June 16, 1936. I. J. NOVAK 2,044,012

MULTIPLE IMPREGNATING DEVICE FOR PAPER MANUFACTURE

Filed March 5, 1934 2 Sheets-Sheet 1

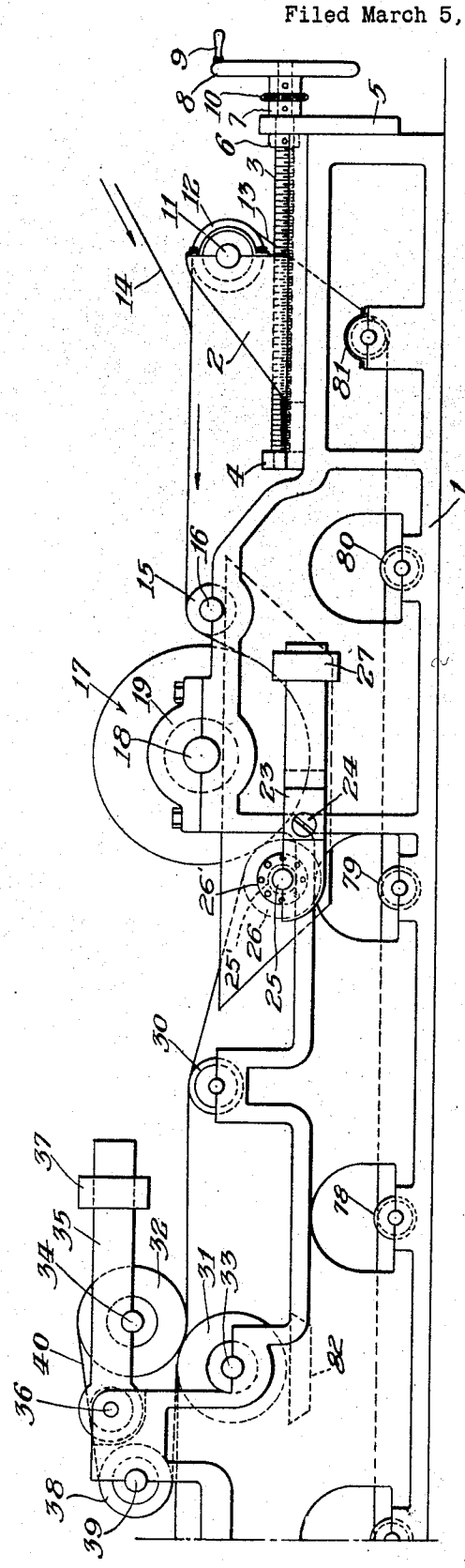


Fig. 1.

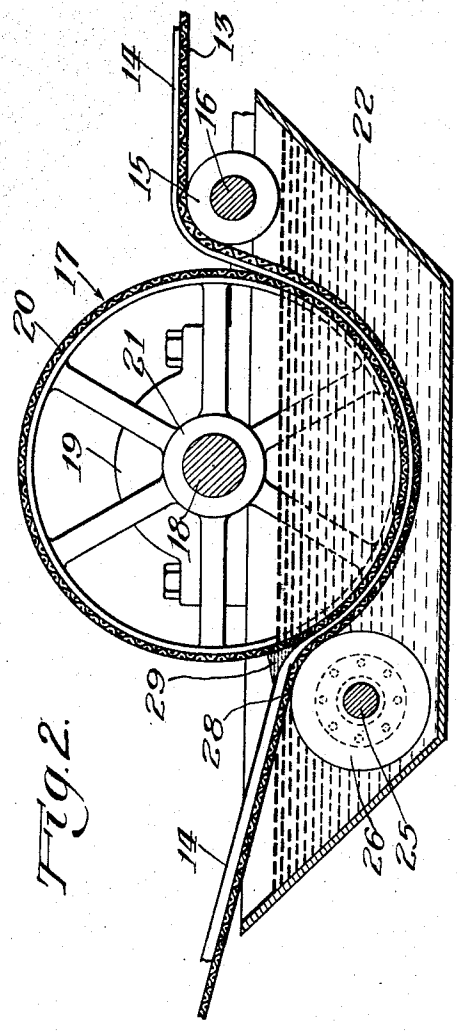


Fig. 2.

