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METHOD OF BONDING PAPER AND COMPOSITION THEREFOR

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FIG. 1.

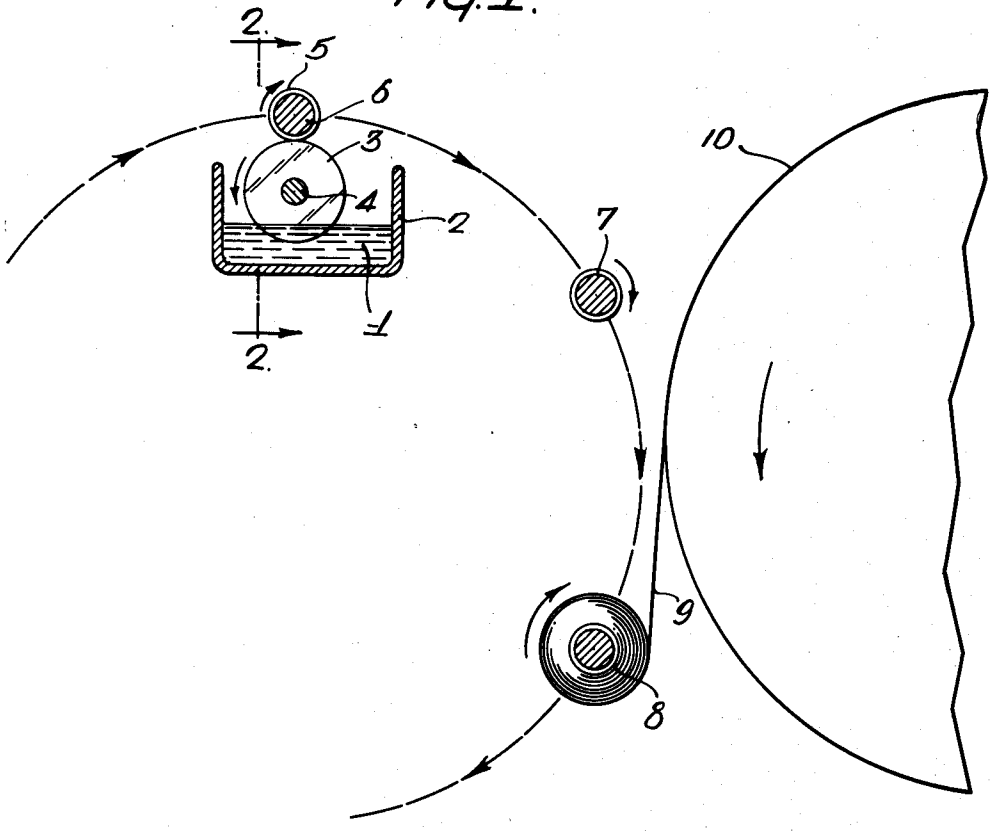
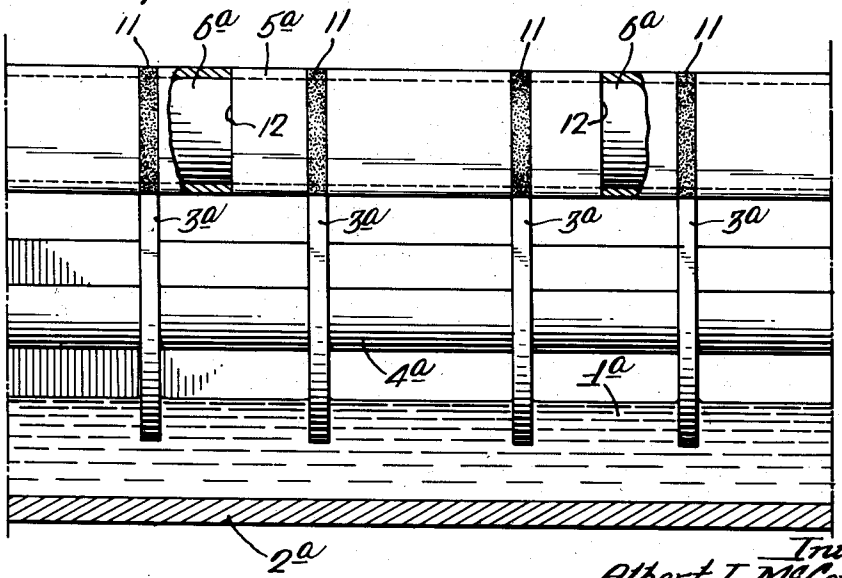


FIG. 2.



