Dec. 3, 1935. I. J. NOVAK 2,022,687

SATURATING MACHINE AND METHOD OF USING SAME

Original Filed Oct. 30, 1933 2 Sheets-Sheet 1

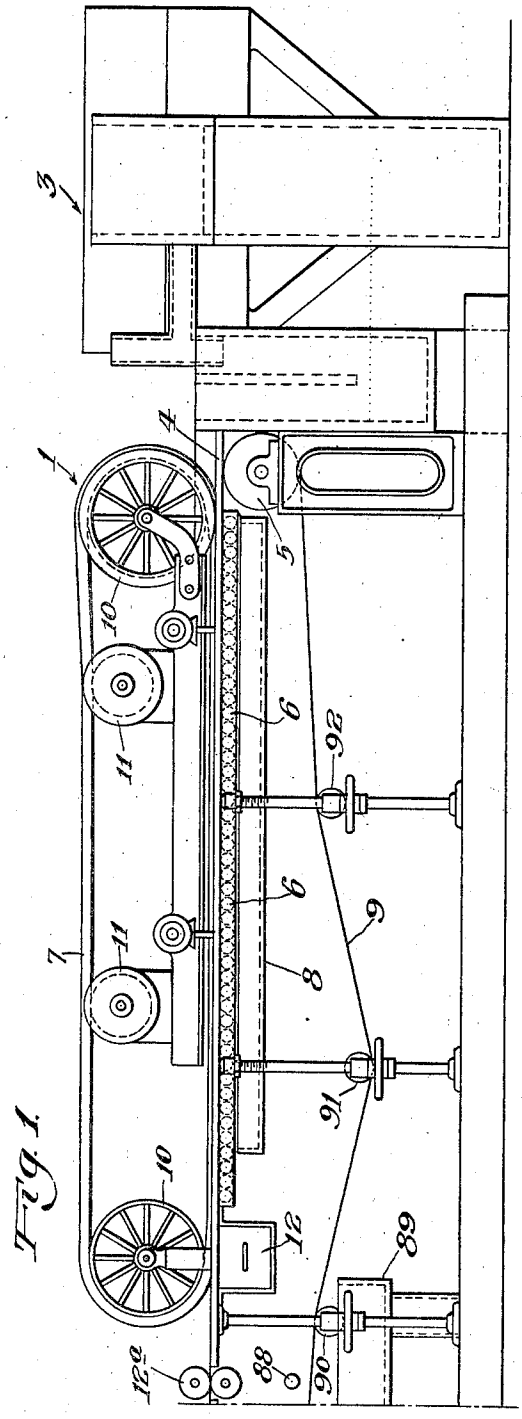


Fig. 1.

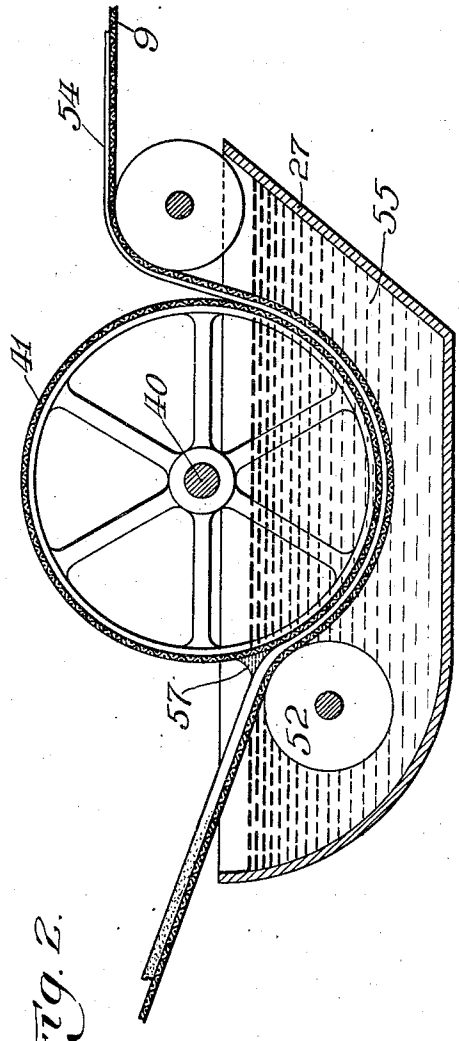


Fig. 2.

