

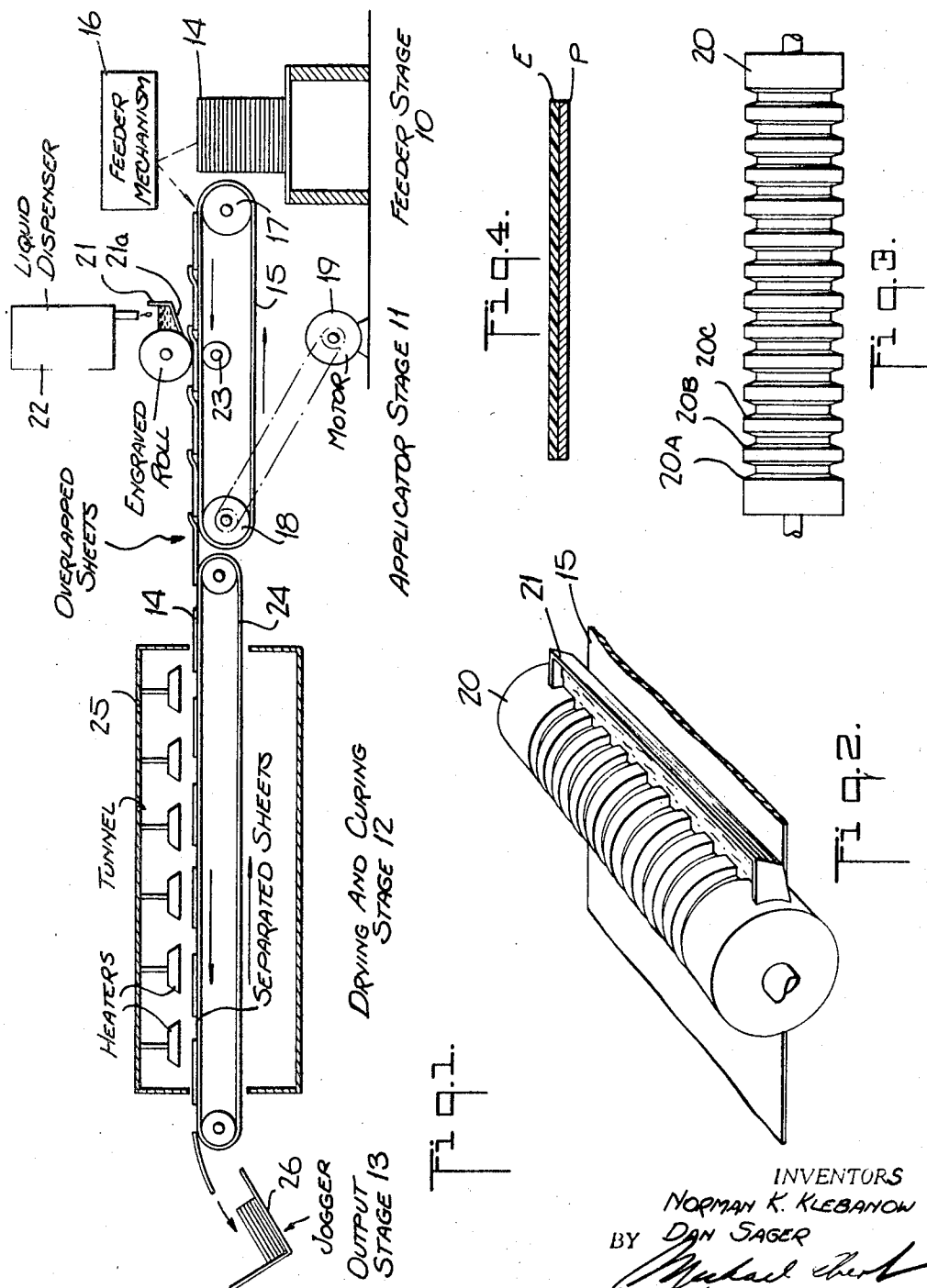
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APPARATUS FOR COATING AND CURING EPOXY RESIN ON SHEETS

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APPARATUS FOR COATING AND CURING EPOXY RESIN ON SHEETS

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5 Claims

ABSTRACT OF THE DISCLOSURE

A technique for epoxy coating paper and cloth surfaces such as dust jackets, book covers, and the like, wherein the printed sheets are fed onto a continuous conveyor and advanced thereby under an engraved roll having an epoxy solution applied thereto, the roll laying down a raised pattern of the solution on the printed face of the sheets, which pattern levels off and merges to form an evenly distributed wet coating, the wet coated sheets thereafter being dried and cured.

