Oct. 22, 1940. I. J. NOVAK 2,218,547

METHOD OF SATURATING FIBROUS STOCK

Original Filed March 29, 1937 2 Sheets-Sheet 1

FIG. 1.

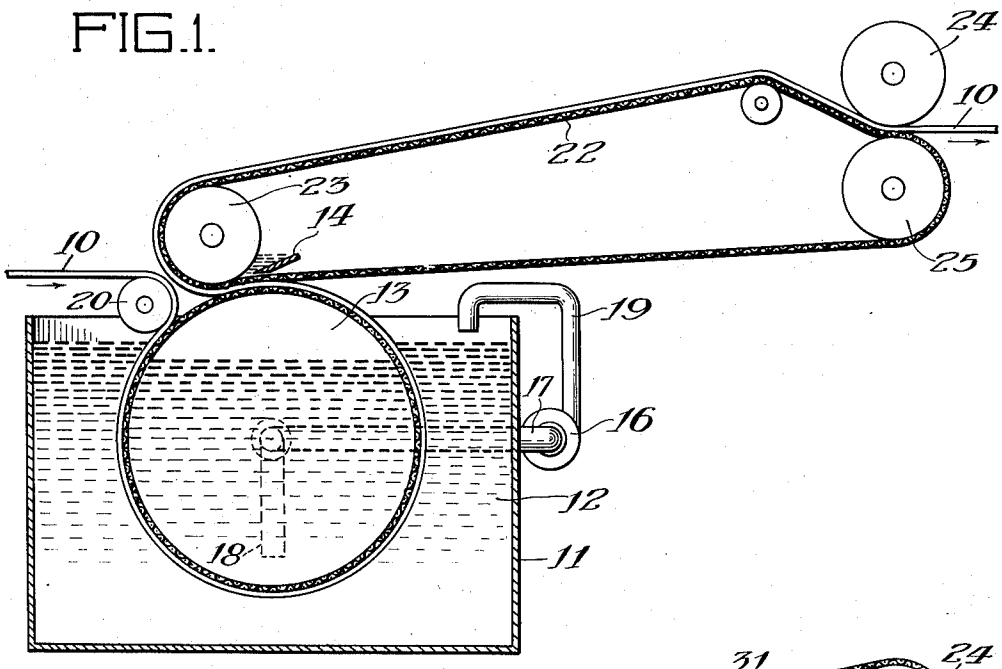
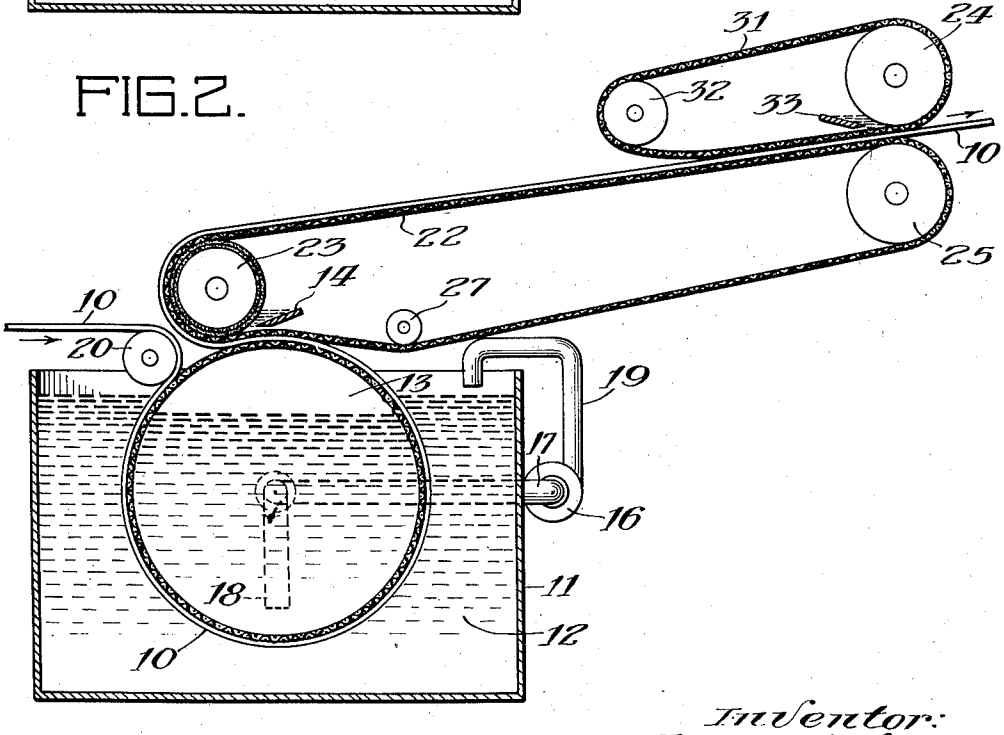