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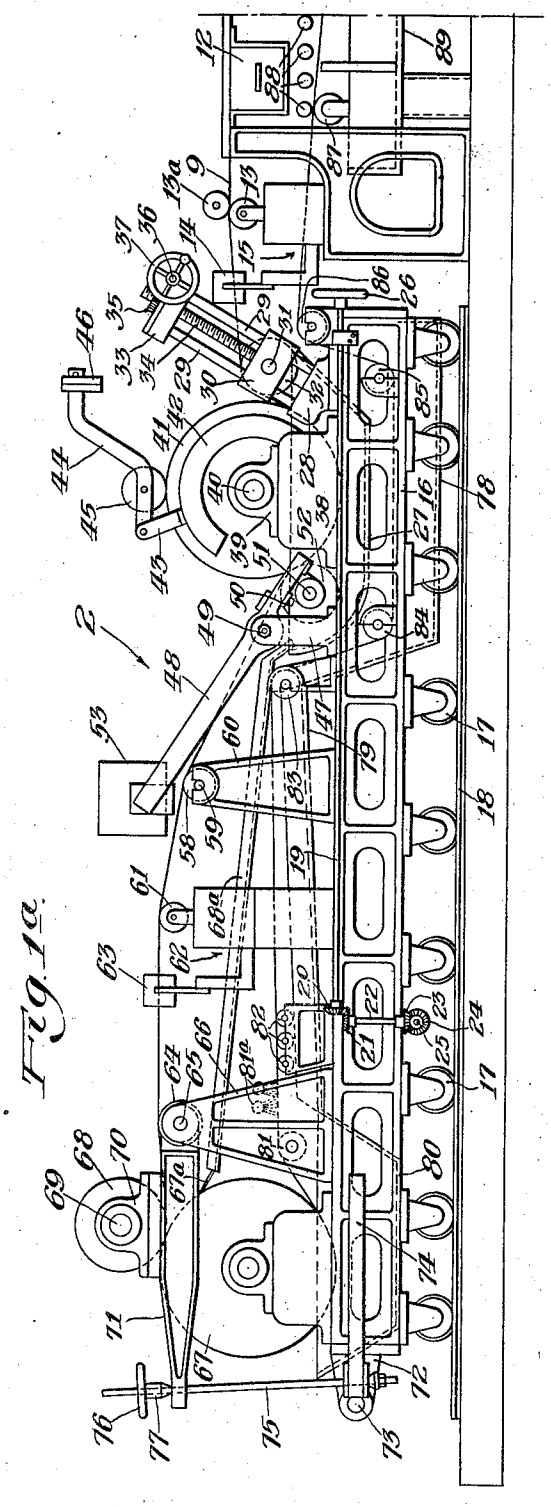


Fig 1a.

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2,022,687

SATURATING MACHINE AND METHOD OF USING SAME

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Application October 30, 1933, Serial No. 695,756
Renewed February 16, 1935

7 Claims. (Cl. 92—40)

This invention relates to a method and apparatus for felting fibers and impregnating said felted fibers as part of a single continuous operation, and more particularly refers to a continuous method and apparatus for producing fibrous structures impregnated with desired modifying materials.

The apparatus comprises the combination of a paper making section with an impregnating section, wherein the endless screen or felt of the paper making machine constitutes the support or carrier for the newly formed wet web during impregnation.

It is an object of the invention to provide a novel apparatus and process for continuously forming pulp solution into a wet fibrous web on a paper making machine and impregnating said wet web with modifying materials suspended or dissolved in water before stripping the web from the carrier of the paper making machine.

In one embodiment the paper making machine consists of a conventional Fourdrinier machine, the Fourdrinier wire constituting the carrier and support for the newly formed wet web during impregnation.

In my co-pending application, Serial No. 681,056, I have described the advantages and desirability of introducing modifying materials suspended or dissolved in water such as binders, waterproofings, et cetera, into a wet fibrous web before substantial drying thereof, and have described a saturating machine therefor, and explained its use. The saturating machine therein shown is a separate machine placed in a conventional paper machine line, and the wet web, after being formed, is threaded from the web forming machine, or from roll presses immediately subsequent thereto, to the saturating machine.

