Nov. 24, 1964 G. G. RUMBERGER 3,158,073

TREATMENT OF CARTON SCORES

Filed Aug. 23, 1961

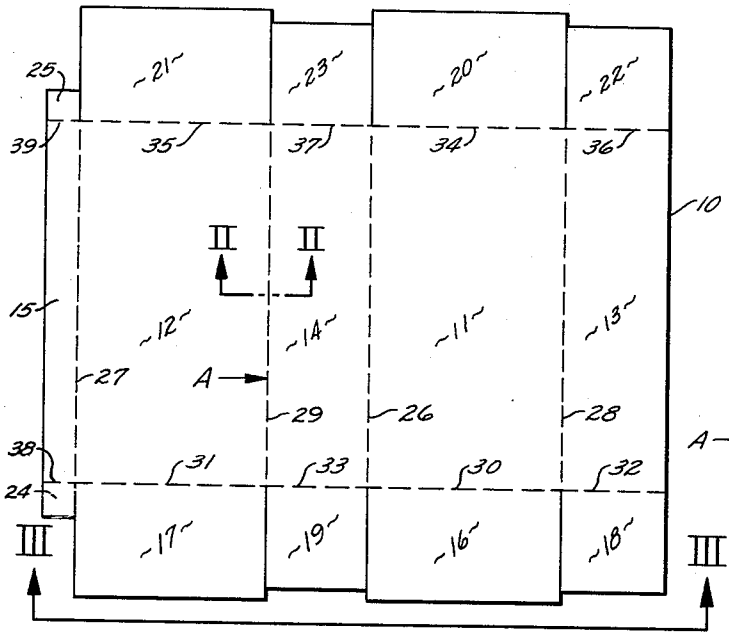


FIGURE 1

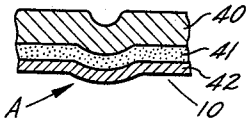


FIGURE 2

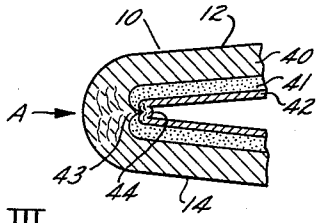


FIGURE 4

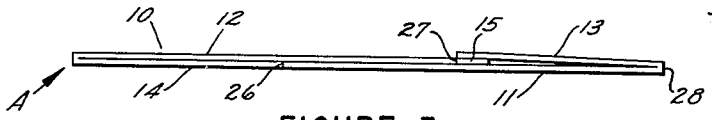


FIGURE 3

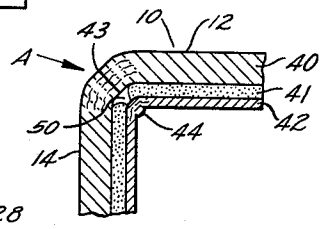


FIGURE 6

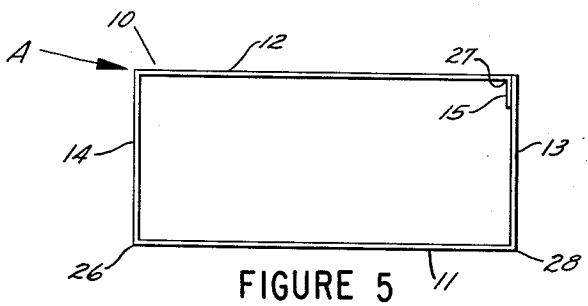


FIGURE 5

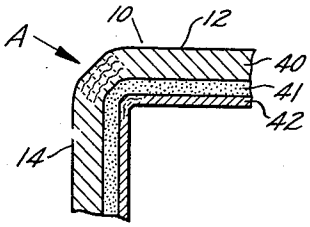


FIGURE 7

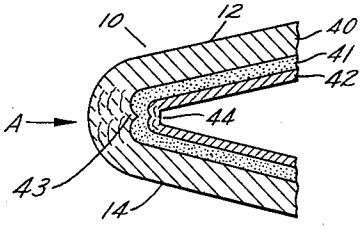


FIGURE 8

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TREATMENT OF CARTON SCORES

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This invention relates to a method of treating score lines of folding cartons manufactured from sheets of material composed of two or more sheets or plies of paperboard, paper, film, or foil laminated together with a thermoplastic adhesive to improve their resistance to the transmission of gases and liquids, in which the plies are the same or different, and in a preferred embodiment relates to the improvement of carton scores from the standpoint of reducing their liquid-vapor transmission characteristics in folding cartons produced from material stocks composed of such laminated sheets or plies wherein one or more of the sheets or plies is thicker than the layer of thermoplastic adhesive thereinbetween.

It has long been recognized that the provision of score lines in folding cartons has been detrimental to the protective properties of cartons fabricated from sheet materials bearing or containing thermoplastic protective layers. For this reason, paraffin coated cartons are generally waxed *after* scoring. Using laminated stocks in the usual manner *without* waxing after scoring, the detrimental effects of scoring and subsequent bending have never heretofore been satisfactorily overcome.

