Jan. 14, 1936. R. L. STERN 2,028,080

WOOD PULP ADAPTED FOR CHEMICAL USE

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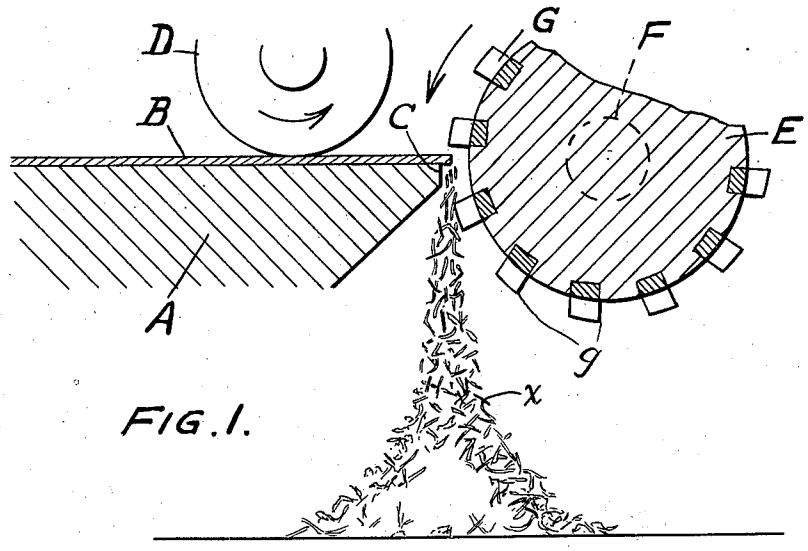

FIG. 1.

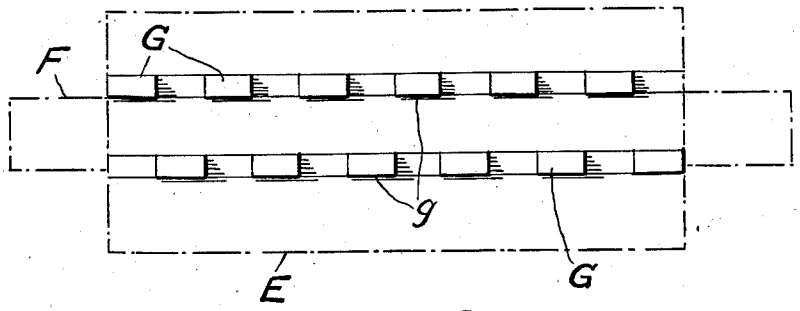

FIG. 2.

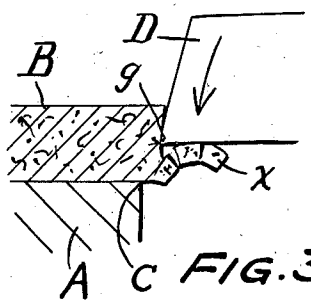

FIG. 3.

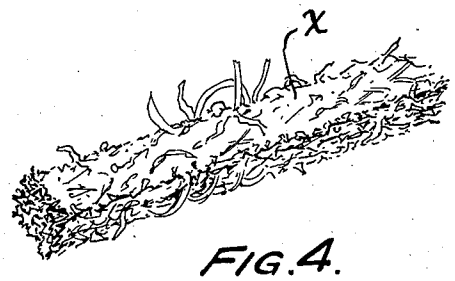

FIG. 4.

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WOOD PULP ADAPTED FOR CHEMICAL USE

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17 Claims. (Cl. 92—20)

This invention relates to wood pulp in a form adapting it for chemical treatment and methods for its production.

More particularly, the wood pulp in accordance with this invention is in a form such that it may be uniformly esterified, as, for example, nitrated with the use of nitrating mixtures substantially the same as those heretofore and presently used for the nitration of cotton, without the expenditure of any substantially greater time than that required for the nitration of cotton, and without the necessity for any special apparatus, or for apparatus modified over that used for the nitration of cotton.

Heretofore it has been the aim of researchers in the art to effect uniform esterification of wood pulp with economy comparable to that obtained in the esterification of cotton, and numerous attempts to accomplish such aim have been made without success, either from the standpoint of failure to obtain uniform esterification, which is essential to the production of clear solutions, or from the standpoint of economy.

Thus for example, it has heretofore been suggested to esterify wood pulp in various forms, such as in the form of crepe paper, lengths cut from hard pulp board, picked relatively dense pulp board of the nature of cardboard, thin wood pulp paper strips, mercerized wood pulp, parchment paper, and the like.

