

April 30, 1946.

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2,399,256

CREPING OF WEBS WITH THIN COATINGS OF CREPING ADHESIVE

Filed Jan. 18, 1943

FIG. 1.

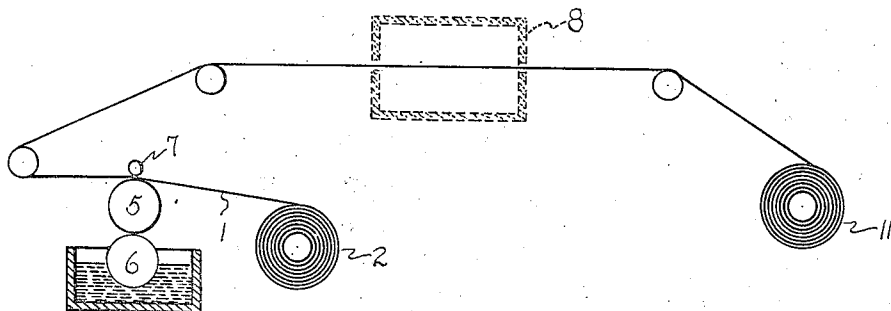
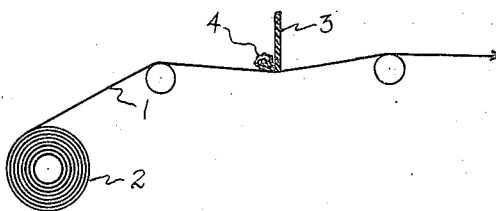


FIG. 2.

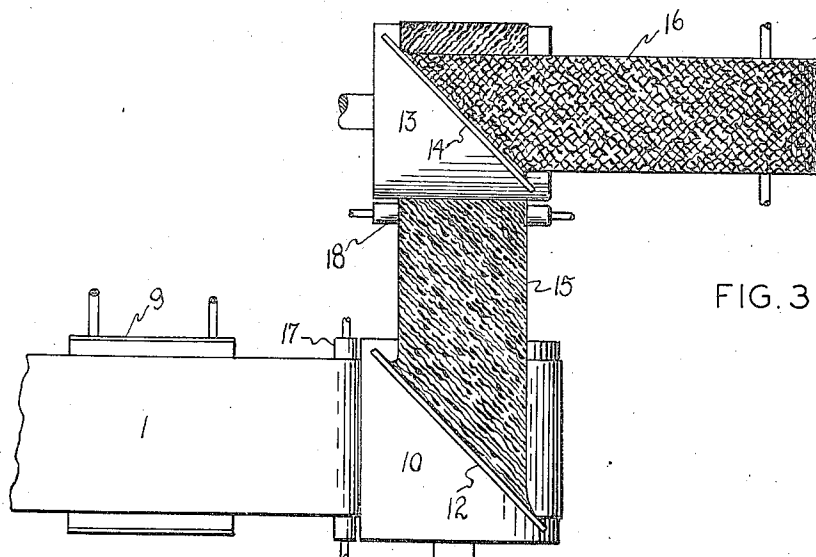
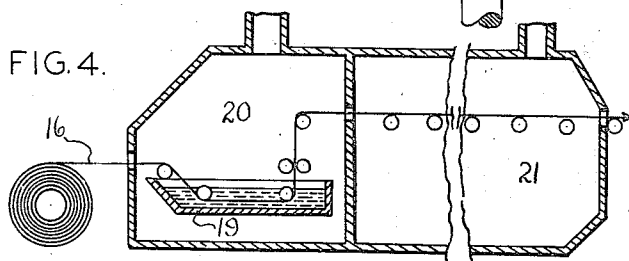


FIG. 3.

FIG. 4.



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UNITED STATES PATENT OFFICE

2,399,256

CREPING OF WEBS WITH THIN COATINGS
OF CREPING ADHESIVEWilliam Wallace Rowe, Cincinnati, Ohio, assign-
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Ohio, a corporation of Ohio

Application January 18, 1943, Serial No. 472,737

8 Claims. (Cl. 154—33.05)

In a copending application entitled Resin molding, Serial No. 328,325 which has now matured into Patent No. 2,343,930, dated March 14, 1944, I have described the manufacture of resinous or other molded articles from laminated structures capable of flowing as such in the mold, and also certain modes of formation of the laminated structures and of the laminae. The present application is a continuation in part of the said copending case.

One of the fundamental objects of the present invention is the provision of procedures for forming creped laminae in which the binder substance can be controlled with great exactness, both as to quantity and as to condition.

Another of the fundamental objects of the invention is the provision of procedures for forming creped webs through the positive adhesive action of very low percentages of binder residual on the web.

