Oct. 13, 1931. G. A. RICHTER ET AL 1,826,825

PREPARATION OF CELLULOSE FIBER FOR CONVERSION INTO DERIVATIVES

Filed Oct. 27, 1927 2 Sheets-Sheet 1

Fig. 1.

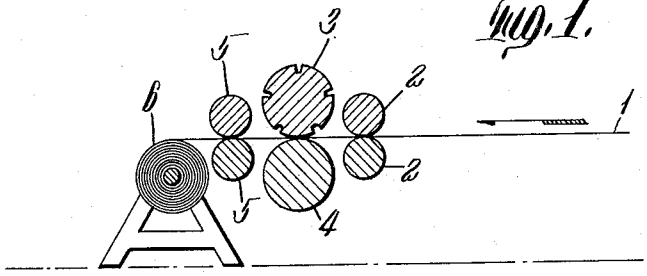


Fig. 2.

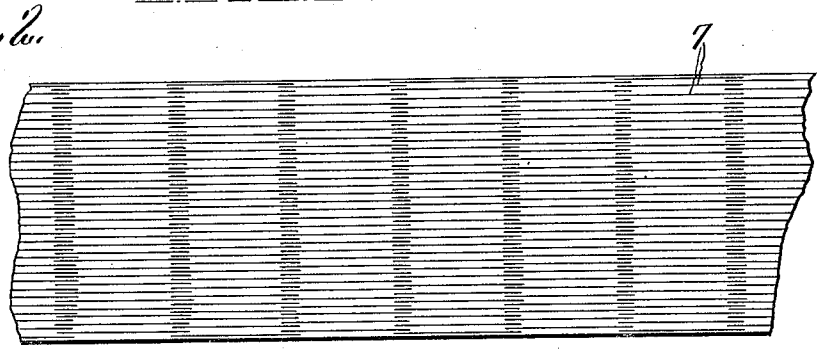


Fig. 3.

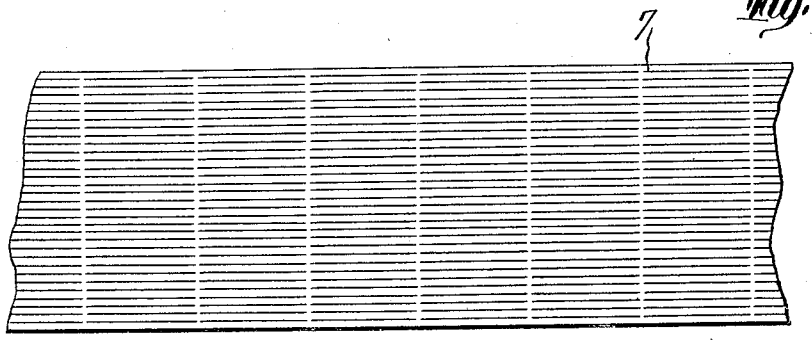


Fig. 5.

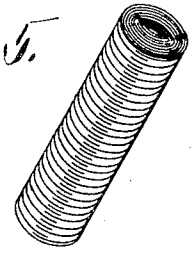
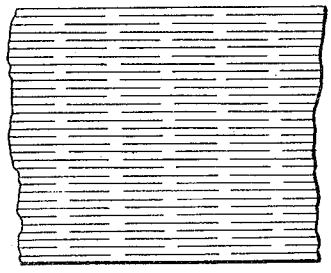


Fig. 4.



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PREPARATION OF CELLULOSE FIBER FOR CONVERSION INTO DERIVATIVES

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Fig. 6.

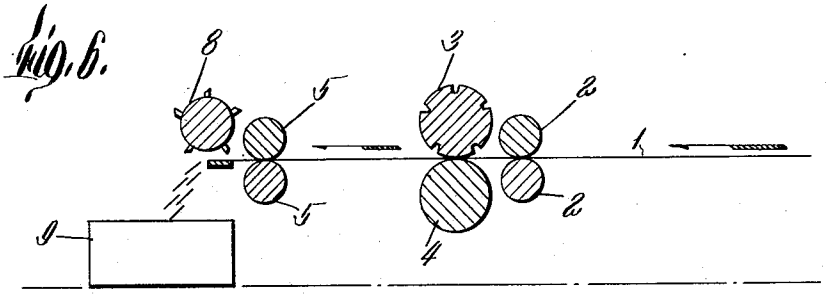
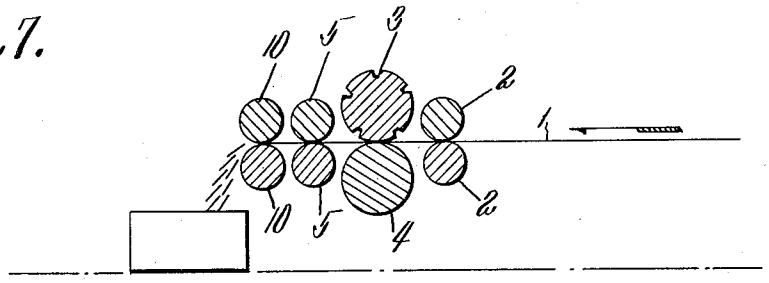


