July 17, 1934. I. J. NOVAK 1,966,458

METHOD OF SATURATING FIBROUS STOCK

Filed Dec. 27, 1932

Fig. 1.

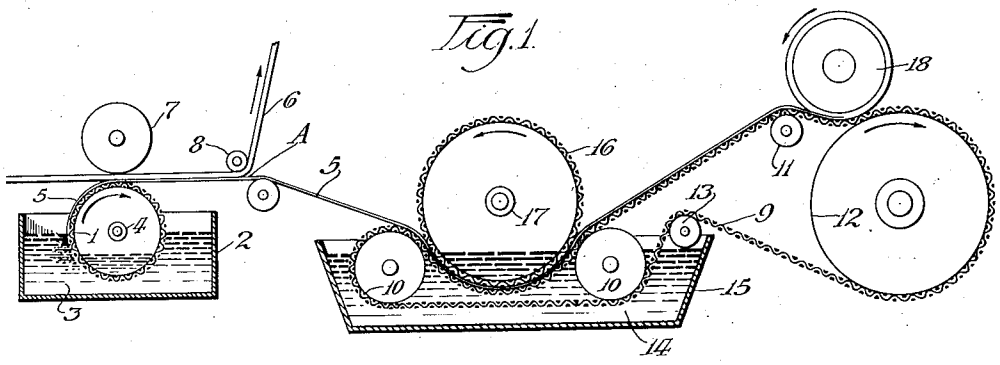


Fig. 2.

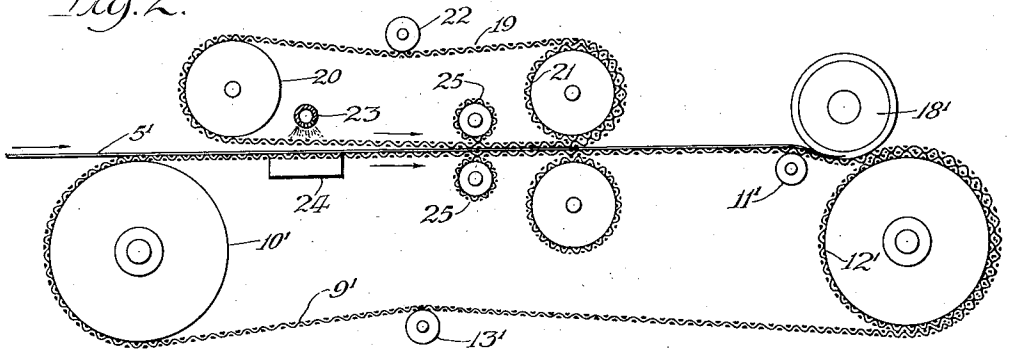


Fig. 4.

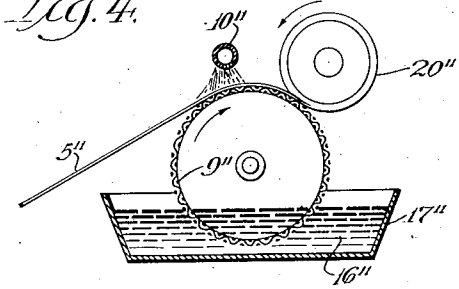


Fig. 5.

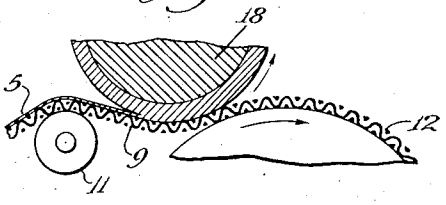
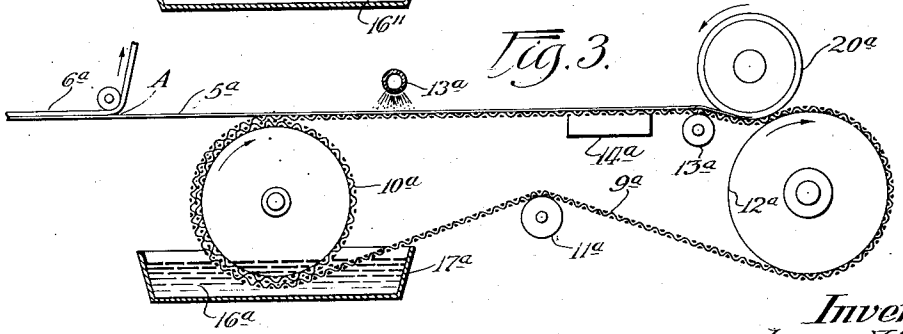


Fig. 3.



