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(54) Improved method and apparatus for pressure saturation of substrate

(57) In the patented Menser apparatus for saturating a substrate with a liquid saturant, or resin, by conveying the substrate through a resin chamber, the invention improvement is disclosed whereby the apparatus is modified by the installation within the chamber of a separation means, such as a bar, to redefine the path of the substrate through the chamber filled with liquid saturant. Rather than having the substrate pass through the chamber following the path defined by the periphery of the lower portion of the circumferential surface of a mandrel and only being directly contacted by the liquid saturant on one side of the substrate, the redefined path creates a separation of the substrate from said periphery thereby permitting the liquid saturant to contact the substrate on opposing sides to achieve optimum saturation of the substrate by the liquid saturant in volume and uniformity. Inasmuch as the geometric principles which cause an increase in pressure within the chamber as the substrate travels from its entrance into the chamber to its exit, the benefits in saturation provided by such pressure increase are enhanced by the invention as, by the invention modification, they are received on opposing surfaces of the substrate.

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Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to an improved method and apparatus for pressure saturation of kraft paper with a resin. More particularly, this invention relates to an improvement in the method and apparatus for pressure saturation of a substrate as taught in U.S. Patent No. 4,588,616, published May 13, 1986.

2. Description of the Prior Art

A porous substrate material, such as paper, can be impregnated with one or more of various solids in a saturant solution to form a product which has greatly increased utility compared to untreated substrate. In particular, a substrate, such as kraft paper, impregnated with phenolic resin, which is a thermosetting resin, can be used to produce decorative laminate construction materials which are similar in form and properties to the product sold under the trademark "Formica". The use of inexpensive precursors, such as paper and the chemical additives to form such products, provides a significant cost or performance advantage over the use of more expensive materials, such as plastic, wood, or metal. The advantages gained from the relative accessibility and low expense of the raw materials, however, are diminished by the relative inefficiency and expense of the impregnation apparatus and process employed in their manufacture.

The process itself involves subjecting a substrate to a normally heated saturant solution to coat the fibers of the substrate with the saturant, and/or to replace the air contained in the interstices of the substrate with the saturant material. With the saturant in place, the carrier, which may be water or another appropriate medium, for example, methanol, then evaporates, leaving the fibers encapsulated by the saturant material. Many interrelated factors combine to influence the end product. For the substrate, the composition and thickness of the material are important. For the saturant solution, the composition, temperature, viscosity, and relative pressure are important. For the process itself, the design of the saturating apparatus and the speed at which the process is carried out are important.

U.S. Patent Number No. 4,588,616 to Menser teaches a substrate saturation which appears to provide the optimum saturation mechanism for efficiency of saturation, thereby reducing manufacturing costs. In FIG. 1, representative of the patented Menser saturator (and applicable to the improvement herein) there is shown a central mandrel **1** interposed between separate conveying means, such as side rollers **2** and **3**, the rollers and the mandrel being rotatably mounted at each end thereof. The rollers **2** and **3** function as conveyors and, in operation, the substrate **4**, or web, passes over roller **2**, under the mandrel **1**, and over roller **3**, as indicated by the arrows in FIG. 1. A suitable driving system, such as chain drive **5**, shown in phantom in FIG. 1, for example, is used to drive the rollers and the mandrel during operation.

The mandrel **1** is mounted over a block member, such as a saddle block **6**, which extends the length of the mandrel **I** and is adjustable both vertically and transversely. The upper surface of the saddle block **6** is sloping and arcuate, or concave, with a diameter greater than that of the mandrel **1** to allow the mandrel **1** to be received therein, and is graduated from a relatively deep portion to a relatively shallow portion.

FIG. 2, which is representative only of the patented Menser apparatus, shows a plenum-like cavity, or chamber, **7** to be thus formed between the mandrel 16 and the saddle block **6** for receiving the saturant solution. The saturant solution is contained in an external reservoir (not shown) which may be heated and pressurized, if desired, to control certain variables, such as the viscosity of the solution. The saturant solution may either be carried into the chamber **7** along with the substrate **4** through inlet **8**, or it may be pumped in through inlet **9**, as shown in FIG. 2. When inlet **8** is used, the saturant solution enters chamber **7** at atmospheric pressure. Inlet **9** is normally closed, but it is used under certain conditions, such as when the substrate **4** is relatively thick, when the solution has relatively high viscosity, or when high saturation levels are desired at a low speed of the substrate **4**. Under such conditions, additional pressure can be added via a positive displacement pump (not shown) connected through inlet **9** to supply pressurized saturant solution, the pressure supplied being in addition to that developed by the present saturator during operation.

