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54 **Protective respirator.**

57 Respiratory protection means having a cup-shaped filter material body (1), the outer end of which is so executed at its edge as to exhibit an element (2) intended to make contact with the face in such a way that the nose and mouth of the wearer are enclosed within the space formed inside the cup shape. During inhalation the air from the surroundings will be obliged in this way to pass through the filter material body, whereas an exhalation valve (8) can be provided to permit exhalation. The filter material body (1) exhibits at least one strip of filter material pleated in its transverse sense, for example a strip of filter paper, which has been given said cup shape. The element intended to make contact with the face consists of a ring (2) of a material which, by casting or some similar process, has been attached to one of the edge parts of the pleated filter material body so as to form an airtight connection, whereas the opposite edge part of the filter material body has been attached in a similarly airtight fashion to a plate (3) or similar which seals the outer end edge of the filter material body.

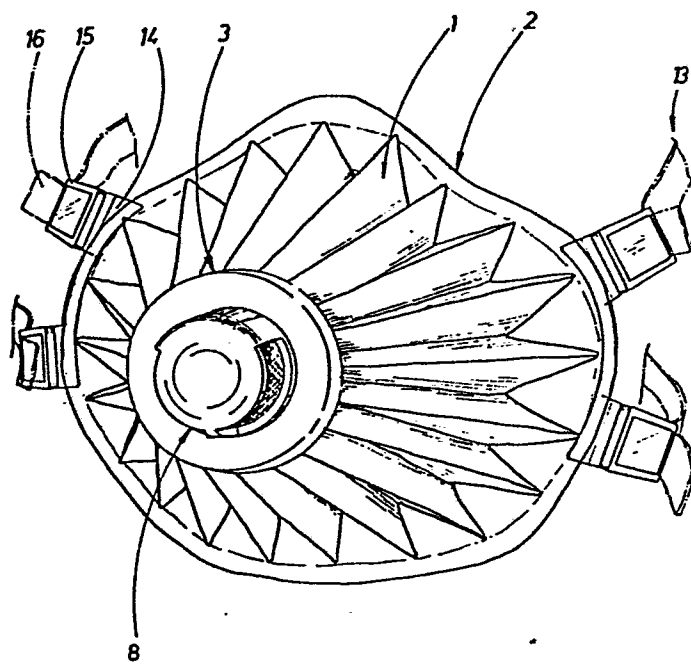


FIG. 1

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Respiratory protection means

The present invention relates to a respiratory protection means intended to be worn over the mouth and nose for the purpose of protecting the respiratory system from pollution.

The respiratory protection means comprises a cup-shaped filter material body, the outer end of which is so executed at its edge as to exhibit an element intended to make contact with the face of a wearer in such a way that either the wearer's nose or mouth or preferably both are enclosed within the space formed inside the cup shape in such a way that the air from the surroundings will be obliged to pass through the filter material body and into said space.

The arrangement of a respiratory protection means of the kind described above is already familiar. Protection means of this kind are worn in those cases, for example when working, in which air pollution in the form of gas, dust or liquid particles may be encountered.

Depending on the nature of and the potential danger from the particles, the requirement for comfort to be assured when wearing the protective means, and the level of cost considered to be reasonable in relation to its use, respiratory protection means of the kind described above have been given various designs. The present invention relates to a protective means of a relatively conventional type which may be used in the course of work where dust or mist, for example oil mist, is encountered. Respiratory protection means of this kind are executed in the form of a cup of a fibrous material, the edge of which extends from the bridge of the nose and down around the mouth. Breathing takes place through the fibrous material, which may be paper pulp or a similar material or a non-woven fibre fabric in one or more layers. If the material is relatively dense, the respiratory protection means is provided with an exhalation valve. In its simplest form a respiratory protection means of this kind will to all intents and purposes possess the characteristics of a disposable item, and these are intended on the whole to last only for a relatively short period, with no provision being made for regeneration after becoming dirtied by replacement of the filter material or by washing. This

means that a requirement exists for a relatively low price to be achieved. In the case of the simplest protection means, which consist only of a cup of a cellulose material, this requirement is easily met, although on the other hand the ability to trap particles will be limited and such protection means may be used only where particles, and not gases, are present, and primarily with relatively coarse dust particles. In order to broaden the field of application of such simple types of breathing masks, attempts have been made to manufacture them from a more complex textile material, although this had the effect of very considerably increasing their resistance to breathing.