This invention relates generally to paper and cloth coating techniques, and more particularly to apparatus for applying a clear epoxy coating to a dust jacket or to a book cover.

Hard-cover books are generally provided with a removable paper dust jacket which serves to protect the relatively expensive stiff binding. While the dust jacket may ultimately be discarded, its form and appearance are commercially significant, for when the book is displayed it is only the dust jacket which is visible to the potential purchaser. An attractive jacket constitutes an important factor in inducing a sale; consequently, book publishers exercise great care in jacket design.

In recent years, the sale of low-cost paperback books has risen to such dimensions that one often speaks of the paperback revolution. The durability of such books depends to a large degree on the quality and strength of the soft cover, whereas the salability of these books is greatly influenced by the appearance of the printed soft cover, for no dust jacket is provided.

Paper of the type ordinarily used for dust jackets or for paperback covers has a somewhat dull finish. Also, the surface of such paper is easily scuffed or otherwise mutilated. It has therefore been the practice to coat the printed face of the paper with a clear top coating, such as oleo-resinous varnish which not only improves its scuff resistance, but also imparts some degree of luster or gloss thereto. However, varnish coatings have a relatively short life and they adversely affect the color print. The main virtue of varnish coatings is that they can be applied at low cost. Also, varnish coatings whether of the press or spirit type tend to yellow with age and they impart only limited scuff resistance to the paper or cloth base.

Attempts have also been made to used cellulosic rather than varnish coatings, but these plastic coatings have certain drawbacks, for they are necessarily thin and do not give the paper good body. Moreover, not only do cellulose acetate and other cellulosic coatings yellow with age, but the plasticizers commonly used therewith tend either to evaporate or to migrate into the paper, thereby embrittling the coating and further degrading this product.

An alternative approach which produces a high-quality product, is to bond a transparent plastic film to the paper jacket or cover. While the resultant laminated cover has excellent scuff resistance and good appearance, there are a number of serious practical disadvantages to the techniques involved. First, there is the matter of cost, for plastic

film of good quality, such as vinyl or Mylar, is expensive, in the order of one dollar a pound and higher. Even the clear adhesive for bonding the film to the paper is costly, the adhesive running as much as fifty cents a pound.

Also, the laminating technique is difficult, time-consuming and costly from the labor standpoint, for the paper sheets must be fed sequentially into combining rolls where they are laminated with liquid adhesive to a continuous web of film, the combination then being wound on a take-up roll. In some cases, several hours are necessary to allow the adhesive to dry, after which the combined web is unwound and the laminated sheets cut therefrom.

Accordingly, it is the main object of this invention to provide a technique for applying an epoxy coating onto a paper cover jacket or other printed paper or cloth surface, which coating imparts a high degree of scuff resistance to the surface, the resultant product having good body and an attractive appearance.

A salient feature of the invention is that the technique is comparable in cost to conventional paper-varnishing, and yet the product is comparable in quality to that heretofore attained only by plastic film lamination. Also the epoxy coating may serve to enhance the gloss of the paper, although it is possible by the use of additives to reduce the glossiness of the surface when a less shiny effect is required.

More specifically, it is an object of the invention to provide a technique for applying a relatively heavy and uniform coating of an epoxy solution onto sequentially fed sheets of paper, the wet coating being quickly dried and cured to form a clear, smooth adherent film on the paper which is highly flexible and crack-free.

Briefly stated, these objects are accomplished in a system wherein sheets of paper or other materials are fed in succession onto a conveyor belt which conducts them under an engraved roller to which is applied an epoxy solution, the solution being picked up by the roller and being laid down on the sheet in a raised, wet pattern pattern which complements the engraved roll pattern, the wet pattern leveling off and merging to form a uniform coating on the sheet, the wet, coated sheets then entering a treatment tunnel wherein the coating is subjected to infra-red radiation or heated air to effect drying and curing thereof, after which the coated sheets are collected in a jogger.

For a better understanding of the invention, as well as other objects and further features thereof, references is made to the following detailed description to be read in conjunction with the accompanying drawing, wherein:

FIG. 1 schematically shows a system in accordance with the invention;

FIG. 2 separately shows the applicator stage of the system;

FIG. 3 is a view of the profile of the engraved roller; and

FIG. 4 is a section taken through the epoxy-coated paper.

The term "epoxy resins" covers a group of resins ranging from brittle solids to low-viscosity liquids made by the reaction of bisphenol and epichlorohydrin. The epoxies are linear copolymers that can cross-link to form thermosetting resins by reaction with amine type compounds. The manufacture of surface coatings was one of the first and continues as one of the largest uses of epoxy resins, for these coatings combine the properties of toughness, flexibility, adhesion and chemical resistance to a degree not found in other coating materials.

