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APPARATUS FOR SATURATING FIBROUS STOCK

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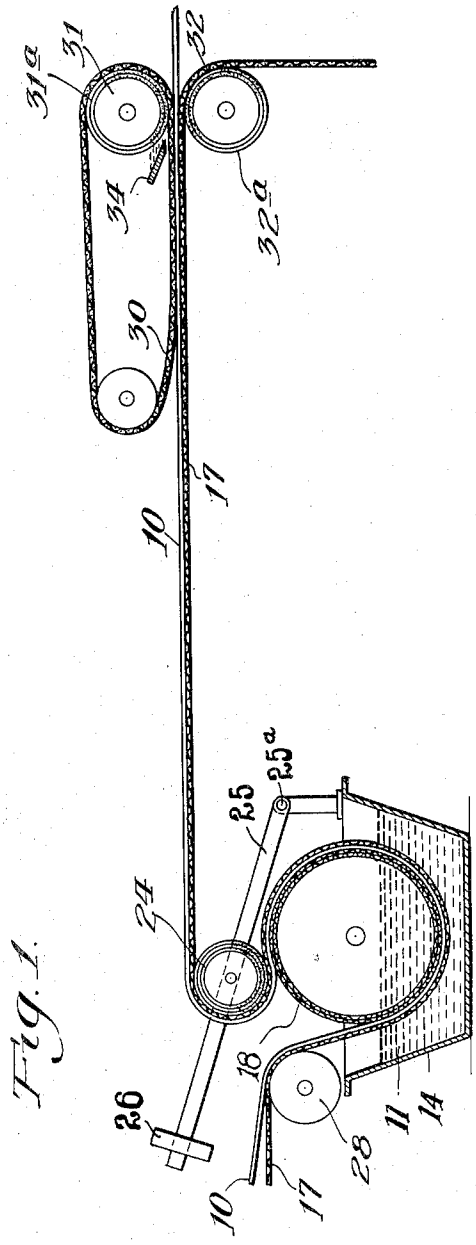


Fig. 1.

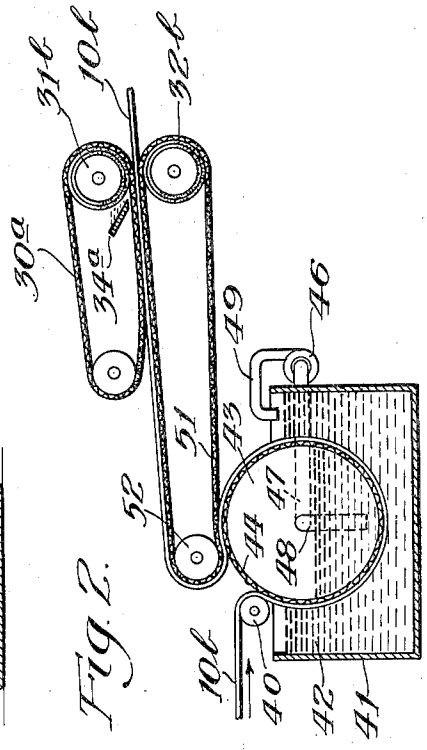


Fig. 2.

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APPARATUS FOR SATURATING FIBROUS STOCK

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Application January 30, 1937, Serial No. 123,197
Renewed November 27, 1939

7 Claims. (Cl. 91—18)

The present invention is directed to an apparatus for, producing saturated sheeted fiber such as paper or fiber board, and is more particularly directed to improvements in both the method and apparatus for incorporating saturant, binder, sizing or other modifying materials, into the paper or fiber board.

In my Patent No. 1,966,458, issued June 17, 1934, I have disclosed an improved method of saturating or impregnating felted fibrous stock, one of the distinguishing characteristics of which is the fact that the saturant, binder or other modifying material is caused to be incorporated in the felted fibrous stock when the fibrous web is in a receptive self-sustaining, wet state, by virtue of which it is possible to obtain a more thorough and uniformly saturated sheet than was theretofore possible.