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[redacted]

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MULTIPLE IMPREGNATING DEVICE FOR PAPER MANUFACTURE

Filed March 5, 1934 2 Sheets-Sheet 2

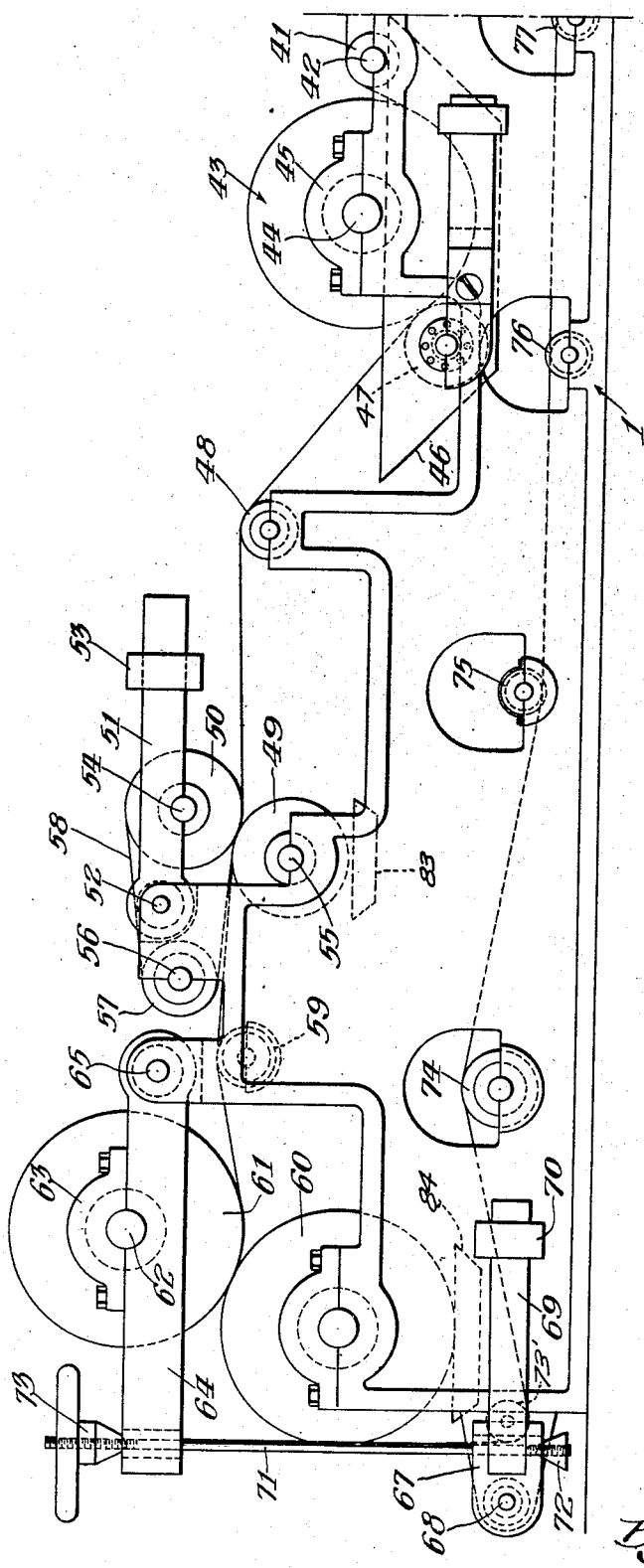


Fig. 1a.

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UNITED STATES PATENT OFFICE

2,044,012

MULTIPLE IMPREGNATING DEVICE FOR PAPER MANUFACTURE

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Application March 5, 1934, Serial No. 714,118

7 Claims. (Cl. 92—40)

This invention relates to improvements in the manufacture of paper, board, or similar felted, fibrous structures wherein modifying materials suspended or dissolved in water, such as sizes, binders, water-proofings, etcetera, are introduced into the wet web before substantial drying thereof, whereby the felted structure, when dried, contains the desired modifying materials uniformly distributed throughout the felted structure.

In its broad aspects, the invention relates to a method and apparatus for felting fibers into a wet web and impregnating said wet web in a progressive continuous operation.

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 into a newly formed continuous wet web being continuously removed from a paper forming machine, before substantial drying thereof, and have described a saturating machine therefor and explained its use. The saturating machine therein shown is placed in a conventional paper machine line, and the continuous wet web, after being felted and formed, is threaded from the web forming machine directly to the saturating machine.

The present invention is directed to an improvement in the operation therein described and in its preferred embodiment comprises the combination, with a paper forming machine, of means for passing the newly felted web being continuously removed from the web forming instrumentality, and while still wet, through a series of impregnating baths, and means, following each bath, for removing the excess liquid from the web.