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Patented July 17, 1934 1,966,458

UNITED STATES PATENT OFFICE

1,966,458

METHOD OF SATURATING FIBROUS STOCK

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Application December 27, 1932, Serial No. 648,921

27 Claims. (Cl. 92—40)

This invention relates to a method of producing an improved saturated sheeted fiber, and is especially directed to an improvement in introducing binder, sizing, or other modifying materials into paper and fiber board.

It is well known in the paper-making art to immerse or coat a previously formed and partially or completely dried paper in or with various binding materials such as casein solution, glue solution, rubber latex, sodium silicate solution, glue-glycerine solution, rosin size, and other binders or sizing materials for the purpose of conferring upon the paper or fiber board the qualities produced by the action of those binding or sizing materials when dried on the fibrous structure of the paper.

It is well known, however, and thoroughly appreciated by the paper industry, by the use of the term "top sizing", that impregnation is quite imperfect in the use of many of these materials, especially those of a viscous or colloidal nature, and a thin layer near the surface is frequently the only portion of the thickness of the sheet affected by the binder. In many cases, this is quite satisfactory and is desirable, but in others, where a thorough impregnation would produce a tougher or more flexible product, the limitations of this method are appreciated. The usual term for the saturation of dry paper with a binder additional to the sizing contained in the dry paper is "tub sizing". Many attempts have been made to overcome the limitation of incomplete saturation.

It has been found, for example, that by using a loosely felted or porous paper of a low caliper, a substantially thorough saturation may be obtained, but inasmuch as one of the requisites for better grades of paper is a smooth, tight, dense structure, the selection of such a porous paper as a base for saturation is not always desirable.

Other methods are the introduction of a "rest" or ageing period between the saturation and the drying to improve uniformity of saturation, or the equivalent of passing the impregnated paper through a cold chamber before drying. These expedients are more or less effective, depending on the colloidal characteristics of the impregnating material and the size of the pores of the paper.

It will be appreciated that the denser the paper and the finer the pores, the more resistant such paper is to impregnation by viscous or colloidal solutions or emulsions. As an example: Many attempts have been made to provide paper containing rubber as a binder, in view of its remarkable toughening properties. Such attempts have been only moderately successful, and in the successful instances there are important limitations to the type of fibrous base which may be used and the adaptability of the method and product.

One method has been to introduce into the beater engine, along with the paper or other fiber, a quantity of liquid rubber latex, which is a suspension of rubber particles of colloidal size, in a watery serum. However, due to the pronounced tendency of such ordinary latex to coagulate and precipitate, in order to make such a combination of materials suitable for running on a paper machine, it is necessary to protect or cover the rubber particles with some suitable agent so as to prevent stickiness and be less affected by the mechanical action of the beater and paper machine. Such materials are, for example, colloidal clay, blood albumin, and certain others, all of which are practically non-adhesive when dry. When such a mixture of fiber and rubber particles is run up into paper by the elimination of most or all of the water, it will be recognized that the particles still carry their protective coat of non-adhesive colloid, and that this coating serves to reduce their stickiness and binding qualities, preventing them from coalescing completely when dry to form a continuous film within the paper fibers. As proof of this, it is a well known fact that paper made by beater sizing with latex has much less strength and water resistance for an equivalent quantity of rubber than paper which, for example, has been made by saturating with a thin rubber solution.

In the production of asbestos rubber sheet packing, the standard method is to use a rubber cement-asbestos mixture, and gradually build it up on a set of calender rolls, one hot and one cold, by evaporation of the solvent. An equivalent material made by the use of latex and asbestos mixed into the beater and run off on a paper machine must contain almost twice as much rubber for the same physical properties.

As a further instance, it is well known that some of the finest writing and printing papers are produced by the application of glue solution to dry paper. It is recognized, however, that this process is only applicable to very thin dense papers, and that it is quite unsuitable for dense thick calipers, in that the glue solution does not penetrate sufficiently for the binder effect to be at all marked in the interior of the paper.

It is an object of the present invention to produce saturated paper or board wherein the binder is uniformly distributed throughout the fibers, said product being characterized by having had the binder incorporated immediately after the

paper or board was in the form of a newly formed, but self-sustaining, wet web. In the preferred embodiment of the process, the fibers are felted in any desired conventional manner on the blanket or wire of the paper forming machine and removed entirely from said blanket or wire after first removing sufficient water to insure that the newly formed wet web is self-sustaining at the time of removal. The self-sustaining wet web is transferred to a carrier, on or by which it is supported during saturation. The carrier preferably takes the form of an endless screen designed to permit sufficient saturation and at the same time provide support for the wet web during saturation. It is to be particularly noted that the wet web is made self-sustaining and the fiber formation is completed (and not destroyed by subsequent saturation) before being separated from the blanket or wire of the paper machine. It is also to be noted that the wet web is removed entirely from the blanket or wire of the paper forming machine and transferred to an independent carrier, designed for saturation and not for paper forming. It is well known that a paper forming blanket or wire must have relatively thin pores to permit of escape of water while preventing escape of fibers; whereas the saturating screen utilized in the present invention is provided with relatively large pores, only small enough to preserve the fiber formation and at the same time large enough to offer no resistance to the passage of saturant into and out of the web without crushing or distortion of the web under pressure.

