200000197-4

Specification 12 JAN 2000

Title of the Invention:

High-quality thin breather filter for a hard-disk drive

Detailed Description of the Invention:

[0001]

[Field of the invention]

The present invention relates to a breather filter that is employed in a hard-disk drive (HDD) by attaching it to a hole provided in the cover of the HDD, and more particularly to a breather filter for an HDD which can be thinned in designing a super-thin type HDD, while maintaining the basic performance required as a filter.

[0002]

[Background art]

The breather filter in an HDD is provided for eliminating a difference between the pressure inside the HDD and the pressure outside the HDD in order to prevent particle contamination from entering the HDD. For this reason, the breather filter is structurally simple. That is, a particle filter is attached to a hole in the top cover of the HDD with adhesive double-coated tape, and thinning is also easy. However, due to the high

recording density in the HDD, there have been demands on the breather filter in order to protect corrodible components, such as a thin disk with a Co-system magnetic film and an MR or GMR head constituted by Ni, Fe, Co, and Mn. That is, not only dust prevention for an HDD but also purification of the outside air (organic gas and acid gas), an inflow restriction on the outside air, a reduction in a humidity change, and a high efficient absorption of organic out gas in the HDD interior have been demanded.

[0003]

Conventionally, these demand items have been met by providing an adsorbent material (such as active carbon or a carbonate) for the purification of the outside air (organic gas and acid gas), providing a diffusing tube for the inflow restriction on the outside air and the reduction in a humidity change, and providing another adsorbent material (active carbon) differing from that used in the purification of the outside air for the high efficient absorption of organic out gas in the HDD interior.

[0004]

Figures 5 and 6 are diagrams showing construction examples of the aforementioned conventional breather filter, respectively. In the example shown in Figure 5, 51 denotes a top cover with a hole 52, 53 a plastic filter main body having a diffusing tube 54 in the interior thereof and also having a recess 55 into which another component is fitted, 56 an adsorbent material comprising active carbon, 57 a plastic flow barrier for dispersing gas being passed through the adsorbent material 56, 58 a particle filter configured by a HEPA filter (trade name), and 59 an adhesive agent. In either example, the purification of the outside air by the adsorbent material 56 and the inflow restriction on the outside air and reduction in the humidity change by the diffusing tube 54 can be effectively attained. The difference between the configuration of Figure 5 and the

configuration of Figure 6 is that in Figure 5 the contacted area between the adsorbent material 56 and the HDD interior is small because there is the flow barrier 57 and therefore the organic out gas in the HDD interior cannot be absorbed at high efficiency, while in Figure 6 the organic out gas in the HDD interior can be absorbed at high efficiency by providing the adsorbent material 56 different from that employed in the purification of the outside air onto the exterior of the flow barrier 57.

[0005]

[Problems to be solved by the invention]

In the conventional breather filter shown in Figure 5 or 6, the aforementioned high functions, i.e., not only is the difference between the outside and inside pressures of the HDD attained, but the purification of the outside air, the inflow restriction on the outside air, and the high efficient absorption of the organic out gas in the HDD interior (which cannot be attained in the example of Figure 5) can also be attained. However, the number of thick components is increased and therefore thinning of the breather filter, which was originally easy because it is structurally simple, cannot be attained. Particularly, for example, in designing a thin-type HDD such as a 1-inch-type HDD, it is difficult to attach such a high-function breather filter of the conventional construction, as it is, to the HDD.

[0006]

The object of the present invention eliminates the aforementioned problems, thereby providing a breather filter for an HDD which is capable of thinning a high-function breather filter in a manner that is high in mass production.

[0007]

[Summary of the Invention]

The present invention relates to a breather filter that is employed in a hard-disk drive (HDD) by attaching it to a hole provided in the cover of the HDD. The breather filter of this kind is configured, by preparing a first sheet forming a diffusing tube at a position corresponding to the hole provided in the cover of the HDD, a second sheet forming an opening at a position corresponding to the diffusing tube of the first sheet, a third sheet having an adsorbent layer at a position corresponding to the opening in the second sheet, and a fourth sheet comprising a filter layer covering the adsorbent layer of the third sheet and also by stacking the prepared first sheet, second sheet, third sheet, and fourth sheet.

[0008]

In the present invention, the breather filter is configured by stacking the first sheet through the fourth sheets respectively comprising thin sheets. This configuration can attain a thin breather filter that can be mounted on a thin-type HDD such as a 1-inch-type HDD. The breather filter of the present invention can also attain the same functions as the conventional breather filter, such as purification of the outside air, an inflow restriction on the outside air, a reduction in a humidity change, and a high efficient absorption of organic out gas in the HDD interior, by forming the diffusing tube and the adsorbent layer in the respective sheets.