The object of the present invention is to produce a respiratory protection means which falls within the aforementioned class of simple protection means intended to be thrown away once they have become choked with trapped material, said respiratory protection means not only exhibiting an excellent trapping ability enabling it to be executed for the purpose of trapping harmful gases and extremely fine particles, and even oil mist, but also exhibiting low resistance to breathing in spite of this.

A further object of the invention is to utilize in the manufacture of the respiratory protection means well-proven methods used in the production of certain other types of filter, enabling a suitable product to be manufactured at low cost.

The object of the invention is achieved by executing the respiratory protection means in such a way that the filter material body exhibits in a previously disclosed fashion at least one strip of filter material pleated in its transverse sense, wherein the ends of the one or more strips have been connected together in such a way as to form a ring which, by the spreading out of its pleats for this purpose has been given said cup shape, wherein the element intended to make contact with the face consists of a ring of a material which, by casting or some similar process, has been attached to one of the edge parts of the one or more pleated filter material strips so as to form an airtight connection, whereas the opposite edge part of the filter material body has been attached in a similarly airtight fashion to a plate or similar, which permits the sealing of the outer end edge of the filter material body.

An embodiment of the invention is shown in the accompanying drawings. Fig. 1 shows a perspective view of the respiratory protection means from the front; Fig. 2 shows a section along the line II-II in Fig. 3; and Fig. 3 shows a section along the line III-III in Fig. 2. The respiratory protection means in accordance with the invention may be seen from the Figures to consist of a filter material body 1 which exhibits a pleated strip 4 of a particle-trapping filter material, for example stiff filter paper. The material is selected to exhibit a particle trapping capacity such that the filtration capacity is suitable for the intended area of use. It is customary to divide up respiratory protection means intended to trap particles in the following classes: coarse, solid particles; fine, solid particles, and oil mist. As a general rule the trapping capacity specified for a particular respiratory protection means should be no better than that which is necessary, in view of the fact that a denser filter material will produce greater resistance to breathing. However, in the case of the respiratory protection means in accordance with the invention the filtration area provided is so large that a denser material can be used throughout with the aim of reducing the number of different versions of the respiratory protection means.

In the embodiment illustrated and described here it has been assumed that the strip 4 of filter material consists, as has been mentioned already, of a particle-trapping filter material. Depending on the nature of the material selected, this is able to trap dry and even liquid particles, but not gaseous particles. It is assumed in this particular embodiment, however, that there is present ahead of the strip 4 of filter material a second strip 5 of filter material consisting of a filter material coated with fine particles of active carbon. Active carbon is known to possess the ability to fix gas molecules of a certain complexity at its surface. Since harmful gases generally have a relatively complex molecular structure, the majority of the toxic gases encountered can be trapped in a filter material containing active carbon.

Although this particular embodiment is shown to have two strips of filter material, both strips need not be present in all designs. Pollution in the form of particles only, such as are produced in

grinding operations, for instance, is encountered in a large number of applications, and in cases such as these it is permissible to select a design containing only the strip 4 of filter material. In this way the cost of the respiratory protection means is not increased unnecessarily, and a lower flow resistance is, of course, achieved from a single strip than from multiple strips.

A carbon filter on its own is not, as a general rule, chosen for respiratory protection means, although an outer, particle-trapping filter is usually present in accordance with what is illustrated in relation to this embodiment. In special circumstances the respiratory protection means in accordance with the invention is executed with additional strips of filter material, including those of a kind other than that indicated above, but without departing from the idea of invention.