OBJECTS

It is accordingly a principal object of the present invention to provide a method for the treatment of score or fold lines of folded cartons manufactured from sheets of material composed of two or more sheets or plies laminated together with a thermoplastic adhesive to improve their resistance to the transmission of gases and liquids.

It is a further object of the invention to provide a method for the treatment of carton scores for the purpose of reducing their liquid-vapor transmission characteristics.

Another object of the invention is the treatment of the score lines of such folding cartons wherein one or more of the sheets from which the carton stock is composed is thicker than the layer of thermoplastic adhesive between the sheets.

An additional object of the invention is to provide a method for the treatment of score or fold lines of such folding cartons which includes the steps of folding the laminated sheet materials from which the carton is constructed to provide a panel intersection at a folded score line and then applying heat, or heat and pressure, in the vicinity of the score line at the panel intersection to reconsolidate the thermoplastic laminant into an essentially continuous layer.

A still further object of the invention is the provision of a method for the treatment of score or fold lines of such folding cartons after partial or complete erection of the carton, which involves the application of heat and pressure to the previously folded and unfolded scored area to reconsolidate the thermoplastic adhesive into an essentially continuous layer, either before or after filling of the carton.

Still a further object is the provision of cartons having improved protective properties which are produced by employing the method of the present invention.

Other objects of the invention will be apparent to one skilled in the art and still other objects and advantages of the invention will become apparent hereinafter.

To the accomplishment of the foregoing and related ends, the present invention then comprises the features hereinafter fully described and particularly pointed out in the claims, the following description setting forth in detail certain illustrative embodiments of the invention, those being indicative, however, of but a few of the various ways in which the principles of the invention may be employed.

DRAWINGS

The invention is illustrated by the drawings in which the same numerals refer to corresponding parts and in which:

FIGURE 1 is a plan view of a carton blank, showing one score line thereof identified as A.

FIGURE 2 is an enlarged partial cross sectional view taken on line II—II of FIGURE 1, showing score line A of the carton blank.

FIGURE 3 is a side elevational view taken on line III—III of FIGURE 1 upon folding of the carton blank into a folded carton.

FIGURE 4 is an enlarged partial cross sectional view taken on line II—II of the carton blank of FIGURE 1 showing the same score line A as shown in FIGURE 2 upon folding of the carton blank at that score line approximately one hundred eighty degrees (as in FIGURE 3).

FIGURE 5 is a side elevational view of the folded carton as shown in FIGURE 3 upon unfolding ninety degrees.

FIGURE 6 is an enlarged partial cross sectional view taken on line II—II of the carton blank of FIGURE 1, showing the same score line A as shown in FIGURE 4 but upon unfolding of the carton blank at that score line to a ninety degree angle (as in FIGURE 5).

FIGURE 7 is the same as FIGURE 6 showing the same score line A shown in FIGURE 6 but after heat treatment according to the present invention.

FIGURE 8 is the same as FIGURE 4 showing the same score line A shown in FIGURE 4 but after heat treatment according to the present invention.

DESCRIPTION

Referring now to the drawings and with particular reference to FIGURE 1, there is shown a generally rectangular precut carton blank 10 of laminated sheet material from which a folding carton is assembled. This blank includes a rectangular front face panel 11, a rectangular back face panel 12, a rectangular right hand end panel 13, and a rectangular left hand end panel 14 between front face panel 11 and back face panel 12. Glue flap 15 is adjacent to and integral with back face panel 12.

The blank includes a front bottom flap 16, back bottom flap 17, and bottom end flaps 18 and 19, all adjacent to and integral with the front, back, and end panels respectively. The blank is also provided with a front top flap 20, a back top flap 21, and top end flaps 22 and 23, all adjacent to and integral with the front, back, and end panels, respectively. The transversely arranged glue flap

15 is provided with bottom and top extensions 24 and 25 adjacent to and integral with said flap 15 at its bottom and top respectively, which in the assembled carton are attached to and fold with flaps 18 and 22.

The carton blank 10 is scored to provide a fold line 26 between front face panel 11 and left hand end panel 14 and to provide a fold line 27 between back face panel 12 and glue flap 15. The blank is likewise scored to provide a fold line 28 between front face panel 11 and right hand end panel 13 and to provide fold line 29 between back face panel 12 and left hand end panel 14. Since fold line 29 between back face panel 12 and left hand end panel 14 is particularly shown in greater detail in other figures, this fold or score line 29 will hereinafter be referred to as fold line or score line A. It is shown as A in all of the drawings.

Score or fold lines 26 through 29 are all parallel and extend transversely across blank 10.

The carton blank 10 is also scored longitudinally in spaced relation to one edge thereof to provide a fold line 30 between front face panel 11 and front bottom flap 16, fold line 31 between back face panel 12 and back bottom flap 17, and to provide fold lines 32 and 33 between end panels 13 and 14 and end bottom flaps 18 and 19. The blank is moreover provided with transverse cuts between the edge and the longitudinal score line forming fold lines 30 through 33 between the bottom flaps 16 and 18, 16 and 19, 17 and 19, and between bottom flap 17 and extension 24, to permit the bottom flaps to be folded inwardly at right angles with respect to their adjacent panels.