The wet web, supported by the screen, is saturated with an excess of the saturant under such conditions that its thickness is slightly increased, while at the same time the fiber formation is not loosened to an extent that the formation cannot be restored to the same relative condition it was in as it left the paper forming machine. The saturated web is then condensed by pressure without crushing, and the condensed web is then subjected to drying.

There are many advantages of the present invention. The original fiber alignment formed on the paper forming machine is maintained and preserved during the saturating step. The fibers are distributed and closely associated in a matrix of saturant and with the removal of water, the fibers are more closely associated and distributed in a matrix of binder and each fiber is surrounded by a film of binder. Thus, there is a uniform distribution of binder in a bonded product.

It will be appreciated that distention of a mass of paper fibers will occur when this mass is in the form of a newly formed wet web in contact with an excess of water or watery fluid, and I have chosen this physical condition of the fibers as the condition in which a saturant or binder material can most easily be entered within the fibrous mass and between the fibers. However, a thoroughly soaked and distended web of paper fibers has not the strength to carry its own unsupported weight in a watery liquid for any distance such as is necessary in a continuous saturation process. Therefore, unless fibers in this distended condition are supported and prevented from disintegrating by their own weight or other mechanical effect into pulp, any previous formation, alignment, intermingling or felting of fibers which are previously produced on the forming elements of the paper machine will be destroyed. Again, besides the support of the web, it must be saturated under such conditions that the fibrous structure in the delicate distended condition will not be materially disturbed. The thickness of the saturated web in my saturating process is directly comparable to the thickness of the web of paper fiber during the period of its formation from the pulp, and before it has been materially densified by pressing or vacuum.

The most suitable backing or support to which such a mass of fibers will adhere, or on which it may lie during saturation, is a fine mesh screen of metal, wire or open mesh cloth, the cleaning of which is, of course, relatively simple.

The relative position of the screen, distended web and aqueous saturant should be such that thorough impregnation of the fibers with the saturant is obtained.

This may be done in several ways:

1. The wet web, while held against, or adhering to, the surface of a rotating cylindrical wire screen roll by an endless screen belt, may be carried below the surface of the saturating liquid so that it is completely immersed therein.

2. The wet web may be carried between two synchronized, endless screen belts, saturant being sprayed or gently poured on the upper belt and passing through the upper belt to the web, while the bottom of the web is saturated by an overflowing reservoir of liquid saturant applied to the lower belt and passing upwardly through the latter to the underface of the web.

3. The web may be passed into contact with the surface of a wire screen roll rotating in a bath of saturant, saturant being gently sprayed on the top of the wet web from a nozzle or other discharge disposed immediately above the screen roll, excess saturant passing through the web and falling by gravity through the screen roll into a vat in which the screen roll rotates.

4. The web may be carried on the surface of an endless screen belt, saturant being applied to the upper surface of said web through a nozzle or other discharge disposed above and in the path of travel of the endless screen belt, excess saturant passing through the web and being removed by suction maintained on the under face of the endless screen belt. The suction assists in drawing the saturant through the web. The endless screen belt itself passes through a bath of saturant maintained in a vat whereby the under face of the wet web which contacts the upper face of the endless screen belt will have saturant applied thereto from the surface of the screen belt.

A further condition which adds to the rapidity and certainty of thorough impregnation, according to the present invention, is that the web which is taken from the paper machine has, of course, lost considerable of the water which was associated with it during the actual filtering or formation on the screen or cylinder of the paper machine (its maximum distention), and when this web is again immersed in a watery fluid, it swells and distends again.

It should be understood that by use of the term "web", I mean not only a single thin web which may be formed on a single cylinder mold of a wet machine or screen of a Fourdrinier machine, but also a greater thickness which may result from the plying of two or more wet webs, as in a multi-cylinder paper machine, or of a single thicker web which may be made by loading a Fourdrinier machine heavily. Dependent upon the freeness of the stock, this film may have a maximum thickness of .030" on a Fourdrinier, or .100" on a multi-cylinder machine. It is evident that a dense or heavy web will not saturate or distend as quickly as a thinner web, but this

retardation is overcome by a longer period in the saturant. The same retardation is noted in the case of dense webs comprising fine short fibers, as against loose webs comprising longer, coarser fibers.

The attached drawing shows apparatus for carrying out the four methods hereinbefore described. However, any mechanical device whereby the conditions therein stated are obtained may also be used.

