April 10, 1934. D. B. DAVIES 1,954,284

PROCESS OF MAKING CELLULOSE PULP IN SHEET FORM AND APPARATUS FOR CARRYING OUT THE SAME

Filed Sept. 27, 1932 2 Sheets-Sheet 1

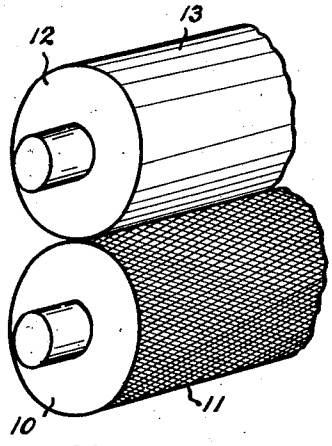


Fig. 1

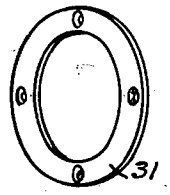


Fig. 4

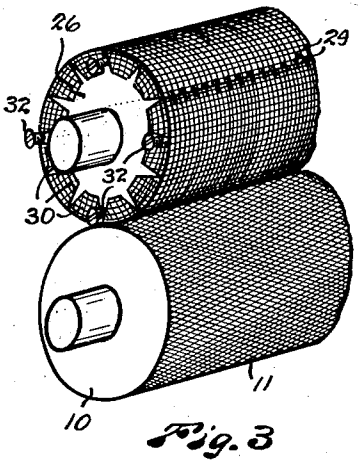


Fig. 3

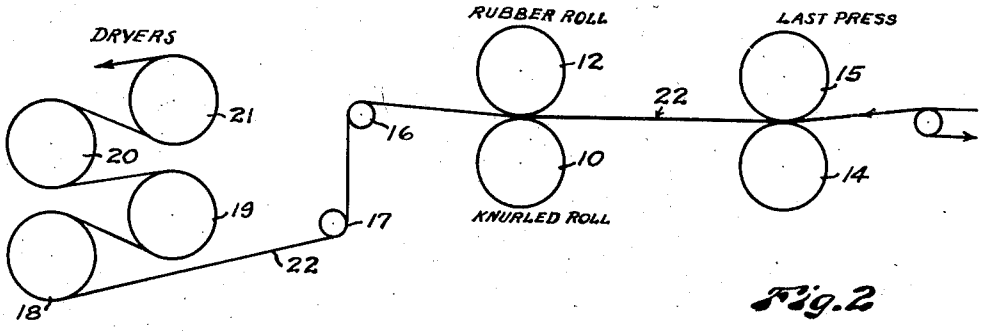


Fig. 2

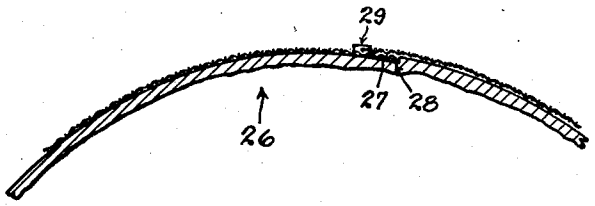


Fig. 5

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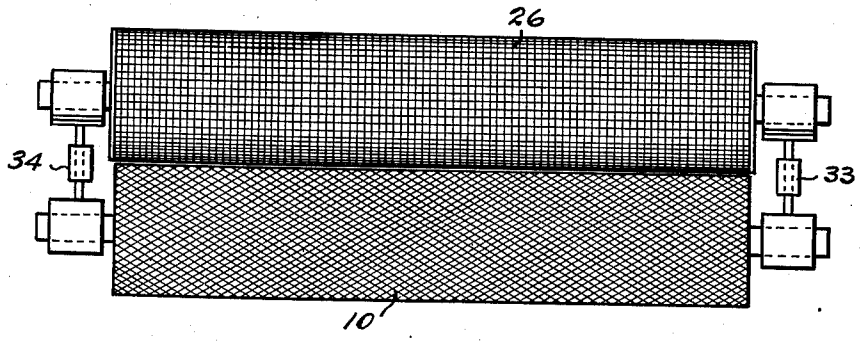