The present invention is directed to certain refinements in an apparatus for incorporating the saturant, binder or other modifying material in the fibrous web and is especially effective when the web is in a wet state.

It is an object of the present invention to provide an improved apparatus for saturating or impregnating paper or fiber board for producing a finished product possessing a relatively high percentage of saturant or binder.

Another object of the present invention is to produce a saturated sheet of paper or fiber board which is thoroughly impregnated and wherein the saturant or binder is uniformly and homogeneously distributed throughout the sheet or board.

In the preferred embodiment of my improved apparatus, the fibers are first felted in any desired conventional manner on a paper forming machine. Preferably, the felted web is removed entirely from the blanket or wire of the paper forming machine after first removing sufficient water to insure that the newly formed wet web is self-sustaining at the time of its removal. The self-sustaining wet web may then be transferred to a carrier or conveyor on or by which it is supported during the saturating operation. The carrier or conveyor desirably is in the form of an endless screen constructed so as to permit adequate saturation of the web while at the same time insuring adequate support for said web during the saturating period. Attention is particularly directed to the fact that the wet web is made self-sustaining and that fiber formation is completed (and not destroyed by subsequent saturation) before removal of the web from the blanket or wire of the paper making machine, notwithstanding the fact that the web in this condition still contains a relatively large percentage of water.

As the wet web becomes saturated, it naturally picks up an excess quantity of the saturant resulting in an increase in thickness of the web. It is to be understood that this excess quantity of saturant is not sufficient to appreciably disturb or loosen the fiber arrangement which the web acquired on the paper making machine.

More specifically, one form of apparatus for carrying out the present invention comprises a relatively flexible porous conveyor in the form of a wire screen on which the wet web is received from the paper making machine, which conveyor travels around a foraminated roll with the normally upper surface of the web in contact with the surface of the roll so that the web is confined between the porous conveyor screen and the foraminated roll. The roll is preferably associated with a receptacle containing a saturating solution through which the wet web travels as it passes around the roll. By confining the wet web between the porous flexible conveyor and the foraminated roll, the fibers of the web are maintained in substantially the same arrangement they acquired on the paper making machine while at the same time the fibers of the web intimately contact the saturant so that the web becomes thoroughly and uniformly impregnated therewith. The saturation here is mainly due to displacement of the air content of the wet web. Some swelling occurs into the mesh openings of the screen conveyor and screen roll.

As another feature of the invention particularly set forth and claimed herein, the couch roll functioning to strip the web from the foraminated roll is disposed beyond the vertical plane of the axis of the foraminated roll whereby the increased length of couch allows the excess saturant to leave the web without distorting or crushing the surface of the web.

Another form of apparatus that may be employed to carry out this invention and more particularly described and claimed in my co-pending application Serial No. 133,573 consists in feeding the wet self-sustaining web around a foraminated roll travelling through a body of liquid saturant, the web being held against the surface of the roll by the differential pressure of the liquid acting upon the inner and outer surfaces of the roll.

In the drawing:

Fig. 1 is a diagrammatic illustration of suitable

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apparatus for carrying out my improved saturating process.

Fig. 2 is a diagrammatic representation of another form of apparatus for carrying out this invention.

Referring to the drawing, the wet, self-sustaining fibrous web 10, which has just been produced on a conventional paper making machine, is fed into and out of contact with a body of saturant or other modifying agent 11 contained in receptacle 14 being supported by a flexible porous conveyor 17 which may be in the form of an endless wire screen. Associated with the saturant receptacle 14 is a foraminated roll 18 disposed so that the lower portion of its periphery travels through the body of saturant. Associated with the roll 18 is a weighted compression roll 24, the outer surface of which is preferably covered with one or more layers of suitable cushioning material preferably porous which contacts the under surface of the conveyor wire 17. This compression roll is desirably mounted on a support 25 pivoted at 25*a*, the outer end of which support may be provided with one or more adjustable weights indicated at 26 to exert a desired yielding pressure for compressing or squeezing the wet fibrous web between the wire screen 17 and screen roll 18. Disposed adjacent the receptacle 14 is a guide roll 28 over which the conveyor 17 is trained into contact with the periphery of the screen roll 18.

