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MANUFACTURE OF SATURATED FIBROUS PRODUCTS

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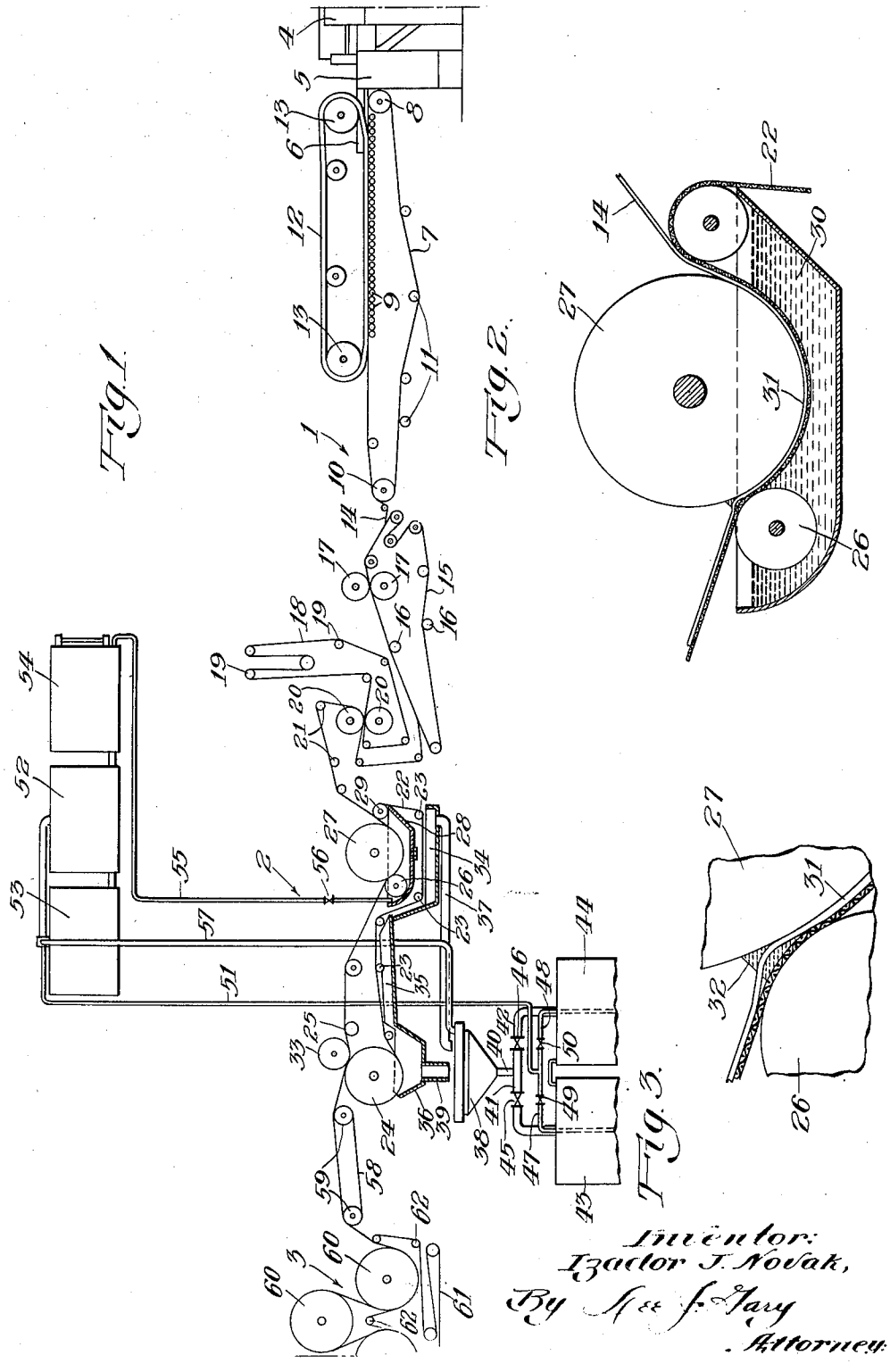


Fig. 1.