[0009]

In a preferred form of the present invention, the first sheet, the second sheet, the third sheet, and the fourth sheet are stacked by adhesion. In another preferred form, the first and third sheets are stacked by adhesion, by configuring them by

adhesive double-coated tapes. In addition, an adsorbent layer provided in the third sheet is configured by an active carbon fiber containing a carbonate. Moreover, the adsorbent layer provided in the third sheet is configured so that it covers the entire opening formed in the second sheet. Furthermore, the adsorbent layer provided in the third sheet is configured so that it covers a portion of the opening formed in the second sheet. In either configuration, the high function required of the breather filter can be attained at higher efficiency.

[0010]

[Preferred embodiment]

Figure 1 is a sectional view showing a configuration example of a breather filter for an HDD, according to the present invention. Figures 2(a) - (d) are plan views showing each sheet configuring the breather filter shown in Figure 1, respectively. The breather filter 1 shown in Figures 1 and 2 is mounted at a position corresponding to a hole 3 in the cover 2 of an HDD. The breather filter 1 in this embodiment is configured by stacking a first sheet 11 formed with a diffusing tube 12 at a position corresponding to the hole 3 provided in the cover 2 of the HDD, a second sheet 21 formed with an opening 22 at a position corresponding to the diffusing tube 12 of the first sheet 11, a third sheet 31 with an adsorbent layer 32 at a position corresponding to the opening 22 of the second sheet 21, and a fourth sheet 41 comprising a filter layer covering the adsorbent layer 32 of the third sheet 31.

[0011]

In this embodiment, the first sheet 11 is configured by adhesive double-coated tape. The first sheet 11 determines the configuration of the diffusing tube 12, in addition to fixation of the breather filter 1 to the cover 2 of the HDD and ensuring airtightness. To meet conflicting requirements such as a proper amount of pressure loss for breathing and an inflow

restriction on the outside air, the characteristics of the diffusing tube 12 must be controlled. However, in this case the characteristics of the diffusing tube 12 can easily be controlled by the thickness of the adhesive double-coated tape configuring the first sheet 11 and the width of the diffusing tube 12. The second sheet 21 is configured by an airtight film. The second sheet 21 forms the diffusing tube 12 along with the cover 2. In other words, for the diffusing tube 12, the four sides in the depth direction of the breather filter 1 is formed with the adhesive double-coated tape, the top surface is formed with the cover 2, and the bottom surface is formed with the second sheet 21. The opening 22 in the second sheet 21 is used for guiding the outside air passed through the diffusing tube 12 to the underlying third sheet 31.

[0012]

The third sheet 31 is configured by an adsorbent layer 32 and adhesive double-coated tape surrounding the layer 32. As the adsorbent layer 32, a mixture of a carbonate and silica gel is employed with active carbon as a main component. The adsorbent layer 32 can adsorb organic gas and acid gas and can also adsorb vapor. The fourth sheet 41 is configured by a particle filter. The fourth sheet 41 is used to prevent particle contamination and fixed by the adhesive double-coated tape configuring the third sheet 31. From the foregoing description it follows that the basic functions of the breather filter 1 are configured by sheets of four thin simple layers.

[0013]

Furthermore, in the breather filter 1 with the structure shown in Figures 1 and 2, the adsorbent layer 32 is exposed to the interior of the HDD through only the fourth sheet 41 configured by the particle filter, so it can adsorb the out gas produced in the interior of the HDD. At the same time, the adsorbent layer 32 can also absorb the vapor entering the interior of the HDD and reduce a rise in the relative humidity of the HDD

interior. Of course, these functions can be obtained without providing an additional filter. Since the aforementioned breather filter 1 of the present invention is thin, it can be practically increased in area without difficulty and it is also easy to further enhance the aforementioned adsorbing property.

[0014]

Note that in the breather filter 1 with the structure shown in Figures 1 and 2, the entire opening 22 in the second sheet 21 is covered with the adsorbent layer 32 of the third sheet 31. That is, air is passed through the adsorbent layer 32 and purified. For this reason, it is preferable that the breather filter 1 in this embodiment be used when air is easily passed through the adsorbent layer 32. Also, it is generally preferable that, as the adsorbent layer 32, fibrous active carbon be employed in the form of cloth.

