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FIBROUS ABSORBENT BODY AND METHOD OF MAKING SAME

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8 Claims. (Cl. 128—156)

This invention relates to fibrous bodies of various forms, such as pads, sheet materials and others. The invention will be herein disclosed in connection with the manufacture of surgical sponges, dressings, bandages, and the like, all of which absorbency is a highly important property, but the invention is equally useful as applied to other fibrous bodies in which this characteristic is not important.

In the manufacture of the various surgical absorbent materials above mentioned, gauze is extensively used. For example, in making surgical sponges as much as a square yard of gauze often is folded to make a single sponge. The chief reason for using gauze is to avoid the presence of loose fibers and to obviate the liability of these fine particles getting into the incision or the wound and remaining there. While it has been proposed to combine gauze with loose cotton or other loose absorbent fibers and thus to reduce the proportion of the gauze used in a sponge or dressing, and such a product has been used to a limited extent, it is necessary in such cases to completely enclose the cotton and to adopt measures to prevent the presence of fibers so short that they cannot be controlled by the gauze. The more common practice still is to use gauze exclusively for surgical purposes.

It is evident, however, that cotton or other absorbent fibers, when once spun, are not in a form suitable for producing maximum absorbency. In other words, the ability of fibrous bodies to absorb liquids is chiefly a surface phenomenon, the liquid being held between the fibers largely by capillarity. The spinning of the fibers into threads and the subsequent weaving of these threads into a fabric therefore greatly reduces the water-holding or absorbing capacity of a given amount of fiber. Or, to state the matter differently the same weight of identical fiber in a loose, free, and fluffy condition could hold a much greater quantity of water.

The present invention aims to devise a fibrous structure in which the necessity for spinning, weaving, and other fabricating processes will be eliminated. As applied to surgical materials, it aims to utilize the greater absorbency of the fiber in a loose and unwoven or unorganized condition and thus to produce surgical sponges, dressings, and the like, in which the benefit of this more efficient utilization of the fiber will be obtained, while at the same time making such a body equally as safe as the gauze sponges and dressings heretofore used.

To these ends one phase or aspect of the present invention involves the steps of producing a fibrous body of approximately the desired shape and size and subjecting all or a portion of the surface of said body, as desired, to a treatment which will bind the surface fibers together and thereby produce a superficial web-like or net-like structure having a high degree of porosity and permeability to the passage of air and water, but which will confine the underlying fibers and keep them under control. Whether such a surface treatment completely encloses the fibrous body, or covers only a portion of it, depends entirely upon the use for which the fibrous body is intended. A typical procedure consists in making a fibrous bat, as for example, by the methods heretofore used in making cotton batting, dividing such a bat into pads, sponges, or dressings of the desired size and shape, and then surface treating them.

This treatment or unification of the surface can be successfully accomplished in several ways. For instance, the body of cotton, or other equivalent fibrous material, may be sprayed, or superficially wetted in any convenient manner, with a liquid binder such as ethylcellulose, cellulose acetate, or some of the other cellulose derivatives dispersed in a suitable solvent, or with rubber latex, either vulcanized or unvulcanized. If such a spray is made rather fine, the spraying period is brief, the viscosity and surface tension of the binder material is properly controlled, and the fibrous mass has a density suitable for use as a surgical sponge, no substantial penetration of the spray into the body of the fiber will be produced, but the particles of binder will be caught and held by the surface fibers. Upon the evaporation of the solvent, or other dispersing liquid, it will be found that the surface fibers are bonded together, forming a strong foraminous surface structure which effectually prevents the interior fibers from sifting through when the body is either wet or dry. At the same time the absorbency of the entire mass is not materially affected. The same treatment may be used on sheeted fibrous bodies and in some cases one face only of the sheet material need be so treated to unite the fibers together.

While a wide variety of binders can be used in this process, it is desirable in making products designed for surgical use, to employ a binder that is not dissolved or adversely affected for the purposes of this invention by the presence of water or blood, it being understood that

the terms "dissolved," "soluble," and the like, are herein used in their common meanings, instead of in accordance with their strictly scientific definitions. In some cases, also, binders which would be substantially affected by alcohol ether, or chloroform should be avoided. Bakelite binders are satisfactory for this purpose. Some of the cellulose derivatives, such as cellulose acetate, answer these requirements as to water or blood, as do also resins of the urea-formaldehyde type, "glyptols" (glycerol-phthalic anhydride), and the condensation products of formaldehyde with aromatic sulfonamides. The last mentioned materials are known in the trade as "Santolites."

