July 6, 1965 R. M. BAUER ETAL 3,192,893

APPARATUS FOR PRODUCING HIGHLY GLOSSY PROTECTIVE SHEETS

Filed Aug. 16, 1962 2 Sheets-Sheet 1

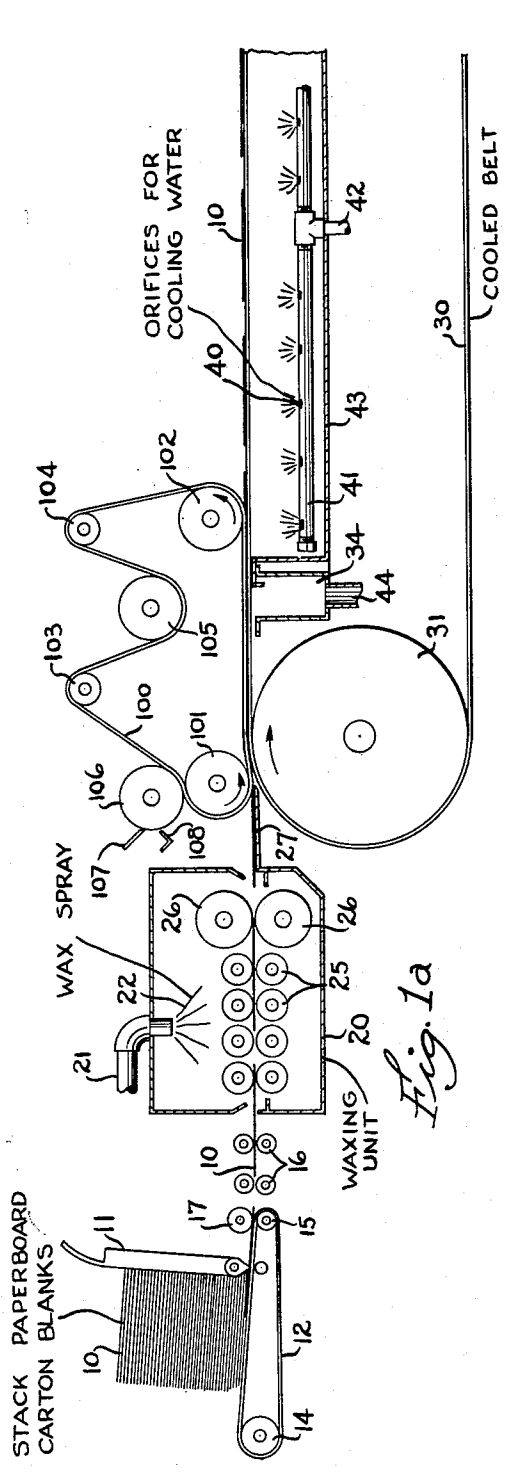


Fig. 1a

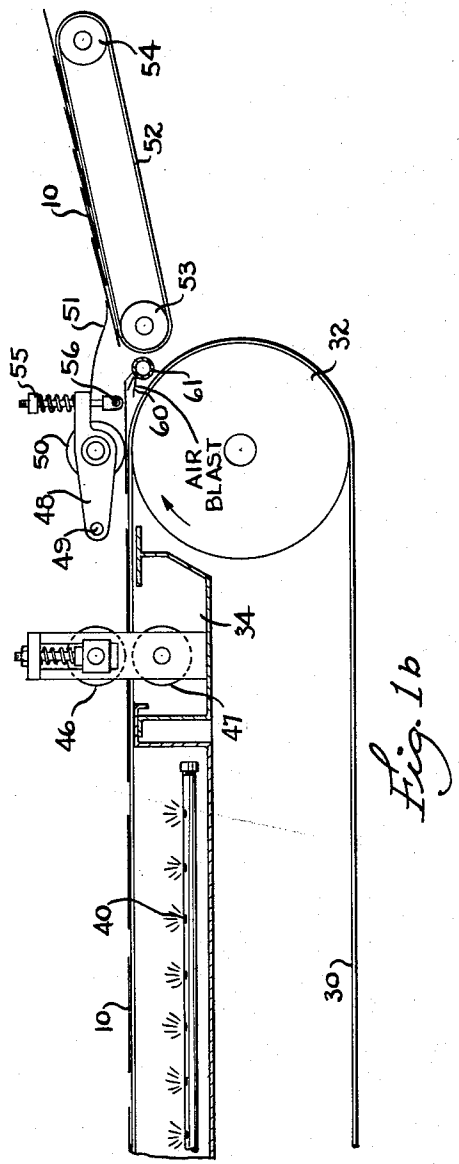


Fig. 1b

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APPARATUS FOR PRODUCING HIGHLY GLOSSY PROTECTIVE SHEETS

Filed Aug. 16, 1962 2 Sheets-Sheet 2

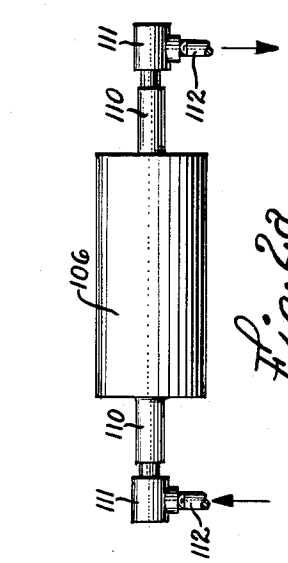


Fig. 2a

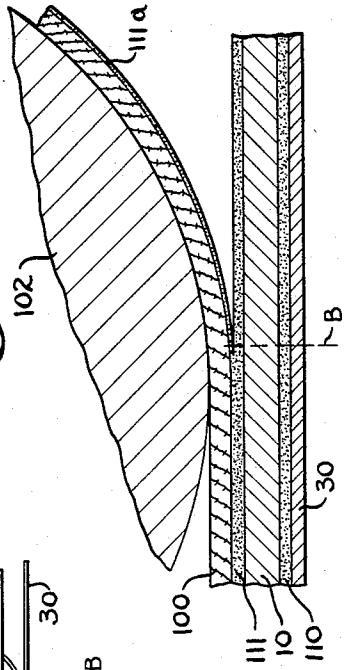


Fig. 3

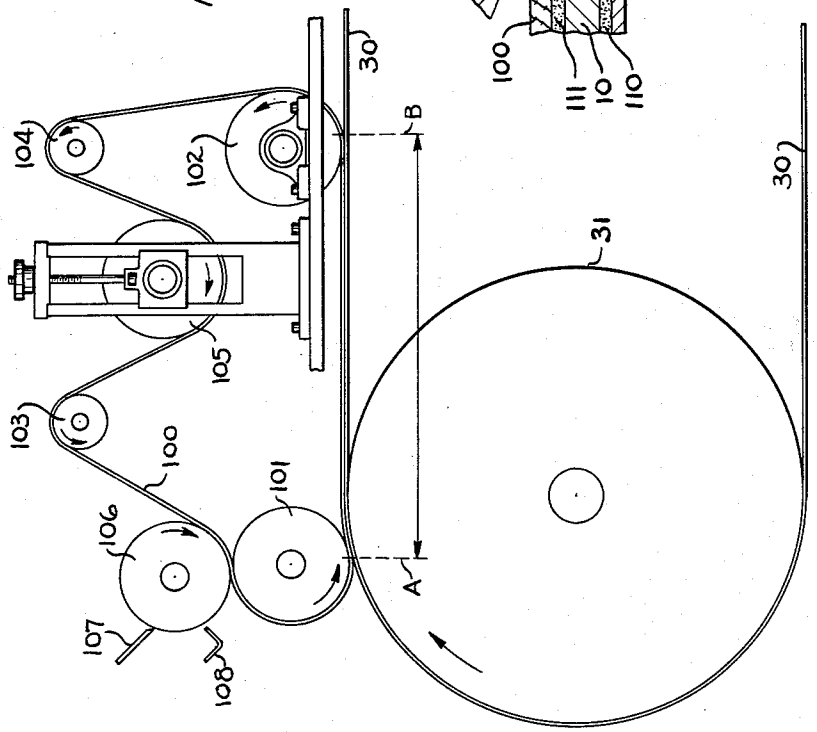


Fig. 2

United States Patent Office 3,192,893 Patented July 6, 1965

3,192,893

APPARATUS FOR PRODUCING HIGHLY GLOSSY PROTECTIVE SHEETS

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Filed Aug. 16, 1962, Ser. No. 217,390
1 Claim. (Cl. 118—69)

This invention relates to an improved method and apparatus for coating individual sheets of paperboard with a wax or synthetic polymer composition and particularly for producing on paperboard carton blanks a coating having a very highly glossy surface and very desirable protective properties.