Referring to FIGs. 2 and 3, the chamber **7**, is composed of three regions that are in fluid contact with each other. The first region is entry region **10**, which defines the largest portion of the chamber into which it is preferred that inlet **9** feed. The second region is narrower central region **11**, which is in turn in fluid contact with the narrowest exit or outlet region **12**.

Theoretically, the superatmospheric pressure created within the chamber **7** as the substrate travels from its entrance into entry region **10** of the chamber to its exit therefrom via exit region **12** due to the sloping and arcuate upper surface of the saddle block **6** (and possibly enhanced by use of a positive displacement pump to supply the saturant) should result in resin incorporation to levels approaching 100% of the void volume of the substrate. In commercial practice, however, filling 100% of the void volume is uneconomical (due to too much or too dilute resin). In addition, resin distribution is not uniform.

As a result of these and other shortcomings, a modified Menser apparatus was disclosed at the 1994 Plastic Laminates Symposium held in Atlanta, Georgia, on August 22-25, 1994 and published in symposium *Proceedings* by TAPPI PRESS (1994). The modification improvements amount to fine-tuning in conjunction with pilot scale testing and do not represent fundamental change in the earlier technology. One modification, for example, involved the etching onto the circumferential surface of the mandrel of a cross-hatching pattern to provide a pathway for removal of the air displaced from the substrate voids by the saturation of the saturant. As the mandrel leaves the resin chamber, the removed air is vented. The modified Menser apparatus includes no modifications related to the central mandrel which affects the patented path of the substrate maintaining contact with the lower portion of the circumferential surface of the mandrel through the resin chamber.

The basic concept of the patented apparatus is to apply, under pressure, resin (or any liquid saturant) to one side of a moving web of paper (or other porous substrate) which wraps around a turning mandrel positioned either adjacent to a conveying roller or between two conveying rollers. The amount of resin the sheet picks up can be controlled, at least to some extent, by varying both the rate of passage of the substrate through the resin bath (chamber **7**) and the pressure in the resin bath. Thus, conceptually, this system would have an advantage in applying resin to a wide range of papers or with a wide range of resin viscosities, compared to treaters which did not employ the same technology. In particular, it would appear that higher viscosity resins, higher density sheets, and higher basis weight papers could be successfully treated.

Nevertheless, substrate saturation practitioners have met with problems in its implementation. In particular, this system has not been successful in the phenolic resin treating of Saturating Kraft (paper). The primary reason for the failure is poor resin penetration, *i.e.*, the coating of paper fibers throughout the thickness of the sheet. Typically, the amount of phenolic resin used in producing decorative laminates does not fill all the void volume in a sheet of Saturating Kraft. With the Menser apparatus, once the target amount of resin is applied, the sheet must leave the pressurized resin bath. At this point, all the resin is on the side of the sheet that has been exposed to the resin. There is no driving force for the resin to penetrate throughout the thickness direction of the sheet. Pressure applied during laminate pressing may cause some resin movement, but this movement is generally not enough to ensure adequately uniform distribution of resin throughout the laminate. Without uniform distribution of resin, laminates may blister or delaminate and give other inferior properties.

Therefore, it is an object of this invention to provide an improvement of the patented saturation apparatus and process to effect improvements in the patented process to optimize resin incorporation and permit the saturating equipment's use in the saturation process to achieve its desired ends of efficiency and reliability.

Various other objects and advantages of the present invention will become apparent from the following description, with reference to the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG 1 is a schematic representation, shown partially in cross-section, of the relationship between the central mandrel and support and adjustment structures and the side rollers in both the patented apparatus and process and the improvement herein.

FIG. 2 is an enlarged, fragmentary, side view, shown schematically and partially in cross-section, of the relationship between the central mandrel and the arcuate, sloping upper surface of the saddle block which defines the saturant receiving chamber therebetween in the prior art apparatus.

FIG. 3 is an enlarged, fragmentary, side view, shown schematically and partially in cross-section, of the relationship between the saturant receiving chamber, defined by the central mandrel and the arcuate, sloping upper surface of the saddle block, and the newly directed path of the substrate therethrough caused by routing the substrate over an additional roller positioned within said chamber in the invention apparatus.

