

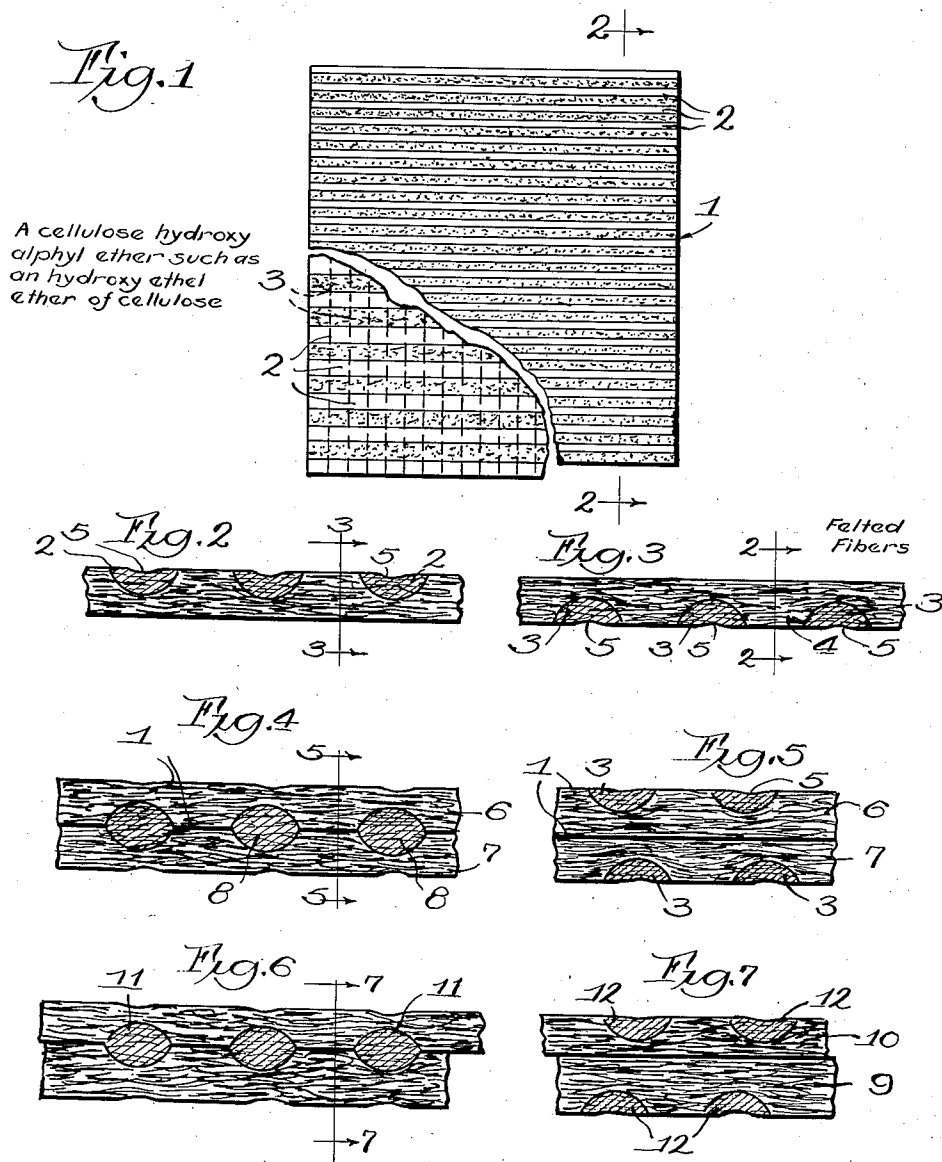
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CLOTHLIKE FABRIC

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UNITED STATES PATENT OFFICE

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CLOTHLIKE FABRIC

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This invention relates to the production and composition of cloth like fabrics produced from unwoven fibers.

The object of this invention is to produce a soft and flexible water absorbent fabric of unwoven fibers, such as wood pulp, which is cheap, washable and resistant to disintegration.

This invention, which is an improvement over the invention claimed and described in the application of Milton J. Shoemaker, Serial No. 299,454, filed August 13, 1928, issued as U. S. Patent No. 1,786,781, December 30, 1930, covers a method of making fabrics from unwoven fibers such as wood pulp which are water absorbent and may be used as wash cloths, towels, napkins and the like without disintegrating when wetted. Furthermore, the fabric which is described and claimed may be washed in the usual way without disintegration.

