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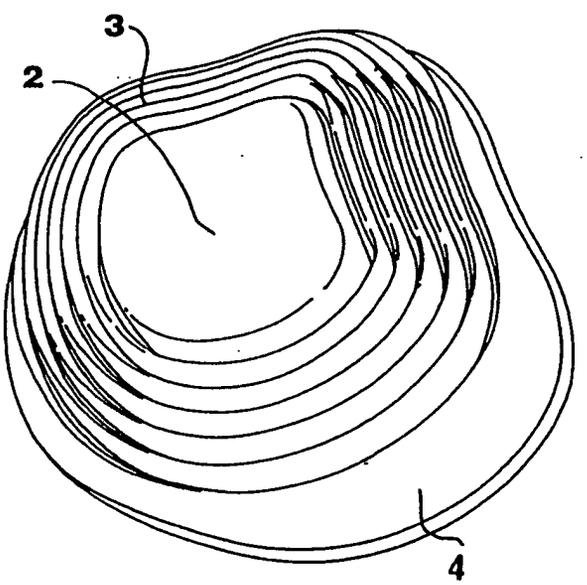
(54) A filter and a disposable dustproof mask with use of said filter

(57) A filter characterizing to be folded to have bellows shape, wherein said filter is peaked at the center position which covers the nose part and gradually becomes lower with steps toward the peripheral brim, and a disposable dustproof mask using said filter.

Fig.1



EP 1 243 291 A1

Description

[0001] The present invention relates to a filter having high dust catching efficiency with low breathing resistance and the dropping of dust catching efficiency is small, further relates to a disposable dustproof mask that uses said filter.

[0002] Regarding to the shape of the filter attached to the conventional filter replaceable dustproof mask, in a case of mechanical filter, it is usual that the filter is folded as a concentric circle or folded in parallel. Further, in a case of an electrostatic filter, a flat shape as cut filter is usually used. And in a case of a disposable dustproof mask or a simplified mask, the use of an electrostatic filter is popular. The structural feature of the conventional disposable dustproof mask can be illustrated as follows. That is, a main filter, which catches fine particles of dust, is arranged at center, and a pre-filter which catches larger size particles of dust is arranged to the outer side of it, further to the inner side of it, a sub-filter which maintains the shape of mask is arranged, these three filters are assembled to one body and forms a filtering part. The face contacting part whose corresponding part to nose an mouth is opened is arranged to said filtering part. The filtering part of main filter is molded to have a cap shape by drawing after heated or by laminating several sheets of flat plate.

[0003] As the material, which is used as a main filter, electrified treated non-woven cloth is generally used, and can be classified to two types according to the principal of dust catching mechanism. One is an electrostatic filter and another one is a mechanical filter. The electrostatic filter is a filter to attract and to catch dusts by static electricity which said filter has, however, has a disadvantage that when oil mist is caught the dust catching efficiency is deteriorated because the electric charge is lost by the effect of caught oil mist. On the contrary, the mechanism of the mechanical filter is very simple, which depends on the structural feature and arrangement of the filter, therefore the dust catching efficiency is not deteriorated even if oil mist is caught. However, the material of the mechanical filter is structurally very fine, and the breathing resistance per unit area of it is higher than that of the electrostatic filter. Therefore, for the purpose to reduce the breathing resistance of it, it is necessary to enlarge the actual filtering area, and so it is necessary to assemble the mask cubically.

[0004] Further, when a complex fiber composed of e.g. glass fiber, which is used as the filter of the filter replaceable dustproof mask, is used as the material of filter, it is necessary to enlarge the effective filtering area, because the breathing resistance of said complex fiber is higher than that of electrified treated non-woven cloth.

[0005] Concerning the above mentioned current situation, the inventors of the present invention have conduced intensive study to develop a filter and a disposable mask characterizing of compact appearance, having high catching efficiency maintaining lower breathing resistance, further characterizing less dropping of catching efficiency, and accomplished the present invention. That is, the object of the present invention is to provide a filter and a disposable mask which has effective filtering area without raising breathing resistance and has high catching efficiency, further characterizing the dropping of catching efficiency is small.