Fig. 2.

Fig. 3.

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MANUFACTURE OF SATURATED FIBROUS PRODUCTS

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8 Claims. (Cl. 92—40)

This invention relates to the manufacture of saturated fibrous structures, and in one specific embodiment refers to a novel process of felting fibers into a continuous wet web in a paper machine and saturating the newly formed wet web as it is removed from the paper machine and prior to drying thereof by feeding said continuous wet web into contact with a saturating liquid. During saturation the web is swelled or distended by the saturating liquid which tends to displace some of the water in the web. As a feature of the invention, during saturation the fibrous web is supported to prevent disintegration of the web and distortion of the original formation imparted to the fibers on the paper machine. Excess saturant is removed from the web by condensation and the condensed saturated web subjected to drying or further treatment.

Substantially all papers or fibrous structures are treated in some manner to fit them for the specific purpose for which they are intended. Thus, stencil boards must be water-proof as must also milk cap board, roofing paper, corrugated box papers; others must be grease-proof as, for example, the lining of certain food bottle caps or pie plates and certain boards must be stiffened to withstand hard usage as, for example, trunk boards, jacquard boards and the like.

Paper, board and other fibrous structures suitable for the purposes mentioned above have substantially all been treated heretofore by incorporating the saturant in the heater during the beating of the pulp or by applying the saturant to the dry paper. In the former case, bindings, waterproofings, grease-proofings and the like are introduced in the beater to the liquid pulp and fixed to the fibers by means of jelly-like substances formed in the beater by suitable chemicals.

Unfortunately, paper pulp will carry only a definite maximum amount of saturant in the beater at best, and any excess of saturant over this amount is merely washed out when the beaten pulp is diluted with water enough to allow it to be filtered out on a fine mesh screen which, of course, is the paper-making process. Inefficiency of treatment is the drawback of beater processes and the saturant is severely limited as to quantity, the losses increasing as the amount of saturant is increased.

In the case wherein dry paper of the ordinary hardness and density is passed through a saturating bath, this is almost entirely limited to coating or surface treating as the pores of the paper are so fine that only perfect liquids can be absorbed, and as is well known, most saturants having binder effect are substantially colloidal and comprise particles or aggregates of appreciable size compared to the size of the pores in the dry paper.

Briefly described, my invention comprises passing a wet fibrous web as it comes from a paper making machine through a saturating bath where the web distends and absorbs saturant, the web being so supported during saturation as to permit this distention to take place while preventing disintegration of the web as such or disturbance of the fibre formation. The saturated web may be couched or pressed as it emerges from the bath, expressing a quantity of its liquid content and, immediately after couching or pressing, said web is free to again distend in the presence of a pool of saturating liquid. The distended fibrous structure or web may then again be couched and condensed, and subsequently dried.

It may be of advantage to a better understanding of the concepts of my invention to describe the present theory of the phenomenon which takes place.

It is known that cellulose fibre is a single elongated cell closed at both ends. When dry, this fibre is collapsed resembling a deflated inner tube of the usual automobile tire. When swollen in water as occurs in the beating of the fibre in a paper beater, the walls of the fibre distend and the inner hollow portion fills with water. On further beating, many of the cells are broken, frayed at the ends or burst between ends and, furthermore, take up water on the inside and outside surfaces in a colloidal condition somewhat similar to the manner in which tanned glue swells in water. When such fibres are brought into intimate contact with the liquid containing, for example, asphalt in emulsion form, as occurs when a wet web containing those swollen, broken fibres is passed through a bath of asphalt emulsion, it will be appreciated that the asphalt emulsion may cover and wet the outside of the swollen fibres and may mix (if the particles of asphalt are small enough) with the water in the interior of the fibre by entering in the fractured walls or ends.