In the drawing, Fig. 1 is a diagrammatic side elevational view, partly in cross-section, of apparatus for carrying out the method described in the operation designated (1);

Fig. 2 is a similar view of apparatus for carrying out the method described in operation (2); and

Fig. 3 is a similar view of an apparatus for carrying out the method described in operation (3);

Fig. 4 is a similar view of apparatus for carrying out the method described in operation (4);

Fig. 5 is a fragmentary detail view illustrating the transfer of a saturated web from a wire screen, such as those shown in Figs. 1, 2, 3 and 4.

Referring to the drawing, and more particularly to Fig. 1, I have shown the conventional rotary foraminated cylinder 1 rotating in the vat 2 containing pulp solution 3. Suction is maintained on the interior of the cylinder 1 by conventional suction conduit 4 communicating with a source of vacuum. The felting cylinder 1 is immersed in the pulp suspension and rotates in the direction of the arrow. A film of felted fibrous stock 5 forms on the surface of said cylinder and is carried upwardly out of the vat, where said newly formed wet web is transferred to a continuous blanket 6, the couch roll 7 assisting in the transfer. The structure just described and the method of operation are conventional.

According to the present invention, the wet web 5 is separated from the blanket 6 at the point A, the endless blanket being trained around rolls 8, and the wet web being brought into contact with the endless screen belt 9 which is trained around rolls 10, 11, 12 and 13. The rolls 10 are disposed beneath the level of saturant 14 in vat 15. Disposed above the vat and adapted to rotate in the bath of saturating material is a rotatable screen roll 16 driven by shaft 17 suitably journaled in a conventional way. The arrangement is such that the wet web 5 has sufficient water removed from it to make it self-sustaining, after which it moves first into contact with the upper surface of the endless screen belt 9 and is then carried into the space between said upper surface and the surface of the screen roll 16. The sheet is then caused to travel through the bath of saturant 14 and, after the desired time of immersion, is removed from said bath, being carried by the screen to the make-up roll 18. The dolly roll 11 functions, in combination with the make-up roll 18, to couch the saturated web whereby to condense it without crushing. The saturated, condensed web 5 may wind around make-up roll 18 and the plies of the wet web may adhere together to the thickness desired. Intermittently, the plied sheet may be stripped from the make-up roll in a conventional manner. Make-up rolls are usually provided with a longitudinal slot (not shown) and when a web has built up on the roll to the desired thickness, a knife may be passed through the web and into the slot, and the wet plied web stripped from the roll. However, I do not wish to limit myself in any way to the steps which may take place after condensation, since, if desired, instead of winding the web upon a make-up roll, said web may be pressed, dried and subsequently calendered, or any other desired operation may be performed upon the same.

Referring particularly to Fig. 2, another type of apparatus for saturating a wet web according to the present invention is illustrated. In Fig. 2 the self-sustaining web web 5' may be formed on any suitable paper forming machine (not shown), separated from the blanket or wire of the paper forming machine, and transferred to endless screen belt 9', which is trained around rolls 10', 12' and 13'. Roll 10' may be a solid roll, whereas roll 12' may be a screen roll. Mounted above the endless screen belt 9' is a second endless screen belt 19 trained around solid roll 20 and screen roll 21, mounted on suitable shafts journaled in suitable bearings. Tension is maintained on screen roll 19 by tension roll 22.

The newly formed self-sustaining wet web 5' is carried on the upper surfaces of endless screen 9' into the space between screens 9' and 19 to the point where saturant is sprayed from nozzle 23 onto screen 19, passing through the latter onto the upper surface of wet web 5'. The two travelling screens 19 are synchronized. The roll 20 is so disposed as to cause the endless screen 19 to travel at a slight sloping downward angle for a portion of its travel just above the web 5' to provide room for slight expansion of the web when saturated. Too great a separation of the screen and too much flow of saturant may cause distortion of the web. An overflowing reservoir of saturant, illustrated diagrammatically at 24, is disposed in contact with the screen 9' below the web 5' and preferably immediately below the nozzle 23. Saturant is supplied to the reservoir 24 at such a rate and at such volume that the saturant continuously overflows onto the surface of the belt 9', passing through said belt onto the lower face of the web 5'. Through the medium of the nozzle 23 and overflowing reservoir 24, both surfaces of the web are brought into contact with an excess of saturant, which saturant freely flows through the wet web. Excess saturant may be removed in any desired way. The relative positioning of the screen belts 9' and 19 is such that the web is confined therebetween so that the fiber formation is not distorted. Squeeze rolls 25 function to partially condense excess saturant and the sheet is carried by belt 9' to make-up roll 18'. A dolly roll 11' is provided, which functions in combination with make-up roll 18' to couch and further condense the sheet.