In said co-pending application I have described a process and apparatus for impregnating the newly felted wet web wherein the web, after contact with an excess of aqueous impregnating material, tends to swell and distend, whereby the liquid impregnant enters between the fibers of the web, displacing the air and some of the water existing between the fibers of the web. Thus, the web is impregnated and on drying acquires the advantages characteristic of this type of impregnation.

Certain stocks, however, due to their method of preparation, do not quickly distend and absorb even very fluid saturants when immersed therein for a short period, such as is necessary in running at commercial speed. Such stocks, for example, may be highly hydrated cellulose fiber webs, webs containing any considerable proportion of sizing materials, or webs containing gelatinous animal fibers or the like, or in paper making term, "slow" webs. Furthermore, even relatively loose webs do not distend rapidly in viscous saturants such as, for example, 60% latex, 40° Baumé sodium silicate, 10% glue solution, 5% viscose. Also, in some cases where the web does distend, suspensions of fillers contained in the impregnating fluid do not enter as quickly as might be desired, especially where the suspended filler particles are relatively large.

In my co-pending application above referred to it will be noted that the web may be allowed to remain in the impregnating bath for a longer period or the web may be run thinner, but these methods may not always be desirable in rapid commercial operation.

I have found that another phenomenon inherent in the operation of said co-pending application also tends to improve uniformity of impregnation to a considerable extent. This is the couching which takes place after the web passes through the impregnating bath due to the action of the stripper roll which is positioned in the impregnating tank and the action of the squeeze rolls which remove the excess of aqueous liquid and allow the sheet to be built up into multiple plies or to be carried forward to roll dryers.

In adapting this inventive concept to the more thorough impregnation of dense or gelatinous wet webs and to the use of viscous saturants and sluggish filler suspensions, according to the present invention, I pass the web through a series of spaced impregnating baths in combination with single or multiple couching between each impregnating bath.

My invention, briefly described, comprises a series of impregnating baths, an impregnating roll rotatably positioned adjacent each bath, a portion of the surface of each roll being immersed in each bath, a stripper roll associated with each impregnating roll, an endless foraminated conveyor for carrying a wet fibrous web adapted to pass around that portion of each impregnating roll which is immersed in the bath, and squeeze rolls following each bath between which said conveyor and fibrous web pass.

Thus, the web may be led through the first bath under conditions which would, on drying, result in a web having only a small residual saturant content but wherein the web has complete uniformity of saturation. It is couched by the stripper roll acting against the impregnating roll on leaving the bath in the presence of an excess of impregnating liquid, then again pressed between squeeze rolls to reduce the excess of impregnating liquid,

Multiple Impregnating Device for Paper Manufacture (US Patent 2,044,012, 1936)
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both of which operations subject the web and the contained impregnating liquid to mechanical pressure, thereby distributing the impregnating liquid more thoroughly. Furthermore, the natural resiliency of the web causes it to be condensed under pressure and to expand again when the pressure is released, which also aids in the more even distribution of the material carried in the saturant. The passage between the squeeze rolls reduces the liquid content of the web and on its subsequent passage into the next impregnating bath of higher concentration or viscosity it absorbs additional impregnating liquid, which may be of a type less readily saturable in a fresh previously unsaturated web, and with further couching and pressing the second impregnating liquid is again mechanically forced in and around the fibres.

The effects of such multiple impregnation, couching and pressing are several. First, combinations of web and impregnating materials which are relatively difficult to combine by a single immersion are more easily combined in plural immersions. Second, while the web previous to the first immersion contains water alone, there is a limit set by various conditions, such as web characteristics, the characteristics of the impregnating material, speed of travel of the web through the paper machine, etc., to the amount of impregnating material which might be introduced into it as the fresh web water is never wholly displaced by the impregnating material. However, after couching and pressing, the web contains a large proportion of impregnating material in addition to some of the original water and on its entrance into the second bath, relatively little water need be displaced and the web on leaving the second and succeeding baths contains a much higher proportion of impregnating material. Depending on the nature of the web, impregnating material and speed, a suitable manner of impregnating and couching stages may be used so that the web may contain substantially full strength impregnating material.

In the case of highly hydrated webs which would not saturate with certain viscous impregnants, for example 40% latex, but would merely surface-coat, the series of operations comprises leading the web first into a sufficiently dilute saturant liquid of the same composition as the saturant finally desired in the web. This dilute saturant will cause the web to distend and will therefore impregnate it without surface precipitation. The succeeding steps include saturation in successively more concentrated latices with intermediate couching and removal of excess liquid until the final saturant is distributed within the web whereupon the web may be in condition for drying. For example, in a three step saturation the first saturant may have a concentration of 10%, the second 25%, and the third 40%. The initial saturation may be a complete saturation and must separate the fibres and distend the web, so that subsequent saturation may be of equal thoroughness.

