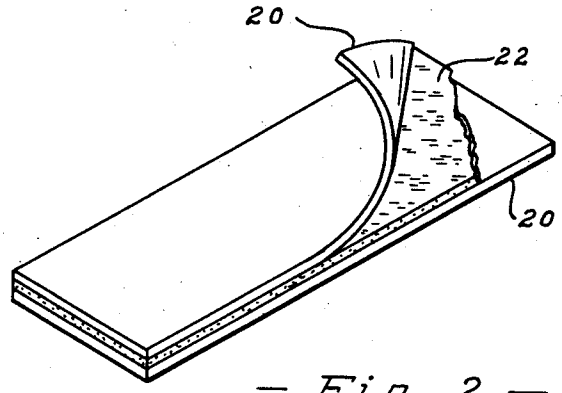
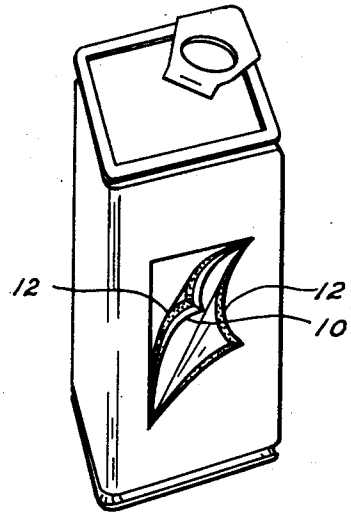
May 4, 1965 F. A. BONZAGNI ETAL 3,181,765

LAMINATED MILK CARTON

Filed Jan. 3, 1961

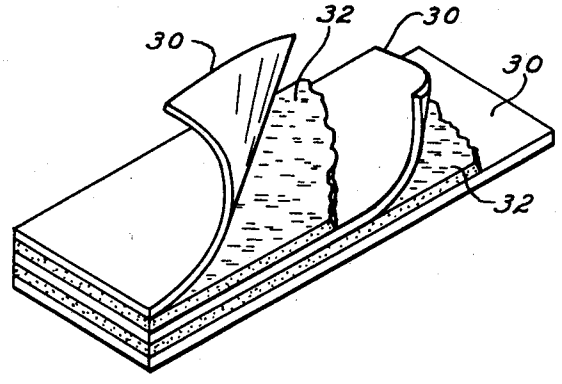


— Fig. 2 —



— Fig. 1 —

— Fig. 3 —



FRANCIS A. BONZAGNI INVENTORS.
OSCAR P. COHEN
BY Richard L. Kelly
ATTORNEY.

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LAMINATED MILK CARTON

Francis A. Bonzagni, Springfield, and Oscar P. Cohen, Longmeadow, Mass., assignors to Monsanto Company, a corporation of Delaware

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This invention relates to an improved petroleum wax coating or adhesive composition, and to an improved process for bonding materials therewith.

Petroleum waxes as such have long been used as a protective coating for various types of containers and wrapping paper, particularly those used for food and dairy products. The coating serves the purpose of protecting the container or the paper from direct contact with the food or dairy product contained therein. This is particularly necessary with paper milk cartons, for example, where resistance to lactic acid is important so as to preserve the rigidity of the container thereby retaining its usefulness and sales appeal. Improvements have been made by incorporating certain additives into the petroleum wax to improve flexibility, toughness and peel resistance. Among some of the additives that have been proposed are polyethylene and copolymers of ethylene with up to about 25% of vinyl acetate as shown in U.S. Patent 2,877,196.

Since a petroleum wax coating is an excellent moisture barrier, it would be desirable to incorporate such a coating in a laminated structure, particularly as an adhesive interlayer. The use of such an adhesive interlayer, for example, in bonding sheets of paper would render the structure resistant to moisture by virtue of the petroleum wax interlayer. However, to effectively form a laminated structure of this type, the petroleum wax composition to be employed therein must possess good adhesive properties in addition to the other desirable properties of flexibility, toughness and resistance to peel. Although the known wax compositions possess some of these properties, they do not have good adhesive qualities.

Therefore, it is an object of this invention to provide an improved petroleum wax adhesive or coating composition.

Another object of this invention is to provide an improved process for laminating sheet materials together in which a petroleum wax composition is interposed between the sheets as an adhesive interlayer.

Still another object of this invention is to provide a paper board milk container which carries on at least the interior surfaces thereof a coating of a petroleum wax composition.

Other objects and advantages of this invention will become apparent from the following description thereof.

FIG. 1 is a schematic drawing of a paper board milk carton with portions thereof cut away to show the wax coating carried thereon.

FIG. 2 is a schematic drawing of a cellulosic paper sheet laminate with a petroleum wax adhesive composition employed as the adhesive interlayer.

FIG. 3 is a schematic drawing of a laminate consisting of three cellulosic paper sheets which are bonded together with a petroleum wax adhesive composition.

