

April 4, 1939.

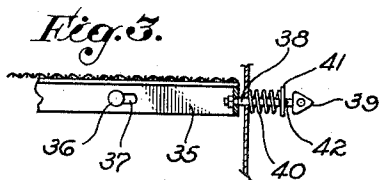
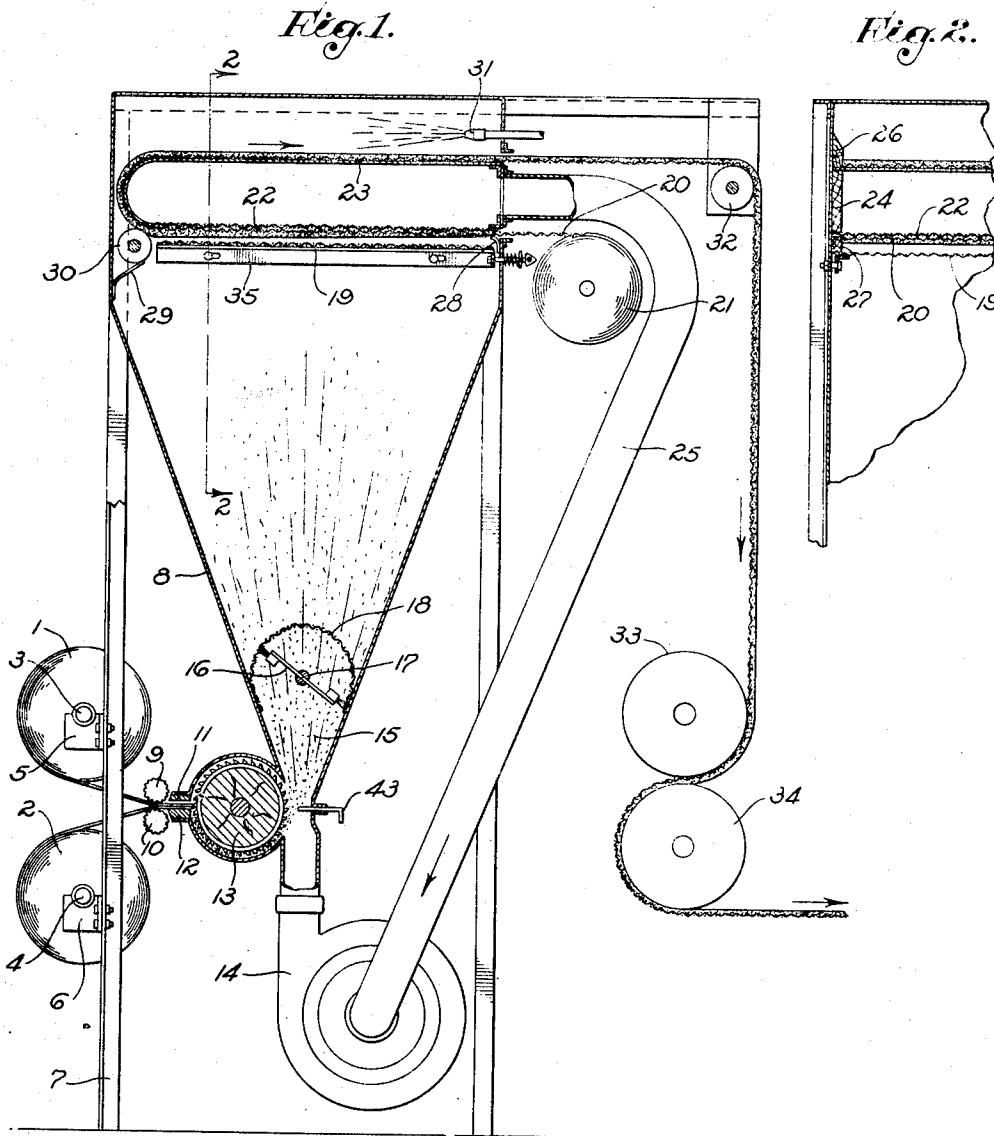
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METHOD OF MAKING FILTER FABRIC