It will be appreciated that whereas the fresh web, for example, when hydrated fibres are used, may be sufficiently close packed and of such fine liquid pore space and adhesiveness of fibres as to resist penetration and separation of fibres by a relatively viscous liquid, if separation of these fibres is once accomplished by a thin dilute saturant of the composition desired or of any suitably acting composition the presence of the new material between the fibres operates to make them more easily separable on subsequent immersion in saturant liquids. Further saturations will of course, increase the ease of separation until the web is capable of saturation in the liquid desired as final residual saturant. By this means the tendency of certain suspensions and emulsions to filter and divide into a more fluid and a more viscous state (the latter concentrating on the web surface) may be avoided and saturation accomplished.

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

In the drawings, Figs. 1 and 1*a* comprise side elevational views of the device of my invention.

Fig. 2 is an enlarged sectional elevation of one of the impregnating units.

Referring in detail to the drawings, **1** indicates a frame which is adapted to support the various impregnating units and pressing units comprising my invention. At one end of the frame **1** a block **2** may be slidably mounted, said block being threadedly engaged with screw **3**. Screw **3** may be journalled at one end in support **4**, which may be mounted upon frame **1** and the opposite end of said screw may be journalled in support **5** which may be mounted at the end of frame **1**. A collar **6** may be positioned upon screw **3** and may be keyed thereto, said collar being adapted to abut support **5**. A collar **7** may also be keyed to the projecting end of screw **3** and is adapted in conjunction with collar **6** to prevent longitudinal movement of screw **3**.

A hand wheel **8** may comprise an integral portion of collar **7**, said hand wheel being provided with handle **9** whereby screw **3** may be rotated to move block **2** longitudinally along the end portion of frame **1**. A sprocket wheel **10** may be provided on the surface of collar **7** whereby screw **3** may be rotated at a point remote from the projecting end of said screw, or said screw may be rotated by power means (not shown). A shaft **11** may be journalled in block **2** and may be adapted to carry cylinder or drum **12**, over which an endless screen **13** is adapted to pass. Screen **13** is preferably constructed of stainless steel or other non-corroding metal and may be of mesh ranging between 20 and 80 openings to the square inch. It can readily be seen that by rotating screw **3** and thereby moving block **2**, the tension of screen **13** may be adjusted.

Screen **13** in its forward travel after passage around drum **12** is adapted to carry a newly formed wet fibrous web **14** which may be continuously passed to screen **13** from a paper making machine (not shown). The wet web **14** carries as much moisture as is carried by a web coming from the press units of a Fourdrinier machine prior to passing the web to the driers. Of course, the quantity of moisture contained in the web **14** will depend upon the characteristics of the fibres constituting the web, the type of impregnating material with which the web is adapted to be treated, the speed of the machine and the characteristics desired in the ultimate product. Screen **13** after passing over drum **12** may travel around drum **15** which may be mounted upon shaft **16** which, in turn, may be journalled in frame **1**.

An impregnating roll **17** mounted upon shaft **18**, which latter may be supported in bearings **19**, may be positioned adjacent drum **15**. Roll **17** may be of hollow construction, its peripheral surface comprising screen **20** which may be of a mesh similar to that of wire **13**. The screen **20** may be supported at each end of the roll by means of spider

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21. A vat 22 may be positioned immediately beneath roll 17, a portion of said roll being adapted during rotation thereof to dip into the interior of said vat. Vat 22 may be adapted to carry a quantity of impregnating material, coating material, sizing material or any other substance with which it is desired to treat web 13.

Referring particularly to Fig. 2, it can be seen that when screen 13 and web 14 pass over drum 15, web 14 will be confined between screen 13 and screen 20 comprising the peripheral surface of roll 17. Confined in this manner between the two foraminous surfaces mentioned, web 14 is passed through the bath carried in vat 22.

As has been hereinbefore described, web 14 contains an appreciable quantity of water and when immersed in the liquid impregnant comprising the bath would tend to disintegrate. However, said web, being positively confined between the foraminated surfaces mentioned, will not disintegrate nor will its fibrous formation be disturbed. However, when said web passes through the bath, its entire surface area is exposed to the liquid comprising the bath and, hence, a degree of substitution takes place, that is, the material comprising the bath tends to replace a portion of the water originally present in the web, and the air surrounding the fibres of the web is replaced by liquid impregnant.