Wax composition coatings have long been applied to paperboard carton blanks by several methods which impart varying degrees of waterproofness. A moderate degree of waterproofness is imparted to paperboard by "paraffining," wherein the carton blank is passed between heated rolls which dip into a bath of molten wax. A higher degree of waterproofness is obtained by "saturating," a process in which the carton blanks are flooded with molten wax and stacked while still hot. Better protective properties against moisture, moisture vapor and grease penetration are achieved by flooding the carton blank with molten wax, removing excess wax by passing the waxed blank between steel or cloth-covered rollers, and immediately dipping the waxed blank in a cold water bath to solidify the wax while a major portion of it remains on the surface of the paperboard. Although the overall appearance of the resulting wax composition coated surface is dull and lifeless and is frequently marred by surface iregularities, pimples, smears and water marks, cartons waxed in this manner have been commonly utilized in the packaging of butter, bacon, lard and many other products. More recently, a process and machine for imparting a very high gloss and mirror-like sheen to wax composition coated paperboard carton blanks were disclosed in U.S. Patents 2,892,735 and 2,982,245, of which one of the present inventors was a co-inventor and which are assigned to the assignee of the present invention. In the process therein disclosed, the carton blank is flooded with a molten wax composition, the excess wax removed by passing the waxed carton blank through the nip formed between a pair of metering rolls and, while still molten, the wax coated surface of the blank is pressed into firm, intimate and overall contact with a cooled surface of a traveling metallic web polished to a specular, mirror-like finish. After chilling to solidify the coating while in contact with the polished surface, the finished blank is removed from the traveling web. The resulting coated carton blank exhibits a highly reflective, mirror-like gloss and has received widespread acceptance in commerce due to its attractive appearance.

In the production of high gloss coated carton blanks by the above procedure, however, it has been found impossible to achieve the degree of waterproofness, water vapor proofness and resistance to grease penetration in the finished carton blank which is desired for some end uses of the carton, since the wax composition coating on the interior surface of the carton blank necessarily is of relatively low thickness due to certain limitations in the amount of wax composition which can be applied to the interior carton blank surface, these limitations being inherent in the apparatus itself, as will be described hereinafter.

In the method and machine for manufacturing glossy coated sheets described in U.S. Patents 2,892,735 and 2,982,245, the paperboard carton blank bearing a coating of molten wax composition coating is pressed into firm,

intimate contact with the polished traveling web by passage through a nip formed between the web **30** and a squeeze roll **35**. Since the coating composition is molten at this point, the squeeze roll becomes coated with molten wax by contact with the upper (the backside or interior) surface of the blank, thus removing most of the molten coating from the back surface of the carton blank and redepositing it on uncovered areas of the polished traveling web in subsequent revolutions of the squeeze roll. In order to prevent this undesirable situation, it has been found necessary to limit the amount of coating applied to the back side of the blank in the waxing section to less than 1 pound per ream (3000 sq. ft.). This amount of coating is substantially less than the optimum weight which imparts the most desirable combination of protective and operating properties to the finished carton.

The present invention overcomes the above-described difficulty by making possible the production of coated paperboard blanks having enhanced protective properties while at the same time retaining the very superior mirror-like gloss and generally attractive appearance of the cartons produced by the use of the process and apparatus previously described.

The invention will be most readily understood by a consideration of the following description in conjunction with the accompanying drawings, in which:

FIGURE 1*a* is a schematic side elevation of a portion of the appartus suitable for practice of the invention,

FIGURE 1*b* is a continuation of the view shown in FIGURE 1*a*,

FIGURE 2 is a somewhat enlarged schematic side elevation of a portion of FIGURE 1*a* showing certain essential elements thereof in greater detail,

FIGURE 2*a* is a front view of roller **106** taken from the left in FIGURE 2 and showing, in addition, means for circulating a heating or cooling medium through the roller, and

FIGURE 3 is a greatly enlarged sectional view showing a paperboard blank at a critical stage in the coating operation.

Referring to FIGURE 1*a*, a stack of unwaxed paperboard carton blanks **10** is held on a carton feeding device comprising a continuous belt **12** passing over roll **14** and driver roll **15** with a device **11** for restraining the stack and allowing single blanks to feed successively from the bottom of the stack. The blanks pass under a small hold-down roll **17** and subsequently between two pairs of feed rollers, the bottom roller of each pair being identified by the number **16**. From the feed rollers, the blanks pass into the waxing unit **20**, which is equipped with four upper carrying rolls and four lower carrying rolls, two of the lower rolls being identified in the drawing by the number **25**. The carrying rollers pass the carton blank through the molten wax composition spray **22** fed to the waxing unit by a plurality of conduits of which one only **21** is shown in the drawing. The wax composition conduit is connected to a suitable wax melting, storage and piping unit not shown in the drawing. An excess of molten wax is applied to both surfaces of the paperboard blank by the wax spray which, as illustrated in FIGURE 1*a*, bathes both upper and lower carrying rolls **25** in molten wax composition for subsequent transfer to the respective upper and lower carton blank surfaces. The blank then passes out of the waxing unit through metering rolls **26** which remove excess wax from the blank. The blank is then led by heated guides **27** onto the surface of a highly polished, continuous, traveling, flexible, belt **30**, of stainless steel or other suitable material, which is supported on the drum **31** and the driving sheaves **32** (FIGURE 1*b*), the drum and sheaves each being about 24 inches in diameter. It is obvious that FIGURE 1*a* and FIGURE 1*b*, being essentially side elevation views, show