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METHOD OF BONDING PAPER AND COMPOSITION THEREFOR

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19 Claims. (Cl. 154—117)

The present invention relates to a method of bonding paper to other materials; and, more particularly, the invention relates to a method of bonding temporarily, paper, such as paper toweling, toilet tissue, waxed paper and the like, to other paper bodies, including cardboard. The invention also relates to a novel adhesive for use in accordance with the present method.

There are many instances where it would be desirable temporarily to adhere paper to another body. In the manufacture of rolls of paper products, such as paper toweling, toilet tissue, waxed paper, and the like, a long strip of the paper is wound about a cardboard core or mandrel to provide a roll. To start this winding operation, an adhesive is applied to the end of the strip or to the cardboard core so that the end of the strip will adhere to the core. Once the winding operation has been started, the bondability of this adhesive is no longer of any importance. In fact, it would be highly desirable if the adhesive would completely lose its bondability so that the last few layers of paper adjacent the core could be easily removed and utilized by the consumer. The conventional adhesives normally employed, such as glue and starch, dry to a relatively permanent bond, so that when the paper is removed from the roll, the last few layers are firmly bonded together and to the cardboard core. In addition, in wrapping paper rolls, such as rolls of toilet tissue, it is desirable temporarily to adhere the wrapper to the roll to facilitate picking up the wrapper sheet by the roll. Once the roll is wrapped, adhesion between the roll and wrapper is no longer desirable.

The permanent bond provided by the above-mentioned conventional adhesives may be diminished to some extent by the use of plasticizers. However, in such cases, it has been found that the initial tack of the material is reduced to a degree such that it becomes unsatisfactory in operation, particularly on the more recent high speed, continuous winding equipment where the core is started rotating at high speed before the paper is brought into contact therewith, and where a high degree of tack is required of the adhesive in order that the rotating core pick up and hold the end of the paper strip at the initiation of the winding operation. Other adhesives have been formulated with the view of providing temporary adhesion of the type mentioned, but these have been found to lack the requisite high initial tack for use in high speed, continuous winding equipment, and would leave markings on the paper so that even if the paper could readily be removed its appearance might discourage its use. It will be seen that the optimum type of adhesive for the aforementioned purposes should have: (1) extremely high initial tack; (2) complete loss of initial tack within a period of days after application to the paper, and (3) a minimum of marks left on the treated paper within a few days after application. Many of the foregoing considerations also apply in winding other sheet materials, such as aluminum foil, plastic film, and the like, about a cardboard core, and it will be seen that the present invention is also applicable to the temporary adhesion of such materials to the

cardboard core, and is included herein where reference is made to temporarily adhering paper (in this case the cardboard core) to another surface.

It is the principal object of the present invention to provide a method for bonding paper temporarily to another surface, at least the paper or the surface to which it is applied, being absorbent, by which, in spite of a very high degree of initial adhesion, the bond is completely lost within a short time after the paper and the other surface have been initially adhered together.

Another object of the invention is to provide a method of bonding, temporarily, paper to another paper body, at least one of said paper members being absorbent.

Another object of the present invention is to provide a method of bonding, temporarily, paper to another paper body, at least one of said paper members being absorbent.

Another object of the present invention is to provide a method for adhering paper temporarily to another surface whereby, after the adhesive bond is lost, the paper exhibits no adverse marking, transparentization, or the like.

A further object of the present invention is to provide a novel adhesive composition for temporarily adhering paper to another surface, especially to another paper body, which composition, after application to paper and performing its initial bonding function, completely loses its adhesive properties and leaves no deleterious markings on the paper such as transparent areas, and the like.

Other objects will become apparent from a consideration of the following specification and the claims.

The process of the present invention comprises applying to at least one of the surfaces which are to be adhered together, that is either to the paper or to the surface to which the paper is to be bonded, or to both, hydrogenated rosin, and then bringing together the surfaces to be bonded with the hydrogenated rosin therebetween. For example, in the winding of a long strip of paper, such as paper toweling, toilet tissue, waxed paper, and the like, onto the cardboard core to make a rolled product, hydrogenated rosin may be applied to the core or to the end of the paper strip, or to both, following which the end of the paper strip is contacted with the cardboard core, with the hydrogenated rosin adhering the end of the paper strip to the cardboard core, and winding the paper strip thereon until the desired roll has been built up. The process is particularly applicable for use in the more recent high-speed, continuous winding equipment wherein the core is started rotating before picking up the end of the paper strip. The hydrogenated rosin will cause the end of the paper strip to adhere securely to the rotating cardboard core so that the paper will not slip from place and the winding operation may be satisfactorily carried to completion.