FIG. 2.



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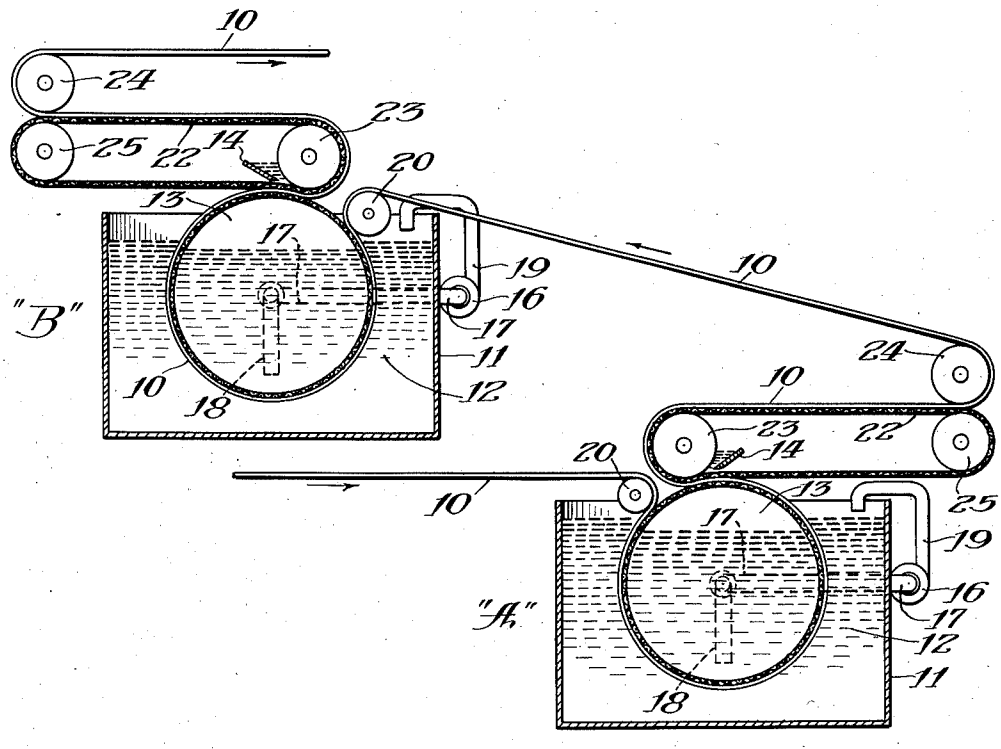
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FIG. 3.



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UNITED STATES PATENT OFFICE

2,218,547

METHOD OF SATURATING FIBROUS STOCK

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Application March 29, 1937, Serial No. 133,573
Renewed November 27, 1939

10 Claims. (Cl. 92—41)

The present invention is particularly directed to improvements in a method of, and apparatus for, incorporating saturant, binder, sizing, filler, or other modifying materials, with paper or fiber board.