At the present time towels are made of paper but such towels are without strength when wet and must be discarded after being used. The resistance to disintegration by water of such towels may be increased by hydrating some of the pulp by prolonged beating. This increased resistance to disintegration is obtained, however, at a sacrifice of pliability and speed of absorption of water. Such towels cannot be used as wash cloths. Consequently, wash cloths are made almost exclusively of knitted or woven fabrics. With my process I produce a satisfactory wash cloth from unwoven fibers which need not be hydrated mechanically.

Ordinary fibers, especially cellulose fibers such as wood pulp, when felted into a sheet such as soft absorbent paper, have little strength when wet with water. Such a paper may be coated with a sizing material or a varnish to increase the water resistance. However, the water absorption is decreased thereby as varnish, lacquers and the like are water repellant. The utility of the product is decreased thereby. If viscose or other cellulose ester as described in the aforesaid Shoemaker patent is substituted for varnish and the like and the cellulose then regenerated in the usual manner, the fibers are held in an in-

soluble mass of regenerated cellulose which does not disintegrate in water. In contrast to the water repellant nature of varnish, lacquer and the like, the regenerated cellulose is water absorbent, so that the impregnated sheet loses little or none of this desirable property. However, if the sheet is coated over its entire surface the resulting product is not soft and pliable but is stiff and crackles much like paper. In the Shoemaker patent the cellulose is applied in discontinuous films as hereinafter described and a soft and pliable cloth like fabric results. I have discovered that if an hydroxy-aphyl ether of cellulose is employed like the viscose or cellulose ester of Shoemaker, further advantages are obtained.

The hydroxy-aphyl ethers of cellulose used in my invention may be made as described in a series of applications of Arlie W. Schorger, Serial Numbers 475,249 filed August 14, 1930, 475,250 filed August 14, 1930, 475,251 filed August 14, 1930, 477,752 filed August 25, 1930, (now Patent No. 1,863,208 granted June 14, 1932), and 477,753 filed August 25, 1930, each of said applications being entitled Manufacture of ether derivatives of carbohydrates like cellulose.

In said applications the ether may be prepared by subjecting alkali cellulose, preferably soda cellulose, to the action of an olefine oxide. The oxides at the lower end of the series, that is, those of ethylene to amylene inclusive, apparently produce the most practical cellulose derivatives. Of these the oxides of ethylene and propylene are preferred, especially the former because it is now more available commercially and the cheaper of the two. The corresponding chlorhydrins, that is, the chlorine esters of corresponding glycols, may be used in place of the oxides. The chlorine esters of glycerol, especially alpha monochlorhydrin, or glycerol monochlorhydrin may also be used to produce a useful hydroxy-aphyl cellulose, the alpha monochlorhydrin producing a dihydroxy-propyl ether of cellulose as compared to the monohydroxy-propyl ether formed when propylene oxide reacts with

soda cellulose. This ether resembles the hydroxy-ethyl ether closely.

When ethylene oxide or ethylene chlorhydrin is used it is preferable to keep the ethylene oxide content of the final product below 20% of the cellulose used or substantially less than one molecule of oxide to one unit of cellulose ($C_6H_{10}O_5$). In this range, an ether containing less than one molecule of ethylene oxide to two units of cellulose is preferable and especially one containing one molecule of oxide to three to four units of cellulose, that is, from 7% to 9%. Such ethers, high in cellulose units, are cheaper because of their relatively high cellulose content, are stronger, are more resistant chemically, are easier to handle, are insoluble in water, have a limited solubility in caustic soda solutions, that is, they are not soluble in all strengths of solutions, and are practically insoluble in caustic potash solutions.

As an example of my invention, an hydroxy-ether containing from 7% to 9% of ethylene oxide is dissolved or dispersed (since these ethers apparently form colloidal solutions in the caustic alkalies) in a solution of 7½% to 8% sodium hydroxide so that the solution contains from 6% to 7% of the ether. Its viscosity is adjusted by regulating the age of the alkali cellulose as set forth in said Schorger applications and as is well known to those skilled in the art of making various cellulose esters and ethers. Other hydroxy-alphyl ethers may be used, the solutions being prepared with due regard for the varying properties of these ethers.

