Oct. 5, 1965 HISAYOSHI KUBODERA 3,209,724

COATING APPARATUS

Filed March 6, 1963

Fig. 1.

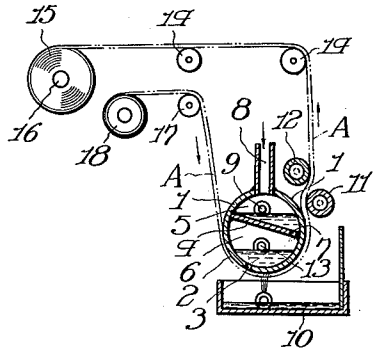
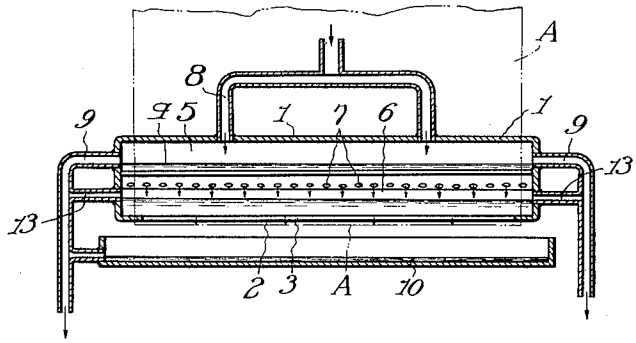


Fig. 2.



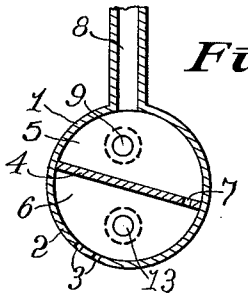


Fig. 1a

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COATING APPARATUS

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2 Claims. (Cl. 118—124)

This invention relates to an apparatus for the continuous homogeneous application of permeating or impregnating fluids to materials from the outer surfaces to the interiors thereof. More particularly, the invention relates to an apparaus for the dispersing of fluids in the form of a gel, sol or colloid such as solutions of synthetic resins, rubber, and similar substances into fibrous materials such as papers and fabrics in long sheet stock sizes.

Briefly stated, the invention contemplates an arrangement whereby one surface of a fibrous material is moved in sliding contact with a fixed slide surface and a solution to be dispersed through the material is discharged from the interior of said slide surface through one or more narrow slits or a large number of small holes and caused to penetrate through the fibrous material, flowing out of the opposite surface thereof. Accordingly, the solution is dispersed homogeneously into all parts of the interior of the fibrous material. Process dependent on coating of both surfaces of the fibrous material and steeping in solution, can be accomplished readily and thoroughly by the apparatus of this invention.

In recent years, all kinds of synthetic resins and similar substances have become numerous, and the field of processes involving the application of solutions of these materials or materials such as papers and fabrics has expanded. However, the solutions formed by dissolving these synthetic resins and like materials in solvents are, for the most part, in the form of gel, sol, or colloid solutions. Consequently, when a fibrous material is steeped in such a dispersoidal solution, the solvent penetrates rapidly in advance even to the parts of the fibrous material which have not yet reached the liquid surface of the steeping liquid and occupies the spaces between the fibers. As a result, the solute cannot permeate into the central part of the fibrous material with the same concentration as the original solution. This phenomenon is not limited to solutions of synthetic resins and like substances but also occurs in the case of various kinds of gel, sol, and colloid liquids. Moreover, it occurs also in the case when the solvent is water.

As a specific example, in the case when a laminated plate material of phenolic resin is to be made, alcohol or a similar liquid is generally used for the solvent of this resin. By conventional methods, however, since the resulting solution is in the form of a gel, sol, or colloid solution, the concentration of the solute, that is, the phenol resin within the impregnated paper or fabric, is not uniform, being lower in the central part than at both outer surfaces of the paper or fabric because of the prior penetration of the solvent. Consequently, the surface of a laminated plate produced by these conventional methods has a laminar structure of high and low concentrations of the solute, and the product unavoidably lacks homogeneity. Accordingly, products of excellent properties such as high strength cannot be obtained by these conventional methods.

In addition, in order to cause a sufficient quantity of the solute to penetrate into the interior of the paper or fabric materials, it is conventional to compress said materials, after being steeped in a solution of high concentration, under a large force by means of squeeze rolls etc. Such method is also deficient in that they cannot produce products with complete homogeneity of material from surface to interior. Moreover, such conventional methods involve steps which are not easy, and the products produced thereby exhibit non-uniformity even when elastic rolls such as rubber rolls are used for compression. Accordingly, by these methods, uniform permeative application of the solute is impossible, and these methods cannot be applied particularly to thin paper and other similar materials.