Referring particularly to Fig. 4, another form of apparatus is shown which may be adaptable in carrying out my invention. Web 5'' may be formed upon any suitable paper making machine (not shown) and may be brought into contact with the upper surface of rotatable screen roll 9'' which is adapted to rotate in and be submerged by the bath of saturant 16'' contained in the vat 17'' during a portion of its travel. While the wet web is passing over the upper surface of the wire screen roll 9'', saturant is sprayed on the upper surface thereof through nozzle 10'', as illustrated. The nozzle 10'' gently sprays an excess of saturant on the surface of the sheet, which excess passes through the web and through the screen roll 9'', collecting with the pool of saturant 16''. The saturated wet web may be wound up on make-up roll 20''.

Referring to Fig. 3, the wet web 5^a is carried by blanket 6^a to the point A where it separates.

The wet web 5^a is then brought into contact with endless wire screen 9^a, trained around rolls 10^a, 11^a and 12^a. Roll 10^a is preferably a wire screen roll, whereas rolls 11^a and 12^a may be solid rolls. Roll 10^a is adapted to rotate in a bath of saturant 16^a contained in vat 17^a. As the wet web 5^a is carried along on the upper surface of the endless screen belt 9^a, saturant is sprayed on the upper surface of the wet web through nozzle 13^a. The arrangement is such that preferably an excess of saturant is applied through the nozzle 13^a, which excess is removed by means of suction maintained in the suction box 14^a. The suction maintained in the box 14^a also assists in drawing the saturant through the wet web. Subsequent to removal of the excess saturant through the medium of the suction box 14^a the wet web is condensed. In the modification illustrated in Fig. 3, condensation takes place by the couching effect of dolly roll 13^a and couch roll 20^a, the condensed and saturated sheet being led from the condensing mechanism to conventional driers instead of being wound on a make-up roll as in the other modifications.

As an illustrative example of the invention, I may use rubber latex as a saturant, and a web comprising well beaten sulphite pulp being concurrently formed on a paper machine. This wet web is made self-sustaining, removed from the blanket or wire of the paper forming machine and led or threaded into the saturating structures illustrated in Figs. 1, 2, 3 and 4 of the drawing. The web speed on the paper machine and through the saturating structure is synchronized to prevent tearing of the wet web at the point of threading or beyond. The web is distended by the excess of liquid saturant and becomes thoroughly saturated.

On leaving the saturant after saturation, any excess adhering to either surface may, if desired, be removed by the passage of the saturated web by or in contact with a suction chamber, or between adjustable press rolls and the saturating cylinder. The adjustable press rolls also serve to densify the web again so that it may be subjected to mechanical handling. The web may be then passed on and pressed, dried, calendered and wound into rolls. Where rubber latex is the saturant, vulcanizing agents, accelerators, antioxidants, preservatives, fillers or the like, may be added, if desired, either to the paper stock or to the saturant.

The sheet when dried is a mass of densely compressed paper fibre permeated and bound by a substantially continuous film of binder.

It has been stated above that the application of rubber latex to paper fibre in a beater engine for the formation of a saturated paper is only partially successful because of the fact that the quantity of rubber required for a specific effect is greater than that required by a saturation process. By the saturation process described above, I am able to obtain higher rubber efficiency because of the formation of continuous films of binder within the fibres.

The proportion of introduced binder or other material may be controlled in the finished paper or board by the concentration of the binder in the saturating solution, and by the densifying of the web between the press rolls after saturation. Due to the possibility of widely varying the thickness of the web leaving the saturating machine, the volume of absorbed saturant and hence the proportion of introduced material may be regulated within wide limits.

Many other binding or sizing materials which are not susceptible to introduction in the beater engine for various reasons, such as too great solubility in water or sensitiveness to mechanical action, etc., may be introduced with safety and efficiency by this process into webs of any desired composition. The web may be composed of long, unbeaten fibre such as cotton, or, at the other extreme, short highly hydrated fibres produced by long beating. It may comprise asbestos, filling materials or pigments, or materials intended to react with the binder material or size later applied. Some examples of these binders or sizing materials are: Alkaline phenolic resin solution, alkaline casein solution, starch solution, alkaline shellac solution, glue solution, diluted viscose, sodium silicate solution, oil or asphalt emulsions, soap solutions, rosin size, etc., or any desirable combination of these or other binding or sizing materials. Most of these are quite inoperative and ineffective when applied in the beater engine, but will produce a full binding effect when saturated by this method. Furthermore, there is no intent to limit this process of saturating to binders or sizing materials, as soluble salts, dyes, suspensions or pigments, clay, or reagents to act on the paper fibre or on materials contained in the web may be employed using the principles described above. In general, any material which may be carried in water, dissolved or suspended, may be introduced effectively into paper fibre by this method to impart many new and desirable characteristics to the finished paper or fibre board. To those familiar with binder materials and paper, this method of saturating fibres provides the possibility of utilizing many combinations heretofore impractical, and of producing many new and useful products.

