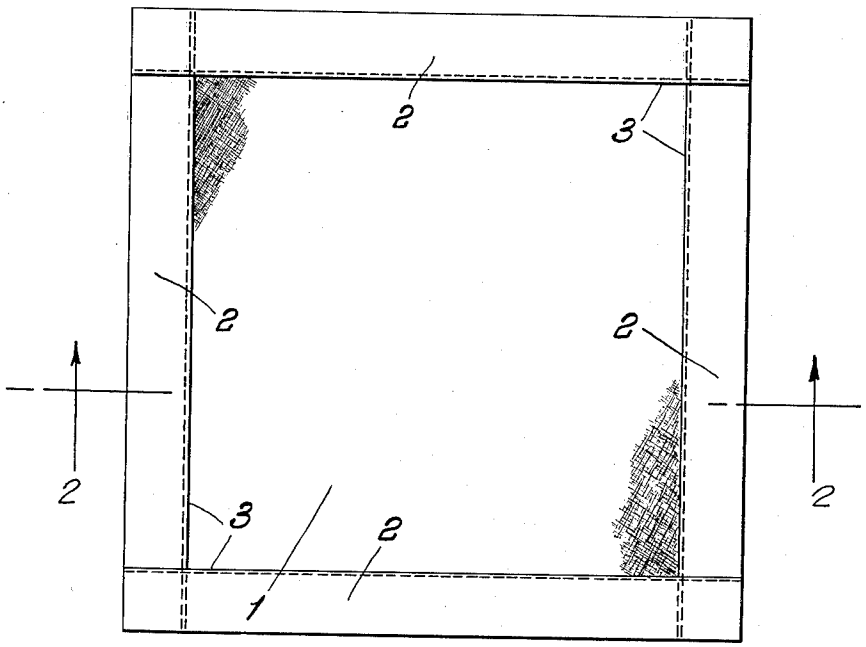
June 13, 1961 HANS-JOACHIM WITTEMEIER ET AL 2,988,168

AIR FILTER

Filed May 14, 1957

Fig. 1



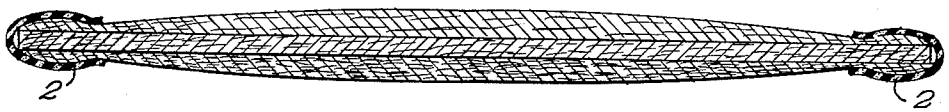


Fig. 2

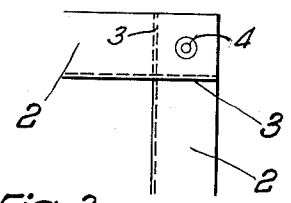


Fig. 3

United States Patent Office 2,988,168 Patented June 13, 1961

2,988,168

AIR FILTER

Hans-Joachim Wittemeier, Berlin-Grunewald, and Fritz Becker, Berlin, Germany, assignors to Delbag-Luftfilter G.m.b.H., Berlin, Germany, a limited-liability company

Filed May 14, 1957, Ser. No. 659,022
Claims priority, application Germany May 16, 1956
5 Claims. (Cl. 183—45)

Our invention relates to an air filter including a layer of fibrous material.

The use of layers of fibrous materials of diverse kinds is common in the air filter art. Animal, vegetable and artificial fibers of widely differing diameters and various combinations thereof have been employed together with a suitable bonding agent for the purpose of combining the fibers to thereby form a layer suitable for filtering purposes.

These known fibrous layers used heretofore and the filters thus formed while apt to be used as filter material are objectionable in certain respects. The most serious disadvantage inherent in nearly all fibrous layers that have become known heretofore is the fact that they do not withstand washing. This lack of resistance to washing may be due either to the fibrous material used or to the bonding agent employed. While certain prior layers may withstand mechanical cleaning, for instance by a beating operation, it is not possible to wash them in gasoline or in a solution of soap because either the bonding agent employed will dissolve in the washing liquid, or the fibers will absorb the washing liquid, requiring a complicated and time consuming drying operation following the washing treatment. Moreover the known fibrous layers after having been washed, will shrink and the consequent reduction of the volume will adversely affect the filtering effect. Since the stability of the fibers will be frequently damaged by the washing treatment, the fibrous layers shrunk in the washing treatment will not be able in the subsequent drying operation to expand in such a manner as to recover the original volume.

It is the object of our invention to provide an improved fibrous layer fit for filtering purposes which has a high moisture resistance and will not shrink when washed.