FIG. 4 is an enlarged, fragmentary, side view, shown in cross-section, embodiment of the invention apparatus with modified substrate pathway designed for return of the saturant-treated substrate in the same direction as its delivery to the invention apparatus by elimination of one conveying roller.

SUMMARY OF THE INVENTION

The object of the invention is accomplished by the modification of the patented Menser apparatus, whereby the apparatus is modified by the installation within the resin chamber of a bar to redefine the path of the substrate through the chamber filled with liquid saturant. Rather than having the substrate pass through the chamber following the path defined by the periphery of the lower portion of the circumferential surface of the central mandrel and only being directly contacted by the liquid saturant on the one exposed side of the substrate, the redefined path creates a separation of the substrate from said mandrel lower portion periphery thereby permitting the liquid saturant to contact the substrate on both sides (front and back) to achieve optimum saturation of the substrate by the liquid saturant in volume and uniformity. Inasmuch as the geometric principles which cause an increase in pressure within the chamber as the substrate travels from its entrance into the chamber to its exit, the benefits in saturation provided by such pressure increase are enhanced by the invention apparatus, as a result of the invention modification, inasmuch as both sides of the substrate can receive said benefits.

DESCRIPTION OF THE PREFERRED EMBODIMENT(S)

The preferred embodiment of the improved apparatus of this invention is shown in FIGs. 3 and 4, and the preferred embodiment of the improved substrate saturation process of this invention is discussed primarily with reference to FIGs. 3 and 4, as well.

A comparison of the prior art apparatus of FIG. 2 with the invention improvement of FIGs. 3 and 4, respectively, readily shows where the invention lies. The contributions made by the Menser patent teaching and the application of geometric principles to a practical commercial problem are noteworthy.

While the patented apparatus and process display an excellent grasp of the principles of physics and chemistry, it is suggested that problems result from an inadequate consideration of the void volume distribution throughout the sheet thickness. The make-up of a paper web (*i.e.*, primarily fiber type, as well as fiber arrangement and void volume distribution within the sheet) impact resin pickup, which includes both resin saturation and resin penetration (which are different phenomena and involve internal sheet dynamics which are not all compensated for by increasing the pressure of the resin bath). When the saturant is applied to one side of the web, there is no driving force to move it through the sheet thickness to the opposing side. The pressurized resin bath can only act to overcome such internal sheet dynamics to a limited extent.

Since the fibers in a sheet have a fairly constant density, the difference between the apparent density of the sheet and the true density of the fibers is an indication of the volume of air, or voids, in the sheet. This void volume represents the space available for resin impregnation. These voids are the spaces between the network of fibers in the sheet. The optimum saturating process effects coating all the fiber surfaces with resin so that no voids will be left when the saturated sheets are pressed into a panel. The spreading of the resin within the sheet structure depends on capillary forces, whereby the resin enters the pores of the sheet at its surface and displaces the air in the voids.

In the commercial saturating of paper, two processes earlier alluded to occur both simultaneously and sequentially. The first of these is referred to as saturation, which involves the rapid uptake of resin which occurs in the brief interval between the application of the resin and the removal of excess resin at the scraper bar or squeeze roll. Typically, nearly all the resin pickup during the first second or so of the treating fills all pores at the sheet surfaces.

The second process, called penetration, involves the spreading of the resin throughout the sheet. In practice, this process commences when resin is applied to the sheet and continues until the resin is completely immobilized in the press. The penetration process involves the smaller capillaries, or pores. The surface energy is at a minimum when all the finer pores are full of resin. This means that the finer pores will steal resin from the larger pores, and the largest pores end up with merely a coating of resin on the walls. Thus, penetration properties are controlled by the number and size distribution of the finer pores of the sheet (<u>not</u> the saturating equipment). These phenomena must be accounted for in equipment design to optimize the saturating, or treating, process.