Briefly, according to this invention, there are provided petroleum wax compositions which consist essentially

of a mixture of 98–90% by weight of a petroleum wax and, correspondingly, 2–10% by weight of a particular restricted type of copolymer of ethylene and vinyl acetate. The ethylene-vinyl acetate copolymer employed in this invention has a vinyl acetate content of 35–30% by weight of the copolymer and, correspondingly, 65–70% by weight of ethylene. In addition, the copolymer has a melt index of 1–250. Both of these limitations must be followed in order to obtain petroleum wax compositions having good adhesive qualities and improved lactic acid resistance.

The following examples are set forth to illustrate more clearly the nature of the invention and to distinguish it from the prior art. Where parts or quantities are mentioned, they are parts or quantities by weight.

EXAMPLE I

Part A

A solution of an ethylene-vinyl acetate copolymer in petroleum wax is prepared by dissolving in 140° C. petroleum wax, pellets of an ethylene-vinyl acetate copolymer having a vinyl acetate content of 35% and a melt index of 60. The amount of the ethylene-vinyl acetate copolymer added is such as to produce a petroleum wax composition having 10% of ethylene-vinyl acetate copolymer therein. This wax composition is henceforth identified as A.

Part B

Part A is repeated except that the ethylene-vinyl acetate copolymer employed therein has a vinyl acetate content of 24% and a melt index of about 5. This wax composition is subsequently identified as B.

Part C

Part A is repeated except that the amount of the ethylene-vinyl acetate copolymer employed therein is such as to produce a petroleum wax composition having 5% of the ethylene-vinyl acetate copolymer therein. This wax composition is subsequently identified as C.

Part D

Part B is repeated except that the amount of the ethylene-vinyl acetate copolymer employed therein is such as to produce a petroleum wax composition having 5% of the ethylene-vinyl acetate copolymer therein. This wax composition is subsequently identified as D.

Part E

The petroleum wax employed in Part A–D is used without modifiers or additives as a control and is subsequently identified as Control I.

Part F

A solution of polyethylene in petroleum wax is prepared by dissolving pellets of polyethylene having a melt index of about 200 in 140° C. petroleum wax to form a wax composition having 5% by weight of polyethylene therein. This wax composition is subsequently identified as Control II.

EXAMPLE II

Laminates are prepared by laminating 2" x 8" sheets of various materials together with the wax compositions of Example I. In each case, the laminate is prepared by

pouring a portion of hot (140° C.) wax composition on the first sheet, placing the second sheet thereon and squeezing out the excess wax composition by drawing down the assembly with a glass rod. No adhesive is used for a distance of 2" from one end of the assembly so that the sheets can be gripped to pull the laminate apart to measure the strength of the bond. Each laminate sample is conditioned for 24 hours at 25° C. and is tested by being pulled apart on an Instron Tensile Tester with the jaws thereof being separated at a rate of twelve inches per minute. The force (in lbs./inch of width) required to separate the laminates are set forth in Table I.

TABLE I

Adhesive Composition	Percent EVA [1] In Adhesive Composition	Percent VA [2] In EVA [1]	Adhesive Strength (lbs./inch of width)		
			Aluminum Foil to Aluminum Foil	Aluminum Foil to Paper	Paper to Paper
A	10	35	1.9	2.3	3.0 (paper failure).
B	10	24	1.2	0.8	0.5.
C	5	35	1.3	1.9	2.0.
D	5	24	0.6	0.7	0.4
Control I			0	0	0
Control II			0	0	0.2

[1] EVA—Ethylene-vinyl acetate copolymer.
[2] VA—Vinyl acetate.

As shown in this example, when a petroleum wax composition contains 10% by weight of the ethylene-vinyl acetate copolymer containing therein 35% by weight of vinyl acetate (Composition A), the adhesive strength is about 600% greater in a paper-to-paper bond than with a comparable composition having a vinyl acetate content of only 24% by weight of the copolymer (Composition B). In fact, failure occurred in the paper instead of in the adhesive interlayer. In comparing the straight petroleum wax (Control I), the adhesion of the composition of this invention (Compositions A and C) is infinitely greater since the straight petroleum wax bond has no adhesive strength. Similar magnitudes of difference are also obtained in the comparison of the results with an aluminum foil to aluminum foil laminate and an aluminum foil to paper laminate.