In my Patent No. 1,966,458, issued June 17, 1934, I have disclosed an improved method of incorporating modifying material with felted fibrous stock, one of the distinguishing characteristics of which is the fact that the saturant, binder, filler, or other modifying material is caused to be incorporated when the fibrous web is in a receptive self-sustaining wet state, by virtue of which the modifying material is incorporated efficiently and effectively.

The present invention is directed to certain refinements in both the method and apparatus for incorporating the saturant, binder, filler, or other modifying material with the fibrous web and is especially effective when the web is in a wet state, as is also my copending application Serial No. 123,197, filed January 30, 1937.

It is a particular object of the invention to provide an improved method for loading the surface of a paper web with filler to improve its smoothness, color, and finish, while also incorporating sizing ingredients.

Another object of the 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.

A further object of this invention and particularly claimed herein resides in the novel method of and apparatus for modifying a self-sustaining fibrous web, without the necessity of supporting the underside of the web on a conveyor or guide surface, during the time the web is passing through the modifying liquid.

And still another object of this invention is to provide means for maintaining an otherwise unsupported wet web against a foraminated surfaced roll travelling in a liquid body of modifying material by the differential of liquid pressures caused by maintaining the level of the liquid in the roll lower than the liquid level at the exterior of the roll or by the differential pressure between the interior and exterior of the roll due to the direction in which the web passes out of the liquid.

It is possible to operate the device of the present invention on webs which have good wet strength without using a circulating pump to maintain a differential in liquid level between the interior and exterior of the roll, thus allowing the levels inside and outside the roll to remain the same. Most high-grade papers are well-beaten and of fine texture, resulting in good wet strength, and thus come in this class. Thus, even without differential levels there is still a differential pressure due to the direction in which the web passes out of the liquid. At this point, of course, the web has been thoroughly wetted and swelled and requires protection from collapsing backward and downward due to its increase in effective weight on entering the air. It is well known that a body immersed in a liquid weighs less than the same body in air. There are at least three conditions which protect a reasonably strong web in this case:

(1) Its felted structure;

(2) At the point where it emerges, it rests on the upper surface of the screen roll;

(3) The saturant entrained by it in passing out of the body of liquid (*a*) falls away on its under side resulting in a pull from below, and (*b*) presses down on its upper side; thus, there is actually a differential pressure operating in the desired direction, even if slight.

This condition exists when the level of liquid is kept above the axis of the roll and is inherent in removing the web from the liquid above the axis of the roll. At this exit position there is a considerable downward component of the forces holding the web against the roll.

I desire to emphasize the following features:

(A) Liquid level well above the roll axis;

(B) First contact of the web and the roll above the liquid level;

(C) Emergence of the web from the liquid on the upper surface of the roll.

In the preferred embodiment of my novel process and apparatus, the fibers are first felted in a conventional manner on a paper making machine. In carrying out my process I prefer to remove the felted web from the paper making machine after sufficient water has been removed to render the web self-sustaining. The wet web is then fed directly into contact with a liquid body of saturant or other modifying agent, during which period the felted formation of the web is maintained. As the web passes through the liquid it picks up a substantial quantity thereof, resulting in an increase in the thickness of the web. It is to be understood that the quantity of liquid picked up by the web is not sufficient to appreciably disturb or loosen the fiber formation which the web acquired on the paper making machine.

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Apparatus for carrying out my novel process is illustrated diagrammatically in the drawings in which:

Fig. 1 is a diagrammatic view, partly in elevation, and partly in section, of apparatus for practicing the invention.

Fig. 2 is a view similar to Fig. 1 disclosing a slight modification.

Fig. 3 is a diagrammatic view of a multiple unit saturating apparatus embodying my invention.

Referring now to Fig. 1 of the drawings, 10 indicates a self-sustaining wet fibrous web which has just been produced on a conventional paper making machine. The web is fed from the paper making machine directly to the apparatus for incorporating the modifying material, which comprises a receptacle 11, containing a body of liquid modifying agent 12, in which the foraminated roll 13 rotates.