Filed Sept. 5, 1936

2 Sheets-Sheet 1



INVENTOR

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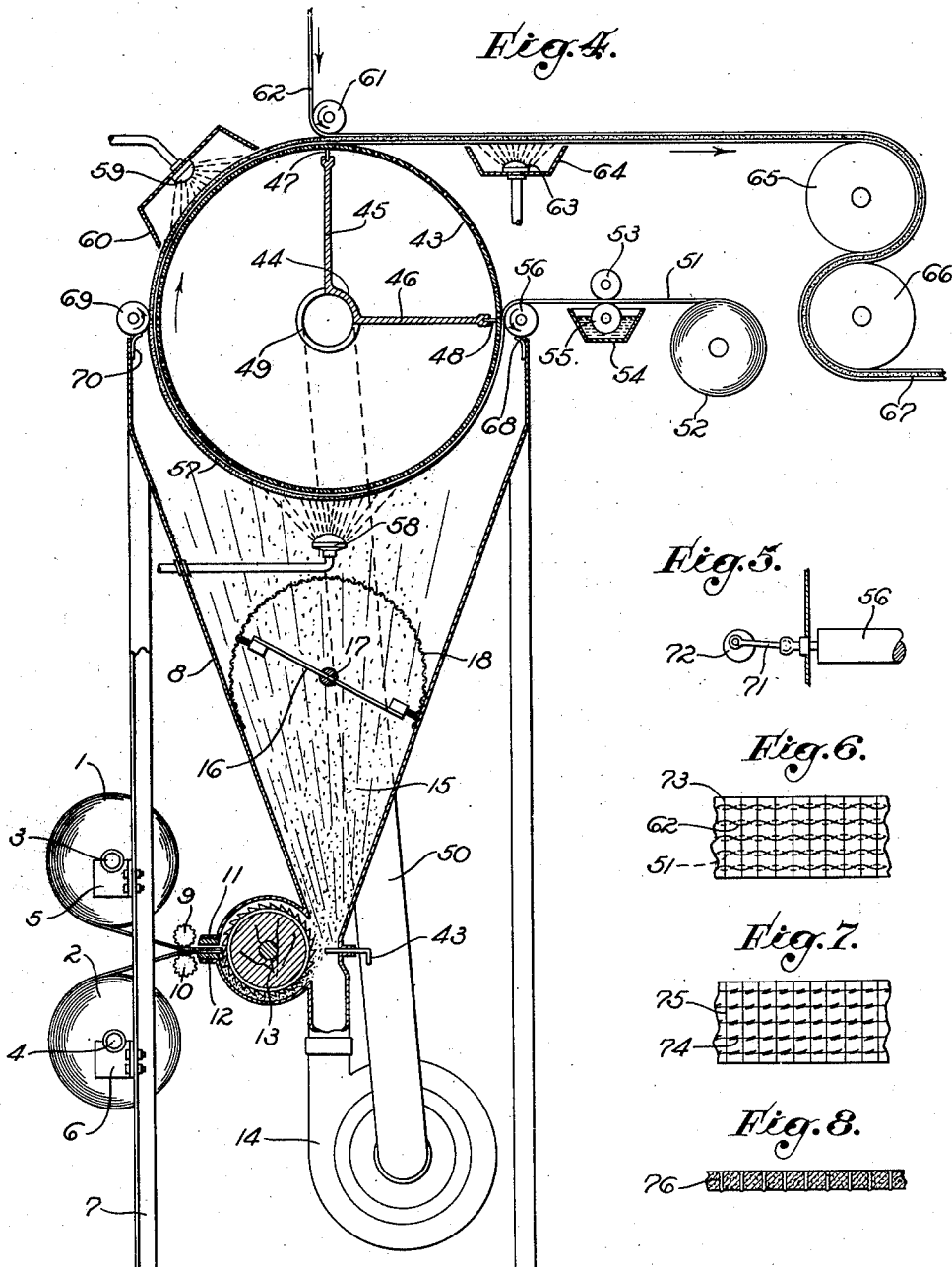
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METHOD OF MAKING FILTER FABRIC

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7 Claims. (Cl. 154—33)

My invention relates to the felting of fibres for surgical bandages, sanitary napkins, artificial leather, wall board, etc., and particularly to the manufacture of fabrics for use in filters. This application is a continuation-in-part of my co-

5 pending applications, "Process of counter-current fabric filtration", Serial No. 750,460, filed October 29, 1934; and, "Filter fabric", Serial No. 57,225, filed January 2, 1936.

