United States Patent [19]

Mayer

[11] **3,772,124**

[45] **Nov. 13, 1973**

[54] **METHOD OF FORMING TISSUE LAMINATE**

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[73] Assignee: **Johnson & Johnson,** New Brunswick, N.J.

[22] Filed: **Mar. 16, 1972**

[21] Appl. No.: **235,413**

Related U.S. Application Data

[60] Division of Ser. No. 22,942, March 26, 1970, Pat. No. 3,720,573, which is a continuation-in-part of Ser. No. 671,963, Oct. 2, 1967, abandoned.

[52] **U.S. Cl.** **156/324,** 117/155, 156/543

[51] **Int. Cl.** **C09j 5/00**

[58] **Field of Search** 156/324, 547, 183, 156/543; 162/112; 117/155; 161/129, 268

[56] **References Cited**

UNITED STATES PATENTS

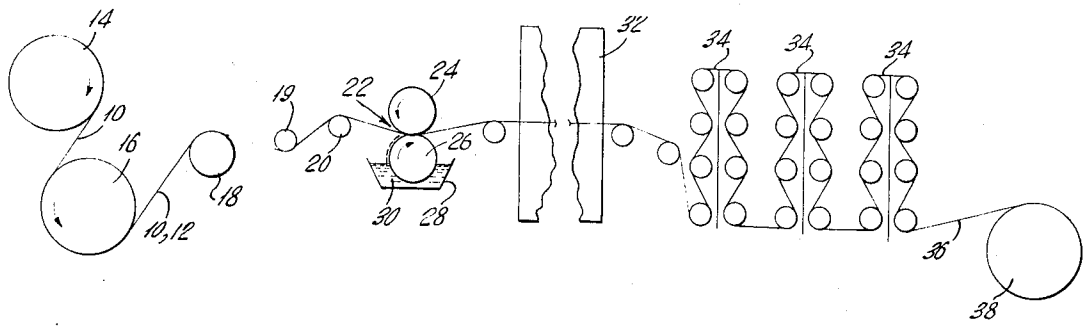
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Primary Examiner—William A. Powell
Attorney—Jason Lipow

[57] **ABSTRACT**

An impregnated paper product having strength, toughness, tear resistance, softness, hand and breathability sufficient to permit such papers to be used as substitutes for woven or non-woven fabrics in making disposable fabric products. By applying conventionally known strength imparting resins, polymers, and co-polymers to multi-ply, dry creped tissue papers of low basis weight, which multi-ply laminate has the crepe removed therefrom as a result of passing through an aqueous suspension or emulsion of such resins, polymers or co-polymers, the stiffness, noisiness and loss of breathability that result from such impregnation of single ply creped or uncreped papers does not occur.