When the water is removed from the web so treated, the individual fibres shrink from their previously inflated condition to the dry shape of a twisted flat ribbon and any asphalt present within the fibre is trapped therein, binding the

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walls together and forming a bond with the asphalt surrounding the outside of the fibre. Furthermore, the fibres shrink and curl in the presence of the asphalt emulsion which is simultaneously losing water and the final effect in the dried sheet is that of a tightly twisted and felted mass of fibres thoroughly bonded together and to some extent, internally reinforced by asphalt.

Of course, it is to be understood that other saturants depending upon their characteristics, whether aqueous solutions, dispersions or emulsions, and the degree of dispersion or particle size, will act in a fashion similar to an asphalt emulsion. For instance, complete penetration of the fibres may be obtained with true solutions and conversely, in the case of relatively coarse emulsions or suspensions, substantially no saturating material will enter the fibre cells. However, the advantages due to the complete contact of the material carried in the aqueous vehicle with the whole external surface of the fiber, and the advantage of the shrinking of the fiber when surrounded by and in close contact with the agent used, is the same in all cases and is one of the distinctive advantages of my process producing greater efficiency in the use of the particular material employed.

In the drawing, Fig. 1 is a diagrammatic side elevational view of an apparatus suitable for carrying out my invention.

Fig. 2 is a diagrammatic, side sectional view of the saturating vat.

Fig. 3 is an enlarged, fragmentary, side elevational view of a pair of osculating rolls illustrating particularly the pool of saturating material maintained adjacent the line of osculation.

Referring in detail to the drawing, Fig. 1 shows an apparatus suitable for carrying out my invention and comprises a paper making section 1, a saturating section 2, and a drying section 3. For purposes of description, the paper making section 1 is illustrated as taking the form of a Fourdrinier machine but it is to be understood that the paper or board to be saturated may be made on any type machine inasmuch as my invention broadly contemplates the saturation of a wet fibrous structure or web of paper regardless of the machine upon which the structure or web is made. Likewise, the drying section 3 is shown and described as an embodiment of a drum type drier, but said section may also take any desired form.

Referring particularly to section 1, 4 indicates a vibrating screen which is adapted to deliver pulp from the beater, not shown, to head box 5. The pulp thus delivered is passed from head box 5 to apron board 6 and is delivered therefrom to endless screen 7 which passes over breast roll 8, table rolls 9, roll 10 and guide rolls 11. Deckle straps 12 passing around rolls 13 may be positioned above the path of travel of screen 7 over table rolls 9.

The pulp thus delivered to screen 7 is relieved of a relatively large quantity of the aqueous vehicle constituting the pulp and a relatively wet fibrous web is deposited upon the screen. When screen 7 returns over roll 10, fibrous web 14 formed upon the screen is stripped therefrom and passed into contact with endless blanket 15 which, in turn, travels over rolls 16. Web 14 in company with blanket 15 passes between press rolls 17 where an additional quantity of water is removed from said web, after which the wet web may be stripped from blanket 15 and brought into contact with a second blanket 18 which travels in endless fashion around guide rolls 19. Web 14 while in contact with blanket 18 passes between press rolls 20 where a further quantity of water may be expressed from said web.

Immediately upon leaving press rolls 20, web 14 is stripped from blanket 18, passed over guide rolls 21 and brought into contact with the flexible endless screen 22. Screen 22 travels in a continuous manner around guide rolls 23, couch roll 24, deflecting roll 25, couch roll 26, and cylinder 27. Cylinder 27 may be mounted immediately above liquid saturant vat 28, the lower portion of said cylinder being adapted to dip into the liquid in said vat. Roll 29 over which screen 22 passes is positioned adjacent cylinder 27 and may be utilized to increase or decrease the tension of screen 22 thereby increasing or decreasing the contacting pressure of screen 22 upon the peripheral surface of cylinder 27.