Still referring to FIGURE 1, the carton blank 10 is also scored longitudinally in spaced relation to its opposite edge to provide a fold line 34 between front face panel 11 and front top flap 20, to provide fold line 35 between back face panel 12 and back top flap 21, and to provide fold lines 36 and 37 between end panels 13 and 14 and top end flaps 22 and 23. The blank is also provided with transverse cuts extending from the marginal edge to the fold line between top flaps 20 and 22, 20 and 23, and 21 and 23, and between top flap 21 and extension 25, to permit the top flaps to be folded inwardly at right angles with respect to their adjacent panels.

Glue flap 15 is joined to back face panel 12 along fold line 27 and is also scored longitudinally in spaced relation to its edges to provide fold lines 38 and 39, which are respectively extensions of fold lines 31 and 35, along which fold lines 38 and 39 glue flap 15 is joined to its bottom and top extensions 24 and 25, respectively.

As shown in FIGURE 2, when the scored carton blank 10 is viewed in an enlarged partial cross section on line II—II of FIGURE 1, the effect of the scoring along score line A is apparent. The scoring produces a hump or indentation along score line A which is clearly visible in paperboard sheet 40, in paper sheet 42, and in the layer of thermoplastic adhesive 41 thereinbetween.

From FIGURE 3 may be seen the configuration of the folded carton blank, in one stage enroute to its erection into a fully erected carton, as seen in a side elevational view along line III—III of FIGURE 1, upon folding back face panel 12 back upon left hand end panel 14 approximately 180° along score line A, and then folding right hand end panel 13 back approximately 180° upon front face panel 11 along score line 28, and upon securing glue flap 15 to the inside or back of right hand end panel 13 with glue or thermoplastic adhesive. In this manner, the folded carton of FIGURE 3 is constituted from carton blank 10. Front and back face panels 11 and 12, end panels 13 and 14, glue flap 15, the not yet folded score lines 26 (between front face panel 11 and left hand end panel 14) and 27 (between back face panel 12 and glue flap 15), as well as the 180° folded score lines A between back face panel 12 and left hand end panels 14 and 28 between front face panel 11 and

right hand end panel 13 are all shown in FIGURE 3.

Referring now to FIGURE 4, an enlarged particular cross sectional view taken on line II—II of FIGURE 1, showing score line A of carton blank 10 upon folding of the carton blank along that score line approximately 180°, the disturbance or rupture of the fiber structure of the paperboard sheet 40 is apparent at 43. Similarly, the disturbance or rupture of the fiber structure of the paper sheet 42 is apparent at 44. The small wavy lines are further illustrative of the disturbance or rupture of the fiber structure of the sheets 40 and 42. It will be observed from FIGURE 4 that the thermoplastic laminant between paperboard sheet 40 and paper sheet 42 has been substantially pinched off along folded score line A by disturbance or rupture of the fiber structure of the paperboard sheet 40 and paper sheet 42 at 43 and 44, respectively, during the folding operation.

FIGURE 5 shows a side elevational view of the folded carton erected from the carton blank 10 upon unfolding 90° from the posture thereof shown in FIGURE 3. Front and back face panels 11 and 12, right hand and left hand end panels 13 and 14, the glue flap 15, and the score lines 26 and 27 (which have by now undergone at least one 90° fold), as well as score lines A and 28 (which have by now undergone at least a folding operation of 180° and then an unfolding operation of 90° in the process of carton erection), are all shown in FIGURE 5.

As will be seen from FIGURE 6, upon erection of the carton from the carton blank 10 by the unfolding of score lines A and 28 approximately 90° from the posture shown in FIGURE 3 to the posture shown in FIGURE 5, paperboard sheet 40 and paper sheet 42 (upon such unfolding) no longer continue to pinch off thermoplastic laminant 41, but rather recede from their previous configuration at 43 and 44, thereby leaving a crevice or crack 50 of microscopic or even submicroscopic dimensions along score line A at the intersection of back face panel 12 and left hand end panel 14. If allowed to remain in this condition, the liquid-vapor transmission of the carton by virtue of crevice or crack 50 will be less than desirable, thermoplastic laminant 41 obviously not being able to provide a continuous liquid-vapor barrier due to the said crevice or crack 50.

FIGURE 7 shows an enlarged partial cross sectional view of a carton erected from carton blank 10 at the intersection of back face panel 12 and left hand end panel 14 along score line A after treatment of the said carton score (or fold line, or panel intersection) according to the method of the invention. It will be observed that the thermoplastic laminant 41 between paperboard sheet or ply 40 and paper sheet or ply 42 is no longer constricted between 43 and 44 by the paperboard and paper sheets, respectively, as in FIGURE 4, and that the crevice or crack 50 which previously existed (see FIGURE 6) in the thermoplastic laminant 41 prior to treatment is no longer present, due to the reconsolidation, by remelting and fluxing, of the thermoplastic adhesive 41 into an essentially continuous layer according to the method of the invention.