Bars 23 may be mounted upon each side of frame 1 adjacent vat 22, the mounting means comprising pin or pivot 24, whereby said bars may be free to rock about said pivot. The forward ends of bars 23 may be adapted to support the ends of shaft 25 which, in turn, carries roll 26, said ends projecting through apertures 25' provided in the side walls of vat 22. Apertures 25' may be relatively larger in diameter than shaft 25, so that roll 26 may be adjustable a limited degree toward or away from roll 17. To prevent excessive leakage of liquid through apertures 25', gaskets 26' may be secured to each face of the side walls of the vat adjacent said apertures, shaft 25 passing through the center of said gaskets. Gaskets 26' may be constructed of flexible material such as rubber, leather or the like. Roll 26 is adapted to be positioned within vat 22 and screen 13 together with web 14 is adapted to pass between roll 26 and roll 20, the normal pressure of roll 26 against the screen and web being controlled by weights 27 which may be adjustably positioned along the opposite ends of bars 23. Roll 26 may be constructed of rubber or other resilient material.

During the period that web 14 passes through the bath within vat 22, the tendency of said web is to expand, due to it being in the presence of an excess of liquid. However, inasmuch as the web is confined between screen 13 and the surface of roll 17, substantial expansion or distention of said web is prevented. As screen 13 and web 14 pass from the bath within vat 22, said screen and web passing between roll 26 and roll 17, the web is slightly compressed by the pressure of roll 26 upon the screen and web. Immediately after passing between roll 26 and roll 17, web 14 is stripped or carried away from the surface of roll 17. Consequently, due to the tendency of the web to expand because of its passing through the bath and due to the fact that the web is compressed between roll 26 and roll 17, the web when stripped, as has been hereinbefore described, tends to expand as shown best at 28 in Fig. 3.

A pool 29 of the material constituting the bath accumulates at the nip of the rolls due to that portion of the liquid carried out of the bath by screen 20, and also due to the liquid absorbed by and adhering to web 14 being compressed between rolls 26 and 17. When the web expands upon leaving the surface of screen 20, it can readily be seen that said expansion takes place in the presence of pool 29 and, therefore, liquid of the character constituting the bath is drawn into said web, being distributed around and through the fibers constituting the internal portion of the web. In addition, screen 13 upon emerging from the bath within vat 22 carries a quantity of the liquid constituting the bath upon its surface. When expansion takes place at 28, the liquid upon said screen is also drawn into the web. In this manner, a relatively large quantity of the moisture originally present in the web is replaced by the liquid constituting the bath.

After emerging from vat 22, screen 13 carrying web 14 passes over guide roll 30 which may be journalled upon frame 1, from whence the screen and web are passed between squeeze rolls 31 and 32. Although a major portion of the expansion of web 14 after it leaves the bath takes place in the vicinity of the nip of rolls 26 and 17, expansion of web 14 continues during its passage from the bath to squeeze rolls 31 and 32. Hence, substantially all of the liquid adhering to the surface of web 14 and the liquid which may adhere to the surface of screen 13 is drawn into the interior of web 14.

Roll 31 may be mounted upon shaft 33 which may be journalled in frame 1 and roll 32 may be mounted upon shaft 34 which may be carried by the floating levers 35 which are, in turn, pivotally mounted at one end upon frame 1, as shown best at 36 in Fig. 1. The opposite end of levers 35 may carry weights 37 which may be movably positioned along the length of the free end of said levers. A roll 38 may be mounted upon shaft 39, which, in turn, may be journalled in frame 1, and an endless screen 40, of similar mesh to screen 13 may travel around rolls 32 and 38. Rolls 31 and 32 exert normal pressure toward each other and inasmuch as screen 13 and web 14 pass between said rolls, said web is squeezed or compressed, removing therefrom a quantity of the liquid, both that originally present in the web and also the liquid absorbed by said web from the bath. Rolls 31 and 32 are preferably covered with relatively soft rubber or other resilient material. In order to increase the duration of the squeezing operation, web 14 after passage between rolls 31 and 32 may be confined between screen 13 and screen 40 thereby permitting the removal of a desired quantity of liquid from web 14.

Screen 13 and web 14, after leaving rolls 31 and 32 and screen 40, pass forwardly over drum 41 mounted on shaft 42 which, in turn, is journalled in frame 1. An impregnating roll 43 may be mounted upon shaft 44 which is journalled in bearing 45. Immediately beneath roll 43 a vat 46 is positioned. Drum 41, roll 43 and vat 46 may be similar in construction respectively to drum 15, roll 17 and vat 22. A stripper roll 47 may be mounted within vat 46, the construction thereof and mounting means therefor being similar to that associated with roll 26.

