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MANUFACTURE OF PARTIALLY SOLUBLE
FELTED FIBROUS ARTICLESW. Bartlett Jones, Chicago, Ill., assignor to
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of DelawareNo Drawing. Application July 1, 1933, Serial
No. 678,595

6 Claims. (Cl. 92—21)

The present invention relates to felted articles, and particularly sheets containing relatively insoluble cellulosic fibers, and relatively soluble cellulosic fibers.

It has reference to the use of solubilized wood fibers, such as nitrated wood fibers, as distinguished from reformed or artificially formed fibers, and as distinguished from solubilized forms of other types of fiber, for example cotton.

It has reference also to use of the same types of fiber for the soluble and for the insoluble constituents, such for example as a chemical wood pulp, and a nitrated chemical wood pulp.

Reference is made to the U. S. patent of Dreyfus and Miles No. 1,829,585 in which it is broadly disclosed that any fibrous material capable of being felted into an article, such as a sheet, is so felted with soluble cellulose derivatives in fibrous form. In particular they refer to nitrocellulose and to organic esters of cellulose, such as the acetate, formate, propionate and butyrate, and cellulose ethers such as methyl cellulose, ethyl cellulose and benzyl cellulose. They describe more in detail the cellulose acetate.

It is well known that cellulose acetate as ordinarily made, and certain other soluble derivatives of cellulose, are obtainable in fibrous form only by reforming processes, such as extrusion as through spinnerettes. Nitrocellulose, and some of the organic derivatives, including cellulose acetate by certain processes, and others such as the aliphatic hydroxy ethers of cellulose described by Schorger in U. S. Patent No. 1,863,208, are obtainable in a fiber form generally similar to the original form of the fiber used for the process of chemical treatment to make the fiber soluble. Mention of such unaltered form is also made in British Patent No. 358,510. Although the chemical character of the fiber is altered its physical megascopic form is substantially unchanged. In particular, it retains some of its characteristic properties, such as length, tapered ends, fibrillae and diameter.

One purpose of the invention is therefore to make a felted wood fiber article of one type of fiber, but of two kinds of fiber substance, one being soluble and the other being insoluble with reference to a given solvent substance.

Another object of the invention is to use solubilized wood fiber in a felted sheet in admixture with an insoluble fiber which is of a type at least not of smaller fiber size, such for example as a cotton or rag paper stock, or other fiber material not necessarily cellulosic in character. By this expedient I am able to make a sheet in which the

soluble fiber is relatively indistinguishable to the eye; and in which the formation is the same or more nearly the same as a similar sheet having only the insoluble form.

Making solubilized cellulose fibers, or derivatives of cellulose, is much cheaper than making extruded fibers. The latter are long threads and it is not a simple matter to cut them into uniform short lengths without waste, and without possibly having extra "longs" which will not felt well, and extra "shorts" or "fines" which may be lost through the felting screen.

Nitrocellulose prepared from cotton, or cotton linters, is available on the market, but usually as an alcohol-wet mass of fibers. In its manufacture it is first wet with water, and then water is replaced by alcohol. I prefer to use nitrocellulose fibers which have not been subjected to a solvent such as alcohol, for the reason that the nitrocellulose may contain some small or large quantity of a nitrated form of cellulose which is soluble in or may be gelatinized by the solvent. The effect is to destroy in whole or in part the open spaces between the fibrillae of the fiber. Because the soluble fibers are to be wetted in felting into sheets, it is not necessary to dry the soluble fibers from the solubilizing process in which the final step in preparation or purification involves the use of water.

The preferred material for the purpose of the invention is a converted fiber which has not been dried after its conversion to soluble form. For example, in carrying out the invention for nitrocellulose, I nitrate the wood cellulose fibers by a suitable or well known nitration procedure, such as that shown in Wilson's U. S. Patent No. 1,883,215. Excess acid may be washed out of the nitrated fibers with water in any well known manner, either with or without any suitable stabilization treatment, if that is essential. These wet fibers are then incorporated in any desired proportion in a slurry admixed with insoluble fibers of the same or of larger type for making paper. The mixed fibers may be beaten in an ordinary manner in a beater, or treated in a Jordan or both. This action prepares the fibers for producing the so-called "paper-maker's bond" by hydrating cellulose so that upon drying the hydrated cellulose provides a residue which is a bonding agent for all the ingredients of the felted sheet. The hydrated cellulose formed by beating fibers is carried by the fibers themselves as a gelatinous substance, the amount depending upon the extent to which beating or hydration is permitted, as is well known in the paper industry. The insol-

ble fibers may first be treated or prepared for felting apart from the soluble fibers. It is not necessary that the pretreatment for sheeting be practiced on the mixed fibers. It is only necessary that the soluble fibers be uniformly dispersed into the insoluble fibers, and the mixture may be effected at any time prior to felting.