The improvement provided by this invention, as shown in the embodiments detailed in FIGs. 3 and 4, is to modify the system (apparatus and process) such that resin is applied under pressure to both sides (surfaces) of the paper web (or other substrate). Several modifications would be required to accomplish this. First, after the substrate or sheet **4**, enters the resin bath or chamber **7**, the sheet run, or path, is changed by having the sheet become separated from the lower circumferential surface of the mandrel **1**, which defines the upper boundary of the resin bath, and pass around a bar which can be stationary but, preferably, is a rotating or turning roller **15** positioned below the mandrel's circumferential surface lower portion. This allows resin to contact opposing sides of the sheet. Then, the sheet would come again in contact with the mandrel circumferential surface before leaving the resin bath. With this modification, when the sheet leaves the resin bath after the target amount of resin has been applied, some resin is on each side of the sheet. Capillary forces provide a driving force for the resin to penetrate through to the center from both sides. An added benefit to the improvement is that even in cases where penetration may not be complete upon treating, with resin on both sides of the sheet, far less resin movement would be required in the press to give uniform resin distribution in the final laminate.

Specifically, an improved saturator for impregnating a substrate is provided which comprises a block member **6** having a first surface, conveying means (**2** and/or **3**) for moving the substrate into and/or out of said saturator, a mandrel **1** rotatably disposed between (or adjacent to at least one of) said conveying means with a selected portion thereof cooperating with the first surface to define a chamber **7** between the first surface and said mandrel portion sized to receive the substrate and cooperating with the conveying means to define a path for moving the substrate through said chamber **7**, and means for supplying a saturant to the chamber, said chamber having a generally converging depth in the direction of travel of the substrate with a relatively deeper entrance region and a relatively shallower exit region for generating a higher pressure in the saturant in the exit region than the entrance region in order to force the saturant into the substrate, wherein the improvement comprises a bar **15** disposed within said chamber **7** and cooperating with the conveying means to redefine the path for conveying the substrate within said chamber **7**, said redefined path creating a separation of the substrate from the mandrel surface.

Preferably, the block member includes sealing means extending therefrom and biased to yieldably contact the mandrel for covering the substrate inlet or entry region (respectively, **8** and **10**), thereby maintaining a positive pressure in said chamber (relative to the pressure external of the chamber). More preferably, sealing means is provided also for covering the outlet or exit region **12** to more effectively maintain the pressure within the chamber. Most preferably, the sealing means also acts to prevent escape of the saturant from the chamber region of the saturator. Finally, the sealing means preferably acts to allow passage of the substrate out of the resin chamber while preventing escape of saturant therefrom, and the exit region is substantially equal in radial width to the thickness of the substrate.

Additionally, the block member should comprise a saddle block and the aforementioned first surface of the block member exhibits a diameter greater than the diameter of the mandrel. In this regard, it is preferable that the mandrel and block are adjustable relative to one another in the radial direction to permit varying the size and shape of the chamber and the size of the chamber outlet.

Preferably also, the conveying means includes at least one roller adjacent to one side of the mandrel or a roller on each side of said mandrel with drive means connecting said roller or rollers to the mandrel for rotation therewith.

To permit introduction of a pre-pressurized saturant into the chamber, there is preferably provided a saturant inlet **9** at a point along the first surface which partially defines said chamber.

It is further preferred that separation means **15** disposed within the chamber be a stationary or rotatable bar, preferably in the form of a roller. Such a roller may take the form of a fixed cylindrical bar fitted with a removable sleeve.

Of course, with the invention modified sheet run, or substrate path, through the resin chamber, a modification is required external to the resin chamber to provide access via a port or panel to allow initial threading of the sheet around the added turning roll. Naturally, the chamber would have to be at least partially drained of resin during the threading operation.

Finally, in view of the closed nature of the positively pressurized resin chamber, it is preferred also to add or augment an air removal system accessed through port **16** to reduce buildup of air in the chamber due to the air displacement from the enhanced penetration of resin in the sheet. In this regard, the improvement of this invention preferably employs a central mandrel **1** which is smooth, rather than cross-hatched, wherein the displaced air resulting from resin saturation of the sheet is retained within chamber **7** for removal through port **16.** Thus, the air removal system can route the air (which is invariably laden with the hydrocarbon resin solvent emissions) through an emission control device, such as a scrubber, or to be consumed as make-up air in the ovens through which the treated substrate is routed to thermoset the applied resin.

The improved process of impregnating a substrate with a liquid saturant employing the above described improved saturator is also disclosed hereby. The improved saturation or treating method comprises introducing the substrate and the liquid saturant into the chamber, rotating the mandrel in the direction of the decreasing depth of the chamber, moving the substrate along the periphery of the lower portion of the circumferential surface of the rotating mandrel at a selected rate which is effective to pressurize the liquid saturant in the chamber and forcing saturant into the substrate to create an impregnated substrate, and withdrawing the impregnated substrate from the chamber through an exit, wherein the improvement comprises moving the substrate through the chamber along a redirected path at least a portion of which is defined by a bar positioned internal of the chamber to create a space between the substrate and the periphery of the mandrel, thus forcing the saturant into the substrate from opposing sides of the substrate and causing uniform saturation of the substrate.