The mesh of screen 22 varies with the type of saturant and the character of the fibers making up the wet fibrous web. A wire screen is utilized since it is sufficiently porous to permit adequate contact of the saturant and the web. The fineness of the porous carrier screen 22 and the degree of porosity of the surface of the cylinder 27, in general, is varied in substantially the same degree as the carrier belt or screen on a Fourdrinier paper machine or the cylinder mold in a wet machine. For example, fine mesh screening is used for thin or free stocks; relatively thick or slow stocks require coarser screen with larger openings. If desired, the screen 22 may be supplanted by woven fabrics for saturants which are stable and which may be easily washed out of the fabric. Unlike an imperforate surface, which would tend to crush the fibers and disturb their relative formation, the screen tends to preserve the fiber formation.

Web 14, after leaving press rolls 17 and 20, still contains a relatively high percentage of water, which water content may be controlled by increasing or decreasing the number of press units, and will depend upon the degree of saturation desired, the properties of the particular saturating liquid used and the rate of saturation.

After passing over guide rolls 21, the continuous wet web 14 is brought into contact with screen 22 as the latter passes around roll 29. As shown best in Fig. 2, web 14 supported by screen 22 is then passed into bath 30 of saturating liquid, said web being maintained in contact with the peripheral surface of cylinder 27. Cylinder 27 may be of hollow construction and its peripheral surface foraminated whereby the saturating liquid 30 may be freely accessible to both surfaces of the web. It is during this step in my process that wet web 14 distends due to the presence of the saturating liquid as shown best at 31 in Figs. 2 and 3.

Thus, the saturating liquid 30 enters the web and mixes with the water already in the web and in some cases, entering the interior hollow portions of the fibers. This penetration, as has been hereinbefore described, is materially facilitated by the fact that the web is in a relatively wet condition and the fibers are initially distended a predetermined degree. During the distention of the web in the saturating bath while in motion the web as such would normally tend to disintegrate, that is, the fibers would tend to return to pulp form. However, by confining the web between the surface of the cylinder 27 and screen 22, the felted formation of the web is

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preserved and a controlled separation of adjacent fibers merely takes place during distention.

Upon emerging from bath 30, web 14 in its distended state, passes between cylinder 27 and couch roll 26. The web is thus pressed or couched and a quantity of the liquid carried by the web is removed therefrom. However, as has been hereinbefore described, a portion of the saturant is trapped within the web and in some cases, depending upon the character of the saturant used, within the fibres themselves. The couching of the web and the upward motion of the cylinder 27 carrying the saturating liquid in its surface interstices causes a pool 32 of saturating liquid to form adjacent the line of osculation of the cylinder 27 and roll 26, and the web 14 emerging from between said cylinder and roll and thus being relieved of pressure, again tends to distend, this latter distention taking place in the presence of the excess saturating material constituting pool 32. A further quantity of the saturating material is thereby absorbed by the web, the latter being induced into the loose, relatively open fibrous structure. In addition, the weight of pool 32 assists in the clean stripping of the web from the surface of cylinder 27.

Web 14, after being stripped from cylinder 27, is supported by screen 22, passed over deflecting roll 25 and between rolls 33 and 24. During the passage of the web, distention thereof continues to take place and the excess saturating material continues to mix with the loosely bonded fibres constituting the web. In passing over the deflecting roll prior to passing between rolls 24 and 33 a degree of couching takes place due to the change in direction of passage of the web and by contact of the carrier with the deflecting roll. A relatively small quantity of the liquid carried by the web is thus expelled. Immediately subsequent in the passage of the web the same is couched or pressed between rolls 24 and 33, thereby compacting the web and expressing a further predetermined quantity of its contained liquid.