I prefer wood base fibers as the raw material and hence use therewith nitrated wood cellulose fibers, preferably in the water-wet form above described.

I have found that the nitrated wood cellulose fibers and the common forms of chemicals, semi-chemical or mechanical wood pulp may be mixed and felted without difficulty on ordinary paper machines, or cylinder machines, in practically any proportion short of 100% nitrated fibers. A sheet of 100% nitrated fibers will easily disintegrate. Because nitrated fibers do not hydrate and swell in beating, in the sense that paper makers use that term in preparing fibers for felting, it is necessary to have present at least some paper making fibers capable of bonding together to include therewith the nitrated fibers.

In using the invention for other soluble derivatives, such as the ethers, it is also desirable to keep the treated fibers in water-wet form until felted, although this is not an essential requirement. Some derivatives are distinctively soluble in non-volatile solvents, such for example Schorger's hydroxy aliphyl ethers, which can be dissolved in an aqueous alkali solution. Other ethers such as those of Dreyfus U. S. Patent No. 1,502,379 are soluble in organic solvents comparable to the solubility of nitrocellulose.

The sheeted product of the present invention may be treated as specified by Dreyfus in his U. S. Patent No. 1,829,585. Solvents with or without plasticizing or modifying agents may be used on the sheets in a variety of ways. The soluble fibers in the sheet may serve to anchor applied coatings to the sheet, as for example by the methods described in the copending application of Pascoe and Hella, Serial No. 631,410, filed September 1, 1932.

The process of making felted sheets of the mixtures herein specified may be modified in the ways suggested by Dreyfus in U. S. Patent No. 1,829,585, or in the ways suggested by Pascoe and Hella. In the former, plasticizing material may be added to the furnish. Either liquid or solid forms may be used. The modification of Pascoe and Hella may be employed whereby the cellulose fibers are highly hydrated or gelatinized, or gelatinized cellulose is added, before the felting is effected.

The particular combination of chemical wood pulp and nitrated wood cellulose fibers, sheeted together in a paper form, is a useful article of commerce, generally similar in appearance to an ordinary sheet of paper, and may have substantially the same strength characteristics. The presence of soluble fibers in the sheet gives the paper new properties. The nitrated wood cellulose fibers have a relatively small diameter like the wood pulp fibers, compared to nitrated cotton fibers, such as nitrated cotton linters. Hence the soluble fibers dissolve more quickly when solvent is used, and more quickly unite with plasticizers. The smaller size limits the spacing between the cellulose fibers. In the manufacture, the nitrated wood cellulose fibers mix more readily with the wood pulp fibers. The apparatus designed for the wood pulp cellulose alone, such as paper-

making machines, needs no alteration because of the added nitrated wood cellulose fibers.

The speed of operation of such machines is controlled by freeness of the pulp slurry and fiber size. It has been observed that nitrated wood fibers give greater freeness to the cellulose portion of the slurry. Having similar sized fibers tends to cause more even distribution of the soluble fibers in the cellulose fibers, and there is less loss of smaller sizes in the white water.

Although I have specified use together of insoluble and soluble fibers of the same physical type, I do not mean to limit the invention to the use of nitrated fibers of "short-fibered" woods with pulp from "short-fibered" woods, or the same relation with reference to "long-fibered" woods. It is a common practice in paper making to mix pulp from both long-fibered woods and from short-fibered woods, and it is therefore to be understood that these are to be considered as one type in the broadest aspects of the invention.

In considering another phase of the invention, it is pointed out that certain of the merits of nitrated wood fibers, as distinguished from nitrated cotton fibers, lie in the smaller size of the former. I therefore consider that the use of these smaller nitrated wood fibers is of particular merit irrespective of the character of the insoluble fibers. The cellulose portion of the sheet need not be derived from wood, but may be from other sources, using for example cotton or rag stock for the insoluble fibers in combination with nitrated wood fibers, or other solubilized wood fibers as the soluble fiber ingredient. Thus the insoluble fibers are larger than the soluble fibers.

