Jan. 3, 1933. H. E. BIRKHOLZ 1,893,048

FILTERING MATERIAL

Filed Aug. 10, 1927 2 Sheets-Sheet 1

Fig. 1.

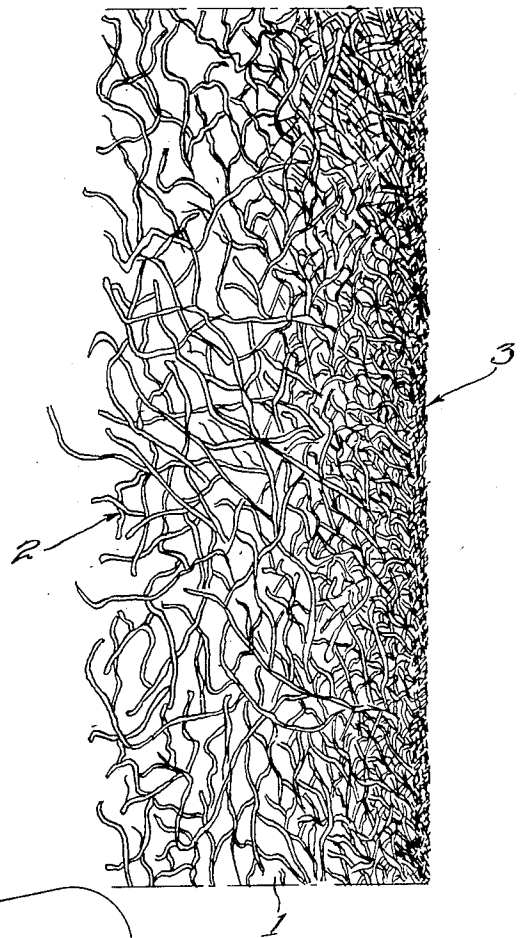
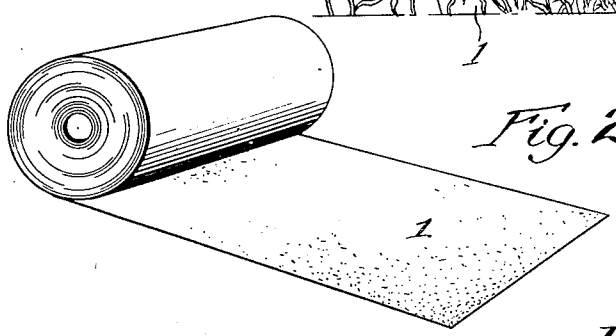



Fig. 2.

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Filed Aug. 10, 1927 2 Sheets-Sheet 2

Fig. 3.