7 Claims, 2 Drawing Figures



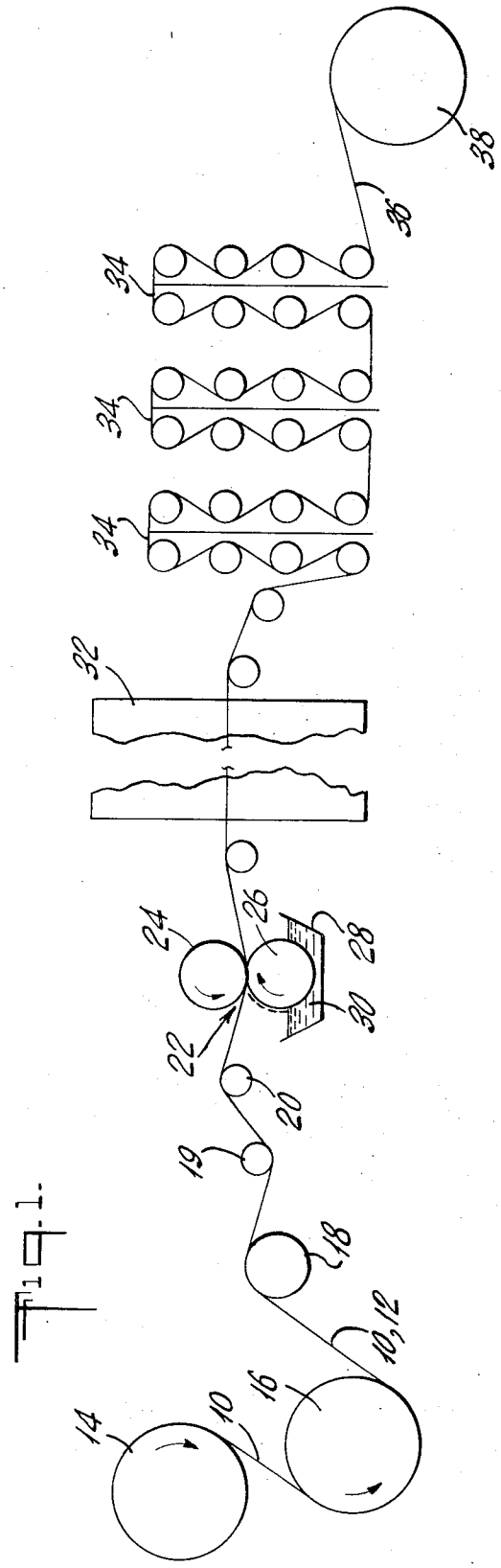

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FIG. 1.

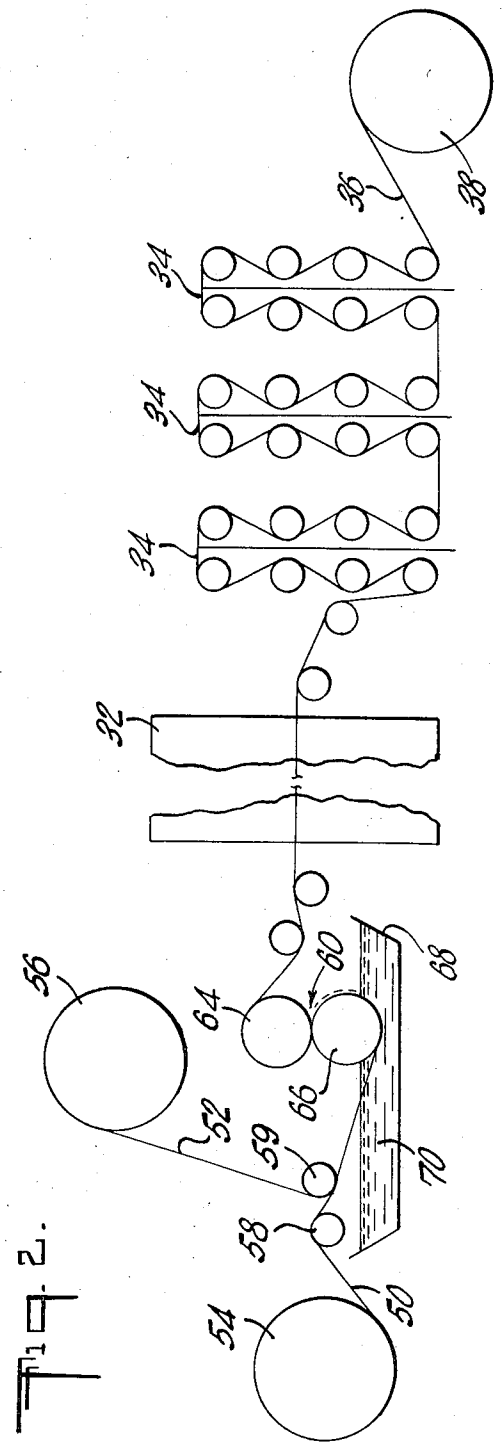

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FIG. 2.

METHOD OF FORMING TISSUE LAMINATE

RELATED APPLICATIONS FOR PATENT

This is a division of application, Ser. No. 22,942, filed Mar. 26, 1970 now U.S. Pat. No. 3,692,715.

Which is a continuation-in-part of application Ser. No. 671,963 filed Oct. 2, 1967 now abandoned.

