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TREATING FABRICS

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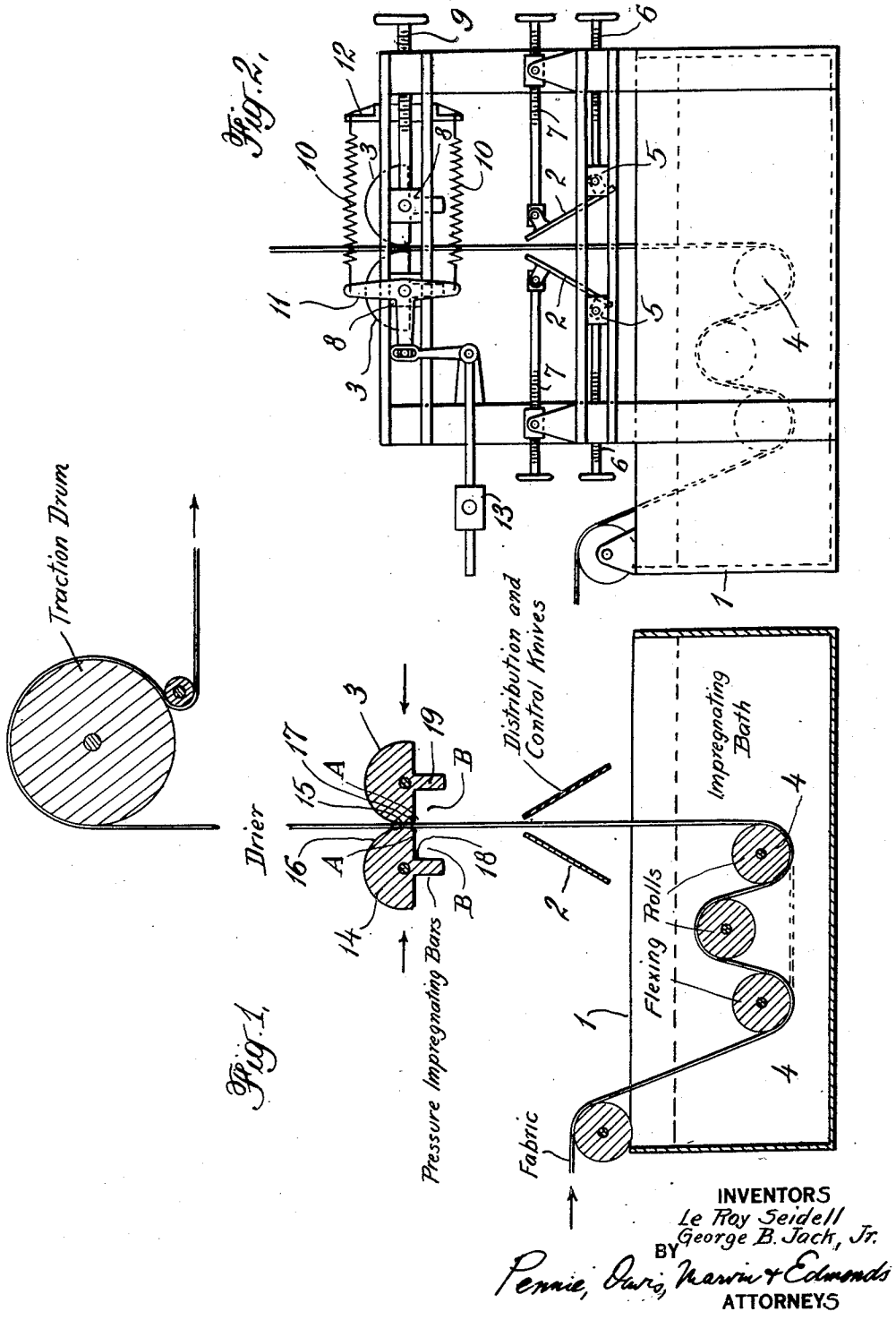

INVENTORS
Le Roy Seidell
George B. Jack, Jr.
BY
Pennie, Davis, Marvin & Edmonds
ATTORNEYS

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UNITED STATES PATENT OFFICE

LE ROY SEIDELL AND GEORGE B. JACK, JR., OF NEW YORK, N. Y., ASSIGNORS, BY MESNE ASSIGNMENTS, TO JATON MANUFACTURING CORPORATION, OF BROOKLYN, NEW YORK, A CORPORATION OF NEW YORK

TREATING FABRICS

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This invention relates to improvements in the impregnation of sheet material, such as fabrics, papers, and the like, with liquid compositions, such as dispersions of pyroxylin or celluloid in volatile solvents. The invention relates particularly to impregnation as distinguished from the mere application of a coating to a base of sheet material, and the invention is of special value and application in connection with the impregnation of sheet material of relatively dense structure and in the impregnation of sheet material with relatively viscous liquids.