Fig. 6

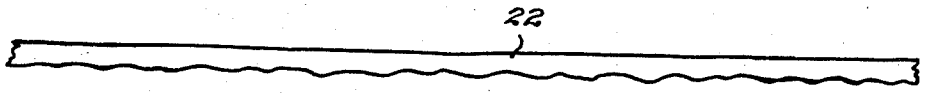


Fig. 7

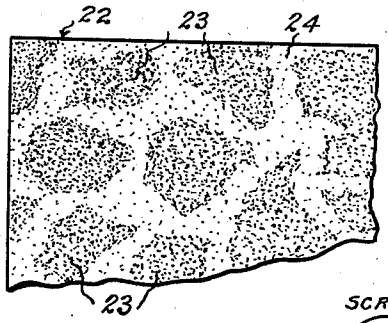


Fig. 8

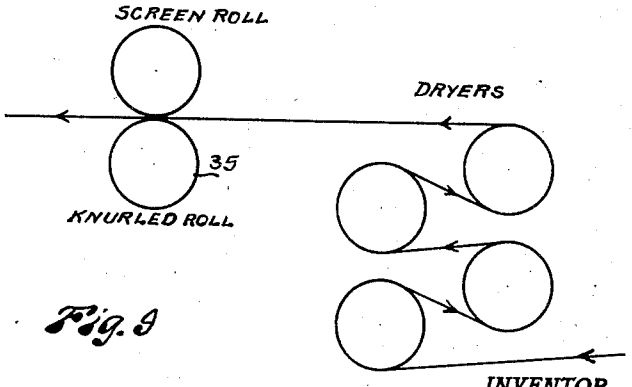


Fig. 9

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Patented Apr. 10, 1934 1,954,284

UNITED STATES PATENT OFFICE

1,954,284

PROCESS OF MAKING CELLULOSE PULP IN SHEET FORM AND APPARATUS FOR CARRYING OUT THE SAME

David B. Davies, Shelton, Wash.

Application September 27, 1932, Serial No. 635,024

2 Claims. (Cl. 92—68)

My invention relates to the process of manufacture of cellulose pulp in the form of sheets which are subsequently to be subjected to the absorption or reaction of chemicals in the manufacture of other products therefrom, to the article of said process and to the apparatus for carrying out said process.

In setting forth my invention, I shall employ, for purposes of clearness and definiteness of illustration and description, the problems presented in the manufacture of viscose, but it is to be understood that my invention is not to be limited to any such specific application, but is co-extensive with all uses involving like problems.

Steeping is one of the steps in the manufacture of viscose and briefly may be defined as the process of exposing the cellulose pulp sheets to the action of caustic soda solution of a given strength. In this, one of the great difficulties experienced is that of providing for uniform absorption and reaction of the said solution upon the fibers of the pulp sheets, i. e., for providing for uniform penetration of the solution. In the forming of the pulp sheet, the entertwined fibers constitute a very porous body with air in and about the fibers. Then, as the sheet is carried through the pressure rolls for the elimination of moisture and through the calendering rolls for ironing out and drying the sheet, a hard surface or skin is formed on the sheet which holds the air or renders it difficult for the air to escape. Accordingly, the hard surface or skin, and the confined air positively hinders the penetration of the caustic soda solution. The primary object of my invention is to provide for the release of the air and the uniform penetration of the caustic soda solution. It is my purpose to achieve these results by providing the pulp sheet with such necessary characteristics to cause it to so react during its regular formation and thereby avoid the expense of separate and independent treatment to secure the stated advantages.

It is of the utmost importance in the manufacture of products from viscose that there should be a positive uniformity of action of the caustic soda solution on each individual fiber. There must be a complete alkalization or reaction with the caustic soda solution throughout the entire sheet. Failing in this, then, all subsequent action with other chemicals is variable, incomplete, and unreliable. Proper alkalization is the key step of the entire process. The carbon bisulphide will not act upon that part of the fibers which has not reacted completely with the caustic soda solution.

The air about the fibers acts as a shield which effectively prevents uniform contact with the caustic soda. The objection to this air is largely physical, as its presence prevents, by exclusion, the proper reaction of the cellulose fibers with the caustic soda solution and manifests itself in a preferential absorption in the pulp sheets and in the formation of "brown spots." This preferential absorption is due to the fact that the cellulose material has a greater attraction for caustic soda than for water. This results in a lowering of the caustic soda concentration in the solution. The "brown spots," it is thought, represent the area of fibers which have been incompletely alkalized by the depleted solution, i. e., the caustic soda solution of low concentration. Also, there is probably a wicking in of soluble organic impurities which have some color. The solution water, remaining after losing the caustic soda to the cellulose material, carries, it is believed, these organic impurities to the said brown areas, and thus contribute to the color of the brown spots.

Imperfect alkalization of fibers in a mass, according to my observation (same being best explanation up to the present, which I have been able to work out), gives "brown spots," but imperfect alkalization of fibers scattered through the sheets does not manifest itself as "brown spots," but nevertheless such imperfectly alkalized fibers are highly objectionable because the incomplete reaction with the caustic soda solution is reflected in the carbon bisulphide reaction step. When the delicacy of the filaments issuing from the spinnerets in the manufacture of rayon from the viscose and the refinement of the steps are considered, the requirement of nicety and precision in the initial steps is obvious. Ordinarily the reaction product is subjected to at least five filtrations to remove parts imperfectly alkalized. Those parts, which are not filtered out, clog or partially clog the very minute spinneret hole. This creates serious difficulties in the spinning operation and results in yarn of low quality.