A further object of the invention is the solution of those problems inherent in the creping of laminae with binder substances and arising from the difficulty of controlling the viscosity and adhesiveness of polymerizable binders before, during, and after a creping operation without producing an unwanted stage of advancement of the polymerization. In explaining this aspect of my invention, I shall describe it in connection with the use of thermosetting resinous binders, but as hereinafter pointed out, its utility is not confined thereto.

These, and the more specific objects of my invention which will be set forth hereinafter or will be apparent to one skilled in the art upon reading these disclosures, I accomplish by those procedures and in those products of which I shall now describe exemplary embodiments.

Reference is made to the accompanying drawing wherein:

Figure 1 is a diagrammatic representation of one mode of applying the adhesive to the web.

Figure 2 is a diagrammatic showing of another mode of applying the adhesive, and includes means for treating the web prior to creping and leading it onto a creping cylinder.

Figure 3 is a representation, again diagrammatic, of the mode and mechanism for double-diagonally creping webs.

Figure 4 shows in section a mechanism for saturating webs.

I crepe the webs by means of a positively acting adhesive substance, and in most instances, prefer to impart universal expansibility to the webs by forming in them crossing sets of creping crinkles after the teachings of the Kemp Patents Nos. 2,008,181 and 2,008,182. When dealing with cloth, my present teachings are applicable to my copending application entitled Expansible cloth

and method of making it, Serial No. 444,298 filed May 25, 1942.

There is no limitation upon the kind and character of webs available for the formation of my products. Any web or sheet-like material having characteristics desirable in the final product and capable of being gathered and associated with the binder, may be employed. The webs need not be saturable. Paper or cloth, or composite fabrics of paper and cloth, are of course the types of webs of greatest general availability and desirability in most molding operations in accordance with my said copending application.

I have discovered that under certain conditions it is possible not only to apply to the webs extremely thin coatings of adhesive, but also to crepe with such coatings, using them to cause the webs to adhere to the creping surface, whence they are removed by the creping doctor. A large number of advantages are secured in such operations, some of which will be pointed out hereinafter. By extremely thin coatings, I mean coatings of, say, two pounds per thousand square feet of web surface, using a binder of the gravity of synthetic resin or bitumen, though the thickness of such coatings may be widely varied. Such coatings in themselves are extremely thin and light. Unless the webs themselves are very thin, the quantity of binder in such coatings will not ordinarily be enough for molding with plastic flow, and more binder will usually be added.

For the formation of very thin coatings for creping, I take a suitable binder and control its viscosity at preferably substantially normal or room temperatures. The viscosity of the binder must be controlled for two primary reasons: first, if the viscosity is too great, it may be found difficult or impossible to produce a thin enough film or coating of the material, second, if the viscosity is too low, it may have too great a tendency to saturate into an absorbent web. With the very thin coatings or films of binder contemplated in my invention, these coatings or films must exist on the web in the form of a superficial coating. If the binder or adhesive is absorbed into the web, it cannot act as the creping adhesive because not enough of it will be present on the surface of the web to bind the web to the creping cylinder.

I have further found it essential to control the viscosity of the binder during the coating operation by means of solvent, although it is not without the spirit of my invention to employ temperature regulation in addition. I start with a binder substance having naturally too great a viscosity, and cut it back to the required viscosity by means of a suitable volatile solvent. Suitable volatile solvents are of course well known to the skilled worker, such as water or alcohol or both

for incompletely polymerized synthetic resins, or hydrocarbon solvents for bitumen or the like.

Many binders are of thermoplastic character, so that their viscosity can be modified by heat; but with any given coating operation the range of suitable viscosities is rather narrow, and reliance upon heat alone is uncertain and inconvenient. Moreover, many binders such, for example, as thermosetting resins, are subject to change under conditions of prolonged heating. Coating a web by means of a resin brought to the required viscosity by means of heat, involves the maintenance, usually, of a considerable reservoir of the resin at an elevated temperature. Even if this does not result in completing the polymerization of some portion of the resin, it will be found that the condition of the resin body is continually changing, and a constant temperature will not produce a constant viscosity. Thus the temperature of the coating material will have to be raised more or less continuously, and it is easy in this way to reach an unwanted stage of advancement in the resin.

The amount of solvent required is not large. By way of example, I frequently employ as a coating substance, say, 45 parts or more by weight of resin solids to 25 parts or less by weight of solvent.