10 The object of my invention is to provide a way in which different fibres and other materials can be fed in a substantially dry condition and at constant rates of speed into a fiberizing machine and there uniformly mixed and deposited on re-

15 tracted reinforcing threads to form a homogeneous felt or fabric that may be extended when in use.

In accordance with my invention, I use a cellulosic fibre, such as wood pulp, or cotton, or 20 other fibre, separately or in mixture, refined to a high alpha cellulose content. Such fibres may be refined by the usual acid or alkali processes, as well understood by those skilled in the art, until they have an alpha cellulose content of 93 per 25 cent or higher; and if they have been felted in an unbeaten and unhydrated condition and then wound into rolls, they can be fed into a fiberizing machine at a substantially continuous rate of speed and the dispersed fibres deposited on re-

30 inforcing threads, or fibres of comparatively great length, to form a uniform sheet of filter fabric that has a high degree of absorptivity, or capillarity. Beating of the fibres destroys the capillary interstices and canals necessary for fil-

35 tration purposes, and this undesirable condition is further accentuated if the pulp has not been refined sufficiently to remove all the resinous and colloidal impurities that tend to clog these pas-

40 sageways in and between the fibres. Bleaching also sometimes lessens the "freeness" of an aqueous pulp suspension and the porosity of the fabric made from the bleached fibres. Heavy pressures and excessive drying temperatures that draw together and shrink the fibres, likewise tend to

45 close the cellular structure and interstitial spaces of the fibres, and should be avoided during the filter fabric forming operations.

Various non-cellulosic fibres, such as asbestos, animal wools, and mineral wools made from mol-

50 ten slag, may also be blended with an aqueous suspension of various cellulose fibres and the mixed fibres dewatered and formed into a sheet by a wet process fabric making machine, such as is described in my Patent No. 1,782,784. How-

55 ever, the wetting, mixing and drying of non-

cellulosic fibres that are not refined in aqueous solutions, with cellulose fibres that are refined in aqueous solutions, is expensive. I therefore usually prefer to obtain non-cellulosic fibres in a dry-felted condition and to mix them with a suitable quantity of cellulose fibres in the fiberizing machine. In dry process filter fabrics for most filtration purposes, asbestos fibres are used in mixture with cellulose fibres in amounts varying by weight from 25 to 50 per cent of the former 5 to between 75 to 50 per cent of the latter. The ratios may vary, however, to a greater extent for some purposes.

The dry disintegration of a web of fibres, as it is fed into the fabric making machine, may be 15 accomplished by a card roll, hammer mill, or any other suitable means, that will separate one fibre from another without breaking or pulverizing them. A rotating cleaning brush, or air current, or steam blast, or combination of them, may be 20 used to keep the card teeth clean, although it is seldom that the brush will be required if the card teeth are short and saw-tooth shape and the blast is properly directed. The dispersion of the fibres into air, or other elastic fluid, and their 25 deposition from a suspended state, may be accomplished by means of the movement of the conveying fluid from the point of disintegration to a foraminous retaining wall through which it passes, and over which a reinforcing thread 30 structure is moved leaving the fibres deposited thereupon. While the dispersion and deposition of the fibres may be accomplished in any direction, it is preferable that such operations take place against the influence of gravity and under 35 a decreasing velocity. This results in any fibres not completely dispersed falling back in small bundles to be recarded or blown upwards again, and the separated fibres dispersed by the card or tumbling action of an elastic fluid, arranging 40 themselves where most needed to make up the uniform heterogeneous coating of fibres extending in all three cubical dimensions that is so highly desirable for filtration purposes. The foraminous retaining member may be a fixed 45 wall, or a traveling belt, but is preferably of the order of a condenser, such as is used for the removal of air and dirt from cotton lint when the latter is being formed into a bat; and if the reinforcing threads are spaced widely apart, an 50 endless Fourdrinier belt may be passed around the condenser to support the fibres until the latter and the reinforcing threads have been properly bonded together.