For most types of fibrous webs this arrangement is ideal. However, there are certain types of webs which cannot be threaded, for example, because of their weakness while wet, or which, because of extreme slowness, will not easily and quickly wet up in the saturating liquid if compressed or otherwise dried sufficiently to be capable of being threaded.

In one use, the process and apparatus of this invention is ideally adapted for treating the type of web which it is not desirable to thread from the forming machine to the saturating machine, as well as those types of wet webs which are distensible or expansible in water, such as described in said co-pending application.

The present invention is directed, therefore, to a process and apparatus whereby those latter types of webs may be impregnated. Briefly, the process comprises the steps of forming a fibrous web upon the wire or felt of a Fourdrinier or cylinder paper making machine and passing said web supported by said wire or felt through an impregnating bath, removing the excess impregnating material from the web and either immediately drying the same in a conventional drier or winding the web into multi-ply sheets upon a "make-up" roll from which it may be subsequently cut and stripped.

Other objects and advantages of my invention will be apparent from the accompanying drawings and following detail description.

In the drawings, Fig. 1 is a fragmentary side elevational view of the paper making section of the machine of the present invention.

Fig. 1a is a similar view of the saturating section of the machine.

Fig. 2 is an enlarged diagrammatic, sectional view of the impregnating roll.

Referring in detail to the drawings, 1 indicates generally a paper making machine of the Fourdrinier type which may be utilized in conjunction with the saturating section 2 to carry out my invention. The section 1, although showing an embodiment of a Fourdrinier paper making machine, may take the form of any conventional paper making machine and, although not shown, the impregnated paper web when passing from section 2, may be carried to conventional driers as a continuous operation.

Referring particularly to Fig. 1, the usual fibrous pulp previously prepared in a conventional type beater (not shown) may be passed to a stuff chest and mix box (not shown). When the pulp has been diluted with water which will bring the same to the desired consistency, it is passed to head box 3 and from the latter to apron board 4 of the paper making machine proper.

The machine 1 may be provided with the usual breast roll 5, table rolls 6, deckle straps 7 and pan 8. A screen 9 may pass around breast roll 5 and over table rolls 6 in the usual manner. Deckle straps 7 may continuously travel around wheels 10 positioned in spaced relationship upon the machine. Guide rolls 11 may serve to support the deckle straps at the upper portion of its travel. The pulp discharged upon apron board 4 from the head box 3 may be passed to the upper surface of screen 9, the body of the pulp being confined by the opposite deckle straps 7. The screen in passing over table rolls 6 permits the passage of the aqueous carrier of the pulp to pan 8 thereby causing a deposit of the fibrous material upon

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the surface of the screen. In other words, the fibrous material is felted into a web of paper.

If desired, additional water may be removed from the web upon the screen by the use of suction boxes 12 which may be positioned beneath the path of travel of wire 9 after it has passed from table rolls 6, or excess water may be removed by the use of smoothing or press rolls 12a.

As a feature of my invention, instead of stripping the fibrous web from wire 9 at the end of the paper making machine, and returning said wire in endless fashion to breast roll 5, wire 9 continues its travel over guide roll 13, which may be movable in response to movement of finger 14 constituting a portion of a conventional wire guide 15. After passing over roll 13, wire 9 carrying the newly formed web passes directly to the saturating portion 2 of the machine.

Referring particularly to Fig. 1a, 16 indicates a frame which may be mounted upon wheels 17 movable on tracks 18. A shaft 19 may traverse a substantial portion of frame 16 and may carry at one end thereof bevel gear 20 which, in turn, may mesh with bevel gear 21 carried at the upper extremity of shaft 22. A bevel gear 23 may be carried at the lower end of shaft 22 and may mesh with bevel gear 24 which may be mounted upon shaft 25. Shaft 25 may make operative connection (not shown) with wheels 17 whereby frame 16 may be moved along track 18 by manipulating hand wheel 26 mounted upon the end of shaft 19.