As above indicated, an important requirement for the conditions here dealt with is that the binder shall not be continuous but that the gauze-like or net-like surface structure produced by the treatment shall be of an open mesh, foraminous and highly porous character. This result is readily obtainable by properly controlling the viscosity or the surface tension of the dispersion sprayed upon the fibers. If the binder is used in forms having a high surface tension, the spraying operation may be so performed that the binder will strike the fibrous body in the form of tiny droplets or globules that will not spread easily even on a highly absorbent material, thus depositing the binder in a discontinuous form. Such binders as vulcanized latex and cellulose acetate and others lend themselves readily to control in this manner. A 10% solution of cellulose acetate in acetone, for example, will have the outlined properties. When droplets of such a binder having a high surface tension strike the fibers, they tend strongly to hold their globular form. If such a droplet happens to contact two or more fibers converging to a common point of intersection, it will try to shift to that point because of the tendency just mentioned. This is a well known phenomenon of high surface tension liquids. Such points of convergence and intersection are present at closely spaced intervals throughout the entire body of fiber. Consequently, this phenomenon is useful in the present process because it tends to position the discrete particles of binder at the intersections of the fibers where their binding action is most effective, with the object of leaving the remainder of the surfaces of the fibers uncovered by a binder so that they may be free, when desired, to exert their absorbent properties.

A further factor demanding attention in the selection of a binder is the wettability of the treated surface with water, blood or other aqueous fluids. In other words, it is important not only to have a foraminous surface structure or layer, but also desirable to make the unified surface layer easily wettable. The untreated fiber used in these products naturally has a high degree of wettability. If the treatment tends to destroy this property, such a result can be avoided in two ways, first, by including in the binder or unifying material a water soluble plasticizer or wetting agent that will suitably change the properties of this material. Such agents as triacetin or dimethyl and diethyl phthalates may be used for this purpose with such binders as cellulose acetate or ethyl cellulose. If a binder of the phthalic-glycerol type is used, then suitable plasticizing and wettability agents as succinic, malic or tartaric acids may be employed. Another method is to apply to the unified surface, after the treatment above described has been completed, a molecular layer of a wetting agent such as one of the sulphonated oils, or very small quantities of such substances as "nekal" or "neomurpin." The latter are understood to be forms of sodium alkyl naphthaline sulphonate. Also, the glycols and fatty alcohols may be used for these purposes, either in combination with the binder as initially applied, or as subsequent surface treating agents.

In making relatively thick fibrous bodies of this nature, the surface treatment alone may not give the desired stability to the structure. Accordingly, another phase of this invention involves the bonding or unification of a fibrous body substantially throughout its mass, while still preserving its porosity, and without substantially altering the nature of its fibrous structure except to bond the fibers together where they come in contact with each other at points so spaced and distributed throughout the mass as to give the entire structure the desired degree of stability. Such a process thus produces a unification of the entire mass. For some purposes it is desirable to use both treatments jointly, or, in other words, to unify the entire mass of the fibrous body in addition to unifying part or all of its surface, as above described. When such unification of the entire mass is desired, it can be produced in the manner disclosed in my copending application referred to below.

A considerable variety of thermoplastic and polymerizable binders are available which are suitable for use in the processes hereinbefore described, including vinyl compounds, such as vinyl chloride, vinyl acetate and copolymers of the same, polymers of styrene, and various esters and ethers of cellulose, such as cellulose acetate, cellulose formate, ethyl cellulose, and others. Also, phenol-formaldehyde, urea-formaldehyde, glyptol, and the like.

Also, the plasticity of these products can be varied by incorporating in their composition suitable plasticizers well known to those skilled in this art. In making surgical sponges, bandages, and the like, it is desirable to use plasticizers which are insoluble in water, or only sparingly soluble, and which are substantially non-toxic and non-corrosive to human tissue. With certain binders that class of plasticizers known as Santicizers are particularly valuable for these purposes. Of this group ethyl-phthalyl-ethyl-glycolate is especially useful where physiological effects are important. By way of illustration, if cellulose acetate is the binder employed, its thermoplastic properties may be enhanced by adding this plasticizer to the binding material in the proportion of one part of plasticizer to two parts of cellulose acetate. Other members of this group which are also useful are the corresponding methyl or butyl compounds.

Where it is desirable to modify the water wettability of such binding materials, this result may be produced by the addition, either to the binder itself or to the finished product, of any of the wetting agents above mentioned, or such others as triethanolamine and sulphonated fatty alcohols.

In making all of these products it is preferable to use textile fibers, partly for the reason that these fibers can be handled by the common commercial textile machines, and partly also because their length is such that they can be better controlled in the manufacture of surgical sponges and other articles where such control is especially important, and for the further reason that the

more common of these textile fibers, especially cotton, is admirably adapted for use in these products. Other fibers, however, such as viscose, also are useful in the manufacture of some of these products.