In certain of my counter-current depth type 55

fabric filters the fabric is required to travel spirally from the inner to the outer circumference of the filter bed, and consequently must stretch during its life an amount equal to the difference in the length of the filter bed's inner and outer peripheries. Increasing the depth of the filter bed for any given diameter will therefore increase the amount of stretch per foot of fabric, but increasing the diameter for any given depth of filter bed, will decrease the amount of stretch. This stretch of the filter fabric can be accomplished by giving the reinforcing warp threads of an open mesh fabric, such as cheesecloth, a traversing motion as the latter is fed over the feeding roll onto the foraminous supporting member through which the conveying fluid is passed. Warp threads, if passed through a reed, or over a comb, to keep them in proper alignment as they move onto the feeding roll, may be used without any filling woven into them. The deposition of the fibres, resulting in their being placed in random formation, will tend to bond the threads together, and this action can be aided by mixing in the sheets of fibrous material to be fed into the fiberizing machine, or precipitating first, fibres of comparatively great length, such as manila, sisal, ramie, or the white shearings that result in the making of napped goods; or the fabric may be reinforced by wavy warp threads of opposed reciprocations by means of a double set of feeding rolls for two sheets of threads alternating in their transverse movements; or the second sheet of warp threads may be fed onto the filter drum after the latter leaves the deposition chamber and before it separates from the fabric, thereby placing the wavy warp threads of opposed reciprocations on opposite sides of the sheet of deposited fibres. Wavy warp threads without woven filling but with well distributed bonding fibres will give longitudinal stretch without width interference in the operation of the filter. Unspun fibres in the form of a sheet of rovings, or card slivers, in which the fibres are placed in random or wavy formation, may also be substituted for a scrim or other open mesh fabric. If desirable, such fibres may be drawn out and attenuated and fed forward to a uniform fibre cutting means by well known methods, before being conveyed into the fiberizing machine and deposited on the foraminous member through which the conveying fluid passes. This arrangement of substituting rovings, or card slivers, or fibres of uniform length, for an open mesh fabric will also provide for longitudinal stretch without width interference, but the reinforcing fibres must have sufficient length and strength to convey the precipitated fibrous filling in the normal operation of the filter. These reinforcing fibres of comparatively great length may be mixed with the shorter fibres at the time the latter are put up in feed rolls for the fiberizing machine, or the reinforcing fibres may be intermixed with the shorter fibres by being introduced separately into either the fiberizing machine, or suction of the blower.

The passage of the conveying fluid through the retaining wall will cause the fibrous filling to become embedded in the reinforcing assembly of longer fibres or threads, and this bond between the two can be strengthened by means of a binder such as water, starch, dextrine, casein, rubber latex, sodium silicate, etc. A silicate solution is usually preferable for both inorganic and organic fibres in that it not only adds strength and rigidity to the fabric but it also has a capacity for ad-

sorbing impurities from the fluids to be filtered. The binder may be applied in any one, or all of several different ways in which steam may, or may not, be used for heating and softening the binder; and its application will depend mostly on the fibres used and the purpose for which the fabric is required. The reinforcing threads may be drawn through a bath before moving into contact with the foraminous retaining wall; or the binder may be sufficiently atomized within the dispersing chamber to cause the fibres, as deposited, to adhere one to another, care being taken to prevent the fibres becoming too heavily weighted for proper deposition; or one or both surfaces of the fabric may be subjected to an atomized spray as the fabric leaves the deposition chamber. However, the inter-matting of the fibres during deposition will usually be sufficient to hold them together, in which case the binder will then be used simply to bond the fibre mat to its reinforcing threads, and may be applied to the reinforcing threads before the latter move over the retaining wall, or after the fabric leaves the foraminous retaining wall. The fabric may then be passed around, or between, calendering and/or low temperature drying rolls. Filter rolls that do not require rewinding before being placed in operation, will not require to be treated with solid or liquid binders in their manufacture as the fibre layers may be sufficiently consolidated by calendering at the time the rolls are made up.

For an understanding of my method, and for an illustration of one of the many forms my apparatus may take, reference is to be had to the accompanying drawings, in which:

Fig. 1 is a vertical sectional view of a complete fiberizing apparatus showing the arrangement for felting the fibres on a stationary foraminous wall.