Ordinary clean cotton duck can be saturated throughout with, for example, water or dilute aqueous solutions such as a 10% solution of ammonium sulfate by the fairly simple process of immersion. When attempts are made to saturate such material with more viscous liquids, however, such as a dispersion containing a relatively high concentration of cellulose nitrate, the tendency is toward the coating of the surfaces of the material rather than toward thorough saturation. Other factors than the viscosity of the liquid may also be involved. For example, surface tension phenomena or the characteristics of the particular liquid with reference to wetting of the material may also have an important effect. Another factor may be the density or texture of the material, and this is particularly the case with reference to relatively closely woven or felted material, such as certain kinds of paper. Reference is made herein particularly to the treatment of cotton duck because it has been largely in the treatment of that material that the invention has been practically applied up to the present time, and the same is true in connection with the references herein to the use of pyroxylin dispersions. Similar considerations apply, however, in the treatment of other woven or knitted or felted materials and in the use of other liquid compositions, and as will be apparent the invention is useful in other connections.

To secure impregnation, forces such as those due to the viscosity or surface tension of the liquid or to the density or structure of the sheet material must be overcome so that the liquid can be distributed throughout the sheet material or throughout the interstices therein. This, however, is only part of the problem as for practical purposes the impregnation must be both thorough and uniform. Likewise, thorough and uniform impregnation must be capable of accomplishment in an economical manner and best in a way capable of continuous operation. This invention provides an improved method of operation and an improved apparatus whereby sheet materials can be thoroughly and completely impregnated and uniformly impregnated with relatively viscous liquids, or liquids otherwise presenting difficulties such as those discussed above, capable of rapid and continuous production and adapted for efficient and economical operation. By appropriate selection of the impregnating liquid, the invention thus provides an improved method and apparatus for waterproofing or fireproofing, or both fire and waterproofing sheet materials and particularly fabrics such as cotton duck or the like.

This invention will be described particularly with reference to the the accompanying drawings, which illustrate, in a somewhat conventional and diagrammatic manner, an apparatus embodying the invention and adapted for carrying out the process of the invention; but it is intended and will be understood that this detailed description and illustration are for the purpose of exemplification only and that the invention is not limited thereto. Various modifications may be made in the apparatus without departing from the spirit or scope of the invention and the process of the invention can be carried out in other and different apparatus, although there are certain relations between the method and apparatus of the invention as will appear from the following description.

In the drawings:

Fig. 1 is a diagrammatic representation of the operation of the apparatus and of one way of carrying out the process of the invention, and

Fig. 2 is an end view of an apparatus embodying the invention and adapted for carrying out the process of the invention.

In the apparatus illustrated, the fabric or

other sheet material to be treated passes through an impregnating bath 1 thence upwardly first between a pair of distribution and control knives 2 and then between a pair of pressure bars 3. The treatment after passing through the pressure bars will depend largely upon the nature of the sheet material, the character of the impregnating liquid and the characteristics desired in the finished product. In the impregnation of fabrics with pyroxylin dispersions, the material may be drawn through a drier for the removal of solvents, and advantageously without contact with other mechanical elements until thoroughly dried.

In the impregnating bath, the fabric may be flexed while immersed in the liquid to assist in thorough impregnation by being passed over one or more rolls 4 arranged in the bath below the normal liquid level. The fabric, for example, may follow the path shown in full lines or that shown in dotted lines in Fig. 1. The distribution and control knives 2 are arranged at a fixed distance from the path of the fabric to provide control of the amount and distribution of the liquid adhering to the fabric passing between the upper adjacent edges of the knives. To permit treatment of different materials with liquid compositions of different characteristics, both the angle and the distance of the knife edges from the fabric path are made adjustable. The lower parts of the knives are pivoted to and supported on slides 5 which are movable by threaded rods 6 and the upper parts of the knives are pivoted to the adjustment rods 7. The pressure bars 3 are non-rotatably mounted between slides 8. One of these sets of slides is adjustably secured in position by means of adjustment rods 9. The other pressure bar is pressed toward the bar thus fixed in position by means of springs 10. The springs 10 are attached at one end to a yoke 11 secured to the slides supporting the movable pressure bar and at the other end to an adjustable yoke 12. The spring pressure may thus be regulated by adjustment of the yoke 12 toward or away from the normal position of the yoke 11. A pivoted and adjustable counterweight 13 connected to the yoke 11 is also provided to assist in controlling the spring pressure exerted between the pressure bars 3.