The overflow of liquid 30 from vat 28 and web 14 during its passage from said vat and between rolls 24 and 33, may be caught, respectively, by pans 34, 35 and 36. A pipe 37 may serve to drain pan 34, said pipe conducting the liquid caught in said pan to basin 38. Pan 36 may be provided with a drain pipe 39 which may also discharge into basin 38. Liquid which may drip from web 14 in its passage from vat 28 to rolls 24 and 33 and caught by pan 35, may be carried to either pan 34 or pan 36 inasmuch as pan 35 is sloped in both directions. Basin 38 discharges through pipe 40 into pipes 41 and 42, which connect into tanks 43 and 44 respectively. Valves 45 and 46 are interposed respectively in pipes 41 and 42 whereby the liquid from basin 38 may be directed to either or both tanks 43 and 44. Tanks 43 and 44 may normally contain a bulk supply of saturating material 30 which may be passed therefrom by suitable means such as pumps or the like, not shown, through pipes 47 and 48 which, in turn, connect through valves 49 and 50 respectively into pipe 51. Pipe 51 may connect into the upper portion of overhead tank 52, the lower portion of which may be connected to adjacent tanks 53 and 54. A pipe 55 having control valve 56 may connect into the lower portion of tank 54 and may discharge into vat 28 delivering saturating material 30 into said vat. An overflow pipe 57 may connect into pipe 51, as shown in Fig. 1, and may discharge into basin 38 at its lower end whereby liquid 30 pumped from tanks 43 and 44 through pipe 51 may be returned to tanks 43 and 44 through pipe 57, in the event that liquid is being charged into tanks 52, 53 and 54 at a greater rate than it is being passed therefrom to vat 28.

After web 14 has passed between rolls 24 and 33, it is stripped from roll 33 and carried to conveyor belt 58 which passes in an endless manner around spaced rolls 59. After leaving conveyor 58 web 14 is passed to drier section 3 which, for purposes of description, is shown as an embodiment of a drum type drier comprising the usual head drums 60 around which web 14 passes. The usual drier felt 61 which passes over guide rolls 62 may or may not be used as desired.

Web 14 when dried, partakes of the characteristics of the saturant used with respect to its waterproofness or water resistance, its greaseproofness or the like, inasmuch as the fibres which constitute the web are bonded together, externally and in some instances, internally coated with the saturant absorbed or induced into the web during its distention in the presence of the saturating liquid.

Among the advantages of my invention may be mentioned, more complete coating and wetting of the fibres at their maximum surface extension than in processes heretofore used; shrinking of the fibres in contact with a partly mobile saturant while the latter is still incompletely dried, and the elimination of loss of treating material, since substantially all of the saturant which remains in the web on leaving roll 33 is retained therein after the web is dried.

(1) Sodium silicate in concentration sufficient to leave 10% to 20% solids in the fibrous stock may be saturated into a moderately refined kraft web. The concentration of the saturant may be, for example, 20% solids. The wet web enters the saturant with a water content of say 60% and leaves the condensing roll at a wetness of 70%, the wetness now comprising silicate in addition to water. The saturant is contained in the web in somewhat greater percent than evidenced by the difference in wet percentages shown above due to some substitution of saturant for primary water content but for any given set of conditions the percent solids in the finished web may be held quite constant. The saturated web containing sodium silicate solution is now passed to the dryers and dried to a moisture content of 10–20% so that the finished sheet will not be too stiff to handle in rolls. It is calendered to a smooth finish and trimmed to width. This sheet in thicknesses of .030'' is suitable for pattern board, jacquard board, stencil board and other paper boards requiring stiffness and hardness. If kept in temper, that is, containing enough moisture (20%) to render it fairly pliable, it may be molded or shaped in various forms which will be retained on thorough drying. For uses where a white board is required, bleached sulphite or white rags may be used instead of kraft as the base, the rags, of course, imparting toughness. A rag paper containing 10% of sodium silicate introduced in this manner is highly suitable for a stiff back for printing and lithographing, advertising cards, filing board (for separating letters in office files), board binding for books and similar uses.