only one of a pair of sheaves 32, and of certain other of the following described machine elements, the other of the pair of such machine elements being positioned to the other side of the machine in obvious fashion. The belt may be of any suitable width for supporting a single series of consecutively fed blanks or may be wide enough to accommodate a plurality of similar series. We have found that a belt about 35 feet long, having a horizontal travel of about 15 feet is satisfactory for commercial operation at speeds up to about 450 feet/minute.

In the process and apparatus of the present invention, as contrasted to that of the previously-mentioned patents, the carton blank bearing the molten wax composition on both sides thereof is pressed into firm intimate and overall fixed contact with the polished belt **30** by an endless traveling back-up belt **100** of a flexible, resilient material which is unaffected by contact with molten hydrocarbon wax. A canvas belt bearing a heavy coating of a synthetic rubber-like material made of a co-polymer of butadiene and acrylonitrile, sold under the name of Hycar synthetic rubber, has proven quite satisfactory for this purpose. Belt surfaces of fluorocarbons, polyethylene terephthalate polyester film, polyisoprene, polyurethanes and the like are also satisfactory. Materials such as butadiene rubber, which soften or otherwise are affected by hot petroleum waxes, are not satisfactory.

The resilient back-up belt **100** is carried by a series of rollers, including rubber covered pressure rolls **101** and **102**, idler rolls **103** and **104**, tension roll **105** and a steel wax-pick-off roll **106**. Roll **101** preferably is mounted slightly back of the point of tangency of the polished belt **30** with drum **31**.

The coated blank enters the nip formed between polished belt **30** and back-up belt **100** as these belts pass at identical speeds over drum **31** and roll **101**, respectively, and the blank is held in firm contact between the two belts until it has passed under roll **102**, at which point the pressure of belt **100** on the coated blank is released. The linear distance between roll **101** and roll **102** and the temperatures of the various elements are critical to the successful operation of the process and apparatus of this invention, as will be discussed in detail hereinafter. Roll **102** is adustably mounted in such a manner that the distance between rolls **101** and **102**, and hence the length of the horizontal travel of the back-up belt, may be varied to achieve optimum operation of the apparatus. Roll **105** is also adustably mounted to compensate for the various positions of roll **102**, while maintaining proper tension on the back-up belt **100**.

A doctor blade **107** is mounted to scrape accumulated wax from the surface of wax-pick-off roll **106** and deposit it in a trough **108** which may be led to wax storage or to discard.

Broadly speaking, the highly polished belt **30** is preferably maintained at a temperature between about 70° F. and 100° F., while the back-up belt **100** and its accessory rolls are maintained at a temperature between about 40° F. and 75° F. higher than that of the polished belt, but also preferably somewhat below the congealing temperature of the coating composition. Suitable coating blends range in congealing temperature from about 130° F. to 200° F., those with congealing points between about 140° F. and 180° F. being generally preferred.

Cooling water for holding the polished belt **30** at the desired temperature is maintained in a suitable water cooling, storage and pumping system, not shown. The cooling water is pumped through a suitable liquid conducting means **42** and thence emerges from a manifold **41** through a plurality of orifices **40** spaced at intervals throughout the length of the manifold. The cooling water fills the shallow tank **43** and overflows its sides into a relatively narrow trough **34** which surrounds the tank **43** on all sides. The water then passes to a drain **44** which is connected to the water storage system so the cooling water may be re-

circulated. During a major portion of its upper reach or horizontal travel, the belt **30** touches and is partially supported by the water in the tank **43**, and is cooled thereby substantially to temperature equilibrium with the water.