Fig. 7.



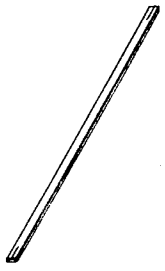


Fig. 8.

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UNITED STATES PATENT OFFICE

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PREPARATION OF CELLULOSE FIBER FOR CONVERSION INTO DERIVATIVES

Application filed October 27, 1927. Serial No. 229,066.

This invention relates to the preparation of cellulose fiber for conversion into cellulose derivatives, its object being to make possible the realization of optimum results upon such conversion.

In preparing cellulose fiber for conversion into cellulose derivatives, e. g., cellulose nitrates, it has heretofore sometimes been the practice to sheet the fiber into paper and then to shred or tear the sheet into small squares or short rectangular pieces, into pieces of random shapes and dimensions, or into exceedingly minute shreds or particles presenting almost as much edge as surface. We have discovered that shape and dimension have a marked influence upon the results obtained upon conversion, and that to secure optimum results it is necessary to use narrow strips or streamers, rather than small squares or short rectangular pieces, pieces of random shapes and dimensions, or minute shreds or particles.

While not restricted thereto, our discovery may be applied to great advantage in the production of nitro-celluloses, for we have found that by using paper strips or streamers, we gain in yield and quality of product and at the same time reduce acid retention. We also increase the facility of handling, and are able to use paper of a thickness or basis weight considerably greater than that ordinarily used, without running into difficulty.

In research work performed in connection with our discovery, it has been our experience that with shreds under, say, $\frac{1}{16}''$ in width there is apt to be disintegration in the acid bath and loss of nitrated material through the holes in the centrifuge basket, leading to low yields and an inferior product. On the other hand, pieces wider than, say, about $\frac{3}{8}''$—for instance, pieces of an average size of $1\frac{1}{2}'' \times \frac{3}{4}''$—tend to stick together in the acid bath and in the centrifuge, thereby being reacted upon non-uniformly and causing more or less hydrolysis when the centrifuged material is drowned in water as the first step in washing the nitrated material free from acids. The yield is thereby lowered, as are also the strength and viscosity of the nitrocellulose. This is particularly true when the paper or tissue is above, say, 10 or 12 pounds in basis weight (480—24 x 36) and is a very serious matter when the basis weight is, say, 20 to 22 pounds.

We have found that if the paper is shredded into pieces, say, $\frac{1}{16}''$ to $\frac{3}{8}''$ in width by, say, $1''$ to $12''$ in length, chemical disintegration in the acid bath is avoided, and the ribbons of paper interlace or felt together in the centrifuge, thereby reducing the fiber loss through the holes in the centrifuge basket to an insignificant value. The interlaced ribbons separate readily when drowned, perhaps because of the fact that strips of the size described are somewhat springy and tend to curl. The final result is a maximum yield of strong, well-nitrated product even when the basis weight of the paper has been increased to, say, 20 to 22 pounds. The ribbons are easily handled with pitchforks and rakes before and after nitration, and are preferable to cotton linters, in that they are free from dust and give more uniform results because of their more uniform physical condition.

Our invention may best be appreciated by citing specific examples. The raw material employed in these examples was a waterleaf paper prepared from a high alpha cellulose wood fiber, but it is to be understood that the results are illustrative of what takes place in greater or less degree when cellulose fiber of other origin is employed. Preferably, the fiber is beaten to a material extent, as described in our application, Serial No. 97,998, filed March 27, 1926, prior to sheeting into paper, and/or mercerized after sheeting, as described in application, Serial No. 140,675, filed October 9, 1926, by Milton O. Schur and Royal H. Rasch, as these treatments further improve the results obtained upon nitration. In one example, $\frac{1}{2}''$ squares of waterleaf paper were nitrated in a bath of mixed acids of suitable composition, then centrifuged and washed, resulting in a 130% to 135% yield of nitrated product and an acid retention of 4.6. In another example, strips of similar paper $3''$ long and $\frac{1}{8}''$ wide, when similarly treated resulted in 150% to 152% yield of nitrated product and an acid retention of 4.3. Solutions prepared from the nitrated strips

were of greater clarity than solutions prepared from the nitrated squares.