The coating substance may be applied in a variety of ways. It may be scraped onto the surface of many webs 1, withdrawn from a roll 2 by means of a sharp scraper knife 3, the coating substance being dammed up behind the knife as at 4 (Figure 1). Where this may be impracticable because of the porous character of the web, as with certain kinds of cloth, I may use metering rolls 5, 6, (Figure 2) to control the thickness of a film of the coating substance on one of the rolls; and I may press the web into contact with the metered film on the roll, by the use of a third roll 7 which is preferably rubber covered. I may apply the film of binder by spraying means. Again, I may apply the coating substance to the creping cylinder or surface by spraying doctoring or metering, and transfer, and press the web into contact with it by means of a resilient or rubber-covered pressing roll.

All of these expedients involve control of viscosity; but they do not contemplate the use of low viscosity solutions, nor the idea of passing a saturable web between rollers in such a way as to squeeze an adhesive solution into the web. The viscosity of the coating substance is so controlled as, on the one hand, to make the formation of a thin film possible, and on the other to preclude the saturation of the coating substance into the web.

Another advantage of the use of a solvent for viscosity control of a normally non-tacky binder is this: that the evaporation of a volatile solvent from the exceedingly thin films or coatings which I produce is usually quite rapid, so that the coated material may be wound into a roll as at 11, if desired, almost at once. Evaporation of solvent may be hastened by passing the coated web through a drying box 8 (Figure 2), or over a steam plate 9 (Figure 3), even where the coated web is led directly to the creping machine.

Evaporation of solvent, of course, increases viscosity and diminishes the tendency toward saturation.

The web is immediately or eventually led to the creping machine and is caused to adhere to the creping surface by means of the thin coating of binder formed on the surface of the web or

formed on the surface of the creping cylinder. The creping operation is carried on in the usual way, and with the usual controls, and will not here be described at length. It is to be noted that in causing the web to adhere to a creping cylinder, it is only necessary to produce tack in the adhesive because the coating of adhesive is extremely thin. In creping webs where a thick layer of adhesive is interposed between the web and the creping surface, it is necessary not only to develop sufficient tackiness in the adhesive to cause it to bind the web to the cylinder but it is also necessary to bring the adhesive to such a state of cohesiveness as will permit it to be creped along with the web. If this is not done, the action of the creping knife is likely to be, in part at least, an action of causing the adhesive layer to divide within its body, thus producing no creping crinkles or producing irregular uncrinkled areas or skips. No such problem is present in the operation of creping by means of the very thin films of creping adhesive which this invention contemplates. Usually at the time the web is caused to adhere to the creping surface, the solvent in the creping adhesive will be largely evaporated, and the required tackiness is developed by the use of temperature control. The creping cylinder may be heated to the required temperature, or the web, bearing the thin layer of adhesive, may be passed over a heating device such as the steam plate or the like 9, just before being led to the creping surface. Upon the development of the required tackiness in the binder a powerful adhesion of the web to the cylinder 10 results, and this may be repeated on successive cylinders as in the process of the Kemp patent referred to above. Figure 3 is a diagrammatic representation of a double creping process in which the web treated as herein taught is led over the steam plate 9 onto the first creping cylinder 10 from which it is removed by the diagonal creping knife 12. It is led to the second creping cylinder 13 and again removed by a diagonal creping doctor 14 to form a set of diagonally arranged creplings or gatherings crossing the first set. In this figure the uncreped web is indicated at 1, the single diagonally creped web at 15, and the double diagonally creped web at 16. 17 and 18 are pressure rolls for pressing the web against the creping cylinders.

It may also be noted that where I am creping with a thermosetting resin, and there is a problem of producing a creped web while avoiding undue advancement or polymerization of the resin, the procedure which I have outlined above enables me to control the advancement of the resin very accurately. While tackiness is developed by the use of temperature for binding the web to the cylinder, it may be noted that the application of such temperature is a very brief one, usually occupying only that very small interval between the time when the web is applied to the creping surface and the time when it is removed therefrom by the creping doctor. Thus the effect of such heat treatment in polymerizing the resin may usually be completely neglected.

The fact that at the time the web is caused to adhere to a creping cylinder the solvent is largely gone from the binder substance, and the fact that the temperature employed need only be sufficient to develop tackiness and therefore need not be so high as to liquefy the binder, diminish the tendency for the binder to saturate into the web being creped even where that web is very porous. I have found no difficulty in causing my webs to adhere successively to different creping cylinders through

the agency of the same thin coating of binder substance thereon.