FIGURE 8 shows the result obtained upon application of heat, or heat and pressure, to the fold of FIGURE 4 while still in the approximately 180° folded condition of FIGURE 4, and which upon erection by unfolding 90° will have the same cross section as shown in FIGURE 7, that is, the treatment of the fold while in the 180° folded condition reconsolidates the thermoplastic laminant at the score line treated and such reconsolidation is still effective even upon unfolding 90°.

In operation, carton blank 10 of sheet materials such as paper ply 40 and paperboard ply 42 laminated together with a thermoplastic laminant 41 is provided according to the conventional procedure of the art. After formation of the carton blank 10, including score or fold lines such as at 26, 27, 28, and A of FIGURE 1, the blank is folded upon its transverse fold lines at A and 28 so

that the bulge of FIGURE 2 is inward. After gluing or cementing glue flap 15 to the back or inside of right hand end panel 13, as with thermoplastic or any other suitable adhesive, the carton blank is fully folded upon its score lines A and 28 approximately one hundred eighty degrees into the folded carton as shown in FIGURE 3. At this state in the erection of the carton, the score lines at A and 28, which have been folded 180°, will be in approximately the condition indicated by FIGURE 4. Upon unfolding the folded carton of FIGURE 3 90°, which will impart a crease or fold of 90° to the carton scores 26 and 27 and which will unfold carton scores A and 28 from their 180° folded position to a 90° angle, a carton having the configuration shown in FIGURE 5 will have been formed. At this stage in the erection of the carton, the panel intersections A and 28, which have been folded 180° and then unfolded 90°, will be in the condition shown by FIGURE 6. The thermoplastic, laminant 41, having been substantially pinched off by the plies of carton material as shown in FIGURE 4, upon unfolding 90° will contain minute crevices or cracks 50 as indicated in FIGURE 6 upon the receding of the partially disrupted fibers of the sheet materials such as paperboard and paper plies 40 and 42 at 43 and 44 as indicated in FIGURE 6. In accord with the method of the invention, upon the application of heat, or heat and pressure, to or in the vicinity of the intersection of the panels as indicated by score line A (at the intersection of back face panel 12 and left hand end panel 14 in FIGURE 6), the thermoplastic laminant is caused to reconsolidate by melting and flowing into the minute crack or crevice 50 (FIGURE 6), thus reconstituting itself into a continuous impervious liquid-vapor barrier having no break at the panel intersections, as shown in FIGURE 7, despite the partial fiber ruptures which still remain in the carton plies, for example, in paperboard and paper plies 40 and 42. Thus, as will be seen from FIGURE 7, treatment according to the method of the invention has resulted in the elimination of the minute crack or crevice 50 (FIGURE 6) at the intersection of carton panels 12 and 14 along score line A and has resulted in the reestablishment of the continuous liquid-vapor barrier at that panel intersection.

In another embodiment of the process of the invention the carton scores, and particularly the scores such as A, which are folded 180° or approximately 180°, can advantageously be treated while the carton is still in the folded condition, by suitable application of heat, with or without pressure other than that caused by the tension of folding. In such cases heat is preferably applied during the gluing of the carton, or subsequent to gluing, but before the carton is erected. FIGURE 4 shows the cross sectional appearance of the 180° fold at score line A as hereinbefore described. FIGURE 8 shows the same fold or score line A after the application of heat to the fold in sufficient degree to cause the thermoplastic laminant to flow. After erection of the carton to form a panel intersection at score line A in which the panels are at an angle of approximately 90° with respect to each other, the fold will have the cross section shown in FIGURE 7 inasmuch as the inner sheet or ply 42, upon the application of heat or heat and pressure in the vicinity of the fold, will move inwardly with respect to the fold line under the compression already induced in said inner sheet or ply by the compressive forces of the folding. An illustration of this embodiment of the invention is given in Example 4.

As will be apparent from the foregoing, I have found by an exhaustive investigation of the factors involved, that the deficiencies of scored laminated cartons are due to a disruption of the protective film of the adhesive which both unites the sheets and acts as protective liquid-vapor transfer barrier layer. This damage is particularly severe when one or more of the sheet materials making up the carton stock is thicker than the layer of the thermoplastic film uniting the layers which, for obvious reasons, provides an effective liquid-vapor barrier only when it is continuous.

Much of the damage occurs during the scoring operation for, when the score is deep enough for proper folding, the protective layer of thermoplastic adhesive is severed, or at least severely thinned. Even when the adhesive film is not completely separated during scoring alone, subsequent folding operations such as occur in the process of gluing, score breaking, and setting up the carton for use, usually result in a break in the protective film of thermoplastic adhesive.

In the course of my investigations, I have found that an alcoholic solution of dye will penetrate small breaks and crevices of the protective film of adhesive and will reveal small imperfections not discernible to the eye or detectable even by microscopic examination. Another test for imperfections can be made by forming the scored sheet material into a carton and measuring its water vapor permeation by sealing anhydrous calcium chloride inside the carton and measuring the weight gain of the carton under atmospheric pressure at various humidities. I have also found that there is a good correlation between the permeation of alcoholic dye solution and water vapor transmission when pinhole type permeation is involved.