Our novel fibrous layer is built up of fibers produced from a polyester resin, said fibers having any one of the commercial diameters of about 1 to 20 denier and having lengths of from 60 to 100 mm., such fibers being joined in the direction of run of the fibers for the purpose of forming plates or webs and being treated with a bonding agent comprising polyvinyl-acetate which preferably has been saponified and thereafter highly acetalized, a medium facilitating the application of the bonding agent to the fibers without leaving any residue being admixed to the polyvinyl-acetate at a suitable ratio of mixture. An example of such a medium is methylene-chloride.

Our novel fibrous layer will fully withstand washing without shrinking or losing its former shape and without any reduction of its filtering effect. It may be cleaned by means of the conventional washing liquids and solutions, for instance by means of gasoline or conventional cold or hot washing solutions. Our novel fibrous layer will dry rapidly because the fibers will not absorb any liquid. Since the fibers are crease-proof and highly elastic, the fibrous layer will expand and recover its original volume after the washing treatment. It may be cleaned as often as desired without losing its original filtering properties. Hence, our novel fibrous layer may be repeatedly used indefinitely.

This material advantage inherent in our novel fibrous layer is enhanced by additional favorable properties. Thus, our novel fibrous layer will withstand mechanical

stresses and has a high strength in the direction of the fibers as well as transversely thereto.

Other advantages of our novel fibrous layer reside in that it will resist high temperatures, is not easily inflamed and will resist organic solvents. The bonding agent is applied to the fibers by being sprayed thereon or applied in form of a foam. After the drying treatment the bonding agent will not leave any residues in form of lumps or grains as is of frequent occurrence with other fibrous layers. The fact that such residues are avoided is a material further advantage, since such residues, if existent, do not firmly adhere to the fibrous material and are therefore liable to pollute the filtered air stream.

Therefore, our novel fibrous layer offers material advantages over all prior fibrous layers, such advantages residing primarily in its unlimited resistivity to washing, its mechanical and chemical resistivity and its excellent elasticity.

It is known to coat the surface of the fibrous layers with a liquid adapted to bind the dust for the purpose of increasing the dust-binding capacity of fibrous layers. For this purpose adhesives of a suitable consistency may be applied to the surface of the layer and by its adhesive effect will increase the dust-binding capacity of the filter.

When a saturation of the adhesive layer will have been reached it is necessary to free the fibrous layer from the dust-binding agent in a washing machine with the aid of a suitable washing agent. It is also known already to use a product having a suitable viscosity and produced from a mineral oil as a dust-binding agent and wetting agent, such product forming a continuous film of suitable thickness on the surface of the filter body. These agents produced from a mineral oil have favorable qualities rendering them particularly fit as a wetting agent. On the one hand, these agents display a high boundary surface tension relative to air so that the film of the wetting agent will not be torn off by the air flowing through the filter. On the other hand, the boundary surface tension relative to the filter and to the dust to be separated from the air is extremely low so that a complete wetting of the filter surface will be effected and that the dust deposited on the surface of the coating film will be immediately taken up by the interior of the film. The viscosity of this known wetting agent is within limits guaranteeing the production of a film of sufficient thickness. The vapour pressure of this known wetting agent is so low that an entry of the wetting agent by vaporization into the air current to be purified will be reliably avoided. From the foregoing explanation it will be understood that when a wetting agent of the known type produced from a mineral oil is employed, the rust particles contacting the surface will be introduced into the interior of the thin coat of the wetting agent. The filter equipped with these dust-binding means will be saturated when the coating film throughout its thickness and on its entire surface will be filled with dust particles.

Also these filters equipped with such known dust-binding agents must be cleaned upon completed saturation in special washing machines with the use of special washing agents. We have found that as dust-binding agent materials may be employed which are capable of performing the dual function of binding the dust just as well as the dust-binding agents produced from mineral oil and also of a washing agent. As a result, the necessity of providing additional washing equipment and the use of a special washing agent is eliminated. The filter body equipped with our novel dust-binding agent needs only be immersed and agitated in water upon complete saturation with dust. In such treatment the accumulated dust will be completely washed out of the filter body under considerable foaming so that the filter

body after having been dried is fully fit for repeated wetting without requiring the use of additional washing equipment and washing agents.