BACKGROUND OF THE INVENTION

This invention relates to paper, and more particularly, is directed to improved paper products useful as a substitute for woven and non-woven fabrics.

There has been and there continues to be a growing tendency for single use disposable fabric products. This is particularly true in the medical field and especially in modern hospitals where disposable surgical drapes, caps, masks, gowns, bedding, and the like have acquired wide acceptance. Similarly, disposable aprons, towels, frocks, etc., are in ever increasing demand by food processing and handling establishments. Even the clothing industry today is looking to inexpensive disposable dresses as a fashionable and practical item.

To satisfy the need for disposable products, it is readily apparent that they must be made of inexpensive materials to warrant but a single use. The first approach to making disposable fibrous products was to substitute dry-laid non-woven fabrics for the woven fabrics from which reusable products had been made in the past. However, while this was a step in the right direction, such non-woven fabrics are still relatively expensive and in many instances have not reached full acceptance for disposable products because of the expense involved.

Substituting paper and paper-like products for woven and non-woven fabrics would be ideal for the making of disposable products, but paper, in general, has had several serious drawbacks from the standpoint of physical characteristics. While paper can be made from very inexpensive wood pulp fibers at a very high rate of speed, such papers that might be suitable as a substitute for fabrics such as creped or uncreped tissues or waddings suffer from an inherent lack of strength and toughness, particularly in the cross direction.

Tear resistance and tensile strength of papers have been increased considerably by saturating or impregnating them with polymeric resins. Particularly suitable have been self-crosslinking acrylic resins such as ethyl acrylates, ethyl hexyl acrylates, ethyl acrylate-methyl-methacrylate copolymers, ethyl hexyl acrylate-methyl methacrylate copolymers, ethyl acrylate-polyvinyl acetate copolymers, and ethyl hexyl acrylate-polyvinyl acetate copolymers.

It is also well known that tear resistance and tensile strength can be imparted to papers by the addition of other materials such as styrene-butadiene polymers, methyl-methacrylates, urea formaldehyde and melamine resins, etc. However, when papers are impregnated or saturated with acrylic resins and such other polymeric materials, the strength and tear resistance may be increased to acceptable levels, but the papers do not have the desirable characteristics of hand, drape, softness and breathability inherent in woven fabrics. Some degree of softness can be imparted to resin impregnated papers by the addition of glycerin or polyethylene glycol softeners to the paper. But, even in such instances, the hand, drape and breathability have been so inferior as to prevent the use of resin or polymer strengthened papers as a substitute for woven or non-woven fabrics.

SUMMARY OF THE INVENTION

I have found, quite unexpectedly, and for some unknown reason, that if two or more plies of light weight, dry creped tissue or wadding are superimposed and are then saturated or impregnated with an emulsion of wellknown strength imparting resins of the types set forth above, the resin bonded laminated, uncreped paper produced does not loose to any appreciable degree its preimpregnated characteristics of hand, drape, softness, and most importantly, breathability. Further, by starting with dry creped tissues having a relatively high level of stretch in the machine direction due to the crepe, and then removing the crepe from the superimposed plies by passing them through the aqueous suspension or emulsion of resins, an overall resin bonded, uncreped laminate results in which the stretch level due to internal fiberpolymer association in both the machine and cross directions are increased and substantially equalized. By contrast, if a single ply of light weight, dry creped tissue wadding of the same basis weight as the combined basis weight of the two or more plies of dry creped tissue wadding are saturated with the same amount of the same strength imparting resins, the tensile strength and tear resistance of the paper is about the same, but it is hard, noisy and of greatly reduced breathability.

Thus it is seen, that by using at least two superimposed sheets of dry creped tissue prior to impregnation or saturation with the strength imparting resin additives, not only is an uncreped paper product produced that has increased wet strength and tear resistance as would be expected, but also a paper product is produced having excellent hand, drape, softness and breathability making it eminently suitable as a substitute for woven or non-woven fabrics in the making of disposable products of the type mentioned above.