The operation of the last-mentioned embodiment will be more readily understood from a consideration of the drawings in which:

Fig. 1 is a diagrammatic side elevational view of apparatus wherein the hydrogenated rosin is applied to a rotating core following which an end of a strip of paper is picked up by and adhered to the rotating core and wound thereon; and

Fig. 2 is a diagrammatic elevational view of a portion of Figure 1 taken along the line 2—2.

In accordance with a preferred embodiment of the present invention, when an absorbent paper sheet is to be adhered temporarily to another surface, a small amount of a finely-divided pigment is included in the hydrogenated rosin to serve as opacifying agent and thus to prevent transparentization of the paper with which the hydrogenated rosin comes into contact. The color of the pigment will match the color of the paper. While in most

cases, the paper will be white, in which event a white pigment will be employed, in some instances, such as with tinted toilet tissue, a pigment matching the color and shade of the colored paper may be employed. In addition, in order to render the hydrogenated rosin easily removable from the machinery and to disperse it in the paper-making system should it get into that system associated with broke, it is also preferred to include in the hydrogenated rosin a small amount of a conventional surface active emulsifying agent. Theses embodiments will be discussed more in detail hereinafter.

The present invention is based upon the discovery that, although hydrogenated rosin possesses an extremely high degree of initial tack when first applied to paper so as to enable the paper to become bonded securely to another surface, especially to another paper body, the bond initially provided by the hydrogenated rosin may be destroyed without further treatment so that after a period of time the paper may readily be removed from the surface to which it was adhered initially. After the paper has been adhered to the surface by means of the tacky hydrogenated rosin, the hydrogenated rosin migrates away from the original bond line and through the paper or through the material of which the other surface is prepared, or through both, thereby losing its adhesive properties. In a matter of a few days, the exact number depending upon ambient temperature conditions, these adhesive properties are completely lost, and the paper may, therefore, readily be separated from the surface to which it was initially applied. In the winding of a long strip of paper onto a cardboard core, for example, in the preparation of rolls of paper toweling, toilet tissue, waxed paper, and the like, the end of the paper strip to be wound may readily be adhered to the cardboard core to facilitate the initiation of the winding operation. After the winding operation has been completed and by the time the resulting roll has reached the consumer, all of the paper on the roll is usable inasmuch as the last few layers or sheets of paper adjacent to the cardboard core will not adhere to the core and can readily be removed therefrom. As stated, the invention is particularly adapted for use on the recently-developed, high-speed, continuous winding equipment, and an important feature of hydrogenated rosin in this connection is that its viscosity can be controlled within a relatively wide range with relatively small changes in temperature. Thus, for ease of application to the rotating cardboard core, the hydrogenated rosin may be warmed to a point where it is relatively fluid and then applied to the rotating core. Contact wtih the rotating core quickly cools the material, rapidly increasing its viscosity so that it will not be thrown, by centrifugal force, from the core.

Although the hydrogenated rosin may transparentize the paper to which it is applied and the paper adjacent the area of initial bonding through migration, the inclusion of the opacifying agent, in accordance with a preferred embodiment of the invention, prevents this transparentization. In fact, any markings remaining on the paper through pick-up and migration of the opacifying agent-containing hydrogenated rosin will be, to the consumer, very slight if, indeed, they are at all perceptible. Although the hydrogenated rosin is not readily soluble in water, it can readily be removed from equipment during cleaning operations and can readily be dispersed in the paper making system, when a conventional surface active emulsifying agent is included therein in accordance with another preferred embodiment of the invention.

Since destruction of the bond is dependent upon migration of the hydrogenated rosin, either the paper or the surface to which the paper is adhered, or both, will be absorbent. When the paper is ordinary paper which is conventionally produced in roll form, such as paper toweling, toilet tissue, and the like, it is sufficiently absorbent to permit migration of the hydrogenated rosin thereinto. When a less absorbent or non-absorbent sheet such as waxed paper, plastic film or aluminum foil is to be adhered to a cardboard core for winding, reliance is placed on the cardboard core to absorb the hydrogenated rosin. Of course, in winding paper toweling, toilet tissue and the like on a cardboard core, the hydrogenated rosin migrates into both the paper and the core.

