not easily separate from the fibers when it comes in contact with water.

46 is a dust remover made of elastic wire, etc. that rotates and strikes the raised portions 62 on the corrugated back side (opposite the filtration surface) of the filtration material and is fixed to a part of a gear 48 by an arm 47. The gear 48 rotates around a bearing 49 integral with the upper case and is rotated by another gear 50. The gear 50 is fixed to an external rotating plate 52 via a bearing 51 in the upper case 36, and the rotating plate 52 rotates when a knob 53 is manually turned. In other words, turning of the knob 53 is transmitted via gear 50, gear 48, and arm 47 to rotate the dust remover 51. The trajectory of the dust remover is the dotted line shown in Fig. 9 (sic). 54 is a handle on the top of the upper case 36, and a dust indicator 55 is provided on the inside of the handle 54. 56 and 57 are clamps that can be rotated freely on arms 61 attached to the front and rear of the upper case 36 so that a mounting shaft 60 is spring-loaded, and that are placed on the outer peripheral annular flat portion 37 of the dust case 32 when the upper case 36 and the main filter 39 are joined together. Clamp 56 joins clamp receiver 58 fixed to intake portion 3 of the motor base 1, and clamp 57 joins clamp receiver 59 fixed to the raised portion 2 to secure the upper case 36 to the motor base 1 with the dust case 32 interposed and secured. Fig. 2 shows the upper case 36 and the main filter 39 joined but separated from the dust case 32 and the motor base 1 by removing the clamps 56, 57, and Fig. 3 shows the dust case 32 and the primary filter covering the opening on the upper end of the dust case 32 separated from the other components. The vacuum cleaner is operated by turning ON the manual switch at the end of the hose (not shown) connected to the hose coupling 30. A remote control relay (not shown) placed on a portion of the motor base 1 is turned ON to operate the fan motor 7. The airflow containing dust enters the doughnut-shaped dust case 32 via the intake port 33 from the hose coupling 30 as shown by the arrow in Fig. 1, the coarse dust is filtered by the primary filter 35, and the upward airflow is completely filtered by the filtration medium 45 of the main filter 39, including fine dust, and enters the inner cylinder 41 of the filter 39 through the radial grate 42 and through the retaining cover 9 and enters the

fan motor 7. The airflow exiting the fan motor 7 passes through the ventilation holes (not shown) in the sound-absorbing cover 11, the sound insulating wall 14, and the ventilation openings (not shown) in the sound insulating plate 12 to reach the exhaust space 16, where it is discharged to the outside via the circumferential gap between the motor base 1 and the reel case 17. When the main filter is clogged, the fan motor 7 is stopped, and the knob 53 is turned from the outside to rotate the dust remover 46. The dust remover 46 strikes the radially arranged corrugated backside raised portions 62 at a nearly right angle to the raised portions, as shown in Fig. 11 (sic). This causes the entire filtration medium to vibrate uniformly, separating the clogged fine dust particles and dropping them onto the primary filter 35. 64 is a reinforcing portion that is molded to come into close contact with the filtration medium in the recessed portions of the filtration medium surface (filtering surface) and is integral with the outer clamp 40 and the inner surface 41, connecting them both. Dust on the primary filter slides down to the center of the primary filter and collects in the dust reservoir 63 because the primary filter is in the shape of a bowl. When the main filter is unclogged in this way, the fan motor 7 operates again to continue cleaning. When the dust case is full of dust, the clamps 56, 57 are removed to detach the upper case 36, the dust case 32, and the primary filter 35 as shown in Fig. 7 and Fig. 8 (sic), and remove the dust in the dust case and on the primary filter. When clogging of the main filter is not fully resolved by removing dust with the dust remover and the recovery rate is poor, the bolts 44 are removed to separate the main filter from the upper case 36 and flush it with water.

In the present invention, as explained above, a filtration medium with numerous pores having high dust removal performance is used, that is, obtained, by layering numerous chemical fibers of, for example, polyester polypropylene, nylon, etc. and bonding the fibers to each other by the application of pressure and melt bonding. Therefore, when immersed in water, the bond between fibers is not weakened and the mechanical strength reduced, unlike filter paper. As a result, a filter is provided that is washable in water to remove dust adhering strongly to the filtration medium that has a high recovery rate and that has a long service life in which there are no concerns about deterioration of the bonding and curing material. Since each fiber that makes up the filtration medium is long and has no protrusions, fluffing on the surface of the filtration medium is minimized, making it easy

to separate and remove adhering dust particles. Also, because the surfactant adheres to the filter fibers, accumulation of easily [hw: {generated}] static electricity is prevented on the filtration medium, eliminating attraction between the dust and filtration medium due to static electricity and making dust separation easier. If a resinized surfactant that adheres to fibers is used, the diameter of the filtration medium pores can be reduced to improve dust collection performance. This is most effective.

#### Brief Description of the Drawings

Fig. 1 is a vertical cross-sectional view of a vacuum cleaner showing the filter device in an

example of the present invention, Fig. 2 and Fig. 3 are perspective views of portions of the vacuum cleaner shown in Fig. 1 when disassembled, Fig. 4 is a top view of the single main filter shown in Fig. 1, Fig. 5 is a front view of Fig. 4, Fig. 6 is a conceptual diagram from cross section G-G' in Fig. 4 showing the operating state when combined with the dust remover, and Fig. 7 is an enlarged view of the filtration medium.

#### Key to the Drawings

45: Filtration medium

73: Surfactant

Agent

Akio TAKAHASHI, Patent Attorney

Fig. 1

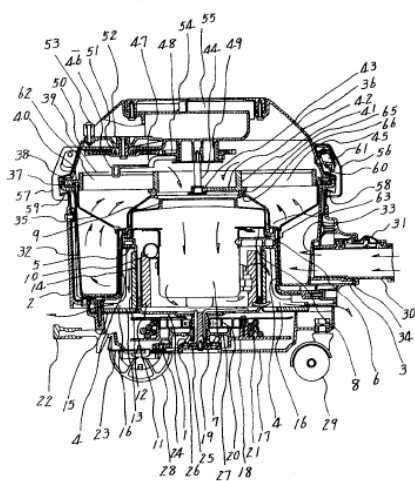


Fig. 2

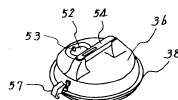


Fig. 3

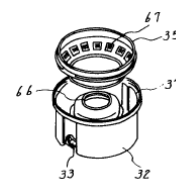


Fig. 4

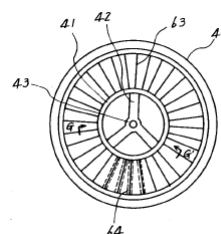


Fig. 5

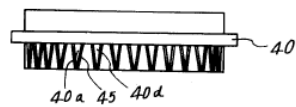


Fig. 6

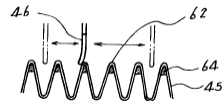
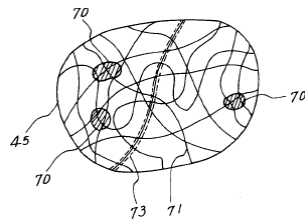


Fig. 7



## TRANSLATOR CERTIFICATION

Date: December 12, 2023

To whom it may concern:

I, Frank McGee, a translator fluent in the English and Japanese languages, on behalf of Morningside Translations, do solemnly and sincerely declare that the following is, to the best of my knowledge and belief, a true and correct translation of the documents listed below in a form that best reflects the intention and meaning of the original text.

The documents are designated as:

- JPS5350580A
- JP2016049141A



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Frank McGee