Fig. 2 is a fragmentary cross-section view of the stationary foraminous wall taken on line 2-2 of Fig. 1.

Fig. 3 is a fragmentary view of the vibrating screen.

Fig. 4 is a vertical sectional view of a complete fiberizing apparatus showing the arrangement for felting the fibres on a rotating foraminous wall.

Fig. 5 is a fragmentary view of the reinforcing thread feed roll showing the arrangement for giving a transverse feed to the threads.

Fig. 6 is a fragmentary view of the filter fabric showing one way of laying the reinforcing threads.

Fig. 7 is a fragmentary view of the filter fabric showing a second way of laying the reinforcing threads.

Fig. 8 is a cross-section of a portion of the filter fabric showing a third way of placing the warp reinforcing threads.

Referring to the drawings more specifically by reference characters: roll 1 in which wood pulp and asbestos fibres are incorporated in web-form, and roll 2 in which cotton and asbestos fibres are incorporated in web form, rotate on shafts 3 and 4 respectively, the shafts being supported by brackets 5 and 6 respectively, which are attached to the angle iron feet 7 of the deposition chamber 8. Feeding rolls 9 and 10, which may be controlled by a variable speed transmission not shown, cause the webs to move at any desired speed between the guiding edges of the top and bottom housings 11 and 12 respectively for the card roll 13. The saw-tooth shaped teeth of the

card roll carry the shredded fibres around until a blast from the blower 14 strikes the teeth tangentially, clearing the teeth and conveying the removed fibers into the chamber 15, where the fibres are thoroughly mixed and sufficiently separated by a rotating brush 16 on the shaft 17, to be passed through the screen 18. As the fibres are now carried upward by the current of air into the deposition chamber, whose cross-sectional area increases with the height of the chamber, the velocity of the air current correspondingly drops, causing any agglomeration of fibres to fall and to be thrown upward again until such tumbling action finally results in all particles passing through the vibrating screen 19. This screen is placed in such close proximity to the scrim 20, as it is withdrawn from roll 21, that all fibres are deposited on the scrim before they can again be attracted one to another. The stationary screen, or foraminous wall 22, supports the scrim against the upward movement of the air current; and this foraminous member with the top imperforated plate 23 and the wooden side pieces 24, form the receiver for the filtered air, which is returned to the blower through the pipe 25, the strips 26 and 27 supporting and guiding the receiver for withdrawal purposes. Flexible strips 28 and 29, and the roller 30, which is held in spring resistant contact with the deposited fibre bed, prevent egress of air from the deposition chamber except through the scrim. After the fibre bed has been built up upon the scrim, the latter is carried around over the top of the air receiver, where it is subjected to an atomizing spray from the nozzle 31, and over the guide roller 32 by the pull of the calendering and drying rolls 33 and 34 respectively. Fig. 3 shows the arrangement for moving the vibrating screen. This screen is supported on the frame 35, which is carried on the bolts 36, the elongated slots 37 permitting a reciprocating movement caused by the thrust on the bolt 38 of the cam 39, which is rotated from a source of power not shown, and the pull of the spring 40, which surrounds the bolt and is retained between the casing of the deposition chamber and the washer 41 and pin 42. Fig. 4 shows an arrangement of a fiberizing apparatus in which the felted fibres are carried on a moving foraminous wall 43, which is a more suitable arrangement for pressures exceeding one or two inches water gauge, especially if the reinforcing threads have little tensile strength. Within the foraminous wall, which has closed ends and is similar to a cotton condenser, is a stationary quadrant 44 having arms 45 and 46 equipped with packing strips 47 and 48, respectively, to cut off the suction chamber from the dead space enclosed within the quadrant and the foraminous wall. An opening 49 in the cylindrical axis of the quadrant, permits the escape of the filtered air, which may contain some fibre particles, from the suction chamber through pipe 50 to the inlet of the blower. As the condenser rotates, a scrim, or plurality of warp threads 51, is removed from the supply roll 52 and carried; between upper and lower binder rolls 53 and 54 respectively, the latter rotating in a sodium silicate vat 55; over the feed roll 56; around the condenser, where a mat of fibres 57 is deposited on the threads, which may be subjected to an atomized mist during deposition from jet 58, or after deposition from jet 59 enclosed within the container 60; under another feed roll 61, where a scrim or plurality of warp threads 62 is fed onto the upper surface of the