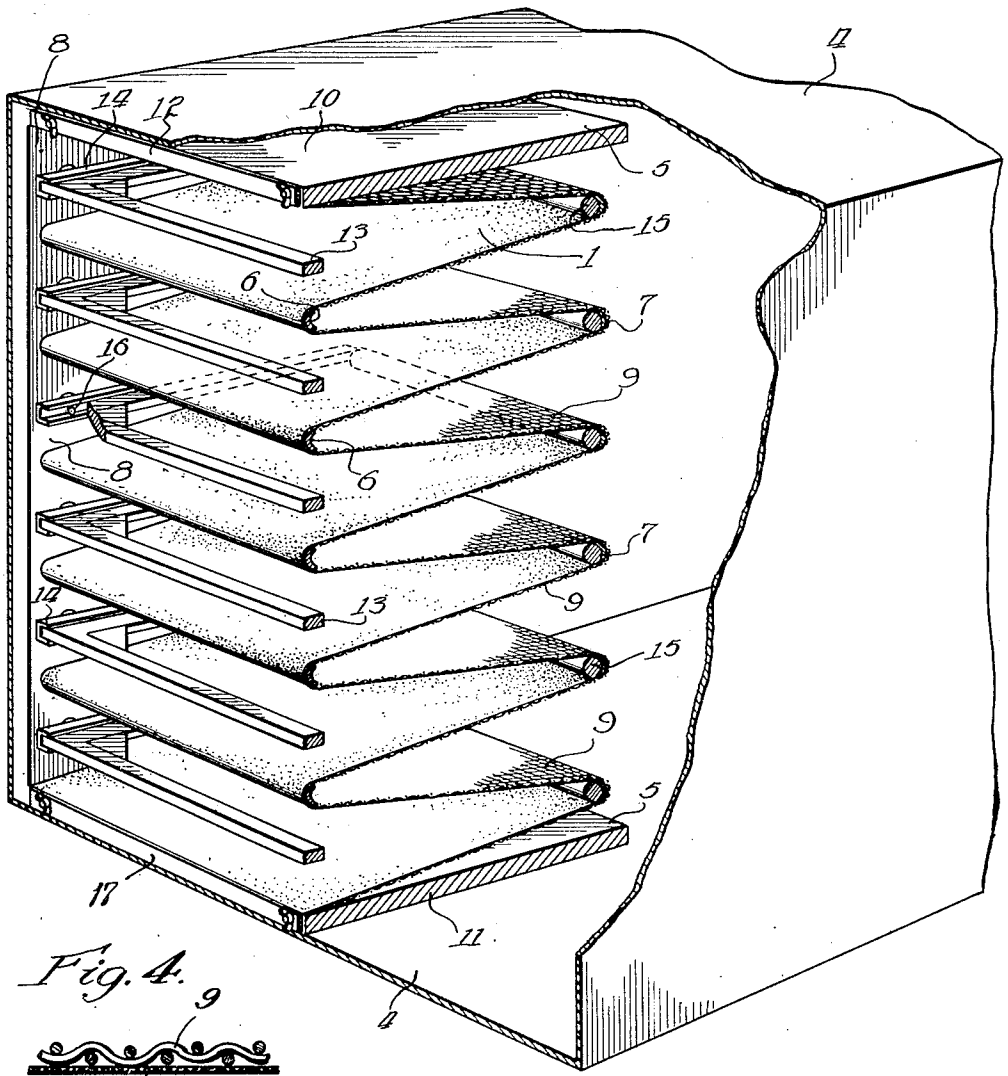


Fig. 4.




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# UNITED STATES PATENT OFFICE

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## FILTERING MATERIAL

Application filed August 10, 1927. Serial No. 211,949.

This invention relates to an improved air filtering means, and its main objects are to provide a more efficient and economic means for cleaning air.

Heretofore air has been filtered commercially, mainly by means of dense masses of material which were usually "charged" or impregnated with a viscous substance for detaining the particles of foreign matter in the air which was forced to flow through the material. The material served mainly as a means for supporting the filtering substance, and the air was driven into the filter mass with a high velocity to cause the particles to impinge upon the adhesive surface instead of flowing by in the air streams. The filters were necessarily quite bulky, occupied a very considerable amount of space, and frequently required special building construction in the installation. The cost of the upkeep as well as the first cost was quite high, and the cleaning of the filter units was a difficult matter.

The main objects of the present invention are to provide an air filtering material which is so inexpensive that it can be discarded when cleaning is required; to provide such material which can be easily installed and removed; to provide an air filter which does not require a complicated structure nor any special mechanism for operating the same; to provide a material which thoroughly cleans the air by true filtration, and which can be installed in such a manner that the resistance to the air flow is very low; and to provide an air filtering material which is uniform in section and offers substantially the same resistance in all portions of the cross section of the air conduit.

In this invention a form of fibrous or paper-like material, preferably fireproof, is provided. The material is readily pervious to the air, but has a large capacity for holding the foreign matter, without becoming coated over or clogged. As in making the ordinary forms of paper, the fibrous material is reduced to a pulp by chemical or mechanical means, in which state the fibres become closely intertwined. The pulp is pumped into rollers, and is rolled out into a sheet or web. In this form, which corresponds to the ordinary form of paper, the leading surface against which the air strikes would soon become coated over with dirt, and the paper would become impervious to the air, apparently because the particles become wedged into the dense mass of the fibres and fill the interstices in the same manner as when a fine stone is used for filtering the water, where it can be seen that a fine silt becomes lodged in the surface of the stone. But in this invention the fibrous structure on one side of the paper is loosened, as by scarification rolls or other well-known means to furnish capacity for holding the dirt. The fibres are thus raised to form a loosely matted structure on one side of the paper so that the density of the material increases progressively from one side to the other. The coarser particles in the air are then caught by the loose fibres at the surface so that space is left around the lodged particles to permit the air to flow past into the increasingly denser mass where the finer particles are caught.

The filtering material shown and described in this application is particularly adaptable for use in filter units of the type shown and described in applicant's copending applications Serial No. 211,948, and Serial No. 211,947, filed of even date herewith.

An illustrative embodiment of this invention, and one manner of using the material, is shown in the accompanying drawings in which:—

Figure 1 is a line drawing of a highly magnified, thin section of the filtering material, as viewed through a microscope.

Fig. 2 is a view in perspective of a roll of the filtering material showing how it is supplied to users.

Fig. 3 is a perspective view showing the paper filtering material installed in an air ventilation conduit.

Fig. 4 is an enlarged fragmentary detail showing the filtering material supported against a wire netting backing.

As shown in Fig. 1, of the drawings, wherein there is illustrated a highly magnified thin section of the fibrous filtering material, the fibres are intertwined with one another so

as to form a mat. In actual size the paper filtering material 1 is preferably about eight to ten one-thousandths of an inch thick. This filtering material can be made by first forming the sheet all of a uniform density as is shown at the side 3 and then forming the loosely matted structure on the side 2 thereof either by scarification or other well-known means. Such paper can, however, be formed by other means.