Continuing, with reference to FIGURE 1*b*, the excess cooling water adhering to the under surface of the belt is removed by a wiping roll **47** which contacts the under surface of the belt. The belt is maintained in contact with the wiping roll by the pressure exerted on its top surface by the adjustable pressure roll **46**. As the belt passes over the moderately small diameter sheave **32**, it is subjected to a relatively sharp flexing, which tends to force the coated paperboard blank to peel loose from its intimate contact with the belt surface. To prevent premature separation of the blank from the belt, an adjustable hold-down roll **50** is mounted at about the point of tangency between the belt and the sheave. The roll **50** is held by arms **48**, pivoted to the frame at **49**, and the pressure of the roll on the carton blanks and traveling belt may be adjusted by spring-actuated tension arms **55** pivotally mounted to the frame at **56**. After the blank passes under the hold-down roll, an air blast **60** is directed against its forward edge from a pipe **61** connected to a source of pressurized air, not shown. The air blast assists in the removal of the coated blank from the belt surface and directs the blank, guided by carton guides **51**, onto a traveling collecting belt **52**, which passes over the roller **53** and drive roller **54**. The collecting belt moves at a lower speed than the polished belt **30** so that the blanks stack up on it in a shingled pile. The finished blanks are then removed from the collecting conveyor and are packaged for shipping.

If desired, a vacuum pick-off system, such as disclosed in U.S. Patent No. 2,511,703 may be substituted for the carton blank removal system hereinbefore described. In this case, the blanks are lifted from the polished belt near the end of its horizontal travel by vacuum, being transferred thereby to the underside of a perforated, endless belt suspended in close proximity to the upper surface of the polished belt and thence to the stacking area. The initial separation of the leading edge of the coated paperboard sheet may, if desired, be assisted by an air jet or by the flexing of the polished belt as it passes over the sheave **32** as previously described.

The function of the back-up belt **100** is essential to the successful operation of the invention, since it is this element which insures the retention of the optimum amount of wax composition coating on the upper surface of the paperboard blank (i.e. the surface which becomes the interior surface of the finished carton). The length of horizontal travel of the back-up belt **100** while in contact with the coated carton blanks (the distance A–B in FIGURE 2) and the temperatures of the coating composition and of the two belts are important interrelated factors affecting the operation of the apparatus.

It has been found that, if the belt temperatures are low enough and the distance A–B is great enough to allow complete solidification of the coating composition before the coated paperboard blank reaches point B, the blank fails to release cleanly from the back-up belt **100**. When this condition prevails, paperboard sheets of relatively low caliper (0.015 inch or less) may be picked off the surface of the polished belt **30** and remain attached to the back-up belt during its return reach, causing jam-up of the machine. Paperboard sheets of heavier caliper generally remain on the polished belt but rupture or splitting of the coating layer on the upper surface of the blank often occurs, substantial amounts of the coating composition being picked off the blank and remaining adhered to the back-up belt surface.

If, on the other hand, the distance A–B is too short and/or the belt temperatures are too high, so that the coating is insufficiently cooled when it reaches point B, an undesirably high amount of coating is transferred as a

continuous coating film from the upper carton blank surface to the back-up belt **100**, leaving too thin a coating on the upper surface of the blank to lend the desired protective properties to the finished carton. Progressive shortening of the distance A–B would result, in the limiting case, in the single squeeze roll disclosed in U.S. Patents 2,892,735 and 2,982,245, which is subject to this particular disadvantage, as earlier pointed out.

Too high temperatures of belt **100** have the further disadvantage of tending to drive the wax composition coating into the body of the sheet material, leaving a noncontinuous coating film on the surface with a consequent decrease in the protective properties of coated sheet material. Insufficient cooling also results in a relatively soft coating surface which is more readily susceptible to marring and scratching.

To obtain a coated sheet sheet material having the optimum combination of protective and operative properties, the distance A–B, representing that portion of its travel in which the coated carton blank is contacted by both the back-up belt **100** and the highly polished belt **30**, is subject to certain practical restrictions. The distance A–B should be at least 18 inches in order that the coating composition become cooled sufficiently to substantially solidify the coating onthe lower surface of the carton and to avoid excessive transfer of molten coating from the upper surface of the coated sheet material to the back-up belt **100** as previously described. This distance A–B may, however, be considerably greater than the above figure, if the temperatures on the two belts are so regulated as to prevent complete solidification of the layer of coating composition immediately adjacent the back-up belt as long as the paperboard blank is in contact with that belt. The cooled polished belt **30** must, of course, extend sufficiently beyond the end of the back-up belt to complete the cooling of the entire coated blank to harden the coating, thereby reducing its susceptibility to surface mars and scratches and to "reversion" or loss of gloss on aging.