A vat 27 may be mounted at one end of frame 16 and may be adapted to contain a quantity of the selected permeating or impregnating medium in liquid form or in a liquid vehicle. Supports 28 may be positioned upon frame 16 on each side of vat 27 and may carry spaced, angularly inclined guide rods 29. Bearing blocks 30 may be slidably positioned upon each pair of guide rods 29 and may carry transversely disposed shaft 31 upon which roll 32 may be mounted. A brace 33 may be mounted at the upper ends of guide rods 29 and may transversely bridge the opposite pairs of rods. A screw 34 may be rigidly secured at one end to each of the blocks 30, the opposite ends of said screws being rotatably positioned in brace 33. A worm wheel 35 having internal threads, not shown, may threadedly engage each screw 34, said worm wheel being rotated by worm gears, not shown, mounted upon shaft 36, which latter, in turn, may be rotated by hand wheel 37.

A pedestal 38 may be mounted upon frame 16 on each side of vat 27, each pedestal being adapted to support a pillow block 39 in which opposite ends of shaft 40 are journalled. Screen roll 41 may be carried by shaft 40 between blocks 39, a portion of said roll extending within vat 27 and as will be hereinafter more fully described, extending beneath the surface of the liquid contained within said vat.

A member 42 may be secured to pedestal 38 and may support arm 43 rigidly positioned upon said member. A lever 44 may be pivoted, at one end, upon arm 43 and may carry intermediate its length cleaner roll 45 constructed of relatively soft felt and covered with cloth. A weight 46 may be adjustably mounted upon the free end of lever 44, the adjustment of the position of said weight varying the normal pressure of roll 45 upon roll 41. Roll 45 is adapted to remove loose pieces of fibrous material which adhere to said latter roll.

A standard 47 may be mounted upon each side of frame 16 adjacent vat 27. Levers 48 may be pivoted intermediate their length as at 49 upon the upper ends of said standards. Each of levers 48 may carry pillow blocks 50 which, in turn, may support shaft 51 upon which may be mounted couch roll 52. The opposite end of levers 48 may carry weights 53 which may be adjustable along the length of lever 48. It can readily be seen that by varying the position of weights 53 upon lever 48, the normal pressure of roll 52 against roll 41 can be varied.

Screen 9 carrying the fibrous web formed in section 1 after passing over roll 13, is trained around roll 32 carried by shaft 31. The web supported by screen 9 may be passed into the liquid within vat 27, the web being confined by the screen 9 and the screen periphery of roll 41. It can readily be seen that by rotating hand wheel 37, shaft 31 may be raised or lowered upon guide rods 29 and, hence, the tension of screen 9 may be increased or decreased thereby controlling the confining force acting upon the web carried by said screen.

The web carried upon screen 9 after its initial formation in section 1, contains an appreciable quantity of water when leaving said section. The quantity of water in the web at this stage is dependent upon the final product desired, the type and degree of permeation desired and the type of fibres constituting said web. As a feature of my present invention by passing the Fourdrinier wire in company with the web through the permeating bath, it is unnecessary to strip the web from the screen as is the case when the Fourdrinier, or paper making machine, is used as a separate unit. With many types of webs it is substantially impossible to strip the same from the screen at this period because of structural weaknesses of the web. Furthermore, some types of webs, if relieved of an excessive quantity of moisture, are difficult to saturate or permeate. Obviously, therefore, inasmuch as it it not necessary to strip the web from the wire, the web may be immersed in the saturating bath while it is in a relatively loose condition and is most susceptible to being permeated or saturated, and capable of rapid distention in the presence of additional liquid.

Referring particularly to Fig. 2, the physical appearance of web 54 carried upon screen 9, is illustrated diagrammatically, before, during and after its passage through bath 55. Prior to entering bath 55, web 54 is of predetermined thickness and contains a predetermined proportion of water and fibrous material. When passed into bath 55, the air existing between the fibers of the web is displaced by permeating liquid. No material dimensional change takes place due to the confinement of the web between the carrier 9 under tension and screen surface of roll 41.

As screen 9 and web 54 leave bath 55 they pass between roll 41 and stripper couch roll 52, said latter roll exerting radial pressure against the former to express some of the liquid contained in the web 54. It will be apparent that a quantity of material 55 has replaced some of the water originally in the web. On passing out of the tension zone into the free saturating zone beyond the line of osculation of rolls 52 and 41, the web is free to distend in the presence of an excess of the permeating liquid existing as a pool, as shown at 57 through which the web passes. As it passes from the confined zone to the free sat-

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urating zone, the web increases in thickness, as illustrated, due to the excess permeating liquid and release from the confined zone.