As will be apparent from the drawing, the wet fibrous web 10 as it is conveyed by the flexible wire 17 is brought into contact with the periphery of the roll 18 as the web is moved through the body of the saturant 11. Because the web is confined between the flexible wire 17 and the screen roll 18, the fibers of the web are confined so that they do not become loosened or moved an appreciable extent by becoming extended by reason of contact with the saturating solution and the fibers are maintained in substantially the same felted arrangement that they acquired on the paper forming wire.

The compression roll 24 is desirably located to the left of the vertical center of the roll 18 with respect to the showing in Fig. 1, which position increases the length of couch and allows ample time for the excess saturant to leave the wet web prior to approaching the compression roll 24. This position of the compression roll results in cleanly stripping the wet fibrous web from the roll 18 for feeding it to the final compression or condensing rolls.

It will be manifest that, as the web passes through the bight formed by the compression roll 24 and the roll 18, it is squeezed and densified by expelling from the web a substantial portion of the water contained in the web as a result of its original formation on the paper making machine and also some of the saturant that it has picked up from the saturating solution. The foraminated character of the roll 18 affords immediate avenue of escape for the liquid squeezed out of the web at this time.

After the wet web leaves the roll 24 on the wire 17, the upper surface of the web, desirably though not essentially, is contacted by an endless wire screen 30 and the saturated web with the wire screens on opposite sides, is fed between a pair of pressure rolls 31 and 32, the surfaces of which are provided with one or more layers of suitable cushioning material indicated at 31*a* and 32*a* respectively, beyond which said wires 17 and 30 are stripped from the web. The double compression and relief from compression at rolls 24 and 18 and rolls 31 and 32 results in even, thorough distribution of the saturant through the web.

The relationship of the pressure rolls 31 and 32 to the path of travel of the saturated web is of importance; in fact, it has been found as more particularly described and claimed in my copending application Serial No. 123,196 that these rolls should desirably be located so that their axes lie in a plane substantially perpendicular to the path of travel of the saturated web. By virtue of this arrangement it has been found that crushing of either or both surfaces of the saturated web is eliminated. Forwardly of the pressure roll 31 in close relationship to the upper surface of the flexible wire 30 is a deflector or baffle 34 whose function is to divert liquid saturant which is squeezed from the wet web as it is passed between the pressure rolls 31 and 32. As the wet web passes between pressure rolls a slight pool of saturant or liquid accumulates on the inner surface of the upper wire screen prior to its entering the roll and it is desirable to remove this excess liquid as rapidly as possible as it is expelled from the web by the action of the pressure rolls 31 and 32.

In the form of apparatus illustrated in Fig. 2, the wet self-sustaining web 10*b*, which has just been produced on a paper making machine, is fed over guide roll 40 making contact with the foraminated roll 43 just before it enters the body of liquid saturant 42 in the receptacle 41, in which the roll 43 rotates. The web passes around the roll in free contact with the liquid saturant until its exit therefrom.

A pump diagrammatically represented at 46 is provided with a conduit 47, connected through the center of the roll with a downward extension 48, opening directly to the interior of the roll, whereby the liquid saturant is removed from the interior of the roll and discharged through a conduit 49, into the receptacle 41, exteriorly of the roll. The rate of liquid transfer is such that the liquid inside the roll is maintained at a lower level than at the exterior of the roll, creating a differential in liquid pressures which causes the web to firmly adhere to the surface of the roll, below the liquid level, as it moves through the saturant. Due to this arrangement, the web becomes thoroughly saturated, and the fibers individually coated, which serves to assist in firmly bonding the fibers together in the finished sheet.