When silicate is introduced into an asbestos web and made up into plied board (either for direct plying of thin sheets or by making up in convolutions on the saturating machine used as a wet machine described above) a stiff strong non-

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combustible sheet may be made which is suitable for uses to which Portland cement-asbestos combinations are now put. Such a board having greater strength and flexibility than the Portland cement-asbestos board may be made lighter for the same uses. Thus thinner and more economical shingles, fireproof partitions, tanks, etc., may be obtained.

(2) Solid or semi-solid hydrocarbon emulsions such as paraffin, asphalt, Montan wax, etc., may be introduced in similar fashion. In this type of saturant where emulsions or suspensions are employed, it is desirable to use one which has only sufficient stability to maintain its emulsified state under the conditions of the saturating machine, so that it will rapidly and thoroughly coalesce when a fibrous stock coated and impregnated with it is subjected to drying under heat. It is not desirable to use too stable an emulsion such as the clay type, as this type while very good under mechanical friction (as in the beater) does not coalesce and cover fibres as thoroughly as a less stable type such as the soap or casein or silicate emulsions. Therefore, by operating under the conditions of this process, it is possible and practical to obtain better and more thorough coverages of the fibres than by beater processes employing asphalt or wax emulsions because of less hindrance to coalescence of the emulsified particles in the presence of less powerful emulsifying agents than heretofore used in hydrocarbon filled or bonded paper. Naturally, the waterproofing properties of the asphalt or wax introduced in this manner may be more powerful. Also, by virtue of the separation of the fibres during the introduction of the emulsion between them and around them, a more thorough and more even distribution of emulsified material is obtained resulting, of course, in a more uniform product and better binder or waterproofing efficiency.

When paraffin is introduced in this manner into a sulphite web in the proportion of about 25% on the finished weight and hard calendered to a thickness of .030 to .033", a paper is produced from which milk caps may be punched, or this paper board may be used for a stock from which picnic plates may be stamped.

With an asphalt emulsion made with sodium silicate, and a base of soft rags, at a thickness of .035", sufficient asphalt may be introduced to produce a satisfactory roofing paper. The asphalt content may be lowered considerably below present practice (70–80% of the total weight) and the product still remain as durable and as curl free as the higher asphalt content roofing. This is obtainable only because of the high degree of uniformity and distribution which is characteristic of this process as against hot saturation of asphalt into dry felt, or introduction of asphalt emulsion into the beater stock. In the hot saturation it is almost impossible without the use of solvents or a very long heating after saturation to completely cover the fibres in dry felt with less than an asphalt introduction of from 6–7 times as much asphalt as felt. In the beater process the asphalt emulsion tends to clot with the fibres in the beater and quantities materially less than 6 times the weight of dry fibres show non-uniform distribution. By this present process any quantity small or large, may be introduced with greater uniformity than with either of the above processes, and proportions of from 25% asphalt and 75% fibre to 50% asphalt and 50% fibre on the basis of weight, give excellent roofing materials.

With a similar asphalt emulsion and a base stock of old news or wood pulp, a plied board (wet machine type) thickness .065", asphalt content 20% to 40% may be made which is highly satisfactory for the so called automobile panel board, used under automobile upholstering.

In the two types discussed above the first shows the use of aqueous colloidal solutions exemplified by sodium silicate. Other saturants of this type may be: starch solution, casein solution, glue solution, dextrin solution, ammonium alginate, alkaline phenol resin, viscose solution, and others similarly colloidally soluble in water.

In the second type other saturating materials may be aqueous dispersions or emulsions of other normally water insoluble organic or inorganic substances such as: drying oils, vegetable waxes, mineral waxes, varnish gums, coal tar pitches, stearin pitch, etc. Also naturally occurring emulsions of the type of rubber latex may be used. Fine solutions of modifying agents are of course included, such as sodium tungstate, ammonium phosphate, glucose etc.