Vat 46 is adapted to contain impregnating liquid with which it is desired to further treat web 14. After passage over drum 41, web 14 may be carried between screen 13 and the foraminated surface of roll 43 through the liquid comprising the bath. During passage through said liquid, web 14 is again brought into intimate contact with the

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liquid impregnating material. When leaving the bath, screen 13 and web 14 pass between roll 47 and roll 43 whereby said web is compressed. Substantially immediately after leaving the nip of rolls 47 and 43, said web expands in a manner similar to that which takes place after web 14 left the nip of rolls 26 and 17. In so expanding, additional impregnating liquid is induced into the interior of web 14.

Screen 13 and web 14 after leaving rolls 43 and 47, pass over drum 48 and are thence carried between squeeze rolls 49 and 50, which, similar to rolls 31 and 32, may be constructed of rubber or other resilient material. Levers 51 may be pivoted at 52 to frame 1, the opposite ends of said levers carrying weights 53. Roll 50 may be mounted upon shaft 54 which, in turn, may be journalled at each end in levers 51. Roll 49 may be mounted upon shaft 55 which may be journalled in frame 1. A shaft 56 may also be journalled in frame 1 and may carry drum 57, and an endless screen 58 may be adapted to travel around roll 50 and drum 57 in a manner similar to that described in conjunction with rolls 32 and 38. When screen 13 and web 14 pass between rolls 49 and 50 and said web in its further progress is confined between screen 13 and screen 58, the excess impregnating material accumulated by web 14 during its passage through vat 46 is removed.

Screen 13 and web 14, after passing from rolls 49 and 50, are carried over drum 59 and are thereafter passed between rolls 60 and 61. Roll 61 may be mounted upon shaft 62 which may be journalled in bearing 63 mounted on lever 64. Lever 64 may be pivoted at one end, as at 65, to a portion of frame 1. A bracket 66 may extend from a lower end portion of frame 1 and member 67 may be pivoted thereto as at 68. Member 67 may carry an extension 69 upon which may be mounted a movable weight 70. A rod 71 may connect the free end of lever 64 and an intermediate portion of the assembly comprising member 67 and extension 69, the effective length of said rod being variable by means of conical nut 72 and hand wheel 73, which are respectively threadedly positioned at the lower and upper end of rod 71. The arrangement is such that the normal pressure of roll 61 upon roll 60 may be changed by changing the position of weight 70 along the length of extension 69.

After passage of screen 13 and web 14 between rolls 60 and 61, web 14 may be stripped from screen 13 and said screen may be carried around roll 60 and returned over guide rolls 73', 74, 75, 76, 77, 78, 79, 80 and 81 to roll 12, all of said guide rolls being mounted at the lower portion of frame 1. Web 14, when stripped from screen 13 may, if desired, be wound upon roll 61, said roll functioning in this instance as a make-up roll. The various layers wound upon roll 61, in this case, may be stripped therefrom in multi-ply sheets. If desired, however, web 14 may be stripped from screen 13 after passage between rolls 60 and 61, and may be carried to a battery of conventional drum dryers (not shown).

A pan 82 may be positioned beneath rolls 31 and 32 to retrieve the liquid expressed from the web by said rolls. Similarly, pans 83 and 84 may be positioned beneath rolls 49 and 50 and 60 and 61, respectively.

It is to be understood, of course, that although two impregnating and squeezing units are shown and described in tandem relationship with each other, as many units as desired may be used depending upon the degree of impregnation desired, the type of impregnating material, the speed of operation or the characteristics of the web both as to the properties of the fibers constituting the web and the original moisture content of the web. It is also to be understood that, in using multiple impregnating and squeezing units in tandem, the supporting screen need not be a continuous screen which is carried through all of the units. For instance, an individual endless screen may be utilized in conjunction with each impregnating and squeezing unit, in which case the web after leaving one squeezing unit will be stripped from the screen associated with that unit and passed to the screen of the next succeeding unit.

The use of one endless supporting screen for a plurality of impregnating and squeezing units may be utilized in those instances where the maintenance of the exact concentration in the various vats is not essential, as in the case where all of the saturating baths contain the same saturant or with different concentrations of the same saturant where slight variations in concentration are unimportant. The multiple separate units with individual supporting screens for each unit may be desirable where the various saturating baths are not the same and must be kept separate as, for example, in the case where it may be desired to fill a web with a relatively inexpensive off-color filler and finish the surface as a last operation with a high grade pigment.