A pump is indicated diagrammatically at 16, having a conduit 17, connected through the center of the roll with a portion 18, opening directly to the interior of the roll, whereby the liquid is removed from the interior of the roll at a definite, predetermined rate, and discharged through a conduit 19, into the receptacle 11, exteriorly of the roll. The rate of transfer of the liquid is such as to maintain the liquid in the inside of the roll at a level lower than at the exterior of the roll, to create a differential in liquid pressures which serves to cause the fibrous web, contacting the surface of the roll below the liquid level, to firmly adhere to the surface of the roll as the web moves out of the body of saturant, which is the point where distortion may occur if the web has been softened and swelled too much by saturation. In some instances, as hereinbefore pointed out, it may not be necessary to maintain any differential in liquid level, for instance, if the web has high wet strength and does not soften too much by saturation, but there is still a differential pressure due to the direction in which the web passes out of the liquid.

Disposed adjacent the entering side of the roll 13, is a guide roll 20, over which the wet web is trained into contact with the surface of the roll 13 above the liquid level. It will be manifest that, due to the difference in pressures inside and outside of the roll, the web will be caused to cling to the roll above the level of the liquid inside the roll 13. Below this level the web tends to float upwards against the roll 13 because of its air content. It should be noted as a feature of the invention that the liquid level is well above the axis of roll 13. Complete penetration of the web by the liquid is assured because the liquid on the exterior of the drum being above the level of the liquid in the drum, will, due to the absence of an opposing force, flow or seep through the wet fibrous web into the interior of the roll, and below the liquid level the air in the web tending to pass out of it upwardly aids the entrance of saturant thus insuring that the fibers become individually coated with saturant which serves to subsequently bind them firmly together in the finished saturated sheet.

As the web emerges from the liquid on the upper surface of roll 13, it is contacted by an endless wire screen conveyor 22, trained around resilient roll 23, which is so positioned relative to roll 13 as to squeeze or densify the web between the conveyor 22 and the screen roll 13, expelling a substantial quantity of excess liquid from the web. Desirably, roll 23 is located, as shown in Fig. 1, beyond the vertical center of roll 13, at the side at which the web first contacts said roll 13, as it has been found that the wet web will strip cleanly from the screen surface of roll 13 at this position. The slice board 14 acts to prevent drip on the web adhering to the saturating roll. The web is then conveyed on wire 22 between a pair of pressure rolls 24, 25, with slight couching against roll 24. This is particularly adapted for thin paper webs. For thicker webs the protection of a top wire is essential and the rolls must be correctly positioned to prevent crushing. The web may then be dried and calendered or handled in any other desired manner. This apparatus, as will be clear to those skilled in the art, may easily be adapted to one of the roll presses following the paper forming section in a conventional continuous paper machine by simply adding to it the tank 11 and using suitable rolls 13 and 23. In this case, the conventional felt blanket serves as the conveyor.

The construction disclosed in Fig. 2 is the same as Fig. 1 except that there is associated with the upper press roll 24, another endless wire screen 31, the opposite end of which is trained around a roll 32. The lower run of screen or wire 31 is positioned to contact the upper surface of the web as it moves along upon conveyor wire 22. The web passes through the pressure rolls 24 and 25 which are desirably arranged so that their axes lie in a plane perpendicular to the plane of the path of travel of the web as it enters the bight of the rolls and particularly set forth in my co-pending application Serial No. 123,196 filed January 30, 1937. This arrangement is important as it has been found that the surfaces of the web do not become crushed due to the squeezing action, and the web strips cleanly from the wire conveyor 22. A deflector 33 is located adjacent pressure roll 24 and the lower run of this wire 31 to promptly remove excess liquid squeezed out of the web as a result of passing between the pressure rolls 24 and 25, so that the expelled liquid does not continue to flow and remain on the oncoming portion of the web as it feeds between these rolls.