The present invention is concerned with epoxy resins used in solution with certain compatible phenolic or urea resins. These blends are heat-convertible and form copolymers or condensates to produce extremely tough, durable

and flexible films with excellent resistance to solvents and chemicals. While it has been known to use such resins as lining materials for tanks and cans as well as hardware finishes, it has not heretofore been feasible to coat paper therewith. Spraying and dipping techniques, while suitable for linings and finishes, are not feasible with paper or other sheets. While the present invention will be described in connection with paper sheets, it is to be understood that it is equally applicable to sheets formed of woven or non-woven materials which are printable.

Application of an organic coating to sheets resolves itself principally into a method of applying a smooth, wet film of a uniform, controlled thickness to a web or sheet of the paper or other material. Various machines are currently available for this purpose in connection with vinyl dispersions and other organic materials, including the reverse-roll coater and the contracreater, both of which involve the use of a metering or doctor roll whose position with respect to a transfer roll determines the thickness of the liquid applied to the sheet.

Conventional applicators are not suitable for liquid epoxies, for the liquid when exposed, has a relatively short life, and with conventional coaters there is a build-up of liquid at the metering roll, as a result of which some of the liquid is stale and undergoes a reaction before reaching the paper. Moreover, it is difficult with conventional roller coatings to control the thickness of viscous epoxy solutions applied to paper sheets.

Referring now to FIG. 1, there is shown a system in accordance with the invention, comprising a paper feeder stage 10, a liquid applicator stage 11, a drying and curing stage 12, and an output stage 13. In the feeder stage, a stack of paper sheets 14 is supported on a platform and is transferred one by one from the stack onto the input feed of an endless conveyor belt 15, formed by a broad web, by means of a feeder mechanism 16. The web may be of fabric screen or any other suitable design. The feeder mechanism may be of the standard vacuum or mechanical finger type. The paper sheets are printed with an appropriate cover design. In practice, each sheet may contain several design impressions and after the sheets are epoxy-coated, they are cut into individual soft cover dust jackets or other individual units.

Conveyor belt 15 is supported between end rollers 17 and 18, roller 18 being driven by a motor 19 whereby the sheets 14 fed thereon are sequentially advanced toward an applicator roll 20 which is supported for rotation above the belt and is transversely disposed with respect thereto. The rate at which the feeder mechanism places sheets on the conveyor belt relative to the speed of the moving belt is made such that sheets 14 are marginally overlapped rather than separated on the belt. This is important, for by such overlap the engraved roll which applies a solution to the face of the sheets effectively sees an uninterrupted paper surface, as a consequence of which no liquid is applied to the belt surface, and the belt remains clean. In a practical embodiment, a belt speed of 10,000 feet per hour has been used, although the invention is by no means limited to this particular rate.

As shown separately in FIGS. 2 and 3, the surface of the roll except for the end portions thereof, is engraved to define a series of equi-spaced annular channels 20A, 20B, 20C, etc., thereacross. This engraving may be effected by known mechanical or chemical etching techniques in a steel roll or a roll of any other suitable material non-reactive with the solution being used.

The epoxy solution preferably is applied to roll 20 by means of a fountain trough 21, the trough being provided with a doctor blade 21A which engages the periphery of the roll so that the solution is admitted only into the engraved annular channels and not on the surface of roll 20. The trough extends across the engraved portions of the roll and a little beyond at each end of the engraved portion, so that the ends of the trough overlap the non-

engraved portions of the roll, thereby preventing leakage of the solution. The position of the doctor blade 21A is adjacent the point at which the advancing paper enters the nip of the engraved roll 20, so that the solution has a very limited exposure before being laid down on the paper surface, thereby minimizing drying effects.

The epoxy solution is dispensed into the trough from a suitable pump metering system 22, the amount of solution fed into the trough being regulated as a function of epoxy take-up by the paper sheets, so that only a small reservoir is built up in the trough, which reservoir is continuously being depleted in the course of coating and is continuously being replenished. This is important in order to avoid an excessive build-up of solution in the reservoir.

Alternatively, the epoxy solution may simply be poured onto the advancing sheets at a point adjacent the nip of the roll 20, the nip acting to spread the solution across the roll. Dams may be installed at the ends of the roll to prevent spillage of the solution.

The solution enters the channels on the roll and is transferred from the channels to the printed face of the sheets passing thereunder. Roll 20 is an idler and operates in conjunction with a platen roll 23 disposed below the belt, such that when a sheet enters the nip of roll 20, sufficient compression of the sheet and of the belt interposed between rolls 20 and 23 occurs to cause the exposed roll to turn and to apply the resin solution to the paper. Alternatively, the engraved roll may be driven at a rate in keeping with the belt movement.