I have used the term "saturate" with both emulsions and suspensions of liquids and solids. It should be realized however, that the coarser the particles are the less mobile the particles are as regards their travel with the liquid medium with which they tend to move. Thus filler suspensions while capable of being carried along with a liquid while being prevented from falling therethrough, are much less mobile and not so much a part of the liquid as for example a fine oil emulsion, due to their size, relatively greater density and their non-spherical shape. In the methods and for the purposes of this invention they may, however, be classed with the more mobile water combinations, provided it is clear that the physical condition of the coarser solid suspensions brings about certain variations from the more perfect distribution described and obtained with the more mobile combinations. Thus, for example, there is a decided tendency for filler suspensions to filter out to some extent on the surface of a fine web while the same filler suspension may easily enter a more open web. However, by the use of a succession of dips in filler suspension and intermediate couchings the filler remaining on the surface of the web is driven through the body of the web by the previously described "breathing" of the web under compression and decompression in the presence of its water content and the filler particles. This relatively sluggish action may be used, therefore, to fill a web with a cheaper filler and finish the surfaces with a more expensive one. It should be noted that the effect of introducing filler by this method is not a coating and covering of the fibres as occurs in ordinary coated paper but a deposition of the filler in the plane of the surface fibres and beneath them. Such a positioning of the fillers results in a non-cracking tough filled surface, and as described is a substantial equivalent of coated paper obtained in a single operation concomitant with the paper making itself. The quantity of filler introduced is variable between wide limits, the upper limit of which may be

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greater than 50% of the total weight of the paper.

Also, the separated multiple arrangement may be used where it is desired to conduct several chemical treatments in tandem. For example, a partially hydrated sulphite web may be passed first into a bath containing cold concentrated caustic soda to form a partial soda cellulose, through a second bath containing emulsified carbon di-sulphide which will react with the partly formed soda cellulose to produce a partial viscose, then through an intermediate warming box and through a third bath containing a hot salt solution to set the viscose previously formed and then through a fourth and fifth unit containing hot water to wash out the salts of inter-action. The web thereupon passes through dryers, super calenders and friction calenders. The result of such a procedure is to form a sheet containing amorphous cellulose derived from the viscose formed by the above steps, which amorphous cellulose acts as a binder for the ungelatinized inner portions of the fibres, giving the effect of very highly hydrated cellulose fibres. The super-calendering breaks down the previously untreated fibre and the final effect is to produce a sheet substantially transparent—a product between the old glassine paper and the "cellophane" of today. This example is given to show the possibilities of multiple treatment of wet webs by the use of the wet web saturating machines in tandem in a continuous process.

The machine also has utility as a washer for a wet web whereby undesirable soluble materials may be removed from a wet web before drying the web. For example, acid introduced in the beater for precipitation of sizing materials, which causes deterioration of paper, may be almost completely removed by washing and then the remaining acid neutralized in a dilute ammonia bath. Conducting salts undesirable in electrical insulating paper may be similarly washed out. The same operations which substitute saturants for water originally present in the web may thus be used to substitute pure water for impure water.

It is to be understood also, that although my invention is particularly adaptable for saturating, coating or sizing a wet fibrous web, it may also be used for other purposes. Broadly, the invention is adaptable for use wherever it is desired to supplant or replace a portion or substantially all of the original moisture content of a wet fibrous web with another liquid having different characteristics.

From the foregoing it will be apparent that I have provided a novel form of device for handling the difficult combinations hereinbefore referred to to produce full, uniform saturation of wet webs whether the web be dense or loose, whether the saturant be viscous or mobile, or in the form of a sluggish suspension or emulsion, and at any desired speed, merely by multiplying the number of operations similar to the single operation described in said co-pending application and operating so as to produce distention and saturation of the web in each saturating unit, as described above. It also provides a means of insuring displacement of the water and air originally contained in the wet web with an aqueous liquid containing a selected modifying material.

It may be desirable in some cases where the web is especially dense and it is desired to introduce a relatively viscous saturant or sluggish suspension, to start the saturation with a more easily saturatable saturant of the composition desired, making certain that in the first bath saturation and distention take place, which saturation is thoroughly distributed by the following couching, increasing the concentration with each progressive saturation or impregnation until the required amount has been introduced into the web.