[0015]

Figure 3 is a sectional view showing another configuration example of the breather filter for an HDD, according to the present invention. Figures 4(a) - (d) are plan views showing each sheet configuring the breather filter shown in Figure 3, respectively. In the embodiments shown in Figures 3 and 4, the same reference numerals will be applied to the same members as those shown in Figures 1 and 2 for omitting a description thereof. In the breather filter with the configuration shown in Figures 3 and 4, the point differing from the breather filter 1 with the configuration shown in Figures 1 and 2 is that, by providing an adsorbent opening 33, a portion of the opening 22 in the second sheet 21 is covered with the adsorbent layer 32 of the third sheet 31. That is, air is passed through the surface of the adsorbent layer 32 and purified. For this reason, it is preferable that the breather filter 1 in this embodiment be used when air is not easily passed through the adsorbent layer 32. Normally, if the adsorbent layer 32 with the weight of active carbon increased by compressing active

carbon onto the sheet is used, a rise in the humidity of the interior of the HDD can be suppressed more effectively. However, in that case, air is not easily passed through. Therefore, it is preferable that air be purified by surface diffusion, as in this embodiment.

[0016]

Actually, in the configuration shown in Figures 1 and 2, the breather filter 1 of the present invention was made by stacking the first sheet 11, the second sheet 21, the third sheet 31, and the fourth sheet 41 shown below. Here, as the first sheet 11, an acrylic adhesive double-coated tape of 150 μm in thickness having a 1.5 × 20-mm slit for forming the diffusing tube 12 was employed. As the second sheet 21, the 3 × 2-mm opening 22 employed a PET film of 150 μm in thickness. As the third sheet 31, an active carbon fiber of 150 μm in thickness, combined with acrylic adhesive double-coated tape of 150 μm in thickness binding potassium carbonate in the form of 22 × 4 mm, was employed. As the fourth sheet 41, a PTFE membrane filter of 70 μm in thickness was employed. With this, the breather filter 1 thinned to a thickness of 520 μm is obtainable and the obtained breather filter 1 can be mounted interiorly of the HDD. In addition, as the characteristics of a 1-inch-type HDD employing this breather filter 1, conflicting characteristics, i.e., a pressure loss of 9 mmH_2O (3 ml/min) and a relative humidity time constant of 250 hours are compatible.

[0017]

[Advantages of the invention]

According to the present invention, as apparent from the foregoing description, the breather filter is configured by stacking the first sheet through the fourth sheets respectively comprising thin sheets. This configuration can attain a thin breather filter that can be mounted on a thin-type HDD such as a 1-inch-type HDD. The breather filter of the present

invention can also attain the same functions as the conventional breather filter, such as purification of the outside air, an inflow restriction on the outside air, a reduction in a humidity change, and a high efficient absorption of organic out gas in the HDD interior, because the diffusing tube and the adsorbent layer are formed in each sheet.

Brief Description of the Drawings:

Figure 1 is a sectional view showing a configuration example of a breather filter for an HDD, according to the present invention;

Figures 2(a) - (d) are plan views showing each sheet configuring the breather filter shown in Figure 1;

Figure 3 is a sectional view showing another configuration example of the breather filter for an HDD, according to the present invention;

Figures 4(a) - (d) are plan views showing each sheet configuring the breather filter shown in Figure 3;

Figure 5 is a sectional view showing a configuration example of a conventional breather filter for an HDD; and

Figure 6 is a sectional view showing a configuration example of the conventional breather filter for an HDD.

[Description of symbols]

1 ... Breather filter
2 ... Cover
3 ... Hole
11 ... First sheet
12 ... Diffusing tube
21 ... Second sheet

22 ... Opening
31 ... Third sheet
32 ... Adsorbent layer
33 ... Adsorbent opening
41 ... Fourth sheet

Claims:

(1) A breather filter that is employed in a hard-disk drive by attaching it to a hole provided in a cover of said hard-disk drive, the breather filter comprising:

a first sheet forming a diffusing tube at a position corresponding to said hole;

a second sheet forming an opening at a position corresponding to said diffusing tube of said first sheet;

a third sheet having an adsorbent layer at a position corresponding to said opening in said second sheet; and

a fourth sheet including a filter layer with which said adsorbent layer of said third sheet is covered,

wherein said first sheet, said second sheet, said third sheet, and said fourth sheet are stacked.

(2) The breather filter as set forth in Claim 1, wherein said first sheet, said second sheet, said third sheet, and said fourth sheet are stacked by adhesion.

(3) The breather filter as set forth in Claim 2, wherein said first and third sheets are configured by adhesive double-coated tapes, respectively.

(4) The breather filter as set forth in Claim 1, wherein said adsorbent layer provided in said third sheet is configured by an active carbon fiber containing a carbonate.

(5) The breather filter as set forth in Claim 1, wherein said adsorbent layer provided in said third sheet is configured so that it covers the entire opening formed in said second sheet.

(6) The breather filter as set forth in Claim 1, wherein said adsorbent layer provided in said third sheet is configured so that it covers a portion of said opening formed in said second sheet.