Hydrogenated rosin is the product of converting rosin to alcohol form by reduction. Hydrogenated rosin, or hydroabietyl alcohol as it is known technically, is a colorless, tacky, viscous liquid at room temperature. The viscosity of the material ranges from about 400 poises at 40° C. to about 0.4 poises at 100° C. This range of viscosity is advantageous as a practical matter since it may be controlled by temperature as mentioned previously. Hydrogenated rosin is actually composed of a mixture of dehydroabietyl, dihydroabietyl and tetrahydroabietyl alcohols plus a minor proportion, usually less than about 20%, of a non-alcohol fraction. Under normal conditions, the material will neither oxidize nor polymerize and, hence, through plastic flow it will migrate through the paper or through the surface to which the paper is applied thereby losing its initial bonding power. A typical hydrogenated rosin which has been found to be highly advantageous in accordance with the present invention is "Abitol," a product of the Hercules Powder Co. The alcoholic fraction of this material contains between about 14 and about 23% of dehydroabietyl alcohol, between about 36 and about 39% of dihydroabietyl alcohol and between about 38 and about 50% of tetrahydroabietyl alcohol. The non-alcohol fraction makes up an average of about 15% of the hydrogenated rosin.

The liquid portion of the adhesive employed in accordance with the present invention consists essentially of the hydrogenated rosin, and if small amounts of an organic solvent such as xylene, carbon tetrachloride, ethylene dichloride, and the like, are included for any reason, it is preferred that such material be in an amount less than about 20% based on the weight of the hydrogenated rosin.

As stated, in order to prevent transparentization of the paper to which the hydrogenated rosin adhesive is applied, it is preferred to include in the hydrogenated rosin a small amount of an opacifying agent. Such opacifying agents may be any finely-divided, inert inorganic material, the color and shade of which, will match or correspond to that of the paper. Such materials will disperse in the hydrogenated rosin and migrate with it through the paper to mask the transparentization effect which would ordinarily be produced by the hydrogenated rosin. While there is a wide variety of materials available for this purpose, titanium dioxide is particularly advantageous. Since the main function of the opacifying agent is to mask the transparentization occasioned by the hydrogenated rosin, the amount thereof employed may vary widely depending upon the results desired. In general, between about 1 and about 10%, by weight, based on the weight of hydrogenated rosin, will be employed.

To render the adhesive easily removable from the equipment by a cleaning operation involving water and to render the adhesive readily dispersable in case it should get into the paper-making system, it is preferred to include in the adhesive composition a small amount of a surface active emulsifying agent. Any conventional surface-active agent may be used for this purpose so long as it is compatible with and dispersible in the remainder of the composition to form a homogeneous mixture. The agent may be cationic, anionic or non-ionic. Examples of anionic surface-active agents in the form of water-soluble salts are: soaps, such as potassium palmitate, triethanolamine oleate, morpholine stearate, sodium laurate, and ammonium myristate; alkyl benzene sulphonates, such as sodium dodecyl-, keryl-, or tridecyl-benzene sulphonates; alkyl diphenyl sulphonates, such as sodium butyl diphenyl sulphonate; alkyl naphthalene sulphonates, such as sodium diisopropyl naphthalene sulphonate, ammonium diamyl naphthalene sulphonate, sodium