As wetting agents for air filters we preferably use surface-active materials which will reduce the boundary surface tension between water and grease acting as a detergent and also have a viscosity between 100 and 10,000, preferably between 100 and 1000 centistokes. If desired, these materials may be dissolved in a suitable solvent. These surface-active materials used according to the present invention are also characterized by those properties which are required for an effective air filter-wetting agent. Our novel wetting agent may be applied to the surface of the filter in any desired manner, for instance by immersing, spraying or the like, and upon such application will display the same favorable properties as the prior wetting agents produced, for instance, from mineral oils. The advantage of our novel wetting material compared with the prior wetting agents resides in the fact that our novel agent serves as a detergent at the same time. When the filter saturated with dust is put in a water bath, a voluminous foam will be produced upon agitation of the filter, whereby the wetting agent with the dust will be washed out of the filter.

Preferably we use a saturated aqueous solution of a hygroscopic surface-active material since this will ensure that the solution will not dry up.

For example, we use alcohol sulphonate and alcohol sulphate in such a saturated solution. Preferably we provide the fibrous layer with a frame formed by strips of a suitable material, such as a resilient textile material or a plastic or preferably foam rubber, such strips having a U-shaped cross-section and embracing the edge of the fibrous layer being connected therewith by crosswise or other stitches, such strips being pervious to water and capable of being washed and of sustaining mechanical stresses. Preferably the material used for such strips should be able to withstand a temperature of at least 200° in order to sustain the mechanical and thermal stresses set up in the washing treatment. The equipment of the fibrous layer with such a marginal frame offers the advantage of preventing the leakage of air past the edges of the fibrous layer and will ensure that the fibrous layer can sustain considerable mechanical stresses without being damaged in the washing treatment and will have a very long life. The connection of the framing with the fibrous layer by stitches offers the advantage of establishing a reliable connection preventing at the same time a lengthwise expansion of the marginal strips. Thus, the fibrous layer will retain its original dimensions upon repeated washing.

In the accompanying drawing there is shown a preferred embodiment of our novel filter. In the drawing,

FIG. 1 is a view in elevation of the air filter provided with a marginal framing,

FIG. 2 is an enlarged cross-section through the marginal layer shown in line 2—2 of FIG. 1 and

FIG. 3 illustrates a corner of the fibrous layer shown in FIGS. 1 and 2, wherein fasteners are additionlly employed.

The margins of the fibrous layer **1** are embraced by a strip **2** of foam rubber having a U-shaped cross-section, such strip being stitched to the layer by means of the seams **3**. In FIG. 3 hollow rivets **4** are mounted in the four corners of the framing, such rivets serving to accommodate pins mounted in frames or cassettes accommodating the air filter packs.

While the invention has been described in connection with a preferred embodiment thereof, it will be understood that it is capable of further modification, and this application is intended to cover any variations, uses, or adaptations of the invention following, in general, the principles of the invention and including such departures from the present disclosure as come within known or customary practice in the art to which the invention pertains, and as fall within the scope of the invention or the limits of the appended claims.

What we claim is:

1. A washable air filter consisting of synthetic resin fibers having a thickness of 1 to 20 denier and lengths of 60 to 100 mm., wherein fibers produced from polyester resin are bonded to each other with a fiber-bonding agent to form a flat filter body, said fiber-bonding agent comprising saponified and subsequently highly acetalisized polyvinyl-acetate, which has been admixed with methylene-chloride.

2. An air filter as claimed in claim 1 comprising a plurality of superimposed fibrous layers.

3. An air filter as claimed in claim 1 in which there is provided a plurality of fibrous layers each of said layers being of different thickness.

4. An air filter as claimed in claim 1 in which said fibers are coated with a dust-binding or wetting agent formed by a solution of a surface-active material having a low boundary surface tension relative to the dust to be separated and capable of reducing the boundary surface tension between water and grease and having a viscosity between 100 and 10,000 centistokes, said material facilitating the washing of the filter.

5. An air filter as claimed in claim 4 in which said surface-active material is of a hygroscopic nature.

References Cited in the file of this patent

UNITED STATES PATENTS

2,008,751	Davies	July 23, 1935
2,138,874	Myers	Dec. 6, 1938
2,178,614	Slayter	Nov. 7, 1939
2,408,659	Lamb	Oct. 1, 1946
2,620,283	Taylor et al.	Dec. 2, 1952
2,707,308	Taylor et al.	May 3, 1955
2,772,195	Gaarder	Nov. 27, 1956
2,784,132	Maisel	Mar. 5, 1957
2,865,466	Frohmader	Dec. 23, 1958
2,888,095	Perrini et al.	May 26, 1959