I have found that the protective properties of scored folding cartons made from sheets laminated together with thermoplastic adhesives can be materially improved by subjecting the scored areas to heat, and preferably heat and pressure, after the carton has been folded, or folded and unfolded, during the setting up operation. This can be conveniently accomplished by applying the heat, preferably heat and pressure, on the carton set up machine, either before or after the carton has been filled and closed. Any suitable means of effecting the heating and fluxing of the thermoplastic laminant at the scored areas may be employed. The operation is in any event most advantageously performed after the folding of the main body scores has been completed.

I have found that the carton score lines which have been bent through an angle of about 180° and then unfolded during setting up suffer the greatest damage, and in some cases the treatment of these scores alone, after folding or after folding and unfolding, will suffice to give the desired increase in protective characteristics to the carton.

The treatment of the score lines by heat, preferably heat and pressure, is beneficial whether the carton is glued shut at the top and bottom or heat sealed. This heat sealing may be done according to conventional procedure or as taught in my copending application Serial Number 133,439. The carton may also be wax dipped to secure the ends, if desired, according to conventional procedure.

My treatment is especially adaptable to the treatment of cartons made from sheets laminated together by the use of wax or microcrystalline wax compositions, especially, but not necessarily, those having a melting point in the range 130°–185° Fahrenheit. Very beneficial results may also be obtained when the laminating agent is basically paraffin wax containing a polymeric additive. Other thermoplastic laminating agents such as asphalt, polyethylenes, polyterpenes, and cellulose derivatives also respond well to the treatment. Microcrystalline waxes or paraffin wax, to which may be added rubbers, gums, resins and other suitable elastomers or film-forming ingredients, are especially suitable thermoplastic laminating agents.

In addition to regular crease scores as ordinarily made in the carton industry using male and female dies, my treatment is also beneficial in the treatment of cut scores, serrated scores, combination scores, and impression scores.

The sheet materals which may be laminated together include fibrous sheet materials such as paper and paperboard, films, foils, regenerated cellulose, and the like. For purposes of this specification, the term "paperboard" is employed to indicate any paper sheet having a weight

in excess of about 100 pounds per ream or any paper sheet more than about .007 inch in thickness, such as the paper board commonly made either on cylinder or Fourdrinier machines. Paper sheet weighing less than 100 pounds per ream or thinner than .007 inch is herein referred to as "paper." Generally speaking, the treatment is most necessary when one or both of the sheet materials used are thicker than the continuous thermoplastic adhesive used to unite the plies.

The treatment is also advantageous when more than two plies of sheet materials are united with thermoplastic adhesive, especially when the thickest sheet material used exceeds the thickness of the total laminating adhesive. The method of the invention has been been found advantageously applicable to laminated carton scores in which the thickness of the thermoplastic adhesive laminant in the carton stock is no greater than one (1) mil. This particular observation involved a carton stock in which a microcrystalline wax layer constituted the thermoplastic adhesive laminant, but the results are equally striking with other thermoplastic adhesive laminants, as will be apparent from the examples which follow.

I have found that it is necessary to treat only the surfaces of the carton at or immediately adjacent to the score lines, although some pressure and heat may be applied to the entire carton as long as the heat and pressure is most concentrated at or near the score lines. Generally speaking, I will apply heat and pressure on areas within one quarter inch of the score lines.

I have found that heat and pressure sufficient only to cause the thermoplastic adhesive material to flow is required. Through a series of tests, I have found that most thermoplastic materials will flow under pressure when the needle penetration as measured by ASTM Method D5–25 exceeds a value of about 60. In other words, with sufficient pressure, I may apply my treatment at any temperature above that at which the thermoplastic adhesive laminant reaches a needle penetration of 60.

In some cases, due to structural limitations, it is inadvisable to apply great pressure to the carton, in which case the temperature can be raised to obtain greater fluidity or plasticity with application of only a very mild pressure. In these cases heat alone is sufficient if the temperature of the thermoplastic adhesive is raised to the point where the adhesive will flow due to the internal stress at the score lines. This will occur readily when the temperature is raised to above the melting point of the adhesive. When the heating is done in or in conjunction with rapidly operating packaging machinery, it is desirable to use as high heat and pressure as is permissible, but for a time of as short a duration as possible, to weld the disrupted portions of the adhesive together. The temperature and pressure employed are only limited by the amounts of each, whether used individually or in combination, which will cause permanent disturbance of the configuration of the erected carton or undesirable alteration of either the carton exterior or the contents thereof, if any.

The following examples are given as illustrative only, and are not to be construed as limiting.