monononyl naphthalene sulphonate, sodium isopropyl isobutyl naphthalene sulphonate, and sodium dinonyl naphthalene sulphonate; sulphated aliphatic alcohols such as sodium hexadecyl sulphate, sodium oleyl sulphate, triethanolamine dodecyl sulphate, sodium 3, 9-diethyl 6-tridecanol sulphate, sodium 2-methyl 7-ethyl 4-undecanol sulphate, and sodium 2-ethyl 1-hexanol sulphate; sulphated and sulphonated fatty oils, acids or ester, such as the sodium salt of sulphonated castor oil, the sodium salt of sulphated red oil, the sodium salt of sulphonated butyl oleate, and the sodium salt of sulphonated isopropyl oleate; alkyl sulpho phthalates, such as sodium hexadecyl sulpho phthalate; sulphated amides, such as sulphated hydroxyethyl lauramide and sulphated hydroxy-isopropyl palmitamide; sodium salt of lauryl sulpho acetate; sodium salt of dioctyl sulphosuccinate; sodium salt of oleyl methyl tauride; sodium salt of sulphonated dodecyl benzoate, and the like. Examples of non-ionic active agents are: partial esters of polyhydric alcohols, such as nonaethylene glycol monolaurate, and tricosaethylene glycol monolaurate; condensation products of alkyl phenols with ethylene oxide such as the reaction product of isooctyl phenol with 12 ethylene oxide units; condensation products of alkyl thiophenols with 10 to 15 ethylene oxide units; condensation products of higher fatty alcohols with ethylene oxide such as the reaction products of oleyl alcohol with 10 to 15 or more ethylene oxide units; ethylene oxide addends of monoesters of hexahydric alcohols and inner ethers thereof such as sorbitan monolaurate, sorbitol monooleate, sorbitan monopalmitate and mannitan monopalmitate; the non-ionic reaction products of fatty acids, or their derivatives, with at least two molecules of hydroxylated amines as described in Patent No. 2,089,212; and the like. Examples of cationic surface-active agents are: salts of primary, secondary and tertiary amines, such as oleyl amine acetate, dodecyl amine acetate, dioctyl amine lactate, stearoyldiethanolamine acetate, and dilauroyl triethylene-tetramine diacetate; and quaternary salts, such as lauryl pyridinium bromide, octodecyl ethyl morpholinium chloride, lauroyl-oxyethyl di- (hydroxy ethyl) ethyl ammonium ethyl sulphate, oleyl-oxyethyl trimethyl ammonium ethyl sulfate, oleyloxyethyl trimethyl ammonium chloride, and the like. The ethylene oxide addends of monoesters of hexahydric alcohols and inner ethers thereof, especially sorbitan monopalmitate, are particularly advantageous.

The amount of emulsifying agent incorporated in the adhesive mixture may vary widely. In addition to facilitating removal of the hydrogenated rosin from the equipment and dispersion thereof in the paper-making system, the surface active agent may be used as a diluent or extender or to adjust the viscosity of the hydrogenated rosin especially to facilitate migration during colder weather. In general, between about 1 and about 20%, by weight, based on the weight of hydrogenated rosin, will be suitable, and preferably between about 5 and about 15% will be used.

In preparing the adhesive composition of the present invention, in the event that an opacifying agent or an emulsifying agent, or both, are to be included in the composition, these materials, or any one of them, may merely be mixed with the hydrogenated rosin. To facilitate mixing, the hydrogenated rosin is preferably heated such as to about 150° F. to reduce its viscosity.

In adhering paper in accordance with the process of the invention, the adhesive composition may be applied either to the paper or to the surface to which the paper is to be adhered, or to both. To facilitate handling and application of the adhesive composition it may be warmed, such as to 120–150° F. in order to reduce its viscosity, or its viscosity may be adjusted by including in the composition a small amount of a solvent of the type mentioned above or by means of the surface active agent. In the preparation of rolled paper products, for example, the adhesive composition is merely applied to the end of a strip of paper to be wound, or to the cardboard core, usually the latter, or to both, initially to adhere the end of the paper strip to the cardboard core. Once the end of the paper strip is in place and adhered to the cardboard core the winding operation may be continued until the desired roll has been built up, and the bondability of the adhesive is no longer important. During the winding operation, the adhesive will migrate through the paper layers and into the coardboard core gradually losing its adhesive effect until by the time the roll has reached the consumer the bond between the paper and the core is completely lost.

The drawings illustrate operation of portions of representative automatic winding equipment of the type mentioned above in carrying out the present invention. In Figure 1, the hydrogenated rosin composition **1** is retained in vessel **2**. **3** represents one of a plurality of applicator wheels mounted on rotating axle **4**. The axle and wheel assembly rotate counter clockwise. **5** is a core, such as a cardboard cylinder, mounted on rotating mandrel **6**. Mandrel **6** and core **5** rotate clockwise. **7** is a similar rotating core and mandrel assembly which has already had the hydrogenated rosin composition applied thereto, and is travelling, in a clockwise orbit as shown, toward the paper-pickup position. **8** is a similar rotating core and mandrel assembly which has passed the paper-pickup position and upon which paper sheet **9** is being wound into a roll. Paper sheet **9** is fed from bed roll **10**. As is known the orbital and rotational movements of the core-mandrel assemblies with respect to paper sheet **9** are synchronized such that when a full roll has been built up on core-mandrel assembly **8**, paper sheet **9** is cut, and the free sheet end meets core-mandrel assembly **7**. Winding then begins on assembly **7**.