The various forms of wood pulp mentioned above have been found definitely unsatisfactory, for example, for nitration for various reasons. Thus, crepe paper is uneconomic because of its cost. Cut pulp board, of the nature of cardboard, and such has involved in certain cases thin, narrow, short lengths and in other cases small squares cut from a sheet, has proved unsatisfactory in that excessive expense is involved. Thus, the cost of obtaining anything like uniform nitration involves excessive expense due to the fact that the board is normally substantially dense and the lengths or squares are rendered more dense by the cutting and requires an excessively high percentage of nitric acid in the nitrating mixture. Further, even with an excessively high percentage of nitric acid an excessive length of time is required for the nitration.

Picked pulp board has proved unsatisfactory, since for anything like uniform nitration an excessive amount of nitric acid is required. Thin wood pulp paper strips have proved unsatisfactory in that they mat together in the nitrating bath and hence do not uniformly nitrate. The resultant product after washing is difficult to dehydrate.

Picked mercerized wood pulp has proved a desirable form for nitration, but is entirely uneconomic because of high cost arising from the mercerization treatment.

Parchment paper is unsatisfactory because of its cost and the time required to obtain uniform nitration.

Now in accordance with this invention wood pulp in the form of thin, narrow, thread-like or ribbon-like lengths formed from felted wood pulp sheet by chipping or cutting and splitting, in accordance with the method of this invention, and comprising loosely felted fibres, lending it to ready and economic chemical treatment is produced and more specifically the wood pulp embodying this invention lends itself to uniform nitration of wood pulp with use of the usual nitrating mixtures used for the nitration of cotton, in substantially the same length of time as is required for the uniform nitration of cotton, and with the use of the same apparatus as is used for the nitration of cotton. Further, the nitrated product may be freed from acid, stabilized and dehydrated in the same manner and with the same apparatus as is used for the treatment of nitrated cotton and with equal facility.

More particularly, in the preparation of wood pulp embodying this invention by the method in accordance with this invention, a relatively thin sheet of loosely felted wood pulp fibre is cut or chipped into lengths preferably of a width less than the thickness of the sheet and, at the same time, the lengths will be split lengthwise into two or more lengths, which, respectively will be of a thickness less than the thickness of the sheet. The resultant lengths will comprise loosely felted fibres. The ends and surfaces of the lengths will be irregular and will have protruding fibres.

The exact nature of the wood pulp contemplated by this invention will be more thoroughly understood from the following specific description by way of example of modus operandi, in accordance with this invention, and of apparatus for the production of the form of wood pulp contemplated, all with reference to the accompanying drawing in which:

Figure 1 is a cross sectional view of the detail of mechanism for the production of the form of pulp contemplated.

Figure 2 is a front view of the cutting device shown in Figure 1.

Figure 3 is an enlarged detail showing the formation of the lengths of the pulp.

Figure 4 is a greatly magnified view of a length of pulp.

Wood pulp in the form contemplated by this invention may be of any type desirable for intended chemical treatment. Thus, for example, the wood pulp may have an alpha-cellulose content of 88%, 95%, or such other percentage as may be suitable or desired for nitration. The wood pulp may be bleached to a high white or to any less degree which may be satisfactory for the purpose for which the ultimate nitrated product is intended.

The sheet from which the thread-like or ribbon-like lengths contemplated by this invention will be formed may be any suitable commercial form of felted pulp. The sheet may be of any width, depending upon the capacity of the apparatus designed to cut off the thread-like lengths contemplated. The sheet may be of a thickness within quite wide limits, say from .02–.05 inches.

Desirably, by way of illustration and not by way of limitation, a sheet of lightly felted wood pulp, having a thickness of .030 inches and of a width suitable to the apparatus to be used, will be found satisfactory for the production of the pulp. Where the lengths contemplated by this invention are formed from a sheet having a thickness of .030 inches, the lengths will desirably have a length of from say about ⅛ inch to about 2 inches, desirably about ¾ inch. They will desirably have a width of about .015 inch and a thickness of about .010 inch.

The lengths such as suggested above by way of illustration and of a length of about ¾ inch. and a width of about .015 inch and a thickness of about .010 inch will be formed by the cutting of .015 inch widths of a length of ¾ inch from the sheet and splitting the lengths lengthwise into three pieces. The lengths will be thread-like or ribbon-like, depending upon their width.