Example 1

A number of laminated sheet materials as described in Table I were cut into carton blanks of the design shown in FIGURE 1. Sets of blanks were prepared for heat sealing by providing slits in the liners of both end flaps, and the side seams were glued. The glued blanks forming carton bodies were folded flat, i.e., through an angle of 180° at two scores. Cartons were set up from one set (Set 1) of glued blanks by heat sealing one end, filling with fifty grams of anhydrous calcium chloride, then heat sealing the other end. These were placed in a room at 50% relative humidity and periodically weighed until a constant rate was obtained. The sidewall scores of each carton were then heated for two seconds under mild pressure with a hot iron having two sealing faces 5/16 inch wide, set at a 90° angle with relation to each other, and heated to 400° F., to provide a second set of cartons identical to the first except for the heat treatment. The cartons were replaced in the room and periodically weighed to obtain a new weight gain rate. A third set of duplicate cartons, after setting up, was tested at the score lines for penetration of alcoholic dye solution. A fourth set of duplicate cartons was tested, after setting up and treating the panel scores with the hot iron as above, in the same manner as for those containing the anhydrous calcium chloride. The results of these tests are given in Table II.

TABLE 1.—DESCRIPTION OF LAMINATED STOCK USED FOR CARTON BLANKS
[3000 Sq. ft.=1 Ream]

Sheet Combination	Outside Sheet	Inside Sheet	Composition and Thickness of Thermoplastic Laminating Adhesive
A	.012" Coated Bleached Paperboard.	23 lb./ream beater filled sulfite.	13.0% attapulgite.[1] 1.5% hydrogenated tallow amide surface active agent (Armid HT). 1.5% TiO_2. 84.0% Microcrystalline wax .006" thick.
B	do	27 lb./ream vegetable parchment.	Same as A.
C	.014" Solid News Paperboard.	50 lb./ream dry waxed sulfite.	1.66% Armid HT (See above). 13.34% attapulgite. 85.00% Microcrystalline wax .006" thick.
D	Same as C	Same as C	7.0% Alkyl ammonium montmorillonite (Bentone). 93.0% Microcrystalline wax 006" thick.
E	.006" (72 lb./ream) litho stock coated.	23 lb./ream beater filled sulfite.	10.0% attapulgite. 1.5% Armid HT (See above). 1.5% TiO_2. 87.0% Microcrystalline wax .006" thick.
F	.017" coated bleached paperboard.	50 lb./ream dry waxed sulfite.	3.6% Butyl Rubber. 96.4% Microcrystalline wax .006" thick.
G	.012" bleached paperboard.	35 lb./ream Roto .003" thick ("Roto" is coated Fourdrinier paper suitable for rotagravure printing).	Microcrystalline wax composition 20 lb./ream, .0013" thick.
H	35 lb./ream coated Roto .003" thick.	.012" bleached paperboard	Do.
I	35 lb./ream coated Roto	.016" bleached paperboard	Microcrystalline wax composition 30 lb./ream .002" thick.
J	.016" bleached paperboard.	35 lb./ream coated Roto	Do.
K	.012" bleached paperboard.	50 lb./ream dry waxed sulfite.	Microcrystalline wax composition .006" thick.

[1] Together constituting a thixotropic bodying agent.

TABLE II.—WEIGHT GAIN, GRAMS/DAY/BOX

Sheet Combination of Table I	Type Score	With Panel Intersections Untreated (Set 1)	With Panel Intersections Heated Under Mild Pressure (Set 2)	Factor Set 1 / Set 2	Dye Stain Test	
					Before Treatment (Set 3)	After Treatment (Set 4)
A	Crease	0.22	0.03	7+	Penetration	No Penetration.
A	Cut	0.20	0.03	7—	do	Do.
B	Crease	0.13	0.04	3+	do	Do.
C	do	0.15	0.09	2—	do	Do.
D	do	0.19	0.08	2+	do	Do.
E	do	0.07	0.04	2—	Spotty Penetration.	Do.

Example 2

A number of foodstuffs were packaged in heat sealing cartons fabricated from .012" coated Fourdrinier board adhesively united to several lightweight sheet materials with microcrystalline wax compositions applied as an intercalated film about .006" thick. The packages were exposed to 50% relative humidity at 73° F. and periodically weighed until a constant rate of weight gain was obtained. The packages were then treated at the panel intersections for two seconds with an iron heated to 450° F. with mild pressure and in such a manner as to heat only the area within one-eighth of an inch of the panel score lines. Rate of weight gain was then again determined. In all instances, the cartons were more protective after heating the panel intersections as shown in Table III.

Example 3

A number of laminated sheet materials were scored in a Boxboard Research and Development Tester with scores appropriate to the thickness of the stocks. Samples were bent through 180° at the score lines, then unfolded to a 90° angle. Alcoholic dye stain was applied to the inside of the score for two minutes, then removed. The test was repeated after the panel intersections of duplicate samples had been heat treated as in Example 1. Results of this test are given in Table IV.

Reference to Example 3 will show that my treatment is adaptable to sheets, laminated together with thermoplastic adhesives and having scores therein, when the adhesive thickness is exceeded by the thickness of one of the sheets. I have found, in general, that the treatment is of considerably reduced benefit when the thickness of the thermoplastic adhesive uniting the carton plies exceeds the thickness of the heaviest sheet, which is in itself a development constituting a separate invention as disclosed and claimed in my copending application Serial No. 133,521.