Pool 57 is used to advantage in several respects. First, the pressure exerted by the stripper couch roll 52 upon web 54 tends to compress said web. When the web leaves the osculating line of the rolls it tends to expand and thus expanding in the presence of pool 57 induces an additional quantity of material 55 into the web.

Secondly, screen 9 and web 54 leave roll 41 at this point and since a portion of pool 55 is above web 54, it assists, by virtue of its weight in cleanly stripping web 54 from the screened surface of roll 41.

The original relative arrangement of the fibers constituting the web does not change but the liquid content of the web is increased. The increase in liquid content of the web, of course, is taken from bath 55 and pool 57 which, as has been hereinbefore described, is a permeating or impregnating medium in liquid solution or suspension.

Screen 9 carrying web 54, after passing from vat 27, is carried over guide roll 58 mounted upon shaft 59 which, in turn, is journalled in the upper portion of standards 60. The screen and web are thence carried forwardly over roll 61 which comprises a portion of wire guide mechanism 62, said mechanism being operated by movement of finger 63. Wire guides 15 and 62 are of conventional construction and are familiar to those skilled in the art. Consequently, said mechanisms are shown diagrammatically. After leaving roll 61, screen 9 in company with web 54 passes over roll 64 mounted upon shaft 65 which, in turn, is journalled at the upper portion of standards 66. The screen and web after passing over roll 64 passes between roll 67 and roll 68. Roll 68 may be mounted upon shaft 69 which, in turn, is journalled in bearing 70 mounted upon arm 71. Arm 71 may be pivotally mounted at one end of shaft 65. A bracket 72 may be mounted upon the end portion of frame 16 and may carry shaft 73. An arm 74 may be pivotally mounted at one end upon shaft 73, the opposite end thereof being free. A tie rod 75 may connect an intermediate portion of arm 74 with the free end of arm 71, the effective length of said tie rod being adjustable by means of hand wheel 76 which may be manipulated to raise or lower the threaded collar 77 thereby bringing the free end of arm 71 closer to, or further away from, arm 74. It can readily be seen that by this lever arrangement the radial pressure of roll 68 upon roll 67 may be varied by changing the effective length of rod 75, or by adding adjustable weights to the free end of arm or both.

When screen 9 and web 54 pass between rolls 67 and 68, web 54 is squeezed thereby expressing a quantity of the liquid contained in said web, comprising water originally in the web prior to passage through the impregnating bath and permeating or impregnating material absorbed in its passage through the bath. After being thus compressed, web 54 has sufficient structural strength to be stripped from screen 9 and threaded, if desired, into a conventional drier (not shown). Thus, roll 68 serves as a condensing roll to make the impregnated web self-sustaining and capable of being threaded to the drier. If desired, however, said web, after being stripped from screen 9, may be wound upon roll 68 in which case said roll assumes the function of a "make-up" roll. In this latter case the permeated fibrous web may be cut and stripped from roll 68 as a multi-ply structure.

A doctor blade 67*a* constructed of rubber or micarta may be positioned in contact with roll 67 below the nip of rolls 67 and 68. Liquid squeezed from the web during its passage between said rolls may flow backwardly over roll 67 and be directed by doctor blade 67*a* to trough 68*a* which may slope toward vat 27. This liquid, of course, is diluted with water from the web so in order to balance this dilution the saturant or impregnating material orginally introduced into vat 27 is purposely made more concentrated than the concentration desired. Preferably, the flow off the doctor blade may be mixed with the feed of saturant to the saturating tank as that mixing may take place before the combined saturant enters the saturating tank.