DESCRIPTION OF DRAWING

The present invention will be even more readily understood by reference to the following detailed description when read in conjunction with the attached drawings wherein:

FIG. 1 is a schematic flow diagram showing one method of making the paper products of the present invention; and

FIG. 2 is a schematic flow diagram showing another method of making the paper products of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

Treatment of papers with strength imparting resins is conventionally accomplished by two well-known methods. These are known as the "tubbing" or "impregnation" method and the "internal addition" method. In the former, an aqueous solution of pulp from which the paper is to be made is processed as a slurry and is placed upon a screen where the actual formation of the paper sheet takes place. Once the paper sheet is formed it is dried to extract the water. The preformed paper sheet is then impregnated with an emulsion of the particular resin desired. In the latter method, the emulsion of the resin is added to the pulp slurry prior to the paper sheet being formed on the screen. In both methods the paper sheet, subsequent to being treated with

the emulsion of the resin, is heated to remove any water which may remain and to cure the resin in its water insoluble state.

In practicing the present invention, the first mentioned tubbing or impregnation method is required since at least two preformed dry creped tissue sheets must be first superimposed before being subjected to treatment with resin emulsion. After the preformed sheets have been superimposed they are then passed through the emulsion of the particular strength imparting resin employed. The resin concentration of the emulsion and the speed with which the paper is passed through the emulsion is controlled within limits to give the desired tensile strength and tear resistance characteristics as set forth more fully hereafter.

Referring now particularly to FIG. **1**, the unique paper products of the present invention are shown being made by first superimposing two webs, **10**, and **12**, of dry creped tissue or wadding being delivered from supply rolls **14** and **16**, respectively. The superimposed webs **10** and **12** then pass over a driven vacuum roll **18** which is provided in the usual manner to control tension in the web. An idler roll **19** is provided to change direction of the web prior to its passing over a spreader roll **20**. The spreader roll **20** is a conventional "Mount Hope" type and is used to maintain the combined web **10** and **12** at its maximum width and wrinkle free.

From the spreader roll **20**, the combined web **10** and **12** is passed into a nip **22** existent between a pair of superimposed, rotating squeeze rolls **24** and **26**, the latter of which is positioned with a portion of its lower half in vat **28** containing an aqueous emulsion or suspension **30** of the resins or polymeric substances to be impregnated into the web. During its rotation, squeeze roll **26** picks up on its surface the resin or polymer suspension **30** and carries it into the nip **22** where the webs **10** and **12** become saturated with the suspension by impregnation. Rolls **24** and **26** are normally biased together to exert a squeezing pressure on the webs **10** and **12** at the nip **22** to squeeze out and remove any excess of the resin or polymer suspension from the web.

Because the webs **10** and **12** are a dry creped tissue or wadding (i.e., the crepe has been imparted thereto while the paper is in a dry state whereby the fiber to fiber bonds have been formed therein while in the uncreped wet state prior to creping), passing through the aqueous suspension **30** readily causes the crepe to be removed therefrom, thus forming an uncreped, overall resin bonded laminate. To further aid in removal of the crepe, however, vacuum roll **18** mentioned earlier, is driven at an angular velocity slightly under the angular velocity of the squeeze rolls **24** and **26** thereby imparting sufficient tension in the webs **10** and **12** to add a mechanical force for the removal of the crepe.

From the squeeze rolls **24** and **26** the combined, saturated webs **10** and **12** pass through a conventional hot-air heating tunnel **32** to drive off excess water and to start curing of the resin or polymeric materials impregnated therein. Curing of the resin or polymeric materials is completed in a series of conventional heated can driers **34** following which the resin bonded, uncreped laminate **36** is rewound into rolls **38** ready to be made into disposable products having true woven and non-woven fabric-like properties.