[0006] The important points of the present invention can be illustrated as follows. Namely, a filter characterizing to be folded to have bellows shape, wherein said filter is peaked at the center position which covers the nose part and gradually becomes lower with steps toward the peripheral brim. Further, a cap shape disposable dustproof mask which covers mouth and nose comprising, a filtering part composed of a pre-filter, a main filter and a sub-filter and a face contacting part, wherein a filter of said main filter is characterized by folded to have bellows shape and is peaked at the center position which covers the nose part and gradually becomes lower with steps toward the peripheral brim. The material of said filter is desirably a product obtained by manufacturing of the mixture of glass fiber, rayon, pulp and active carbon fiber.

[0007] Namely, the present invention has realized the disposable dustproof mask which has high catching efficiency, low breathing resistance and the dropping of catching efficiency is slow; that is, by folding a filter used as a main filter to have bellows shape and is peaked at the center position which covers the nose part and gradually becomes lower with steps toward the peripheral brim, and to maintain large effective filtering area without changing appearance and size i.e. keeping the projection area same to the conventional disposable dustproof mask.

[0008] Fig.1 is the perspective view of the filter of this invention

[0009] Fig.2 is the plane view of the filter of this invention

[0010] Fig.3 is the AA center line cross sectional view of the filter of this invention

[0011] Fig.4 is the perspective illustrating view showing the construction of the disposable dustproof mask of this invention

[0012] In the drawing, each numerical numbers indicates; 1: filter (main filter), 2: center part which covers nose, 3: folded part, 4: outermost peripheral brim, 5: pre-filter, 6: sub-filter, 7: face contacting part, 8: fastening string fitting clamp

[0013] The present invention will be illustrated more readily as follows.

[0014] The filter of the present invention is folded to have bellows shape and is peaked at the center position which covers the nose part and gradually make lower with steps toward the peripheral brim. As the material of the filter used in the present invention, non-woven cloth composed of cellulose fiber or synthetic fiber which is used as the conventional mask of this kind can be used, however, it is desirable to use the non-woven cloth composed of glass fiber, rayon,

active carbon fiber or the mixed fiber thereof. The filter is fabricated by manufacturing these kinds of fiber, and then formed as follows; the highest part which covers nose part is formed at the center and is folded to have bellows shape gradually with steps toward the lower outskirts part which covers mouth part.

[0015] Fig. 1 is the perspective view and Fig.2 is the plane view of the filter of this invention, further, Fig.3 is the AA centerline cross sectional view of said filter. In Figs.1 to 3, the filter 1 is consisted of center part 2 that covers nose part, folded bellows shape part 3 and outskirts part 4 that covers mouth part. This filter is used as the filter part of the dustproof mask.

[0016] The disposable dustproof mask of this invention is also called as a simplified mask, and indicating a mask excepting a filter changeable dustproof mask. And the structural feature of the disposable dustproof mask of this invention can be illustrated as follows; that is, the filtering part composed of a pre-filter, a main filter and a sub-filter and the face contacting part form one body and can be put on a face using a fastening string.

[0017] The pre-filter catches relatively larger particles and protect the main filter from loading. The main filter is the filter which decide the ability of the disposable dustproof mask of the present invention, and above mentioned filter material of the present invention is used. That is, the filter is folded to have bellows shape and is peaked at the center position which covers nose part and gradually become lower with steps toward the peripheral brim (refer to Figs 1 to 3). The sub-filter is arranged to support the main filter.

[0018] The center part of the face contacting part has an opening at the center part which corresponds to nose and mouth part, and the outer peripheral part of it is contacted to above mentioned filtering part so as to be tightly contacted to face. The face contacting part is made from thermo-plastic resin and is adhered to the outermost peripheral brim of the filtering part composed of a pre-filter, a main filter and a sub-filter by heat fusing.