Fig. 3 shows a multiple unit saturating apparatus substantially as shown in Fig. 1 which is particularly adapted for filler application on both sides of a web and for convenience the units are designated as "A" and "B". As may be seen in the drawings the wet fibrous web 10 is fed into contact with screen roll 13 of unit "A", thoroughly treated, transferred onto conveyor screen or wool felt blanket 22, and passed between pressure rolls 24 and 25 of said "A" unit. Then the web is fed to the "B" unit for similar handling and treatment. For convenience, "A" and "B" units are shown in opposite arrangements so as to coat both sides equally with filler, but obviously if desired they may be identically arranged. It is to be understood that the liquids in the receptacles 11 of the respective units may be alike, or of different concentrations, or may be of entirely different characteristics, depending upon the characteristics desired in the final product. This apparatus is particularly adapted for coating with a filler both sides of the paper web, the liquid in such case containing filler material in suspension, preferably a filler suspension in a sizing solution, for example, a titanium dioxide suspension in 3% ammonia-shellac solution. The pump acts as a desirable agitator for filler suspensions so that both sizing and filling of surface can be done in one operation. This method al-

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lows the use of cheap alkaline fillers such as calcium carbonate, which ordinarily destroy sizing value of beater sizes. The only requirement in this case is that the sizing material be one which is not affected by slight alkalinity, e. g., glue, starch, shellac, etc. In making wet machine type board the wet filled web is wound up on a mandrel under conditions of slight crushing to produce a well felted structure. Large quantities of filler may thus be incorporated.

The proportions of saturant or other modifying materials desired in the finished product may be controlled by the concentration of the liquid and the densifying of the web by the pressure rolls.

This process has certain advantages over prior processes in that modifying materials which cannot be properly used in a beater engine because of their solubility in water, or because of their sensitiveness to mechanical action, etc., may be used in my wet web saturating process efficiently and safely. Particularly satisfactory results have been obtained in using several different modifying agents, such as glue, starch, shellac, etc., by moving the web through the saturant at paper making speeds. I do not, however, intend that this indication of speed of movement of the web shall be construed in a limiting sense, as obviously, successful results may be obtained at different speeds with these and certain other agents.

The felted product produced by my novel process is highly and thoroughly saturated, and the saturant in addition to individually coating the fibers, serves as a continuous binder to firmly secure the fibers in their bonded, interlaced and locked arrangement assumed during their felting operation on the paper machine. Where filler suspensions are used, the filler is locked with the fibers just under the surface of the paper.

The term "web" as used herein and in the claims is intended to also include single thin or thick webs, or plied webs composed of two or more wet webs. Also, the term "saturant" is intended to broadly include all materials that may be satisfactorily employed for modifying or altering the characteristics of a fibrous web.

I claim as my invention:

1. A process of adding a modifying agent in a liquid vehicle to a wet fibrous web, which comprises moving the wet web into contact with a foraminated roll, rotating said roll about a substantially horizontal axis in a body of said liquid for immersing said web therein, maintaining the level of liquid in the interior of the roll at a level lower than the level at the exterior of the roll, whereby the wet web is caused to adhere to the surface of the roll solely by the differential in pressures of the liquid levels as it passes through the body of liquid, compressing the treated web against the roll after immersion, and stripping the web from the roll.

2. A process of adding a modifying agent in a liquid vehicle to a wet fibrous web, which comprises moving the wet web into supporting contact with a foraminated roll, rotating said roll about a substantially horizontal axis in a body of said liquid for immersing said web in the liquid, and maintaining a differential in liquid pressures on the inner and outer surfaces of the web trained around the roll and immersed in the liquid for causing said liquid to flow through said web and for causing said web to adhere to the surface of said roll solely by the differential in pressures of the liquid levels as it passes through the body of liquid.

3. A process of adding a modifying agent in a liquid vehicle to a wet fibrous web, which comprises moving a wet fibrous web into contact with a foraminated roll, rotating said roll about a substantially horizontal axis in a body of liquid for immersing said web in the liquid, and maintaining the liquid in the interior of the roll at a level lower than the liquid level at the exterior of the roll, whereby the wet web is caused to adhere to the surface of the roll solely by the differential in pressures of the liquid levels as it passes through the body of liquid.