In FIG. **2** of the drawings, the resin emulsion or suspension is impregnated into the superimposed dry creped webs by passing them directly into the vat containing the aqueous suspension or emulsion. As shown, the webs **50** and **52** of dry creped tissue or wadding are delivered separately from supply rolls **54** and **56** respectively into superimposed relationship over and under respectively a pair of idler rolls **58** and **59**. The superimposed webs **50** and **52** are then passed under the lower roll **66** of a pair of superimposed squeeze rolls **64** and **66**, which lower roll **66** is positioned in a vat **68** with a portion of its lower half immersed in the aqueous resin or polymeric suspension or emulsion **70** contained therein. The combined webs **50** and **52** then follow around the lower roll **66** passing through the nip **60** defined between rolls **64** and **66** where the excess emulsion or suspension picked up by the web is squeezed out. From the following over the upper roll **64**, the impregnated and saturated web passes through the conventional hot-air tunnel **32** and the series of heated can driers **34** to remove excess water and to cure the resin or polymeric materials in precisely the same manner as shown and described with respect to the method depicted in FIG. **1**. The resin bonded, uncreped laminate **36** is also then rewound into rolls **38** ready for use in fabric-like products.

As with the method of FIG. **1**, the crepe present in the dry creped webs **50** and **52** is readily removed when the combined webs pass into the aqueous emulsion or suspension **70** in the vat **68**, thus assuring overall resin bonding between the webs in the uncreped laminate ultimately produced.

The papers used as the starting materials for making the products of the present invention are of the class known as dry creped wadding or tissues which are of a porous character having a thickness ranging from about 2 mils to about 20 mils. Their basis weight (each single ply) can be from about 5 pounds up to about 30 pounds which means the weight in pounds of a standard ream (3,000 square feet) of paper. Most preferred is a basis weight of about 10 pounds. As a dry creped paper, the wadding used As have a crepe based stretch level in the machine direction ranging from about 5 to about 50 percent and most preferred is a stretch level of about 15 percent, and an inter-fiber stretch level in the cross direction ranging from about 2.3 percent to about 6 percent and most preferred is a stretch level of about 4.5 percent.

When two or more continuous webs of dry creped tissue or wadding having the above characteristics, are superimposed prior to removal of the crepe and impregnation with aqueous suspension of the particular resins or polymers, the combined web will have a total basis weight ranging from about 10 ponds to about 60 pounds and most preferably about 30 pounds. Its machine direction stretch level due to creping will remain substantially unchanged from the individual plies as will the cross-direction stretch level due to inter-fiber bonding.

The saturation bath in general will be made up of an aqueous suspension or emulsion containing from about 5 to about 50 percent resin or polymer solids and preferably about 15 percent solids. As mentioned earlier, the particular resins or polymers used or mixtures thereof, can be any or all of those well known in the paper making art as strength imparting additives, whether they are added to impart increased dry strength or wet strength or to increase abrasion or tear resistance or any combination of such properties to pa-

pers of all types. It is only essential in making the uncreped, resin bonded paper laminate of the present invention that a lightweight dry creped tissue or wadding be used as a starting material and that at least two plies of such tissue or wadding be superimposed prior to saturation or impregnation of the superimposed webs with the strength imparting resins or polymers.

The superimposed dry creped webs are delivered together to the aqueous emulsion or suspension of resins or polymetic materials at a controlled rate of speed to provide a dwell time in the suspension sufficient to obtain a wet pick-up of the suspension or emulsion ranging from about 75 percent to about 250 percent based upon the weight of the combined superimposed webs. Most preferred is a wet pick-up of about 150 percent of the suspension or emulsion. The wet pick-up is further controlled by adjusting the biasing force between the squeeze rolls where any excess pick-up of the emulsion or suspension is pressed out of the webs.

Following such saturation, the saturated webs are dried at 240°F–350°F for about 2 minutes to remove the water from the webs and to cure the resins or polymers in their water insoluble state. Such treatment results in a lightweight, resin bonded, uncreped paper laminate containing from about 10 percent to about 30 percent resin and most preferred, about 20 percent of resin or polymer solids based upon the weight of the dry resin bonded laminate.