In the formation of laminated molding materials, by the procedure outlined above, there are a further number of advantages. The character of the plastic flow of the laminated material in the mold is affected by a number of factors such as the stage of advancement of the resin, the total quantity of resin in the laminated material, and the degree to which any given amount of resin exists on the webs in the form of a coating as distinguished from a saturation. It has already been explained how my process causes a resin to form primarily a coating on the surface of the webs. This is an ideal condition where the total quantity of the resin in the finished product is to be low. The fact that I can coat and crepe my webs with resins without subjecting the resins to prolonged heat enables me to control very accurately the degree of advancement of the resin in the mold charge. The fact that my coatings of the resin are extremely thin, with ordinary heavy webs, gives me a further factor of control, in that I may accurately add to such creped webs any additional quantity of resin desired, in any desired degree of advancement.

In fact with the heavier webs, where the amount of resin in the exceedingly thin films which I use for creping is small compared with the total quantity of resin desired in the product, the characteristics of the resin employed during creping may be inconsequential in the final product. After creping webs as hereinabove taught, I may cause the very thin film of resin thereon to set up completely or to a high degree of polymerization by passing the web through an oven. I have found that setting up the resin in this way tends to retard the stretchability of the creped webs and enables me to pass such creped materials through the ordinary saturating pans or apparatus used for uncreped webs, whereby to add to the webs carefully controlled amounts of additional resin in desired stages of advancement. Figure 4 indicates a conventional saturating means comprising a pan of resinous varnish 19 through which the web 16 may be drawn. This is contained in a housing divided into a saturation chamber 20 and a drying chamber 21.

Setting up thin films of resin on my creped products, thus is of assistance in recoating operations; and it may be noted that if the initial thin film of resin is set up to an insoluble stage, it will not be affected by solvents used in applying additional increments of binder. The binder used in creping the webs may, of course, be different from the binder added to the webs subsequently, for the formation of mold charges having desired resin contents. Finally, it may be noted that creping by means of very thin films of binder substance, enables me to produce laminated mold charges for pressing in which, or in parts of which, the resin content while uniform is very low.

Modifications may be made in my invention without departing from the spirit of it. Having thus described my invention in certain exemplary embodiments, what I claim as new and desire to secure by Letters Patent, is:

1. A process of creping webs with very thin coatings of creping adhesive which comprises forming a high viscosity solution, non-saturating to webs, of heat softenable adhesive solids, said solution being capable of being applied thinly in a coating operation, adhering a web to a crep-

ing surface by means of adhesive solids derived from a coating of said solution so thin as to contain about 2 pounds solids per 1000 square feet, controlling the coating intermediate the point of coating formation and the creping point by the elimination of some at least of the solvent and by temperature control to a consistency providing a positive adhesive bond between the creping surface and the web for creping purposes, the coating being capable of serving as a creping adhesive because the said adhesive solids are substantially unabsorbed into the web, and removing the web from said surface with a creping doctor.

2. A process of creping webs with very thin coatings of creping adhesive which comprises forming a high viscosity solution, non-saturating to webs, of heat softenable adhesive solids, applying a thin superficial coating of said solution to a web, said coating being so thin as to contain about 2 pounds solids per 1000 square feet, leading the web to a creping surface and causing it to adhere thereto by means of said coating, controlling the coating intermediate the point of coating formation and the creping point by the elimination of some at least of the solvent and by temperature control to a consistency providing a positive adhesive bond between the creping surface and the web for creping purposes, the coating being capable of serving as a creping adhesive because the adhesive solids are substantially unabsorbed into the web, and removing the web from said surface with a creping doctor.

3. The process as claimed in claim 2 wherein the elimination of some at least of the solvent is effected by brief heating prior to leading the web against the creping surface.

4. A process as claimed in claim 1 in which said heat softenable adhesive solids include an incompletely polymerized synthetic resin and wherein said solution is applied at substantially room temperatures whereby to avoid premature polymerization.

5. A process as claimed in claim 1 in which said heat softenable adhesive solids include an incompletely polymerized synthetic resin and wherein said solution is applied at substantially room temperatures whereby to avoid premature polymerization, and including the step of applying additional resin to said web after creping it.

6. A process as claimed in claim 2 in which said heat softenable adhesive solids include an incompletely polymerized synthetic resin and wherein said solution is applied to said web at substantially room temperatures whereby to avoid premature polymerization, and including the step of applying additional resin to said web after creping it, said web being a web of paper.

7. A process as claimed in claim 2 in which said heat softenable adhesive solids include an incompletely polymerized synthetic resin and wherein said solution is applied to said web at substantially room temperatures, whereby to avoid premature polymerization.

8. A process as claimed in claim 2 in which said heat softenable adhesive solids include an incompletely polymerized synthetic resin and wherein said solution is applied to said web at substantially room temperatures, whereby to avoid premature polymerization, and including the step of applying additional resin to said web after creping it.

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