4. A process of adding a modifying agent in a liquid vehicle to a wet fibrous web, which comprises moving a wet fibrous web into contact with a foraminated roll, rotating said roll about a substantially horizontal axis in a body of said liquid for immersing said web in the liquid, maintaining the liquid in the interior of the roll at a level lower than the liquid level at the exterior of the roll, whereby the wet web is caused to adhere to the surface of the roll solely by the differential in pressures of the liquid levels as it passes through the body of liquid, and compressing the web against the roll after immersion in the liquid.

5. A process of adding a modifying agent in a liquid vehicle to a wet fibrous web, which comprises moving a wet fibrous web into contact with a foraminated roll, rotating said roll about a substantially horizontal axis in a body of said liquid for immersing said web in the liquid, maintaining the liquid in the interior of the roll at a level lower than the liquid level at the exterior of the roll, whereby the wet web is caused to adhere to the surface of the roll solely by the differential pressures of the liquid levels as it passes through the body of liquid, compressing the web against the roll after immersion in the liquid, and stripping the web from the roll at a plane beyond the vertical axis of the roll at the side at which the web first contacts the roll.

6. A process of adding a modifying agent in a liquid vehicle to a wet fibrous web, which comprises moving a wet fibrous web into contact with a foraminated roll, rotating said roll about a substantially horizontal axis in a body of said liquid for immersing said web in the liquid, maintaining the liquid in the interior of the roll at a level lower than the liquid level at the exterior of the roll, whereby the wet web is caused to adhere to the surface of the roll solely by the differential in pressures of the liquid levels as it passes through the body of liquid, compressing the web against the roll after immersion in the liquid, stripping the web from the roll, and feeding the web onto a porous conveyor.

7. A process of adding a modifying agent in a liquid vehicle to a wet fibrous web, which comprises moving a wet fibrous web into contact with a foraminated roll, rotating said roll about a substantially horizontal axis in a body of said liquid for immersing said web in the liquid, maintaining the liquid in the interior of the roll at a level lower than the liquid level at the exterior of the roll, whereby the wet web is caused to adhere to the surface of the roll solely by the differential in pressures of the liquid levels as it passes through the body of liquid, compressing the web against the roll after immersion in the liquid, stripping the web from the roll and feeding the web between a pair of pressure rolls in a plane substantially perpendicular to a plane passing through the axes of said pressure rolls.

8. A process of adding a modifying agent in a liquid vehicle to a wet fibrous web, which comprises moving a continuous wet fibrous web into

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contact with a plurality of separated, foraminated rolls, rotating the rolls about substantially horizontal axes in separate bodies of said liquid for immersing the web, and maintaining the liquid in the interior of the rolls at a level lower than the exterior of the rolls, whereby the wet web is caused to adhere to the surfaces of the respective rolls solely by the differential in pressure of the liquid levels as said web passes through the respective bodies of liquid.

9. A process of adding a modifying agent in a liquid vehicle to a wet fibrous web which comprises moving the wet web into supporting contact above the liquid with a foraminated roll rotating on a horizontal axis and immersed to substantially above its axis in the liquid, causing it to emerge from the liquid on the upper surface of the roll and pressing the excess liquid from the web the wet web being caused to adhere to the surface of the roll solely by differential in pressures of the liquid levels as it passes through the body of liquid.

10. A process of adding a modifying agent in a liquid vehicle to a wet fibrous web which comprises moving the wet web into supporting contact above the liquid with a foraminated roll rotating on a horizontal axis and immersed to substantially above its axis in the liquid, causing the web to emerge from the liquid on the upper surface of the roll, and thereafter pressing the excess liquid from the web, the wet web being caused to adhere to the surface of the roll due to the direction in which the web passes out of the liquid.

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