The discontinuous film of hydroxy alphyl ethers of cellulose may be obtained by applying the ether dissolved in a caustic alkali solution, and especially caustic soda solution for the preferred ethers, from which the ether is subsequently precipitated. The properties of the ether are varied to suit the fibrous product which is to be impregnated but should in general slowly penetrate the sheet without flooding. The fibers which are used are preferably cellulosic. Wood fibers are especially suitable because of their cheapness and availability. Since the product is to be water absorbent it is best to use sheets of wood fibers or pulp which contain little or no sizing and which are not calendered. It is also preferable to use a long fibered stock for reasons which will become apparent as the process is described further. Long fibered pulp may be made from spruce, tamarack or jack pine. Spruce is especially suitable since it not only is long fibered but it yields when bleached a product of high white color which is usually desirable. Various special treatments of the fibers or the sheeted fibers may be carried out to modify the physical properties of the fibers, such as the absorption qualities.

In the accompanying drawing the inven-

tion is illustrated by one exemplary embodiment thereof but it will be understood that the invention is not to be considered as limited by the illustrated disclosure.

Fig. 1 is an illustration of the simplest form of my invention with a portion broken away and somewhat further enlarged more clearly to show the structure of the sheet,

Fig. 2 is a transverse sectional view of the sheet shown in Fig. 1 along line 2—2 thereof, and along line 2—2 of Fig. 3,

Fig. 3 is a sectional view along line 3—3 of Fig. 2,

Fig. 4 is a transverse sectional view of a composite sheet comprising two of the sheets of Fig. 1 superimposed upon each other,

Fig. 5 is a sectional view along line 5—5 of Fig. 4,

Fig. 6 is a transverse sectional view of a modified form of my invention,

Fig. 7 is a sectional view along line 7—7 of Fig. 6.

To make a thin product suitable for towels and napkins, I use for the base a thin sheet 1, of suitable fibers such as bleached sulphite pulp. A sheet weighing from .07—.09 lbs. per square yard gives excellent results. I coat this sheet with a discontinuous film of the hydroxy-alphyl ether preferably of the concentration and quality hereinbefore described. The discontinuous film may be produced in any one of a number of ways. I prefer applying it in the form of lines 2 by means of a corrugated roller the ridges applying the cellulose ether to the sheet. For the above long-fibered sulphite pulp a coater of 12 lines per inch with ridges .025 inches wide may be used with an ether of the previously described quality. The ether is thereby applied discontinuously over the sheet and if it is of the correct viscosity it does not flood the space between the lines. It spreads only slightly on either side of the lines, also through the sheet. The areas between the lines of ether are substantially free from ether but most of the uncoated fibers are anchored at one or the other end in the contiguous lines of impregnating cellulose ether. The lines may be straight as shown or they may be in the form of curves or any other desired configuration or pattern. The ether may also be applied in the form of a series of dots. Other methods will suggest themselves to those skilled in the art. I do not wish to be limited to the exact methods described but comprehend any method which gives a product which has the ether distributed discontinuously throughout the sheet forming fibrous areas substantially free from the ether. Most of the fibers in the unimpregnated areas being anchored by contiguous portions of the ether.

Although a suitable product may be made by impregnating the pulp sheet on one side in discontinuous areas with an hydroxy-alphyl ether of cellulose, I prefer to impregnate both

sides of the sheet in a similar manner. If one side of the sheet has been impregnated with parallel lines of ether as hereinbefore described and as illustrated in Fig. 2 I then
5 impregnate the other side in the same way except that the impregnating lines 3 as shown in Fig. 3 are substantially at right angles to the lines 2 on the first side. This results in a reinforcement of impregnated cellulose ether
10 in the form of lines, squares, or other configurations. This produces a product of excellent strength and anchors practically all of the fibers 4 of the unimpregnated areas on both sides of the sheet. In general the maximum dimension of the unimpregnated areas
15 is at most equal to the average length of the fibers.

The impregnated sheet is then passed through the various baths for precipitating and washing the cellulose ether. It is at this
20 stage of the manufacture of the cloth like fabrics that the advantages of the hydroxy-alkyl ethers of cellulose over viscose become apparent. The fabric needs merely to be
25 dipped into a precipitating bath to precipitate the ether after which it is washed free of the precipitating bath. On the other hand, when viscose is used as disclosed in the earlier application, the fabric has to be first
30 run into a precipitating bath then desulphurized and then bleached and washed. The procedure necessary with the hydroxy-alkyl ether is less strenuous, affects the fabric less, and is more economical in time, material and
35 apparatus. No odors or poisonous gases are liberated when the hydroxy-alkyl ether is used. In the case of viscose, the large quantities of sulphur in the impure coagulated product must be eliminated. This requires a
40 number of washing operations.