As shown in the drawings, the fibres adjacent one side of the sheet are arranged in greater compactness than at the opposite surface thereof and preferably the structure is arranged so that the fibres become uniformly progressively more compact from one side through to the other side thereof. The side 3 of the paper having not been disturbed by scarification serves as a substantial supporting backing for the sheet so that it does not tear easily when being handled and in use, whereas if the entire structure were of the same formation as on the loosely matted side of the paper the sheet would be too flimsy for ordinary handling, that is to say not self-sustaining.

By having the loosely matted structure raised in this manner the interstices provide storage pockets or cavities for particles of dirt so that the filtering material has a life sufficiently long to be practicable for use in air and gas filters.

In use, the paper may be supported in spaced folds across the air conduit, as shown in Fig. 3, in which 4 represents the sheet metal air duct. The rectangular open-ended frame 5 is provided for supporting the filtering apparatus and is installed in and becomes substantially a part of the conduit 4. Two spaced rows of bars 6 and 7, are mounted in the side walls 8 of the frame 5 in staggered relation and extend across the same. A strip of foraminated wire fabric 9 is then wound on the bars in zigzag formation, and permanently secured at the ends to the top 10 and bottom 11 of the frame 5. A sheet of the filtering material 1 is then mounted in position by securing the upper end to the frame by means of the clamp 12, which is mounted at the edge of the top wall 5. The folds of the paper are then shoved in between the convolutions of the rigidly mounted fabric 9 by means of the frames 13, which are slidably mounted in the stationary channel members 14 which are secured to the side walls 8. At the front ends, the frames carry rollers 15 for contacting with the paper, and the frames are movably secured in position by means of spring-pressed detent pins 16, which are mounted in the side walls 8 to project through the webs of the channels 14, and engage in suitable recesses in the sides of the frames 13. When the frames are all in position, the bottom end of the paper is clamped by means of the clamping member 17 which is secured to the edge of the bottom frame wall 11.

In this manner a very large area of filtering surface is provided in relation to the cross sectional area of the air conduit. The filtering section is substantially of uniform thickness in all portions of the conduit, and the resistance to the air can be very closely pre-determined. The air flows from the left in Fig. 3 into the wider portions of the pockets formed between the folds of the paper, and flows through the paper as it moves towards the narrower and less efficient ends of the pockets.

The use of the reinforcing fabric permits high velocities in the air flow, if such are required, although the filter will operate very effectually at low air velocities. In the ordinary installations, the filtering material may be used for two or three weeks, or even several weeks, depending upon the volume of air required and the condition of the air before it becomes necessary to renew the material. The action of the filter is the same under all prevailing temperatures being substantially independent of seasonal changes, and excessively large ducts are not required. When the paper becomes dirty, it can be removed in a very simple manner, and can be quickly and easily replaced by a new sheet.

I claim:

1. A filter medium comprising an integral layer of fibrous material which has the fibres adjacent one surface thereof arranged in greater compactness than those adjacent the opposite surface thereof.

2. A filter medium comprising an integral sheet-like fibrous material in which the fibres are arranged to have a progressively greater compactness from one surface to the other surface thereof.

3. A filter medium comprising a thin sheet of paper, the fibres at one side of said sheet being more closely arranged than at the opposite side thereof.

4. A filter medium comprising a relatively thin paper sheet having a nap raised on one side thereof so that the structure thereof becomes progressively denser from one side through to the other side thereof.

5. A filter of the class described, comprising a conduit, spaced series of staggered supports mounted in said conduit and a filter medium comprising a thin sheet of paper extended alternately around a support of one series and a support of an adjacent series, forming a plurality of converging pockets, the fibre of that side of said sheet with which material passing through the conduit first engages being more loosely arranged than the opposite side thereof.

6. A filter of the class described, comprising a conduit, spaced series of staggered supports mounted in said conduit, a wire screen extending alternately around a support of

one series and a support of an adjacent series, and a fibrous filter member extending along said wire screen in engagement with alternate supports thereby forming a plurality of superimposed rearwardly diverging pockets.

7. A filter of the class described, comprising a conduit, spaced series of staggered supports mounted in said conduit and a wire screen extending alternately around a support of one series and a support of an adjacent series and a fibrous filter member extending along said wire screen in engagement with alternate supports the fibre of the rearward surface of said filter member being more loosely arranged than the fibre of the opposite surface.

8. A filter medium comprising an integral sheet-like body of fibrous material loosely matted on one side and closely matted on the other side.

Signed at Chicago this 6th day of August 1927.

HANS E. BIRKHOLZ.