In attempting to solve the absorption and penetration difficulties set forth above, relatively thin sheets have been tried. However, this renders the process expensive and slows down production considerably. Moreover, it often does not solve the problem, owing to the presence of the hard surface or skin on the sheet of pulp. My aim is to provide as heavy a sheet as possible, consistent with good steeping.

Also, the attempt has been made to reduce the "brown spots" by the use of relatively pure caustic soda solution, that is, the solution is main-

tained relatively free of colloidal impurities, such as hemicellulose. The quantity of such impurities may vary from .4% to 3.0%. Obviously, to so maintain the solution to this degree of purity is expensive, and is not altogether positive and reliable on account of the preferential absorption explained above.

I have discovered that in providing a roll with a knurled surface to puncture or fracture the hard surface or skin which develops on the pulp sheets during their formation, or semi-puncture of the sheet, that I obtain the highly important result of rolling out the high spots and providing a sheet of more uniform thickness. This also results in a closer hugging of the sheet to the drying roll, thereby more completely releasing the water vapor and permitting the drying rolls to be operated at a lower temperature to obtain the same drying action and thereby obtaining a substantial saving of steam consumed. This expedites the drying of the pulp. The knurled roller tends to eliminate the undulations which ordinarily characterize pulp sheets, so that the excessive packing of the fibers occurring ordinarily in the area of the crests of the undulation waves is avoided and a sheet of greater uniformity of thickness results. The effect of the knurled roll is to open up capillaries or openings as fractures to the surface for the elimination of moisture during drying, and for the release of the air when the sheet is wetted, and thereby provides for the uniform penetration of the chemical solution in the steeping process.

The above mentioned general objects of my invention, together with others inherent in the same, are attained by the process illustrated in the following drawings, the same being preferred exemplary forms of embodiment of my invention, throughout which drawings like reference numerals indicate like parts:

Figure 1 is a fragmentary view in perspective of a knurled roll and its cooperating rubber faced pressure roll embodying my invention;

Fig. 2 is a schematic view showing the preferred location of said knurled roll in relation to the pulp pressure and dryer rolls;

Fig. 3 is a fragmentary view of a modified form of roller combination embodying my invention;

Fig. 4 is a view of a detail; an end clamping collar, of the screen roller;

Fig. 5 is an enlarged fragmentary diagrammatic view in cross section of the screen roller showing the method of overlapping and securing the longitudinal edges of the screen or wire cloth on the face of the screen roller;

Fig. 6 is a view in longitudinal elevation of said screen and knurled roller combination showing the spacing means;

Fig. 7 is an enlarged view in elevation of the pulp sheet before passing over the knurled roller;

Fig. 8 is a view of one face of the sheet after being subjected to the action of the knurled roller;

Fig. 9 is a schematic view showing the puncturing device used after the pulp sheet has passed the dryer rolls.

The roller 10 is provided with a knurled surface 11. Immediately above roller 10 is a roller 12 provided with a rubber face 13, which acts as a pressure roller upon the sheet passing over the knurled roller 10.

The combination of the knurled roller 10 and rubber roller 12 (see Fig. 2) is preferably located after the last of the pressure rollers 14 and 15, and before the guide rollers 16 and 17, which are immediately in advance of the dryer rollers 18, 19, 20, and 21.

After the pulp sheet is formed and as it issues from the pressure rollers 14 and 15, the surface of the pulp sheet 22 is undulatory, as illustrated in Fig. 7.

The nature of the pulp sheet 22 is such that there is formed by the action of the rollers a hardened surface or skin. The knurled rollers operate to puncture or fracture this skin and provide the sheet with capillaries or small openings by means of which the release of the moisture is facilitated. Also, the knurled roller tends to operate in pressing out the crest portion of the undulations and fill in the valley, portions of the undulations, thereby rendering the sheet more uniform in thickness. This results in the sheet hugging more closely the dryer rollers so that the drying is expedited, as it provides a much greater contacting of the dryer rolls with the sheet. The face of the sheet (see Fig. 8) has areas where the knurled marks, punctures, or fractures 23 are much more pronounced than other areas 24. By thus puncturing or rupturing the hard surface or skin of the sheet 22 the penetration and the reaction of the caustic solution is much more uniform than when the surface of skin is not so provided with openings.