mat; over another mist from the atomizing jet 63, enclosed within container 64; and over and around the calender roll 65 and the drying roll 66. Leakage of air at the top of the fiberizer casing is prevented on one side by the feeding roll and the flexible packing strip 68, and on the other side by the roll 69, which lightly rotates against the fibre mat, and the flexible packing strip 70. The feeding rolls are given a traverse motion by means of connections 71 to eccentrics 72, as shown in Fig. 5, by which means the warp threads are given opposed reciprocations, while the weft threads 73 remain straight, as shown in Fig. 6; or the potential stretch may be given to the reinforcing threads, if properly sized, by running the latter first between fluted rolls, in which case the warp threads 74 will be doubled back during the calendering operation, and the weft threads 75 remain straight, as shown in Fig. 7; or the potential stretch may be obtained by first forming the fibre mat and then passing the warp threads 76 through the mat, as in the making of pile fabrics, as shown in Fig. 8.

The conveying fluid, in most cases, will consist of air, but it may also consist of steam, carbon dioxide, chlorine gas, etc., or a mixture of gases, and many contain water vapor, atomized sodium silicate, or other binder. It may also be desired to subject the finely divided materials passing through the dispersing chamber to a carbonizing action by introducing hot reducing gases. Such an action is desirable, for example, in depositing carbonized cellulose materials on asbestos reinforcing threads. Therefore, it is to be understood that when referring to fibres, or other treating solids, as "dry" it is not my intention to imply that such solids have no moisture content, but rather that they are in such condition that they can be suspended in a current of air, or other elastic fluid, and be deposited therefrom in the manner described.

It will be obvious from the foregoing description that fibrous material can be fed into a dispersing and deposition chamber at a uniform rate of speed, if in the form of a web; and that a constant ratio in the feed of two or more contiguous webs of fibres can be maintained by prearranging the widths and thicknesses of the webs, or if the webs are not in contact with one another, the ratio can also be maintained by feeding the webs at constant speeds but one more rapidly than another; likewise a discrete solid, such as a granular treating agent on the order of fuller's earth, decolorizing carbon, diatomaceous earth, a powdered binder, etc., can be either incorporated in webs of fibrous fed material, or introduced separately into the mixing chamber at a uniform rate of speed and a constant ratio maintained between a fibrous web and a discrete solid. Such arrangements will result in a uniform blending of the fibres and other solids during their initial dispersion in a mixing chamber, and if there is not too great a drop in the velocity of the air current during deposition, the solids will be deposited in a thoroughly mixed condition despite any ordinary difference in their specific gravities. To deposit different fibres in successive layers, each fibre must have its own disintegrating and dispersion chamber connected to its respective portion of the foraminous retaining wall over which the reinforcing threads are moved.

It will also be evident that fibres may be bonded together in a felted mass, or felted to reinforcing threads in the form of a filter fabric, in many different ways. The reinforcing fibres,

or threads, may be sized in a prior operation and moistened before, during, and/or after the deposition of the fibres; likewise, the fibrous feeding web may be moistened with water or other binder before it is fed into the fiberizing machine, or the disintegrated fibres may be moistened as they are being dispersed, or the surface of the bed of deposited fibres may be wetted. The individual fibres and reinforcing fibres or threads may be completely coated with a film of water, sodium silicate, silicate gel, or other adhesive, but the coating of all the fibres, or the entire surface of the fibre bed, is not necessary in order that the fibres may be bonded together, or bonded to their reinforcing threads. The wetting of the fibres, or the fibre bed, only at certain points, as when a moistened scrim comes in touch with the fibres, will be found sufficient for bonding purposes and, of course, this bonding action is greatly aided by the interlocking of the fibres during deposition. The compacting and drying of the fabric or felted sheet so moistened may be accomplished separately, or simultaneously. However, both operations may be accomplished more quickly if a partial drying takes place before, or simultaneously with, the compacting. Complete drying before compacting tends toward loss of permanency in the latter, whilst compaction before drying results in loss of time for the latter operation.