It will be noted that this invention produces a fibrous structure from a body of unorganized, heterogeneously disposed fibers intermingled with each other loosely and without spinning, weaving, or other fabricating processes. Consequently, substantially the maximum efficiency of the fiber as an absorbing medium is utilized. In addition, the manufacturing steps involved in making this product are relatively inexpensive.

Furthermore, the surface unification affords a control or restrain of the free fibers below the unified surface, which makes such a product fully as safe to use on wounds, incisions, and the like, as are the gauze sponges commonly used heretofore.

This application is a continuation, in part, of my copending application Ser. No. 29,375, filed July 1, 1935, since issued as Patent No. 2,229,061, dated Jan. 21, 1941. The broad claims on subject-matter common to the two applications and those on a fibrous body unified throughout its mass are presented in the parent case, while the claims in this application are directed to products involving the net-like surface structure described in the specification.

Having thus described my invention, what I desire to claim as new is:

1. An article of the character described, comprising an absorbent body of intermingled, unorganized, textile fibers easily water-wettable, those fibers of at least a substantial area of the surface of said body being water-insolubly united by discrete particles of a waterproof synthetic resinous binder to produce a net-like surface structure which is highly permeable to air and water, said binder containing a non-toxic plasticizer.

2. An article of the character described, comprising an absorbent body of intermingled, unorganized, textile fibers easily water-wettable, those fibers of at least a substantial area of the surface of said body being water-insolubly united by discrete particles of a cellulose ester binder to produce a net-like surface structure which is highly permeable to air and water, said binder containing a plasticizer of the Santicizer type.

3. An article of the character described, comprising a body of intermingled, unorganized, absorbent, textile cellulose fibers united by discrete particles of a water-insoluble, freely water wettable bonding agent, and the fibers of at least a substantial area of the surface of said body being united to produce a net-like surface structure, highly permeable to air and water, insoluble in in water, but of easy wettability, whereby, when in contact with an aqueous material, the material may be freely absorbed into the passages between said absorbent cellulose fibers.

4. An article of the character described, comprising a body of intermingled, unorganized, cellulose fibers united to each other by discrete particles of a water-insoluble bonding agent, and a portion of said body of cellulose fibers at the surface thereof being united to form a water-indestructible net-like film highly permeable to air, and the surface of the whole structure of said fibers and the bonding material being highly water wettable due to the presence thereon of a film consisting of a substance which is highly wettable by water.

5. An article of the character described comprising a thick, fluffy, flexible, soft layer of intermingled, unorganized, absorbent, textile fibers, said layer being bounded on at least one of its surfaces by a thin, water-indestructible, highly porous, web-like film serving to confine the underlying fibers and keep them under control during the use of said article, said film comprising textile fibers attached to each other at their points of crossing by discrete bodies of cellulosic binder.

6. An article of the character described, comprising an absorbent body of heterogeneously intermingled textile fibers, those fibers of at least a substantial area of the surface of said body being water-inseparably bonded together into a gauze-like, open-mesh, foraminous and highly porous web at the surface of said body, said web being highly permeable to the passage of air and water therethrough, and confining underlying fibers of said body to keep them under control during the use of said article, said underlying fibers being more loosely associated than the fibers of said web.

7. An article of the character described, comprising an absorbent body of heterogeneously intermingled fibers, a substantial part at least of the surface area of said body being bounded by a water-indestructible net-like web, highly permeable to air and water and composed of textile fibers at the surface of said body and forming a part thereof but united to each other by a water-insoluble binder, said web being of a structurally different character from that of the body of fibers underlying it and serving to restrain underlying fibers of said body.

8. An article of the character described, comprising an absorbent body of heterogeneously intermingled textile fibers, those fibers of at least a substantial area of the surface of said body being water-inseparably bonded together into a foraminous web or net-like structure by a water-insoluble synthetic resinous binder, said web being of an open mesh and highly porous character serving to restrain underlying loosely associated fibers of said body, whereby when said body is in contact with an aqueous material, such material may be freely absorbed into the passages between said fibers.

WARNER EUSTIS.

CERTIFICATE OF CORRECTION.

Patent No. 2,339,562. January 18, 1944.

WARNER EUSTIS.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 1, first column, line 6, before the word "all" insert --in--; page 2, first column, line 6, after the syllable "hol" insert a comma; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 28th day of March, A. D. 1944.

Leslie Frazer

(Seal) Acting Commissioner of Patents.