In Figure 2 the applicator mechanism of Figure 1 is viewed along line **2—2**. Hydrogenated rosin composition **1*a*** is retained in vessel **2*a***. Applicator wheels **3*a***, mounted on axle **4*a***, rotate picking up adhesive composition **1*a*** transferring it in the form of bands **11** to core **5*a***. Core **5*a***, mounted on mandrel **6*a***, is shown as cut into sections of the desired length along lines **12**, each section carrying two bands, **11**, of adhesive composition in this illustration.

It will be realized that the drawings and above description thereof are illustrative only, since, as will be apparent to those familiar with the art, the deposit of adhesive composition may take a wide variety of forms. For instance, each core section may be provided with one or more than two bands of adhesive, and the adhesive deposit need not be in the form of continuous bands but may be discontinuous deposits about the periphery of the core.

The practice of the present process and the preparation of the novel adhesive composition may be more clearly understood from a consideration of the following specific example which is given for the purpose of illustration only and is not intended to limit the scope of the invention in any way.

Example

Five parts of titanium dioxide, 10 parts of sorbitan monopalmitate and 100 parts of technical hydroabietyl alcohol are thoroughly mixed together. The resulting adhesive composition, warmed to 125° F., is applied in two bands about a cardboard core. The end of a strip of toilet tissue is then adhered to the cardboard core and the core rotated to wind the tissue about the core. After the roll has been prepared and has stood for a few days, it is found, upon unrolling the paper, that the paper adjacent the cardboard core no longer adheres thereto and may readily be removed therefrom. Moreover, the composition leaves markings which are only barely perceptible.

Considerable modification is possible in the selection of the various materials employed as well as in the tech-

niques followed without departing from the scope of the invention.

We claim:

1. The method of bonding paper temporarily to another surface, at least one of which members is absorbent, which comprises bringing together the paper and the surface to which the paper is to be adhered temporarily with hydrogenated rosin therebetween.

2. The method of bonding paper temporarily to another paper body, at least one of said paper members being absorbent, which comprises bringing together the paper members with hydrogenated rosin therebetween.

3. The method of claim 2, wherein said hydrogenated rosin contains a small amount of a surface active emulsifying agent.

4. The method of claim 2, wherein said hydrogenated rosin contains a small amount of a finely-divided inert inorganic opacifying agent.

5. The method of claim 4, wherein said hydrogenated rosin also contains a small amount of a surface active emulsifying agent.

6. The method of bonding paper temporarily to cardboard which comprises bringing together the paper and cardboard with hydrogenated rosin therebetween.

7. The method of claim 6, wherein said hydrogenated rosin contains a small amount of a surface active emulsifying agent.

8. The method of claim 6, wherein said hydrogenated rosin contains a small amount of a finely-divided inert, inorganic opacifying agent.

9. The method of claim 8, wherein said hydrogenated rosin also contains a small amount of a surface active emulsifying agent.

10. In the winding of sheet material about a cardboard core in the manufacture of a rolled product, the method of bonding the sheet strip temporarily to the cardboard core to facilitate the initiation of the winding operation without, however, providing a permanent bond between the sheet and the core, which comprises bringing together one end of the sheet strip and the cardboard core with hydrogenated rosin therebetween.

11. In the winding of a paper strip about a cardboard core in the manufacture of a rolled paper product the method of bonding the paper strip temporarily to the cardboard core to facilitate the initiation of the winding operation without, however, providing a permanent bond between the paper and the cardboard core, which comprises bringing together one end of the paper strip and the cardboard core with hydrogenated rosin therebetween.

12. The method of claim 11, wherein said hydrogenated rosin contains a small amount of a surface active emulsifying agent.

13. The method of claim 11, wherein said hydrogenated rosin contains a small amount of a finely-divided, inert inorganic opacifying agent.

14. The method of claim 13, wherein said hydrogenated rosin also contains a small amount of a surface active emulsifying agent.

15. A composition for bonding, temporarily, paper to another surface, at least one of which members is absorbent, which consists essentially of hydrogenated rosin containing small amounts of a surface active emulsifying agent and of a finely-divided, inert, inorganic opacifying agent.

16. The composition of claim 15, wherein said surface active emulsifying agent is sorbitan monopalmitate.

17. The composition of claim 15, wherein said opacifying agent is titanium dioxide.

18. A composition for bonding, temporarily, paper to cardboard which consists essentially of hydrogenated rosin containing between about 1 and about 10%, by weight, of a finely-divided, inert, inorganic opacifying agent and between about 1 and about 20% of a surface active emulsifying agent.

19. The composition of claim 18, wherein said opacifying agent is titanium dioxide and, wherein, said surface active emulsifying agent is sorbitan monopalmitate.

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