EXAMPLE III

The purpose of this example is to illustrate the lactic acid resistance of the wax compositions as prepared according to Example I, Part C, Part D, Part E and Part F. Each composition is used to coat separate samples of 16 point milk carton board by a dip treating method. The test samples are dipped into each of the hot (140° C.) was compositions for 30 seconds. The coated samples are withdrawn and allowed to set at room temperature. They are then soaked in a 1% aqueous lactic acid solution for 48 hours. The increase in weight and the wet stiffness of each sample (both of which are affected by the quantity of lactic acid solution adsorbed) are determined on each sample. The wet stiffness is determined on a Gurley R.D. Stiffness Tester and this test shows the force required to bend the sample. The results are as follows:

Composition	Percent Lactic Acid Pickup	Wet Stiffness Grams
C	12.7	12.8
D	23.2	8.3
Control I	40.0	3.2
Control II	30.2	5.4

As shown in this example, an almost 50% decrease in lactic acid pickup is found with a wax composition of this invention (Composition C) as compared to a similar composition in which the ethylene-vinyl acetate copolymer component has a vinyl acetate content of only 24%

(Composition D). Similarly, the wet stiffness of the sample coated with the wax composition of this invention (Composition C) is approximately 50% greater than the sample coated with the wax composition in which the ethylene-vinyl acetate component has a vinyl acetate content of only 24% (Composition D). Similar magnitudes of difference are also obtained when comparing the composition of this invention with control Compositions I and II.

FIGURE 1 is a milk carton with a portion of the side thereof cut away to show the cellulosic paperboard base structure **10** having deposited on both sides thereof film **12**. Film **12** consists of a blend of 95% wax and 5% of an ethylene-vinyl acetate copolymer having a melt index and an ethylene/vinyl acetate ratio within the limits herein described.

FIGURE 2 is a laminated structure with portions thereof cut way. The structure consists of two sheets of cellulosic paper **20—20** which are bonded together by an adhesive interlayer **22**. FIGURE 3 is a laminated structure which consists of three sheets of cellulosic paper **30—30** which are bonded together with adhesive interlayers **32**. The adhesive interlayers **22** and **32** consist of a blend of 95% of petroleum wax and 5% of an ethylene-vinyl acetate copolymer having a melt index and an ethylene/vinyl acetate ratio within the limits herein described.

The petroleum wax compositions of this invention consist essentially of 98–90% by weight of a petroleum wax and, correspondingly, 2–10% by weight of a copolymer of 35–30% by weight of vinyl acetate and, correspondingly, 65–70% by weight of ethylene. The ethylene-vinyl acetate copolymer employed has a melt index of about 1 to 250, as determined by ASTM D–1238–57T (Condition E). The cloud point of the petroleum wax composition is in the range of 75° C.–130° C. Cloud point, as herein used, means that temperature at which sufficient crystallization occurs, so as to render newsprint illegible when viewed through a 60 mm. column of the petroleum wax composition. In determining the cloud point the wax composition is cooled at a rate of about 2° C./minute from an initial temperature of 140° C.

The petroleum wax compositions of this invention have improved lactic acid resistance and improved adhesive strength as compared with analogous compositions in which petroleum wax is blended with either polyethylene or an ethylene-vinyl acetate copolymer which contains up to 25% of vinyl acetate.

The wax compositions of this invention, because of their good adhesive properties, can be used advantageously in bonding together sheets of diverse types of materials to form laminated structures. In preparing such laminated structures, the wax composition is heated to above its melting temperature and interposed between the sheets to be bonded together. Preferably, the lamination step is carried out under pressure and the wax composition is conventionally employed in the amount of from about 5 grams to about 40 grams per sq. ft. of glue line. The laminated structure may contain any desired number of sheets bonded together. Particularly valuable structures are obtained by bonding sheets of cellulosic paper, metal foil, and woven or non-woven textiles to themselves or to other materials.

The lactic acid resistance of the petroleum wax compositions renders them highly useful in coating paper that is to be used in wrapping or packaging dairy products such as butter, cottage cheese, milk or the like. The petroleum wax compositions are particularly useful in coating the interior surfaces (and optionally the exterior surfaces) of paper board milk cartons.

It will thus be seen that the objects set forth above, among those made apparent from the preceding description, are efficiently attained. Since certain changes may be made in the above described processes and compositions without departing from the spirit and scope of the

invention, it is intended that all matters contained in the above description shall be interpreted as illustrative and not in a limiting sense.

What is claimed is:

1. A laminated structure having improved lactic acid resistance and improved adhesion consisting essentially of a plurality of cellulosic paper sheets bonded together by a petroleum wax adhesive composition and carrying on at least one exposed surface thereof a petroleum wax coating composition; said petroleum wax adhesive composition and said petroleum wax coating composition consisting essentially of 98–90% by weight of a petroleum wax and, correspondingly, 2–10% by weight of a copolymer of 65–70 weight percent of ethylene and, correspondingly, 35–30 weight percent of vinyl acetate and wherein said copolymer has a melt index of about 1–250 and has a cloud point of about 75–130° C.

2. The laminated structure of claim 1 suitable for packaging dairy products wherein the laminated structure

consists of at least two cellulosic paper sheets bonded together with the petroleum wax adhesive composition and carrying on at least the interior surface thereof the petroleum wax coating composition.

3. The laminated structure of claim 2 being a milk carton.

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EARL M. BERGERT, *Primary Examiner.*

HAROLD ANSHER, CARL F. KRAFFT, *Examiners.*