It has been found that a back-up belt having a horizontal travel of from about two feet to about eight feet is very satisfactory for the practice of this invention, two to four feet of horizontal travel being preferred. Belts having an A–B distance greater than about eight feet unnecessarily increase the overall length of the apparatus and are less readily maintained in perfect alignment and even pressure contact with the cooperating cooled, polished belt. Furthermore, penetration of the coating into the internal structure of the sheet material tends to be increased as the back-up belt is lengthened, thus reducing the weight of coating on the upper surface of the sheet with a consequent reduction in its protective properties.

As is evident from the above discussion, the temperatures which should be maintained on the various elements of the apparatus will vary somewhat depending on the length of horizontal travel of the back-up belt. Excellent results have been obtained with a back-up belt having a length of horizontal travel, A–B, of about three feet in combination with a cooled, highly polished metallic belt having an upper horizontal reach of about 15 feet. Under these conditions, the temperature of the wax composition in waxing unit **20** should be maintained between about 215° and 240° F., depending on the caliper of the paperboard sheet being processed. The lower temperatures with this range are generally utilized with relatively low caliper paperboard (0.010 to about 0.016 in.) and the higher temperatures are utilized with paperboard ranging from about 0.017 to 0.030 and higher in caliper.

The cooling water in tank **43**, utilized to maintain the desired temperature on the polished belt **30**, should be maintained between about 70° and 100° F. A somewhat higher gloss is obtained on the carton surface at the higher temperatures within this range, but the surface is somewhat more susceptible to damage by scuffing and scratching if the coated sheets are handled at the higher temperatures, since under these conditions the coating does not achieve its maximum hardness and resistance to scuffing. For this reason, the preferred temperature range of the cooling water is from about 75–85° F. The desired temperature of the back-up belt **100** during its contact with the coated paperboard sheet is obtained by heating or cooling the belt at any of several points during its passage over rolls **103**, **104**, **105** and **106**. For this purpose, any or all of these rolls may be equipped with connections for circulating a heating or cooling medium therethrough. Rolls **105** to **106**, which contact the outer face of the belt, are particularly satisfactory for this purpose. As illustrated in FIGURE 2*a*, wherein roll **106** is utilized as an example, the selected roll or rolls may be hollow, drumlike shells with bored bearing shafts **110** fitted with conventional leakproof rotary pressure steam joints **111** having flexible, braided, reinforced high pressure hose **112** connected thereto. Steam or water supplied from a suitable source (not shown) at a desired temperature for heating or cooling the roll may be circulated through the roll as indicated by the arrows in FIGURE 2*a*. Under the conditions of waxing bath temperature, polished belt temperature and length of horizontal travel of the back-up belt hereinbefore set forth, the back-up belt, as it enters the nip at point A in FIGURE 2, should have a temperature of between about 120° F. and 160° F. This temperature is substantially below that of the wax composition as originally applied to the paperboard sheet but is also substantially higher than the surface temperature maintained on the polished belt **30**.

Preferably, the back-up belt temperature is adjusted to range between 50° F. and 75° F. higher than the temperature maintained on the polished belt **30**. In this connection, it should be noted that the back-up belt temperature limitations are somewhat more critical when operating on relatively heavy paperboard stock (0.02 in. or greater in thickness), thinner stock (0.012 to 0.02 in.) giving excellent results over a somewhat wider range of belt temperatures.

As the coated blank proceeds in contact with both belts, the wax coating is rapidly cooled from the face which is in contact with the water-cooled polished belt **30**, and, to a lesser extent, from the face which contacts the relatively hot back-up belt **100**. Solidification of the coating by crystallization of the wax composition is thus initiated at the surface of the polished belt and progresses through the wax layer on the bottom surface of the paperboard sheet and thence, through cooling of the paperboard itself, upward through the wax layer on the upper surface of the sheet. The rate of solidification of the coating composition on the upper sheet surface is retarded, however, by the somewhat elevated temperature of the back-up belt surface.

As the coated blank reaches the point of emergence from contact with the back-up belt (point B as best illustrated in FIGURE 3) the coating layer **110** on the bottom of the paperboard blank **10** should be completely congealed by contact with the cooled polished belt **30**, while the coating layer **111** on the upper surface of the sheet material is partially congealed by transfer of heat through the paperboard to the cold polished belt **30** and also, to a lesser degree, by contact wtih the warmer back-up belt **100**. At this point a thin layer of wax composition coating within the coating on the upper sheet material surface is, however, still molten by virtue of the retarded cooling rate of the hot back-up belt **100**.