The present invention further relates to a continuous method of preparing paper strips or streamers of any suitable length, for instance 1″ to 12″ in length and of a width of the order of magnitude of $\frac{1}{16}$″ to $\frac{3}{8}$″, from a continuous sheet of paper. The sheet may be cut or shredded into a mass of individual, narrow strips at the paper mill, while continuously coming off the paper machine or a rewinder, and marketed in baled form, or it may be cut to form a continuous series of rows of such strips integral with the body of the sheet, and then wound up into rolls, which are less bulky and easier to handle than strips. The rolls may then be shipped to derivative mills, where they may be unwound and the strips progressively severed from the sheet, as by passing through a coarse, simple shredder.

Our method may best be understood by the following more detailed description thereof when considered in connection with the accompanying drawings, wherein

Figure 1 illustrates diagrammatically and conventionally means for cutting the sheet for rolling.

Figures 2, 3, and 4 each show a portion of the sheet cut for rolling.

Figure 5 shows in perspective a rolled sheet of paper cut into strips integral with the body of the sheet.

Figure 6 illustrates diagrammatically and conventionally means for severing the strips from the sheet.

Figure 7 illustrates somewhat different means for this purpose.

Figure 8 shows in perspective a severed strip.

Referring to Figure 1 of the drawings, 1 represents a continuous sheet of paper coming directly from a paper machine or a rewinder, for example, and passing between a pair of guide rolls 2 and thence between a rotary cutter 3 and a supporting roll 4, as shown the sheet being drawn along by a pair of feed rolls 5 and finally being wound into a roll 6. The cutter 3 is designed to form a series of rows of longitudinal, sharply cut strips integral with the sheet, this being effected by producing a series of transverse rows of parallel, longitudinal slits 7 in the sheet. The slits may be of any suitable length, say 1″ to 12″, and spaced a distance in magnitude of the order of $\frac{1}{16}$″ to $\frac{3}{8}$″. The slits shown in Figure 2 are arranged in staggered relation transversely of the sheet, with the ends of the slits of one row somewhat overrunning the ends of the slits of an adjacent row, so that by cutting across the successive zones of overrun, a mass of individual strips is at once produced. If the strips are to be severed from the sheet as by a coarse, simple shredder, the rows of slits may be arranged as shown in Figure 3, with the ends of the slits of one row somewhat spaced from the ends of the slits of an adjacent row, or arranged in staggered relation, as shown in Figure 4. Any one of these ways of cutting the longitudinal slits permits winding of the sheet into a roll such as illustrated in Figure 5.

In lieu of winding into rolls after longitudinally slitting, as shown in Figure 5, the sheet cut as illustrated in Figure 2 may pass directly from the rolls 5 under a rotary cutter 8 designed to cut the sheet transversely across the successive zones of overrun, thus at once producing a mass of individual strips, which may be allowed to fall into a suitable receptacle 9. Or, as shown in Figure 6, the sheet may pass from the feed rolls 5 between a pair of rolls 10 rotating at suitably higher speed than the rolls 5, and thus serving to tear the strips from the body of the paper where the slits overrun. The preparation of strips may thus be carried out continuously, beginning with pulp, continuing through the formation of a waterleaf sheet of paper on a paper machine, and ending with cutting of the paper into a mass of individual strips as the sheet comes off the paper machine.

It is to be understood that in lieu of forming straight-lined slits in the paper to produce narrow strips having straight side edges, we may form zig-zag or sinuous slits spaced so as to yield narrow strips upon coarse shredding. Moreover, the slits may be of varying lengths, from, say, 2″ to 12″, in order to obtain a mass of strips of different lengths, which may interlace even better during baling, centrifuging, etc., than strips of uniform length. Or batches of strips of different uniform lengths may be blended to give a mass of the desired characteristics. It is to be further understood that, while we find it preferable to cut the strips lengthwise of the sheet or along the "machine direction" as hereinbefore described, the strips may be cut transversely of the sheet or across the "machine direction."