However, the present invention, differing from the conventional method such as that wherein a traveling sheet of a long fibrous material is merely steeped in the solution in the traveling path thereof or that wherein the solution is applied onto both surfaces of the material, comprises causing the fibrous material to travel in such a manner that one surface of the material is made to slide along a fixed slide surface, discharging a solution from the interior side of the said slide surface through one or more narrow slits or a large number of small holes provided in the said slide surface, and thereby causing this solution to pass through the entire body of the fibrous material from one surface to the opposite surface thereof in such a manner that the solution in its original state, without any change whatsoever in its concentration, is caused to fill and remain in all spaces between the fibers. As necessary, both surfaces of the material so treated are rendered uniformly coated by means such as scraping rolls, and surplus solution is removed. Accordingly, it is possible, thereby, to accomplish permeative application of the solution with extreme uniformity from both surfaces of the fibrous material to the interior central part thereof.

The nature, principle, and details of the invention will be more clearly apparent by reference to the following description of one embodiment of the invention when taken in conjunction with the accompanying drawing in which like parts are designated by like reference characters, and in which:

FIGURE 1 is an end elevational view, in section, showing the essential parts of the embodiment of the apparatus according to the invention;

FIGURE 1*a* shows a portion of the apparatus shown in FIG. 1 but with a slight modification; and

FIGURE 2 is a front elevational view, in section, of the apparatus shown in FIGURE 1.

Referring to FIGURE 1, the principal part of the apparatus is a solution application box **1** having, at its lower outer surface, a slide surface **2** of a form constituting a part of a cylinder. The solution application box **1** is of sufficient length to fully accommodate the width of the fibrous material A to be treated, and the slide surface **2** is provided with narrow slits **3** extending across the transverse distance of the region to contact the entire width of the material A. In some cases, these narrow slits may be substituted by a large number of small holes. The interior of the solution application box **1** is partitioned by a slightly inclined shelf plate **4** into an upper solution-

receiving chamber 5 and a lower solution application chamber 6. The shelf plate 4 is provided at its lower edge, over its entire length, with a row of solution distribution holes 7. The solution application box 1 is further provided with solution supply piping 8 for supplying the solution to the solution-receiving chamber 5 and overflow pipes 9 and 13 for removing surplus solution from the chambers 5 and 6, respectively. The apparatus is further provided with a catch pan 10 disposed below the solution application box 1 and extending over the entire length of the said box in the transverse direction and rolls 11 and 12 disposed to contact the two surfaces of the material A as it travels away from the slide surface 2.

The apparatus of the present invention of the above-described construction has the following operation. The fibrous material A in a long sheet form is caused by a suitable driving device to travel continuously with one surface thereof sliding in contact with the slide surface 2, said driving device consisting of for example, a drum 15 on which said material A is wound, a driving motor (not shown) for driving the shaft 16 of said drum, and guide rollers 14 of a suitable number. On one hand, the solution to be applied is supplied through the piping 8 into the solution-receiving chamber 5 and, temporarily collecting on the shelf plate 4, flows downwardly through the solution distribution holes 7 into the solution application chamber 6 in a uniform manner over the entire length of the said chamber 6 in the transverse direction. Surplus solution in the chambers 5 and 6 are drained off through the overflow pipes 9 and 13, respectively.

The solution which has flowed down into the chamber 6 temporarily collects in this chamber and then is discharged downwardly through the narrow slits 3, whereupon this solution enters the material A through its nearest surface and, passing through the substance of the material A, flows out from the far surface without any change in its concentration. During this process all spaces between the fibers within the body of the fibrous material, from the two surfaces to the central part, are filled with the solution which is of the same concentration as the originally supplied solution, and surplus solution drops into the catch pan 10. Surplus solution which could not be dropped off is spread out by the rolls 11 and 12 evenly over the entire surface of the material A which has separated from the slide surface 2, and any surplus solution still remaining is removed by these rolls.

The material A to be discharged out of the apparatus is, for example, wound on a supply drum 18 and passes over a guide roller 7, said drum being driven by a driving motor (not shown). This motor may be used as the driving motor of the drum 15.