It will also be evident that in the manufacture of mineral wools, molten slag may be sprayed within a dispersion chamber by means of a current of an elastic fluid such as a blast of air or steam, or combination of them; the wool deposited on, or in mixture with, or without any, threads or fibres of asbestos, or other inorganic materials moving over a foraminous surface; and the wool removed from the retaining wall in the form of a web to be used later as a filter fabric, or in the manufacture of other filter fabrics. The spinning and depositing of the wool in an upward direction will result in the elimination by gravity of the small spheroids of chilled slag, commonly called "shot" and other incompletely spun particles.

It will furthermore be evident that the web rolls, as they are removed from the fabric making machine, may be enclosed in germ-proof covers of parchment or other suitable material and subjected to a suitable temperature, as of 120° C., to destroy all bacteria, care being taken not to carry the temperature to a point at which the organic components of the fabric would be carbonized or otherwise injured. In this way filter rolls may be kept in an absolutely sterile condition until required for use.

It will still furthermore be evident that a liquid conveying fluid may also be used for depositing fibres on reinforcing threads having the stretch arrangement shown in Figs. 6, 7 and 8.

It will be understood throughout the appended claims that "reinforcing threads" may include any assembly of fibres, or threads, or other foraminous flexible structure, of vegetable, animal, or mineral origin that will increase the tensile strength of a contacting web of filtering material; and that the word "retracting" as applied to reinforcing threads, means any take-up of the threads in the way of waving, doubling-back, etc., as described in Figures 6, 7 and 8, which allow the fabric to be extended when in use.

I claim as my invention:

1. The method of making an extensible filter fabric comprising: moving reinforcing threads

onto a foraminous supporting member; simultaneously retracting the length of the reinforcing threads; dispersing a fibrous material in a current of elastic fluid; and passing the said fluid through the retracted reinforcing threads and foraminous supporting member to deposit the dispersed fibres on the said retracted reinforcing threads.

2. The method of making an extensible filter fabric comprising: continuously moving reinforcing threads onto a foraminous supporting member; simultaneously retracting the length of the reinforcing threads; dispersing a fibrous material in a current of elastic fluid; and passing the said fluid through the retracted reinforcing threads and foraminous supporting member to deposit the dispersed fibres on the said retracted reinforcing threads.

3. The method of making an extensible fabric comprising: moving reinforcing threads onto a foraminous supporting member; simultaneously giving the reinforcing threads a traverse motion to make the said threads wavy; dispersing a fibrous material in a current of elastic fluid; and passing the said fluid through the wavy reinforcing threads and foraminous supporting member to deposit the dispersed fibres on the said wavy reinforcing threads.

4. The method of making an extensible fabric comprising: moving reinforcing threads onto a foraminous supporting member; simultaneously giving the reinforcing threads a traverse motion to make the said threads wavy; dispersing a fibrous material in a current of elastic fluid; passing the said fluid through the wavy reinforcing threads and foraminous supporting member to deposit the dispersed fibres on the said wavy reinforcing threads; and treating the deposited fibres and the said wavy threads with a binder to bond the fibres to the threads.

5. The method of making an extensible filter fabric comprising: dispersing a fibrous material in a current of elastic fluid; passing the said fluid through a foraminous retaining wall to deposit the dispersed fibres thereupon; superimposing reinforcing threads on the deposited fibres; and simultaneously retracting the length of the superimposed reinforcing threads.

6. The method of making an extensible filter fabric comprising: dispersing a fibrous material in a current of elastic fluid; passing the said fluid through a moving foraminous retaining wall to deposit and distribute the dispersed fibres thereupon; continuously superimposing reinforcing threads on the deposited fibres; and simultaneously retracting the length of the superimposed reinforcing threads.

7. The method of making an extensible fabric comprising: moving primary reinforcing threads onto a foraminous supporting member and simultaneously retracting the length of the said primary threads; dispersing a fibrous material in a current of elastic fluid; passing the said fluid through the retracted primary reinforcing threads and foraminous supporting member to deposit the dispersed fibres thereupon; superimposing secondary reinforcing threads on the deposited fibres and simultaneously retracting the length of the said secondary threads; and bonding the primary reinforcing threads, deposited fibres and secondary reinforcing threads together.

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