While embodiments of a pressure saturator and several modifications thereof have been shown and described in detail herein, various other changes and modifications may be made without departing from the scope of the present invention.

Claims

1. An improved saturator for impregnating a substrate with a saturant, comprising:

   a. a block member having a first surface;
   b. conveying means for moving the substrate into and out of said saturator;
   c. a mandrel rotatably disposed between said conveying means with a selected portion thereof cooperating with the first surface to define a chamber between the first surface and said mandrel sized to receive the substrate and cooperating with the conveying means to define a path for moving the substrate through said chamber; and
   d. means for supplying a saturant to the chamber, said chamber having a generally converging depth in the direction of travel of the substrate with a relatively deeper entrance region and a relatively shallower exit region for generating a higher pressure in the saturant in the exit region than the entrance region in order to force the saturant into the substrate,

   wherein the improvement comprises a separation means disposed within said chamber and cooperating with the conveying means to redefine the path for conveying the substrate within said chamber, at least a portion of said redefined path creating a separation of the substrate from the mandrel surface.

2. The improved pressure saturator as defined in claim 1 in which said block member includes sealing means extending therefrom and biased to yieldably contact said mandrel for covering said entrance region and maintaining pressure in said

chamber.

3. The improved pressure saturator as defined in claim 2 in which said block member comprises a saddle block, and said first surface has a diameter greater than the diameter of said mandrel.

4. The improved pressure saturator as defined in claim 1 in which said block member includes sealing means extending therefrom and biased to yieldably contact said mandrel for covering said entrance region and exit region and maintaining pressure in said chamber.

5. The improved pressure saturator as defined in claim 1 in which sealing means are yieldably disposed over said entrance region for allowing passage of the substrate into said entrance region and preventing escape of the saturant therefrom.

6. The improved pressure saturator as defined in claim 5 in which additional sealing means are yieldably disposed over said exit region for allowing passage of the substrate out of said chamber and preventing escape of the saturant therefrom, and said exit region is substantially equal in radial width to the thickness of the substrate.

7. The improved pressure saturator as defined in claim 1 in which said conveying means includes a least one roller adjacent to at least one side of said mandrel with drive means connecting said roller to said mandrel for rotation therewith.

8. The improved pressure saturator as defined in claim 7 in which said chamber has an inlet and an outlet with sealing means releasably disposed over said inlet and said outlet for admitting the substrate therethrough and for preventing escape of the saturant from said chamber.

9. The improved pressure saturator as defined in claim 1 wherein the separating means is a bar.

10. The improved pressure saturator as defined in claim 9 wherein the bar is rotatable.

11. The improved pressure saturator as defined in claim 10 wherein the bar is a roller.

12. An improved pressure saturator for impregnating a substrate with a liquid saturant, comprising:

a. a block member having a concave upper surface;
b. conveying means rotatably mounted near each side of said block member for moving the substrate through said saturator;
c. a mandrel rotatably mounted between said conveying means and having an outer circumferential surface, the lower portion of which extends into a recess formed by said concave surface and is spaced to define a chamber therebetween, said mandrel outer circumferential surface lower portion also defining the path of the substrate through the chamber;
e. means for supplying a pressurized liquid saturant to said chamber; and
f. said chamber having an inlet and an outlet and being shaped to converge gradually in depth from a relatively deep entrance region near said inlet to a relatively shallow exit region near said outlet such that rotation of the mandrel further pressurizes the liquid saturant and forces the liquid saturant into the substrate,

wherein the improvement comprises a separation means mounted within said chamber to redefine the path for moving the substrate through said recess, at least a portion of said redefined path resulting in a separation of the substrate from said mandrel circumferential surface lower portion.

13. The improved pressure saturator as defined in claim 12 in which said saturator includes sealing means releasably disposed over said chamber inlet for admitting the substrate therethrough and preventing escape of the saturant from said chamber.

14. The improved pressure saturator as defined in claim 13 in which said saturator includes additional sealing means releasably disposed over said chamber outlet for admitting the substrate therethrough and minimizing escape of the saturant from said chamber, and said outlet is adjustable and is normally substantially equal in radial width to the thickness of the substrate.