Referring now to the drawing A indicates a support or table adapted for the support of a lightly felted wood pulp sheet B adapted to be fed over a shearing edge C, by means of a feed roller D. Cooperating with the shearing edge C of the table is a cylinder E provided at opposite ends with trunnions F mounted in suitable bearings and carrying on its periphery a series of chipping knives G. The cylinder is adapted to be driven through any suitable driving means from any suitable source of power, as is also the feed wheel D. The end of the sheet B will be fed forwardly into the path of the knives. A plurality of superimposed sheets may be fed to the knives.

The knives G carried by cylinder E are of a relatively short length and are arranged in rows, the knives in each row being in spaced relation and staggered with respect to the knives in adjacent rows. The knives G in a row may be formed integral from a bar of a length to extend the width of cylinder E by recessing the bar. The bar may be secured to the cylinder in any suitable manner. The chipping knives G, comprise a body portion extending from the periphery of the cylinder E and a cutting edge *g* formed at the outer lower edge of the body. The length of the knives G is governed by the desired length of the product. Thus, the knives will be from ⅛ to 2 inches in length. By way of example, the knives will be about ¾ inch long.

Now, with reference to Figure 3, assuming, in line with the example given above, that lengths of a width of about .015 inch are to be cut from the sheet, it will be noted that as the cutting edge *g* of the knives penetrates the sheet, the under side of the body portion of the knives causes the severed portion of the sheet to be bent outwardly and downwardly, thus splitting the lengths into sections as they are severed. The severing and splitting action of the knives G is illustrated clearly in Figure 3. It will be noted that with reference to the instant example the lengths, of a width of .015 inch severed from the sheet by the cutting edges *g* of the knives is, by the action of the body portion of the knives, split into three lengths of substantially equal thickness, or a thickness of .010 inch in the case of a sheet, as in the example, having a thickness of .030 inch.

The splitting of the lengths causes their upper and lower surfaces to be substantially irregular or rough, with protruding fibres. Their side edges are substantially irregular or rough due to the tearing as well as shearing action of the cutting edge *g*. The end faces of the lengths are irregular and rough with protruding fibres due to the fact that the lengths are torn rather than cut from the sheet at their ends, since the cutting edges *g* of the knives G are staggered with respect to one another rather than aligned.

In the drawing, Figure 4, X indicates, by way of example, a typical length of wood fibre contemplated by this invention and having the characteristics described above. With reference to Figure 4, which is based on great magnification, the nature of the lengths of wood fibre will be noted. It will be noted that the surfaces and ends of the length are irregular and have protruding fibres. It will be noted that the fibres lie or are felted together lightly. It will be noted that by the procedure for their formation, involving shearing, splitting and tearing, the lengths will be less dense than the sheet from which they are formed.

It will be noted that the lengths as shown in Figure 4 are characterized by the fact that they are formed by splitting in connection with the shearing from the sheet and that the lengths are, if anything, less dense and in any event no more dense than the sheet from which they are formed.

Wood fibre in the form contemplated by this invention and as described in detail above in connection with a description of illustrative procedure and apparatus for its formation will be found admirably adapted for nitration. The lengths will be readily penetrated by the nitrating mixture and may be readily nitrated with a nitrating mixture comparable from the standpoint of economy with that used for the nitration of cotton. As illustrative, the lengths may be nitrated uniformly with no excessive time requirement, by utilizing a nitrating mixture comprising 28% nitric acid and 55% sulphuric acid and 17% of water. The particular form of wood pulp may be nitrated in the usual apparatus used for nitrating cotton. The particular form of wood pulp will not mat and form dense masses in the nitrating apparatus or in the subsequent operations of stabilizing and dehydrating, in which operations it may be handled with the same facility as in the case of nitrated cotton.

It will be understood that the form of wood pulp contemplated by this invention is not intended to be limited in any way by the specific description given above, more particularly with reference to dimensions, it being contemplated that the lengths of pulp may be of any desired suitable dimensions and that in the production

of a mass of the lengths contemplated, the lengths in a given mass will vary substantially in dimensions even when produced with a given apparatus from a sheet of given thickness, it being noted, for example, that variously the lengths in their formation will split into more or less than the three sections as described above for illustrative purposes.

It will be appreciated that the lengths may have any desired length. The range given in the above description, while being preferable, is intended as merely illustrative.

It will be further appreciated that while for illustrative purposes the wood pulp contemplated by this invention has been more particularly described as adapted for nitration, its adaptability for various chemical treatment is contemplated.