Where a number of strips of filter material are employed, these are best pleated in an identical manner and laid one against the other with the pleats engaging one inside the other as shown in Fig. 2.

The filter material consists originally of a long strip, which is then pleated in order to reduce its length. The pleated strip is then given the conical form illustrated here, which is finished off by having the free ends of the strip stuck together. The pleating of the material gives it a large surface area, providing low flow resistance and high trapping capacity in respect of the pollutants, thereby providing a long service life. The pleated form also provides excellent mechanical strength, especially if the strip is bent into cylindrical form.

The two pleated strips are maintained in the conical form illustrated, and a plastics material is cast around their edges. The plastics material used should preferably be PVC, which is easily worked and produces a soft, elastic body. Previously disclosed for use in the casting process is the substance known as plastisol, this being a viscous mass which is injected into a mould, whereupon it is caused to gelate by the application of heat.

The casting mould used for this purpose is executed in such a way that the plastics body produced at the outer end of the conical form is given a shape suitable for making contact with the face of the

person who is to wear the respiratory protection means. This plastics body is referred to below as the face ring 2 . At the narrower end of the pleated, conical strips 4 and 5 of filter material there is cast in position a second plastics body, referred to below as the end plate 3 . The two plastics bodies 2 and 3 are cast in such a way around the edges of the strips 4 and 5 of pleated material as to provide complete airtight sealing at this point, thereby producing a space 7 inside the respiratory protection means, into which space air inhaled through the ring 2 pressed against the wearer's face is able to flow from the surroundings only by passing through the filter material contained in the filter material body 1 .

To the material of the face ring 2 there is attached by casting an adjustable strap 13 by means of which the breathing mask can be held against the face. This consists of four short lengths of tape 14 projecting from the ring 2 , said short lengths of tape being attached in pairs by means of the clamps 15 to two longer tapes 16 (of which only short, connecting sections are shown).

In the embodiment shown here, the end plate 3 supports an exhalation valve 8 which may be cast as an integral part of the material of the plate 3 in the same operation in which the plate 3 is formed and the strips 4 and 5 of filter material are attached. The exhalation valve 8 is intended to permit exhalation to take place with low resistance, which is necessary in order to facilitate respiration if the filter material in the strip 1 presents high flow resistance. In the case of a filter material having low flow resistance, and especially when working under less strenuous conditions, the exhalation valve may be omitted. The potential applications for the respiratory protection means in accordance with the invention appear to be particularly great in this respect, since the filter material possesses a very large surface area and also exhibits low specific flow resistance.

The exhalation valve 8 illustrated may consist of a housing 9 with a valve seat 10 against which an elastic disc, for example a rubber plate 11 is arranged to locate. In the presence of positive pressure inside the space 7 , the disc 11 will be caused to lift from the valve seat 10 , permitting air to flow out,

whereas in the presence of equalized pressure or negative pressure inside the space 7 , it will locate against the valve seat 10 , cutting off the flow of air.

When in use, the respiratory protection means is held against the face with the assistance of the adjustable strap 13 in such a way that the face ring 2 forms a seal against the upper part of the nose, over the cheeks, and around the mouth. The exhalation valve 8 will close as air is inhaled, and if the face ring 2 is required to make full contact with the face, the arriving air must flow through the strip 1 of filter material. Exhalation will produce a certain level of positive pressure inside the space 7 , and the exhalation valve 8 will open, permitting most of the exhaled air to flow out through it. In those cases in which it is preferred not to provide an exhalation valve, air will also flow through the strip 1 of filter material during exhalation. It will be appreciated that the air which is sucked inwards will first encounter the strip 4 of filter material on which particles are trapped and will then pass through the strip 5 of filter material where certain types of gas molecules can be trapped. The air, which is by this stage pure, can now be inhaled after having arrived in the space 7 .