It is also a characteristic of multiple saturation and intermediate couching, according to the present invention, that almost any desirable amount of filler may be worked into a wet web. It is characteristic of fillers, unlike dissolved saturants, that they tend to remain entangled in the web on passage through squeeze rolls, and on further saturation and couching add successively to the amount of filler contained in the web. Thus, a quantity of filler greatly in excess of proportions obtainable by beater processes may be efficiently and evenly introduced into a paper web, producing filled papers of greater smoothness and opacity than heretofore produced without surface coating.

In the field of waxed papers a quantity of paraffin wax or oil emulsion may be introduced, according to the present invention, sufficient to make the paper translucent on drying, which has not heretofore been possible by introduction into the beater because of low retention.

It is an essential of the multiple process described when obtaining thorough impregnation in the final web that each step beginning with the first, must result in material distention of the wet web and introduction and distribution of the saturant to be introduced in that step. In other words, an imperfection of distribution, or a coating of the web in any one step as against impregnation, results in later imperfection of distribution and is therefore to be avoided.

I claim as my invention:

1. The combination with means for forming a wet felted fibrous web, of means for impregnating said wet web with a permeating liquid comprising a plurality of individual impregnating units, each unit comprising an impregnating device and a squeezing device, and flexible foraminated means associated with said units for positively supporting and conveying the wet fibrous web through said units in seriatim.

2. The combination with means for forming a wet felted fibrous web, of means for impregnating said wet web with a permeating liquid comprising a plurality of individual impregnating units, each unit comprising an impregnating device and a squeezing device, each impregnating device comprising a vat for liquid impregnating material, a roll having a foraminated surface rotatably positioned in said vat, flexible foraminated means associated with said units for positively supporting and conveying the wet fibrous web through said units in seriatim, and means for confining said web passing through the impregnating device between said foraminated means and the foraminated surface of said roll.

3. The combination with means for forming a wet felted fibrous web, of means for impregnating said wet web with a permeating liquid comprising a plurality of individual impregnating units, each unit comprising an impregnating device and a squeezing device, each impregnating device comprising a vat for liquid impregnating material, a roll having a foraminated surface rotatably positioned in said vat, flexible foraminated means associated with said units for positively support-

ing and conveying the wet fibrous web through said units in seriatim, means for confining said web when passing through the impregnating devices between said foraminated means and the foraminated surfaces of said rolls, and a couch roll mounted in each vat which the web passes in traveling through said impregnating devices.

4. The combination with means for forming a wet felted fibrous web, of means for impregnating said wet web with a permeating liquid comprising a plurality of individual impregnating units, each comprising an impregnating device and a squeezing device, each impregnating device comprising a vat for liquid impregnating material, a roll having a foraminated surface rotatably positioned in said vat, flexible foraminated means associated with said units for positively supporting and conveying the wet fibrous web through said units in seriatim, and means for confining said web when passing through the impregnating devices between said foraminated means and the foraminated surfaces of said rolls, a couch roll mounted in each vat which the web passes in traveling through said impregnating devices, each of said squeezing devices comprising a pair of juxtaposed rolls between which said foraminated means and said web pass after leaving each impregnating device whereby said web is compressed and the excess liquid contained therein is removed.

5. The combination with means for forming a wet felted fibrous web, of means for impregnating said wet web with a permeating liquid comprising a plurality of individual impregnating units disposed in tandem, an endless screen adapted to pass through and carry the wet fibrous web through said units in seriatim, said screen supporting the web during such passage, each treating unit comprising an impregnating device and a squeezing device alternately positioned in the path of travel of the screen and web.

6. The combination with means for forming a wet felted fibrous web, of means for impregnating said wet web with a permeating liquid comprising a plurality of individual impregnating units disposed in tandem, an endless screen adapted to pass through and carry the wet fibrous web through said units in seriatim, said screen supporting the web during such passage, each treating unit comprising an impregnating device and a squeezing device alternately positioned in the path of travel of the screen and web, each of said impregnating devices comprising a vat for impregnating liquid, a roll having a foraminated surface positioned to rotate in said vat, means for carrying said web into the liquid in said vat confined between said screen and the surface of the roll, and means for couching said web in the presence of an excess of impregnating liquid as it emerges from the liquid in said vat.

7. The combination with means for forming a wet felted fibrous web, of means for impregnating said wet web with a permeating liquid comprising a plurality of individual impregnating units disposed in tandem, an endless screen adapted to pass through said units and carry a fibrous web therethrough, said screen supporting the web during such passage, each treating unit comprising an impregnating device and a squeezing device alternately positioned in the path of travel of the screen and web, each of said squeezing devices comprising a pair of juxtaposed rolls having resilient surfaces, and means for passing said screen and web after the web is couched in the impregnating device between said resilient surfaced rolls.

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