As the web leaves the saturant it moves with the roll for a substantial distance, to permit free discharge of the excess saturant, and the web is then contacted by an endless wire conveyor 51 trained around roll 52, which is positioned beyond the vertical center of roll 43, in a manner to squeeze and densify the web between said roll 43 and the wire screen 51. This arrangement insures clean stripping of the web from the surface of the roll. The web is then conveyed by the wire screen 51 between a pair of press rolls 31*b* and 32*b*. As above mentioned, press rolls 31*b* and 32*b* are preferably positioned so that the plane passing through their axes is substantially perpendicular to the plane of the web as it is fed onto the nip of the rolls, so as to prevent crushing of the surfaces of the web. An endless wire screen 30*a* and a baffle or deflector 34*a* may be provided similarly to screen 30 and baffle 34 in Fig. 1.

The proportion of introduced saturant or other

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modifying material may be controlled in the finished paper or board by the concentration of the saturating solution and by the densifying of the web between the press rolls. Due to possible variation and thickness of the web leaving the saturating solution, the volume of absorbed saturant may be controlled within wide limits.

Many modifying materials which are not susceptible to introduction in the beater engine for various reasons such as too great solubility in water, sensitiveness to mechanical action, etc., may be used in my wet web saturating process with safety and efficiency.

By virtue of my novel apparatus it has been found possible to produce a fibrous web that has been saturated to the extent of approximately 35% of its weight. It will therefore be manifest that by virtue of this apparatus it is now possible to employ relatively cheap saturants or modifying agents for producing a paper or fiber board possessing the characteristics which heretofore were only available by the use of more expensive materials, and which materials could only be incorporated to a much lesser degree in such fibrous paper or board. It is to be understood that the speed of travel of the web through the saturating solutions may be varied as desired. I have obtained excellent results with such saturants as glue, starch, shellac, etc., by moving the web through the saturating solution at paper making speeds.

The structure resulting from my apparatus is a felted fibrous sheet of densely compressed fibers which are individually and thoroughly coated with a saturant which constitutes a continuous connecting medium or binder for the fibers. In view of the fact that the process is such that the fibers are not appreciably disturbed or disarranged during this saturating operation, these fibers during the drying become firmly interlocked and intertwined by the concomitant shrinking of the fibers and saturant. It will, therefore, be apparent that the quality of the final fibrous web will naturally be greatly improved as a result of a continuous binder connecting the fibers of the web.

By the use of the term "web" in the specification and claims, I intend to include single thin webs, thick webs or plied webs composed of two or more wet webs.

It is also to be understood that the term "saturant" as used in the specification and claims is intended to comprise all aqueous binders, sizing and other materials which in any way may be used to modify the character of the fibrous web.

I claim as my invention:

1. Apparatus for adding saturant to a wet fibrous web, comprising a receptacle containing a saturating solution for modifying the character of the web, a foraminated roll partly immersed in and rotating in a body of saturant, a porous conveyor for supporting and moving a wet fibrous web to dispose its normally upper surface in contact with the surface of the roll while simultaneously immersing said web in the saturating solution, a guide roll for bringing the web into supported relationship with the foraminated roll, and means disposed between the point of web immersion and the vertical plane of the axis of the foraminated roll in juxtaposed relation to the roll for resiliently compressing the web against the roll after immersion, said means comprising a resilient surfaced roller yieldingly urged toward the roll to retain the web thereon over a major portion of its unsubmerged area.