A suitable precipitating solution may be dilute sulphuric acid or it may be any other suitable acid or combination of salts as is well known in the art. A solution containing
45 68% water, 20% sodium sulphate and 12% sulphuric acid is suitable. An ammonium sulphate bath may be used followed by a dilute mineral acid bath instead of the above bath. The fabric is then passed into about
50 0.2% caustic soda after which it is washed in water. The fabric may be dried but I prefer to pass it through an emollient bath. Various emollients may be used such as glycerine alone or associated with other materials,
55 paraffin, oil, etc. I prefer to use a bath containing about 1% soap, such as the brand "Ivory," 2% sulphonated castor oil and 4% glycerine. The fabric retains a small portion of this emollient which softens it, thereby
60 producing a fabric with a soft cloth like texture.

The fabric may be dried either before or after passing it through the emollient solution. After the treatment to introduce emollient the sheet is first squeezed as dry as possible.

I prefer to dry it under slight tension. If it is allowed to dry without any tension, the shrinking of the ether causes it to have a rough, wrinkled appearance. If it is dried under high tension the fabric has
70 a flat paper-like appearance. If dried under slight tension it stays flat but the greater shrinkage of the ether causes it to be depressed below the surface of the unimpregnated areas of fibers as shown at points 5 in
75 Fig. 2 and the corresponding points in Figs. 3, 5 and 7. This gives the fabric a pleasing appearance and a feel similar to a woven fabric which is desirable. The fabric may be colored and embossed to give pleasing
80 effects similar to those of woven fabrics.

A paper towel made in the above manner has a decided advantage over ordinary paper towels in that it is non-linting, highly absorbent, and has a higher wet strength.
85 Such a towel made from thin pulp sheets weighing from .07 to .09 pounds per square yard may contain from 7.0 to 8.0 grams of ether per square yard when coated on both sides.

The above procedure is satisfactory for thin fabrics. For heavier fabrics, such as wash cloths and pads, the procedure and raw materials are changed somewhat. I prefer making a heavy fabric by packing several
90 thin fabrics such as fabrics 6 and 7 shown in Figs. 4 and 5 and pressing them into a unitary structure, the cellulose ether 8 with which they are lined serving as the adhesive to cement the several sheets together. A
95 heavy single fabric of fibers cannot be impregnated thoroughly without flooding the top surface as the cellulose ether travels more readily along the surface fibers, which are in general in parallel relation to the surface of the sheet. Such a heavy fabric may
100 therefore have an unsaturated plane in the center along which it will cleave readily when used in the wet condition. The impregnating agent should penetrate sufficiently inwardly from the surface toward the opposite
105 surface to prevent such cleavage.

In one method of carrying out my invention in which the hereinbefore described viscous cellulose ether solution is used in conjunction with a plurality of cellulosic fiber sheets, I prefer using as the fabric base a pulp sheet 9 (see Figs. 6 and 7) which is heavier than those previously described. I
110 prefer to use mercerized bleached sulphite stock instead of using a pulp sheet of .07 to .09 pounds per square yard. I use a sheet weighing from .15 to .17 pounds per square yard.

I pass this heavier sheet through the hereinbefore described coating machine and line or otherwise coat one side of said pulp sheet with a discontinuous film 11 of cellulose ether. A second sheet 10 of similar pulp but weighing .07 to .09 lbs. per sq. yd. is then
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placed on the coated side of the heavier first sheet and said stacked sheets are then pressed through squeeze rolls which cause the two sheets to adhere firmly to each other since the
5 cellulose ether on the heavier sheet penetrates the fibers of the thinner sheet and causes adherence between the two sheets.

The above composite sheet is then passed through the coater to line or otherwise coat
10 the two outside surfaces with film 12 of ether, the pattern preferably being applied in a direction at right angles to the first coat. This insures the proper anchoring of the fibers in the unimpregnated areas. The
15 sheet may then be passed through the cellulose ether precipitating, washing and other baths as described previously. Instead of using the two pulp sheets as described, additional thin sheets of pulp may be
20 added by the same method before precipitation and the fabric built up by the same procedure into any desired thickness. Two sheets, one thick and one thin, are sufficient to serve as a wash cloth. By this
25 method the final product consists of a plurality of sheets of unwoven fibers which have a reinforcement comprising precipitated cellulose ether distributed discontinuously throughout the sheet and forming fibrous
30 areas or sections substantially free from the ether, most of the fibers in the unimpregnated areas or sections being anchored by contiguous portions of the ether. The reinforcing material extends in all directions and ce-
35 ments or ties the sheets together into a unit.