Beyond point B, the back-up belt breaks away from contact with the coated paperboard and begins its return reach, bearing on its surface a very thin film **111***a* of the wax composition coating. The splitting of the wax composition film **111** in such a manner that only a thin film **111***a* of wax adheres to the back-up belt, while substantially the entire thickness of coating remains on the paperboard sheet as a continuous layer **111**, is essential to the development of the desired optimum protective properties of the final coated sheet. Splitting of the wax film in this

manner depends on the development of certain critical conditions within the coated sheet, wherein the bottom coating layer **110** is essentially completely congealed and the top coating layer **111** is substantially congealed except for a thin layer coating lying close to the relatively hot back-up belt. Since the cohesion in this uncongealed layer is less than that in the congealed wax and also less than the adhesive forces acting between the coating composition and the back-up belt, the paperboard sheet material and the polished metallic belt, the necessary separation occurring at point B will take place within this thin layer of uncongealed coating. For this reason, the length of the back-up belt and the temperature relationships of the waxing unit, the back-up belt, the cooled polished belt and the amount of coating composition on the sheet are critically interrelated factors which determine the successful operation of the process of this invention.

For the demonstration of the unique combination of protective properties and attractive, extremely glossy appearance of coated paperboard carton blanks prepared according to the present invention, printed carton blanks of 17 point (0.017" caliper) solid bleached sulfite paperboard stock were coated with a wax composition coating by each of the three following procedures:

EXAMPLE I

The blanks were flooded with the molten wax composition at a temperature of 220° F., the excess wax was removed by passage through a nip formed between two cloth-covered rolls and the coated blanks immediately immersed in a bath of water maintained at a temperature of 40–50° F. to congeal and harden the wax composition coating. This procedure has been utilized for a number of years in the production of the so-called high gloss, water waxed cartons which have been the standard of the industry for water and water vapor proofness, greaseproofness and also for appearance.

EXAMPLE II

The carton blanks were flooded with the molten wax composition at a temperature of 220° F., the excess wax was removed by passage through a nip formed between a cloth-covered roll and a steel roll and the coated blank pressed into intimate contact with the surface of a cooled, mirror-finished metallic belt maintained at a temperature of 80° F. by passage through the nip formed between the polished belt and a rubber-covered squeeze roll. The amount of coating on the upper side of the carton blank contacted by the squeeze roll was limited to the maximum amount which could be tolerated without excessive pick off by the squeeze roll. After the coating was congealed and hardened in contact with the polished belt, the carton blanks were removed from the belt.

EXAMPLE III

(Present invention)

The cartons were flooded with the molten wax composition coating at a temperature of 220° F., the excess wax was removed by passage through a nip formed between two cloth-covered rolls and the coated blank pressed into intimate contact with the surface of a cooled, mirror-finished metallic belt maintained at a temperature of 80° F. by passage through a nip formed between the polished belt and a heated, synthetic rubber covered back-up belt into an area wherein the blank was maintained in pressure contact between the two belts as hereinbefore described. The temperature of the back-up belt at the point of first contact with the coated blank was 160° F. and at the point where contact with the coated blank was broken was 130° F. After release from contact with the back-up belt, the blanks were maintained in contact with the cooled, polished belt until the coating was hardened and then removed from the belt.

In each of the above examples, the wax composition contained 75% fully refined paraffin wax, 5% microcrystalline wax and 20% coating grade polyethylene. Examples II and III, wherein the coated blanks were pressed into contact with a polished metallic belt, the wax composition also contained 0.1% of a silicone oil, added to control the degree of adhesion of the coated blank to the polished belt.

The following Table I includes data on the weight of wax composition applied to the paperboard, the distribution of the coating in and on the paperboard, the appearance of the coated sheets on their exterior surface as measured by their gloss, and the protective properties afforded by the various coating processes.

The weight of wax composition on each surface of the coated sheet was determined by carefully scraping the coating from a measured area of the specified surface with a razor blade and determining the weight loss. Interior wax was obtained by solvent extraction of the coated sheet after the surface wax had been removed by scraping, and the total coating weight computed as the sum of the surface and interior wax weights.

Gloss was measured by TAPPI standard method T–653 on a Hunter glossmeter, which records the percentage reflectance from the surface of the coated sheet at an angle of 20° from the vertical.

The water vapor permeability (W.V.P.) on flat and on creased coated sheets was measured by TAPPI standard methods T–464 and T–465, respectively.