[0019] The construction of the disposable dustproof mask of the present invention is illustrated in Fig.4. In the disposable dustproof mask of the present invention, the main filter 1 that uses above mentioned filter material is placed at the center and the pre-filter 5 is arranged at the outside, further, the sub-filter 6 is arranged at the inner side, then these are assembled to form one body which composes the filtering part. The face contacting body 7 is laminated to the sub-filter 7 and the filtering part and the face contacting part is adhered to form one body, further fastening string fitting clamps 8 are fitted to the outermost peripheral brim of it.

[0020] According to the kind of material which compose the main filter, the sub-filter can be omitted, that is, the main filter can be consisted of a main filter and a pre-filter.

[0021] One example of the preparing method of the filter of this invention is illustrated as follows. As the first step, glass fiber is manufactured using a screen of paper manufacturing machine and is set to a folding machine. Said folding machine is a cylindrical forming machine which can fold the work by nest shape. The non-woven cloth made of glass fiber is folded by steps and is folded to have bellows shape so as the center position is the highest and gradually becomes lower toward the outermost periphery.

EXAMPLE

Example 1

[0022] The filter composed of glass filter, rayon and pulp is used as the main filter. As shown in Fig.4, said main filter is placed at the center, and the pre-filter consisted of polyolefin type fiber non-woven cloth and a net is arranged at the outside of it and at the inner side of it, sub-filter made of polyolefin type fiber non-woven cloth is arranged, then laminated them to one body.

[0023] The ability of the obtained disposable dustproof mask is measured, and also the deterioration test of the mask is carried out.

[0024] Dioctyl phthalate (DOP) or sodium chloride (NaCl) is used as the test particles for the catching ability measuring method. Air in which test particles are contained is supplied to the inside of the dustproof mask attached to a particle catching ability measuring apparatus by 85 L/min. flow rate. The concentration of particles contained in the test air before and after passing through the dustproof mask are continuously measured until the total numbers of particles supplied to the filter reaches to the prescribed value, using a test particle concentration measuring apparatus based on scattering ray method.

[0025] As the test air containing test particles, following air can be used. Namely, when DOP is used, the air characterizing center value of particles size distribution of DOP mist is from 0.15 to 0.25 μm and the geometrical standard deviation of it is smaller than 1.6, further, DOP concentration is smaller than 100 mg/1m^3 and the variation of it is smaller than ±15% is used. Meanwhile, in a case when NaCl is used, the air characterizing center value of particles size distribution of NaCl is from 0.06 to 0.1 μm and the geometrical standard deviation of it is smaller than 1.8, further, NaCl concentration is smaller than 50 mg/1m^3 and the variation of it is smaller than ± 15% is used. And the prescribed value at the end of test, is 200 mg in a case of DOP and 100 mg in a case of NaCl.

[0026] In the deterioration test of the mask, NaCl particles is used as the test particles which gives mild deterioration,

while, DOP (dioctyl phthalate) is used as the particles which gives remarkable deterioration to the mask.

[0027] The obtained results are summarized in Table. 1.

Table 1

No	particles catching efficiency (%)		breathing resistance (Pa)resistance (Pa)L/min)
	NaCl	DOP	
1	98.4	96.2	38
2	98.0	96.3	38
3	97.6	96.3	36

Effect of the invention

[0028] As mentioned above, since the disposable dustproof mask is formed to have a profile of cap shape similar to the conventional mask, the size is small. And the effective filtering area of main filter of the mask is enlarged by folding the filter to have bellows shape so as the center part which covers nose make high and gradually make lower with steps toward the peripheral end. Further, since the filtering part and the face contacting part are formed separately and then assembled to one body, filtering area of filtering part can be used effectively without useless area. Therefore, the feature of the filter can be adjusted concerning the features of kinds of particle, and can prepare a mask fitted to the uses. Especially, the high efficiency filter can be prepared adjusted for the fine particles of 0.3 μm particles size of DOP.

Claims

1. A filter characterizing to be folded to have bellows shape, wherein said filter is peaked at the center position which covers the nose part and gradually becomes lower with steps toward the peripheral brim.

2. The filter of claim 1, wherein the material of said filter is a product obtained by manufacturing the mixture of fibers selected from the group consisting of glass fiber, rayon, pulp and active carbon fiber.