The resin bonded uncreped paper laminate thus formed exhibits substantially equal stretch levels in both the machine and cross directions, and since the crepe has been removed, the stretch exhibited by the laminate is due solely to the internal resin-fiber bonding relationship. The resin bonded, uncreped laminate produced exhibits an internal resin or polymer-fiber stretch level in both the machine and cross directions ranging from about 8 to about 20 percent and most preferred is a stretch level of about 13 percent.

It is also found that removal of the crepe in the aqueous solution of the dry creped webs assures overall lamination of the webs and reduces the bulk of the resulting resin bonded laminate, thus also assuring low flexural resistance which, among other factors, contributes to the paper laminate's fabric-like quality.

The paper product of the present invention, even though containing hardening water-insoluble resins, has excellent softness, hand, drape and breathability, Softeners such as glycerin or polyethylene glycols are not required when practicing the present invention to produce a suitable paper substitute for woven and non-woven fabrics, but they may be included where it is desired to produce a paper product having a very high degree of softness. When such conventional softeners are used, they are added to the saturation emulsion or suspension along with the resin or polymer solids. If used at all, the bath will contain no more than 25 percent of the glycerin or polyethylene glycols. But it is emphasized, softeners are not required in most instances to make the unique resin bonded, uncreped paper laminate of the present invention.

While I have described my invention with some degree of particularity in the resins or polymers employed, it is to be understood that such resins and many other equivalents are well known in the paper making art, and that many substitutions can be made while still remaining within the spirit and scope of the invention as defined in the appended claims.

I claim:

1. The method of making a laminated paper product suitable as a substitute for woven and dry-laid non-woven fabrics comprising the steps of:

a. superimposing at least two plies of a plies dry creped tissue;

b. removing the crepe from each of said plis while impregnating therein strength imparting polymeric resins by passing said superimposed plies through an aqueous suspension or emulsion of said resins;

c. removing the water from the suspension or emulsion impregnated in said superimposed plies; and

d. curing said resins impregnated in said superimposed webs in their water insoluble state.

2. The method according to claim **1** wherein said aqueous suspension or emulsion contains from about 5 percent to about 50 percent polymeric resin solids.

3. The method according to claim **1** wherein said superimposed plies are passed through said suspension or emulsion at a rate of speed sufficient to obtain a wet pick-up of the suspension or emulsion ranging from about 75 percent to about 250 percent based upon the combined weight of the superimposed plies.

4. The method according to claim **1** wherein each of said superimposed plies of dry creped tissue has a basis weight ranging from about 5 pounds up to 30 pounds, a crepe-based stretch level in the machine direction ranging from about 5 percent to about 50 percent and an inter-fiber stretch level in the cross direction ranging from about 2.3 percent to about 6 percent prior to impregnation with said polymeric resin and removal of the crepe therefrom.

5. The method according to claim **2** wherein said aqueous suspension or emulsion contains about 15 percent polymeric resin solids.

6. The method according to claim **3** wherein said superimposed plies are passed through said suspension or emulsion at a rate of speed sufficient to obtain a wet pick-up of the suspension or emulsion of about 150 percent based upon the combined weight of the superimposed plies.

7. The method according to claim **4** wherein each of said superimposed plies of dry creped tissue has a basis weight of about 10 pounds, a crepe-based stretch level in the machine direction of about 15 percent and an inter-fiber stretch level in the cross direction of about 4.5 percent prior to impregnation with said polymeric resin and removal of the crepe therefrom.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,772,124 Dated November 13,1973

Inventor(s) Warren C. Mayer

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

In Column 4, line 40, "used As have" should read --- used can have ---.

In Column 4, line 63, "any or all" should read --- any and all ---.

In Column 5, line 10, "polymetic" should read --- polymeric ---.

In Column 5, line 40, "solution" should read --- saturation ---.

In Column 6, line 14, "plies dry" should read --- lightweight dry ---.

In Column 6, line 16, "plis " should read --- plies ---.

In Column 6, line 35, add "about" before 30 lbs.

Signed and sealed this 29th day of April 1975.

(SEAL)
Attest:

RUTH C. MASON
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents
and Trademarks