Resistance to the penetration of grease and oil was measured by a method developed by the Best Foods Corp., in which 40 individual drops of a vegetable oil such as corn oil or cottonseed oil are placed in spaced relationship on the back coated surface of the sheet material under test and observed after 5 minutes, 1 hour, 2 hours, 4 hours, 8 hours and 24 hours to determine the number of drops of oil which penetrate the coated sheet and the time required for penetration. Penetration of the oil is manifested by the appearance of a generally circular, translucent area surrounding the original drop area, caused by absorption of oil by the paperboard fibers and subsequent wicking of the oil within the inner structure of the sheet radiating outwardly from the original drop area. Test data are recorded in terms of the number of drops penetrating the sheet in a given period of time, the greatest resistance to the oil or grease being evidenced by low numerical values in the table even after a substantial period of time as measured in hours.

TABLE I

Coating solidification method	Coating weight in lbs. per ream (3000 sq. ft.)				Gloss percent reflectance (Hunter) TAPPI T-653	W. V. P. in g./M²/24 hrs.		Grease Penetration Best food oil drop test No. of penetrations from 40 drops					
	Total	Face	Back	Interior		Flat TAPPI T-464	Creased TAPPI T-465	5 min.	1 hr.	2 hrs.	4 hrs.	8 hrs.	24 hrs.
Example I: Cold water dipping	17	6	5	6	40	30	45	4	9	12	15	19	38
Example II: Squeeze roll and polished belt	17.5	8	0.5	9	72	35	100	40	------	------	------	------	------
Example III: Back up belt and polished belt	22.0	8	5.0	9	72	10	45	0	0	1	1	1	3

As is evident from the data in the above Table I, the process of the invention herein described results in a wax composition coated paperboard sheet which combines optimum protective properties with an extremely high surface gloss, thereby achieving a very desirable combination of utility and attractive appearance heretofore considered unattainable in a wax composition coated paperboard.

The penetration of grease and oil through the coated sheet is remarkably reduced by the process of this invention as compared to either of the known processes of Examples I and II. The water vapor proofness of the coated sheet is also improved, while the remarkable gloss and attractive appearance attained through application of the coated sheet to a highly polished cooled surface is retained in its entirety.

Comparable improvements may be obtained when paperboard sheets are coated with wax coating blends varying widely in composition from that used in the foregoing examples. Various compositions of paraffin and/or microcrystalline wax, with and without added polyolefins such as polyethylene and polypropylene or copolymers of blends of monomers such as ethylene and vinyl acetate have been utilized to advantage in the practice of this invention. The degree of adhesion of such blends to the polished belt may be controlled by varying the type or percentage of the various components or by the addition of appropriate amounts of a silicone oil or similar additive. Preferably, the wax compositions will have congealing points between about 140° F. and 180° F., and the temperatures maintained on the waxing unit and on the two conveyor belts may be adjusted accordingly for the most desirable results, as hereinbefore described.

Although the process and apparatus of this invention have been described in reference to a particular and preferred embodiment it will be evident to those skilled in the art that various changes and modifications can be incorporated without departing from the spirit thereof, and it is intended to cover all such changes and modifications as fall within the true spirit and scope of the invention.

We claim:

In a machine for providing a highly polished specular wax composition surface on a succession of paperboard sheets employing means for applying a molten wax composition to both sides of said sheets, a flexible endless planar conveyor means having a highly polished smooth exterior surface, means for maintaining said conveyor surface at a temperature substantially below the congealing point of the wax composition, means for moving said conveyor in a substantially horizontal plane while said sheets are maintained thereon in fixed, adhered contact with the planar surface thereof, and means for guiding said conveyor through a curvilinear return path, the improvement comprising pressure applying means for successively applying a coated surface of said sheets while said coating is in molten condition in intimate overall and fixed adhered contact with said conveyor surface and for maintaining such contact under pressure of said pressure applying means until said coating in contact with said planar conveyor is in a congealed state and said coating on the reverse side of said sheet in direct contact with said pressure applying means is in a partially congealed state, said pressure applying means comprising a flexible endless traveling belt, a series of rollers for carrying said belt during a sufficient portion of its travel in contact with and at a speed coincident with said planar conveyor means during its movement in a horizontal plane to effect complete congealing of said coating except for a thin layer thereof in contact with said pressure applying means, means for maintaining said belt within a predetermined temperature range higher than that maintained on said planar conveyor means and below the congealing point of said wax composition, and means for adjusting the length of travel of the portion of said belt in contact with said planar conveyor means so that said contact may be terminated at a point at which the coating on said reverse side of said sheets is completely congealed except for a thin layer thereof in contact with said pressure applying means.

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