From the foregoing, it will be apparent that my wet web must be made in such a way that it is in an "expansible" or "distensible" condition when it is passed through the saturation zone. To produce such a web, as has been herein explained, the duration of beating of the fibers should be limited so that the fibers are in a relatively long condition, or, in the event that short fibers are employed, the quantity of sizing, if employed at all, must be limited, and the quantity of water retained in the wet web after removal of the excess thereof, must be such as to leave the wet, but self-sustaining web, in the condition stated.

By the use, therefore, of the terms "expansible" or "distensible", as employed herein and in my claims, I intend to define a felted fibrous web having the capability of increasing in thickness by the presence of an added liquid, when undergoing the saturation step, whereby to permit the fibers to change or adjust their position for the purpose of enlarging the pores or interstices without, however, complete dissociation of the fibers, inasmuch as the "hooked" or inter-tangled relationship of the fibers continues to exist. That is to say, there is an increase of the vertical component of their direction which may be roughly compared with a "lazy tong" structure.

Such a "distensible" web, may, therefore, after saturation and concomitant distension or expansion, upon condensing, resume the fiber relationship or formation existent in the web before saturation. In other words, the paper making characteristics of the web remain substantially unmodified by the saturation thereof in

view of the fact that the fibers remain "hooked" or intertangled when the web is distended in the presence of the excess of saturant. Such a wet web, therefore, when immersed in a saturation bath, such as, for instance, latex, assumes what may be termed, for want of a more apt expression, a "floating" condition; that is to say, the fibers tend to float in the excess of the liquid of the saturating bath, but because of the "hooked" or intertangled relationship, as aforesaid, they cannot entirely separate and, therefore, the "floating" is restrained to a condition short of complete separation.

The wet web may be further characterized by the fact that it would disintegrate when immersed in a saturating bath if it were not supported by a porous carrier; moreover, the web may be characterized by the fact that a single and rather rapid passage thereof through the saturating bath will completely saturate the same and, in fact, provide an excess of saturant therefor, as distinguished from webs of such a character as would require a rest period or which would require no carrier when undergoing immersion during the saturating step.

As herein stated, the structure resulting from my process is a felted fibrous sheet composed of a plurality of fibers, individually coated with a binder, the binder constituting a continuous connecting medium for the individual fibers and being present in the sheet without substantially disturbing the paper making characteristics or the structural foundation of the sheet as it has been felted before the saturation step. In other words, the modifying material, such as rubber from latex, exists in a continuous phase and serves to both individually coat and connect the fibers contained therein without substantially altering or changing the felted fibrous arrangement of the fibers. Therefore, the resultant structure has increased flexibility, tensile and tear strengths. Moreover, in view of the fact that the web is wet when undergoing saturation, there occurs subsequent to saturation, a shrinking action of the fibers which causes the same to more tenaciously hook together and to the connecting medium, such as, for example, rubber from latex. Of course, both the saturant and the wet fibers shrink together and at the same time during drying.

I claim as my invention:

1. In a process for forming and saturating a felted fibrous web as part of a single continuous operation, the improvement which comprises the following successive steps: felting fibers in aqueous suspension into a relatively wet web, removing sufficient water from the newly formed wet web to make the web self-sustaining, transferring the web to a porous conveyor, saturating said wet web in the presence of an excess of saturant in contact with the web while positively supporting the web on said porous carrier during saturation whereby to prevent loosening of the fiber formation as a result of saturation to the extent of permanent distortion of the web, condensing the web by pressure to remove excess saturant, and separating the condensed web from the carrier for use in making a single ply or multi-ply product therefrom.

2. In a process for forming and saturating a felted fibrous web as part of a single continuous operation, the improvement which comprises the following successive steps: felting fibers in aqueous suspension into a relatively wet web on a felting screen, removing sufficient water from the newly formed wet web to make the web self-sustaining, transferring the web from the felting screen to a porous conveyor, saturating said wet web in the presence of an excess of saturant in contact with the web while positively supporting the web on said porous carrier during saturation whereby to prevent loosening of the fiber formation as a result of saturation to the extent of permanent distortion of the web, condensing the web by pressure to remove excess saturant, and separating the condensed web from the carrier for use in making a single ply or multi-ply product therefrom.

3. A process such as claimed in claim 1, wherein the saturation takes place while the web is moving through and in contact with a body of the saturant.