It will be appreciated that all these saturating materials should be used in as mobile a condition as possible, at the same time operating so as to prevent undesirable deposits of solid materials on the saturating machine carrier and rolls, and various expedients may be introduced for each saturant according to its characteristics. Thus glue solutions when concentrated should be heated for lowered viscosity below 160° F., ammonia casein solutions should be heated to thin them and loss of ammonia prevented or additional ammonia regularly added, rubber latex should be stabilized against mechanical coagulation and protected from substances in the paper web which might tend to coaguate it by suitable anti-coagulants, viscose solutions should be kept very cold, and emulsion of oils, etc., selected which do not too rapidly break down under pressure.

I claim as my invention:

1. In the manufacture of saturated fibrous structures for use in products requiring water- or grease-resistance wherein fibrous pulp in an aqueous vehicle is formed into a continuous relatively wet web, capable of distention in the presence of excess added liquid, on a paper making machine and removed from the latter, the improvement which comprises passing said continuous wet web removed from the paper making machine through a bath of saturating liquid whereby the web distends and the fibers thereof absorb saturant, preventing disintegration of the web or disturbance of the original fiber formation by supporting the web during saturation in contact with a porous screen, pressing said distended web to remove a predetermined quantity of liquid therefrom, causing said web to again distend in the presence of an excess of saturating liquid, finally condensing said saturated web to remove all excess liquid and recovering the saturated, condensed web.

2. In the manufacture of saturated fibrous structures for use in products requiring water- or grease-resistance wherein fibrous pulp in an aqueous vehicle is formed into a continuous relatively wet web, capable of distention in the presence of excess added liquid, on a paper making machine and removed from the latter, the improvement which comprises passing said continuous wet web removed from the paper making machine through a bath of saturating liquid whereby the web distends and the fibers thereof absorb saturant, preventing disintegration of the web or disturbance of the original fiber formation by sup-

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porting the web during saturation in contact with a porous screen, couching said web as it emerges from said bath to temporarily compact the same and express liquid therefrom, relieving the pressure upon the web thereby causing the same to again controllably distend, maintaining an excess of said saturating liquid in the presence of said web adjacent the point of second distention, finally condensing said web to express the excess liquid and recovering the saturated, condensed web.

3. In the manufacture of saturated fibrous structures for use in products requiring water- or grease-resistance wherein fibrous pulp in an aqueous vehicle is formed into a continuous relatively wet web, of such a character that it would disintegrate in the presence of excess added liquid if unsupported, on a paper making machine and removed from the latter, the improvement which comprises passing said continuous wet web removed from the paper making machine through a bath of saturating liquid whereby the web distends and the fibers thereof absorb saturant, preventing disintegration of the web or disturbance of the original fiber formation by supporting the web during saturation in contact with a porous screen, couching said web as it emerges from said bath to temporarily compact the same and express liquid therefrom, maintaining a pool of saturant contiguous to the zone of said couching and causing said web to pass through said pool, relieving the pressure upon the web thereby causing the web to again controllably distend in the presence of an excess of said saturating liquid, finally condensing said web to express the excess liquid and recovering the saturated, condensed web.

4. In the manufacture of saturated fibrous structures for use in products requiring water or grease-resistance wherein fibrous pulp in an aqueous vehicle is formed into a self-sustaining continuous wet web, capable of distention in the presence of excess added liquid, the improvement which comprises confining the wet web between opposed foraminated surfaces without disturbing the fibrous structure thereof, passing the web while so confined through a saturation zone where the web is exposed on both surfaces to an excess of saturant and the saturant passes through the web, releasing the web from said confinement while continuing to support the web on one of said foraminated surfaces to prevent disintegration of the web or disturbance of the fiber formation thereof, maintaining an excess of said saturant in contact with said web immediately adjacent the zone of release from said confinement, whereby the web distends and the fibers absorb the saturant, carrying said distended web on said screen surface after release from said confined zone for a distance sufficient to secure effiecient absorption of the saturant by the fibers, then subjecting the web to mechanical pressure to remove all excess liquid and make the web self-sustaining, removing the web from the foraminated carrier and recovering the saturated, condensed web.