The aforementioned overflow pipe 13 is provided at an intermediate part thereof with a deflectable pipe capable of being deflected freely to a high or low level, whereby the solution depth within the chamber 6 can be regulated so as to regulate the flow rate of the solution discharged to suit the material A being processed.

The fibrous materials which may be treated by the apparatus of this invention have different resistances to the passage of the solution depending on their kind, thickness, and other factors. Furthermore, the solutions also vary in their degree of ease with which they can pass through the material. However, since a meaningless discharge of a large quantity of the solution merely leads to wasteful cost, it is necessary to regulate the flow rate to a appropriate value in each case. The height of the solution level is increased in accordance with the difficulty with which the solution passes through the material, but since the liquid pressure is thereby increased, if the material is simply pulled as indicated in the drawing, the material will adhere to the slide surface and be unable to travel, or there will be the risk of the material being damaged because of its low strength with respect to the liquid pressure. In such cases, a means such as a wire screen capable of traveling together with the material is adapted to press against the material.

Furthermore, the apparatus according to the present invention can be advantageously utilized also in the production of special fibrous products, such as non-woven sheets, for special uses as, for example, a product which requires an interior wherein the fibers are amply bonded with a concentrated adhesive such as a synthetic resin or some other adhesive material and, at the same time, is required to have an outer surface which is fluffy and soft or has high thermal insulating property. That is, to a fibrous sheet formed by causing fibers to be intertwined, an adhesive is permeatively applied by means of the apparatus of this invention and caused to penetrate uniformly into all parts of the sheet, and then only the adhesive on the surface thereof is removed by dissolving. As a result, a special product in which the fibers are firmly bonded in the interior, and the surface has only fibers and is soft is obtained.

Furthermore, the apparatus of the present invention can be advantageously utilized in producing superior products or in developing original products also in the application of solutions of gels, sols, and colloids of cosmetics, dyes, perfumes, insect repellents, fireproofing agents, and numerous other agents to fibrous products.

Although this invention has been described with respect to a particular embodiment thereof, it is not to be so limited as changes and modifications can be made therein which are within the full intended scope of the invention, as defined by the appended claims.

What is claimed is:

1. An apparatus for the continuous permeating application of liquids in gel, sol, and colloid form to elongated sheets of fibrous material workpieces, comprising in combination, an application station having an elongated hollow cylindrical body of more than sufficient length to accommodate the width of the workpiece to be treated, the lower portion of said body forming a fixed slide surface; a shelf plate partition across said cylinder, dividing it into an upper solution receiving chamber and a lower solution application chamber, said partition having across it entire length a flow of solution distribution holes; a supply pipe for supplying solution to said solution receiving chamber; overflow pipes for removing solution from said solution distribution and solution application chambers; an elongated narrow slit located in said lower body portion at the slide surface thereof and extending across the length of said body so as to contact said workpiece and so as to place said liquid in communication with said workpiece; guide roller means above said application station to guide the workpiece around said slide surface in sliding contact therewith; pay-off and take-up means for said workpiece; and, squeeze rollers along the path of travel of said workpiece past said application station disposed to spread out the liquid evenly over said workpiece.

2. An apparatus for the continuous permeating application of liquids in gel, sol, and colloid form to elongated sheets of fibrous material workpieces, comprising in combination, an application station having an elongated hollow cylindrical body of more than sufficient length to accommodate the width of the workpiece to be treated, the lower portion of said body forming a fixed slide surface; a shelf plate partition across said cylinder, dividing it into an upper solution receiving chamber and a lower solution application chamber, said partition having across its entire length a flow of solution distribution holes; a supply pipe for supplying solution to said solution receiving chamber; overflow pipes for removing solution from said solution distribution and solution application chambers; a plurality of elongated narrow slits located in said lower body portion at the slide surface thereof and extending across the length of said body so as to contact said workpiece and so as to place said liquid in communication with said workpiece; guide roller means above said appli-

cation station to guide the workpiece around said slide surface in sliding contact therewith; pay-off and take-up means for said workpiece; and, squeeze rollers along the path of travel of said workpiece past said application station disposed to spread out the liquid evenly over said workpiece.

References Cited by the Examiner

UNITED STATES PATENTS

255,129	3/82	Bancroft	118—124 X
1,361,932	12/20	Van Avermaete	118—410
1,667,408	4/28	Allen	118—415 X
1,773,167	8/30	Bronander	118—124 X
2,309,981	2/43	Randall	118—410
2,833,666	5/58	Neidich	118—415 X

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