TABLE III.—WEIGHT GAIN, GRAMS/DAY/BOX AT 50% R.H. AND 73° F.

Material Packaged	Sheet combination [1]	Untreated Panel Intersections	Heated Panel Intersections	Factor
Brown Sugar	F	−0.014	−0.002	7
Powdered Skim Milk	F	+0.033	+0.005	6+
Sugared Cereal	F	+0.017	+0.005	3+
Powdered Skim Milk	A	+0.055	+0.024	2+
Sugared Cereal	A	+0.032	0.000	∞
Instant Mashed Potato Flakes.	A	+0.057	+0.008	7+

[1] Of Table I.

TABLE IV.—STAIN TESTS FOR PENETRATION

Sheet Combination of Table I	Panel Intersection Stain Untreated 3¾" Length	Panel Intersection Stain After Heating 3¾" Length
G	Entire length stained from penetration.	One pinpoint spot stained.
H	Complete penetration, seven spots.	Slight stain, no penetration.
I	General penetration	No penetration.
J	do	Penetration, one small spot.
K	do	No penetration and no staining.

Example 4

Cartons were die-cut and scored from stocks comprised of:

(A) Coated news-filled cylinder board, .015 inch thick, laminated to a 37 pound beater-filled Fourdrinier paper having a thickness of three mils, with ninety pounds per ream of a thermoplastic microcrystalline wax composition, and

(B) A .0083 inch thick Fourdrinier paperboard laminated to a forty pound kraft Fourdrinier paper with ninety pounds per ream of a microcrystalline wax.

These cartons were glued on a straight-line gluer to provide folded cartons having four body panels and two 180° folds.

When the cartons were erected to a rectangular shape having four 90° folds, the 180° folds, now returned to 90° folds, showed bad penetration when tested by means of an alcoholic dye solution trickled over the inside surface of the carton at the scored area.

Heat was applied to the 180° folds of representative folded cartons by application of a heating iron before the erection. When erected to their final configuration just as indicated before, the alcoholic dye stain test showed no penetration.

A number of folding cartons were produced and erected, with and without heating of the 180° folds before erection. The cartons were then tested by sealing anhydrous calcium chloride therein, and measuring the average rate of weight gain of the carton and enclosed contents when exposed to 50% relative humidity at 73° F. The following Table V shows the comparative rates obtained.

TABLE V.—GAIN RATE, GRAMS/DAY/BOX AT 50% R.H. AND 73° F.

	As Glued	After 180° Folds Heated
Stock A	.17	.10
Stock B	.20	.13

It is thus seen that a novel method is hereby provided for the simple and economical reestablishment of a continuous liquid-vapor transfer barrier, in folding cartons produced from sheets or plies laminated to each other by a thermoplastic adhesive laminant, at the intersections of carton panels along a carton score or fold line by the expedient of applying heat or heat together with pressure to the score or fold line at or in the vicinity of the panel intersection, either after folding to provide such panel intersection along a score or fold line or after both folding and unfolding to provide an erected panel intersection substantially as desired in the fully erected carton, so as to reconsolidate the thermoplastic adhesive between the sheets or plies and thereby seal off breaks and crevices in said laminant along said carton score line and improve materially the liquid-vapor transfer characteristics of the carton and minimize leakage thereof, and whereby all of the other objects of the invention hereinbefore set forth are accomplished.

It will be apparent to one skilled in the art that the present invention may be embodied in other specific forms

without departing from the spirit or essential attributes thereof. It is therefore desired and intended that the present embodiments herein specifically set forth be considered in all respects as illustrative and not restrictive, reference being made to the appended claims rather than the foregoing description and drawings to indicate the scope of the invention, which is to be understood as being limited only by the scope of the appended claims.

I claim:

1. The method of improving the protective properties of a folding carton produced, from sheet materials laminated to each other by a thermoplastic adhesive, by a process which includes scoring such sheet materials, folding at a score line to provide a panel intersection, and erecting the carton, wherein said thermoplastic adhesive between said sheet materials is disturbed or ruptured at said score line by scoring or folding during the process of constructing or erecting the carton, which comprises the step of applying heat in the vicinity of said score line at said panel intersection to reconsolidate the thermoplastic adhesive laminant between said sheet materials into an essentially continuous layer at said score line.

2. The method according to claim 1, wherein the panels at said panel intersection at the time of applying heat in the vicinity of said score line are at approximately the same angle with regard to each other as desired in the fully erected carton.

3. The method according to claim 1, wherein the panels at said panel intersection at the time of applying heat in the vicinity of said score line are folded substantially flat upon each other.

4. The method according to claim 1, wherein both heat and pressure are applied to said score line at said panel intersection treated.

5. The method of improving the protective properties of a folding carton produced by scoring and folding sheet materials laminated to each other by a thermoplastic adhesive, wherein said thermoplastic adhesive between said sheet materials is disturbed or ruptured at a score line during scoring and folding, comprising at least partially erecting the carton to provide a panel intersection at a folded score line and thereafter applying heat to the scored area at said panel intersection to remelt and flux the thermoplastic adhesive laminant between said sheet materials into an essentially continuous barrier layer at said score line.