The external dimensions of a respiratory protection means of this type are closely governed by the fact that its circumference must fit the face, and that it cannot be allowed to extend too far outwards in a longitudinal sense as it would then obstruct the vision and the freedom of movement of the wearer, at the same time as the gravitational torque would make the respiratory protection means uncomfortable to wear. In the case of the respiratory protection means in accordance with the invention, however, these dimensional limitations have been compensated for by causing the strip of filter material to be pleated, enabling the desired large surface area of filter material to be achieved within the limited, inscribed space available.

The desired simplicity of the respiratory protection means has been achieved by causing its structure to consist of the face ring and the outer plate, and for these to be connected to the filter material. As has already been stated, a material which exhibits such low

strength characteristics as paper is endowed with considerable rigidity and strength if the strip of material is pleated and formed into the shape of a cup and is also held securely around its edges. By the use of this design, all other forms of supporting structure or sleeve can be dispensed with. At the same time, the use of the casting process provides a very simple means of securing the edges of the strip of filter material, together with the necessary sealing of the ends, as well as the ring arranged to make contact with the face and serving also as an attachment point for the adjustable strap, all in a single operation. It is possible in this way to produce a very simple respiratory protection means which is also very inexpensive in relation to its functional capacity even under difficult operating conditions, and which can be so executed as to clean the air of both particles and gases.

The respiratory protection means can also be executed within the scope of the following Patent Claims in a manner other than that illustrated and described in connection with the preferred embodiment. As has already been stated, the choice of the materials for the filter material body, consisting of one or more pleated strips, is free depending on the cleaning capacity desired for a given area of application. Although the model illustrated, in which the respiratory protection means covers the nose and the mouth, is an acceptable design, the respiratory protection means illustrated in the drawings can, of course, as an alternative, constitute part of a full mask, for example a breathing mask equipped with eye protection means.

Patent Claims:

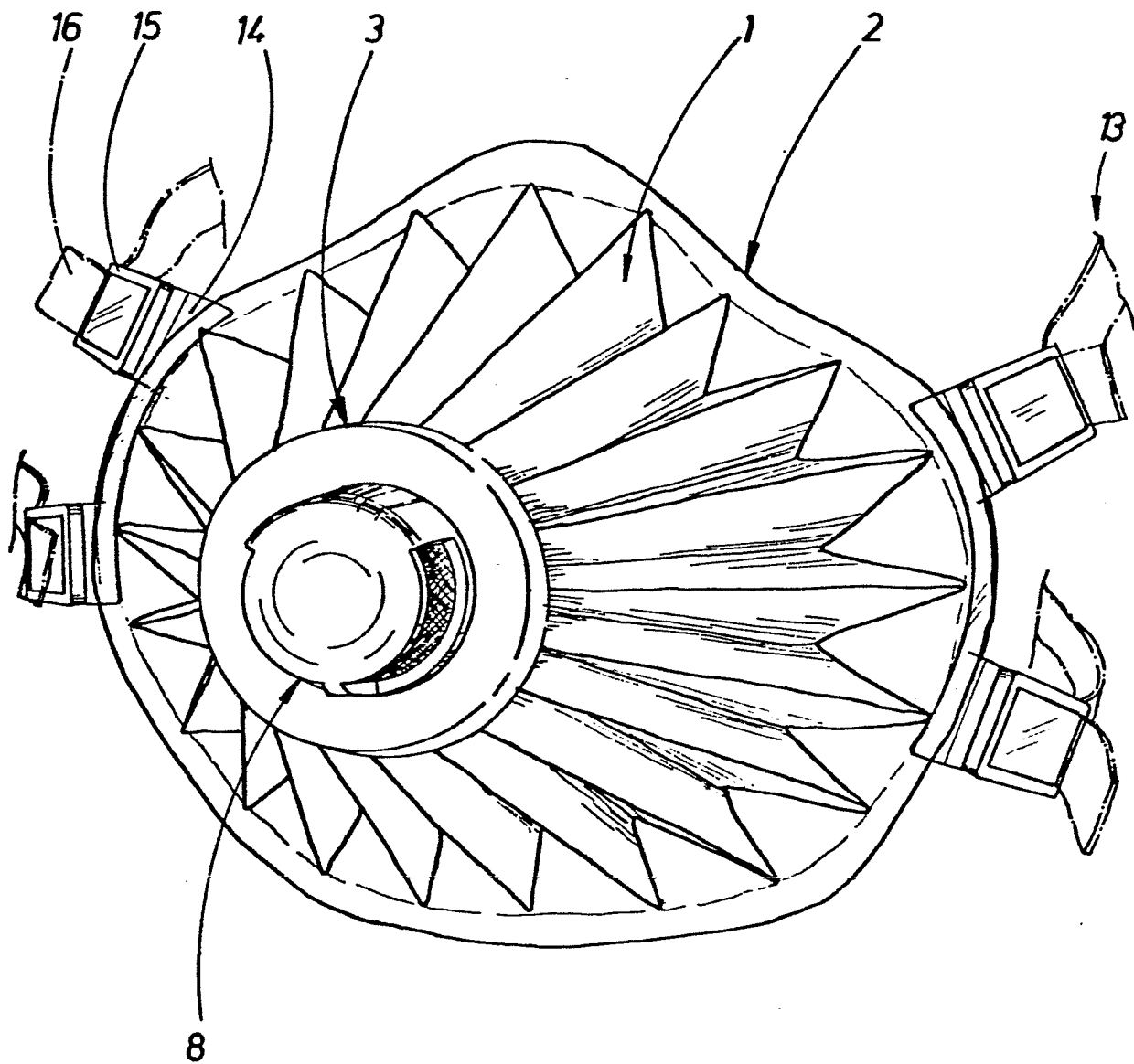
1. Respiratory protection means comprising a cup-shaped filter material body (1), the outer end of which is so executed at its edge as to exhibit an element (2) intended to make contact with the face of a wearer in such a way that either the wearer's nose or mouth or preferably both are enclosed within the space (7) formed inside the cup shape in such a way that, at least during inhalation, the air from the surroundings will be obliged to pass through the filter material body (1) and into said space (7), whilst an exhalation valve (8) can be provided to permit exhalation, c h a r a c t e r i z e d in that the filter material body (1) exhibits in a previously disclosed fashion at least one strip of filter material (4, 5) pleated in its transverse sense, for example a strip of filter paper, wherein the ends of said one or more strips have been brought together in such a way as to form a ring which, by the spreading out of its pleats for this purpose has been given said cup shape, wherein the element intended to make contact with the face consists of a ring (2) of a material which, by casting or some similar process, has been attached to one of the edge parts of the one or more pleated filter material strips so as to form an airtight connection, whereas the opposite edge part of the filter material body has been attached in a similarly airtight fashion to a plate (3) or similar, which permits the sealing of the filter material body at the supporting, outer end edge of the face protector.
2. Respiratory protection means as claimed in Patent Claim 1, c h a r a c t e r i z e d in that the ring (2) which forms the element intended to make contact with the face and the plate (3) or similar at the outer end edge of the filter material body (1) are made from a plastics material, preferably a polyvinyl chloride produced by the gelation of plastisol, attached by casting to each of the end edge parts of the filter material body (1).
3. Respiratory protection means as claimed in Patent Claim 2, c h a r a c t e r i z e d in that the filter material body (1) consisting of said strip or strips (4, 5) connecting together said ring (2) and plate (3) constitutes the structure of the respiratory protection means capable of providing the necessary mechanical

strength to hold the ring and the plate in their pre-determined relative positions.

4. Respiratory protection means as claimed in Patent Claims 2 or 3, c h a r a c t e r i z e d in that the ring (2) provided in order to
5 make contact with the face is so arranged as to form an attachment for an adjustable strap (13) for use when wearing the face protector by attachment components (14) for the adjustable strap having been combined with the material of the ring, preferably during said casting process.

10 5. Respiratory protection means as claimed in Patent Claims 1, 2, 3 or 4, c h a r a c t e r i z e d in that said plate (3) at the outer end edge of the filter material body (1) is so executed as to support an exhalation valve (8).

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FIG. 1