The solution is applied to the face of the paper in the form of parallel streams corresponding to the configuration of the channels. However, the viscosity of the solution is such that the streams level and merge to form a uniformly-distributed wet coating on the paper surface before drying and curing takes place. The invention is not limited to any one form of engraved pattern, and includes various other patterns, such as waffle-like or spiral configurations.

The wet coated sheets on the conveyor belt 15 are transferred to an elongated conveyor 24 constituted by continuous bands in spaced parallel relation. Conveyor 24 advances the wet-coated sheets at a slightly greater speed than conveyor 15, thereby causing the sheets to separate. The separate sheets are conveyed through a tunnel 25 wherein the wet coating is subjected to infrared radiation, circulating heated air, or other curing means which acts to dry and cure the epoxy to produce an adherent film on the sheets.

The thickness of the coating depends primarily on the depth of the engraving, and in practice this may be made to range from .1 mil to any greater thickness. As shown in FIG. 4, each dried and cured sheet is constituted by a paper base P and a uniform epoxy film E adhered to the printed face thereof.

The sheets from tunnel 25 are transferred to an output stage 26 which is preferably in the form of an automatic jogger or vibrator which serves to restack the sheets and to place them in condition for efficient handling or further processing.

As pointed out previously, the chemical nature of the epoxy solution must be such that it has a satisfactory pot life, proper viscosity, and a solvent system which will avoid drying of the solution on the engraved roll.

While there has been shown and described a preferred embodiment of the invention, it will be appreciated that many changes and modifications may be made therein without, however, departing from the essential spirit of the invention.

Thus, while the applicator has been described as it operates in connection with epoxy solutions, it will be appreciated that it can also be used to advantage with other solutions for coating sheets which are not in wet form, such as vinyl dispersions, organosols and plastisols.

Another approach to applying the epoxy solution to the surface of the sheets is by the use of an offset press

arrangement including a three roller unit constituted by an impression cylinder which coats with a blanket cylinder, this in turn engaging a plate cylinder. Operating in conjunction with the plate cylinder is a fountain containing the solution to be applied. Rotating within the fountain is a metal metering roll, preferably engraved in the manner previously described, which picks up a controlled amount of the solution and applies it to a rubber transfer roll, the latter roll engaging the surface of the plate cylinder, which in turn applies the liquid coating to the blanket cylinder.

The paper sheets are fed between the impression cylinder and the blanket cylinder in overlapping relationship, as in the embodiment previously described, the coated sheets then being fed into the curing and drying zone. Alternatively one may dispense with the plate cylinder and apply the solution from the transfer roll directly onto the blanket roll. The thickness of the coating depends on the viscosity of the solution and the roller speed, as well as the depth of the engraving on the metering roll.

What we claim is:

1. A system for applying a wet solution to the surface of sheets, which solution is of a composition which, when dried, forms an adherent scuff-resistant protective film; said system comprising:

(A) an applicator stage including a conveyor operating at a predetermined speed, a roll supported above said conveyor to engage the surface of sheets fed therebetween, and means to apply said solution to said roll to coat same whereby said roll in turn applies said solution to said surface;

(B) a feeding stage provided with a stack of sheets and including means to remove said sheets sequentially from the stack and to transfer them to the applicator conveyor at a rate relative to the speed thereof at which said sheets are caused to marginally overlap whereby said roll effectively sees an uninterrupted surface and applies said solution thereto;

(C) a drying stage coupled to the output of said applicator stage and including a conveyor operating at a speed slightly greater than said predetermined speed

to cause said sheets conveyed thereby to separate, and means to subject said separated sheets to heat to dry said solution thereon; and

(D) a collector stage coupled to the output of said drying stage to receive said separated sheets one above the other to form a stack thereof.

2. A system, as set forth in claim 1, wherein said solution has a predetermined viscosity and said roll has a pattern of indentations thereon to receive said solution, the roll forming a corresponding raised pattern of the solution on the surface of the sheets engaged thereby, the viscosity of the solution relative to the conveyor speed in said applicator stage being such that the solution levels off on the surface to form a wet coating which becomes uniform before the sheets enter the drying stage.

3. A system as set forth in claim 2, wherein said means to apply said solution to said engraved roll is constituted by a trough having a doctor blade engaging the surface of the roll.

4. A system as set forth in claim 3, wherein said engraved roll has non-engraved end portions and said trough overlaps said non-engraved portions to prevent leakage of the solution.

5. A system as set forth in claim 3, wherein said solution is dispensed into said trough by a metering pump which is regulated to maintain a substantially level reservoir in said trough.

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