

SPECIFICATION

Treating filter materials

The present invention relates to apparatus for the treatment of filter material to make it suitable for use in dust-proof masks.

- 5 In factories where large quantities of pulverized dust are generated, as in the case of the welding, casting and forging industries, wearing of a dust-proof mask is obligatory, and at present a filter for use in such a mask needs to be replaced every 1 to 3 days. 5

- The Applicants have proposed in the Specification of their Japanese Patent Application No. 52—34997 a treatment process for greatly improving the dust collecting efficiency of a filter material for use in a dust-proof mask in which the filter material is subjected to impregnation with synthetic resin, and having been dried to provide a resin film on the filter material, is subjected to a physical distortion treatment, such as bypassing it through an apparatus in which rolls are disposed in a zig-zag manner. 10 10

- As used herein the phrase "physical distortion treatment" means a treatment which is performed through purely a physical process and which does not use any chemical agent such as tannin. 15 15

Unwoven webs consisting of chemical fibres of polypropylene, rayon, or acrylic resin, either singly or in combination, woven webs, felt, foam rubber, urethane foam, etc can be used as the filter material.

With regard to the varieties of the synthetic resin to be impregnated, almost every resin such as vinyl acetate resin, acrylic resin, alkyd resin, polystyrol resin or phenolic resin can be used.

- 20 The process for the physical distortion treatment requires that the filter material be passed through the said apparatus for the purpose of improving its dust-collecting efficiency by generating fine cracks in the resin film on the filter material. However, in such an apparatus, since the said material is maintained in a stretched condition so as not to sag during its passage between the rolls, said material is considerably deformed after treatment. Thus, the apparatus has disadvantages in that the deformation results in difficulties with the process of cutting the treated filter material to a predetermined size, and also the dust-collecting efficiency is too low. 20 25

An object of the present invention is to resolve the above-described problem and also to provide apparatus for physical distortion treatment having improved efficiency and performance.

- According to the present invention, apparatus for the treatment of filter material to make it suitable for use in a dust-proof mask, is characterized in that at least one pair of treatment rolls are provided, each roll having cone or rectangular pyramid shaped protrusions with sharp tip ends formed regularly on its surface, the rolls of each pair being arranged substantially parallel to provide an adjustable gap therebetween and so that their respective protrusions and recesses mesh with each other in said gap, the arrangement being such that the gap can be adjusted in relation to the thickness of a web of filter material passed therethrough, and the tips of said protrusions are such that they pierce through, pull and tear the fibres of the web material so that the material as it separates from the rolls becomes fluffy to improve its dust collecting efficiency and to reduce its resistance to gas penetration. 30 35

- Preferably a number of spaced pairs of treatment rolls are provided to provide for a number of passes for a web of material fed therethrough. 40 40

- Conveniently, the apparatus includes a pair of pinch rolls arranged to be driven and to feed a web of material through the pair of pairs of treatment rolls, and may also include an uncoiler in front of a pair of pinch rolls, for supporting a wound web of untreated filter material, and a take-up roll behind the treatment rolls for taking-up the treated web of material, said uncoiler and take-up rolls being arranged to be driven substantially at the same speed as the pinch rolls. 45 45

In order that the invention may be readily understood and further features made apparent one preferred embodiment of apparatus for physical distortion treatment of filter material to make it suitable for use in a dust-proof mask according to the present invention will be described with reference to the accompanying drawings in which:—

- 50 Figure 1 is a perspective view of a treatment roll, 50

Figures 2a and 2b are schematic side and end views respectively of a pair of assembled treatment rolls, illustrating the state of the filter material as it passes between said rolls.

Figures 3a and 3b are schematic side and end views respectively,

Figures 4a and 4b are plan and side elevations respectively, and,

- 55 Figure 5 is a graph relating to the dust collecting rate of the apparatus. 55

- Figure 1 illustrates one example of a treatment roll 1 for the physical distortion treatment having V-shaped grooves machined in both the axial and circumferential directions of the roll, at equal pitches over its entire surface, so that sharp protrusions 7 consisting of the tip portions of rectangular pyramids are arrayed regularly both in the axial and circumferential directions. As shown in Figure 2 a pair of upper and lower rolls 1 are assembled so that their respective protrusions and recesses mesh with each other both in the axial and circumferential directions, both the upper and lower rolls being adapted to be driven. Referring now to Figure 3 as the filter material 8 is passed between the treatment rolls 1 it is deformed into a finely corrugated state whilst being pressed in both the axial and circumferential directions, and thereby the impregnatic synthetic resin is distributed more widely over the filter material. 60 60

In addition, since the tip end of the protrusions 7 on the surfaces of the rolls 1 are quite sharp, they pierce into the filter material 8 as it passes between the rolls, and through the outlet side (referenced A) of the rolls. When the tip ends of the said protrusions release from the filter material, they effect a pulling and tearing action to make the filter material fluffy. Due to the fluffy nature of the material so produced, the dust collecting efficiency of the filter material is improved, and its resistance to air permeation is reduced so that any undue difficulty in breathing by the wearer is alleviated.

Referring to Figure 4 the treatment apparatus comprises a mounting frame 6 supporting the treatment rolls 1 as well as a pair of pinch rolls 2, an uncoiler 3, a take-up roll 4 and a drive motor 5 for the pinch rolls 2.