It has been found that upon cutting the sheets that action of a knurled roller tends to cause the sheet to curl. This is highly objectionable, as it interferes with the automatic cutting and stacking of sheets one upon each other. To overcome this, and to provide for more efficiently puncturing and fracturing of the surface of the pulp sheet 22, I provide the combination form of the knurled roller 10 and roller 26, which roller 26 is provided with a screen facing as shown in Fig. 3. This screen is commonly referred to as wire cloth. The size of the openings may vary from 10 to 30 mesh. However, I prefer about 20 mesh as it has been giving very satisfactory results. If the higher mesh is used, then the openings are too small, and there is not the development of the openings in the hard surface or skin which result when a more open mesh is used, such as about 20 mesh. If, on the other hand, too low a mesh is used, then the openings are too large and the desired puncturing effect does not result. The wire cloth or screen is secured over the open face of a roller, one edge portion 27 being secured by screws or any other suitable means in a recess 28 on the face of the roller 26. The screen or cloth is then wrapped around the roller 26 and the other edge portion overlaps the part secured in the recess 28, the latter edge portion being sewed down with wire 29, so that a smooth longitudinal joint is provided. (See Fig. 5.) The V shaped sections 30 are cut out of the end portions of the wire cloth roller, and the projecting edge portions bent over the edges of the ends of the roller 26. Clamping collar 31 is then secured on the end of the roller by means of screws 32, and in this manner the screen is securely held to the roller. The screen roller 26 is mounted in place of the rubber roller 12 shown in Fig. 1.

The screen roll 26 is supported by the pulp sheet 22 passing between rolls 10 and 26. In order to protect against the wire cloth roller 26 and the knurled roller 10 damaging each other, in the event that the pulp sheet should break, micrometer adjusting spacing bars 33 and 34 of established construction prevent the rollers 10 and 26 from approaching each other by a space

considerably less than the thickness of the pulp sheet, but nevertheless of sufficient magnitude to prevent contacting, so that the danger of one roller damaging the other is eliminated.

Upon running the pulp through between the knurled roller 10 and the screen roller 26, any curling effect is avoided and a most efficient puncturing or fracturing of the hard surface portion or skin on the pulp is obtained.

The product resulting from the process above set forth provides for an exceedingly high degree of uniformity in penetration of the caustic soda solution in the steeping step of the process of the manufacture of viscose. Moreover, it is characterized by the uniformity of thickness which greatly expedites the drying operation. I am able to produce sheets forty-eight one thousandths of an inch in thickness which is a relatively very thick sheet to be used in the steeping process of the manufacture of viscose. This contrasts decidedly with the attempt to overcome the steeping difficulties by providing a very thin sheet. Such has been attempted of a thinness of twenty-eight one thousandths of an inch. In the operation of the knurled roller in connection with either the rubber pressure roller 12 or the screen roller 26 avoids undue condensing or packing of the fibers occurring ordinarily in the midst of the undulation waves. The knurled roller 10 operates to provide a sheet of pulp much more uniform in thickness. In thus providing for uniformity of penetration of the caustic soda solution, the preferential absorption of the caustic soda solution is avoided, together with all of the ensuing difficulties in the subsequent chemical steps due to imperfect alkalization of the sheet. Thus, the product embodying my invention is characterized by having a more uniform density of cellulose fibers and also by uniformity of thickness, and also by having the hard surface or skin provided with punctures or fractures, whereby capillaries or openings are provided for more uniform penetration of the caustic soda solution and the release of the air in and about the fibers.

In Fig. 9, I have illustrated the use of a knurled roll and screen roll upon the pulp sheet after the same has passed the dryer rolls. The knurled roll 35 in this operation may be similar to the knurled roll 10, however it is preferably provided with sharper knurling. The upper roll here illustrated may be in the form of the roller illustrated by rollers 12 or 26.

This apparatus will permit the puncturing effect to be obtained upon a "dry" sheet as distinguished from the operation upon a "wet" sheet heretofore discussed. The operation upon a wet sheet permits the advantages heretofore discussed, such as the hugging of the dryer rolls by the pulp sheet, more effective and efficient drying by the dryer rolls and the production of a more uniform product as respects thickness and such "wet" process is therefore the preferable method.

Obviously, changes may be made in the form, dimensions and arrangement of the parts of my invention, without departing from the principle thereof, the above setting forth only a preferred form of embodiment.

I claim:

1. In apparatus for providing a plurality of punctures or semi-punctures to a cellulose pulp sheet, a knurled roll and a screen faced roll positioned thereabove in spaced relation, said screen faced roll being mounted to normally rest upon a pulp sheet passing between said rolls.

2. In the process of making cellulose pulp in the form of sheets which are to absorb or react with chemicals in the manufacture of other products therefrom, the step of passing said pulp sheet while wet between a knurled roller and a roller cooperating with said knurled roller whereby raised portions of said sheet are pressed into depressed portions of said sheet so that said sheet is made relatively uniform in thickness.

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