2. Apparatus for adding saturant to a wet fibrous web, comprising a receptacle containing a saturating solution for modifying the character of the web, a foraminated roll rotating in a body of saturant, a porous conveyor for supporting and moving a wet fibrous web to dispose its normally upper surface in contact with the surface of the roll while simultaneously immersing said web in the saturating solution, a guide roll for bringing the web into supported relationship with the foraminated roll, and means disposed in juxtaposed relation to the roll for resiliently compressing the web against the roll, said means comprising a resilient surfaced roller yieldingly urged toward the roll and disposed adjacent the upper peripheral portion of the roll the vertical plane of the axis of said roller being between the point of web immersion and the vertical plane of the axis of said foraminated roll, the said roller being adapted to retain the web against the unsubmerged surface of the foraminated roll through its said vertical plane.

3. Apparatus for adding saturant to a wet fibrous web, comprising a receptacle containing a saturating solution for modifying the character of the web, a foraminated roll rotating in the body of saturant and around which a wet self-sustaining fibrous web is trained for immersion in the saturating solution, a guide roll for bringing the web into supported relationship with the foraminated roll, and means disposed in juxtaposed relation to said roll for resiliently compressing the web against the roll, after immersion, said means comprising a resilient surfaced roller yieldingly urged toward the roll and disposed in laterally offset relation thereto in the direction in opposition to the direction of travel of the web between the point of web immersion and the vertical plane of the axis of the foraminated roll, and adapted to retain the web against the unsubmerged surface of said foraminated roll through said vertical plane.

4. Apparatus for adding saturant to a wet fibrous web, comprising a receptacle containing a saturating solution for modifying the character of the web, a foraminated roll rotating in a body of saturant, a porous conveyor for supporting and moving a wet fibrous web to dispose its normally upper surface in contact with the surface of the roll while simultaneously immersing said web in the saturating solution, a guide roll for bringing the web into supported relationship with the foraminated roll, and means disposed in juxtaposed relation to the roll for resiliently compressing the web against the roll after immersion, said means comprising a resilient surfaced roller yieldingly urged toward the roll and disposed in laterally offset relation to said roll in the direction in opposition to the direction of travel of the web between the point of web immersion and the vertical plane of the axis of the foraminated roll, and adapted to retain the web against the unsubmerged surface of said foraminated roll through said vertical plane.

5. Apparatus for adding saturant to a wet fibrous web, comprising a receptacle containing a saturating solution for modifying the character thereof, a foraminated roll rotating in the body of saturant for immersing the wet web therein while supported against said roll, a guide roll for bringing the web into supported relationship with said foraminated roll, and a cushioned surfaced couch roll having a porous carrier passing around it and resting on the upper peripheral portion of the foraminated roll in couching relationship

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thereto, the said couch roll being adapted to remove a portion of the excess liquid from the treated web without distortion thereof and to strip the web from the foraminated roll and cause it to adhere to the porous carrier passing around the couch roll.

6. Apparatus for adding saturant to a wet fibrous web, comprising a receptacle containing a saturating solution for modifying the character of the web, a foraminated roll partially submerged and rotating in the body of saturant around which a wet self-sustaining fibrous web may be trained for immersion in the saturating solution, a guide roll for bringing the web into supported relationship with said foraminated roll, and means comprising a cushion surfaced roll disposed between the point of web immersion and the vertical plane of the axis of the foraminated roll in juxtaposed relation to said roll for resiliently compressing the web against the roll after immersion and retaining it against the unsubmerged surface of the first named foraminated roll through said vertical plane.

7. Apparatus for adding saturant to a wet fibrous web comprising a receptacle containing a saturating solution for modifying the character of the web, a foraminated roll partially extending into and rotating in the body of saturant, a porous conveyor for supporting and moving a wet fibrous web to dispose its normally upper surface in contact with the surface of the foraminated roll while simultaneously immersing said web in the saturating solution, a guide roll for said porous conveyor and for bringing the web into supported relationship against said foraminated roll, and means comprising a cushion surfaced roll disposed between the point of web immersion and the vertical plane of the axis of the foraminated roll in juxtaposed relation to said foraminated roll for resiliently compressing the web against it after immersion and after being carried over it against at least one-half of its unsubmerged surface.

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