3. A cap shape disposable dustproof mask which covers mouth and nose comprising, a filtering part composed of a pre-filter, a main filter and a sub-filter and a face contacting part, wherein a filter of said main filter is **characterized by** folded to have bellows shape and is peaked at the center position which covers the nose part and gradually becomes lower with steps toward the peripheral brim.

Fig.1

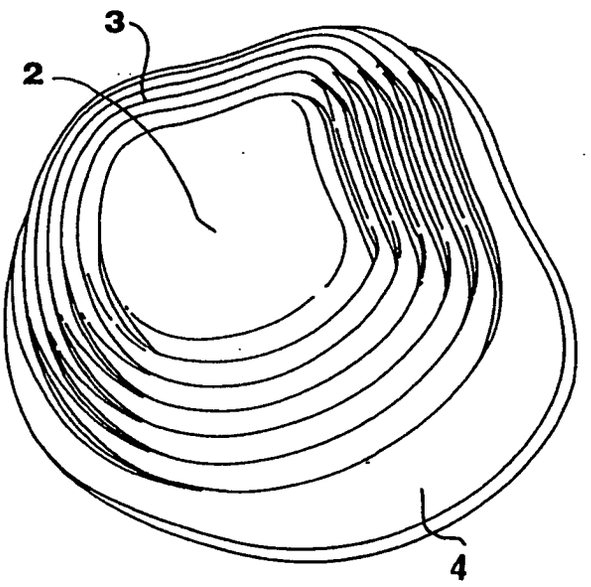


Fig.2

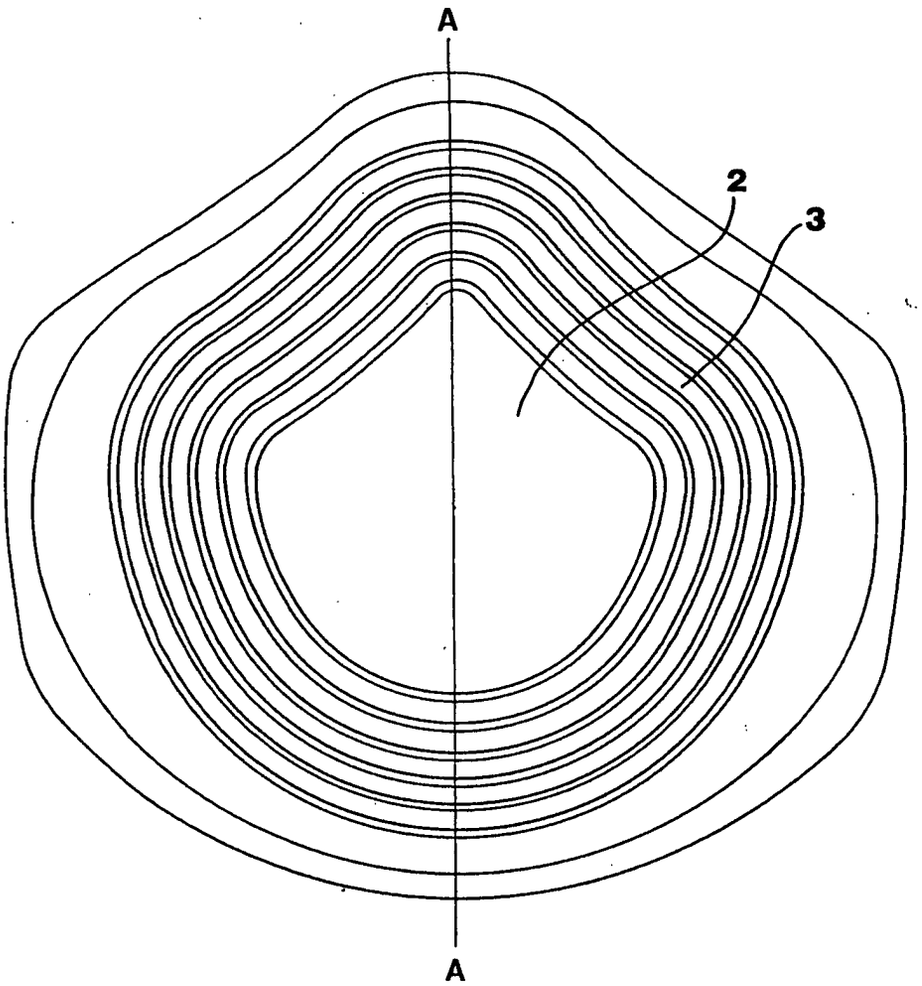