5. In the manufacture of saturated fibrous structures for use in products requiring water or grease-resistance wherein fibrous pulp in an aqueous vehicle is formed into a self-sustaining continuous wet web of such a character that it would disintegrate in the presence of excess added liquid if unsupported, the improvement which comprises confining the wet web between opposed foraminated surfaces without disturbing the fibrous structure thereof, passing the web while so confined through a saturation zone where the web is exposed on both surfaces to an excess of saturant and the saturant passes through the web, releasing the web from said confinement while continuing to support the web on one of said foraminated surfaces to prevent disintegration of the web or disturbance of the fiber formation thereof, maintaining a pool of said saturant in contact with said web contiguous to the zone of release from said confinement, whereby the web distends and the fibers absorb the saturant, carrying said distended web on said screen surface after release from said confined zone for a distance sufficient to secure efficient absorption of the saturant by the fibers, then condensing the web by mechanical pressure to reduce its thickness and remove excess liquid while retaining the original fiber alignment thereof, removing the web from the foraminated carrier and recovering the saturated, condensed web.

6. A process of producing saturated fibrous sheet material which comprises forming a self-sustaining wet felted fibrous web capable of distention in the presence of excess added liquid, supporting said web on a porous surface and leading the surface while said web is still wet and without disturbing the fibrous structure thereof into a saturation zone where the web is exposed on both surfaces to an excess of saturant, passing the surface through said zone, protecting the web against disintegration of the fibrous structure by confining the same between said porous surface and a second porous surface, releasing said web from said confinement with said second porous surface while continuing to support the web on said first-mentioned porous surface, simultaneously applying pressure to said web to remove a portion of the excess saturant, maintaining a pool of saturant contiguous to the zone of release from said confinement and causing said web to pass through said pool, leading said web while supported on said porous surface away from the zone of confinement whereby to permit the web to swell or distend and the fibers thereof to absorb said saturant without disturbing the fiber formation thereof, thereafter subjecting the web to pressure to remove all excess liquid and restore the web to a self-sustaining condition, removing the web from the porous support and recovering the condensed saturated web.

7. A process of producing saturated fibrous structures which comprises leading a felted fibrous web, of such a character that it would disintegrate in the presence of excess added liquid if unsupported, while still wet from its formation step and without disturbing the fibrous structure thereof into a bath of saturant while confining the same between opposed foraminated synchronously moving surfaces which protect the web from structural disruption by the saturant, passing said web while so confined through said bath, removing said web from said confinement while simultaneously applying pressure thereto to remove some of the surplus saturant, causing said web to pass through a pool of saturant maintained contiguous to the zone of release from said confinement, leading the web while supported on one of said foraminated surfaces away from the bath of saturant whereby the web swells and distends and the saturant is absorbed by the fibers, thereafter subjecting the web to mechanical pressure to remove excess saturant and to condense the web, removing the web from the

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foraminated surface and recovering the saturated condensed web.

8. A process of producing saturated fibrous sheet material which comprises forming a self-sustaining wet felted fibrous web capable of distention in the presence of excess added liquid, supporting said web on a porous surface and leading the surface while said web is still wet and without disturbing the fibrous structure thereof into a saturation zone, including a bath of saturant, passing the porous surface through said zone, confining the web while passing through said bath between said porous surface and a second porous surface to protect the web against disintegration of the fibrous structure, releasing the web from said confinement on emergence from the bath while still supporting the web on one of said porous surfaces and while maintaining a pool of saturant contiguous to the zone of release from said confinement through which the web passes, whereby the web distends or swells and the fibers absorb the saturant, thereafter condensing the web to remove excess saturant and restore the web to a self-sustaining condition, removing the web from said porous surface and recovering the saturated condensed web.

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