The disposition and functions of the components of the present invention are as follows:—

A plurality of pairs of treatment rolls 1 are spaced along the frame 6 to provide a number of stages for treatment of the filter material 8. The pinch rolls 2 are arranged to be driven by the motor 5 for feeding the filter material and are provided in front of the rolls 1. The uncoiler is disposed in front of the pinch rolls 2 and is intended to support wound webs of untreated filter material; said uncoiler is

arranged to be rotated by a further motor at the same speed as the pinch rolls 2 for assisting the feeding by said pinch rolls. The take-up roll 4 provided for winding up the treated filter material 8 is provided behind the rolls 1 and is also arranged to be driven by a motor preferably at the same speed as the pinch rolls and uncoiler. If the apparatus for associated processes before and after the physical distortion treatment process are arranged in a line, then either or both the uncoiler 3 and the take-up roll 4 are unnecessary, since it becomes possible to feed from one apparatus directly to the next. For example, the treatment apparatus could be connected directly to apparatus for cutting the filter material into predetermined lengths, in which case the feed-in of this apparatus would render the take-up roll 4 unnecessary.

An example of a treatment process and apparatus therefore in accordance with the invention will now be described.

The filter material comprising a mixed woven web consisting of 80% polypropylene and 20% rayon was vacuum-impregnated with a vinyl acetate resin emulsion. Excess liquid was squeezed out by means of rolls, and the filter material was then dried with a hot blower type of dryer, set at 105°C. The dried filter material was passed through the above described physical distortion treatment apparatus and the treatment was performed whilst varying the gap between the treatment rolls as well as varying the number of times the filter material was passed between the rolls. As a result of measuring the relationship between the dust-collecting rate as well as the resistance of gas penetration in the respective cases, the following data was obtained.

Type of Pulverized Dust: stearic acid fumes

Test Duct, Filter Area: 3.3 m²

Linear Speed: gas quantity 1 l/min

Method of Measurement: Piezo-balance type dust meter made by Nihon Kagaku Kogyo Co. 2 sets

The relationship found between the dust collecting rate and the gap between the rolls is shown in Figure 5, whilst the relationship between the number of times the material was passed between the rolls and the resistance to gas penetration (expressed as a pressure loss) is shown in the following table. The gap in this case was (−2 mm):

	No physical distortion treatment	3 Passes	5 Passes	10 Passes
Resistant to Air Penetration				
H Pressure loss (mmAg)	34	30	26	24

Results of Measurement

As shown in Figure 5, the dust collecting rate was improved by increasing the number of passes of the material between the rolls and by reducing the gap between the rolls. It will be seen that the best result was obtained with 20 passes and a gap of about −2 mm. Furthermore, as will be apparent from the above table of pressure loss, the resistance to gas penetration is progressively lowered the more times the filter material is passed between the rolls 1. By employing apparatus according to the present invention a filter material can be produced having a high dust-collecting efficiency and a small resistance to gas (and air) penetration and by careful selection of the number of pairs of treatment rolls, to produce the required number of passes over the filter material, said treatment can be effected as a continuous process.

It will be appreciated with regard to the gap that "O" refers to a datum position where the tips 7 of the pyramids just touch the web of the material passed therethrough; thereby any adjustment of the gap from this datum position to bring the tips 7 of the pyramids towards each other is an effective reduction of said gap and is given a negative notation above and in Figure 5.

5 CLAIMS

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1. Apparatus for the treatment of filter material to make it suitable for use in a dust-proof mask; characterized in that at least one pair of treatment rolls are provided, each roll having cone or rectangular pyramid shaped protrusions with sharp tip ends formed regularly on its surface, the rolls of each pair being arranged substantially parallel to provide an adjustable gap therebetween and so that 10 their respective protrusions and recesses mesh with each other in said gap, the arrangement being such that the gap can be adjusted in relation to the thickness of a web of filter material passed therethrough, and the tips of said protrusions are such that they pierce through, pull and tear the fibres of the web material so that the material as it separates from the rolls becomes fluffy to improve its dust collecting efficiency and to reduce its resistance to gas penetration.

15 2. Apparatus according to Claim 1, characterized in that a number of spaced pairs of treatment rolls are provided to provide for a number of passes for a web of material fed therethrough.

3. Apparatus according to Claim 1 or Claim 2, having a pair of pinch rolls arranged to be driven and to feed a web of material through the pair or pairs of treatment rolls.

20 4. Apparatus according to Claim 3, having an uncoiler in front of a pair of pinch rolls, for supporting a wound web of untreated filter material, and a take-up roll behind the treatment rolls for taking-up the treated web of material, said uncoiler and take-up rolls being arranged to be driven substantially at the same speed as the pinch rolls.

25 5. Apparatus for the treatment of filter materials to make it suitable for use in dust-proof masks constructed, arranged and adapted to operate substantially as hereinbefore described, with reference to the accompanying drawings.

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2. Apparatus according to Claim 1, characterized in that a number of spaced pairs of treatment rolls are provided to provide for a number of passes for a web of material fed therethrough.
3. Apparatus according to Claim 1 or Claim 2, having a pair of pinch rolls arranged to be driven and to feed a web of material through the pair or pairs of treatment rolls.
4. Apparatus according to Claim 3, having an uncoiler in front of a pair of pinch rolls, for supporting a wound web of untreated filter material, and a take-up roll behind the treatment rolls for taking-up the treated web of material, said uncoiler and take-up rolls being arranged to be driven substantially at the same speed as the pinch rolls.
5. Apparatus for the treatment of filter materials to make it suitable for use in dust-proof masks constructed, arranged and adapted to operate substantially as hereinbefore described, with reference to the accompanying drawings.