A pan 80 may be positioned immediately beneath rolls 67 and 68 and a pan 79 may be disposed adjacent said pan 80 and inclined thereto. After stripping web 54 from screen 9, said screen may be trained around roll 67 and may be passed over guide roll 81. Said screen may then pass beneath sprays 81*a* which may be adapted to clean screen 9, the wash water being caught by pan 79 and transferred thereby to vat 80. Vat 80 may be provided with an outlet (not shown) which may lead said wash water to waste. After passing beneath sprays 81*a*, the screen may be carried over pick-up rolls 82 which are adapted to remove bits of fibrous material which may adhere to the screen and to cleanse same. After passing over pick-up rolls 82, said screen may be carried over guide rolls 83, 84, 85, 86 and 87, and beneath another series of showers 88 by which means said screen may be thoroughly cleaned. A vat 89 may be positioned immediately beneath showers 88 to recover the wash water or other washing medium if desired. After leaving the washing zone, screen 9 may pass tightening rolls 90, 91 and 92. When screen 9 has passed over roll 92 it may be trained around breast roll 5 and again carried forwardly over table rolls 6 in endless fashion.

From the foregoing, it will be seen that the roll at which the formed web ordinarily leaves the conventional Fourdrinier is made the breast roll of the saturating machine and the Fourdrinier wire web carrier is lengthened so as to pass through the saturating machine and after being cleansed of saturant returns to the breast roll of the Fourdrinier. Thus, the two machines are combined and one long wire web carrier serves as the forming wire and the carrier for the saturated wet web. There is no break in the supporting of the web, no need of strength therein nor of reduction of its moisture content to produce strength sufficient for threading it between machines with the attendant reduction of ease of saturation.

The Fourdrinier has been given as the example of web forming machine, but for saturants which do not injure woolen felts, the single or multiple cylinder machine may be joined with the saturating machine in similar fashion, the felt serving as common carrier for the wet web and the saturated web.

As an example of a type of web too weak to thread but which may be handled successfully by the present machine and method: A furnish of 20 parts kraft pulp and 80 parts 40—60 mesh sawdust are beaten together for one-half hour to open up the kraft, and formed into a web .010–.020 inch thick on the Fourdrinier end of

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the machine described above. This web is not considered threadable in commercial paper machines. It is passed continuously into the saturating tank of the saturating machine which tank may contain a 10° Baumé sodium silicate solution. After saturation it passes to the make-up roll of the saturating machine, whereon it is wound to thicknesses varying from .125" to .250". In these thicknesses and after having been compressed by the action of the make-up roll, it may now be slit and stripped from the make-up roll in a sheet. On drying, this sheet is a light porous strong insulating or wall board. If it is desired to make the material quite water insoluble, and to improve its color, five parts of hydrated lime may be added to the furnish. If it is desired to make a dense fireproof board of very short fiber, "C" asbestos may be used in place of the sawdust. It will be appreciated that extremely weak fiber combinations which when they cannot practically be threaded from one machine to another, but which when built up on a make-up roll, may be removed therefrom, can now be modified by treatment in the wet web saturating machine in similar manner to the stronger threadable webs used in the previously described separate saturating machine.

It is obvious that strong webs which do not actually need the continuous support afforded by the present machine may be run in the same way as the weak webs. An advantage is that stoppages and waste due to the breaking of the web between machines cannot of course occur in this combined machine.

The combination machine is also advantageous in the saturation of webs whose saturatability is decreased materially by compression or lowering of moisture content below that produced on the web forming machine. For example, highly hydrated stock, which may be rope, rags, kraft, et cetera, will not saturate satisfactorily or in some cases at all with ordinary rubber latex if it has been passed through press rolls in the standard paper machine line up before entering the saturating machine. The fibers in the surfaces of highly hydrated web pack down so closely and adhere to each other so tightly that on immersion in latex the only effect is the precipitation of a film of rubber on the surfaces, similar to the effect of immersion of ordinary dry paper in latex. For saturation with this and similar suspensions or emulsions where the suspended particles are larger than the surface pores of a hydrated web it is necessary to minimize compression of the web and reduction of its mobile moisture content in order to obtain satisfactory distention of the web by the saturant and concomitant good saturation.

Again, a loose web, even of hydrated cellulose fibers, containing a large amount of water is weak and heavy, and difficult, if not occasionally impossible, to thread satisfactorily between machines. However, as explained above, unless the web is kept in this condition and the fibers are allowed to remain separated as far as necessary in the wet web, satisfactory saturation will not take place.

The present invention provides a suitable method and device for meeting these conditions, and allowing thorough saturation of highly hydrated cellulose fibers with desirable binders in emulsion form such as latex, asphalt, et cetera. Inasmuch as highly hydrated cellulose stocks when treated with latex, for example, show marked toughness and strength superior to the same stock untreated, paper and boards made therefrom are very desirable for uses requiring these qualities.