Fig.3

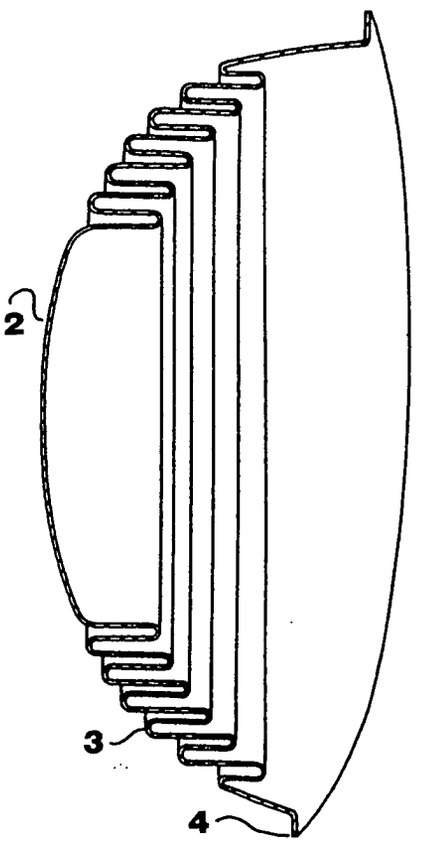
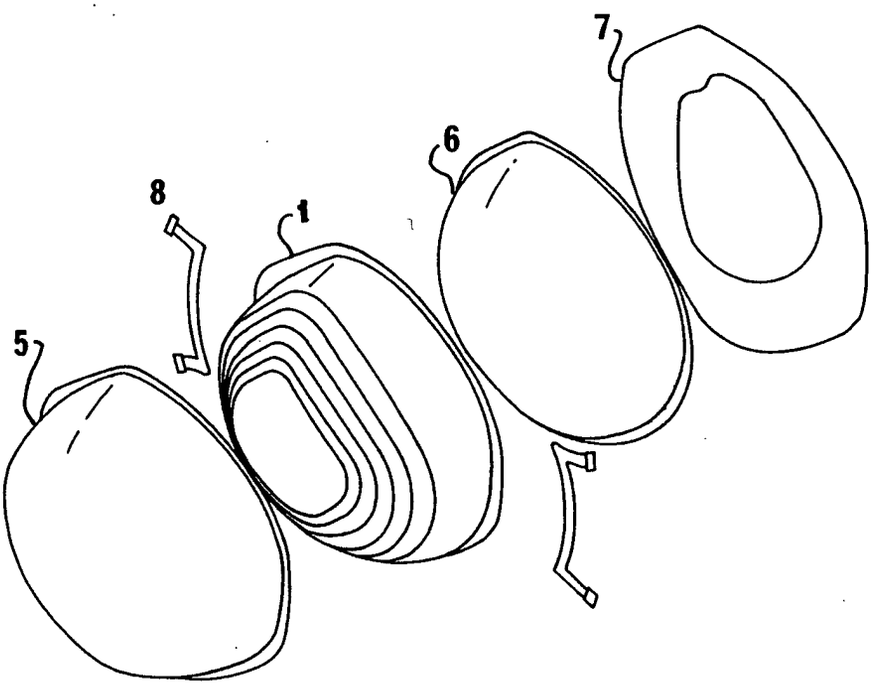


Fig.4



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EUROPEAN SEARCH REPORT

Application Number
EP 02 00 6551

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TECHNICAL FIELDS SEARCHED (Int.Cl.7)

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	10 July 2002	Neiller, F

CATEGORY OF CITED DOCUMENTS

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