To illustrate the operation of the apparatus in impregnation of say cotton duck with a viscous liquid, the impregnating bath may be made up of a mixture in proportions about as follows: 25 gallons of a 20 ounce solution of pyroxylin (e. g. a solution of pyroxylin in a solvent such as ethyl acetate or a mixture of ethyl acetate with ethyl alcohol and benzol containing 20 ounces of pyroxylin per gallon), 5 gallons of tricresylphosphate, 1¼ gallons of ethyl acetate, ¾ gallon of benzol, and ⅜ gallon of methyl alcohol. In passing through the bath, the duck picks up a considerable amount of this liquid. The knives 2 remove a part of the excess and return it to the bath and also distribute in a substantially uniform manner the remaining liquid so that the fabric leaves the upper edges of the knives uniformly coated with substantially uniform layers of the liquid. In passing between the pressure bars, part of the coating layers are squeezed into and through the duck by the pressure exerted by the bars and the remaining excess is returned to the bath. In treating duck, the pressure may amount to say 2 or 3 pounds per linear inch of the pressure bars in contact with the duck, and in treating a duck 22 inches wide and weighing about 13 ounces per linear yard with the solution just described and with these pressures the weight may be increased to something more than about 15 ounces per linear yard. The pressures used may vary from about 1 to 2 pounds per linear inch or less up to 10 to 12 pounds per linear inch or more. In general, with lighter fabrics lower pressures and with heavier fabrics higher pressures are usually employed. After passing through the pressure bars, the impregnated fabric may be drawn through a drier to remove the volatile solvents used, and the impregnating apparatus may be enclosed and this enclosure, as well as the drier, connected to suitable apparatus for the recovery of the volatile solvents employed. The impregnating apparatus may also be enclosed within a chamber in which a pressure of the vapors of the solvents employed is maintained to inhibit or retard vaporization of the solvents therein. To assist impregnation the fabric may be immersed in the solvent or mixture of solvents used in the impregnating bath before being immersed in the bath containing dispersed pyroxylin. The foregoing treatment will render cotton duck substantially waterproof. To render it fire resistant as well, the duck may be immersed in a solution of ammonium sulfate, say an aqueous solution containing about 6 pounds of crystallized ammonium sulfate per gallon maintained at the boiling temperature with immersion for about 2 minutes, and then thoroughly dried prior to the waterproofing treatment.

One of the important features of the invention is the provision of a pressure bar of the cross-section illustrated and arranged as illustrated, and the invention includes this improved pressure bar. To render the bars reversible, they are symmetrically constructed about a plane approximately parallel to the path of the fabric at the point of contact with the bar, but as will be apparent the operating characteristics of the bar depend primarily upon the configuration of that side of the bar arranged toward the fabric or other sheet material. As illustrated, the bars comprise a body por-

tion 14 having a continuous convex edge 15 adapted for engagement with the fabric. On one side of this edge, on the side from which fabric moves away, the surface 16 of the body portion gradually recedes from the fabric path or from a plane tangent to the line of contact on the edge engaging the fabric. A concave recess 18 is arranged in the body portion on the other side of the contact edge connected to the edge by a convex surface 17. In the symmetrical construction shown, a downwardly depending vane is provided at 19. One convenient way to make these pressure bars is to mill them from round steel bars, a 4" round steel bar for example may be used. The surfaces in contact with fabric may advantageously be finished by grinding.