Our discovery that long, narrow strips as hereinbefore described yield excellent results even when the basis weight of the sheet is raised from the usual 10 to 12 pounds to 20 to 22 pounds is of considerable importance, for, on the one hand, the preparation of the heavier paper is much less expensive and, on the other hand, the heavier sheet is less bulky, increasing materially the weight of cellulose that can be handled per nitrating pot.

While the specific examples herein given are directed to the preparation of cellulose nitrates, our invention may be applied to advantage when preparing other derivatives such as cellulose acetates, for here, too, handling before and after acetylation is facilitated, and there is no tendency for the strips to pack together or disintegrate during acetylation or centrifuging.

Having thus described certain embodiments of this invention, it should be evident to those skilled in the art that various changes and modifications might be made therein without departing from the spirit or scope of invention as defined in the appended claims.

What we claim is:

1. Material for conversion into cellulose derivatives, comprising a mass of strips of waterleaf paper having a width of the order of magnitude of $\frac{1}{16}''$ to $\frac{3}{8}''$ and having a length of at least about 1″ to 12″.

2. Material for conversion into cellulose derivatives, comprising a mass of narrow waterleaf paper strips of beaten fiber having a length of at least about 1″ to 12″.

3. Material for conversion into cellulose derivatives, comprising a mass of narrow waterleaf paper strips of mercerized fiber.

4. Material for conversion into cellulose derivatives, comprising a mass of narrow waterleaf paper strips of beaten and mercerized fiber.

5. Material for conversion into cellulose derivatives, comprising a mass of narrow strips of waterleaf paper of different lengths but falling within the range of at least about 1″ to 12″.

6. Material for conversion into cellulose derivatives, comprising a mass of narrow strips of waterleaf paper having a basis weight greater than 12 pounds.

7. A step product in the preparation of material for conversion into cellulose derivatives, consisting of a rolled sheet of waterleaf paper having a series of transverse rows of longitudinal slits therein.

8. A step product in the preparation of material for conversion into cellulose derivatives, consisting of a sheet of waterleaf paper having a series of transverse rows of parallel longitudinal slits therein.

9. A step product in the preparation of material for conversion into cellulose derivatives, consisting of a sheet of waterleaf paper having a series of rows of parallel longitudinal slits therein arranged in staggered relation transversely of the sheet.

10. A method which comprises beating cellulose fiber to a material extent, sheeting the beaten fiber into paper, cutting the paper into narrow strips, and converting the strips into cellulose derivatives.

11. A method which comprises mercerizing paper, cutting the mercerized paper into narrow strips, and converting the strips into cellulose derivatives.

12. A method which comprises beating cellulose fiber to a material extent, sheeting the beaten fiber into paper, mercerizing the paper, cutting the paper into narrow strips, and converting the strips into cellulose derivatives.

13. A method which comprises cutting up paper into narrow strips having a length of at least about 1″ to 12″ and converting the strips into cellulose derivatives.

14. A method which comprises nitrating narrow paper strips having a length of about 1″ to 12″.

15. A method which comprises nitrating narrow strips of waterleaf paper having a width of an order of magnitude of about 1/16″ to $\frac{3}{8}''$ and having a length of at least about 1″ to 12″.

16. A method of preparing cellulose fiber for conversion into cellulose derivatives, which comprises sheeting such fiber on a paper machine and sharply cutting a continuous series of transverse rows of longitudinal slits in the paper sheet while it is coming off the machine.

17. A method of preparing paper for conversion into cellulose derivatives, which comprises cutting a continuous series of transverse rows of longitudinal slits in a continuous sheet of paper to form a succession of strips integral with the sheet, and then progressively severing the strips from the sheet.

18. A method of preparing paper for conversion into cellulose derivatives, which comprises cutting a continuous series of transverse rows of longitudinal slits in a continuous sheet of paper to form a succession of strips integral with the sheet, rolling up the sheet, and then unrolling and progressively severing the strips from the sheet.

19. A method of preparing paper for conversion into cellulose derivatives, which comprises sharply cutting a continuous series of transverse rows of longitudinal slits in a continuous sheet of paper to form a succession of strips integral with the sheet, and rolling up the sheet.

20. A method of preparing material for conversion into cellulose derivatives from a continuous sheet of paper, which comprises cutting a continuous series of rows of parallel longitudinal slits arranged in staggered relation transversely of the sheet with the ends of the slits of one row somewhat overrunning the ends of the slits of an adjacent row, and cutting across the successive zones of overrun to produce a mass of paper strips.

In testimony whereof we have affixed our signatures.

GEORGE A. RICHTER.
MILTON O. SCHUR.
ROYAL H. RASCH.