These examples show specific uses wherein the combination machine is adapted for purposes in which a weak wet web must be saturated. It is understood that any of the functions of the wet web treating machine may be employed whether the function is saturating, sizing, filling or coating, and any wet web regardless of strength may be so treated.

The process and apparatus of the present invention may be utilized in the manufacture of saturated, sized, coated or filled fibrous structures, and it is to be expressly understood that the invention is not limited to any particular class of modifying materials. Thus, for instance, the modifying material may have binding properties, waterproofing properties, moisture-proofing properties, grease-proofing properties, acid resisting characteristics, or it may be used to make the structure more rigid or more flexible. The essential characteristic of the modifying material is that it be capable of being suspended or dissolved in an aqueous vehicle.

Among the modifying materials contemplated for use in the present invention may be cited asphalt emulsions, rubber emulsions, including artificially prepared rubber emulsions as well as rubber latex, rosin, glue, phenol resin, starch, gelatin, et cetera.

I claim as my invention:

1. A method of making a fibrous structure impregnated with a modifying material as a continuous operation, which comprises forming a fibrous web from pulp in aqueous suspension upon a continuously moving foraminated surface, and immersing said web while supported by said surface and prior to stripping therefrom by passing same through a permeating bath containing the selected modifying material in an aqueous vehicle to cause said web to distend and induce modifying material thereinto while maintaining the original formation.

2. A method of making a fibrous structure impregnated with a modifying material as a continuous operation, which comprises forming a fibrous web from pulp in aqueous suspension upon a continuously moving foraminated surface, passing said web while supported by said surface and prior to stripping therefrom through an excess of the selected modifying material in an aqueous vehicle whereby both surfaces are subjected to said excess and the web is caused to distend, and subjecting the web to pressure while the same is supported upon said surface to remove excess modifying material and water therefrom.

3. A method of making a fibrous structure impregnated with a modifying material as a continuous operation, which comprises forming a fibrous web from pulp in aqueous suspension upon a continuously moving foraminated surface, passing said web while supported by said surface and prior to stripping therefrom through a permeating bath containing the selected modifying material in an aqueous vehicle, subjecting the web to pressure while the same is supported upon said surface to remove excess modifying material and water therefrom, and thereafter stripping said web from said surface.

4. In a method of making a fibrous web wherein pulp in aqueous suspension is deposited on a continuously moving foraminated surface and the excess water removed through said surface to

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form a fibrous web thereon, the improvement which comprises immersing said web while still supported upon said surface in a bath containing a selected modifying material in an aqueous vehicle to expose both sides of said web to said modifying material and induce said modifying material into the web.

5. A device for making and impregnating fibrous material in a continuous operation, which comprises in combination a flexible foraminated surface, means for moving said surface in an endless path, means for depositing pulp in aqueous suspension on said surface and forming a fibrous mat thereon, a vat containing a permeating liquid, and means for passing said mat while supported by said surface through the liquid in said vat whereby the mat distends and permeating liquid is induced thereinto while maintaining the original formation of the mat.

6. A device for making and impregnating fibrous material in a continuous operation which comprises in combination, a flexible foraminated surface, means for moving said surface in an endless path, means for depositing pulp in aqueous suspension on said surface and forming a fibrous mat thereon, a vat containing a permeating liquid, means for passing said mat while supported by said surface through the liquid in said vat whereby the mat distends and permeating liquid is induced thereinto while maintaining the original formation of the mat, and pressure means for expressing excess water and permeating liquid from said mat while the same is supported upon said surface.

7. A device for making and impregnating fibrous material in a continuous operation which comprises in combination, a flexible foraminated surface, means for moving said surface in an endless path, means for depositing pulp in aqueous suspension on said surface and forming a fibrous mat thereon, a vat containing a permeating liquid, means for passing said mat while supported by said surface through the liquid in said vat whereby the mat distends and permeating liquid is induced thereinto while maintaining the original formation of the mat, means for expressing excess water and permeating liquid from said mat while the same is supported upon said surface, means for stripping said permeated mat from said supporting surface, and means for cleaning said surface after the mat has been stripped therefrom.

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