4. A process such as claimed in claim 1, wherein the saturant comprises rubber latex.

5. A process of producing a sheet of felted fibers distributed and closely associated in a matrix of binder which comprises the following successive steps: felting fibers in aqueous suspension into a continuous wet web, removing sufficient water from said web to make same self-sustaining and yet retain the web in relatively wet condition, transferring the web to a forwardly advancing porous carrier, bringing said web while so supported into contact with an excess of saturant whereby the proportion of liquid to fiber is greatly increased and the saturant impregnates the web, positively supporting the web during saturation on said porous carrier to prevent disintegration of the web, condensing the web by pressure, and recovering the condensed web for use in making single ply or multi-ply products therefrom.

6. A process such as claimed in claim 1, wherein the amount of surplus saturant in contact with the web is such that the web would be reduced to a condition where it would not be self-sustaining in the absence of the porous carrier support.

7. A process of adding an aqueous saturant to a wet fibrous web, which comprises supporting the web on a porous conveyor in contact with an excess of the saturant, while preventing distortion of the original fiber formation, passing the supported web into contact with said excess of saturant whereby said web is saturated, condensing the web by pressure to remove excess saturant, separating the saturated web from the porous conveyor, and recovering the condensed web for use in making single ply of multi-ply products therefrom.

8. A process of adding an aqueous saturant to a wet fibrous web, which comprises supporting the web on a porous conveyor in contact with an excess of the saturant, while maintaining the original fiber formation, passing the supported web into contact with said excess of saturant whereby said web is saturated, condensing the web by pressure to remove excess saturant, separating the saturated web from the porous conveyor, and recovering the condensed web for use in making single ply or multi-ply products therefrom.

9. A process of producing a sheet of felted fibers permeated and bound by a substantially continuous film of binder, which comprises felting fibers in aqueous suspension into a continuous wet web on a paper forming machine, removing the wet web entirely from the paper forming machine, bringing said wet web into contact with an excess of saturant before substantial drying of the web has taken place whereby the propor-

tion of liquid to fiber is increased and saturant impregnates the web, preventing desintegration of the wet web during saturation by positively supporting the web against a porous screen in contact with the saturant, condensing the web by pressure, removing the condensed web from the porous screen, and recovering the condensed web for use in making single ply of multi-ply products therefrom.

10. A process which comprises continuously feeding a self-sustaining wet web of felted fibers being concurrently formed on, and removed entirely from, the paper forming end of a paper machine through a bath of saturant whereby to increase the proportion of liquid to fiber and saturate the web, preventing disintegration of said web during saturation by positively supporting the web on a porous conveyor of such a character as to maintain the original fiber formation and yet permit thorough saturation, condensing the web to decrease the proportion of liquid to fiber and remove excess liquid whereby the saturated web is again self-sustaining, and thereafter removing the condensed web from the porous conveyor.

11. A felted fibrous sheet normally repellent to saturation with a saturant in an aqueous vehicle, the fibers of which sheet exhibit the property of having been shrunk in the presence of the saturant, said fibers being entirely coated and connected by a continuous film of the binder derived from the saturant, which film has the same properties as a film of the dried fiber-free saturant.

12. A saturated, felted fibrous sheet having all of the structural characteristics of an unsaturated felted fibrous sheet of the same fiber composition, the fibers of which are coated and intimately associated with a uniformly distributed continuous film of the saturant, said film being in the same condition as a film of the dried saturant in the absence of the fibers, the sheet possessing the characteristics of having had the saturant incorporated after the sheet was formed but prior to drying.

13. A felted fibrous sheet normally repellent to saturation with latex when dry, the fibers of which sheet exhibit the property of having been shrunk in the presence of the latex, said fibers being entirely coated and connected by a continuous film of latex, which latter film has the same properties as the rubber in a film of dried fiber-free latex.

14. A latex saturated felted fibrous sheet having all of the structural characteristics of an unsaturated felted fibrous sheet of the same fiber composition, the fibers of which are coated and intimately associated with a uniformly distributed continuous film of rubber derived from the latex, said rubber film being in the same condition as a film of dried fiber-free latex, the sheet possessing the characteristics of having had the saturant incorporated after the sheet was formed but prior to drying.

15. A felted fibrous sheet normally repellent to saturation with latex when dry, containing rubber in the condition of the rubber in a film of dried fiber-free latex.

16. A felted fibrous paper normally repellent to saturation with a saturant when dry, all of the fibers of which are entirely coated and connected by a continuous film of the dried saturant in the condition of a film of dried fiber-free saturant.

17. The process of producing a felted fibrous web which comprises the step of providing a wet web of felted fibrous material of such a character as to permit "expansion" of the web when contacted with an excess of aqueous treating liquid without substantially disturbing the fibrous formation of the web, introducing the said wet web to a saturating zone for treating the same in the presence of an excess of saturant whereby to completely saturate the web during its passage through said zone and thereafter condensing the saturated web.