The hydroxy-alphyl ethers used have a further advantage over the regenerated cellulose obtained from viscose in that these ethers when wet may be stretched as much as 50%
40 before tearing as against 8% to 10% for the regenerated cellulose previously referred to. The wet fabric sheets therefore may be abused to a greater extent while wet if the hydroxy-alphyl ethers are used. After drying the hy-
45 droxy ether of cellulose is much more pliable than the sheet having cellulose material regenerated from viscose. As a result glycerine or other emollient is not essential with the fabric made with the cellulose ether reinforcing,
50 whereas it is important with the regenerated cellulose.

The invention is not limited to the process above described for adding the hydroxy-alphyl ether cement to the fibers. It is not nec-
55 essary to produce a regular relation of the cementing areas as exemplified by lines or dots mechanically applied, for it is contemplated that a spray, controlled in character and in proportion to fiber be applied to felted
60 fibers or to individual fibers or groups of fibers to be felted or in process of being felted so that contacting sections of fibers or a fractional portion of the fibers are cemented together in the finished product, leaving a sub-
65 stantial area of the untreated fiber.

It will be noted that whatever method is employed, the sheet or mass which results is supported by a continuous network of cellulose ether which comprises a fraction of the fibers cemented into a supporting struc-
70 ture by the ether without weakening any fiber entering the network.

In the foregoing and in the appended claims I have used the term "alphyl" as indicating a radical of the aliphatic series inas-
75 much as the term "alkyl" which is sometimes used to make this distinct reference is frequently indicative of both aliphatic and aromatic radicals. The term "alphyl" is specific to the aliphatic series in the same manner as
80 "aryl" is specific to the aromatic series. See Richter's "Organic Chemistry" vol. 1, page 43, first English edition, 1916.

Various other modifications of the process and of the product are contemplated as com-
85 ing within the scope of the invention as defined by the appended claims.

I claim:

1. A reinforced, water-absorbent sheet of unwoven fibers, the reinforcing material comprising a water-insoluble hydroxy-alphyl
90 ether of cellulose distributed discontinuously throughout said sheet forming fibrous areas substantially free from said ether, most of the fibers in said areas being anchored by
95 contiguous portions of said ether.

2. A reinforced, water-absorbent sheet of unwoven cellulosic fibers, the reinforcing material comprising hydroxy-alphyl ether of cellulose containing substantially less than
100 one hydroxy-alphyl radical to one unit of cellulose distributed discontinuously throughout said sheet forming fibrous areas substantially free from said ether, a substantial por-
105 tion of the fibers in said areas being anchored by contiguous portions of said ether.

3. A reinforced, water absorbent sheet of unwoven cellulosic fibers, the reinforcing material comprising an hydroxy-ethyl ether of cellulose containing substantially less than
110 one hydroxy-ethyl radical to one unit of cellulose distributed discontinuously throughout said sheet forming fibrous areas substantially free from said ether, a substantial por-
115 tion of the fibers in said areas being anchored by contiguous portions of said ether.

4. A reinforced, water-absorbent sheet of unwoven cellulosic fibers, the reinforcing material comprising an hydroxy-ethyl ether of cellulose containing a hydroxy-ethyl radical
120 and cellulose units in a range of ratios from one to three to one to four distributed discontinuously throughout said sheet forming fibrous areas substantially free from said
125 ether, the maximum dimensions of said areas being at most equal to the average length of said fibers, said sheet being impregnated with a small amount of emollient.

5. A fibrous sheet comprising water absorbent cellulose fibers, fractional portions of in-
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dividual fibers being cemented together by an hydroxy-alphyl ether of cellulose containing substantially less than one hydroxy-alphyl radical to one unit of cellulose into a supporting network to leave uncemented substantial portions of said cemented fibers.

6. A fibrous cellulosic material in an aggregate of fibers having portions of single fibers cemented to portions of other single fibers by an hydroxy-alphyl ether of cellulose, whereby to unite the aggregate into a cemented whole.

In testimony whereof, I have subscribed my name.

MILTON J. SHOEMAKER.