15. The improved pressure saturator as defined in claim 14 in which said sealing means extends inwardly from said block member to contact said mandrel.

16. The improved pressure saturator as defined in claim 12 in which said mandrel and block are adjustable relative to one another in the radial direction to vary the size and shape of said chamber and the size of said chamber outlet.

17. The improved pressure saturator as defined in claim 16 in which said conveying means includes a roller on each side of said mandrel with drive means connecting said rollers to said mandrel for rotation therewith.

18. The improved pressure saturator as defined in claim 12 in which said conveying means includes a roller on each side of said mandrel with drive

means connecting said rollers to said mandrel for rotation therewith.

19. The improved pressure saturator as defined in claim 18 in which the sealing means are releasably disposed over said entrance region for allowing passage of the substrate into said entrance region and preventing escape of the saturant therefrom.

20. The improved pressure saturator as defined in claim 19 in which said block member is a saddle block and said upper surface has a diameter greater than the diameter of said mandrel.

21. The improved pressure saturator as defined in claim 12 wherein the mandrel is positioned between two end blocks, and wherein the mandrel is provided with two end seals, each operating to seal a respective end of the mandrel against the associated end block.

22. The improved pressure saturator as defined in claim 12 wherein the separation means is a bar.

23. The improved pressure saturator as defined in claim 22 wherein the bar is rotatable.

24. The improved pressure saturator as defined in claim 23 wherein the bar is a roller.

25. The improved method of impregnating a substrate with a liquid saturant, using a mandrel having a circumferential surface and a peripheral saturant chamber of a generally decreasing radial depth from its entrance to its exit such that the saturant chamber converges in depth from a relatively large depth at its entrance to a relatively smaller depth at its exit, the steps comprising:

a. introducing the substrate and the liquid saturant into the chamber;
b. rotating the mandrel in the direction of the decreasing depth of the chamber;
c. moving the substrate along the periphery of a lower portion of the circumferential surface of said rotating mandrel through said chamber from the entrance to the exit at a selected rate, said selected rate effective to pressurize the liquid saturant in the chamber, thereby forcing saturant into the substrate to create an impregnated substrate; and
d. withdrawing the impregnated substrate from said chamber through said exit;

wherein the improvement comprises a moving the substrate through said chamber along a path at least a portion of which is defined by a separation means positioned internal of the saturant chamber to create a space between the substrate and the periphery of the lower portion of the circumferential surface of said mandrel forcing said saturant into the substrate from opposing sides of said substrate causing more uniform saturation of said substrate.

26. The improved method of claim 25, wherein the liquid saturant is pressurized in a delivery system and is introduced under pressure into the chamber in step (a).

27. The improved method of claim 25, further comprises the step of restricting said entrance and exit to said chamber during step (c) to maintain the pressure developed within said chamber at an elevated level.

28. The improved method of claim 25, further comprising the step of removing excess saturant from the substrate after it emerges from said chamber.