18. In the art of producing a saturated, felted web, the step which comprises providing a wet web of felted fibrous material of such a character as to permit "expansion" of the wet web when contacted with an excess of aqueous treating liquid and of such character that it would disintegrate if subjected to a saturating bath while unsupported, the improvement which comprises introducing said web to a saturating zone for treating the same in the presence of an excess of saturant, while supporting the same during its passage through said zone to prevent disintegration, said process being characterized by the capability of the wet web to be "expanded" during its passage through the saturating step whereby to enable complete saturation of the fiber of the web without substantial disturbing the structural formation of the wet web as it existed before saturation.

19. In the herein described process of forming a saturated, felted fibrous web, the steps which comprise forming a wet web of a character permitting "distension" thereof when contacted with an excess of aqueous liquid, introducing the wet web thus formed to a saturating bath comprising an excess of aqueous treating liquid wherein the web is caused to be distended and the fibers assume a "floating" condition relative to each other, thereby enabling complete saturation of the wet web during its passage through said saturating zone, removing the saturated and "distended" web from the saturating zone and condensing the same whereby to cause the fibers to resume substantially their same structural formation as existed before the saturating step.

20. In the herein described process of forming a saturated felted fibrous web, the steps which consist as a continuous operation in the formation of a wet web characterized by its ability to "distend" when subjected to an excess of aqueous medium, removing undesirable quantities of water from said wet web, introducing the wet web to a saturating zone wherein it is subjected to an excess of saturating treating fluid and is caused to quickly distend, and the fibers thereof caused to "float" therein whereby the web is completely saturated during its passage through said zone, condensing the thus saturated wet web, said process being further characterized by the saturating material being present in the web in a substantially continuous phase throughout the web.

21. In a paper making process for producing a saturated felted web, the steps which comprise, as a continuous process, the formation of a wet web of such a character that the same will distend and the fibers thereof assume a "floating" condition when subjected to an excess of aqueous treating fluid, leading the wet web thus formed to a saturating zone and there subjecting it to an excess of treating saturant whereby to cause the fibers to "float" and to permit the saturating fluid to extend to all portions thereof during the passage of the web

through the saturating zone, and subsequently condensing the treated web to cause the fibers to resume substantially their felted relationship as it existed before the passage of the wet web through said saturating zone.

22. A paper making process of the character described, comprising the steps of forming a felted wet web of such a weak nature as would cause the same to disintegrate if passed unsupported through a bath of saturating material, introducing the wet web thus formed to a saturating bath while supporting the same on a porous carrier, whereby the fibers of the web are completely coated by the saturant during the passage through the saturation zone, said process being characterized by the fact that the structural characteristics of the wet web remain substantially unaltered subsequent to saturation.

23. A continuous process of the character described comprising the steps of forming a web of distensible character when subjected to an excess of aqueous treating liquid, leading the web thus formed to a saturating zone having an excess of saturant therein whereby the fibers of the web are adjusted and the interstices enlarged to permit the saturant to rapidly and completely saturate the web during its passage therethrough, and thereafter condensing the saturated felted web.

24. The process of saturating a wet fibrous web which comprises the steps of providing a web which is "distensible" when contacted with an excess of an aqueous treating liquid, introducing the wet web to an excess of saturating bath whereby to cause distension of the fibers to permit coating of the individual fibers, condensing the saturated web whereby to cause the fibers to substantially resume their original formation, said process being further characterized by the fact that the saturant in the completed web constitutes a substantially continuous connecting medium for the fibers.

25. A saturated, felted fibrous sheet comprising a plurality of fibers individually coated with a binder, said binder constituting a connecting medium for the individual fibers and being present in the sheet without substantially disturbing the structural formation of the sheet before saturation, said sheet being further characterized by the incorporation of the binder therein while the sheet is in a wet condition.

26. A saturated, felted fibrous sheet comprising a plurality of fibers individually coated with a binder, said binder constituting a continuous connecting medium for the felted fibers of the sheet and being present in the sheet without substantially disturbing the structural formation of the sheet as it existed before incorporation of the binder therein and said saturated sheet being further characterized by the incorporation of the binder into the sheet while the same is in a wet condition whereby the fibers are caused to shrink into intimate relationship with respect to the bonding medium.

27. A felted fibrous sheet having the structural foundation characteristic of a product made by a paper making process comprising a saturant present in the form of a continuous bonding medium connecting the individual felted fibers of the sheet without substantially disturbing the felted characteristics thereof, said sheet being characterized by the incorporation of the binder into the sheet while in a wet distended condition.

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