With fabric passing between the pressure bars two successively smaller recesses are provided on opposite sides of the fabric; a larger recess B between the vane 19, the body portion 14 of the bar and the fabric, and a smaller recess A between the fabric and the convex surface 17. With a viscous liquid, the liquid adhering to the fabric is pulled into the zones B where due to its viscosity it forms an inverted pool through which the fabric passes, excess dropping back into the path from the vanes 19. Due to the viscosity of the liquid, there is also a slight increase in pressure in the zones B. As the fabric enters the zones A, however, the viscosity of the liquid is more effective in increasing the pressure due to the smaller cross-section and a further increase in pressure takes place. This pressure then gradually increases as the fabric moves toward the edges 15 contacting with the fabric on opposite sides. An improved impregnation is thus secured, the liquid being actually pushed into and through the fabric. The impregnation is moreover effected in progressive stages with progressive increase in pressure. Sometimes, particularly with highly viscous liquids, a tendency may develop for patches of the liquid on the surface of the fabric to be forced through the pressure bars, but this can readily be controlled and obviated by adjustment of the knives 2 to prevent too great an excess of the liquid passing on with the fabric.

In carrying out the improved method of the invention, the fabric is thus first treated to cause the liquid for impregnation to adhere to it and the fabric with the liquid adhering to it is then passed through a pool of the liquid supplied by excess liquid adhering to the fabric and the fabric while immersed in the liquid is subjected to gradually increasing liquid pressures and finally to actual contact pressure, the liquid thereby being squeezed into and through the fabric and a thorough and uniform impregnation being secured. Some saturation may take place in the initial treatment of the fabric. It is also advantageous to control the amount of and to distribute the liquid adhering to the fabric before the fabric enters the pool of liquid described above. This can advantageously be effected by initially causing an excess of the liquid to adhere to the fabric and by removing a controlled part of this excess. The successive operations making up the complete process of the invention might be carried out as separate disconnected steps, but it will be noted, and it is one of the particular advantages of the process of the present invention, that it is carried out as a continuous and continuously progressive operation. The invention also includes improved means for carrying out the method of the invention as a continuous operation.

The method of the present invention is not claimed in this application but is claimed in a divisional application.

We claim:

1. A pressure bar, for use in apparatus for impregnating sheet material, comprising a body portion having a continuous convex edge adapted for engagement with sheet material moving thereover, the surface of the body portion on one side of said edge gradually receding from a plane tangent to the normal line of contact on said edge, a concavity in the body portion on the other side of said edge concave with respect to said convex edge, and a convex surface on the body portion connecting the said concavity and the said convex edge.

2. In apparatus for impregnating sheet material, a pair of oppositely arranged pressure bars and means for pressing the bars together, said pressure bars comprising body portions having continuous convex edges adapted for engagement with opposite sides of sheet material moving between the bars with the surfaces of the body portions on one side of said edges mutually receding from each other and with concavities in the body portions on the other side of said edges connected to the said edges by convex surfaces.

3. In apparatus for impregnating sheet material, a pair of oppositely arranged pressure bars spring pressed together, said pressure bars comprising body portions having continuous convex edges adapted for engagement with opposite sides of sheet material moving between the bars with the surfaces of the body portions on one side of said edges mutually receding from each other and with concavities in the body portions on the other side of said edges connected to the said edges by convex surfaces.

4. In combination, in apparatus for impregnating sheet material, a pair of doctor blades and a pair of pressure bars, means adapted for causing sheet material to pass successively between the doctor blades and the pressure bars, means for maintaining the

edges of the doctor blades at a fixed distance away from opposite surfaces of sheet material moving between the doctor blades, means for preventing rotation of the pressure bars, and means for exerting a substantially constant force on each of said pressure bars in the direction of the other, said pressure bars comprising body portions having continuous convex edges adapted for engagement with opposite sides of sheet material moving between the bars with the surfaces of the body portions on one side of said edges mutually receding from each other and with concavities in the body portions on the other side of said edges connected to the said edges by convex surfaces.

5. In combination, in apparatus for impregnating sheet material, a pair of doctor blades and a pair of pressure bars, means adapted for causing sheet material to pass successively between the doctor blades and the pressure bars, means for maintaining the edges of the doctor blades at a fixed distance away from opposite surfaces of sheet material moving between the doctor blades, means for preventing rotation of the pressure bars and means for exerting a substantially constant force on each of said pressure bars in the direction of the other, said pressure bars having edges adapted for engagement with opposite surfaces of sheet material moving between the pressure bars and having arranged toward the said knives from the said edges pairs of successive recesses of successively smaller cross-section generally parallel to the said edges.

In testimony whereof we affix our signatures.

LE ROY SEIDELL.
GEORGE B. JACK, JR.