29. The improved method of claim 25, wherein said separation means is a bar.

30. The improved method of claim 29, wherein said bar is rotatable.

31. The improved method of claim 30, wherein said bar is a roller.

FIG.1

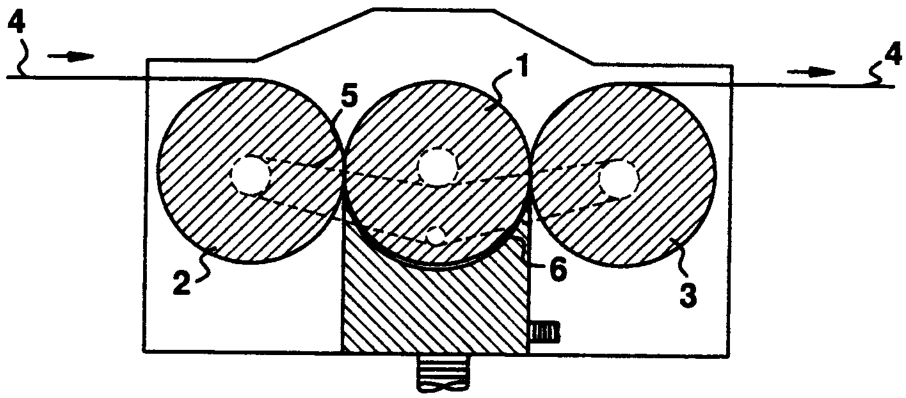


FIG.2

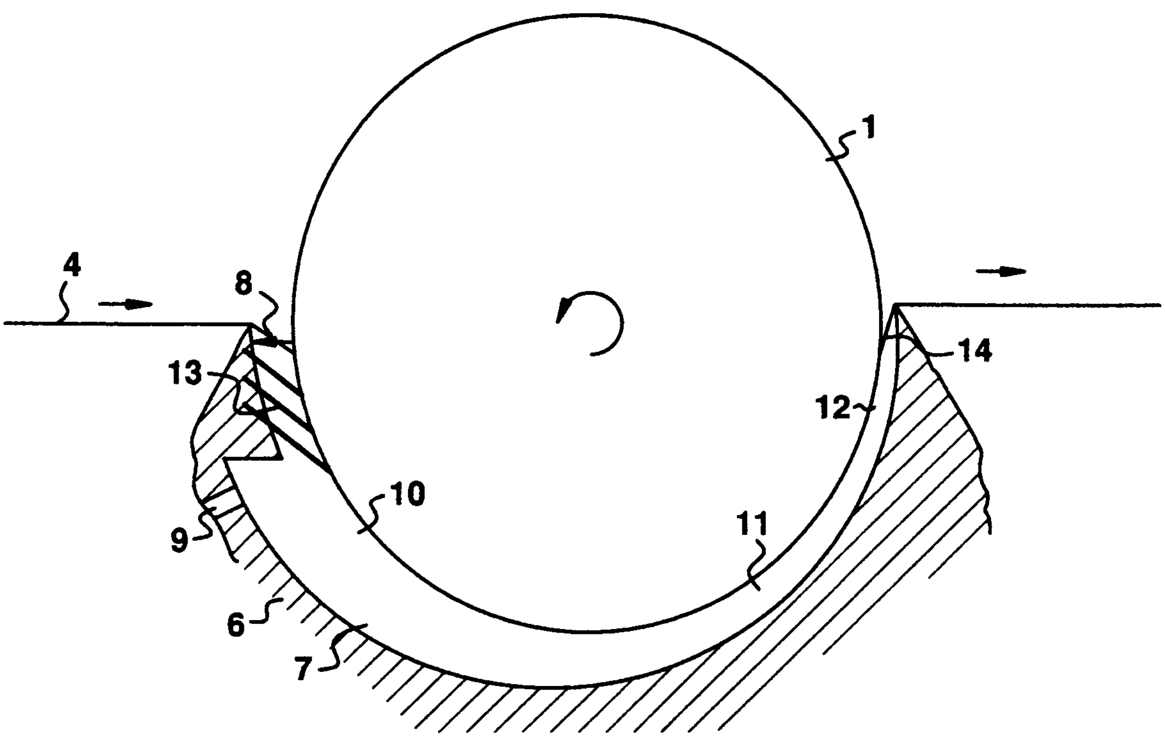


FIG.3

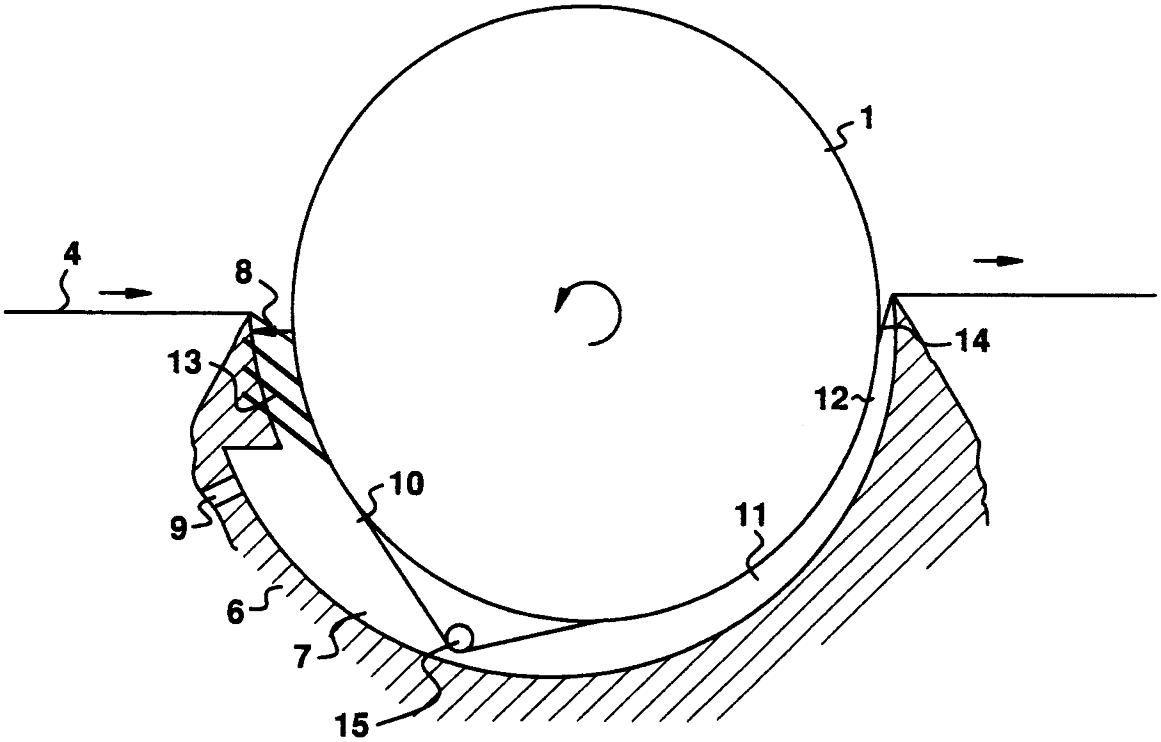
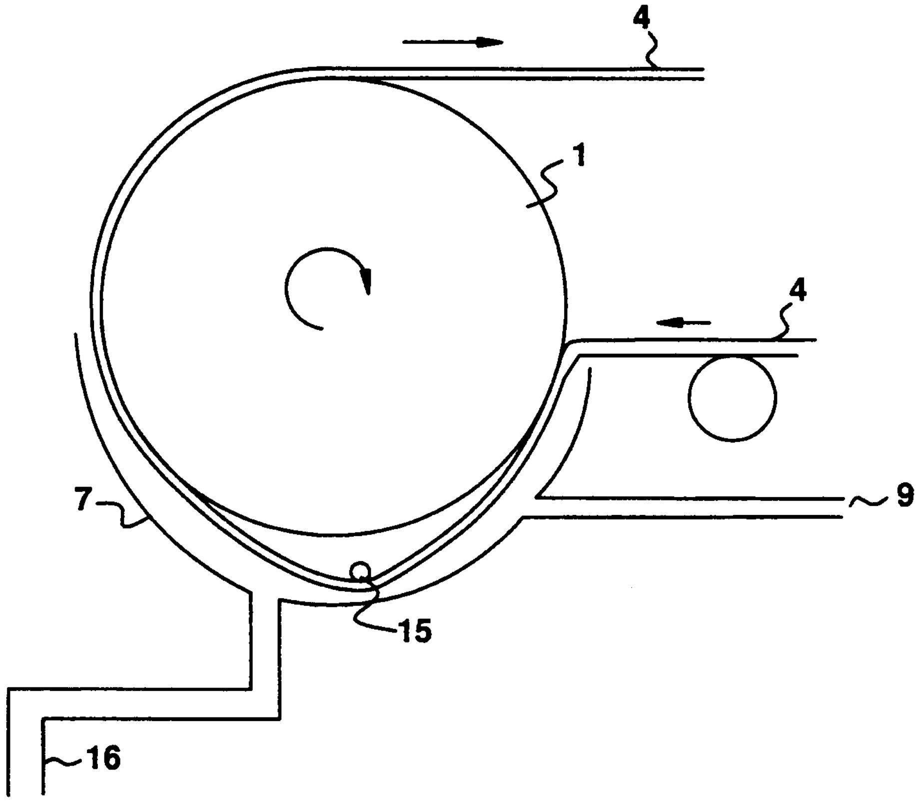


FIG.4



European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 97 30 2678

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
A	US 4 411 216 A (MENSER HOWARD K) 25 October 1983 * the whole document * ---	1-31	D21H23/42 D06B3/20
A	EP 0 640 408 A (BEIERSDORF AG) 1 March 1995 * figure 1 * ---	1-31	
A,D	EP 0 173 519 A (MIPLY EQUIPMENT INC) 5 March 1986 * figures * -----	1-31	

TECHNICAL FIELDS SEARCHED (Int.Cl.6)

D21H
B05C
D06B
B29B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	29 July 1997	Barathe, R

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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