Thus, by way of further example, 10 grams of wood pulp in accordance with this invention, after the usual pretreatment with glacial acetic acid, may be acetylated by treatment, in any usual manner and in any usual apparatus for acetylation, with a mixture of 30 grams acetic anhydride, 50 grams acetic acid and 1 gram 95% sulphuric acid. The acetylation may be carried out with stirring at a temperature of 30° C.–40° C. and over a period of about 4 hours. The product will be uniform and will form a smooth solution.

Again, the wood pulp in accordance with this invention, will be adaptable for the formation of mixed esters. For example, 10 grams of wood pulp, after the usual pretreatment with glacial acetic acid, may be readily converted into cellulose butyro-acetate by treatment with a mixture comprising 50 grams butyric acid, 30 grams acetic anhydride, and 1 gram 95% sulphuric acid. The cellulose aceto-butyrate product will be uniform and will form a smooth solution.

What I claim and desire to protect by Letters Patent is:

1. Wood pulp in the form of lengths of substantial length and cross section formed from a sheet of felted wood pulp and adapted for chemical treatment, the lengths being of a thickness less than the thickness of the original sheet and comprising wood cellulose fibres lying together in loosely felted relation.

2. Wood pulp in the form of lengths and adapted for esterification, said lengths having surface characteristics resultant from their formation by shearing lengths from a sheet of felted wood pulp and splitting the lengths.

3. Wood pulp in the form of lengths of substantial length and cross section and adapted for esterification, said lengths having surface characteristics resultant from their formation by chipping lengths from a sheet of felted wood pulp the lengths being of a thickness less than the thickness of the original sheet.

4. Wood pulp in a form adapted for esterification comprising lengths of substantial length and cross section and chipped from a sheet of felted wood pulp, said lengths being characterized by the fact that they are of less thickness than the sheet from which they are chipped.

5. Wood pulp in a form adapted for esterification comprising lengths characterized by their formation from a sheet of felted wood pulp by shearing in one direction with reference to the sheet and splitting in a direction transverse to the direction of shearing.

6. Wood pulp in a form adapted for esterification comprising lengths characterized by their formation from a sheet of felted wood pulp by chipping in one direction with reference to the sheet and splitting in a direction transverse to the direction of chipping.

7. Wood pulp in a form adapted for esterification comprising lengths characterized by their formation from a sheet of felted wood pulp by shearing in one direction with reference to the sheet, splitting in a direction transverse to the direction of shearing and tearing at the ends.

8. Wood pulp in a form adapted for esterification comprising lengths characterized by their formation from a sheet of felted wood pulp by chipping in one direction with reference to the sheet, splitting in a direction transverse to the direction of chipping and tearing at the ends.

9. Wood pulp in a form adapted for esterification comprising lengths characterized by their formation from a sheet of felted wood pulp by shearing in one direction with reference to the sheet and splitting in a direction transverse to the direction of shearing and by the fact that they are less dense than the sheet from which they are formed.

10. The method of producing wood pulp in a form adapting it for esterification which includes chipping lengths from a sheet of felted wood pulp.

11. The method of producing wood pulp in a form adapting it for esterification which includes shearing a sheet of felted wood pulp in one direction, splitting in a transverse direction and tearing to form lengths.

12. The method of producing wood pulp in a form adapting it for esterification which includes reducing a sheet of felted wood pulp into lengths by shearing, splitting and tearing.

13. The method of producing wood pulp in a form adapting it for esterification which includes shearing a sheet of felted wood pulp vertically with respect to its horizontal surface and splitting the sheared portion longitudinally.

14. The method of producing wood pulp in a form adapting it for esterification which includes reducing a sheet of felted wood pulp into lengths by chipping, splitting and tearing.

15. The method of producing wood pulp in a form adapting it for esterification which includes chipping a sheet of felted wood pulp in one direction, splitting in a transverse direction and tearing to form lengths.

16. Wood pulp in the form of lengths formed from a sheet of felted wood pulp and adapted for chemical treatment, the lengths comprising wood cellulose fibres lying together in loose felted relation and being characterized by the fact that the lengths are less dense than the sheet from which they are formed.

17. Thread-like short lengths of nitrated wood pulp comprising thread-like short lengths of wood pulp split from a sheet of wood pulp at least once in the general direction of the plane of the sheet and nitrated.

RAPHAEL L. STERN.