6. The method according to claim 5, wherein the sheet materials from which the carton is constructed are laminated to each other by a microcrystalline wax composition.

7. The method according to claim 5, wherein the folding carton is treated along score lines which have been folded at an angle approaching 180° prior to its erection and treatment.

8. The method according to claim 5, wherein the temperature to which the score lines of the carton at the panel intersections are exposed is sufficient to melt the thermoplastic adhesive laminant.

9. The method according to claim 5, wherein pressure is applied at a temperature sufficient to produce a needle penetration of thermoplastic adhesive laminant at the carton score lines of at least sixty as measured by ASTM Method D5–25.

10. The method according to claim 5, wherein one or more of the sheet materials exceeds the thickness of the adhesive layer.

11. The method according to claim 5, wherein at least two of the sheet materials are selected from the group consisting of paper and paperboard.

12. The method according to claim 5, wherein one sheet material is paper and one sheet material is paperboard.

13. The method of improving the protective properties of a folding carton produced by scoring sheet materials laminated to each other by a thermoplastic adhesive, wherein said thermoplastic adhesive between said sheet material is disturbed or ruptured at score lines during scoring and folding, comprising erecting the carton to its final configuration and thereafter applying heat and pressure to previously folded and unfolded scored areas of the carton to reconsolidate the thermoplastic adhesive laminant between said sheet materials into an essentially continuous barrier layer at said score lines.

14. The method according to claim 13, wherein the sheet materials from which the carton is constructed are laminated to each other by a microcrystalline wax composition.

15. The method according to claim 13, wherein the folding carton is treated along score lines which have been folded to an angle approaching 180° prior to its erection.

16. The method according to claim 13, wherein heat and pressure are applied to folded score lines at panel intersections prior to filling of the carton.

17. The method according to claim 13, wherein heat and pressure are applied to folded score lines at panel intersections after filling of the carton.

18. The method of improving the protective properties of a folding carton produced by scoring and folding sheet materials laminated together by a thermoplastic adhesive, in the manufacture or erection of which folding carton said thermoplastic adhesive laminant between said sheet materials is ruptured at score lines during scoring and folding, comprising erecting the carton from a scored carton blank of such laminated sheet material to its final configuration and thereafter applying heat and pressure to the previously folded and unfolded score lines at the panel intersections of the carton in sufficient amount to effect consolidation of the thermoplastic adhesive between said sheet materials laminant into an essentially continuous layer at said score lines, the pressure applied in such process being insufficient to permanently disturb the configuration of the erected carton and the heat applied during such process being insufficient to cause undesirable alteration of either the carton exterior or of any contents thereof.

19. The method of improving the protective properties of a folding carton produced by scoring and folding sheet materials laminated together by a thermoplastic adhesive, wherein one or more of the sheet materials exceeds the thickness of the adhesive layer, and in the manufacture or erection of which folding carton said thermoplastic adhesive laminant between said sheet materials is ruptured at score lines during the scoring, folding and unfolding along score lines, comprising erecting the carton from a scored carton blank of such laminated sheet material to its final configuration and thereafter applying to the previously folded and unfolded score lines at the panel intersections of the carton heat and pressure sufficient to effect consolidation of the thermoplastic adhesive laminant between said sheet materials into an essentially continuous layer at said score lines, but insufficient to permanently disturb the configuration of the erected carton or cause undesirable alteration of either the carton exterior or of any contents thereof.

20. The method of improving the protective properties of a folding carton produced from sheet materials laminated together by a thermoplastic adhesive and having panel intersections along a folded score line, at which the thermoplastic laminant between said sheet materials is disturbed or ruptured by scoring or folding during the process of constructing or erecting the carton, which consists in reconsolidating the thermoplastic adhesive into an essentially continuous barrier layer by melting and fluxing said thermoplastic adhesive between said sheet materials into an essentially continuous layer at said score line at a point in the construction and erection of the carton subsequent to the initial folding of said sheet materials along said score line.

21. An erected folding carton produced from sheet

materials laminated together by a solid thermoplastic adhesive layer comprising wax and having panel intersections along folded score lines, said carton having been folded along said score lines approximately 180° and then unfolded approximately 90°, said carton being characterized by improved protective properties and in that the solid thermoplastic adhesive layer comprising wax between said sheet materials at said folded and unfolded score lines is essentially continuous and unbroken, the adhesive layer comprising wax between said sheet materials at said score lines having been heat reconsolidated into the essentially continuous and unbroken layer.

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UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,158,073 November 24, 1964

George G. Rumberger

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 4, line 2, for "particular" read -- partial --; column 5, line 18, strike out the comma; column 7, line 14, for "been", first occurrence, read -- even --; columns 7 and 8, TABLE 1, fourth column, opposite "D", for "006"" read -- .006" --; column 12, line 2, for "material" read -- materials --; line 34, after "adhesive" insert -- laminant --; line 35, strike out "laminant".

Signed and sealed this 6th day of April 1965.

(SEAL)
Attest:

ERNEST W. SWIDER
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