In using both wood fiber and solubilized wood cellulose fiber, it is of practical importance that both can be made in the same manufacturing plant from one basic raw material. Wood may be cooked to produce cellulose fibers. A part of the product may be solubilized by esterification or etherification, using those processes which do not destroy the general physical form of the fiber, such as nitration, or the etherification described by Schorger. The fibers so solubilized may be taken in water-wet form from the solubilizing process and then be added to the unconverted portion of the cellulose fibers, or to other feltable relatively insoluble fibers, and the mixed fibers felted into sheet or other form.

In describing the felting process, and in referring to paper-like sheets, I do not intend to limit the invention to paper-like sheets, nor to practice on paper-forming machines. "Felted articles" such as boards or formed articles, like dishes, are intended. "Felting" refers broadly to formation by entangling of fibers, and includes such processes as produce compact articles, like paper, and board, or loosely felted fluffy materials, such for example as the product made by the process of foaming a liquid slurry of fibers, as described in the Bryant Patent No. 1,740,280.

It has been clearly demonstrated that where the process and materials are the same, except that nitrated cotton fibers is used in place of nitrated wood-base cellulose fibers, the product is distinctly different. Comparable processes involving considerable beating to form a highly hydrated stock, leave nodules of nitrated cotton in the body and the surface of the felted article. Even distribution is not obtained and absence of nodules is not assured where the nitrated cotton fibers are employed, but these features are as-

5 sured when nitrated wood fibers are employed. Where a sheet of paper for example made by the present invention is treated to fix and disperse the soluble fibers, the sheet is not glassy and spotty as it would be where a nodule of nitrocellulose were present. The surface is thus assured to be free from lumps and may be smoothed to an even texture to receive and exhibit printing matter, either before or after a treatment to alter the
10 soluble fibers in the sheet.

15 It is of course understood that fillers, dyes, or pigments, plasticizers, resins, moisture-proofing agents, etc. may be added without departing from the present invention. Numerous other modifications and variations may be carried out without departing from the spirit and scope of the invention as defined by the appended claims.

I claim:

20 1. The method of forming a paper product which comprises preparing for the felting operation a cellulosic paper-making stock including hydrated cellulose, mixing therewith cellulose derivative in the form of solubilized fibers of wood cellulose having substantially the physical form
25 and size of wood cellulose fibers, felting the mixture to form a sheet, and drying the sheet to form a paper product wherein the residue of hydrated cellulose binds the ingredients together.

30 2. The method of forming a paper product which comprises preparing for the felting operation a cellulosic paper-making stock consisting of wood pulp fibers and hydrated cellulose, mixing therewith cellulose derivative in the form of solubilized fibers of wood cellulose having substantially the physical form and size of wood
35 cellulose fibers, felting the mixture to form a sheet, and drying the sheet to form a paper product wherein the residue of hydrated cellulose binds the ingredients together.

40 3. The method of forming a paper product

which comprises mixing a wood base paper-making stock containing hydrated cellulose with solubilized wood base cellulose fibers, felting the mixture to form a sheet, and drying the sheet to form
5 a paper product wherein the residue of hydrated cellulose binds the ingredients together.

4. A felted article comprising a felted mixture of insoluble fibers of cellulose paper-forming stock and of solubilized fibers of wood cellulose, said fibers being bonded by the dry residue of hydrated cellulose, the soluble fibers retaining the
10 essential size and form of the initial wood cellulose fibers, being substantially straight and of about the same average length as the insoluble fibers, and being well separated into substantial
15 individuality and uniformly distributed throughout the sheet.

5. A felted article comprising a felted paper-making stock of insoluble wood cellulose fibers containing solubilized fibers of wood cellulose, said fibers being bonded by the dry residue of hydrated cellulose, the soluble fibers retaining the
20 essential size and form of the initial wood cellulose fibers, being substantially straight and about the same average length as the insoluble fibers, and being well separated into substantial
25 individuality, uniformly distributed throughout the sheet, and encased therein by the paper formation resulting from felting the paper-making stock containing hydrated cellulose.
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6. The method of making a paper product comprising preparing a cellulose paper-making stock containing hydrated cellulose, including therein individual nitrated wood fibers, and felting and
35 drying the mixed fibers to form a product in which the hydrated cellulose of the paper-making stock provides a residue acting as the bond in the resulting paper stock.

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